UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
P.O. Box 21668
Juneau, AK 99802-1668

December 4, 2024

MEMORANDUM FOR: Ryan J. Wulff
Assistant Regional Administrator for Sustainable Fisheries,
West Coast Region

FROM: Gretchen A. Harrington
Assistant Regional Administrator for Sustainable Fisheries,
Alaska Region

SUBJECT: 2023 Annual Report for the Alaska Groundfish Fisheries Chinook Salmon Coded Wire Tag and Recovery Data for Endangered Species Act Consultation

We transmit the final 2023 data on salmon incidental catch in the Alaska groundfish fisheries, including stock of origin and coded wire tag (CWT) data for salmon caught in the Alaska groundfish fisheries in 2023. This report supplements the annual report data provided to you on January 18, 2024 on salmon incidental catch and salmon bycatch reduction measures.

Annual data from the Alaska Fisheries Science Center's (AFSC) North Pacific Observer Program bycatch sampling in 2023 are provided in Attachment 1. Annual data from the AFSC's Tag Lab on the stock of origin and CWT data from incidental catch of salmon in 2023 are provided in Attachment 2.

The AFSC's Genetics Program annually prepares a report to the North Pacific Fishery Management Council on the genetic stock composition of Chinook salmon Prohibited Species Catch in the pollock fishery. The most recent report to the Council is available at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=ea59d5e2-4de4-4d4e-9369-4ffe0991cf43.pdf&fileName=C2%20Chinook%20Genetics%20Report.pdf

In addition, the AFSC Genetics Program periodically compiles and publishes genetic stock of origin data as NOAA Technical Memorandums. These Technical Memorandums are available at: https://www.fisheries.noaa.gov/alaska/science-data/genetics-research-alaska-fisheries-science-center

This report fulfills one of the terms and conditions of the incidental take statements in the December 2, 2009, and January 11, 2007 (NMFS 2009a and NMFS 2007) supplements to the November 30, 2000, Biological Opinion regarding authorization of the BSAI and GOA groundfish fisheries (NMFS 2000), and the supplemental Biological Opinion issued on January 9, 2012 (NMFS 2012).

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Attachment 1. Alaska Fisheries Science Center North Pacific Observer Program Bycatch Sampling for 2023.

North Pacific Observer Program Salmon 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 collecting fisheries data used by managers for stock assessment and inseason monitoring of the commercial groundfish fisheries. Managers use data collected by observers to monitor quotas, manage groundfish and prohibited species catch, and document interactions with protected resources. This data provides 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 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 in 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. Regulations governing the Amendment 91 fishery 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 can view all sorting and weighing of fish, as well as a secure storage area for salmon. The samples for salmon in the Bering Sea pollock fishery were collected using the sampling protocols recommended by Pella and Geiger (2009). This protocol includes a complete census of retained salmon bycatch, which is then sampled systematically by certified fishery 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 10th Chinook and 30th Chum, with a random start point, for further biological data collection. These randomly selected fish are used to obtain a length measurement, weight, a genetic tissue sample, and five scales to verify species identification. These salmon are also checked for a missing adipose fin, indicating a potential Coded Wire Tag (CWT). If the adipose fin is missing, a snout specimen will be collected.

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

On catcher vessels delivering to processing plants[1], observers do not conduct an at-sea census count of salmon because they may not sample every haul or have access to all of the catch. Instead, observers attempt to sample all hauls and identify every salmon encountered in their randomly collected at-sea composition samples from these hauls. Salmon encountered in the at-sea samples are counted,

[1] 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.

weighed, sex determined, and checked for a missing adipose fin. A separate scale collection is also collected to verify the observer's species identification skills. These observers monitor that no salmon are discarded at sea to the best of their ability. The plant observer obtains total retained salmon numbers and related genetics samples from catcher vessel pollock deliveries at the processing facility.

Once the catch is delivered to the processing facility, the plant and vessel observers coordinate to 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. This data is reported under the plant observer's cruise number.

During the 2020 fishing season, an Exempted Fishing Permit (EFP) was issued to test the utility of Electronic Monitoring (EM) as a compliance tool in the Trawl Catcher Vessel Pollock fisheries. Under this EFP, a portion of catcher vessels fishing pollock in the Bering Sea/Aleutian Islands (BSAI) and Gulf of Alaska (GOA) use electronic monitoring at sea in place of an observer to monitor vessel compliance with maximized retention as specified under the EFP. As a result, additional observers are assigned to select BSAI and GOA shoreside plants. These observers are responsible for collecting salmon retention data and completing halibut counts in the delivered catch. The Salmon Retention Count (SRC) occurs at the end of all BSAI and selected GOA Pollock offloads.

In the 2023 Bering Sea Pollock fishery, 1,181 Chinook, 3,713 Chum, 122 Coho, 84 Pink, and 32 Sockeye salmon were measured for length. Of these fish, 1,170 Chinook and 3,635 Chum salmon were sampled for genetic tissue (Table 1). In addition, 24 Chinook, 1 Chum, and 5 Coho were missing their adipose fin, and their snouts 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 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 when compared to the Bering Sea pollock fishery. In these fisheries, the total number of incidentally caught salmon is obtained using the vessel observer's at-sea species composition samples extrapolated to the vessel's total catch. Sampling protocols for observers in these non-pollock fisheries differ from 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 counted, weighed, measured, sex determined, 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 2023 BSAI non-pollock fisheries, observers measured 41 Chinook, 66 Chum, 4 Coho, and 5 Sockeye salmon for length. Of these fish, 1 Chinook and 2 Chum salmon were sampled for genetic tissue (Table 1). In addition, 0 Chinook salmon were missing their adipose fin, and their snout was collected and shipped to Auke Bay Laboratories (Auke Bay Lab) to be scanned for CWT presence and analysis.

Table 1. - Number of length, genetic, and CWT samples collected from incidentally caught salmon in the 2023 Bering Sea/Aleutian Islands (BS/BSAI) pollock and non-pollock fisheries.

			Sample	
Area/fishery	Salmon species	Length	Genetic tissue	CWT[1]
BS pollock				
	Chinook	1,181	1,170	24
	Chum	3,713	3,635	1
	Coho	122	n/a[2]	5
	Pink	84	n/a[2]	0
	Sockeye	32	n/a[2]	0
subtotal		5,132	4,805	30
BSAI non-pollock				
	Chinook	41	1	0
	Chum	66	2	0
	Coho	4	n/a[2]	0
	Pink	0	n/a[2]	0
	Sockeye	5	n/a[2]	0
subtotal		116	3	0
Total		5,248	4,808	30

[1]Salmon head collected from fish missing adipose fin.

[2]n/a - Not part of the sampling protocol.

GOA Pollock Fishery Sampling and Data Collection

The Observer Program's biological salmon sampling protocols for the GOA pollock fishery are guided by the regulations implementing Amendment 93 to the GOA FMP (77 FR 42629, July 20, 2012). These regulations require 100% retention of all salmon caught in the Western and Central GOA-directed pollock trawl fishery. The restructured observer program requires participation of catcher vessels between 40 ft. and 125 ft. LOA in the partial coverage observer program. These vessels are randomly selected for observer coverage on a trip-by-trip basis through the Observer Declare and Deploy System (ODDS).

In 2023, 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. Catcher vessel observers also reported (to the best of their ability while completing other sampling duties) that no salmon were discarded at sea. The total number of salmon encountered by the observers 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 Prohibited Species Catch (PSC) rate of salmon for unobserved vessels.

During the 2020 fishing season, an Exempted Fishing Permit (EFP) was issued to test the utility of Electronic Monitoring (EM) as a compliance tool in the Trawl Catcher Vessel (CV) Pollock fisheries. Under this EFP, a portion of catcher vessels fishing pollock in the Gulf of Alaska (GOA) used EM at sea instead of an observer to monitor vessel compliance with maximized retention as specified under the EFP. Observers were assigned to GOA plants and were responsible for collecting salmon retention data. In the GOA, EFP deliveries were randomly selected to be monitored/sampled at a rate of every 1 in 3 (33%).

In 2023, vessel observers assigned to non-EM participating pollock catcher vessels collected biological specimens at the shoreside processing facility from salmon delivered by the vessel following the same procedure outlined previously for catcher/processors and motherships fishing BSAI pollock. Following the coverage rates outlined in the annual deployment plan, vessel observers were not deployed on all catcher vessels fishing pollock in the GOA.

If the vessel observer could not monitor the offload due to pandemic restrictions (or illness), the plant observers stationed at the GOA plants for the Trawl EM EFP monitored offloads. They collected salmon retention and genetic tissue data for the vessel observers assigned to Pollock CVs. This was in addition to their monitoring data collection requirements for deliveries selected for data collection per the EM trawl EFP. If neither the vessel observer nor the plant observer were able to count the salmon encountered during the offload, the vessel observer would not report any salmon retention data. The Alaska Regional Office of NOAA (AKRO) would apply an average salmon bycatch rate from other observed pollock trips to the unobserved offload or use the number of salmon in the at-sea samples to extrapolate to the entire vessel offload.

The total numbers and associated lengths of all salmon species were collected using the protocols described above for sampled offloads. In contrast, genetic samples were collected from all Chinook and Chum salmon (from the sampled GOA Pollock deliveries) that plant personnel made available to the vessel or plant observer.

In the 2023 GOA Pollock fishery, 4,316 Chinook, 636 Chum, 17 Coho, 16 Pink, and 37 Sockeye salmon were measured for length. Of these fish, 4,085 Chinook and 616 Chum salmon were sampled for genetic tissue (Table 2). In addition, 613 Chinook, 3 Chum, and 5 Coho salmon were missing their adipose fin, and their snouts 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 than the pollock fishery. In 2023, observer coverage for groundfish vessels was the same for both pollock and non-pollock vessels, except for the rockfish fishery, which 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 differ from those in the pollock fishery; length measurements and biological data were only collected from Chinook and Chum salmon encountered within 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 2023 GOA non-pollock fisheries, observers measured 47 Chinook, 111 Chum, 5 Coho, and 1 Pink salmon for length. In addition, 37 Chinook and 95 Chum salmon were sampled for genetic tissue. Of these fish, 10 Chinook salmon were missing an adipose fin (Table 2). These salmon snouts were collected and shipped to the Auke Bay Lab to be scanned for CWT presence and analysis.

Table 2. - Number of length, genetic, and CWT samples collected from incidentally caught salmon in the 2023 Gulf of Alaska (GOA) pollock and non-pollock fisheries.

		Sample		
Area/fishery	Salmon species	Length	Genetic tissue	CWT[1]
GOA pollock				
	Chinook	4,316	4,085	613
	Chum	636	616	3
	Coho	17	n/a[2]	5
	Pink	16	n/a[2]	0
	Sockeye	37	n/a[2]	0
subtotal		5,022	4,701	621
GOA non-pollock				
	Chinook	47	37	10
	Chum	111	95	0
	Coho	5	n/a[2]	0
	Pink	1	n/a[2]	0
	Sockeye	0	n/a[2]	0
subtotal		164	132	10
Total		5,186	4,833	631

[1]Salmon head collected from fish missing adipose fin.

[2]n/a - Not part of the sampling protocol.

Attachment 2. Alaska Fisheries Science Center annual report on the stock of origin and coded wire tag (CWT) data from incidental catch of salmon for 2023.

October 10, 2024

MEMORANDUM FOR: Maggie Chan
NOAA Fisheries Alaska Regional Office

FROM: Michele Masuda
NOAA Fisheries Alaska Fisheries Science Center

SUBJECT: 2023 Coded-Wire Tagged Chinook Salmon Recoveries in the Gulf of Alaska and Bering Sea-Aleutian Islands (Including 2021 Recoveries from U.S. Surveys)

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SUMMARY

We document in this report the stock origins of coded-wire tagged Chinook salmon recovered in the 2023 Gulf of Alaska (GOA) and Bering Sea-Aleutian Islands (BSAI) groundfish fisheries and in 2021 U.S. bottom trawl surveys in the GOA. Stock origins also include any listings under the U.S. Endangered Species Act (ESA). Twenty coded-wire tagged Chinook salmon from ESA-listed evolutionarily significant units (ESUs) were recovered in the 2023 GOA groundfish fisheries: Lower Columbia River ($N = 4$), Puget Sound ($N = 1$), Snake River fall run ($N = 1$), Upper Columbia River spring run ($N = 1$), and Upper Willamette River ($N = 13$). No coded-wire tagged Chinook salmon from ESA-listed ESUs were recovered in the 2023 BSAI groundfish fisheries or in the 2021 GOA U.S. bottom trawl surveys.

CODED-WIRE TAG SAMPLING

Gulf of Alaska fisheries and research

Groundfish fisheries (2023)
In the 2023 GOA groundfish fisheries, observers of the North Pacific Observer Program (Observer Program) sampled snouts for coded-wire tagged Chinook salmon. Sampling of snouts for coded-wire tags (CWTs) was based on visual detection only of a clipped adipose fin. Observers sampled 4,122[1] Chinook salmon and collected snouts from 624 fish, of which all fish had clipped adipose fins (Table 1). Of the snouts examined, 168 had readable CWTs (Table 1). Note that the CWT from one Chinook salmon was lost before it could be read.

U.S. research (1996–2016)
The National Marine Fisheries Service (NMFS) has not conducted research surveys on juvenile salmon in non-state waters of the GOA since 2016.

U.S. summer bottom trawl survey (2021)
In 2021, two Chinook salmon with readable CWTs (previously unreported) were recovered during the U.S. summer bottom trawl survey in the GOA by the NMFS Groundfish Assessment Program of the Resource Assessment and Conservation Engineering Program, Alaska Fisheries Science Center. The two Chinook salmon had clipped adipose fins.

Bering Sea-Aleutian Islands fisheries

Groundfish fisheries (2023)
In the 2023 BSAI groundfish fisheries, observers of the Observer Program sampled snouts for coded-wire tagged Chinook salmon. Sampling of snouts for CWTs was based on visual detection of a clipped adipose fin. Some observers used electronic handheld wands to detect CWTs; however, detection was still mostly visually based. Observers sampled 1,222[2] Chinook salmon in

[1]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).
[2]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).

the BSAI and collected 23 snouts, of which all fish had clipped adipose fins (Table 1). Of the snouts examined, 3 had readable CWTs (Table 1).

ORIGINS OF CODED-WIRE TAGS

Results in this report are summarized for two time periods. For the GOA fisheries, results are summarized for periods 2001–2011 and 2012–2023 because of the implementation of a revised genetic sampling protocol by the Observer Program in 2012. For the BSAI fisheries, results are summarized for periods 2001–2010 and 2011–2023 because of a revised genetic sampling protocol implemented in 2011.

Gulf of Alaska fisheries

Groundfish fisheries (2023)
Coded-wire tagged Chinook salmon recovered as bycatch in the GOA are comprised of stocks originating from Alaska, British Columbia, Washington, Idaho, and Oregon and are summarized (observed and mark-expanded numbers) for 2001–2023 in Table 2. Chinook salmon tagged in Alaska and harvested in the GOA have historically originated from two regions, Cook Inlet and Southeast Alaska, with most of the coded-wire tagged Alaska Chinook salmon originating from Southeast Alaska (Table 3). Since the tagging of Cook Inlet Chinook salmon with CWTs by the Alaska Department of Fish and Game (ADF&G) has been intermittent since the 2008 brood year (2010 release), most coded-wire tagged Alaska Chinook salmon harvested in the GOA for 2012–2023 originated from Southeast Alaska (Table 3).

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 also comprised of a variety of age classes (Table 6). Total age of each fish was calculated by subtracting the brood year of the coded-wire tagged recovery from the recovery year and includes freshwater and saltwater residency.

Bering Sea-Aleutian Islands fisheries

Groundfish fisheries (2023)
Coded-wire tagged Chinook salmon recovered as bycatch in the BSAI are comprised of stocks originating from Alaska, the Yukon Territory, British Columbia, Washington, and Oregon and are summarized (observed and mark-expanded numbers) for 2001–2023 in Table 7. Starting in 2011, sampling expansion factors were calculated for coded-wire tagged recoveries in the bycatch of the BSAI groundfish fisheries, and total estimated numbers (mark- and sample-expanded numbers) by state or province of origin are reported for 2011–2023 (Table 8). Chinook salmon tagged in Alaska and harvested in the BSAI have historically originated from two regions, Cook Inlet and Southeast Alaska (Table 9). Since the tagging of Cook Inlet Chinook salmon with CWTs by ADF&G has been intermittent since the 2008 brood year (2010 release),

most coded-wire tagged Alaska Chinook salmon harvested in the BSAI in 2011–2023 originated from Southeast Alaska (Table 9).

Most of the Chinook salmon represented by CWTs and harvested in the BSAI groundfish fisheries 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. Chinook salmon recovered in the BSAI are also comprised of a variety of age classes (Table 6). Total age of each fish was calculated by subtracting the brood year of the coded-wire tagged recovery from the recovery year and includes freshwater and saltwater residency.

ESA-LISTED RECOVERIES

The NMFS Alaska Regional Office contracted Cramer Fish Sciences to compile a database of coded-wire tagged release groups of West Coast salmon listed under the U.S. ESA; this database was last updated in September 2024 (Flaherty 2024). The database was compiled using the Pacific States Marine Fisheries Commission's Regional Mark Information System CWT database and a list of artificial propagation programs determined by NMFS to be included in ESA-listed ESUs. We determined from this database the coded-wire tagged Chinook salmon recovered in the GOA and BSAI that originated from ESA-listed ESUs.

GOA and BSAI groundfish fisheries (2023)
Coded-wire tagged Chinook salmon from ESA-listed ESUs have been recovered in GOA and BSAI fisheries (Tables 12–13). Since 1981, coded-wire tagged Chinook salmon recovered in GOA groundfish fisheries have originated from the following ESA-listed ESUs: Lower Columbia River, Puget Sound, Snake River fall run, Snake River spring/summer run, Upper Columbia River spring run, and the Upper Willamette River (Tables 12–13). Coded-wire tagged Chinook salmon recovered in BSAI groundfish fisheries have also originated from ESA-listed ESUs: Lower Columbia River, Snake River spring/summer run, and the Upper Willamette River (Tables 12–13).

U.S. research (1996–2016)
U.S. research surveys directed at juvenile salmon in the GOA have also documented the occurrence of Chinook salmon from ESA-listed ESUs. Since 1996, research surveys in the GOA have recovered coded-wire tagged Chinook salmon from the following ESA-listed ESUs: Lower Columbia River, Puget Sound, Snake River fall run, Snake River spring/summer run, Upper Columbia River spring run, and Upper Willamette River (Tables 14–15). NMFS has not conducted research surveys on juvenile salmon in non-state waters of the GOA since 2016. No ESA-listed, coded-wire tagged Chinook salmon have been recovered in U.S. research surveys in the BSAI.

U.S. summer bottom trawl survey (2021)
The two Chinook salmon recovered during the 2021 GOA U.S. summer bottom trawl survey did not originate from ESA-listed ESUs.

Ocean Distribution of Chinook Salmon from ESA-listed ESUs, 1981–2023

Maps show the ocean distribution of coded-wire tagged Chinook salmon from ESA-listed ESUs from the Pacific Northwest (Figures 1–7). These maps were compiled from the historical database of CWT recoveries (1981–2023) from high seas commercial fisheries and research surveys: GOA and BSAI groundfish fisheries, at-sea Pacific hake trawl fishery off the U.S. West Coast, and the West Coast groundfish trawl fishery, as well as domestic and foreign research surveys in the North Pacific Ocean, GOA, and BSAI. Note that data from the 2021–2023 West Coast groundfish trawl fishery were not available for the maps in this report (Figures 1–7). Note maps are for informational purposes only. Recoveries from NMFS Areas with unknown latitude and longitude are plotted with locations interpolated from previous recoveries in those areas with known latitude and longitude.

ACKNOWLEDGMENTS

Fishermen, processors, observers, contractors, and scientists who participated in the high seas CWT recovery program are gratefully acknowledged. Annie Masterman, Emily Fergusson, Cathy Mattson, and Wil Licht dissected salmon snouts, decoded CWTs, and entered CWT recovery data in a database.

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Pella, J., and Geiger, H. J. 2009. Sampling considerations for estimating geographic origins of Chinook salmon bycatch in the Bering Sea pollock fishery. Alaska Department of Fish and Game Special Publication No. SP 09-08. 58 p.

Vaughan, J. 2011. Production of stream type (spring-run) Chinook salmon from ESA-listed ESUs originating in Washington, Oregon, and Idaho. Technical Memorandum: Cramer Fish Sciences, 600 NW Fariss Rd., Gresham, OR 97030, 8 p.

Table 1. Number of Chinook salmon sampled, number sampled for coded-wire tags (CWTs), and number with readable CWTs in the sampling programs in the Gulf of Alaska (GOA) and Bering Sea-Aleutian Islands (BSAI) in 2023. The number of Chinook salmon that were ad-clipped is in parentheses.

Region	Year	Fishery	Sampling program	Detection method	Number sampled	Number sampled for CWTs	Number with readable CWTs
GOA	2023	Groundfish	Observer Program	Visual	4,122[1,2]	624 (624)	168[4] (168)
BSAI	2023	Groundfish	Observer Program	Visual	1,222[2,3]	23 (23)	3 (3)

[1]Number of Chinook salmon sampled for genetics in the pollock and non-pollock fisheries.
[2]Number from the Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center.
[3]Number of Chinook salmon sampled for length in the pollock and non-pollock fisheries.
[4]One additional CWT was lost before it could be read.

Table 2. Observed and mark-expanded numbers of coded-wire tagged Chinook salmon captured in the bycatch of the Gulf of Alaska groundfish fisheries (excluding augmented sampling in the rockfish trawl fishery, 2013–2020, and salmon excluder device testing, 2013–2014), by run year and state or province of origin: A) 2001–2011 and B) 2012–2023. Average numbers and percentages of the total averaged over years are reported.

A. 2001–2011

	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
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**
Mean	**6.8**	**54.4**	**3.5**	**54.2**	**0**	**0**	**4.4**	**9.5**	**4.6**	**8.3**	**19.4**	**126.4**
% of total averaged over years	**34%**	**46%**	**20%**	**38%**	**0%**	**0%**	**23%**	**9%**	**23%**	**7%**		

Table 2. Continued.

B. 2012–2023

	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	6	43.6	1	1.1	0	0	2	2.0	2	10.8	**11**	**57.6**
2013	5	25.9	9	38.1	0	0	7	69.4	6	7.4	**27**	**140.7**
2014	5	62.6	10	48.8	1	1.0	13	77.9	5	6.7	**34**	**197.0**
2015	27	311.2	30	176.2	0	0	15	17.3	30	48.6	**102**	**553.4**
2016	59	364.0	69	318.6	0	0	60	284.5	86	125.6	**274**	**1,092.7**
2017	33	186.2	40	235.2	0	0	64	195.6	42	75.7	**179**	**692.7**
2018	11	54.9	19	91.3	2	2.2	11	30.0	25	53.2	**68**	**231.5**
2019	17	90.9	19	77.5	0	0	18	38.2	30	84.6	**84**	**291.2**
2020	27	149.5	61	284.5	2	3.4	16	35.5	36	45.4	**142**	**518.3**
2021	13	80.7	31	71.3	0	0	18	107.6	20	119.9	**82**	**379.5**
2022	18	131.8	18	46.2	1	21.0	15	76.3	27	40.1	**79**	**315.4**
2023	36	198.0	40	256.5	0	0	41	201.7	51	139.3	**168**	**795.6**
Mean	**21.4**	**141.6**	**28.9**	**137.1**	**0.5**	**2.3**	**23.3**	**94.7**	**30.0**	**63.1**	**104.2**	**438.8**
% of total averaged over years	**22%**	**35%**	**27%**	**28%**	**1%**	**1%**	**22%**	**22%**	**27%**	**15%**		

Table 3. Observed and mark-expanded numbers of coded-wire tagged, Alaska-origin Chinook salmon captured in the bycatch of the Gulf of Alaska groundfish fisheries (excluding augmented sampling in the rockfish trawl fishery, 2013–2020, and salmon excluder device testing, 2013–2014) by run year and release region: A) 2001–2011 and B) 2012–2023. Numbers averaged over time periods are reported. The Chinook salmon tagging program in the Cook Inlet, Alaska region has been intermittent since the 2008 brood year (2010 release).

A. 2001–2011

	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	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**
Mean	**0.5**	**0.5**	**6.3**	**53.9**	**6.8**	**54.4**

B. 2012–2023

	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
2012	0	0	6	43.6	**6**	**43.6**
2013	0	0	5	25.9	**5**	**25.9**
2014	0	0	5	62.6	**5**	**62.6**
2015	0	0	27	311.2	**27**	**311.2**
2016	1	1.0	58	363.0	**59**	**364.0**
2017	3	3.1	30	183.2	**33**	**186.2**
2018	2	2.0	9	52.8	**11**	**54.9**
2019	2	2.0	15	88.9	**17**	**90.9**
2020	0	0	27	149.5	**27**	**149.5**
2021	0	0	13	80.7	**13**	**80.7**
2022	0	0	18	131.8	**18**	**131.8**
2023	0	0	36	198.0	**36**	**198.0**
Mean	**0.7**	**0.7**	**20.8**	**140.9**	**21.4**	**141.6**

Table 4. Observed numbers of coded-wire tagged Chinook salmon captured in the bycatch of the Gulf of Alaska groundfish fisheries (excluding augmented sampling in the rockfish trawl fishery, 2013–2020, and salmon excluder device testing, 2013–2014) by rearing type and state or province of origin: A) 2001–2011 and B) 2012–2023. Percentages of the total are reported.

A. 2001–2011

	Rearing type		
Origin	**Hatchery**	**Mixed**	**Wild**
Alaska	59	0	6
British Columbia	33	0	0
Idaho	0	0	0
Oregon	36	0	0
Washington	35	10	2
% of total	**90%**	**6%**	**4%**

B. 2012–2023

	Rearing type		
Origin	**Hatchery**	**Mixed**	**Wild**
Alaska	225	0	32
British Columbia	347	0	0
Idaho	6	0	0
Oregon	274	0	6
Washington	346	0	14
% of total	**96%**	**0%**	**4%**

Table 5. Observed numbers of coded-wire tagged Chinook salmon captured in the bycatch of the Gulf of Alaska groundfish fisheries (excluding augmented sampling in the rockfish trawl fishery, 2013–2020, and salmon excluder device testing, 2013–2014) by run type and state or province of origin: A) 2001–2011 and B) 2012–2023. Percentages of the total 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
% of total	**46%**	**15%**	**36%**	**3%**

B. 2012–2023

	Run type			
Origin	**Spring**	**Summer**	**Fall**	**Late fall upriver bright**
Alaska	217	40	0	0
British Columbia	26	172	149	0
Idaho	1	0	0	5
Oregon	174	0	103	3
Washington	20	133	181	26
% of total	**35%**	**28%**	**35%**	**3%**

Table 6. Observed numbers of coded-wire tagged Chinook salmon captured in bycatch of the Gulf of Alaska (GOA) groundfish fisheries (excluding augmented sampling in the rockfish trawl fishery, 2013–2020, and salmon excluder device testing, 2013–2014) and the Bering Sea-Aleutian Islands (BSAI) groundfish fisheries (excluding salmon excluder device testing, 2015–2016) by age during time periods. Age was calculated by subtracting the brood year of the coded-wire tagged recovery from the recovery year and includes freshwater and saltwater residency. Percentages are in parentheses.

		Age				
Fishery	**Time period**	**2**	**3**	**4**	**5**	**6**
GOA	2001–2011	14 (7%)	89 (42%)	92 (43%)	16 (8%)	2 (1%)
	2012–2023	207 (17%)	694 (56%)	307 (25%)	40 (3%)	1 (0%)
BSAI	2001–2010	34 (12%)	141 (49%)	92 (32%)	20 (7%)	2 (1%)
	2011–2023	4 (2%)	71 (44%)	68 (42%)	17 (11%)	1 (1%)

Table 7. Observed and mark-expanded numbers of coded-wire tagged Chinook salmon captured in the bycatch of the Bering Sea-Aleutian Islands groundfish fisheries (excluding salmon excluder device testing, 2015–2016) by run year and state or province of origin: A) 2001–2010 and B) 2011–2023. Average numbers and percentages of the total averaged over years are reported.

A. 2001–2010

	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
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**
Mean	**9.6**	**18.6**	**8.9**	**74.9**	**5.9**	**25.1**	**4.2**	**8.3**	**0.8**	**0.8**	**29.4**	**127.6**
% of total averaged over years	**30%**	**18%**	**33%**	**49%**	**20%**	**26%**	**15%**	**7%**	**2%**	**1%**		

Table 7. Continued.

B. 2011–2023

	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**
2015	1	16.7	3	7.1	2	7.8	3	14.9	2	2.1	**11**	**48.5**
2016	4	15.3	14	79.2	5	9.6	4	4.3	1	1.0	**28**	**109.5**
2017	9	99.3	18	93.5	8	25.7	9	15.0	0	0	**44**	**233.5**
2018	3	18.7	8	42.6	2	4.5	4	7.6	0	0	**17**	**73.4**
2019	0	0	10	34.1	4	7.6	2	3.6	0	0	**16**	**45.3**
2020	2	5.1	13	24.6	5	13.0	1	1	0	0	**21**	**43.7**
2021	1	1	3	11.0	2	7.3	0	0	0	0	6	19.3
2022	0	0	1	1.0	0	0	1	1.0	0	0	2	2.0
2023	0	0.0	2	28.6	1	1.0	0	0.0	0	0.0	3	29.6
Mean	**1.6**	**12.1**	**5.8**	**25.9**	**2.6**	**6.3**	**2.4**	**4.3**	**0.2**	**0.2**	**12.6**	**48.9**
% of total averaged over years	**8%**	**11%**	**40%**	**51%**	**22%**	**16%**	**28%**	**22%**	**2%**	**0%**		

Table 8. CWT mark- and sample-expanded numbers of Chinook salmon captured in bycatch of the Bering Sea-Aleutian Islands groundfish fisheries (excluding salmon excluder device testing, 2015–2016) by run year and state or province of origin: 2011–2023. Observed numbers are in parentheses.

	Estimated numbers				
Run year	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)	32.6 (1)	45.7 (3)	11.7 (1)	0 (0)
2015	214.6 (1)	91.1 (3)	99.9 (2)	192.1 (3)	26.6 (2)
2016	206.9 (4)	1,071.1 (14)	130.1 (5)	58.7 (4)	13.7 (1)
2017	1,163.3 (9)	1,095.9 (18)	300.9 (8)	176.2 (9)	0 (0)
2018	225.7 (3)	513.9 (8)	54.7 (2)	91.8 (4)	0 (0)
2019	0 (0)	413.9 (10)	92.0 (4)	43.5 (2)	0 (0)
2020	52.3 (2)	253.5 (13)	134.2 (5)	10.3 (1)	0 (0)
2021	11.2 (1)	123.2 (3)	81.7 (2)	0 (0)	0 (0)
2022	0 (0)	12.1 (1)	0 (0)	12.2 (1)	0 (0)
2023	0 (0)	341.7 (2)	12.2 (1)	0 (0)	0 (0)

Table 9. Observed and mark-expanded numbers of coded-wire tagged, Alaska-origin Chinook salmon captured in bycatch of the Bering Sea-Aleutian Islands groundfish fisheries (excluding salmon excluder device testing, 2015–2016) by run year and release region: A) 2001–2010 and B) 2011–2023. Numbers averaged over time periods are reported. The Chinook salmon tagging program in the Cook Inlet, Alaska region has been intermittent since the 2008 brood year (2010 release).

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**
Mean	**7.5**	**8.3**	**2.1**	**10.3**	**9.6**	**18.6**

B. 2011–2023

	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**
2015	0	0	1	16.7	**1**	**16.7**
2016	1	1.0	3	14.3	**4**	**15.3**
2017	2	2.1	7	97.2	**9**	**99.3**
2018	1	1.0	2	17.7	**3**	**18.7**
2019	0	0	0	0	**0**	**0**
2020	0	0	2	5.1	**2**	**5.1**
2021	0	0	1	1	**1**	**1**
2022	0	0	0	0	**0**	**0**
2023	0	0	0	0	**0**	**0**
Mean	**0.3**	**0.3**	**1.3**	**11.8**	**1.6**	**12.1**

Table 10. Observed numbers of coded-wire tagged Chinook salmon captured in bycatch of the Bering Sea-Aleutian Islands groundfish fisheries (excluding salmon excluder device testing, 2015–2016) by rearing type and state or province of origin: A) 2001–2010 and B) 2011–2023. Percentages of the total are reported.

A. 2001–2010

	Rearing type		
Origin	**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
% of total	**99.3%**	**0.3%**	**0.3%**

B. 2011–2023

	Rearing type		
Origin	**Hatchery**	**Mixed**	**Wild**
Alaska	17	0	4
British Columbia	75	0	0
California	0	0	0
Oregon	34	0	0
Washington	30	0	1
Yukon Territory	3	0	0
% of total	**97.0%**	**0%**	**3.0%**

Table 11. Observed numbers of coded-wire tagged Chinook salmon captured in bycatch of the Bering Sea-Aleutian Islands groundfish fisheries (excluding salmon excluder device testing, 2015–2016) by run type and state or province of origin: A) 2001–2010 and B) 2011–2023. Percentages of the total 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
% total	**48%**	**13%**	**39%**	**1%**

B. 2011–2023

	Run type			
Origin	**Spring**	**Summer**	**Fall**	**Late fall upriver bright**
Alaska	20	1	0	0
British Columbia	4	43	28	0
Oregon	16	0	17	1
Washington	1	8	20	2
Yukon Territory	3	0	0	0
% total	**27%**	**32%**	**40%**	**2%**

Table 12. Observed and mark-expanded numbers of coded-wire tagged Chinook salmon listed under the Endangered Species Act and captured in bycatch of the Gulf of Alaska (GOA) groundfish fisheries (excluding augmented sampling in the rockfish trawl fishery, 2013–2020, and salmon excluder device testing, 2013–2014) and Bering Sea-Aleutian Islands (BSAI) groundfish fisheries (excluding salmon excluder device testing, 2015–2016) by evolutionarily significant unit (ESU) for 1981–2023.

	GOA		BSAI	
Chinook salmon ESU	Observed number	CWT Mark Expanded Number	Observed number	CWT mark expanded number
Lower Columbia River	42	158.4	10	10.1
Puget Sound	1	1.0	0	0
Snake River fall run	10	17.2	0	0
Snake River spring/summer run	1	1.9	1	1.9
Upper Columbia River spring run	3	3.1	0	0
Upper Willamette River	233	876.9	24	107.3

Table 13. Observed and mark-expanded numbers of coded-wire tagged Chinook salmon listed under the Endangered Species Act and captured in bycatch of the Gulf of Alaska (GOA) groundfish fisheries (excluding augmented sampling in the rockfish trawl fishery, 2013–2020, and salmon excluder device testing, 2013–2014) and Bering Sea Aleutian Islands (BSAI) groundfish fisheries (excluding salmon excluder device testing, 2015–2016) by evolutionarily significant unit (ESU) and year, 1981–2023.

A. Lower Columbia River Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
1981	0	0	0	0
1982	0	0	0	0
1983	0	0	0	0
1984	5	14.1	0	0
1985	1	1.0	0	0
1986	0	0	0	0
1987	1	1.3	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	1	1.0	0	0
1991	0	0	0	0
1992	1	1.6	0	0
1993	1	60.3	0	0
1994	2	2.8	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	2	18.8	0	0
1999	4	5.9	0	0
2000	2	2.0	0	0
2001	2	2.0	1	1.0
2002	0	0	1	1.0
2003	0	0	0	0
2004	1	1.1	3	3.0
2005	0	0	3	3.1
2006	0	0	1	1.0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	1	1.0
2013	1	5.7	0	0
2014	1	1.0	0	0

Table 13. Continued.

A. Lower Columbia River Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2015	4	5.0	0	0
2016	6	6.0	0	0
2017	1	1.0	0	0
2018	2	5.7	0	0
2019	0	0	0	0
2020	0	0	0	0
2021	0	0	0	0
2022	0	0	0	0
2023	4	22.0	0	0

Table 13. Continued.

B. Puget Sound Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
1981	0	0	0	0
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	0	0	0	0
2002	0	0	0	0
2003	0	0	0	0
2004	0	0	0	0
2005	0	0	0	0
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0
2017	0	0	0	0
2018	0	0	0	0
2019	0	0	0	0
2020	0	0	0	0
2021	0	0	0	0

Table 13. Continued.

B. Puget Sound Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2022	0	0	0	0
2023	1	1.0	0	0

Table 13. Continued.

C. Snake River fall-run Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
1981	0	0	0	0
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	0	0	0	0
2002	0	0	0	0
2003	0	0	0	0
2004	0	0	0	0
2005	0	0	0	0
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	2	3.0	0	0
2013	0	0	0	0
2014	1	1.0	0	0
2015	0	0	0	0
2016	1	2.1	0	0
2017	0	0	0	0
2018	3	4.2	0	0
2019	0	0	0	0
2020	1	2.3	0	0
2021	0	0	0	0

Table 13. Continued.

C. Snake River fall-run Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2022	1	2.3	0	0
2023	1	2.3	0	0

Table 13. Continued.

D. Snake River spring/summer-run Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
1981	0	0	0	0
1982	0	0	0	0
1983	1	1.9	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	0	0	0	0
2002	0	0	0	0
2003	0	0	0	0
2004	0	0	0	0
2005	0	0	0	0
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	1	1.9
2015	0	0	0	0
2016	0	0	0	0
2017	0	0	0	0
2018	0	0	0	0
2019	0	0	0	0
2020	0	0	0	0
2021	0	0	0	0

Table 13. Continued.

D. Snake River spring/summer-run Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2022	0	0	0	0
2023	0	0	0	0

Table 13. Continued.

E. Upper Columbia River spring-run Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
1981	0	0	0	0
1982	0	0	0	0
1983	0	0	0	0
1984	0	0	0	0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	0	0
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	1	1.0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	0	0	0	0
2002	0	0	0	0
2003	0	0	0	0
2004	0	0	0	0
2005	0	0	0	0
2006	0	0	0	0
2007	0	0	0	0
2008	0	0	0	0
2009	0	0	0	0
2010	0	0	0	0
2011	0	0	0	0
2012	0	0	0	0
2013	0	0	0	0
2014	0	0	0	0
2015	0	0	0	0
2016	0	0	0	0
2017	0	0	0	0
2018	0	0	0	0
2019	1	1.0	0	0
2020	0	0	0	0
2021	0	0	0	0

Table 13. Continued.

E. Upper Columbia River spring-run Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2022	0	0	0	0
2023	1	1.0	0	0

Table 13. Continued.

F. Upper Willamette River Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
1981	0	0	0	0
1982	1	12.0	0	0
1983	2	2.0	0	0
1984	11	16.8	1	1.0
1985	0	0	0	0
1986	0	0	0	0
1987	0	0	0	0
1988	0	0	0	0
1989	0	0	0	0
1990	4	4.0	0	0
1991	1	13.3	0	0
1992	4	28.5	0	0
1993	14	52.1	0	0
1994	3	8.8	0	0
1995	2	4.9	0	0
1996	1	1.3	1	1.0
1997	1	7.5	0	0
1998	4	30.7	0	0
1999	20	49.3	1	1.0
2000	16	16.6	1	1.0
2001	7	7.1	1	1.0
2002	1	1.0	2	12.4
2003	1	5.3	0	0
2004	1	5.8	1	7.9
2005	0	0	2	10.9
2006	1	1.0	0	0
2007	0	0	0	0
2008	1	6.5	0	0
2009	1	1.8	1	10.2
2010	3	12.8	1	15.5
2011	2	13.4	0	0
2012	11	44.5	0	0
2013	2	2.0	0	0
2014	5	18.8	1	1.0
2015	2	4.1	2	2.0
2016	30	187.0	0	0
2017	41	123.1	5	22.7
2018	6	17.9	1	3.5
2019	5	17.8	0	0
2020	6	15.9	1	8.9
2021	6	47.9	2	7.3

Table 13. Continued.

F. Upper Willamette River Chinook salmon ESU

	GOA		BSAI	
Run year	Observed number	CWT mark expanded number	Observed number	CWT mark expanded number
2022	4	14.4	0	0
2023	13	81.1	0	0

Table 14. Observed and mark-expanded numbers of coded-wire tagged Chinook salmon listed under the Endangered Species Act (ESA) and captured in U.S. research surveys, 1996–2016. NMFS has not conducted research surveys on juvenile salmon in non-state waters of the GOA since 2016. No coded-wire tagged Chinook salmon from ESA-listed evolutionarily significant units (ESUs) were recovered in Gulf of Alaska (GOA) research surveys before 1996, and no coded-wire tagged, ESA-listed Chinook salmon have been recovered in Bering Sea-Aleutian Islands research surveys.

	GOA	
ESU	Observed number	CWT mark expanded number
Lower Columbia River	11	26.6
Puget Sound	1	1.0
Snake River fall run	6	7.1
Snake River spring/summer run	39	141.0
Upper Columbia River spring run	27	54.9
Upper Willamette River	28	92.2

Table 15. Observed and mark-expanded numbers of coded-wire tagged Chinook salmon listed under the Endangered Species Act (ESA) and captured in U.S. research surveys in the Gulf of Alaska (GOA) by evolutionarily significant unit (ESU) and year, 1996–2016. NMFS has not conducted research surveys on juvenile salmon in non-state waters of the GOA since 2016. No coded-wire tagged Chinook salmon from ESA-listed ESUs were recovered in GOA research surveys before 1996.

	Lower Columbia River		Puget Sound		Snake River fall run	
Run year	Observed Number	CWT Mark Expansion	Observed Number	CWT Mark Expansion	Observed Number	CWT Mark Expansion
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	0	0	0	0	0	0
1999	1	1.0	0	0	0	0
2000	0	0	0	0	0	0
2001	1	1.0	0	0	0	0
2002	0	0	0	0	0	0
2003	0	0	1	1.0	0	0
2004	0	0	0	0	0	0
2005	0	0	0	0	0	0
2006	0	0	0	0	0	0
2007	0	0	0	0	0	0
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
2011	0	0	0	0	0	0
2012	1	5.7	0	0	2	3.1
2013	4	9.6	0	0	2	2.0
2014	3	8.3	0	0	1	1.0
2015	1	1.0	0	0	0	0
2016	0	0	0	0	1	1.0

Table 15. Continued.

	Snake River spring/summer run		Upper Columbia River spring run		Upper Willamette River	
Run year	Observed Number	CWT Mark Expansion	Observed Number	CWT Mark Expansion	Observed Number	CWT Mark Expansion
1996	0	0	0	0	0	0
1997	0	0	0	0	0	0
1998	2	5.8	0	0	2	2.3
1999	0	0	0	0	0	0
2000	0	0	0	0	0	0
2001	0	0	0	0	3	11.1
2002	0	0	0	0	3	26.6
2003	0	0	0	0	0	0
2004	0	0	0	0	0	0
2005	0	0	0	0	0	0
2006	0	0	0	0	0	0
2007	0	0	0	0	0	0
2008	0	0	0	0	0	0
2009	0	0	0	0	0	0
2010	0	0	0	0	0	0
2011	0	0	0	0	1	1.0
2012	12	27.0	13	26.4	9	14.0
2013	11	49.9	6	10.0	5	15.9
2014	8	35.1	6	16.4	1	3.5
2015	4	13.0	0	0	3	15.7
2016	2	10.2	2	2.0	1	2.1

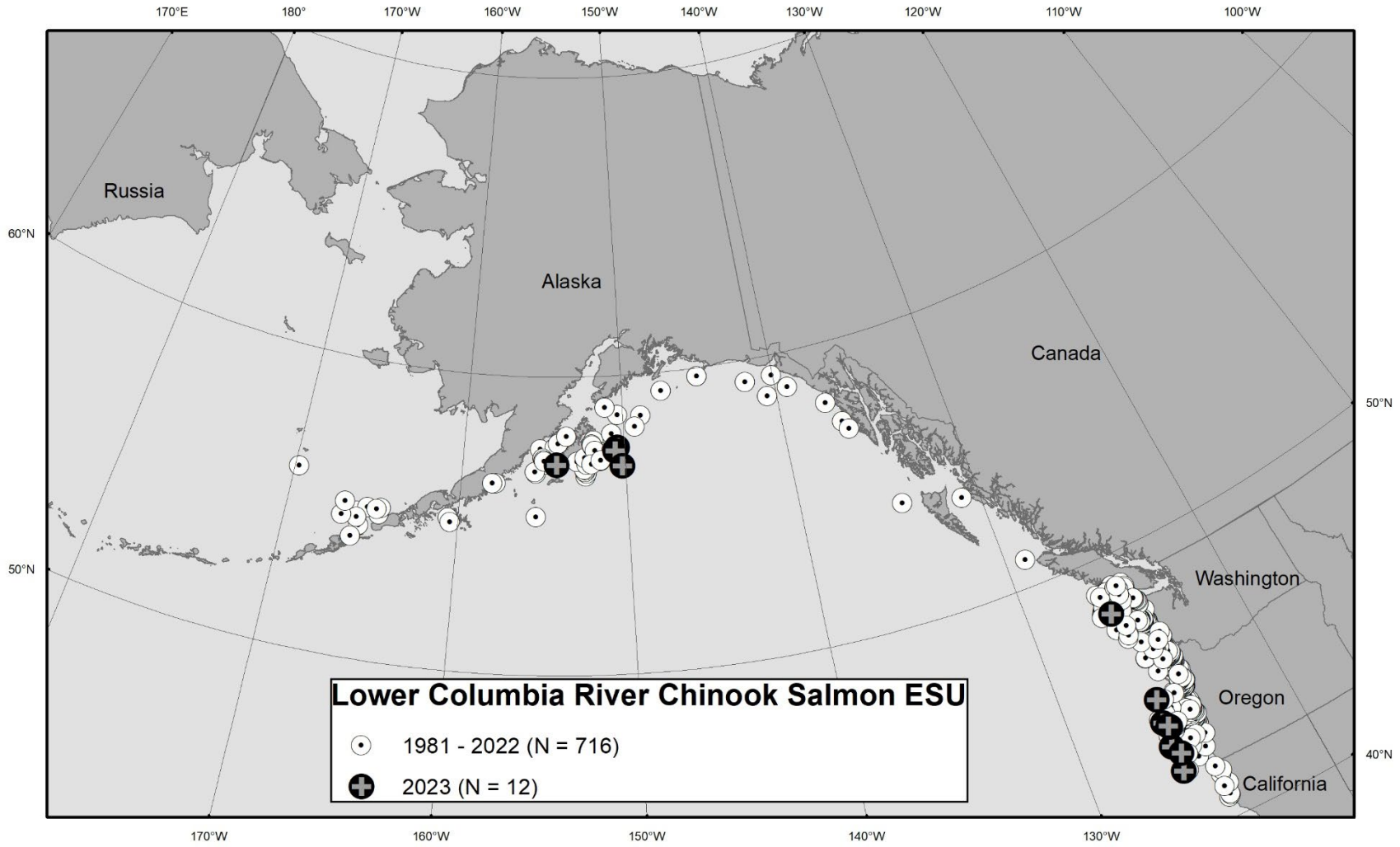

Figure 1. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Lower Columbia River ESU, 1981–2023. Coded-wire tags were recovered in fisheries and research surveys.

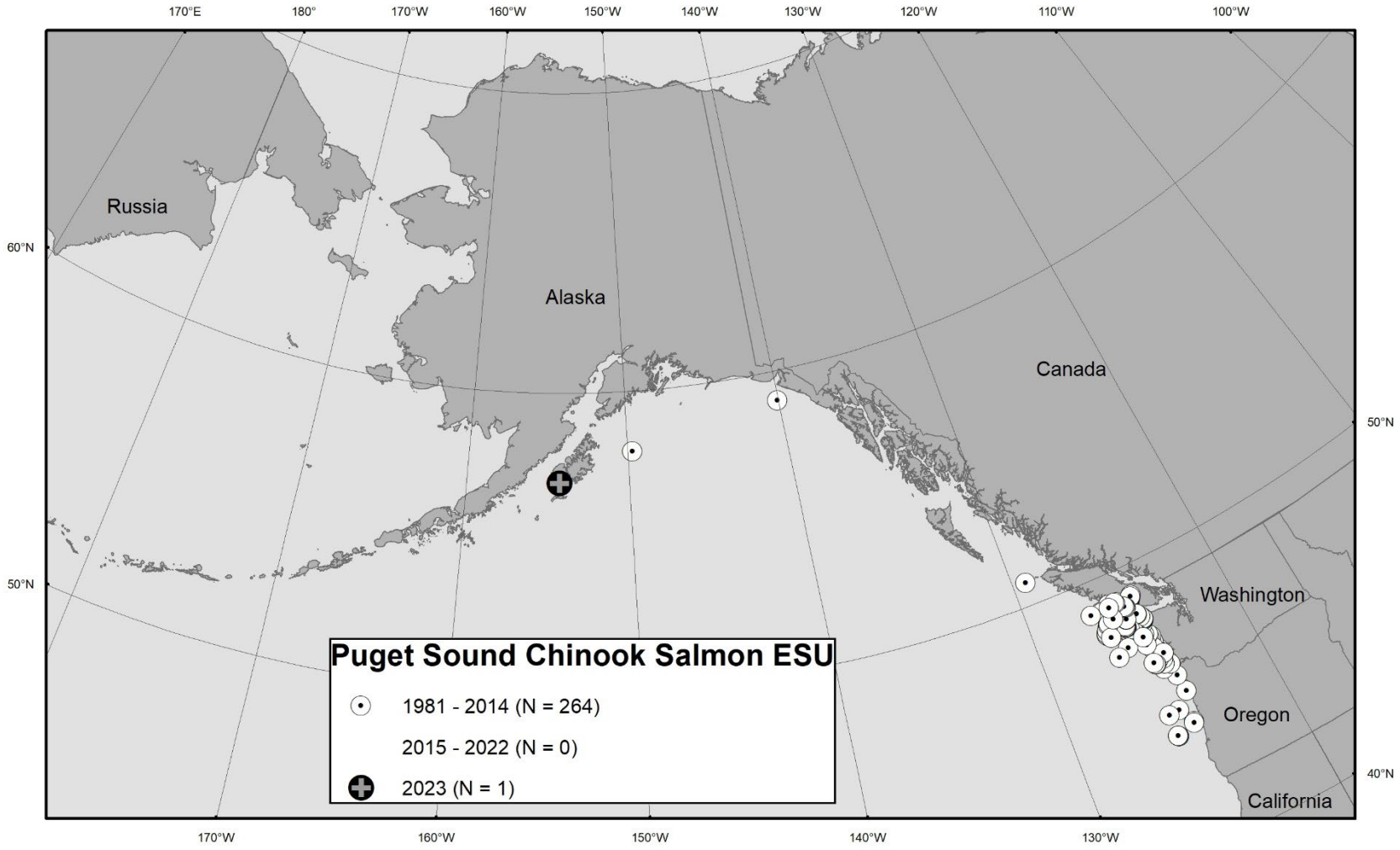

Figure 2. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Puget Sound ESU, 1981–2023. Coded-wire tags were recovered in fisheries and research surveys.

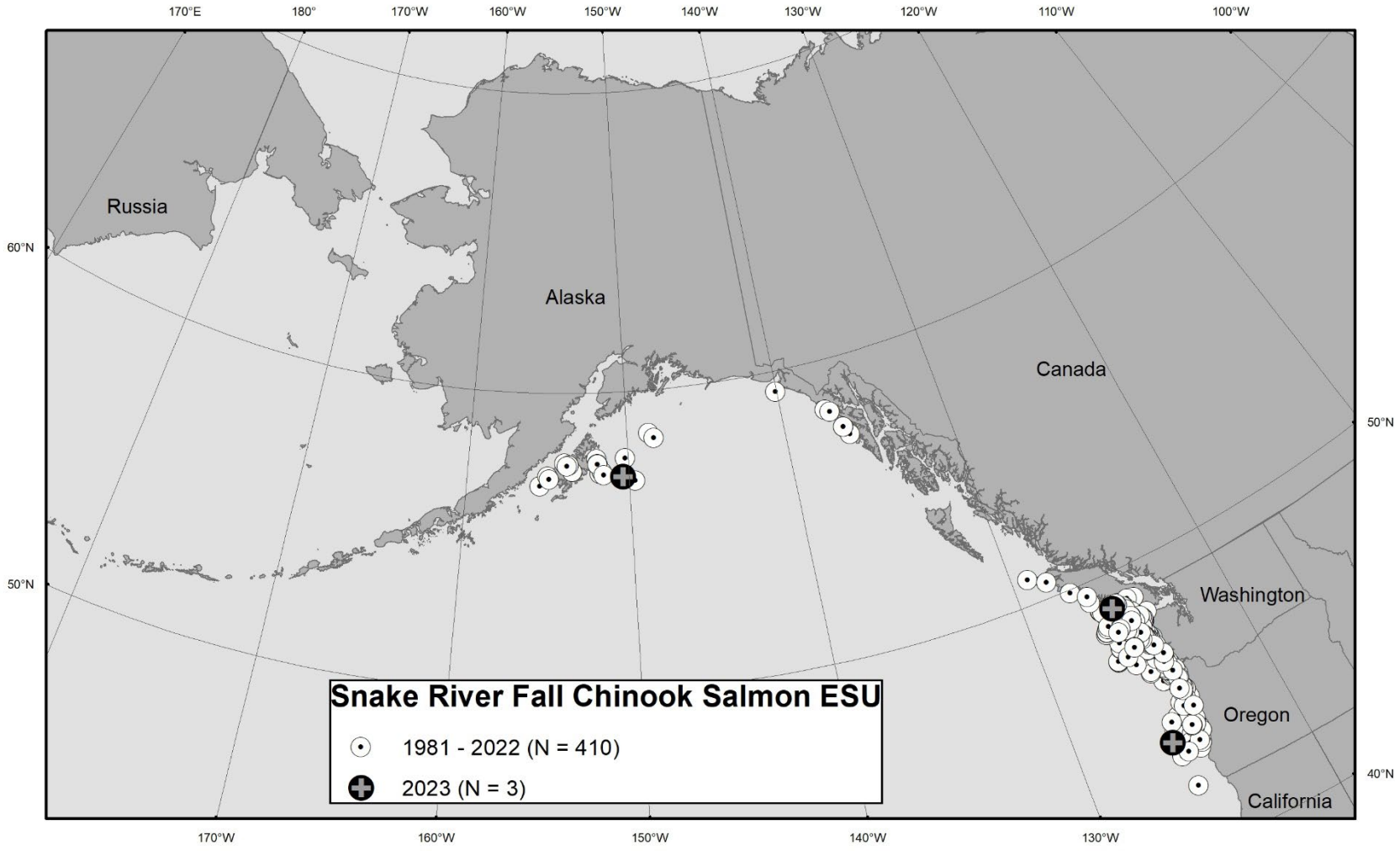

Figure 3. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Snake River fall-run ESU, 1981–2023. Coded-wire tags were recovered in fisheries and research surveys.

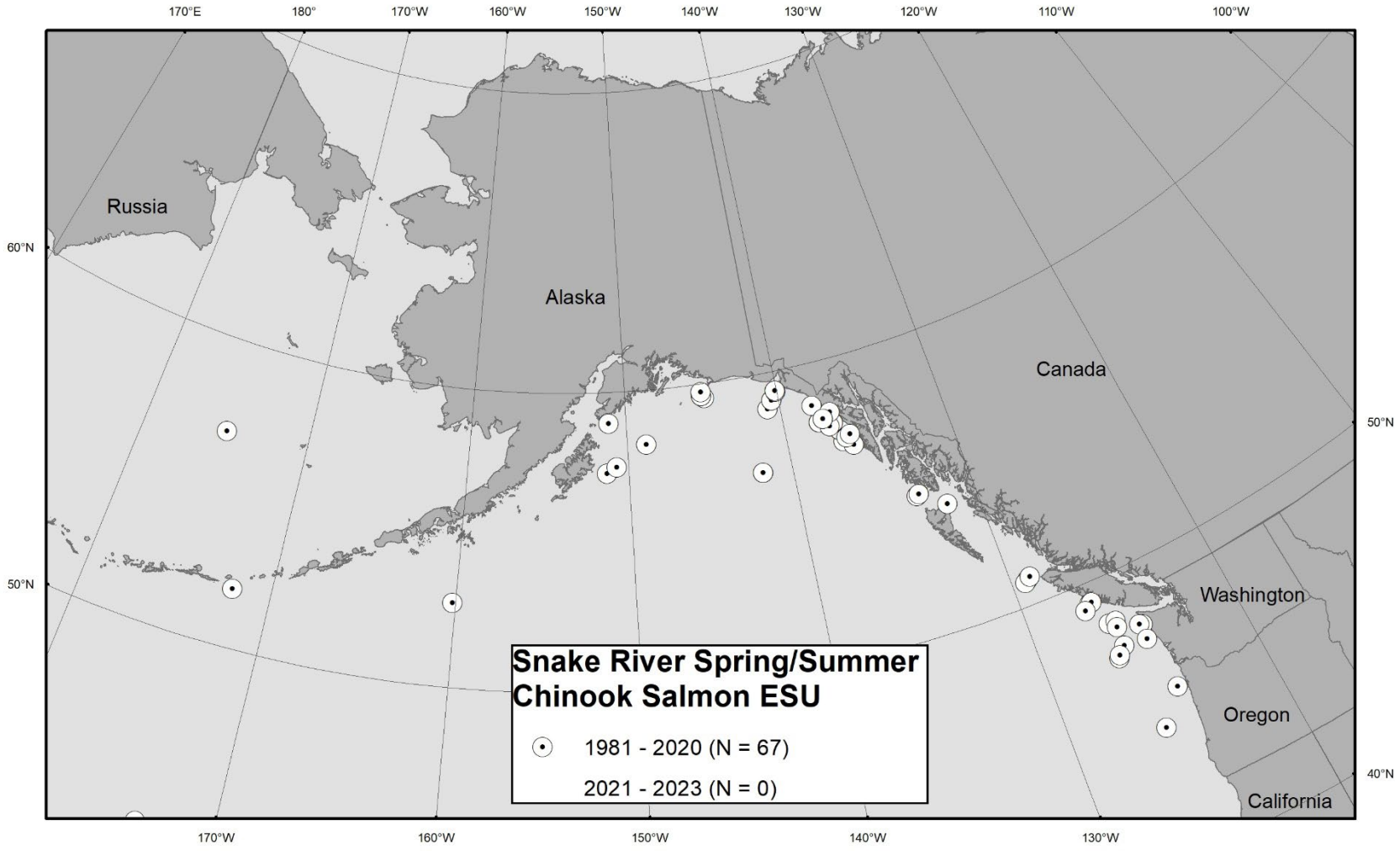

Figure 4. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Snake River spring/summer-run ESU, 1981–2023. Coded-wire tags were recovered in fisheries and research surveys.

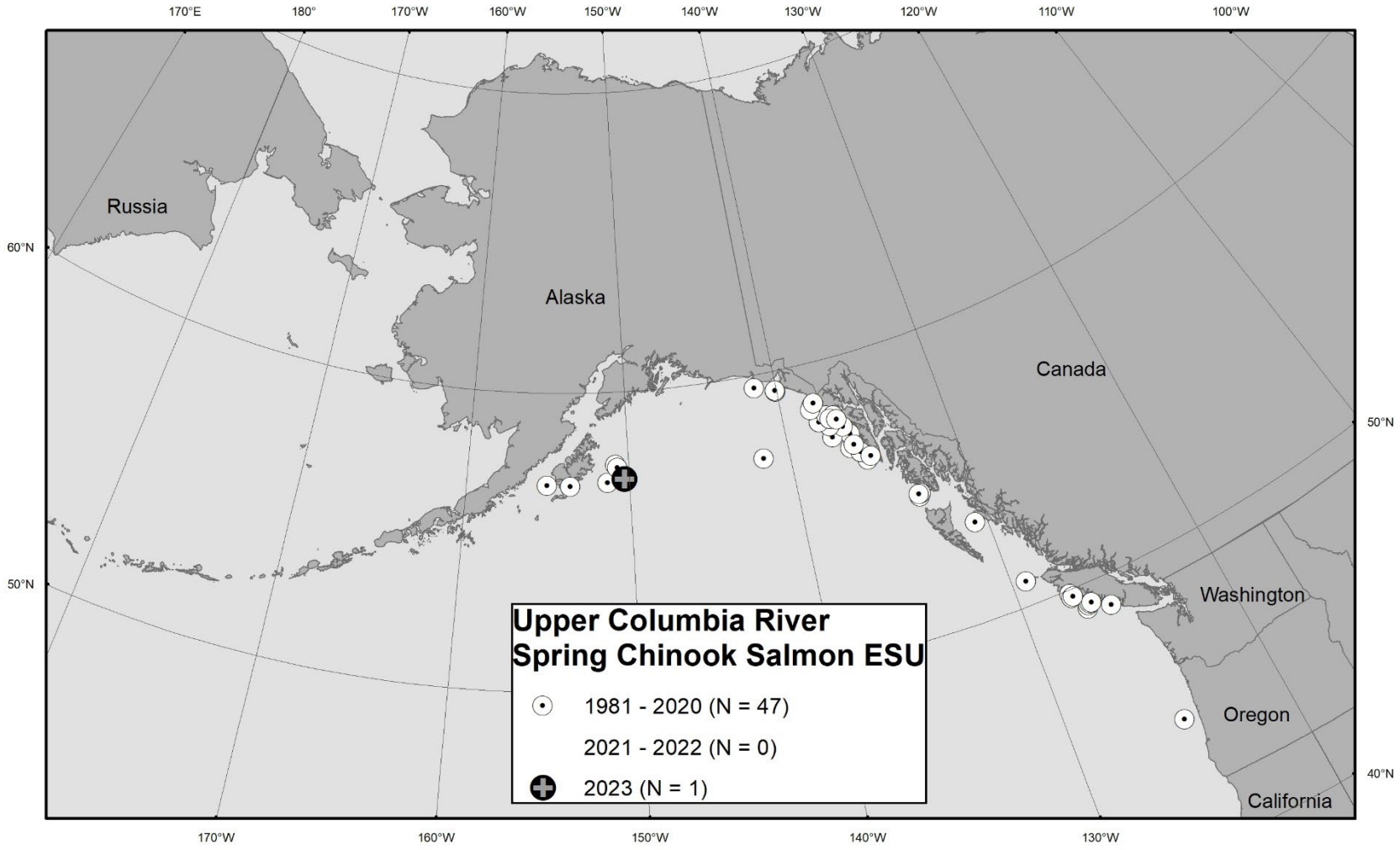

Figure 5. Ocean distribution of code-wire tagged Chinook salmon recoveries from the Upper Columbia spring-run ESU, 1981–2023. Coded-wire tags were recovered in fisheries and research surveys.

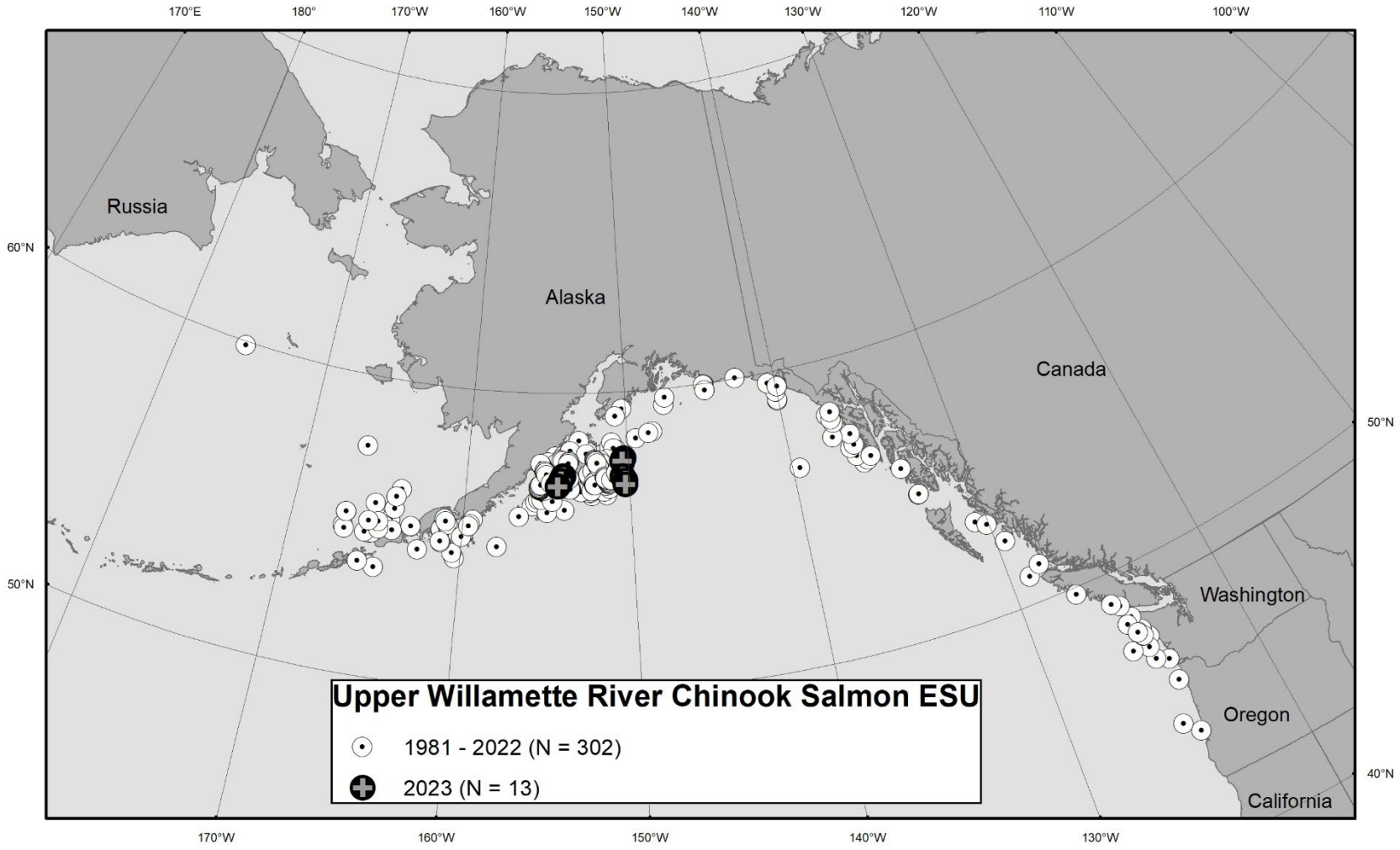

Figure 6. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Upper Willamette River ESU, 1981–2023. Coded-wire tags were recovered in fisheries and research surveys.

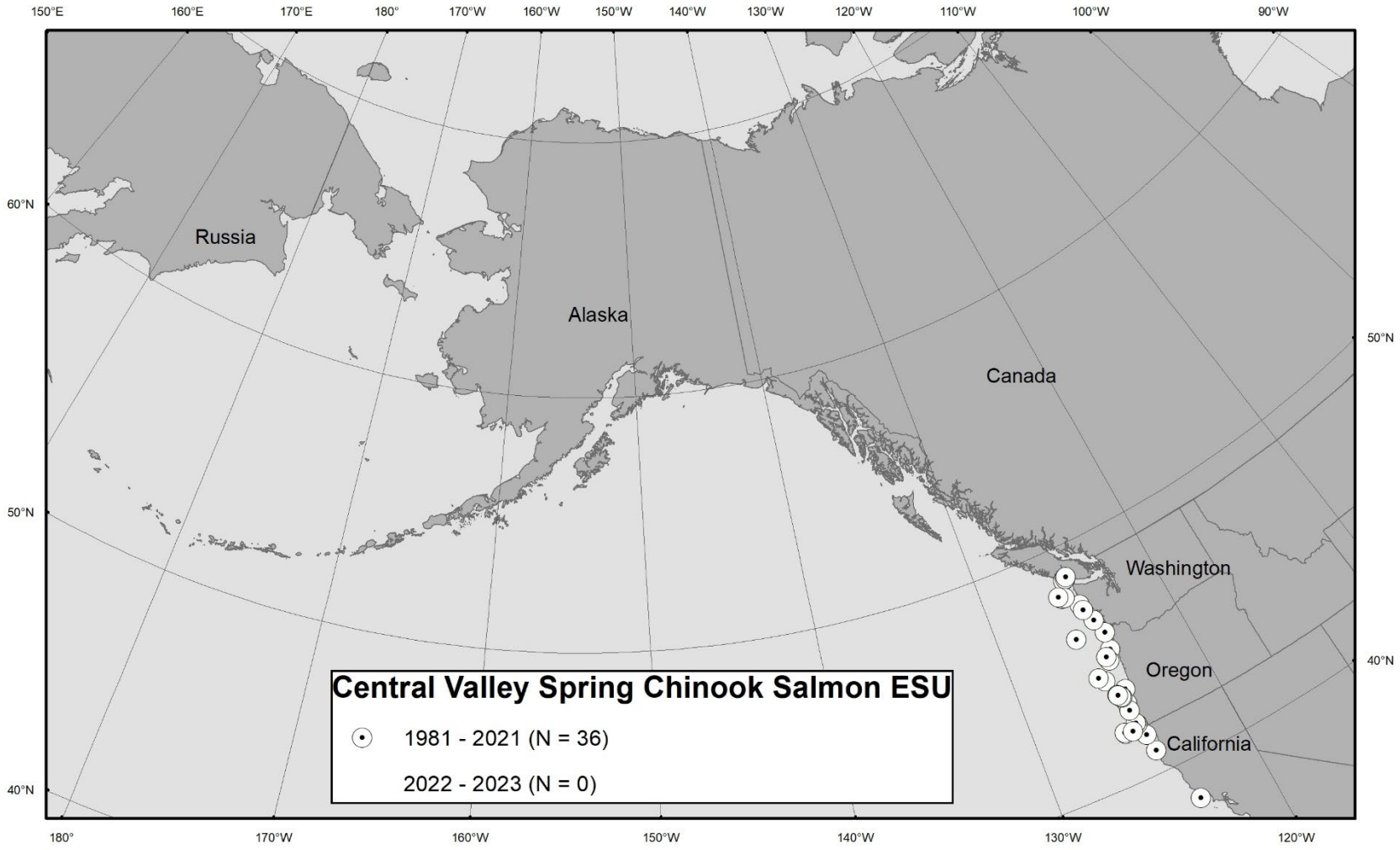

Figure 7. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Central Valley spring-run ESU, 1981–2023. Coded-wire tags were recovered in fisheries and research surveys.

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 = (total catch of each species by fishery by year)/ (sampled 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:

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

R_{Ti} = estimated total recoveries of tags for the i^{th} release group;
R_{Oi} = observed number of tags for the i^{th} release group 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^{th} release group = (total fish released)/ (total fish marked) for the i^{th} release group;
R_{Ti} = estimated total recoveries of tags for the i^{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 / (proportion hatchery component for the j^{th} 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:

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

R_{TMEij} = the total estimated mark expansion for the i^{th} release group in the j^{th} ESU;
c_j = 1 / (proportion hatchery component for the j^{th} ESU);
b_{ij} = the CWT marking expansion for the i^{th} release group in the j^{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[1]
Puget Sound	95.0	5.0	1.05	Recent adult return estimates[2]
Snake River fall run	75.2	24.8	1.33	2007–2011 spawning escapement estimates[3]
Snake River spring/summer run	73.2	26.8	1.37	1995–2012 adult return estimates[4]
Upper Columbia River spring run	89.1	10.9	1.12	1995–2012 adult return estimates[4]
Upper Willamette River	81.7	18.3	1.22	2005–2010 adult return estimates[1]

[1] Vaughan 2011.
[2] LaVoy 2013a.
[3] LaVoy 2013b.
[4] 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 Stated [sic] 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.