



**UNITED STATES DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**

National Marine Fisheries Service

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Juneau, Alaska 99802-1668

June 29, 2016

MEMORANDUM FOR: William W. Stelle, Jr.  
Administrator, Northwest Region

FROM: James W. Balsiger, Ph.D.  
Administrator, Alaska Region

SUBJECT: 2015 Annual Report for the Alaska Groundfish Fisheries Chinook  
Salmon Incidental Catch and Endangered Species Act Consultation

We are providing to you the annual report on salmon incidental catch in the Alaska groundfish fisheries, including current information on salmon bycatch reduction measures and sources for the genetic composition of salmon caught in these fisheries. This report updates previous annual reports on salmon incidental catch and includes:

- 2015 data on salmon incidental catch in groundfish fisheries,
- an update of NMFS's efforts to reduce the incidental catch of salmon in groundfish fisheries,
- web locations for the NMFS Alaska Fisheries Science Center's reports on stock of origin information from incidental catch of salmon in 2013 groundfish fisheries,
- data from the Alaska Fisheries Science Center's North Pacific Observer Program Bycatch Sampling for 2014 (see Appendix 1), and
- the Alaska Fisheries Science Center annual report on the stock of origin and coded wire tag (CWT) data from incidental catch of salmon for 2013 and 2014 (see Appendix 2).

Salmon incidental catch reported in groundfish fisheries for 2015 and stock of origin and coded wire tag data for 2015 will be forthcoming in the fall of 2016, after CWT numbers are merged with data on stock of origin, hatchery, and location of origin.

This report fulfills one of the terms and conditions of the December 2, 2009, and the January 11, 2007 (NMFS 2009a and NMFS 2007), supplements to the November 30, 2000, Biological Opinion (BiOp) regarding Authorization of the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA) Groundfish Fisheries (NMFS 2000). The most recent BiOp that addresses incidental catch of Chinook salmon in the GOA groundfish fisheries is the supplemental BiOp issued on January 9, 2012. This BiOp concluded that the GOA groundfish fisheries are not likely to jeopardize the continued existence of listed salmon Evolutionarily Significant Units (ESUs) (NMFS 2012).





## Data Reports: Accounting for Chinook Salmon Incidental Catch in the GOA and BSAI Groundfish Fisheries

Tables 1 through 5 provide data on the incidental catch of Chinook salmon by fishery type or target fishery, quarter, and from Western Alaska Community Development Quota (CDQ) Program and non-CDQ Program sources. The annual Chinook salmon incidental catch data in these tables are current for slightly different dates in 2016. For example, NMFS revised Tables 1 and 2 on May 25, while Tables 3, 4, and 5 are automatically updated on a monthly basis (May 18, 2016). These slightly different revision dates account for small differences in some of the incidental catch estimates in Tables 1 and 2 versus 3, 4, and 5. Updated versions of Tables 3, 4, and 5 are available at the NMFS Alaska Region website.<sup>1</sup>

Tables 1 and 2 provide annual estimates of Chinook salmon incidental catch by fishery target for the groundfish trawl and non-trawl fisheries for the BSAI and GOA from 2004 through, 2015. In 2015, approximately 72 percent of the incidental catch of Chinook salmon in the BSAI and GOA occurred in the pollock pelagic trawl fishery. Twenty-five percent of the Chinook salmon incidental catch occurred in the non-pelagic trawl flatfish fishery. Tables 3 through 5 provide seasonal or quarterly Chinook salmon incidental catch estimates by pollock and non-pollock fishery categories.

In BSAI groundfish fisheries, the majority of the Chinook salmon incidental catch occurs during the A season groundfish fishery, from January 20 through June 10 (Tables 3 and 4). In GOA groundfish fisheries, the seasonal distribution of Chinook salmon incidental catch across the pollock fishery is highly variable from year to year, with no consistently predominant quarter or season with high incidental catch (Table 5). In the Bering Sea pollock fishery, most Chinook salmon incidental catch occurs in the non-CDQ groundfish fisheries (Table 4). For example in 2015, 94 percent of the Chinook salmon incidental catch from Bering Sea groundfish fisheries was from non-CDQ groundfish fisheries. The non-CDQ groundfish fisheries account for the majority of groundfish catch in the BSAI groundfish fisheries.

The amount of Chinook salmon incidental catch in the Alaska groundfish fisheries in 2015 (Tables 1 and 2) was below the incidental take statement amounts for both the BSAI and GOA groundfish fisheries.

Groundfish Fishery	BSAI Pollock Trawl	BSAI non-Pollock	GOA Pollock and Non-Pollock fisheries
Chinook Incidental Take Statement	47,591 to 60,000 Chinook salmon <sup>2</sup>	8,745 Chinook salmon <sup>2</sup>	40,000 Chinook salmon <sup>3</sup>
2015 Incidental Catch of Chinook Salmon	18,329	6,924	18,971

<sup>1</sup> [https://alaskafisheries.noaa.gov/sites/default/files/reports/chinook\\_salmon\\_mortality2016.pdf](https://alaskafisheries.noaa.gov/sites/default/files/reports/chinook_salmon_mortality2016.pdf) and <https://alaskafisheries.noaa.gov/sites/default/files/reports/goasalmonmort2016.pdf>

<sup>2</sup> See the 2009 BiOp (NMFS 2009a) for Amendment 91. ITS includes Chinook PSC limit from non-trawl groundfish of 8,745 salmon.

<sup>3</sup> See the 2012 Section 7 Consultation for GOA groundfish fisheries (NMFS 2012).



The amount of Chinook salmon incidental catch in the BSAI groundfish fisheries in 2015 was 25,253 salmon (Table 1). Of this amount, 18,329 Chinook salmon were caught in the Bering Sea pollock trawl fishery. The amount of Chinook salmon incidental catch in the 2015 BSAI non-pollock groundfish fisheries was 6,924 salmon, below the incidental take permit amount for the non-pollock trawl fishery of 8,745 established in the December 2009 BiOp.

The amount of Chinook salmon incidental catch in the GOA groundfish fisheries in 2015 was 18,971 salmon (Table 2). Of this amount, 14,342 Chinook salmon were caught in the GOA pollock trawl fishery and 4,629 Chinook salmon were caught in the non-pollock groundfish fisheries. The total Chinook salmon incidental catch in the GOA was below the annual incidental take limit of 40,000 Chinook salmon established in the 2012 BiOp for groundfish fisheries of the GOA (NMFS 2012) and for the previous 2000 BiOp incidental take of Chinook salmon in GOA groundfish fisheries (NMFS 2000).

### **Current Genetic Analysis of Salmon Incidental Catch in the BSAI and GOA for 2013**

In 2015, two NOAA technical memorandums were published providing genetic information on salmon incidental catch from the BSAI groundfish fisheries in 2013. The publication *Genetic Stock Composition Analysis of Chum Salmon Bycatch from the 2013 Bering Sea Walleye Pollock Trawl Fishery* may be found at the NMFS Alaska Region website.<sup>4</sup> The publication *Genetic Stock Composition Analysis of the Chinook Salmon Bycatch from the 2013 Bering Sea Walleye Pollock (*Gadus chalcogrammus*) Trawl Fishery* may also be found at the NMFS Alaska Region website.<sup>5</sup>

In 2015, two NOAA technical memorandums were published providing genetic information on salmon incidental catch from the GOA groundfish fisheries in 2013. The publication *Genetic Stock Composition Analysis of Chinook Salmon Bycatch Samples from the Rockfish and Arrowtooth Flounder 2013 Gulf of Alaska Trawl Fisheries and the Gulf of Alaska Salmon Excluder Device Test* may be found at NMFS Alaska Region website.<sup>6</sup> The publication *Genetic Stock Composition Analysis of the Chinook Salmon Bycatch in the Gulf of Alaska Walleye Pollock (*Gadus chalcogrammus*) Trawl Fisheries, 2013* may be found at the NMFS Alaska Region website.<sup>7</sup> Finally, technical memorandums providing salmon genetic information for other years may be found at the NMFS Alaska Region website.<sup>8</sup>

### **Groundfish Management Measures for Salmon Incidental Catch in Groundfish Fisheries**

#### **Bering Sea Management Measures—Amendment 91**

Amendment 91 to the Fishery Management Plan for Groundfish of the Bering Sea and Aleutian Islands Management Area (BSAI FMP) was implemented in September 2010 (75 FR 53026, August 30, 2010), for management of Chinook salmon bycatch in the Bering Sea pollock fishery. Amendment 91 (NMFS 2009b) combines a prohibited species catch (PSC) limit on the amount

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<sup>4</sup> <http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-292.pdf>

<sup>5</sup> <http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-290.pdf>

<sup>6</sup> <http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-289.pdf>

<sup>7</sup> <http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-291.pdf>

<sup>8</sup> <http://www.afsc.noaa.gov/Publications/techmemos.htm>



of Chinook salmon that may be caught incidentally with an incentive plan agreement (IPA) and performance standard designed to minimize bycatch to the extent practicable. Amendment 91 applies only to management of the Bering Sea pollock fishery and does not affect the management of pollock fisheries in the Aleutian Islands.

Amendment 91 established two Chinook salmon PSC limits: 60,000 Chinook salmon and 47,591 Chinook salmon. Under Amendment 91, the pollock fleet is prevented from exceeding the 60,000 Chinook salmon PSC limit in every year. Each year, NMFS allocates a portion of the 60,000 Chinook salmon PSC limit to the mothership sector, catcher/processor sector, inshore cooperatives, and CDQ Program groups if an IPA is formed and approved by NMFS. The sector-level performance standard of 47,591 Chinook salmon is a tool to ensure that each sector does not fully harvest its Chinook salmon PSC allocation in most years. For a sector to continue to receive Chinook salmon PSC allocations under the 60,000 Chinook salmon PSC limit, that sector may not exceed its portion of 47,591 in any three years within seven consecutive years. If a sector fails this performance standard, it is permanently allocated an annual fixed portion of the 47,591 Chinook salmon PSC limit. All vessels choosing to not participate in an IPA fish under a portion of the “opt-out” cap of 28,496 Chinook salmon PSC limit and are ineligible to participate in management measures intended to offer flexibility to vessels harvesting pollock. Chinook salmon PSC in the BSAI has remained well below 47,591 Chinook salmon, since implementation of this program (Table 1). For more information on how Amendment 91 PSC limits apply to the incidental take permit, see the incidental take permit established in the December 2009 BiOp (NMFS 2009a).

#### Bering Sea Management Measures—Amendment 110

In 2015, the North Pacific Fishery Management Council (Council) recommended Amendment 110 to the BSAI FMP to further reduce Chinook and chum salmon PSC in the BSAI. The proposed rule (81 FR 5681, February 3, 2016) would improve the current management for chum salmon and Chinook salmon PSC by providing Bering Sea pollock fishery participants opportunities for increased flexibility to respond to changing conditions and greater incentives to minimize PSC of both salmon species, to the extent practicable. The proposed measures include adding chum salmon PSC management to existing industry IPAs, adding more incentives to avoid Chinook salmon, modifying the seasonal allocation of the pollock quota, and reducing the Chinook salmon PSC limit and performance standard threshold in low Chinook salmon abundance years.

The final rule for Amendment 110 (81 FR 37534, June 10, 2016) adjusts the Chinook salmon PSC limit and performance standard implemented under Amendment 91 to further reduce Chinook salmon PSC use in the Bering Sea pollock fishery. If the Alaska Department of Fish and Game determines that Chinook salmon abundance in western Alaska is low in a given year, NMFS would set the performance standard at 33,318 Chinook salmon and the PSC limit at 45,000 Chinook salmon for the following pollock fishing year. NMFS would publish the lower PSC limit and performance standard in the annual harvest specifications. In years when western Alaska Chinook salmon abundance is above 250,000 salmon, NMFS would manage the Bering Sea pollock fishery under the current 47,591 Chinook salmon PSC performance standard and 60,000 Chinook salmon PSC limit established under Amendment 91.

Since the PSC limits established in Amendment 110 cannot exceed the incidental take limit established by the December 2009 BiOp, this action will not affect ESA-listed species or designated critical habitat in a manner or to an extent not considered in prior section 7 consultations for the BSAI groundfish fisheries. Therefore, reinitiation of consultation is not required for this proposed action.

#### GOA Management Measures—Amendment 93

In 2012, Amendment 93 to the Fishery Management Plan for Groundfish of the Gulf of Alaska (GOA FMP) was implemented to limit the amount of Chinook salmon caught in the Central and Western GOA pollock fisheries (77 FR 42629, July 20, 2012). Amendment 93 establishes separate PSC limits in the Central and Western GOA for Chinook salmon that would cause NMFS to close the directed pollock fishery in the Central or Western regulatory areas of the GOA, if the applicable limit is reached. This action also requires retention of salmon by all vessels in the Central and Western GOA pollock fisheries until the catch is delivered to a processing facility where an observer is provided the opportunity to count the number of salmon and to collect scientific data or biological samples from the salmon.

Under Amendment 93, the Chinook salmon PSC in the Central and Western GOA pollock fisheries is limited to no more than 25,000 salmon. This limit, in addition to the total PSC limit established by Amendment 97 (see the following action), is below the annual amount of Chinook salmon established by the 2012 Incidental Take Statement for GOA groundfish fisheries of 40,000 Chinook salmon.

#### GOA Management Measures—Amendment 97

In 2014, NMFS published a final rule to implement Amendment 97 to the GOA FMP (79 FR 71350, December 2, 2014) to reduce catch of Chinook salmon PSC in the Central and Western GOA for all trawl fisheries, except the directed pollock fishery, starting in 2015. This action set an annual Chinook salmon PSC limit of 7,500 in the Central and Western GOA for Chinook salmon, which closes fisheries in those regulatory areas once a sector-level limit is attained. An additional PSC buffer provides an incentive to annually reduce Chinook salmon PSC to less than 6,500 salmon annually.

#### GOA Management Measures—GOA Trawl Emergency Rule

On May 3, 2015, all groundfish fisheries for the Non-Rockfish Program catcher vessel sector were closed for the remainder of 2015, because the sector unexpectedly reached its annual Chinook salmon PSC limit for the Western and Central GOA of 2,700 Chinook salmon. A prolonged closure would have been detrimental to the community of Kodiak, harvesters, and processors. In June 2015, the Council therefore recommended and NMFS implemented an emergency rule to provide an additional 1,600 Chinook salmon PSC allowance to the GOA groundfish trawl fisheries for the Non-Rockfish Program catcher vessel sector. Providing the additional limit of 1,600 Chinook salmon PSC restored a substantial portion of the forgone groundfish harvest and associated revenue made unavailable by the closure, by allowing the sector to harvest its recent average amount of groundfish for the remainder of 2015, while



keeping the total Chinook salmon PSC at or below 32,500, well below the annual 40,000 threshold. The emergency rule was published on August 10, 2015 (80 FR 47864), and became effective on publication in the *Federal Register*. The effectiveness period ended on December 31, 2015. Between August 10, and December 31, 2015, only 12 additional Chinook salmon PSC of the 1,600 allowed were caught by the Non-Rockfish Program catcher vessel sector.

GOA Management Measures—GOA Amendment 103 to Reapportion Chinook Salmon PSC in Pollock and Non-pollock Fisheries

In December 2015, the Council recommended Amendment 103 to the GOA FMP. If approved, Amendment 103 would authorize NMFS inseason manager's greater flexibility to reapportion unused Chinook salmon PSC among various trawl sectors in the Central and Western GOA. The authority to reapportion Chinook salmon PSC is restricted under Amendments 93 and 97 to the GOA FMP. Improved reapportionment flexibility would help to minimize closures in GOA trawl fisheries due to reaching a Chinook salmon PSC limit, such as the May 3, 2015, closure of the Non-Rockfish Program catcher vessel sector.

Amendment 103 would not result in the GOA groundfish fisheries exceeding 32,500 Chinook salmon because an increase in PSC limit for one trawl sector must be offset by an equal decrease in Chinook salmon PSC from the donor sector. Even with reapportionments, NMFS inseason management would be able to close these fisheries with sufficient precision to avoid exceeding 32,500 Chinook salmon. Therefore, Amendment 103 is not expected to allow the GOA groundfish fisheries to exceed the aggregate amount of 32,500 Chinook salmon PSC on the incidental take statement of 40,000 Chinook salmon.

## Literature Cited

- NMFS (National Marine Fisheries Service). 2012. Supplemental Biological Opinion on the Re-initiation of Endangered Species Act Section 7 Consultation on Incidental Catches of Chinook Salmon in the Gulf of Alaska Groundfish Fisheries. January 9, 2012. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Seattle, WA.
- NMFS 2009a. Supplemental Biological Opinion Reinitiating Consultation on the January 11, 2007 Biological Opinion regarding Authorization of Bering Sea/Aleutian Islands (BSAI) Groundfish Fisheries. December 2, 2009. U.S. Dept. of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Seattle, WA.  
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- NMFS. 2000. ESA Section 7 Consultation Biological Opinion and Incidental Take Statement. Activities Considered: Authorization of Bering Sea/Aleutian Islands groundfish fisheries based on the Fishery Management Plan for the Bering Sea/Aleutian Islands Groundfish and Authorization of the Gulf of Alaska groundfish fisheries based on the Fishery Management Plan for Groundfish of the Gulf of Alaska. November 30, 2000. NMFS Alaska Region, P. O. Box 21668, Juneau, Alaska 99802. URL:  
[https://alaskafisheries.noaa.gov/sites/default/files/fmp\\_sec07-NOV30\\_2000\\_FINAL.pdf](https://alaskafisheries.noaa.gov/sites/default/files/fmp_sec07-NOV30_2000_FINAL.pdf).



**Table 1. BSAI groundfish fisheries total Chinook salmon incidental catch compared against total groundfish catch: 2004 through 2015**

BSAI Chinook Count			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Trawl Gear	Pelagic	Pollock Target	48,733	67,362	82,695	121,770	21,481	12,406	9,693	25,499	11,344	13,034	15,031	18,329
		Pacific Cod Target	5,599	3,764	3,620	6,287	2,063	1,054	1,256	404	927	864	1,303	1,419
	Non-Pelagic	Flatfish	2,166	2,950	725	1,169	246	166	636	19	175	557	1,173	4,542
		Other Targets	404	135	13	279	308	354	883	644	434	1,537	556	894
Non-Trawl Gear		All Targets	57	56	31	74	10	11	12	44	50	15	33	69
TOTAL			56,960	74,266	87,084	129,579	24,107	13,990	12,479	26,609	12,930	16,007	18,096	25,253
BSAI Groundfish			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Trawl Gear	Pelagic	Pollock Target	1,452,486	1,461,803	1,474,864	1,341,395	980,866	810,475	803,513	1,198,527	1,202,056	1,247,743	1,257,199	1,294,719
		Pacific Cod Target	109,816	81,230	85,564	93,077	43,859	38,238	36,938	44,978	53,599	53,778	53,859	41,573
	Non-Pelagic	Flatfish	180,893	192,555	194,683	217,734	293,334	245,561	277,416	309,567	324,415	348,303	333,222	269,442
		Other Targets	75,530	78,422	80,320	85,251	83,688	99,496	100,458	81,813	79,235	63,297	70,799	96,213
Non-Trawl Gear		All Targets	160,425	167,103	146,677	122,831	144,323	143,798	136,863	177,669	195,995	193,774	206,928	209,461
TOTAL			1,979,151	1,981,113	1,982,108	1,860,289	1,546,070	1,337,568	1,355,187	1,812,554	1,855,299	1,906,895	1,922,008	1,911,408
BSAI Chinook Rate			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Trawl Gear	Pelagic	Pollock Target	0.034	0.046	0.056	0.091	0.022	0.015	0.012	0.021	0.009	0.010	0.012	0.014
		Pacific Cod Target	0.051	0.046	0.042	0.068	0.047	0.028	0.034	0.009	0.017	0.016	0.024	0.034
	Non-Pelagic	Flatfish	0.012	0.015	0.004	0.005	0.001	0.001	0.002	0.000	0.001	0.002	0.004	0.017
		Other Targets	0.005	0.002	0.000	0.003	0.004	0.004	0.009	0.008	0.005	0.024	0.008	0.009
Non-Trawl Gear		All Targets	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
TOTAL			0.029	0.037	0.044	0.070	0.016	0.010	0.009	0.015	0.007	0.008	0.009	0.013

Updated May 25, 2016

**Table 2. GOA groundfish fisheries total Chinook salmon incidental catch compared against total groundfish catch: 2004 through 2015**

Gulf of Alaska Chinook Count			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Trawl Gear	Pelagic	Pollock Target	12,506	26,631	15,564	35,127	10,667	2,916	42,885	12,419	16,004	12,209	10,859	13,448
		Other Targets	-	63	6	304	726	126	148	59	598	154	38	894
	Non-Pelagic	Pollock Target	908	41	882	624	436	111	435	440	291	742	24	162
		Pacific Cod Target	2,800	2,853	1,909	2,654	2,804	3,784	7,750	1,349	520	387	278	1,162
		Flatfish	885	387	263	1,732	1,514	1,181	1,448	4,481	1,581	7,655	3,300	2,253
		Other Targets	646	1,296	380	50	30	278	1,893	1,039	999	2,183	1,209	1,025
Non-Trawl Gear	All Targets	32	-	-	47	-	-	-	-	-	4	43	27	
TOTAL			17,777	31,270	19,004	40,539	16,176	8,397	54,559	19,787	19,992	23,334	15,751	18,971

Gulf of Alaska Groundfish			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Trawl Gear	Pelagic	Pollock Target	57,984	83,218	73,225	52,832	47,182	39,558	74,743	72,912	99,615	86,265	133,928	162,572
		Other Targets	977	1,433	3,497	4,647	4,522	3,381	4,743	3,905	4,452	2,173	4,308	3,851
	Non-Pelagic	Pollock Target	7,195	897	3,259	1,351	3,556	1,921	2,994	9,328	3,616	9,924	11,761	7,168
		Pacific Cod Target	16,785	12,443	11,403	13,590	22,857	8,736	17,230	13,945	20,200	20,054	21,269	21,735
		Flatfish	20,449	29,622	41,313	42,572	47,085	52,052	42,619	45,608	32,502	38,240	52,627	25,788
		Other Targets	26,094	21,884	22,149	20,337	20,452	22,579	24,203	20,466	23,627	22,980	24,208	27,173
Non-Trawl Gear	All Targets	59,180	50,758	53,912	54,101	56,181	55,019	71,117	85,617	74,847	70,542	78,120	75,835	
TOTAL			188,664	200,254	208,758	189,429	201,835	183,246	237,649	251,782	258,859	250,178	326,222	324,122

Gulf of Alaska Chinook Rate			2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Trawl Gear	Pelagic	Pollock Target	0.216	0.320	0.213	0.665	0.226	0.074	0.574	0.170	0.161	0.142	0.081	0.083
		Other Targets	-	0.044	0.002	0.065	0.161	0.037	0.031	0.015	0.134	0.071	0.009	0.232
	Non-Pelagic	Pollock Target	0.126	0.045	0.271	0.462	0.123	0.058	0.145	0.047	0.080	0.075	0.002	0.023
		Pacific Cod Target	0.167	0.229	0.167	0.195	0.123	0.433	0.450	0.097	0.026	0.019	0.013	0.053
		Flatfish	0.043	0.013	0.006	0.041	0.032	0.023	0.034	0.098	0.049	0.200	0.063	0.087
		Other Targets	0.025	0.059	0.017	0.002	0.001	0.012	0.078	0.051	0.042	0.095	0.050	0.038
Non-Trawl Gear	All Targets	0.001	-	-	0.001	-	-	-	-	-	0.000	0.001	0.000	
TOTAL			0.094	0.156	0.091	0.214	0.080	0.046	0.230	0.079	0.077	0.093	0.048	0.059

Updated May 25, 2016



**Table 3. Chinook salmon –incidental catch in BSAI groundfish fisheries**

Year	ANNUAL WITH CDQ	ANNUAL NO CDQ	ANNUAL CDQ	SEASON A WITH CDQ	SEASON B WITH CDQ	SEASON A BWITH NO CDQ	SEASON B WITH NO CDQ	SEASON A CDQ ONLY	SEASON B CDQ ONLY
1991	48,880	48,880	0	46,392	2,488	46,392	2,488	0	0
1992	41,954	41,954	0	31,418	10,536	31,418	10,536	0	0
1993	46,013	46,013	0	24,688	21,325	24,688	21,325	0	0
1994	43,821	40,613	3,207	38,921	4,899	36,698	3,915	2,222	984
1995	23,436	21,430	2,005	18,939	4,497	18,284	3,145	654	1,351
1996	63,204	60,744	2,460	43,316	19,888	42,027	18,716	1,288	1,171
1997	50,530	48,046	2,483	16,401	34,128	14,902	33,144	1,499	984
1998	60,548	55,431	5,117	19,869	40,679	18,930	36,500	939	4,178
1999	14,599	12,937	1,662	8,793	5,805	8,204	4,732	589	1,073
2000	8,222	7,473	749	6,567	1,655	6,137	1,336	430	319
2001	40,547	37,986	2,561	24,871	15,676	23,093	14,893	1,778	783
2002	39,683	37,580	2,103	26,276	13,407	24,858	12,722	1,418	685
2003	53,661	50,948	2,713	40,058	13,603	38,262	12,685	1,795	918
2004	60,038	57,028	3,010	30,766	29,272	29,626	27,402	1,140	1,870
2005	75,084	73,028	2,056	33,622	41,462	32,326	40,702	1,296	760
2006	87,115	85,325	1,790	62,547	24,568	60,943	24,381	1,603	187
2007	130,000	124,356	5,644	78,156	51,844	75,062	49,294	3,094	2,550
2008	23,914	23,197	717	18,828	5,086	18,223	4,973	604	113
2009	14,171	13,668	503	11,345	2,825	10,931	2,736	414	89
2010	12,430	12,095	335	9,487	2,943	9,151	2,943	335	0
2011	26,609	25,845	764	7,602	19,007	7,171	18,673	430	334
2012	12,930	12,552	378	8,981	3,949	8,636	3,915	344	34
2013	16,007	15,346	661	9,186	6,821	8,714	6,632	472	189
2014	18,096	17,203	893	13,836	4,261	13,143	4,060	692	201
2015	25,254	23,805	1,449	17,503	7,751	16,455	7,350	1,048	401

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**Table 4. Chinook salmon incidental catch in BS pollock directed fisheries.**

Year	ANNUAL WITH CDQ	ANNUAL NO CDQ	ANNUAL CDQ	SEASON A WITH CDQ	SEASON B WITH CDQ	SEASON A WITH NO CDQ	SEASON B WITH NO CDQ	SEASON A CDQ ONLY	SEASON B CDQ ONLY
1991	40,906	40,906	0	38,791	2,114	38,791	2,114	0	0
1992	35,950	35,950	0	25,691	10,259	25,691	10,259	0	0
1993	38,516	38,516	0	17,264	21,252	17,264	21,252	0	0
1994	33,136	30,572	2,564	28,451	4,686	26,871	3,701	1,580	985
1995	14,984	12,978	2,006	10,579	4,405	9,924	3,053	655	1,351
1996	55,623	53,162	2,460	36,068	19,554	34,780	18,383	1,289	1,172
1997	44,909	42,434	2,475	10,935	33,973	9,445	32,989	1,490	985
1998	56,440	51,322	5,118	16,132	40,308	15,193	36,130	939	4,179
1999	11,978	10,381	1,597	6,352	5,627	5,768	4,614	584	1,013
2000	4,961	4,242	719	3,422	1,539	2,992	1,250	430	289
2001	33,444	30,937	2,507	18,484	14,961	16,711	14,227	1,773	734
2002	34,495	32,402	2,093	21,794	12,701	20,378	12,024	1,416	677
2003	45,661	43,096	2,565	33,478	12,183	30,913	12,183	2,565	0
2004	51,762	48,796	2,966	24,925	26,837	21,959	26,837	2,966	0
2005	68,184	66,251	1,933	27,960	40,224	26,027	40,224	1,933	0
2006	82,752	81,015	1,737	58,547	24,205	56,810	24,205	1,737	0
2007	124,723	116,575	8,148	72,943	51,780	67,323	49,252	5,620	2,528
2008	21,307	20,667	640	16,495	4,811	15,891	4,775	604	36
2009	12,579	12,132	447	9,882	2,697	9,524	2,608	358	89
2010	9,748	9,413	335	7,656	2,093	7,321	2,093	335	0
2011	25,499	24,735	764	7,137	18,362	6,707	18,028	430	334
2012	11,344	10,995	349	7,765	3,579	7,421	3,574	344	5
2013	13,034	12,514	520	8,237	4,797	7,765	4,749	472	48
2014	15,031	14,303	728	11,539	3,492	10,847	3,456	692	36
2015	18,330	17,299	1,031	12,305	6,025	11,524	5,775	781	250

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**Table 5. Chinook salmon incidental catch (numbers of salmon) by quarter from 1991 through 2015 in the GOA pollock and other non-pollock groundfish fisheries**

Year	Annual Total	GOA Pollock Fisheries					Other Fisheries
		First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual	Annual
1991	38,894	3,239	538	1,799	2,862	8,439	30,455
1992	16,787	2,289	2,663	1,457	1,801	8,210	8,578
1993	19,260	6,499	157	2,730	4,192	13,578	5,682
1994	13,615	3,685	88	1,973	1,474	7,219	6,396
1995	14,652	1,408	32	2,342	1,136	4,917	9,735
1996	15,761	4,802	57	6,421	100	11,380	4,381
1997	15,230	4,622	48	4,742	30	9,443	5,787
1998	16,984	1,672	1	8,550	4,005	14,228	2,755
1999	30,600	10,408	35	5,981	10,003	26,428	4,173
2000	26,729	4,298	2,313	9,744	2,058	18,413	8,317
2001	15,104	4,204	3,107	754	1,466	9,531	5,573
2002	12,920	1,505	640	553	2,463	5,161	7,758
2003	15,367	765	389	948	2,298	4,400	10,967
2004	17,778	3,632	2,176	2,207	5,137	13,152	4,626
2005	31,271	11,100	5,123	1,076	10,629	27,928	3,343
2006	18,768	2,918	4,292	4,640	3,861	15,711	3,057
2007	40,616	1,525	28,486	1,315	3,866	35,192	5,424
2008	16,264	578	7,691	389	2,087	10,745	5,519
2009	8,475	718	1,406	653	412	3,189	5,286
2010	54,655	4,992	2,038	4,869	32,935	44,831	9,824
2011	21,519	1,717	1,260	1,317	10,296	14,590	6,929
2012	19,992	2,907	861	4,398	8,129	16,295	3,697
2013	23,333	4,303	684	1,156	6,807	12,950	10,383
2014	15,752	1,718	1,626	3,406	4,134	10,884	4,868
2015	18,968	2,592	4,254	2,181	4,580	13,607	5,361

1991–2002: Blend data. Week end date was used to determine quarters. Week end dates do not always match quarter dates.

2003–2010: Catch Accounting System.

2010–Current : Catch Accounting System 2

Due to changes in regulatory pollock season dates from 1991 to 2001 and to match current pollock season dates, data were grouped by quarter. Multiple fixes were applied to the Catch Accounting System in early 2014. This has resulted in minor changes in prior years.

First Quarter Jan 1–Feb 28

Second Quarter Mar 1–May 31

Third Quarter Jun 1–Sep 30

Fourth Quarter Oct 1–Dec 31

Updated May 18, 2016

**Appendix 1. Alaska Fisheries Science Center North Pacific Observer Program Bycatch Sampling for 2014**

## **North Pacific Observer Program Bycatch Sampling**

The Alaska Fisheries Science Center, Fisheries Monitoring and Analysis (FMA) Division manages the North Pacific Observer Program (Observer Program), which monitors groundfish and halibut fishing activities in the U.S. Exclusive Economic Zone off Alaska. The Observer Program is responsible for the collection of fisheries data used by managers for stock assessment and inseason monitoring of the commercial groundfish fisheries. Data collected by observers are used by managers to monitor quotas, manage groundfish and prohibited species catch, and document interactions with protected resources. These data provide the best available scientific information for managing fisheries and developing measures to minimize incidentally caught species, including salmon. The methods used to estimate the number of incidentally caught salmon in the Alaska Federal groundfish fisheries vary by area and fishery.

Observers are deployed in the field for up to three months at a time and debrief with FMA staff following their deployment. The data are not finalized until all observers return from the field for debriefing and their data are scrutinized following FMA quality control protocols. Generally, the annual observer data are finalized in late March to early April of the year following the fishery.

## **Bering Sea Pollock Fishery Sampling and Data Collection**

The Bering Sea pollock fishery is one of the most heavily observed fleets in the nation. In August 2010, NMFS published regulations implementing Amendment 91 to the BSAI FMP (75 FR 53026, August 30, 2010). These regulations, effective January 1, 2011, require 100% observer coverage in the Bering Sea pollock fisheries regardless of vessel length, 100% retention of all salmon species, a census of all salmon species in every haul or fishing trip, and an expanded biological sampling program. Also, NMFS requires shoreside processors to provide a location from which the observer is able to view all sorting and weighing of fish, as well the storage area for salmon. A new sampling protocol for Chinook salmon in the Bering Sea pollock fishery was initiated at the start of the 2011 fishing year. This protocol was designed to conform with recommendations provided in Pella and Geiger (2009). This new protocol includes a complete census of retained salmon bycatch in the pollock fishery which is then sampled systematically by observers.

On catcher/processors and motherships, the vessel personnel are required to save all salmon in an approved storage container until the end of the haul, and electronic monitoring systems are used to ensure compliance with this rule. For each haul, the observers count and identify every salmon retained. Observers implement a systematic sampling design for all Chinook and chum salmon collected from the haul by selecting every tenth Chinook and every thirtieth chum for further biological data collection. The selected fish are used to obtain a length measurement, a genetic tissue sample, and five scales to verify species identification. These randomly selected fish are also checked for a missing adipose fin, indicating a potential coded wire tag (CWT).

Chinook and chum salmon that are not selected using the systematic sample design are identified to species and counted but no additional biological data are collected. All other salmon species are identified, measured, counted, and checked for a missing adipose fin. Additionally, a separate scale collection is collected to verify the observer's species identification skills.



On catcher vessels delivering to processing plants<sup>9</sup> observers do not conduct an at-sea - census count of salmon because they may not sample every haul. Instead, observers randomly sample hauls, and identify every salmon encountered in their randomly collected at-sea composition samples from these hauls and collect a scale sample to verify species identification and check for missing adipose fins. The observers monitor that no salmon are discarded at sea to the best of their ability. Total retained salmon numbers and related genetics samples are obtained from catcher vessel pollock deliveries at the processing facility by the plant observer.

Once the catch is delivered to the processing facility, the plant and vessel observers monitor the entire offload to ensure that all retained salmon are sorted and placed in an approved salmon storage container. The observers collect total salmon numbers and associated biological specimens following the same procedure outlined above for catcher/processors and motherships.

In the 2014 Bering Sea pollock fishery, 1,512 Chinook, 7,679 chum, 17 coho, 48 pink, and 21 sockeye salmon were measured for length. Of these fish, 1,475 Chinook and 7,253 chum were sampled for genetic tissue (Table 1). In addition, 9 Chinook salmon were missing their adipose fin and their heads were shipped to the Auke Bay Laboratories (Auke Bay Lab) to be scanned for CWT presence and analysis. It is important to note that every biological specimen, such as genetic tissue samples or scale samples, is associated with a length. For this reason the total number of lengths is expected to exceed the total number of any biological specimen.

#### BSAI Non-pollock Fishery Sampling and Data Collection

The non-pollock fisheries in the BSAI, such as flatfish and Pacific cod trawl, contribute a smaller number of incidentally caught salmon in comparison to the Bering Sea pollock fishery. In these fisheries, the total number of incidentally caught salmon is obtained by using the vessel observer's at-sea species composition samples that are extrapolated to the vessel's total catch. Sampling protocols for observers in these non-pollock fisheries are different than those in the pollock fishery, and genetic tissue samples are not required to be collected. However, all salmon species encountered in the randomly collected at-sea species composition samples are checked for a missing adipose fin, and scale samples are collected to verify species identification. The catch is not monitored for salmon during off-load at the processing plant. In 2014 BSAI non-pollock fisheries, observers measured a total of 41 Chinook, 96 chum, 24 coho and 1 pink salmon (Table 1).

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<sup>9</sup> Catcher vessels delivering to motherships are not required to carry observers. The hauls are sampled by observers on the mothership following the procedures described for catcher/processors and motherships.

**Table 1. Number of length, genetic, and CWT samples collected from incidentally caught salmon in the 2014 Bering Sea/Aleutian Islands pollock and non-pollock fisheries**

Area/fishery	Salmon species	Sample		
		Length	Genetic tissue	CWT <sup>1</sup>
BS pollock				
	Chinook	1,512	1,475	9
	Chum	7,679	7,253	0
	Coho	17	n/a <sup>2</sup>	0
	Pink	48	n/a <sup>2</sup>	0
	Sockeye	21	n/a <sup>2</sup>	0
	subtotal	9,277	8,728	9
BSAI non-pollock				
	Chinook	41	1	0
	Chum	96	2	0
	Coho	24	n/a <sup>2</sup>	0
	Pink	1	n/a <sup>2</sup>	0
	Sockeye	0	n/a <sup>2</sup>	0
	subtotal	162	3	0
Total		9,439	8,731	9

<sup>1</sup> Salmon head collected from fish missing adipose fin.

<sup>2</sup> n/a = not part of sampling protocol

#### GOA Pollock Fishery Sampling and Data Collection

In 2011, the Observer Program's biological salmon sampling protocols for the GOA pollock fishery were revised to be as consistent as possible with the changes implemented in the Bering Sea pollock fishery. In July 2012, NMFS published regulations implementing Amendment 93 to the GOA FMP (77 FR 42629, July 20, 2012). These regulations, effective August 25, 2012, required 100% retention of all salmon caught in the Western and Central GOA directed pollock trawl fishery. Beginning 1 January 2013, the restructured observer program was implemented, which required participation of catcher vessels between 40 ft. and 125 ft. LOA in the partial coverage observer program. These vessels were randomly selected for observer coverage either on a trip by trip basis or a two-month duration, dependent on the coverage category of the vessel.

In 2014, the 100% retention of all salmon by vessels with observers in the pollock fishery allowed catcher vessel observers to check every salmon encountered in their randomly collected at-sea composition samples for missing adipose fins, collect a scale sample to verify species identification, and monitor the vessel offload at the shoreside processing facility to record a total count of salmon species retained by the vessel personnel. The catcher vessel observers also monitored that no salmon were discarded at sea to the best of their ability while completing other sampling duties. The total number of salmon encountered by the vessel observer while monitoring the offload was used as the source of total salmon numbers for the vessel. The

information obtained from observed vessels was then used to determine a PSC rate of salmon for un-observed vessels.

It is important to note that, unlike the Bering Sea pollock fishery, observers were not stationed at Gulf of Alaska shoreside processing facilities in 2014. Vessel observers collected biological specimens at the shoreside processing facility from salmon delivered by vessel personnel following the same procedure outlined above for catcher/processors and motherships fishing BSAI pollock. Due to the restructured observer program, vessel observers were not deployed on all catcher vessels fishing pollock in GOA. Genetic samples from Chinook and chum salmon made available to the vessel observer by plant personnel were obtained from pollock vessel deliveries at the processing facility using the systematic sample design described above.

Data collected from the observed vessels provided an indication of the relative numbers and species of salmon incidentally taken in the GOA pollock fishery. The total numbers of incidentally caught salmon were obtained using the number encountered by the vessel observers during the vessel offload at the processing facility. In rare circumstances where the offload sample was not completed, NMFS Alaska Region used the number of salmon in the at-sea samples to extrapolate to the entire vessel offload.

Total numbers of all other salmon species were collected following the Chinook and chum sampling protocols described above while length measurements and biological data were only collected from Chinook and chum salmon encountered within the at-sea composition sample or during the vessel offload monitored by the plant observer. In the 2014 GOA pollock fishery, 1,412 Chinook, 284 chum, 8 coho, and 1 pink salmon were measured for length. Of these fish, 1,317 Chinook and 265 chum salmon were sampled for genetic tissue (Table 2). In addition, 123 Chinook salmon were missing their adipose fin and their heads were shipped to the Auke Bay lab to be scanned for CWT presence and analysis.

#### GOA Non-pollock Fishery Sampling and Data Collection

The non-pollock fisheries in the GOA, such as flatfish and Pacific cod trawl, contribute a smaller number of incidentally caught salmon in comparison to the pollock fishery. In 2014, observer coverage for groundfish vessels was the same for both pollock and non-pollock vessels with the exception of the rockfish fishery that requires 100% observer coverage regardless of vessel length.

In these non-pollock fisheries, the total number of incidentally caught salmon is obtained using at-sea species composition samples collected by vessel observers and extrapolated to the vessel's total catch. Sampling protocols for observers in these non-pollock fisheries are different than those in the pollock fishery, length measurements and biological data were only collected from Chinook and chum salmon encountered with the randomly collected at-sea composition sample. However, all salmon species encountered in the randomly collected at-sea species composition samples are checked for missing adipose fins indicating a potential CWT, and scale samples are collected to verify species identification.

In the 2014 GOA non-pollock fisheries, observers measured a total of 56 Chinook, 14 chum, and 31 coho salmon. A total of 38 Chinook salmon and 10 chum salmon were sampled for genetic tissue. Of these fish, 4 Chinook salmon were missing their adipose fin (Table 2). These salmon heads were collected and shipped to the Auke Bay Lab to be scanned for CWT presence and analysis.



**Table 2. Number of samples collected from incidentally caught salmon in the 2014 Gulf of Alaska pollock and non-pollock fisheries**

Area/fishery	Salmon species	Sample		
		Length	Genetic tissue	CWT <sup>1</sup>
GOA pollock				
	Chinook	1,412	1,357	123
	Chum	284	265	0
	Coho	8	n/a <sup>2</sup>	1
	Pink	1	n/a <sup>2</sup>	0
	Sockeye	0	n/a <sup>2</sup>	0
	subtotal	1,705	1,622	124
GOA non-pollock				
	Chinook	56	38	4
	Chum	14	10	0
	Coho	31	n/a <sup>2</sup>	0
	Pink	n/a <sup>2</sup>	n/a <sup>2</sup>	0
	Sockeye	n/a <sup>2</sup>	n/a <sup>2</sup>	0
	subtotal	101	48	4
Total				
		1,806	1,670	128

<sup>1</sup> Salmon head collected from fish missing adipose fin.

<sup>2</sup> n/a = not part of sampling protocol

**Appendix 2: Memo: 2013 and 2014 Coded-Wire Tag Recoveries from Chinook Salmon in the Gulf of Alaska and Bering Sea-Aleutian Islands**

April 29, 2016

**MEMORANDUM FOR:** Jeff Hartman  
NOAA Fisheries Alaska Region

**FROM:** Michele Masuda  
NOAA Fisheries Alaska Fisheries Science Center

**SUBJECT:** 2013 and 2014 Coded-Wire Tag Recoveries from Chinook  
Salmon in the Gulf of Alaska and Bering Sea-Aleutian Islands  
(Revision 1 of Memo dated September 1, 2015)



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## **Sampling for CWTs in the Gulf of Alaska**

In the 2014 Gulf of Alaska (GOA) groundfish trawl fisheries, snout collection for coded- wire tagged (CWT) salmon was conducted by at-sea and plant observers of the North Pacific Observer Program. Snout collection for CWTs was based on visual detection only of an adipose fin clip. Observers sampled 1,395<sup>10</sup> Chinook salmon and collected snouts from 127<sup>11</sup> fish with an adipose fin clip (Table 1). Of the snouts examined, 33 had readable CWTs (Table 1).

In 2014, electronic detection for CWTs in the GOA salmon bycatch was conducted by the North Pacific Research Foundation in salmon excluder device (SED) testing directed at pollock. The goal of the SED is to reduce the amount of salmon bycatch in trawl catches by allowing salmon to exit the trawl while groundfish are retained. Of the 151 Chinook salmon scanned with handheld CWT detection wands and visually inspected for adipose fin clips, 32 (21.2%) had an adipose fin clip, and 6 (4.0%) had readable CWTs (Table 1). Of the 6 fish with readable CWTs, all 6 (100%) had an adipose fin clip and 0 (0%) had no fin clip (Table 1).

Also in 2014, electronic detection for CWTs in the salmon bycatch of the GOA rockfish trawl fishery was conducted by the Alaska Groundfish Data Bank, and nearly all of the Chinook salmon bycatch was scanned with CWT detection wands. Of the 468 Chinook salmon scanned with handheld wands and visually inspected for adipose fin clips, 74 (15.8%) had an adipose fin clip, and 17 (3.6%) had readable CWTs (Table 1). Of the 17 fish with readable CWTs, all 17 (100%) had an adipose fin clip, and 0 (0%) had no fin clip (Table 1).

In the 2013 U.S. trawl research conducted by the National Marine Fisheries Service (NMFS) and directed at juvenile salmon in the GOA, electronic sampling was used to scan all salmon for CWTs, although all salmon were also visually inspected for presence of an adipose fin clip. Researchers sampled 369 Chinook salmon, of which 213 (57.7%) had an adipose fin clip and 59 (16.0%) had readable CWTs (Table 1). Of the 59 fish with readable CWTs, 46 (78.0%) had a clipped adipose fin, and 13 (22.0%) had no fin clip.

## **Sampling for CWTs in the Bering Sea-Aleutian Islands**

In the 2014 Bering Sea-Aleutian Islands (BSAI) groundfish trawl fisheries, sampling for CWTs continued under a systematic sampling design recommended by Pella and Geiger (2009), and implemented by the NPGHOP in 2011, for collecting genetic samples from 1 out of every 10 Chinook salmon encountered in the bycatch. Snout collection for CWTs was based on visual detection only of an adipose fin clip in every 10<sup>th</sup> Chinook salmon encountered and sampled for genetics. In 2014, observers of the NPGHOP sampled 1,553<sup>12</sup> Chinook salmon in the BSAI and collected 9<sup>13</sup> snouts from fish with an adipose fin clip (Table 1). Of the snouts examined, 5 had readable CWTs (Table 1).

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<sup>10</sup>Number of Chinook salmon sampled for genetics in the pollock and non-pollock fisheries (Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center).

<sup>11</sup>Number from the Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center.

<sup>12</sup>Number of Chinook salmon sampled for length in the pollock and non-pollock fisheries (Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center).

<sup>13</sup>Number from the Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center.

## **CWT releases from ESA-listed ESUs**

The North Pacific Fishery Management Council contracted Cramer Fish Sciences to compile a database of CWT release groups of West Coast salmon and steelhead listed under the Endangered Species Act (ESA); this database was last updated in June 2015 (Caldwell, 2015). The database was compiled using the Pacific States Marine Fisheries Commission Regional Mark Information System CWT database and a list of artificial propagation programs determined by NMFS to be included in ESA-listed evolutionarily significant units (ESUs). We determined from this database the CWT Chinook salmon recovered in the GOA and BSAI that originated from ESA-listed ESUs.

## **Results**

Results in this report are summarized over two time periods. For the GOA fisheries, because of implementation of a revised genetic sampling protocol by the NPGHOP in 2012 and increased CWT recoveries by electronic detection programs beginning in 2012, results are summarized for periods 2001–2011 and 2012–2014. For the BSAI fisheries, because a revised genetic sampling protocol was instituted in 2011, results are summarized for periods 2001–2010 and 2011–2014.

### **Origins of CWT Chinook salmon in the Gulf of Alaska**

Tagged Chinook salmon recovered as bycatch in the GOA are comprised of stocks originating from Alaska, British Columbia, Idaho, Oregon, and Washington. Recoveries of CWT Chinook salmon in the bycatch of the GOA groundfish fishery are summarized by state or province of origin for 2001–2014 (Table 2). Tagged Alaska Chinook salmon harvested in the GOA have historically originated from two regions, Cook Inlet and Southeast Alaska, with most of the CWT Alaskan Chinook salmon originating from Southeast Alaska (Table 3). Since the Alaska Department of Fish and Game (ADF&G) ended the tagging of Cook Inlet Chinook salmon with CWTs after the 2008 brood year (2010 release), all CWT Alaskan Chinook salmon harvested in the GOA in 2012–2014 have originated from Southeast Alaska.

Most of the Chinook salmon represented by CWTs and harvested in the GOA originated from hatchery production (Table 4), a reflection that wild stocks of Chinook salmon are under-represented by CWTs, especially outside of Alaskan production. Chinook salmon recovered in the GOA are comprised of a variety of run types (Table 5) that are designated by the tagging agency. Chinook salmon recovered in the GOA are comprised of a variety of age classes (Table 6). Total age of each fish was calculated by subtracting the brood year of the CWT recovery from the recovery year which includes freshwater and saltwater residency.

### **Origins of CWT Chinook salmon in the Bering Sea-Aleutian Islands**

Tagged Chinook salmon recovered as bycatch in the BSAI are comprised of stocks originating from Alaska, British Columbia, Oregon, Washington, and the Yukon Territory. Recoveries of CWT Chinook salmon in the bycatch of the BSAI groundfish fishery are summarized by state or province of origin for 2001–2014 (Table 7). Starting in 2011, sampling expansion factors were calculated for CWT recoveries in the bycatch of the BSAI groundfish fisheries. Total estimated numbers by state or province of origin are shown for 2011–2014 (Table 8). Tagged Alaska Chinook salmon harvested in the BSAI have historically originated from two regions, Cook Inlet and Southeast Alaska (Table 9). Since ADF&G ended the tagging of Cook Inlet Chinook salmon with CWTs after the 2008 brood year (2010 release), all CWT Alaskan Chinook salmon harvested in the BSAI in 2011–2014 have originated from Southeast Alaska.



Most of the Chinook salmon represented by CWTs and harvested in the BSAI originated from hatchery production (Table 10), a reflection that wild stocks of Chinook salmon are under-represented by CWTs, especially outside of Alaskan production. Chinook salmon recovered in the BSAI are comprised of a variety of run types (Table 11) that are designated by the tagging agency.

### **Occurrence of ESA-listed Chinook salmon ESUs in the GOA and BSAI**

Coded-wire tagged Chinook salmon from ESA-listed ESUs have been recovered in GOA and BSAI trawl fisheries pre- and post-listing under the ESA (Tables 12 and 13). Since 1981, CWTs in Chinook salmon have been recovered in the GOA trawl fisheries from the Lower Columbia River (LCR), Puget Sound (PS), Snake River fall run (SRf), Snake River spring/summer run (SRss), Upper Columbia River spring (UCRs), and Upper Willamette River (UWR) ESUs: 25 LCR, 1 PS, 9 SRf, 2 SRss, 2 UCRs, and 130 UWR Chinook salmon (Tables 12 and 13). CWTs in Chinook salmon have been recovered in the BSAI trawl fisheries from the Lower Columbia River, Snake River spring/summer run, and Upper Willamette River ESUs: 10 LCR, 1 SRss, and 13 UWR Chinook salmon (Tables 12 and 13). By applying a total mark expansion factor to account for the wild, untagged component of each ESU (see Appendix 1), the estimated numbers were 132.9 LCR, 1.1 PS, 17.8 SRf, 4.0 SRss, 2.2 UCRs, and 484.5 UWR Chinook salmon in the GOA trawl fisheries and 11.3 LCR, 2.6 SRss, and 76.7 UWR Chinook salmon in the BSAI trawl fisheries (Tables 12 and 13).

U.S. trawl research directed at juvenile salmon has also documented the occurrence of ESA-listed Chinook salmon in the GOA. Since 1996, CWTs have been recovered from 7 LCR, 1 PS, 4 SRf, 27 SRss, 19 UCRs, and 23 UWR Chinook salmon (Tables 14 and 15). By applying a total mark expansion factor to account for the wild, untagged component of each ESU (see Appendix 1), the estimated numbers from U.S. trawl research were 19.4 LCR, 1.1 PS, 6.8 SRf, 116.2 SRss, 40.8 UCRs, and 86.5 UWR Chinook salmon in the GOA (Tables 14 and 15). No ESA-listed CWT salmon have been recovered in U.S. trawl research surveys in the BSAI.

### **Ocean distribution of ESA-listed Chinook salmon, 1981–2014**

Maps of the ocean distribution of CWT Chinook salmon from ESA-listed ESUs are shown (Figures 1–7). These maps were compiled from the historical database of CWT recoveries (1981–2014) from high seas commercial fisheries (GOA groundfish trawl fisheries, BSAI groundfish trawl fisheries, at-sea Pacific hake trawl fishery off the U.S. West Coast, and the groundfish trawl and fixed-gear fisheries off the U.S. West Coast), as well as domestic and foreign research surveys in the North Pacific Ocean, GOA, and BSAI. The maps show the ocean distribution for CWT recoveries from ESA-listed Chinook salmon ESUs from the Pacific Northwest for three time periods: pre-listing (1981–listing), post-listing to 2011, and 2012–2014.

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Table 1. Number of Chinook salmon sampled, number with adipose fin-clips (ad-clipped), and number with readable coded-wire tags (CWTs) in the various sampling programs in the Gulf of Alaska (GOA) and eastern Bering Sea-Aleutian Islands (BSAI) in 2013 and 2014. The number of Chinook salmon with readable CWTs that were also ad-clipped is in parentheses. Only sampling programs based on electronic detection can be expected to recover CWTs from fish that are not ad-clipped.

Region	Year	Fishery and gear	Sampling program	Detection method	Number sampled	Number ad-clipped	Number with readable CWTs
GOA	2013	Research trawl	National Marine Fisheries Service	Electronic and visual	369	213	59 <sup>1</sup> (46)
GOA	2014	Groundfish trawl	Observer program	Visual	1,395 <sup>2,3</sup>	127 <sup>3</sup>	33 (33)
		Salmon excluder device trawl	North Pacific Fisheries Research Foundation	Electronic	151	32	6 (6)
		Rockfish trawl	Alaska Groundfish Data Bank	Electronic	468	74	17 (17)
BSAI	2014	Groundfish trawl	Observer program	Visual	1,553 <sup>3,4</sup>	9 <sup>3</sup>	5 (5)

<sup>1</sup>Includes one CWT with a tag code that could not be reconciled with release information.

<sup>2</sup>Number of Chinook salmon sampled for genetics in the pollock and non-pollock fisheries.

<sup>3</sup>Number from the Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center.

<sup>4</sup>Number of Chinook salmon sampled for length in the pollock and non-pollock fisheries.

Table 2. Observed numbers and CWT mark expanded numbers of CWT Chinook salmon captured in the bycatch of the GOA groundfish fishery by run year and state or province of origin, A) 2001–2011 and B) 2012–2014. Total numbers, numbers averaged over years, and percentages of the total averaged over years are reported.

A) 2001–2011

Run year	Alaska		British Columbia		Idaho		Oregon		Washington		Total	
	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2001	10	100.2	6	74.8	0	0	12	16.5	4	4.0	32	195.6
2002	10	47.2	5	113.0	0	0	4	4.3	3	3.7	22	168.2
2003	2	22.4	2	28.6	0	0	4	8.3	1	1.0	9	60.3
2004	3	30.5	4	22.0	0	0	5	16.9	1	1.1	13	70.6
2005	3	33.6	4	86.5	0	0	2	3.1	2	2.2	11	125.4
2006	10	58.3	7	158.3	0	0	2	2.1	5	14.5	24	233.1
2007	13	99.1	3	50.9	0	0	2	2.1	5	21.3	23	173.3
2008	6	52.3	1	1.0	0	0	3	9.3	12	12.9	22	75.5
2009	5	41.4	2	5.2	0	0	2	2.8	4	4.5	13	53.9
2010	10	81.3	4	4.0	0	0	10	25.9	12	23.7	36	135.0
2011	3	32.3	1	51.4	0	0	2	13.4	2	2.0	8	99.2
<b>Total</b>	<b>75</b>	<b>598.6</b>	<b>39</b>	<b>595.8</b>	<b>0</b>	<b>0</b>	<b>48</b>	<b>104.8</b>	<b>51</b>	<b>91.0</b>	<b>213</b>	<b>1390.1</b>
<b>Mean</b>	<b>6.8</b>	<b>54.4</b>	<b>3.5</b>	<b>54.2</b>	<b>0</b>	<b>0</b>	<b>4.4</b>	<b>9.5</b>	<b>4.6</b>	<b>8.3</b>	<b>19.4</b>	<b>126.4</b>
<b>% of total averaged over years</b>	<b>34%</b>	<b>46%</b>	<b>20%</b>	<b>38%</b>	<b>0%</b>	<b>0%</b>	<b>23%</b>	<b>9%</b>	<b>23%</b>	<b>7%</b>		

Table 2. Continued.

B) 2012–2014

	Alaska		British Columbia		Idaho		Oregon		Washington		Total	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2012	11	78.0	13	34.7	1	2.0	25	135.1	30	59.2	80	309.0
2013	12	68.2	24	136.0	6	9.4	41	216.3	97	165.4	180	595.3
2014	10	105.0	12	54.2	1	1.0	24	113.4	10	13.4	57	287.0
<b>Total</b>	<b>33</b>	<b>251.2</b>	<b>49</b>	<b>224.9</b>	<b>8</b>	<b>12.5</b>	<b>90</b>	<b>464.7</b>	<b>137</b>	<b>238.0</b>	<b>317</b>	<b>1191.3</b>
<b>Mean</b>	<b>11.0</b>	<b>83.7</b>	<b>16.3</b>	<b>75.0</b>	<b>2.7</b>	<b>4.2</b>	<b>30.0</b>	<b>154.9</b>	<b>45.7</b>	<b>79.3</b>	<b>105.7</b>	<b>397.1</b>
<b>% of total averaged over years</b>	<b>13%</b>	<b>24%</b>	<b>17%</b>	<b>18%</b>	<b>2%</b>	<b>1%</b>	<b>32%</b>	<b>40%</b>	<b>36%</b>	<b>17%</b>		



Table 3. Observed numbers and CWT mark expanded numbers of CWT Alaska-origin Chinook salmon captured in the bycatch of the GOA groundfish fisheries by run year and release region, A) 2001–2011 and B) 2012–2014. Total numbers and numbers averaged over years are reported. The tagging program on Chinook salmon in the Cook Inlet, Alaska region ended with the 2008 brood year.

A) 2001–2011

Run year	Cook Inlet, Alaska		Southeast Alaska		Alaska Total	
	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2001	2	2.0	8	98.2	10	100.2
2002	1	1.0	9	46.2	10	47.2
2003	0	0	2	22.4	2	22.4
2004	0	0	3	30.5	3	30.5
2005	0	0	3	33.6	3	33.6
2006	0	0	10	58.3	10	58.3
2007	0	0	13	99.1	13	99.1
2008	2	2.0	4	50.3	6	52.3
2009	1	1.0	4	40.4	5	41.4
2010	0	0	10	81.3	10	81.3
2011	0	0	3	32.3	3	32.3
<b>Total</b>	<b>6</b>	<b>6.0</b>	<b>69</b>	<b>592.6</b>	<b>75</b>	<b>598.6</b>
<b>Mean</b>	<b>0.5</b>	<b>0.5</b>	<b>6.3</b>	<b>53.9</b>	<b>6.8</b>	<b>54.4</b>

B) 2012–2014

Run year	Cook Inlet, Alaska		Southeast Alaska		Alaska Total	
	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2012	0	0	11	78.0	11	78.0
2013	0	0	12	68.2	12	68.2
2014	0	0	10	123.2	10	123.2
<b>Total</b>	<b>0</b>	<b>0</b>	<b>33</b>	<b>269.4</b>	<b>33</b>	<b>269.4</b>
<b>Mean</b>	<b>0</b>	<b>0</b>	<b>11.0</b>	<b>89.8</b>	<b>11.0</b>	<b>89.8</b>

Table 4. Observed numbers of CWT Chinook salmon captured in the bycatch of the GOA groundfish fishery by rearing type and state or province of origin, A) 2001–2011 and B) 2012–2014. Total numbers, numbers averaged over years, and percentages of the total averaged over years are reported.

A) 2001–2011

Origin	Rearing type			Total
	Hatchery	Mixed	Wild	
Alaska	59	0	6	65
British Columbia	33	0	0	33
Idaho	0	0	0	0
Oregon	36	0	0	36
Washington	35	10	2	47
<b>Total</b>	<b>163</b>	<b>10</b>	<b>8</b>	<b>181</b>
<b>Mean</b>	<b>32.6</b>	<b>2.0</b>	<b>1.6</b>	<b>36.2</b>
<b>% of total averaged over years</b>	<b>91%</b>	<b>5%</b>	<b>3%</b>	

B) 2012–2014

Origin	Rearing type			Total
	Hatchery	Mixed	Wild	
Alaska	30	0	3	33
British Columbia	49	0	0	49
Idaho	8	0	0	8
Oregon	90	0	0	90
Washington	135	0	2	137
<b>Total</b>	<b>312</b>	<b>0</b>	<b>5</b>	<b>317</b>
<b>Mean</b>	<b>62.4</b>	<b>0</b>	<b>1.0</b>	<b>63.4</b>
<b>% of total averaged over years</b>	<b>98%</b>	<b>0%</b>	<b>2%</b>	

Table 5. Observed numbers of CWT Chinook salmon captured in the bycatch of the GOA groundfish fishery by run type and state or province of origin, A) 2001–2011 and B) 2012–2014. Total numbers and percentages of the total in parentheses are reported.

A) 2001–2011

	Run type			
Origin	Spring	Summer	Fall	Late fall upriver bright
Alaska	67	0	0	0
British Columbia	7	12	20	0
Idaho	0	0	0	0
Oregon	20	0	25	3
Washington	1	18	29	3
<b>Total</b>	<b>95 (46%)</b>	<b>30 (15%)</b>	<b>74 (36%)</b>	<b>6 (3%)</b>

B) 2012–2014

	Run type			
Origin	Spring	Summer	Fall	Late fall upriver bright
Alaska	30	0	0	0
British Columbia	3	36	10	0
Idaho	0	1	0	7
Oregon	40	0	40	10
Washington	1	25	85	26
<b>Total</b>	<b>74 (24%)</b>	<b>62 (20%)</b>	<b>135 (43%)</b>	<b>43 (14%)</b>

Table 6. Observed numbers of CWT Chinook salmon captured in the bycatch of the GOA and BSAI groundfish fisheries by age during different time periods. Percentages are in parentheses.

Fishery	Time period	Age				
		2	3	4	5	6
GOA	2001–2011	14 (7%)	89 (42%)	92 (43%)	16 (8%)	2 (1%)
	2012–2014	45 (14%)	182 (57%)	81 (26%)	9 (3%)	0 (0%)
BSAI	2001–2010	34 (12%)	141 (49%)	92 (32%)	20 (7%)	2 (1%)
	2011–2014	0 (0%)	7 (44%)	6 (38%)	2 (13%)	1 (6%)

Table 7. Observed numbers and CWT mark expanded numbers of CWT Chinook salmon captured in the bycatch of the BSAI groundfish fishery by run year and state or province of origin, A) 2001–2010 and B) 2011–2014. Total numbers, numbers averaged over years, and percentages of the total averaged over years are reported.

A) 2001–2010

Run year	Alaska		British Columbia		Oregon		Washington		Yukon Territory		Total	
	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2001	14	16.9	6	31.0	2	2.0	1	1.7	1	1.0	24	52.6
2002	27	32.7	18	284.8	21	42.8	12	31.2	1	1.0	79	392.5
2003	6	24.6	13	82.3	4	4.1	3	18.3	2	2.0	28	131.3
2004	16	37.2	21	122.3	11	115.8	6	7.7	2	2.0	56	285.1
2005	12	15.9	17	114.6	8	22.8	7	7.9	1	1.0	45	162.2
2006	16	38.8	8	93.7	6	12.9	5	5.2	1	1.0	36	151.5
2007	5	19.4	1	12.2	2	2.0	1	1.5	0	0	9	35.2
2008	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	3	4.8	1	10.2	0	0	0	0	4	15.0
2010	0	0	2	2.9	4	37.9	7	9.8	0	0	13	50.6
<b>Total</b>	<b>96</b>	<b>185.5</b>	<b>89</b>	<b>748.7</b>	<b>59</b>	<b>250.5</b>	<b>42</b>	<b>83.3</b>	<b>8</b>	<b>8.0</b>	<b>294</b>	<b>1276.0</b>
<b>Mean</b>	<b>9.6</b>	<b>18.6</b>	<b>8.9</b>	<b>74.9</b>	<b>5.9</b>	<b>25.1</b>	<b>4.2</b>	<b>8.3</b>	<b>0.8</b>	<b>0.8</b>	<b>29.4</b>	<b>127.6</b>
<b>% of total averaged over years</b>	<b>30%</b>	<b>18%</b>	<b>33%</b>	<b>49%</b>	<b>20%</b>	<b>26%</b>	<b>15%</b>	<b>7%</b>	<b>2%</b>	<b>1%</b>		



Table 7. Continued.

B) 2011–2014

	Alaska		British Columbia		Oregon		Washington		Yukon Territory		Total	
Run year	Observed Number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2011	0	0	0	0	0	0	2	2.0	0	0	2	2.0
2012	1	1.7	1	9.4	1	1.0	2	2.0	0	0	5	14.2
2013	0	0	1	2.6	1	1.0	2	3.4	0	0	4	7.0
2014	0	0	1	2.8	3	3.9	1	1.0	0	0	5	7.7
Total	1	1.7	3	14.9	5	6.0	7	8.4	0	0	16	31.0
Mean	0.3	0.4	0.8	3.7	1.3	1.5	1.8	2.1	0	0	4.0	7.7
% of total averaged over years	5%	3%	16%	35%	26%	18%	53%	44%	0%	0%		

Table 8. CWT mark expanded and sample expanded numbers of Chinook salmon captured in the bycatch of the BSAI groundfish fishery by run year and state or province of origin, 2011–2014. Observed numbers are in parentheses.

Run year	Estimated numbers				
	Alaska	British Columbia	Oregon	Washington	Yukon Territory
2011	0 (0)	0 (0)	0 (0)	21.4 (2)	0 (0)
2012	18.9 (1)	105.4 (1)	11.5 (1)	22.7 (2)	0 (0)
2013	0 (0)	31.9 (1)	12.2 (1)	40.7 (2)	0 (0)
2014	0 (0)	66.0 (1)	92.6 (3)	23.6 (1)	0 (0)

Table 9. Observed numbers and CWT mark expanded numbers of CWT Alaska-origin Chinook salmon captured in the bycatch of the BSAI groundfish fishery by run year and release region, A) 2001–2010 and B) 2011–2014. Total numbers and numbers averaged over years are reported. The tagging program on Chinook salmon in the Cook Inlet, Alaska region ended with the 2008 brood year.

A) 2001–2010

	Cook Inlet, Alaska		Southeast Alaska		Alaska Total	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2001	14	16.9	0	0	14	16.9
2002	25	28.9	2	3.8	27	32.7
2003	4	4.1	2	20.6	6	24.6
2004	11	11.1	5	26.1	16	37.2
2005	8	8.2	4	7.7	12	15.9
2006	11	11.4	5	27.4	16	38.8
2007	2	2.0	3	17.4	5	19.4
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
<b>Total</b>	<b>75</b>	<b>82.6</b>	<b>21</b>	<b>103.0</b>	<b>96</b>	<b>185.5</b>
<b>Mean</b>	<b>7.5</b>	<b>8.3</b>	<b>2.1</b>	<b>10.3</b>	<b>9.6</b>	<b>18.6</b>

B) 2011–2014

	Cook Inlet, Alaska		Southeast Alaska		Alaska Total	
Run year	Observed Number	CWT Mark Expansion	Observed Number	CWT Mark Expansion	Observed Number	CWT Mark Expansion
2011	0	0	0	0	0	0
2012	0	0	1	1.7	1	1.7
2013	0	0	0	0	0	0
2014	0	0	0	0	0	0
<b>Total</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1.7</b>	<b>1</b>	<b>1.7</b>
<b>Mean</b>	<b>0</b>	<b>0</b>	<b>0.3</b>	<b>0.4</b>	<b>0.3</b>	<b>0.4</b>

Table 10. Observed numbers of CWT Chinook salmon captured in the bycatch of the BSAI groundfish fishery by rearing type and state or province of origin, A) 2001–2010 and B) 2011–2014. Total numbers are reported.

A) 2001–2010

Origin	Rearing type		
	Hatchery	Mixed	Wild
Alaska	90	0	6
British Columbia	89	0	0
California	2	0	0
Oregon	59	0	0
Washington	40	1	1
Yukon Territory	8	0	0
<b>Total</b>	<b>288</b>	<b>1</b>	<b>7</b>

B) 2011–2014

Origin	Rearing type		
	Hatchery	Mixed	Wild
Alaska	1	0	0
British Columbia	3	0	0
California	0	0	0
Oregon	5	0	0
Washington	7	0	0
Yukon Territory	0	0	0
<b>Total</b>	<b>16</b>	<b>0</b>	<b>0</b>

Table 11. Observed numbers of CWT Chinook salmon captured in the bycatch of the BSAI groundfish fishery by run type and state or province of origin, A) 2001–2010 and B) 2011–2014. Total numbers and percentages of the total in parentheses are reported.

A) 2001–2010

	Run type			
Origin	Spring	Summer	Fall	Late fall upriver bright
Alaska	93	0	0	0
British Columbia	12	34	39	0
Oregon	17	0	40	0
Washington	8	2	30	2
Yukon Territory	6	0	2	0
<b>Total</b>	<b>136 (48%)</b>	<b>36 (13%)</b>	<b>111 (39%)</b>	<b>2 (1%)</b>

B) 2011–2014

	Run type			
Origin	Spring	Summer	Fall	Late fall upriver bright
Alaska	1	0	0	0
British Columbia	0	3	0	0
Oregon	2	0	3	0
Washington	1	1	5	0
<b>Total</b>	<b>4 (25%)</b>	<b>4 (25%)</b>	<b>8 (50%)</b>	<b>0 (0%)</b>



Table 12. Observed number and mark expanded numbers of ESA-listed CWT salmon by ESU captured in the bycatch of the GOA and BSAI trawl fisheries, summed over pre-listing and post-listing periods, 1981–2014.

Listing status	Chinook salmon ESU	GOA			BSAI		
		Observed number	CWT Mark Expanded Number	Total mark expanded number	Observed number	CWT mark expanded number	Total mark expanded number
Pre-listing	Lower Columbia River	12	82.1	92.0	0	0.0	0.0
	Snake River spring/summer-run	1	1.9	2.6	0	0.0	0.0
	Upper Willamette River	43	143.7	175.2	2	2.0	2.4
Post-listing	Lower Columbia River	13	36.5	40.9	10	10.1	11.3
	Puget Sound	1	1.0	1.1	0	0.0	0.0
	Snake River fall-run	9	13.4	17.8	0	0.0	0.0
	Snake River spring/summer-run	1	1.0	1.4	1	1.9	2.6
	Upper Columbia River spring-run	2	2.0	2.2	0	0.0	0.0
	Upper Willamette River	87	253.5	309.3	11	60.9	74.3

Table 13. Observed number and mark expanded numbers of ESA-listed CWT salmon captured in the bycatch of the GOA and BSAI groundfish fisheries by ESU and year, 1981–2014.

A. Lower Columbia River Chinook salmon ESU

Listing status	Run year	GOA			BSAI		
		Observed number	CWT mark expanded number	Total mark expanded number	Observed number	CWT mark expanded number	Total mark expanded number
Pre-listing	1981	0	0.0	0.0	0	0.0	0.0
	1982	0	0.0	0.0	0	0.0	0.0
	1983	0	0.0	0.0	0	0.0	0.0
	1984	5	14.1	15.8	0	0.0	0.0
	1985	1	1.0	1.1	0	0.0	0.0
	1986	0	0.0	0.0	0	0.0	0.0
	1987	1	1.3	1.5	0	0.0	0.0
	1988	0	0.0	0.0	0	0.0	0.0
	1989	0	0.0	0.0	0	0.0	0.0
	1990	1	1.0	1.1	0	0.0	0.0
	1991	0	0.0	0.0	0	0.0	0.0
	1992	1	1.6	1.8	0	0.0	0.0
	1993	1	60.3	67.5	0	0.0	0.0
	1994	2	2.8	3.1	0	0.0	0.0
	1995	0	0.0	0.0	0	0.0	0.0
	1996	0	0.0	0.0	0	0.0	0.0
Post-listing	1997	0	0.0	0.0	0	0.0	0.0
	1998	2	18.8	21.1	0	0.0	0.0
	1999	4	5.9	6.6	0	0.0	0.0
	2000	2	2.0	2.2	0	0.0	0.0
	2001	2	2.0	2.2	1	1.0	1.1
	2002	0	0.0	0.0	1	1.0	1.1
	2003	0	0.0	0.0	0	0.0	0.0
	2004	1	1.1	1.2	3	3.0	3.4
	2005	0	0.0	0.0	3	3.1	3.5
	2006	0	0.0	0.0	1	1.0	1.1
	2007	0	0.0	0.0	0	0.0	0.0
	2008	0	0.0	0.0	0	0.0	0.0
	2009	0	0.0	0.0	0	0.0	0.0
	2010	0	0.0	0.0	0	0.0	0.0
	2011	0	0.0	0.0	0	0.0	0.0
	2012	0	0.0	0.0	1	1.0	1.1
	2013	1	5.7	6.4	0	0.0	0.0
	2014	1	1.0	1.1	0	0.0	0.0

Table 13. Continued.

## B. Puget Sound Chinook salmon ESU

Listing status	R n year	GOA			BSAI		
		Observed number	CWT mark expanded number	Total mark expanded number	Observed number	CWT mark expanded number	Total mark expanded number
Pre-listing	1981	0	0.0	0.0	0	0.0	0.0
	1982	0	0.0	0.0	0	0.0	0.0
	1983	0	0.0	0.0	0	0.0	0.0
	1984	0	0.0	0.0	0	0.0	0.0
	1985	0	0.0	0.0	0	0.0	0.0
	1986	0	0.0	0.0	0	0.0	0.0
	1987	0	0.0	0.0	0	0.0	0.0
	1988	0	0.0	0.0	0	0.0	0.0
	1989	0	0.0	0.0	0	0.0	0.0
	1990	0	0.0	0.0	0	0.0	0.0
	1991	0	0.0	0.0	0	0.0	0.0
Post-listing	1992	0	0.0	0.0	0	0.0	0.0
	1993	0	0.0	0.0	0	0.0	0.0
	1994	0	0.0	0.0	0	0.0	0.0
	1995	0	0.0	0.0	0	0.0	0.0
	1996	0	0.0	0.0	0	0.0	0.0
	1997	0	0.0	0.0	0	0.0	0.0
	1998	0	0.0	0.0	0	0.0	0.0
	1999	0	0.0	0.0	0	0.0	0.0
	2000	0	0.0	0.0	0	0.0	0.0
	2001	0	0.0	0.0	0	0.0	0.0
	2002	0	0.0	0.0	0	0.0	0.0
	2003	0	0.0	0.0	0	0.0	0.0
	2004	0	0.0	0.0	0	0.0	0.0
	2005	0	0.0	0.0	0	0.0	0.0
	2006	0	0.0	0.0	0	0.0	0.0
	2007	0	0.0	0.0	0	0.0	0.0
	2008	0	0.0	0.0	0	0.0	0.0
	2009	0	0.0	0.0	0	0.0	0.0
	2010	0	0.0	0.0	0	0.0	0.0
	2011	0	0.0	0.0	0	0.0	0.0
	2012	0	0.0	0.0	0	0.0	0.0
	2013	1	1.0	1.1	0	0.0	0.0
	2014	0	0.0	0.0	0	0.0	0.0

Table 13. Continued.

## C. Snake River fall-run Chinook salmon ESU

Listing status	Run year	GOA			BSAI		
		Observed number	CWT mark expanded number	Total mark expanded number	Observed number	CWT mark expanded number	Total mark expanded number
Pre-listing	1981	0	0.0	0.0	0	0.0	0.0
	1982	0	0.0	0.0	0	0.0	0.0
	1983	0	0.0	0.0	0	0.0	0.0
	1984	0	0.0	0.0	0	0.0	0.0
	1985	0	0.0	0.0	0	0.0	0.0
	1986	0	0.0	0.0	0	0.0	0.0
	1987	0	0.0	0.0	0	0.0	0.0
	1988	0	0.0	0.0	0	0.0	0.0
Post-listing	1989	0	0.0	0.0	0	0.0	0.0
	1990	0	0.0	0.0	0	0.0	0.0
	1991	0	0.0	0.0	0	0.0	0.0
	1992	0	0.0	0.0	0	0.0	0.0
	1993	0	0.0	0.0	0	0.0	0.0
	1994	0	0.0	0.0	0	0.0	0.0
	1995	0	0.0	0.0	0	0.0	0.0
	1996	0	0.0	0.0	0	0.0	0.0
	1997	0	0.0	0.0	0	0.0	0.0
	1998	0	0.0	0.0	0	0.0	0.0
	1999	0	0.0	0.0	0	0.0	0.0
	2000	0	0.0	0.0	0	0.0	0.0
	2001	0	0.0	0.0	0	0.0	0.0
	2002	0	0.0	0.0	0	0.0	0.0
	2003	0	0.0	0.0	0	0.0	0.0
	2004	0	0.0	0.0	0	0.0	0.0
	2005	0	0.0	0.0	0	0.0	0.0
	2006	0	0.0	0.0	0	0.0	0.0
	2007	0	0.0	0.0	0	0.0	0.0
	2008	0	0.0	0.0	0	0.0	0.0
	2009	0	0.0	0.0	0	0.0	0.0
	2010	0	0.0	0.0	0	0.0	0.0
	2011	0	0.0	0.0	0	0.0	0.0
	2012	2	3.0	4.0	0	0.0	0.0
	2013	6	9.4	12.5	0	0.0	0.0
	2014	1	1.0	1.3	0	0.0	0.0

Table 13. Continued.

## D. Snake River spring/summer Chinook salmon ESU

Listing status	Run year	GOA			BSAI		
		Observed number	CWT mark expanded number	Total mark expanded number	Observed number	CWT mark expanded number	Total mark expanded number
Pre-listing	1981	0	0.0	0.0	0	0.0	0.0
	1982	0	0.0	0.0	0	0.0	0.0
	1983	1	1.9	2.6	0	0.0	0.0
	1984	0	0.0	0.0	0	0.0	0.0
	1985	0	0.0	0.0	0	0.0	0.0
	1986	0	0.0	0.0	0	0.0	0.0
	1987	0	0.0	0.0	0	0.0	0.0
	1988	0	0.0	0.0	0	0.0	0.0
	1989	0	0.0	0.0	0	0.0	0.0
	1990	0	0.0	0.0	0	0.0	0.0
	1991	0	0.0	0.0	0	0.0	0.0
Post-listing	1992	0	0.0	0.0	0	0.0	0.0
	1993	0	0.0	0.0	0	0.0	0.0
	1994	0	0.0	0.0	0	0.0	0.0
	1995	0	0.0	0.0	0	0.0	0.0
	1996	0	0.0	0.0	0	0.0	0.0
	1997	0	0.0	0.0	0	0.0	0.0
	1998	0	0.0	0.0	0	0.0	0.0
	1999	0	0.0	0.0	0	0.0	0.0
	2000	0	0.0	0.0	0	0.0	0.0
	2001	0	0.0	0.0	0	0.0	0.0
	2002	0	0.0	0.0	0	0.0	0.0
	2003	0	0.0	0.0	0	0.0	0.0
	2004	0	0.0	0.0	0	0.0	0.0
	2005	0	0.0	0.0	0	0.0	0.0
	2006	0	0.0	0.0	0	0.0	0.0
	2007	0	0.0	0.0	0	0.0	0.0
	2008	0	0.0	0.0	0	0.0	0.0
	2009	0	0.0	0.0	0	0.0	0.0
	2010	0	0.0	0.0	0	0.0	0.0
	2011	0	0.0	0.0	0	0.0	0.0
	2012	0	0.0	0.0	0	0.0	0.0
	2013	1	1.0	1.4	0	0.0	0.0
	2014	0	0.0	0.0	1	1.9	2.6



Table 13. Continued.

## E. Upper Columbia River spring Chinook salmon ESU

Listin status	Run year	GOA			BSAI		
		Observed number	CWT mark expanded number	Total mark expanded number	Observed number	CWT mark expanded number	Total mark expanded number
Pre-listing	1981	0	0.0	0.0	0	0.0	0.0
	1982	0	0.0	0.0	0	0.0	0.0
	1983	0	0.0	0.0	0	0.0	0.0
	1984	0	0.0	0.0	0	0.0	0.0
	1985	0	0.0	0.0	0	0.0	0.0
	1986	0	0.0	0.0	0	0.0	0.0
	1987	0	0.0	0.0	0	0.0	0.0
	1988	0	0.0	0.0	0	0.0	0.0
	1989	0	0.0	0.0	0	0.0	0.0
	1990	0	0.0	0.0	0	0.0	0.0
	1991	0	0.0	0.0	0	0.0	0.0
	1992	0	0.0	0.0	0	0.0	0.0
	1993	0	0.0	0.0	0	0.0	0.0
	1994	0	0.0	0.0	0	0.0	0.0
	1995	0	0.0	0.0	0	0.0	0.0
	1996	0	0.0	0.0	0	0.0	0.0
Post-listing	1997	0	0.0	0.0	0	0.0	0.0
	1998	1	1.0	1.1	0	0.0	0.0
	1999	0	0.0	0.0	0	0.0	0.0
	2000	0	0.0	0.0	0	0.0	0.0
	2001	0	0.0	0.0	0	0.0	0.0
	2002	0	0.0	0.0	0	0.0	0.0
	2003	0	0.0	0.0	0	0.0	0.0
	2004	0	0.0	0.0	0	0.0	0.0
	2005	0	0.0	0.0	0	0.0	0.0
	2006	0	0.0	0.0	0	0.0	0.0
	2007	0	0.0	0.0	0	0.0	0.0
	2008	0	0.0	0.0	0	0.0	0.0
	2009	0	0.0	0.0	0	0.0	0.0
	2010	0	0.0	0.0	0	0.0	0.0
	2011	0	0.0	0.0	0	0.0	0.0
	2012	0	0.0	0.0	0	0.0	0.0
	2013	1	1.0	1.1	0	0.0	0.0
	2014	0	0.0	0.0	0	0.0	0.0

Table 13. Continued.

## F. Upper Willamette River Chinook salmon ESU

Listing status	Run year	GOA			BSAI		
		Observed number	CWT mark expanded number	Total mark expanded number	Observed number	CWT mark expanded number	Total mark expanded number
Pre-listing	1981	0	0.0	0.0	0	0.0	0.0
	1982	1	12.0	14.6	0	0.0	0.0
	1983	2	2.0	2.4	0	0.0	0.0
	1984	11	16.8	20.5	1	1.0	1.2
	1985	0	0.0	0.0	0	0.0	0.0
	1986	0	0.0	0.0	0	0.0	0.0
	1987	0	0.0	0.0	0	0.0	0.0
	1988	0	0.0	0.0	0	0.0	0.0
	1989	0	0.0	0.0	0	0.0	0.0
	1990	4	4.0	4.9	0	0.0	0.0
	1991	1	13.3	16.2	0	0.0	0.0
	1992	4	28.5	34.8	0	0.0	0.0
	1993	14	52.1	63.6	0	0.0	0.0
	1994	3	8.8	10.7	0	0.0	0.0
	1995	2	4.9	6.0	0	0.0	0.0
	1996	1	1.3	1.6	1	1.0	1.2
Post-listing	1997	1	7.5	9.2	0	0.0	0.0
	1998	4	30.7	37.5	0	0.0	0.0
	1999	20	49.3	60.1	1	1.0	1.2
	2000	16	16.6	20.3	1	1.0	1.2
	2001	7	7.1	8.7	1	1.0	1.2
	2002	1	1.0	1.2	2	12.4	15.1
	2003	1	5.3	6.5	0	0.0	0.0
	2004	1	5.8	7.1	1	7.9	9.6
	2005	0	0.0	0.0	2	10.9	13.3
	2006	1	1.0	1.2	0	0.0	0.0
	2007	0	0.0	0.0	0	0.0	0.0
	2008	1	6.5	7.9	0	0.0	0.0
	2009	1	1.8	2.2	1	10.2	12.4
	2010	3	12.8	15.6	1	15.5	18.9
	2011	2	13.4	16.3	0	0.0	0.0
	2012	11	44.5	54.3	0	0.0	0.0
	2013	9	16.0	19.5	0	0.0	0.0
	2014	8	34.2	41.7	1	1.0	1.2

Table 14. Observed number and mark expanded numbers of ESA-listed CWT Chinook salmon captured in U.S. research surveys in the GOA post-listing, 1996–2013. No CWT Chinook salmon from ESA-listed ESUs were recovered in GOA research surveys before 1996, and no ESA-listed CWT salmon have been recovered in BSAI research surveys.

Listing status	ESU	GOA		
		Observed number	CWT mark expanded number	Total mark expanded number
Post-listing	Lower Columbia River	7	17.3	19.4
	Puget Sound	1	1.0	1.1
	Snake River fall-run	4	5.1	6.8
	Snake River spring/summer-run	27	84.8	116.2
	Upper Columbia River spring-run	19	36.4	40.8
	Upper Willamette River	23	70.9	86.5

Table 15. Observed number and mark expanded numbers of ESA-listed CWT salmon captured in U.S. research surveys in the GOA by ESU and year, 1996–2013. No CWT Chinook salmon from ESA-listed ESUs were recovered in GOA research surveys before 1996, and no ESA-listed CWT salmon have been recovered in BSAI research surveys.

A. Lower Columbia River Chinook ESU

Listing status	Run year	GOA		
		Observed number	CWT mark expanded number	Total mark expanded number
Post-listing	1996	0	0.0	0.0
	1997	0	0.0	0.0
	1998	0	0.0	0.0
	1999	1	1.0	1.1
	2000	0	0.0	0.0
	2001	1	1.0	1.1
	2002	0	0.0	0.0
	2003	0	0.0	0.0
	2004	0	0.0	0.0
	2005	0	0.0	0.0
	2006	0	0.0	0.0
	2007	0	0.0	0.0
	2008	0	0.0	0.0
	2009	0	0.0	0.0
	2010	0	0.0	0.0
	2011	0	0.0	0.0
	2012	1	5.7	6.4
	2013	4	9.6	10.8

Table 15. Continued.

## B. Puget Sound Chinook ESU

Listing status	Run year	GOA		
		Observed number	CWT mark expanded number	Total mark expanded number
Post-listing	1996	0	0.0	0.0
	1997	0	0.0	0.0
	1998	0	0.0	0.0
	1999	0	0.0	0.0
	2000	0	0.0	0.0
	2001	0	0.0	0.0
	2002	0	0.0	0.0
	2003	1	1.0	1.1
	2004	0	0.0	0.0
	2005	0	0.0	0.0
	2006	0	0.0	0.0
	2007	0	0.0	0.0
	2008	0	0.0	0.0
	2009	0	0.0	0.0
	2010	0	0.0	0.0
	2011	0	0.0	0.0
	2012	0	0.0	0.0
	2013	0	0.0	0.0

## C. Snake River fall-run Chinook ESU

Listing status	Run year	GOA		
		Observed number	CWT mark expanded number	Total mark expanded number
Post-listing	1996	0	0.0	0.0
	1997	0	0.0	0.0
	1998	0	0.0	0.0
	1999	0	0.0	0.0
	2000	0	0.0	0.0
	2001	0	0.0	0.0
	2002	0	0.0	0.0
	2003	0	0.0	0.0
	2004	0	0.0	0.0
	2005	0	0.0	0.0
	2006	0	0.0	0.0
	2007	0	0.0	0.0
	2008	0	0.0	0.0
	2009	0	0.0	0.0
	2010	0	0.0	0.0
	2011	0	0.0	0.0
	2012	2	3.1	4.1
	2013	2	2.0	2.7

Table 15. Continued.

## D. Snake River spring/summer Chinook ESU

Listing status	Run year	GOA		
		Observed number	CWT mark expanded number	Total mark expanded number
Post-listing	1996	0	0.0	0.0
	1997	0	0.0	0.0
	1998	2	5.8	7.9
	1999	0	0.0	0.0
	2000	0	0.0	0.0
	2001	0	0.0	0.0
	2002	0	0.0	0.0
	2003	0	0.0	0.0
	2004	0	0.0	0.0
	2005	0	0.0	0.0
	2006	0	0.0	0.0
	2007	0	0.0	0.0
	2008	0	0.0	0.0
	2009	0	0.0	0.0
	2010	0	0.0	0.0
	2011	0	0.0	0.0
	2012	12	27.0	37.0
	2013	13	52.0	71.2

## E. Upper Columbia River spring Chinook ESU

Listing status	Run year	GOA		
		Observed number	CWT mark expanded number	Total mark expanded number
Post-listing	1996	0	0.0	0.0
	1997	0	0.0	0.0
	1998	0	0.0	0.0
	1999	0	0.0	0.0
	2000	0	0.0	0.0
	2001	0	0.0	0.0
	2002	0	0.0	0.0
	2003	0	0.0	0.0
	2004	0	0.0	0.0
	2005	0	0.0	0.0
	2006	0	0.0	0.0
	2007	0	0.0	0.0
	2008	0	0.0	0.0
	2009	0	0.0	0.0
	2010	0	0.0	0.0
	2011	0	0.0	0.0
	2012	13	26.4	29.6
	2013	6	10.0	11.2



Table 15. Continued.

F. Upper Willamette River Chinook ESU

Listing status	Run year	GOA		
		Observed number	CWT mark expanded number	Total mark expanded number
Post-listing	1996	0	0.0	0.0
	1997	0	0.0	0.0
	1998	2	2.3	2.8
	1999	0	0.0	0.0
	2000	0	0.0	0.0
	2001	3	11.1	13.5
	2002	3	26.6	32.5
	2003	0	0.0	0.0
	2004	0	0.0	0.0
	2005	0	0.0	0.0
	2006	0	0.0	0.0
	2007	0	0.0	0.0
	2008	0	0.0	0.0
	2009	0	0.0	0.0
	2010	0	0.0	0.0
	2011	1	1.0	1.2
	2012	9	14.0	17.1
	2013	5	15.9	19.4

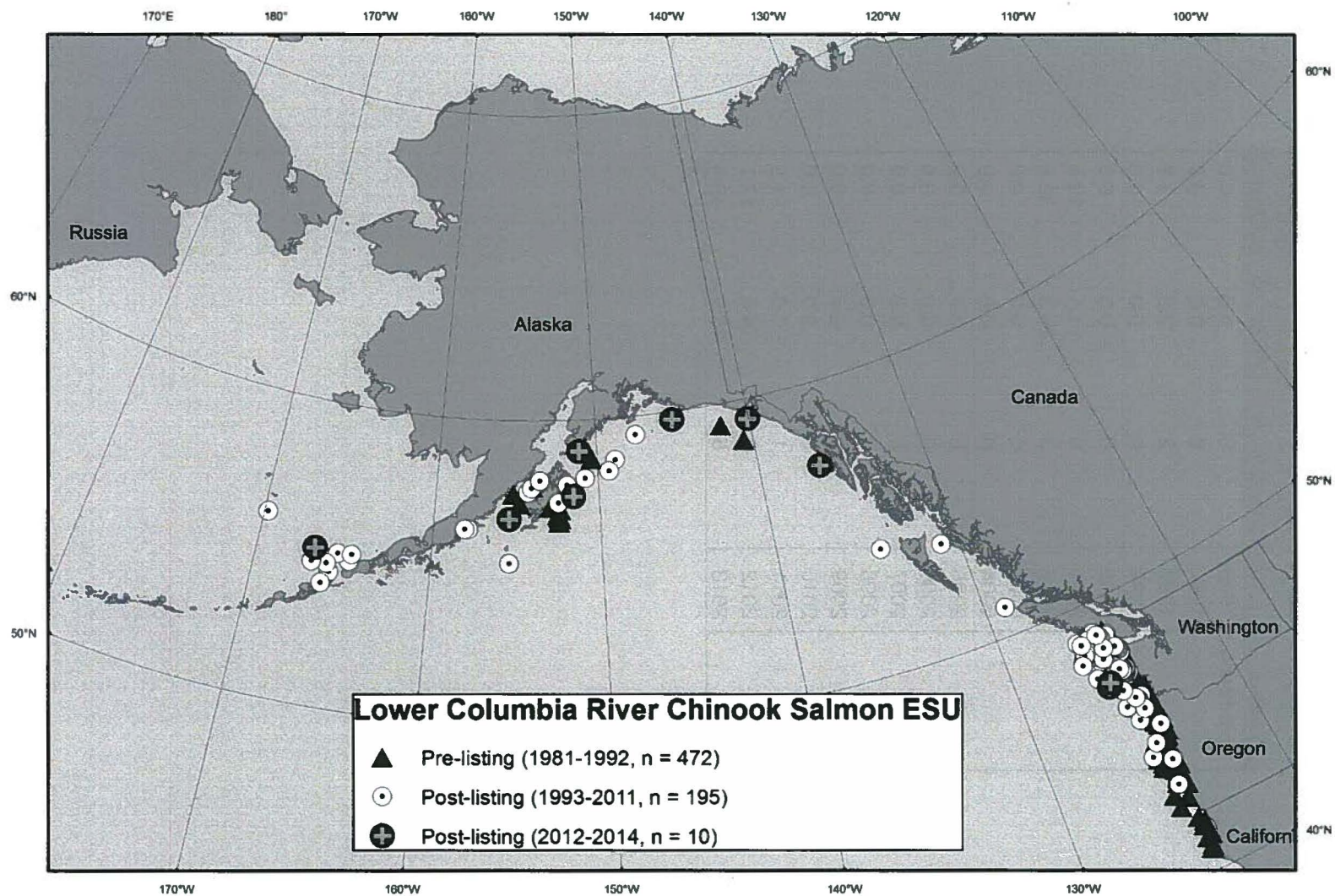


Figure 1. Ocean distribution of Chinook salmon CWT recoveries from the Lower Columbia River ESU in pre-listing and post-listing periods under the ESA, 1981–2014. CWTs were recovered in fisheries and research surveys.

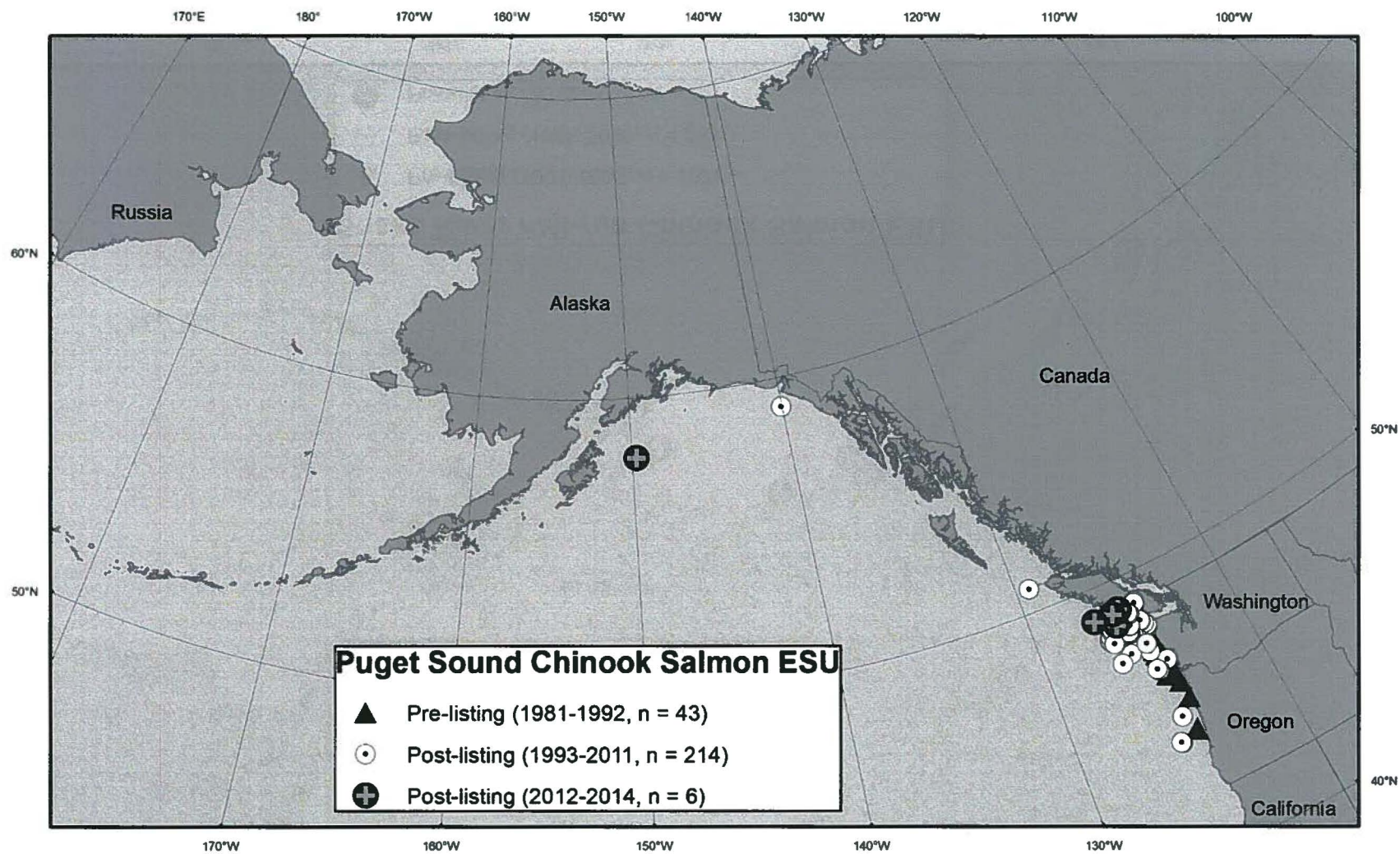


Figure 2. Ocean distribution of Chinook salmon CWT recoveries from the Puget Sound ESU in pre-listing and post-listing periods under the ESA, 1981–2014. CWTs were recovered in fisheries and research surveys.



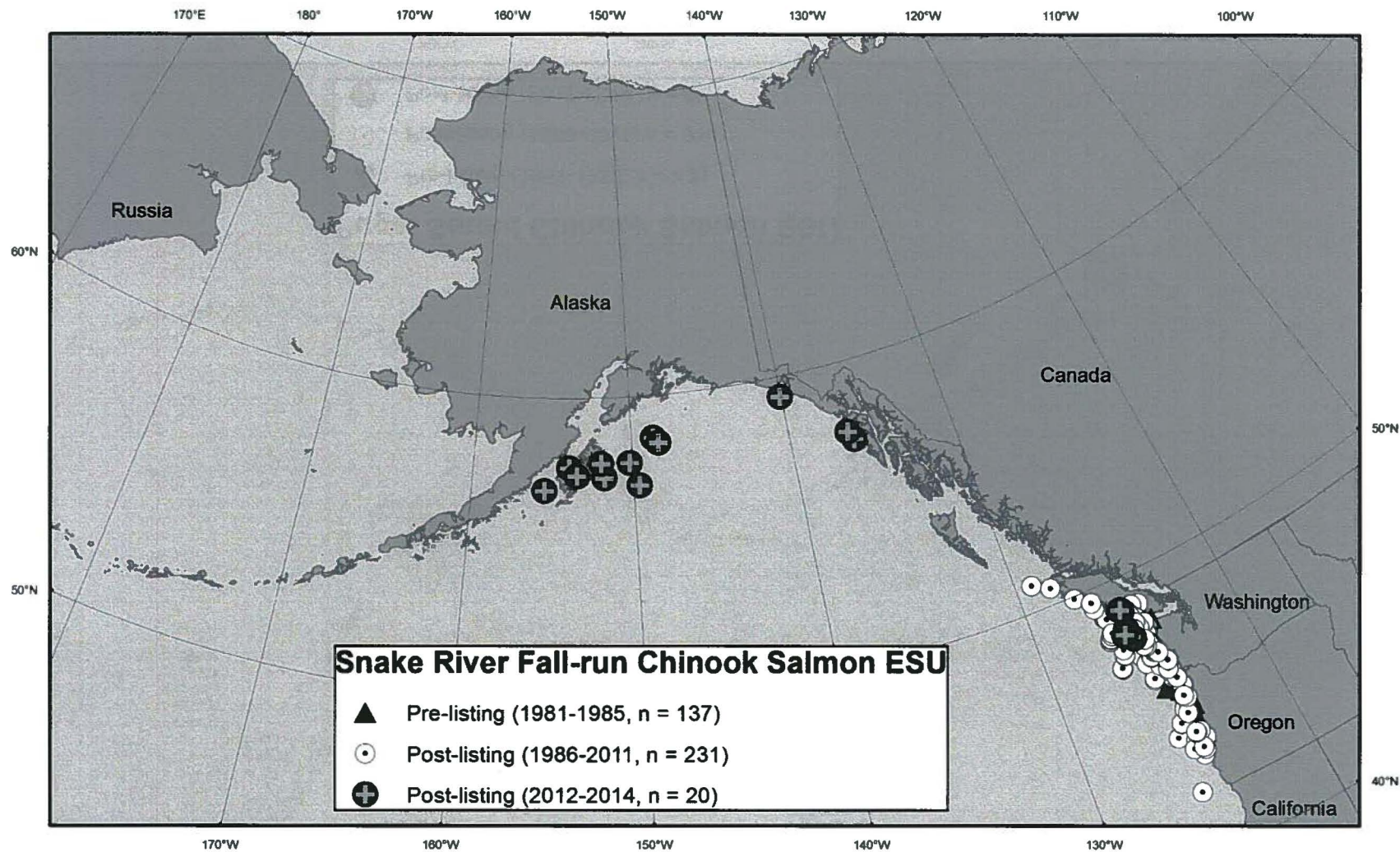


Figure 3. Ocean distribution of Chinook salmon CWT recoveries from the Snake River fall-run ESU in pre-listing and post-listing periods under the ESA, 1981–2014. CWTs were recovered in fisheries and research surveys.

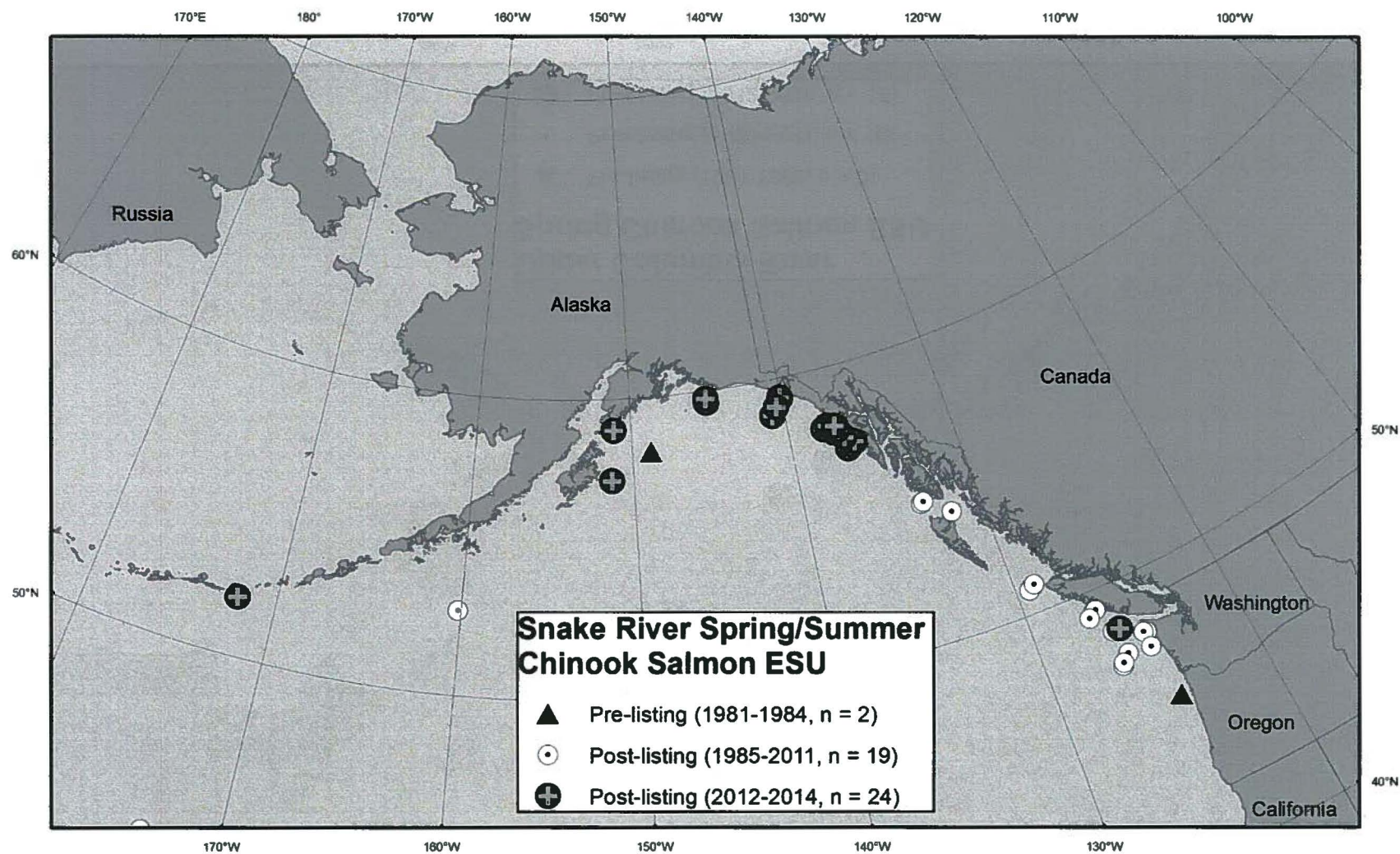


Figure 4. Ocean distribution of Chinook salmon CWT recoveries from the Snake River spring/summer-run ESU in pre-listing and post-listing periods under the ESA, 1981–2014. CWTs were recovered in fisheries and research surveys.



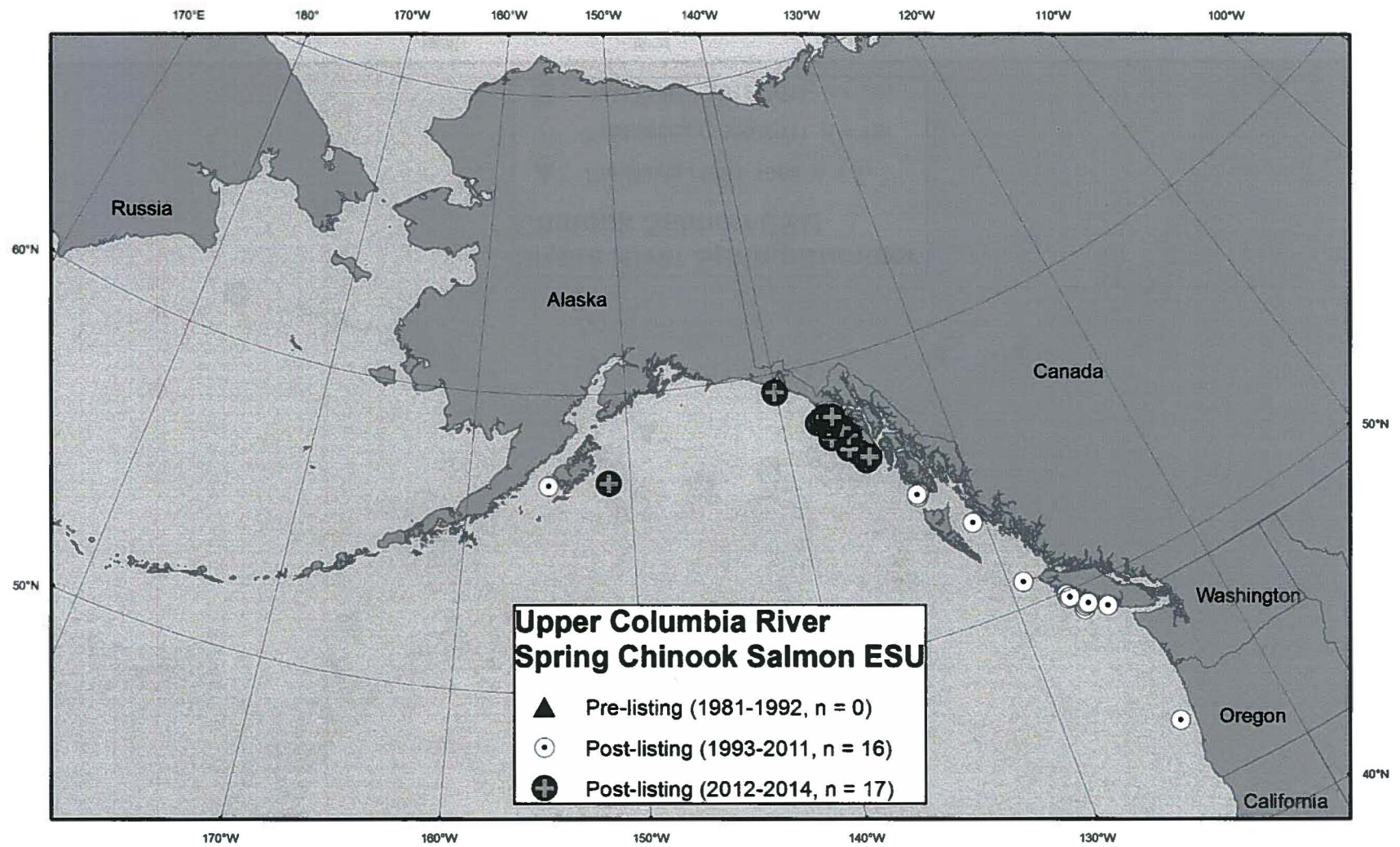


Figure 5. Ocean distribution of Chinook salmon CWT recoveries from the Upper Columbia spring-run ESU in pre-listing and post-listing periods under the ESA, 1981–2014. CWTs were recovered in fisheries and research surveys.



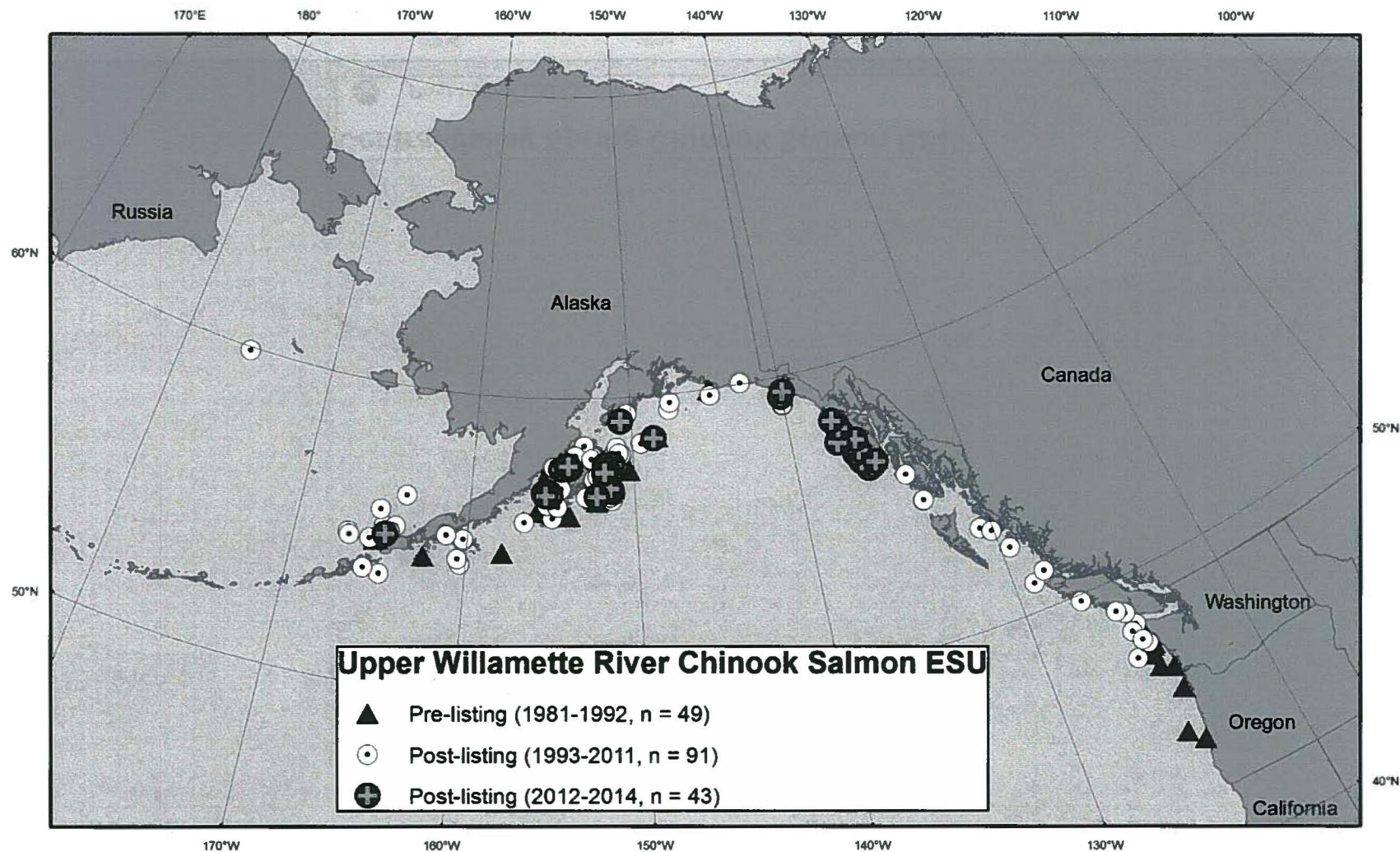


Figure 6. Ocean distribution of Chinook salmon CWT recoveries from the Upper Willamette River ESU in pre-listing and post-listing periods under the ESA, 1981–2014. CWTs were recovered in fisheries and research surveys.

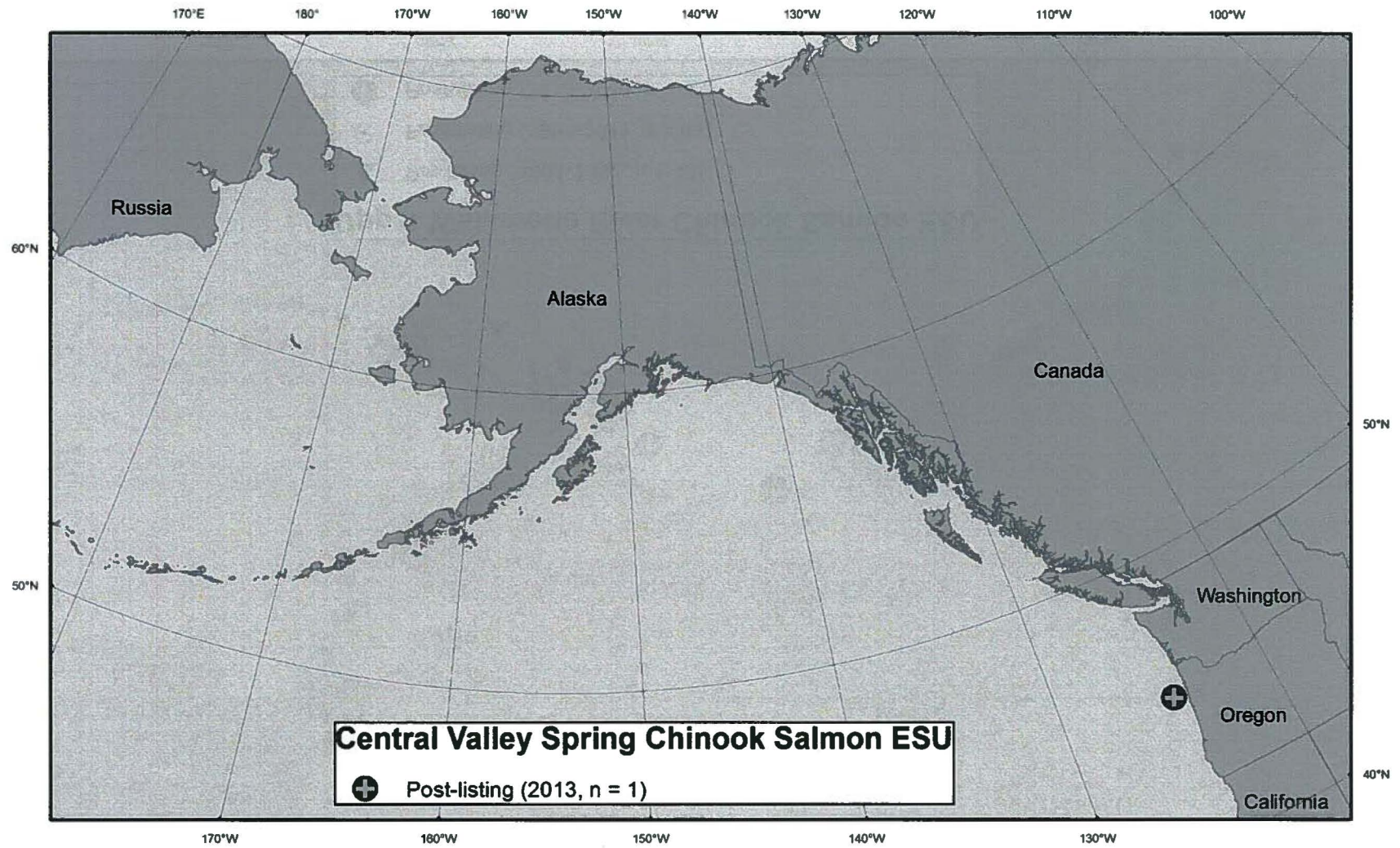


Figure 7. Ocean distribution of Chinook salmon CWT recoveries from the Central Valley spring-run ESU in pre-listing and post-listing periods under the ESA, 1981–2014. CWTs were recovered in fisheries and research surveys.



## Appendix 1

### Recovery Estimation Technique by Adrian Celewycz

The total number of fish from a particular release group that are caught in a particular area during a particular time period can be estimated in a two-step process (Nandor et al. 2010). The first step is to calculate a sampling expansion factor ( $a$ ) for the fishery in each year (Johnson 2004):

$$a = (\text{total catch of each species by fishery by year}) / (\text{sampling catch of each species by fishery by year}).$$

A sampling expansion factor can only be calculated from CWTs recovered from *inside* a sample where the number of sampled fish is known. CWT recoveries from *outside* the sample ("select" recoveries where the total number of fish examined is unknown) cannot be used to calculate a sampling expansion factor.

For the sampled catch, the estimated total recoveries of tags for each release group of interest by fishery and year are calculated:

$$R_{Ti} = a R_{Oi};$$

$R_{Ti}$  = estimated total recoveries of tags for the  $i^{\text{th}}$  release group;

$R_{Oi}$  = observed number of tags for the  $i^{\text{th}}$  release group;

$a$  = sampling expansion factor for each fishery in each year.

The second step is to account for the fraction of each release group of interest that was tagged (Johnson 2004):

$$C_T = \sum_{i=1}^n b_i R_{Ti};$$

$C_T$  = the total estimated contribution for a release group of interest;

$b_i$  = a CWT marking expansion factor for the  $i^{\text{th}}$  release group = (total fish released) / (total fish marked) for the  $i^{\text{th}}$  release group;

$R_{Ti}$  = estimated total recoveries of tags for the  $i^{\text{th}}$  release group.

The contribution estimates are then summed over all relevant area and time strata. These are the simplest forms of recovery expansion equations (Nandor 2010).

For ESA-listed ESUs, the CWT mark expansion factor can be additionally expanded to take into account the untagged, wild component of each ESU that is not represented by CWTs. A total mark expansion factor ( $c_j$ ) for each ESU can be calculated:

$$c_j = 1 / (\text{proportion hatchery component for the } j^{\text{th}} \text{ ESU}).$$

The proportion hatchery component is calculated separately for each ESU based on the mean hatchery/wild ratio of a number of years of adult returns for each ESU (Appendix Table 1). The total estimated mark expansion of recoveries ( $R_{TMEj}$ ) can be calculated:

$$R_{TMEj} = c_j b_{ij};$$

$R_{TMEij}$  = the total estimated mark expansion for the  $i^{\text{th}}$  release group in the  $j^{\text{th}}$  ESU;  
 $c_j = 1 /$  (proportion hatchery component for the  $j^{\text{th}}$  ESU);  
 $b_{ij}$  = the CWT marking expansion for the  $i^{\text{th}}$  release group in the  $j^{\text{th}}$  ESU.

Once again, the contribution estimates are then summed over all relevant area and time strata. For these calculations, each tag code is considered to be a separate release group.

**Appendix Table 1. Percentages of hatchery and wild components and Total Mark Expansion Factors for Chinook salmon ESUs.**

Chinook salmon ESU name	% Hatchery	% Wild	Total Mark Expansion Factor	Source of hatchery/wild ratios
Lower Columbia River	88.9	11.1	1.12	2008–2010 adult return estimates <sup>1</sup>
Puget Sound	95.0	5.0	1.05	Recent adult return estimates <sup>2</sup>
Snake River fall-run	75.2	24.8	1.33	2007–2011 spawning escapement estimates <sup>3</sup>
Snake River spring/summer-run	73.2	26.8	1.37	1995–2012 adult return estimates <sup>4</sup>
Upper Columbia River spring-run	89.1	10.9	1.12	1995–2012 adult return estimates <sup>4</sup>
Upper Willamette River	81.7	18.3	1.22	2005–2010 adult return estimates <sup>1</sup>

<sup>1</sup> Vaughan 2011.

<sup>2</sup> LaVoy 2013a.

<sup>3</sup> LaVoy 2013b.

<sup>4</sup> Joint Columbia River Management Staff 2013.

## **Appendix 2**

**Excerpts from “Analysis of Recoveries of Coded-Wire Tags (CWTs) from Chinook Salmon in the Gulf of Alaska (GOA) and Bering Sea-Aleutian Islands (BSAI), 2012 and 2013” by Adrian Celewycz**

### **Processing Snouts for Coded-Wire Tags (CWTs) at Auke Bay Laboratories CWT Lab at TSMRI**

At the Auke Bay Laboratories (ABL) Coded-Wire Tag (CWT) Lab at TSMRI, snouts are processed to recover CWTs from tagged salmon collected in the bycatch in Federally-managed groundfish fisheries as well as from domestic and foreign research surveys in the Gulf of Alaska (GOA) and Bering Sea-Aleutian Islands (BSAI). The CWTs are extracted from each snout, read and verified under a microscope, and then recovery data associated with each snout are entered into a NMFS database. Once the recovery data and tag data have been verified and finalized, they are incorporated into the master historical database of all CWTs processed by ABL's CWT Lab and reported to the coastwide Regional Mark Information System (RMIS) of the Pacific States Marine Fisheries Commission (PSMFC). At that point the data are available for further analysis. ABL's historical CWT database contains records of CWT recoveries from the salmon bycatch of the GOA and BSAI groundfish fisheries dating back to 1981.

### **The CWT Program in the Greater Pacific Region of North America**

Since the late 1960s, CWTs have been used in the greater Pacific region (Alaska, British Columbia, Washington, Idaho, Oregon, and California) to mark anadromous salmonids, particularly hatchery fish (Nandor et al. 2010). Coastwide, more than 53 million juvenile Chinook salmon have been tagged with CWTs in the last several years (2009 and 2010 brood years) by 36 State, Federal, Tribal, and private entities in the U.S. and Canada, at more than 160 hatcheries and rearing facilities on the West Coast, in addition to natural origin fish trapped and tagged at many sites. The total number of Chinook salmon represented by these 53 tagged million Chinook salmon is over 162 million fish annually (2009 and 2010 brood years). Over a billion Chinook salmon from the greater Pacific region have been tagged with CWTs since 1968. CWT data are used for many purposes, including stock contribution studies where fishery managers seek information on the contribution rates of key stocks in a given fishery (by time and area strata) in order to better manage harvest rates for conservation of the resource (Nandor et al. 2010). CWT data play a key role in the U.S.-Canada Salmon Treaty allocations and management of transboundary stocks (Nandor et al. 2010). After 40 years, the CWT program in the greater Pacific region of North America continues to be the most important tool for salmonid research and management (Nandor et al. 2010).

However, CWTs do not provide information on all Chinook salmon stocks harvested in the GOA and BSAI. In particular, no wild or hatchery origin Alaska Chinook salmon stocks are currently being tagged with CWTs in other regions outside of Southeast Alaska. A tagging program on Chinook salmon in the Cook Inlet, Alaska region ended with the 2008 brood year, and no Western Alaska Chinook salmon stocks are currently being tagged. The only tagging of Chinook salmon in the whole Yukon River drainage has been conducted by the Whitehorse Hatchery, Yukon Territory, Canada.

Although some tagging of wild stocks occurs (mainly in Alaska), CWTs are used mostly for tagging of hatchery fish. Wild stocks of Chinook salmon are generally under-represented by CWTs, especially outside of Alaska. In the greater Pacific region, Alaska has had the strongest tagging program on wild stocks of Chinook salmon. Of the 26 million CWT Chinook salmon that have been tagged and released



in Alaska from the 1992 brood onward, 88% were of hatchery origin and 12% were from wild stocks. Of the 787 million CWT Chinook salmon that have been tagged and released in all locations other than Alaska from the 1992 brood onward, 98% was of hatchery origin, 1% was from wild stocks, and 1% was from mixed-origin stocks.

Because of recent persistent statewide declines in Chinook salmon productivity in Alaska, the Alaska Department of Fish and Game (ADF&G) Chinook Salmon Research Team is recommending establishing a suite of twelve Chinook salmon indicator stocks of wild origin that will provide an ongoing statewide index of Chinook salmon productivity and abundance trends (ADF&G Chinook Salmon Research Team 2013). The twelve Chinook salmon indicator stocks originate in the Unuk, Stikine, Taku, Chilkat Rivers in the Southeastern Alaska region, the Copper, Susitna, and Kenai Rivers in the Central Alaska region, the Karluk, Chignik, Nushagak, Kuskokwim Rivers in Western Alaska, and the U.S. side of the transboundary Yukon River (ADF&G Chinook Salmon Research Team 2013). A key component of the recommended stock assessment program will involve tagging a representative number of wild juvenile Chinook salmon from each indicator stock with CWTs (ADF&G Chinook Salmon Research Team 2013).

### **Sampling for CWTs**

Historically, the only sampling for CWTs in salmon harvested as bycatch in the Gulf of Alaska (GOA) and Bering Sea-Aleutian Islands (BSAI) groundfish fisheries has been conducted by vessel and plant observers based on visual detection of a missing adipose fin in select samples. A missing adipose fin can be a visual indicator of the presence of a CWT. In 2012 and 2013, however, in addition to visual sampling for missing adipose fins by observers, electronic detection of CWTs was initiated in several new sampling programs in the GOA to supplement the number of CWTs collected in GOA groundfish fisheries. Electronic detection allows CWTs to be recovered from salmon irrespective of whether the fish had an adipose fin clip. In addition, a small percentage of salmon are released from hatcheries with a CWT but no adipose fin clip; electronic detection is the only way to recover these CWTs without the visual indicator of a fin clip.

### **CWT Expansions**

Ideally, it would be preferable to calculate a total estimated contribution of Chinook salmon from stocks of interest harvested in GOA and BSAI groundfish fisheries in order to determine the total impact of the fisheries on these stocks. Total estimated contributions for CWT recoveries can be calculated in a two-step process involving a sampling expansion factor and a CWT marking expansion factor (see Appendix 1, Recovery Estimation Technique for a more detailed explanation).

Starting in 2011 in the BSAI pollock fishery, sampling expansion factors can be calculated for CWT recoveries from the bycatch, thus allowing calculation of total estimated contributions for stocks of interest. In 2011 in the BSAI, a systematic random [sic] sampling design recommended by Pella and Geiger (2009) was implemented by the Observer Program to collect genetic samples and check for adipose fin-clipped salmon from approximately 1 out of 10 Chinook salmon (10% sampling rate) encountered as bycatch in the BSAI pollock fishery. This 10% sampling rate was established to meet genetic sampling goals, and snouts from adipose fin-clipped salmon have been collected at this same rate.

A sampling rate adequate for genetic sampling, however, may not necessarily be adequate for CWT sampling. According to the Regional Mark Processing Center of the Pacific States Marine Fisheries Commission, all recovery agencies should strive to randomly sample at least 20% of the commercial landings to have a statistically acceptable estimate of total tag recoveries for a given area-time stratum

(Nandor et al. 2010). The ADF&G Chinook Salmon Research Team also recommends that sampling for CWTs be increased to the coastwide standard of 20% of the catch in both the Eastern Bering Sea and Gulf of Alaska trawl fisheries (ADF&G Chinook Salmon Research Team 2013). It should also be pointed out that CWTs do provide certain data that genetic sampling cannot replicate, such as positive identification that a fish originated from an ESA-listed ESU.

Sampling expansion factors cannot be calculated for the CWT recoveries in the GOA pollock fishery at all or in the Bering Sea pollock fishery before 2011 because of limitations with how the data were collected. In these fisheries, salmon heads from adipose fin-clipped salmon were collected not only from the observers' samples, but also opportunistically when encountered by observers outside of the sample. For CWT recoveries from these fisheries, it is unknown whether the CWTs were collected from *inside* or *outside* either the genetics or the observer species composition sample sets. A sampling expansion factor can only be calculated from CWTs recovered from *inside* a sample where the total number of sampled fish is known. Of the 71 documented CWT recoveries of Chinook salmon from ESA-listed ESUs (post-listing) by observers in the GOA trawl fishery before 2012, three CWTs are known to have been recovered from *inside* the sample, three CWTs were recovered *outside* the sample, and for the remaining 65, the sample status is unknown. Starting in 2012 in the GOA, under revised sampling protocols implemented by the Observer Program intended to be as consistent as possible with the sampling changes implemented by the Observer Program in the Bering Sea pollock fishery in 2011, adipose fin-clipped salmon were collected randomly and systematically only from inside a genetic sample at the offload or from inside the vessel observer's species composition sample. Nonetheless, even with voluntary 100% retention of all salmon and random, systematic sampling for fish with missing adipose fins, sampling expansion factors can still not be calculated for the GOA pollock fishery because not all vessels were sampled.

However, CWT marking expansions can be calculated for each CWT recovery from the mark expansion factors for each tag code. Because not all fish in a tag release group are actually tagged with CWTs, marking expansion factors account for the fraction of each release group that is not tagged (see Appendix 1, Recovery Estimation Technique). Additionally for ESA-listed ESUs, the CWT mark expansion of each CWT recovery can be adjusted to take into account the untagged, wild component of each ESU that is not represented by CWTs to derive a total mark expansion for each ESU (Appendix 1). Without being able to calculate total estimated contributions because of unknown sampling expansion factors, total mark expansions offer the closest approximation to the contribution of Chinook salmon from ESA-listed ESUs. Total mark expansions should be considered minimal estimates for the actual total contribution of Chinook salmon from ESA-listed ESUs in the GOA at the present time and in the BSAI before 2011.

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