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

July 20, 2017

MEMORANDUM FOR: Barry Thom
Administrator, West Coast Region

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

SUBJECT: 2016 Annual Report for the Alaska Groundfish Fisheries Chinook Salmon Coded Wire Tag and Recovery Data for Endangered Species Act Consultation

We transmit the final 2016 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 2016. This report supplements the annual report data provided to you on June 15, 2017, on salmon incidental catch, salmon bycatch reduction measures, and data sources for the genetic composition of salmon caught in these fisheries.

Annual data from the Alaska Fisheries Science Center's North Pacific Observer Program bycatch sampling in 2016 is provided in Attachment 1. Annual data from the Alaska Fisheries Science Center's Tag Lab on the stock of origin and CWT data from incidental catch of salmon in 2016 is provided in Attachment 2. Note that the results of the 2016 CWT recoveries in the Bering Sea and Aleutian Islands (BSAI) and the Gulf of Alaska (GOA) (Attachment 2) do not identify any West Coast Region salmon recoveries for Endangered Species Act (ESA)-listed Evolutionarily Significant Units (ESUs) that have not been identified in previous annual reports.

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 (BiOp) regarding authorization of the BSAI and GOA groundfish fisheries (NMFS 2000), and the supplemental BiOp issued on January 9, 2012 (NMFS 2012).

cc: Peter Dygert, West Coast Region
Susan Bishop, West Coast Region

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**Attachment 1. Alaska Fisheries Science Center North Pacific Observer Program Bycatch Sampling for 2016.**

**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[1] observers do not conduct an at-sea

1 Catcher vessels delivering to motherships are not required to carry observers. The hauls are sampled by

-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, collect a scale sample to verify species identification and check for missing adipose fins. These 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 2016 Bering Sea pollock fishery, 2,185 Chinook, 11,497 chum, 26 coho, 126 pink, and 34 sockeye salmon were measured for length. Of these fish, 2,156 Chinook and 11,219 chum salmon were sampled for genetic tissue (Table 1). In addition, 62 Chinook, 2 chum, 26 coho, 126 pink, and 34 sockeye 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 2016 BSAI non-pollock fisheries, observers measured a total of 223 Chinook, 97 chum, 10 coho, 1 pink, and 3 sockeye salmon. Of these fish, 4 Chinook salmon were sampled for genetic tissue (Table 1). In addition, 7 Chinook and 1 chum 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.

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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 2016 Bering Sea/Aleutian Islands pollock and non-pollock fisheries

| | | Sample | | |
|---|---|---|---|---|
| Area/fishery | Salmon species | Length | Genetic tissue | CWT[1] |
| BS pollock | | | | |
| | Chinook | 2,185 | 2,156 | 62 |
| | Chum | 11,497 | 11,219 | 2 |
| | Coho | 26 | n/a[2] | 26 |
| | Pink | 126 | n/a[2] | 126 |
| | Sockeye | 34 | n/a[2] | 34 |
| subtotal | | 13,868 | 13,375 | 250 |
| BSAI non-pollock | | | | |
| | Chinook | 223 | 4 | 7 |
| | Chum | 97 | 0 | 1 |
| | Coho | 10 | n/a[2] | 0 |
| | Pink | 1 | n/a[2] | 0 |
| | Sockeye | 3 | n/a[2] | 0 |
| subtotal | | 334 | 4 | 8 |
| Total | | 14,202 | 13,379 | 258 |

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

[2] 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 2016, 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 prohibitive species catch (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 2016. 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 vessel observer. In the 2016 GOA pollock fishery, 5,439 Chinook, 508 chum, 17 coho, and 2 sockeye salmon were measured for length. Of these fish, 5,381 Chinook and 505 chum salmon were sampled for genetic tissue (Table 2). In addition, 930 Chinook, 2 chum and 1 coho 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 2016, 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 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 2016 GOA non-pollock fisheries, observers measured a total of 166 Chinook, 22 chum, and

11 coho salmon. A total of 161 Chinook and 16 chum salmon were sampled for genetic tissue. Of these fish, 2 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 2016 Gulf of Alaska pollock and non-pollock fisheries

| | | Sample | | |
|---|---|---|---|---|
| Area/fishery | Salmon species | Length | Genetic tissue | CWT[1] |
| GOA pollock | | | | |
| | Chinook | 5,439 | 5,381 | 930 |
| | Chum | 508 | 505 | 2 |
| | Coho | 17 | n/a[2] | 1 |
| | Pink | 0 | n/a[2] | 0 |
| | Sockeye | 2 | n/a[2] | 0 |
| subtotal | | 5,966 | 5,886 | 933 |
| GOA non-pollock | | | | |
| | Chinook | 166 | 161 | 2 |
| | Chum | 22 | 16 | 0 |
| | Coho | 11 | n/a[2] | 0 |
| | Pink | 0 | n/a[2] | 0 |
| | Sockeye | 0 | n/a[2] | 0 |
| subtotal | | 199 | 177 | 2 |
| Total | | 6,165 | 6,063 | 935 |

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

[2] n/a = not part of 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 2016.**

June 26, 2017

| | |
|---|---|
| MEMORANDUM FOR: | Megan Mackey<br>NOAA Fisheries Alaska Regional Office |
| FROM: | Michele Masuda<br>NOAA Fisheries Alaska Fisheries Science Center |
| SUBJECT: | 2016 Coded-wire Tagged Chinook Salmon Recoveries in the Gulf of Alaska and Bering Sea-Aleutian Islands (Including 2015 Recoveries from U.S. Trawl Research) |

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# METHODS

## Sampling for Coded-wire Tagged Chinook Salmon in the Gulf of Alaska

*Groundfish trawl fisheries*
In the 2016 Gulf of Alaska (GOA) groundfish trawl fisheries, at-sea observers of the North Pacific Groundfish and Halibut Observer Program (i.e. Observer Program) sampled snouts for coded-wire tagged salmon. Sampling of snouts for coded-wire tags (CWTs) was based on visual detection only of a clipped adipose fin. Observers sampled 5,542[2] Chinook salmon and collected snouts from 932[3] fish with clipped adipose fins (Table 1). Of the snouts examined, 234 had readable CWTs (Table 1).

*Rockfish trawl fishery*
Electronic detection of CWTs in the salmon bycatch of the GOA rockfish trawl fishery was conducted by Alaska Groundfish Data Bank in 2016, and nearly all Chinook salmon bycatch were scanned with handheld CWT detection wands. Of the 496 Chinook salmon scanned with handheld wands, 86 (17.3%) had a clipped adipose fin, and 23 (4.6%) had readable CWTs (Table 1). Of the 23 with readable CWTs, 20 (87.0%) had a clipped adipose fin and 3 were unclipped (Table 1). In addition, one Chinook salmon was tagged with an agency-only wire. Agency-only wire tags are not etched with a binary or decimal code and therefore cannot be resolved to a specific release tag code (Nandor et al. 2010). The only information provided by agency-only wire tags is the release agency.

*U.S. trawl research (2015)*
In the 2015 U.S. trawl research conducted by the National Marine Fisheries Service (NMFS) and directed at juvenile salmon in the GOA, electronic and visual detection were used to sample salmon for CWTs. Researchers sampled 93 Chinook salmon, of which 84 (90.3%) had a clipped adipose fin, and 25 (26.9%) had readable CWTs (Table 1). Of the 25 with readable CWTs, 19 (76%) had a clipped adipose fin and 6 were unclipped (Table 1).

*U.S. pollock acoustic trawl survey*
In 2016, two Chinook salmon with readable CWTs were recovered during the U.S. pollock acoustic trawl survey conducted in Shelikof Strait in the GOA by the NMFS Midwater Assessment and Conservation Engineering Program. Staff of Auke Bay Laboratories used electronic detection to opportunistically sample salmon for CWTs. Of the two Chinook salmon with readable CWTs, one salmon had a clipped adipose fin, and the other did not.

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2Number of Chinook salmon sampled for genetics in the pollock and non-pollock fisheries (Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center).
3Number from the Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center.

## Sampling for Coded-wire Tagged Chinook Salmon in the Bering Sea-Aleutian Islands

*Groundfish trawl fisheries*

In the 2016 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 Observer Program 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 a clipped adipose fin in one of every tenth Chinook salmon encountered and sampled for genetics. In 2016, observers sampled 2,408[4] Chinook salmon in the BSAI and collected 69[5] snouts from fish with clipped adipose fins (Table 1). Of the snouts examined, 28 had readable CWTs (Table 1).

*Salmon excluder device testing (2015–2016)*

In 2016, electronic detection of CWTs in the BSAI salmon bycatch was conducted by the North Pacific Fisheries 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 437 Chinook salmon scanned with handheld CWT detection wands, 11 (2.5%) had a clipped adipose fin, and 5 (1.1%) had readable CWTs (Table 1). Of the 5 with readable CWTs, 3 (60%) had a clipped adipose fin and 2 were unclipped (Table 1).

## Coded-wire Tagged Chinook Salmon Releases from ESA-listed ESUs

The North Pacific Fishery Management Council contracted Cramer Fish Sciences to compile a database of coded-wire tagged release groups of West Coast salmon and steelhead listed under the Endangered Species Act (ESA); this database was last updated in June 2017 (Drenner, 2017). 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 coded-wire tagged 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, results are summarized for periods 2001–2011 and 2012–2016 because of the implementation of a revised genetic sampling protocol by the Observer Program in 2012.

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4Number of Chinook salmon sampled for length in the pollock and non-pollock fisheries (Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center).

5Number from the Fisheries Monitoring and Analysis Division of the Alaska Fisheries Science Center.

For the BSAI fisheries, results are summarized for periods 2001–2010 and 2011–2016 because a revised genetic sampling protocol was instituted in 2011.

## Origins of Coded-wire Tagged Chinook Salmon in the Gulf of Alaska

*Groundfish trawl fisheries*
Coded-wire tagged Chinook salmon recovered as bycatch in the GOA are comprised of stocks originating from Alaska, British Columbia, Washington, Idaho, and Oregon. Recoveries of coded-wire tagged Chinook salmon in the bycatch of the GOA groundfish fisheries are summarized by state or province of origin for 2001–2016 (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 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 2012–2016 have 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.

*Rockfish trawl fishery*
Recoveries of coded-wire tagged Chinook salmon in the bycatch of the GOA rockfish trawl fishery are summarized by state or province of origin for 2013–2016 (Table 7). In 2016, an additional Chinook was tagged with an agency-only wire. The agency-only wire identified the release agency and state: Colville Tribes and Washington.

*Salmon excluder device testing (2013–2014) and U.S. pollock acoustic trawl survey*
Recoveries of coded-wire tagged Chinook salmon caught in the salmon excluder device testing in the GOA (2013–2014) are summarized by state or province of origin (Table 8). The two recoveries from the NMFS pollock acoustic trawl survey in Shelikof Strait in the GOA originated from British Columbia and Washington (Table 9).

## Origins of Coded-wire Tagged Chinook Salmon in the Bering Sea-Aleutian Islands

*Groundfish trawl fisheries*
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. Recoveries of coded-wire tagged Chinook salmon in the bycatch of the BSAI groundfish fisheries are summarized by state or province of origin for 2001–2016 (Table 10). Starting in 2011, sampling expansion factors were calculated for coded-wire tagged recoveries in the bycatch of the BSAI groundfish fisheries. Total estimated numbers by state or province of origin are reported for 2011–2016 (Table 11). Tagged Alaska Chinook salmon harvested in the BSAI have historically originated from two regions, Cook Inlet and Southeast Alaska (Table 12). 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 2011–2016 have originated from Southeast Alaska (Table 12).

Most of the Chinook salmon represented by CWTs and harvested in the BSAI groundfish trawl fisheries originated from hatchery production (Table 13), 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 14) 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.

*Salmon excluder device testing (2015–2016)*
Recoveries of coded-wire tagged Chinook salmon caught in the salmon excluder device testing in the BSAI (2015–2016) are summarized by state or province of origin (Table 8).

## Occurrence of Chinook Salmon from ESA-listed ESUs in the Gulf of Alaska and Bering Sea-Aleutian Islands

*GOA and BSAI groundfish trawl fisheries*
Coded-wire tagged Chinook salmon from ESA-listed ESUs have been recovered in GOA and BSAI trawl fisheries (Tables 15–16). Since 1981, coded-wire tagged Chinook salmon have been recovered in the GOA groundfish trawl fisheries from the Lower Columbia River, Snake River fall run, Snake River spring/summer run, Upper Columbia River spring run, and the Upper Willamette River ESUs (Tables 15–16). ESA-listed coded-wire tagged Chinook salmon have been recovered in the BSAI groundfish trawl fisheries from the Lower Columbia River, Snake River spring/summer run, and the Upper Willamette River ESUs (Tables 15–16). A total mark expansion factor was applied to observed recoveries to account for the wild, untagged component of each ESU (Tables 15–20) (see Appendix 1).

*GOA rockfish trawl fishery*
Coded-wire tagged Chinook salmon have been recovered in the GOA rockfish trawl fishery from 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 (Table 17).

*Salmon excluder device testing in the GOA (2013–2014) and BSAI (2015–2016)*
Coded-wire tagged Chinook salmon from ESA-listed ESUs have been recovered in salmon excluder device testing in the GOA and BSAI trawl fisheries (Table 18): Upper Willamette River and Snake River fall run in the GOA and Lower Columbia River in the BSAI.

*U.S. trawl research (2015)*
U.S. trawl research directed at juvenile salmon has also documented the occurrence of Chinook salmon from ESA-listed ESUs in the GOA. Since 1996, trawl research in the GOA has recovered coded-wire tagged Chinook salmon from the Lower Columbia River, Puget Sound, Snake River fall run, Snake River spring/summer run, Upper Columbia River, and Upper Willamette River ESUs (Tables 19–20). No ESA-listed, coded-wire tagged Chinook salmon have been recovered in U.S. trawl research surveys in the BSAI.

### Ocean Distribution of Chinook Salmon from ESA-listed ESUs, 1981–2016

Maps of the ocean distribution of coded-wire tagged Chinook salmon from ESA-listed ESUs from the Pacific Northwest are shown (Figures 1–7). These maps were compiled from the historical database of CWT recoveries (1981–2016) from high seas commercial fisheries: GOA groundfish trawl fisheries, GOA rockfish trawl fisheries, BSAI groundfish trawl 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.

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Table 1. Number of Chinook salmon sampled, number with clipped adipose fins (ad-clipped), and number with readable coded-wire tags (CWTs) in the various sampling programs in the Gulf of Alaska (GOA) and Bering Sea-Aleutian Islands (BSAI) in 2015 and 2016. 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 | 2015 | Research trawl | National Marine Fisheries Service | Electronic and visual | 93 | 84 | 25 (19) |
| | | | | | | | |
| GOA | 2016 | Groundfish trawl | Observer Program | Visual | 5,542[1,2] | 932[2] | 234 (234) |
| | | Rockfish trawl | Alaska Groundfish Data Bank | Electronic | 496 | 86 | 23 (20) |
| | | Survey midwater trawl | National Marine Fisheries Service | Electronic | - | 1 | 2 (1) |
| | | | | | | | |
| BSAI | 2016 | Groundfish trawl | Observer Program | Visual | 2,408[2,3] | 69[2] | 28 (28) |
| | | Salmon excluder device trawl | North Pacific Fisheries Research Foundation | Electronic | 437 | 11 | 5 (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.

Table 2. Observed and CWT 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, 2013–2016, and salmon excluder device testing, 2013–2014), by run year and state or province of origin: A) 2001–2011 and B) 2012–2016. 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) 2012–2016

| | 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 | 5 | 25.9 | 9 | 38.1 | 0 | 0.4 | 7 | 69.4 | 5 | 7.4 | **27** | **140.7** |
| 2014 | 5 | 54.9 | 10 | 48.8 | 1 | 1.0 | 13 | 77.9 | 5 | 6.7 | **34** | **189.4** |
| 2015 | 27 | 305.8 | 30 | 176.2 | 0 | 0 | 15 | 15.9 | 30 | 48.7 | **102** | **546.6** |
| 2016 | 55 | 356.6 | 64 | 261.4 | 0 | 0 | 48 | 234.8 | 67 | 95.3 | **234** | **948.1** |
| **Mean** | **20.6** | **164.2** | **25.2** | **111.8** | **0.4** | **1.5** | **21.6** | **106.6** | **27.6** | **43.5** | **95.4** | **426.8** |
| **% of total averaged over years** | **19%** | **33%** | **27%** | **25%** | **1%** | **0%** | **26%** | **32%** | **26%** | **9%** | | |

Table 3. Observed and CWT 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, 2013–2016, and salmon excluder device testing, 2013–2014) by run year and release region: A) 2001–2011 and B) 2012–2016. 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) 2012–2016

| | 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 | 11 | 78.0 | **11** | **78.0** |
| 2013 | 0 | 0 | 5 | 25.9 | **5** | **25.9** |
| 2014 | 0 | 0 | 5 | 73.2 | **5** | **73.2** |
| 2015 | 0 | 0 | 27 | 305.8 | **27** | **305.8** |
| 2016 | 0 | 0 | 42 | 356.6 | **42** | **356.6** |
| **Mean** | **0** | **0** | **18.0** | **167.9** | **18.0** | **167.9** |

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, 2013–2016, and salmon excluder device testing, 2013–2014) by rearing type and state or province of origin: A) 2001–2011 and B) 2012–2016. 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) 2012–2016

| | Rearing type | | |
|---|---|---|---|
| **Origin** | **Hatchery** | **Mixed** | **Wild** |
| Alaska | 93 | 0 | 5 |
| British Columbia | 113 | 0 | 0 |
| Idaho | 1 | 0 | 0 |
| Oregon | 83 | 0 | 1 |
| Washington | 109 | 0 | 1 |
| **% of total** | **98%** | **0%** | **2%** |

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, 2013–2016, and salmon excluder device testing, 2013–2014) by run type and state or province of origin: A) 2001–2011 and B) 2012–2016. 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) 2012–2016

| | Run type | | | |
|---|---|---|---|---|
| **Origin** | **Spring** | **Summer** | **Fall** | **Late fall upriver bright** |
| Alaska | 95 | 3 | 0 | 0 |
| British Columbia | 8 | 81 | 24 | 0 |
| Idaho | 0 | 0 | 0 | 1 |
| Oregon | 52 | 0 | 30 | 2 |
| Washington | 11 | 49 | 42 | 8 |
| **% of total** | **41%** | **33%** | **24%** | **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, 2013–2016, 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%) |
| | 2012–2016 | 83 (20%) | 208 (51%) | 94 (23%) | 19 (5%) | 1 (0%) |
| BSAI | 2001–2010 | 34 (12%) | 141 (49%) | 92 (32%) | 20 (7%) | 2 (1%) |
| | 2011–2016 | 1 (2%) | 23 (43%) | 22 (42%) | 7 (13%) | 1 (2%) |

Table 7. Observed and CWT mark-expanded numbers of coded-wire tagged Chinook salmon captured in the bycatch of the Gulf of Alaska rockfish trawl fishery, 2013–2016, by run year and state or province of origin. Average numbers and percentages of the total averaged over years are reported.

| | 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 |
| 2013 | 4 | 26.8 | 9 | 61.7 | 5 | 7.3 | 28 | 136.4 | 67 | 110.8 | **113** | **343.1** |
| 2014 | 3 | 34.7 | 1 | 4.4 | 0 | 0.0 | 10 | 38.0 | 3 | 4.6 | **17** | **81.8** |
| 2015 | 3 | 75.3 | 2 | 17.0 | 1 | 2.0 | 13 | 39.8 | 8 | 9.9 | **27** | **144.0** |
| 2016 | 1 | 1.0 | 4 | 20.6 | 0 | 0.0 | 7 | 12.5 | 11 | 14.0 | **23** | **48.1** |
| **Mean** | **2.8** | **34.5** | **4.0** | **25.9** | **1.5** | **2.3** | **14.5** | **56.7** | **22.3** | **34.8** | **45.0** | **154.2** |
| **% of total averaged over years** | **9%** | **26%** | **10%** | **19%** | **2%** | **1%** | **41%** | **35%** | **39%** | **19%** | | |

Table 8. Observed and CWT mark-expanded numbers of coded-wire tagged Chinook salmon captured in the bycatch of salmon excluder device testing in the Gulf of Alaska, 2013–2014, and in the Bering Sea-Aleutian Islands, 2015–2016, by run year and state or province of origin.

| | | Alaska | | British Columbia | | Idaho | | Oregon | | Washington | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Run year | Fishery | 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 |
| 2013 | GOA | 3 | 15.5 | 6 | 36.2 | 1 | 2.1 | 6 | 10.5 | 24 | 47.2 | **40** | **111.5** |
| 2014 | GOA | 2 | 15.3 | 1 | 1.0 | 0 | 0.0 | 1 | 2.0 | 2 | 2.0 | **6** | **20.3** |
| | | | | | | | | | | | | | |
| 2015 | BSAI | 0 | 0.0 | 1 | 16.0 | 0 | 0.0 | 1 | 9.0 | 1 | 1.0 | **3** | **26.0** |
| 2016 | BSAI | 0 | 0.0 | 1 | 15.1 | 0 | 0.0 | 1 | 3.5 | 3 | 4.4 | **5** | **23.0** |

Table 9. Observed and CWT mark-expanded numbers of coded-wire tagged Chinook salmon captured opportunistically during a U.S. pollock acoustic trawl survey conducted in Shelikof Strait in the Gulf of Alaska by the NOAA Fisheries Midwater Assessment and Conservation Engineering Program in 2016 by state or province of origin.

| | 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 |
| 2016 | 0 | 0.0 | 1 | 5.0 | 0 | 0.0 | 0 | 0.0 | 1 | 1.0 | **2** | **6.0** |

Table 10. Observed and CWT 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) 2011–2016. 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 10. Continued.

B) 2011–2016

| | 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 | 2 | 6.2 | 2 | 2.1 | **10** | **39.8** |
| 2016 | 4 | 15.3 | 14 | 79.2 | 5 | 9.6 | 4 | 4.3 | 1 | 1.0 | **28** | **109.5** |
| **Mean** | **1.0** | **5.6** | **3.3** | **16.9** | **2.0** | **3.9** | **2.2** | **3.2** | **0.5** | **0.5** | **9.03** | **30.0** |
| **% of total averaged over years** | **6%** | **11%** | **19%** | **32%** | **25%** | **18%** | **46%** | **38%** | **4%** | **1%** | | |

Table 11. 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: 2011–2016. 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) | 79.6 (2) | 26.6 (2) |
| 2016 | 206.9 (4) | 1,071.1 (14) | 130.1 (5) | 58.7 (4) | 13.7 (1) |

Table 12. Observed and CWT 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) 2011–2016. 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) 2011–2016

| | 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 | 1.04 | 3 | 14.3 | **4** | **15.3** |
| **Mean** | **0.2** | **0.2** | **0.8** | **5.4** | **1.0** | **5.6** |

Table 13. 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) 2011–2016. 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) 2011–2016

| | Rearing type | | |
|---|---|---|---|
| **Origin** | **Hatchery** | **Mixed** | **Wild** |
| Alaska | 62 | 0 | 0 |
| British Columbia | 22 | 0 | 0 |
| California | 0 | 0 | 0 |
| Oregon | 14 | 0 | 0 |
| Washington | 16 | 1 | 0 |
| Yukon Territory | 3 | 0 | 0 |
| **% of total** | **98.4%** | **0%** | **1.6%** |

Table 14. 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) 2011–2016. 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) 2011–2016

| | Run type | | | |
|---|---|---|---|---|
| **Origin** | **Spring** | **Summer** | **Fall** | **Late fall upriver bright** |
| Alaska | 6 | 0 | 0 | 0 |
| British Columbia | 0 | 15 | 5 | 0 |
| Oregon | 5 | 0 | 6 | 1 |
| Washington | 1 | 3 | 8 | 1 |
| Yukon Territory | 3 | 0 | 0 | 0 |
| **% total** | **28%** | **33%** | **35%** | **4%** |

Table 15. 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, 2013–2016, 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 1981–2016. The calculation of total mark-expanded numbers is an attempt to account for the untagged, wild component of each ESU that is not represented by coded-wire tags (see Appendix 2 for a description of the method). The total mark-expansion factors used for Chinook salmon ESUs are listed in Appendix 1, Table 1.

| | GOA | | | BSAI | | |
|---|---|---|---|---|---|---|
| Chinook salmon ESU | Observed number | CWT Mark Expanded Number | Total mark expanded number | Observed number | CWT mark expanded number | Total mark expanded number |
| Lower Columbia River | 29 | 123.6 | 138.4 | 10 | 10.1 | 11.3 |
| Snake River fall run | 3 | 4.0 | 5.4 | 0 | 0.0 | 0.0 |
| Snake River spring/summer run | 1 | 1.9 | 2.6 | 1 | 1.9 | 2.6 |
| Upper Columbia River spring run | 1 | 1.0 | 1.1 | 0 | 0.0 | 0.0 |
| Upper Willamette River | 120 | 367.9 | 448.7 | 13 | 62.9 | 76.8 |

Table 16. 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, 2013–2016, 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, 1981–2016. The calculation of total mark-expanded numbers is an attempt to account for the untagged, wild component of each ESU that is not represented by coded-wire tags (see Appendix 2 for a description of the method). The total mark-expansion factors used for Chinook salmon ESUs are listed in Appendix 1, Table 1.

A. Lower Columbia River Chinook salmon ESU

| | GOA | | | BSAI | | |
|---|---|---|---|---|---|---|
| Run year | Observed number | CWT mark expanded number | Total mark expanded number | Observed number | CWT mark expanded number | Total mark expanded number |
| 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 |
| 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 |

Table 16. Continued.

A. Lower Columbia River Chinook salmon ESU

| | GOA | | | BSAI | | |
|---|---|---|---|---|---|---|
| Run year | Observed number | CWT mark expanded number | Total mark expanded number | Observed number | CWT mark expanded number | Total mark expanded number |
| 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 |
| 2015 | 4 | 5.0 | 5.6 | 0 | 0.0 | 0.0 |
| 2016 | 6 | 6.0 | 6.7 | 0 | 0.0 | 0.0 |

Table 16. Continued.

B. Snake River fall-run Chinook salmon ESU

| | GOA | | | BSAI | | |
|---|---|---|---|---|---|---|
| Run year | Observed number | CWT mark expanded number | Total mark expanded number | Observed number | CWT mark expanded number | Total mark expanded number |
| 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 |
| 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 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2014 | 1 | 1.0 | 1.4 | 0 | 0.0 | 0.0 |
| 2015 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2016 | 1 | 2.1 | 2.8 | 0 | 0.0 | 0.0 |

Table 16. Continued.

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

| | GOA | | | BSAI | | |
|---|---|---|---|---|---|---|
| Run year | Observed number | CWT mark expanded number | Total mark expanded number | Observed number | CWT mark expanded number | Total mark expanded number |
| 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 |
| 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 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2014 | 0 | 0.0 | 0.0 | 1 | 1.9 | 2.6 |
| 2015 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2016 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |

Table 16. Continued.

D. Upper Columbia River spring-run Chinook salmon ESU

| | GOA | | | BSAI | | |
|---|---|---|---|---|---|---|
| Run year | Observed number | CWT mark expanded number | Total mark expanded number | Observed number | CWT mark expanded number | Total mark expanded number |
| 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 |
| 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 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2014 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2015 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2016 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |

Table 16. Continued.

E. Upper Willamette River Chinook salmon ESU

| | GOA | | | BSAI | | |
|---|---|---|---|---|---|---|
| Run year | Observed number | CWT mark expanded number | Total mark expanded number | Observed number | CWT mark expanded number | Total mark expanded number |
| 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 |
| 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 | 2 | 2.0 | 2.5 | 0 | 0.0 | 0.0 |
| 2014 | 5 | 18.8 | 23.0 | 1 | 1.0 | 1.2 |
| 2015 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2016 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |

Table 17. 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 rockfish trawl fishery by evolutionarily significant unit (ESU) and year, 2013–2016. The calculation of total mark-expanded numbers is an attempt to account for the untagged, wild component of each ESU that is not represented by coded-wire tags (see Appendix 2 for a description of the method). The total mark-expansion factors used for Chinook salmon ESUs are listed in Appendix 1, Table 1.

| | Lower Columbia River | | | Puget Sound | | | Snake River fall run | | |
|---|---|---|---|---|---|---|---|---|---|
| Run year | Observed Number | CWT Mark Expansion | Total Mark Expansion | Observed Number | CWT Mark Expansion | Total Mark Expansion | Observed Number | CWT Mark Expansion | Total Mark Expansion |
| 2013 | 0 | 0.0 | 0.0 | 1 | 1.0 | 1.1 | 4 | 6.3 | 8.3 |
| 2014 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2015 | 1 | 1.0 | 1.1 | 0 | 0.0 | 0.0 | 1 | 2.0 | 2.6 |
| 2016 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 1 | 1.0 | 1.3 |

| | Snake River spring/summer run | | | Upper Columbia River spring run | | | Upper Willamette River | | |
|---|---|---|---|---|---|---|---|---|---|
| Run year | Observed Number | CWT Mark Expansion | Total Mark Expansion | Observed Number | CWT Mark Expansion | Total Mark Expansion | Observed Number | CWT Mark Expansion | Total Mark Expansion |
| 2013 | 1 | 1.0 | 1.4 | 1 | 1.0 | 1.1 | 5 | 7.6 | 9.3 |
| 2014 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 2 | 13.4 | 16.4 |
| 2015 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2016 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |

Table 18. Observed and mark-expanded numbers of coded-wire tagged Chinook salmon listed under the Endangered Species Act and captured in bycatch of the salmon excluder device testing in the Gulf of Alaska (2013–2014) and Bering Sea-Aleutian Islands (2015–2016) by evolutionarily significant unit (ESU) and year. The calculation of total mark-expanded numbers is an attempt to account for the untagged, wild component of each ESU that is not represented by coded-wire tags (see Appendix 2 for a description of the method). The total mark-expansion factors used for Chinook salmon ESUs are listed in Appendix 1, Table 1.

| | | Lower Columbia River | | | Upper Willamette River | | | Snake River fall run | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Run year | Fishery | Observed Number | CWT Mark Expansion | Total Mark Expansion | Observed Number | CWT Mark Expansion | Total Mark Expansion | Observed Number | CWT Mark Expansion | Total Mark Expansion |
| 2013 | GOA | 0 | 0.0 | 0.0 | 2 | 6.3 | 7.7 | 2 | 3.1 | 4.1 |
| 2014 | GOA | 0 | 0.0 | 0.0 | 1 | 2.0 | 2.4 | 0 | 0.0 | 0.0 |
| | | | | | | | | | | |
| 2015 | BSAI | 1 | 1.0 | 1.1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2016 | BSAI | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |

Table 19. 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, 1996–2015. 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. The calculation of total mark-expanded numbers is an attempt to account for the untagged, wild component of each ESU that is not represented by coded-wire tags (see Appendix 2 for a description of the method). The total mark-expansion factors used for Chinook salmon ESUs are listed in Appendix 1, Table 1.

| | GOA | | |
|---|---|---|---|
| ESU | Observed number | CWT mark expanded number | Total mark expanded number |
| Lower Columbia River | 8 | 18.3 | 20.5 |
| Puget Sound | 1 | 1.0 | 1.1 |
| Snake River fall run | 5 | 6.1 | 8.1 |
| Snake River spring/summer run | 36 | 123.4 | 169.0 |
| Upper Columbia River spring run | 21 | 38.4 | 43.0 |
| Upper Willamette River | 23 | 70.9 | 86.5 |

Table 20. 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, 1996–2015. No coded-wire tagged Chinook salmon from ESA-listed ESUs were recovered in GOA research surveys before 1996, and no coded-wire tagged, ESA-listed Chinook salmon have been recovered in Bering Sea-Aleutian Islands research surveys. The calculation of total mark-expanded numbers is an attempt to account for the untagged, wild component of each ESU that is not represented by coded-wire tags (see Appendix 2 for a description of the method). The total mark-expansion factors used for Chinook salmon ESUs are listed in Appendix 1, Table 1.

| | Lower Columbia River | | | Puget Sound | | | Snake River fall run | | |
|---|---|---|---|---|---|---|---|---|---|
| Run year | Observed Number | CWT Mark Expansion | Total Mark Expansion | Observed Number | CWT Mark Expansion | Total Mark Expansion | Observed Number | CWT Mark Expansion | Total Mark Expansion |
| 1996 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 1997 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 1998 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 1999 | 1 | 1.0 | 1.1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2000 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2001 | 1 | 1.0 | 1.1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2002 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2003 | 0 | 0.0 | 0.0 | 1 | 1.0 | 1.1 | 0 | 0.0 | 0.0 |
| 2004 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2005 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2006 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2007 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2008 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2009 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2010 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2011 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2012 | 1 | 5.7 | 6.4 | 0 | 0.0 | 0.0 | 2 | 3.1 | 4.1 |
| 2013 | 4 | 9.6 | 10.8 | 0 | 0.0 | 0.0 | 2 | 2.0 | 2.7 |
| 2014 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 1 | 1.0 | 1.3 |
| 2015 | 1 | 1.0 | 1.1 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |

Table 20. Continued.

| | Snake River spring/summer run | | | Upper Columbia River spring run | | | Upper Willamette River | | |
|---|---|---|---|---|---|---|---|---|---|
| Run year | Observed Number | CWT Mark Expansion | Total Mark Expansion | Observed Number | CWT Mark Expansion | Total Mark Expansion | Observed Number | CWT Mark Expansion | Total Mark Expansion |
| 1996 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 1997 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 1998 | 2 | 5.8 | 7.9 | 0 | 0.0 | 0.0 | 2 | 2.3 | 2.8 |
| 1999 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2000 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2001 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 3 | 11.1 | 13.5 |
| 2002 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 3 | 26.6 | 32.5 |
| 2003 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2004 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2005 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2006 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2007 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2008 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2009 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2010 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |
| 2011 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 | 1 | 1.0 | 1.2 |
| 2012 | 12 | 27.0 | 37.0 | 13 | 26.4 | 29.6 | 9 | 14.0 | 17.1 |
| 2013 | 13 | 52.0 | 71.2 | 6 | 10.0 | 11.2 | 5 | 15.9 | 19.4 |
| 2014 | 5 | 25.5 | 35.0 | 2 | 2.0 | 2.3 | 0 | 0.0 | 0.0 |
| 2015 | 4 | 13.0 | 17.8 | 0 | 0.0 | 0.0 | 0 | 0.0 | 0.0 |

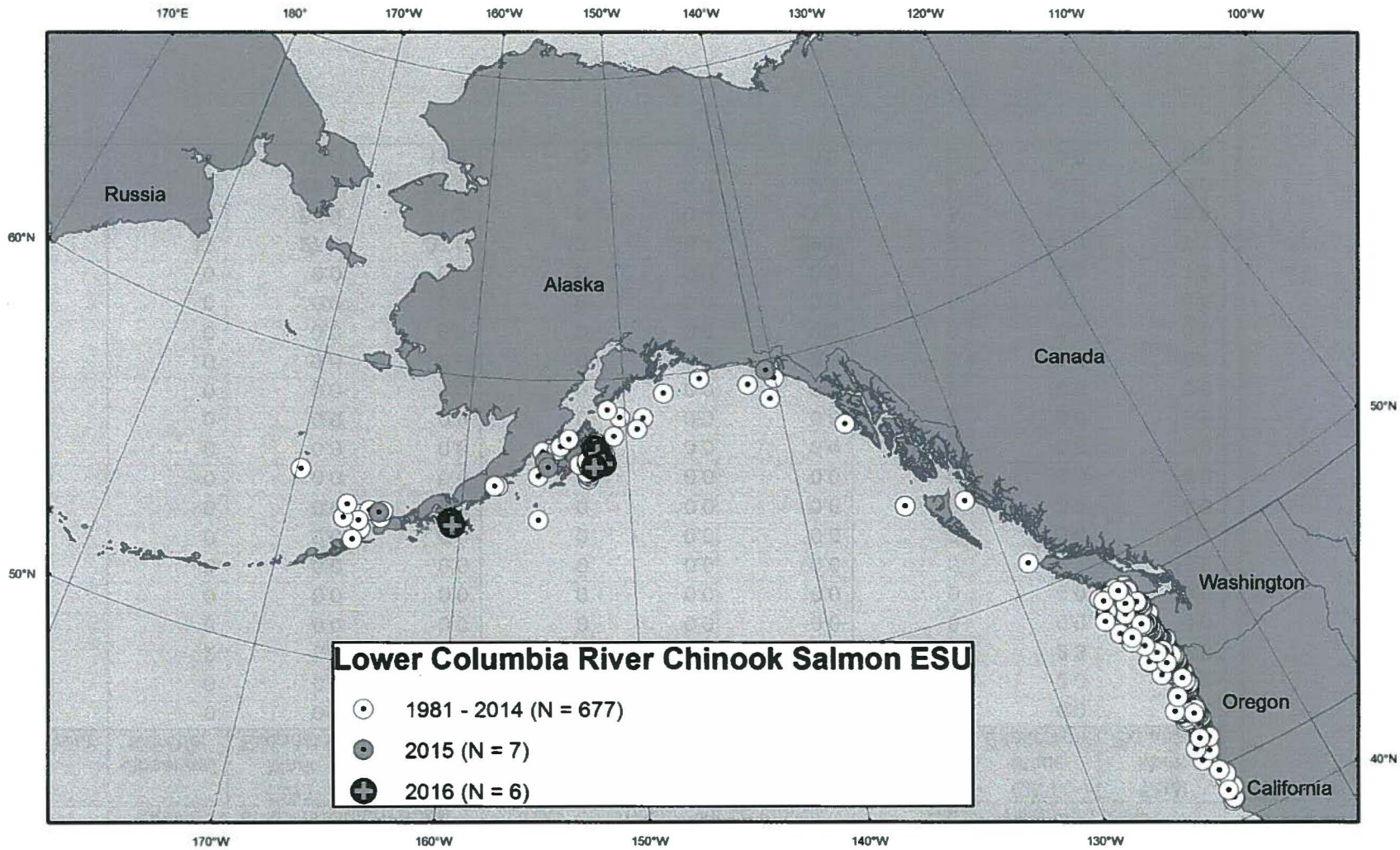


Figure 1. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Lower Columbia River ESU, 1981–2016. Coded-wire tags were recovered in fisheries and research surveys.

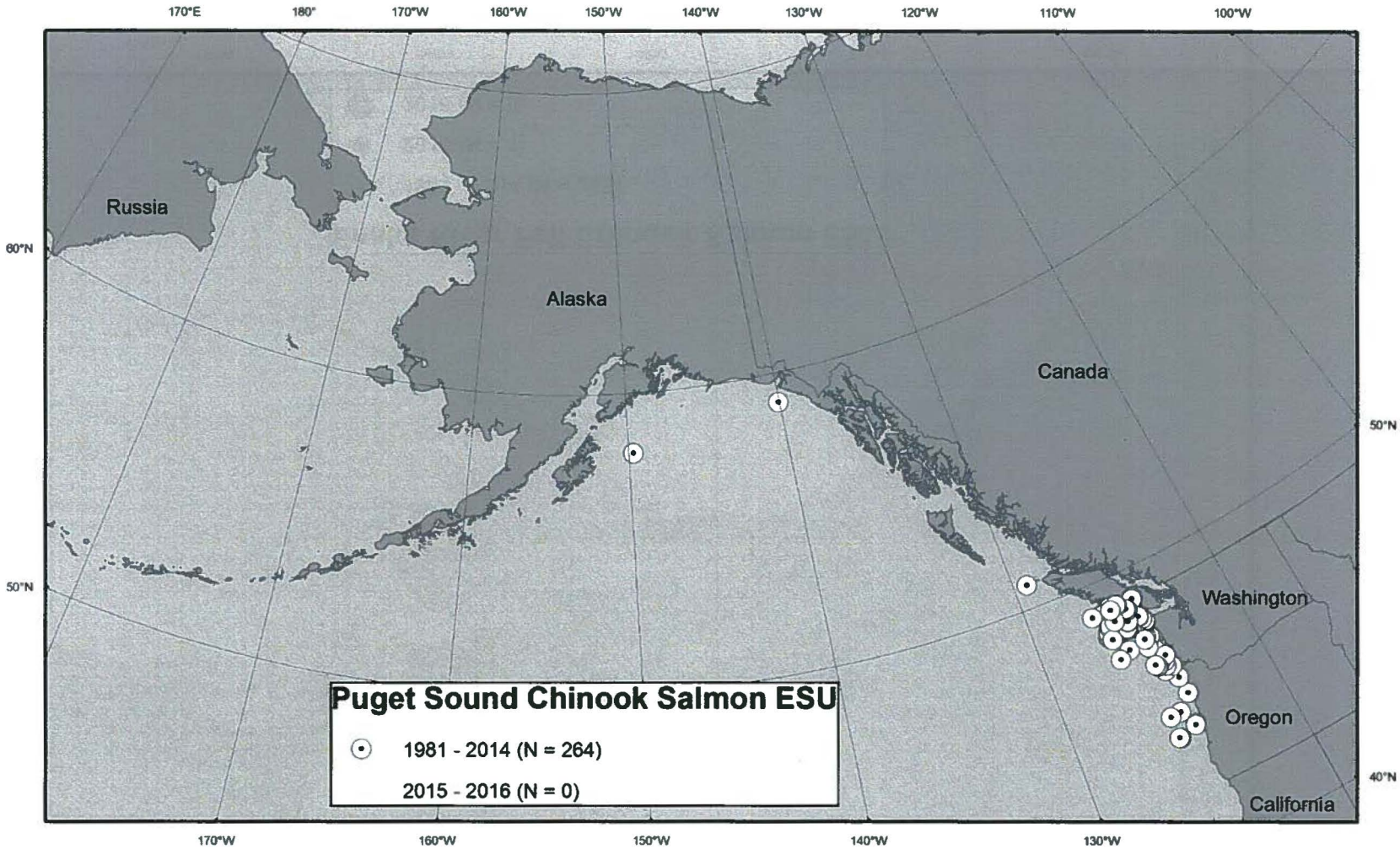


Figure 2. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Puget Sound ESU, 1981–2016. Coded-wire tags were recovered in fisheries and research surveys.

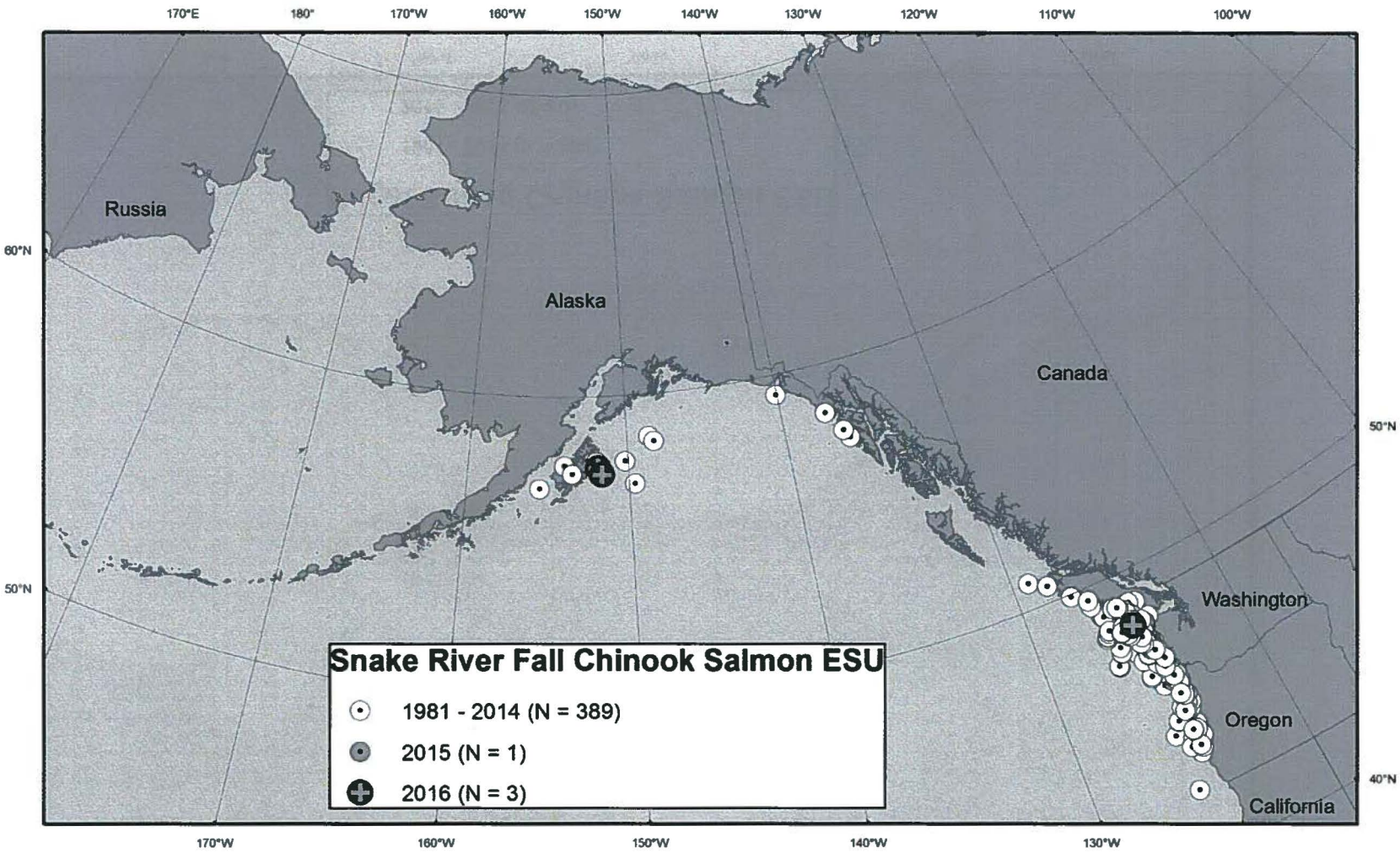


Figure 3. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Snake River fall-run ESU, 1981–2016. Coded-wire tags were recovered in fisheries and research surveys.

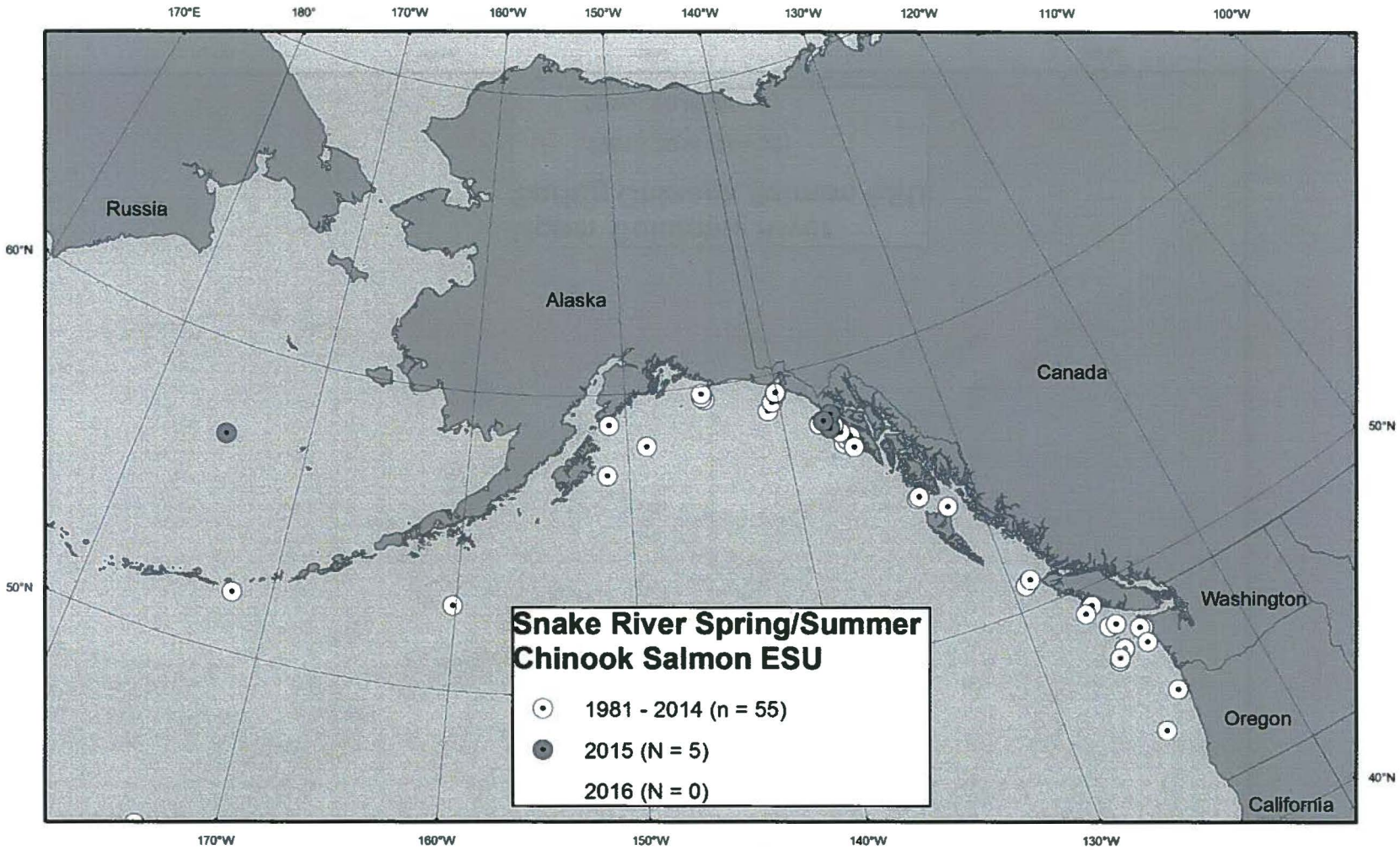


Figure 4. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Snake River spring/summer-run ESU, 1981–2016. Coded-wire tags were recovered in fisheries and research surveys.

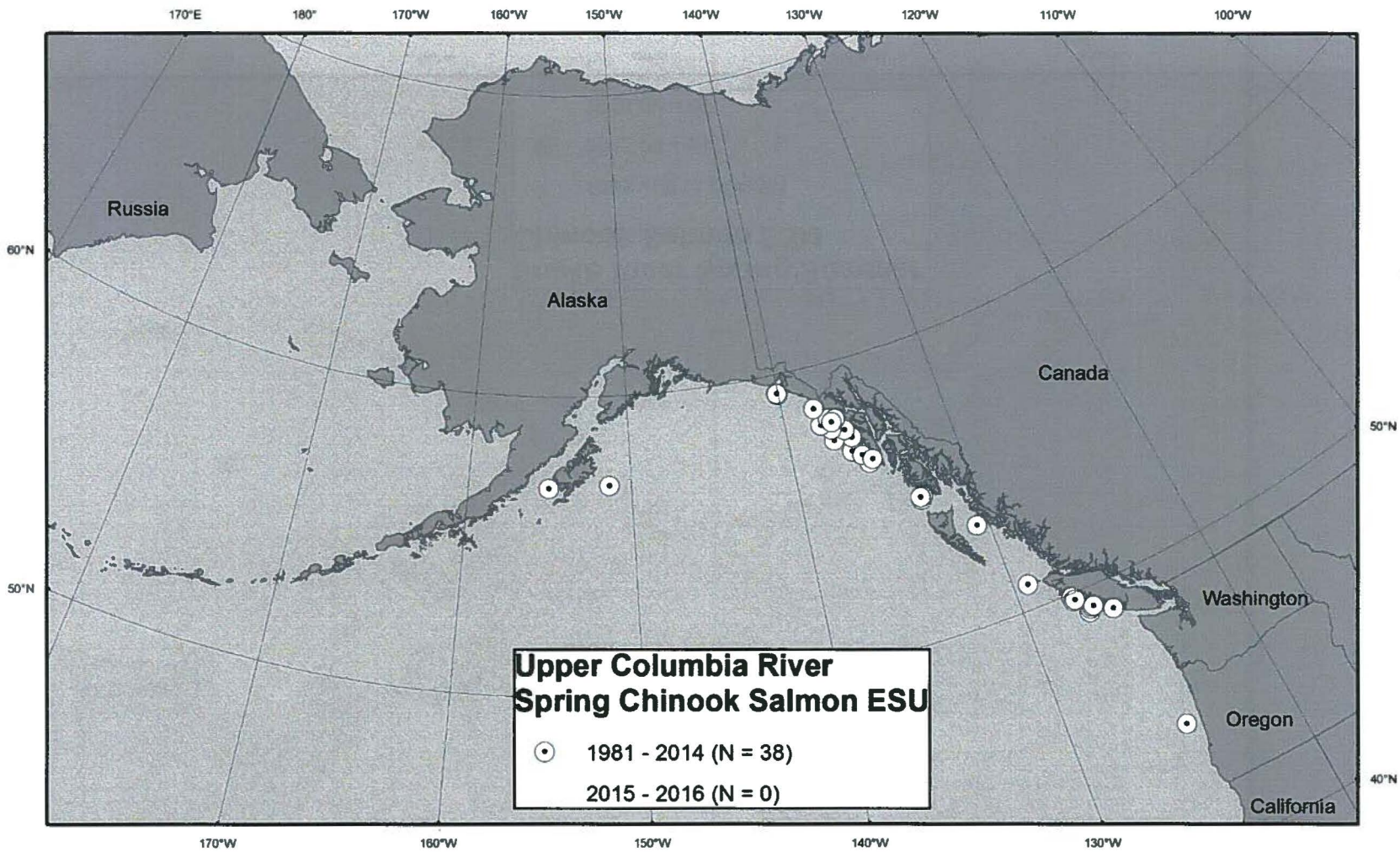


Figure 5. Ocean distribution of code-wire tagged Chinook salmon recoveries from the Upper Columbia spring-run ESU, 1981–2016. Coded-wire tags were recovered in fisheries and research surveys.

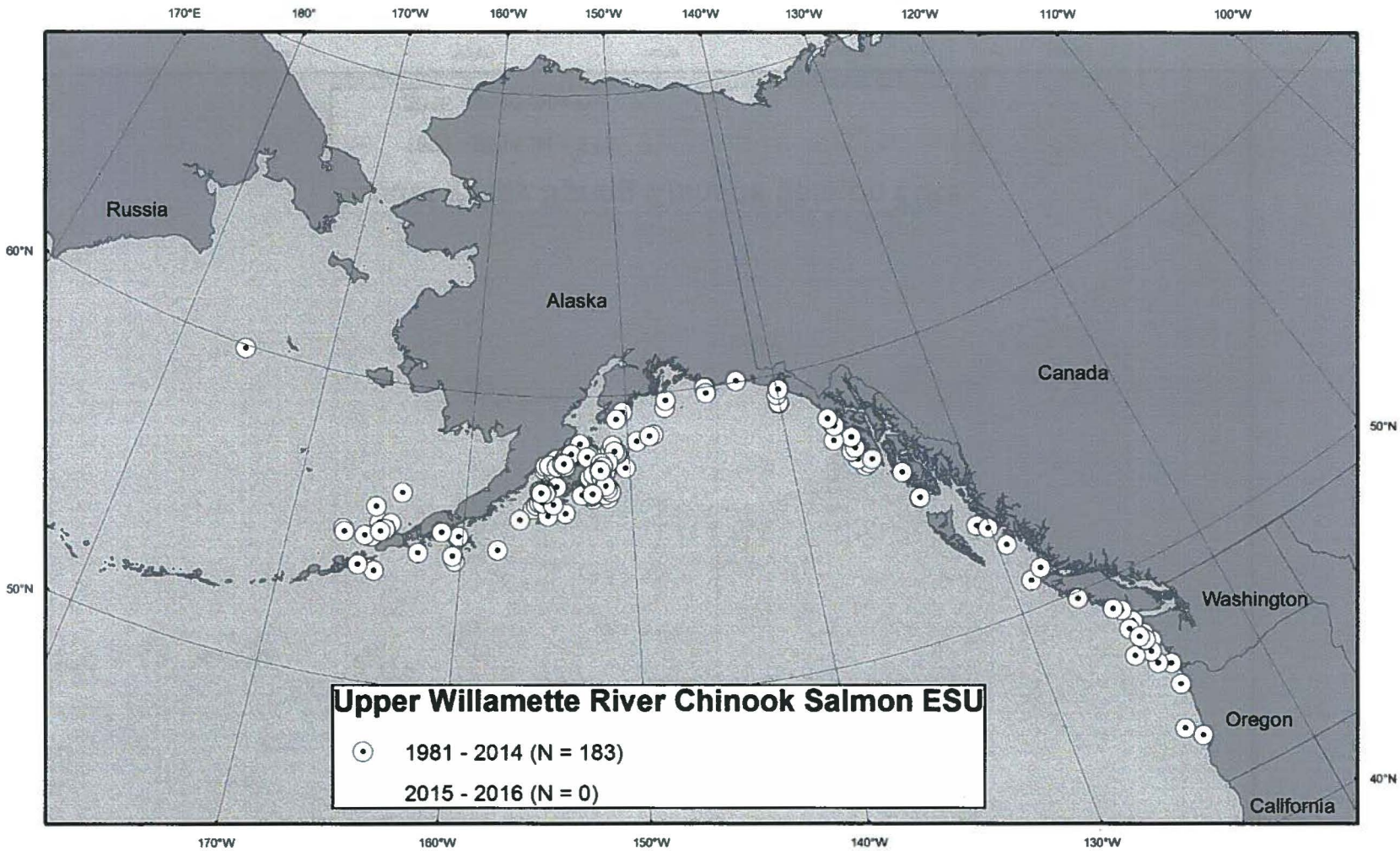


Figure 6. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Upper Willamette River ESU, 1981–2016. Coded-wire tags were recovered in fisheries and research surveys.

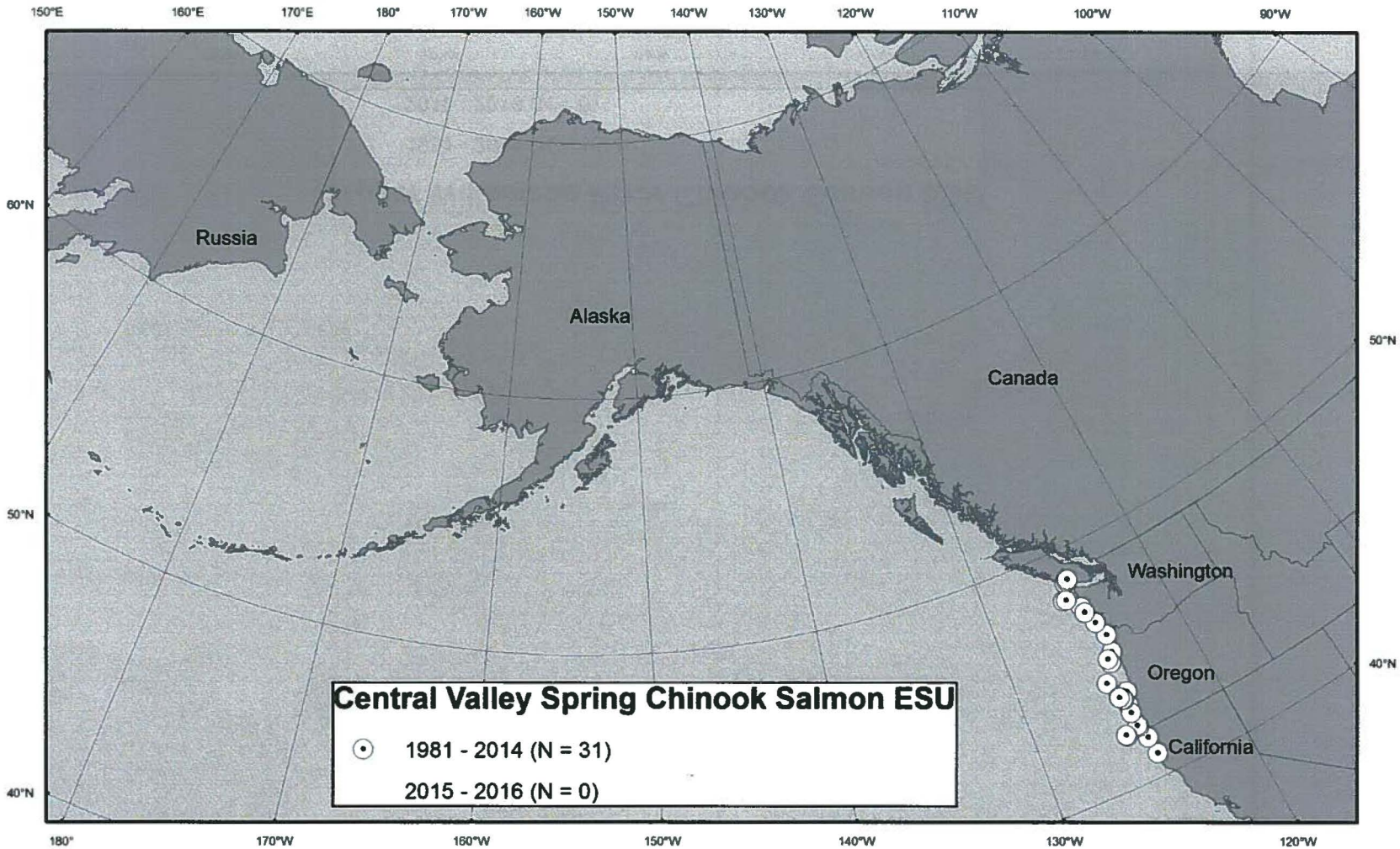


Figure 7. Ocean distribution of coded-wire tagged Chinook salmon recoveries from the Central Valley spring-run ESU, 1981–2016. Coded-wire tags were recovered in fisheries and research surveys.

## 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.