Oregon Department of Fish and Wildlife

SCIENCE BULLETIN

Number 2020-07

Chum Salmon Reintroduction Project

Monitoring of juvenile Chum Salmon and other fishes in Oregon tributaries to the Lower Columbia River

Comprehensive Report for 2012−2019

This report should be cited as:

Wiley, D., K. Homel. 2020. Monitoring of juvenile Chum Salmon and other fishes in Oregon tributaries to the Lower Columbia River, Comprehensive Report for 2012-2019. Science Bulletin 2020-07. Oregon Department of Fish and Wildlife, Salem.

Monitoring of juvenile Chum Salmon and other fishes in Oregon tributaries to the Lower Columbia River

Comprehensive Report for 2012–2019

Oregon Department of Fish and Wildlife

Prepared By

Derek Wiley[1]

and

Kristen Homel[2], Ph.D.

[1]Oregon Department of Fish and Wildlife
Chum Salmon Reintroduction Project
Assistant Project Leader
93000 Ritter Road
Astoria, OR 97103
Current email: derek.j.wiley@odfw.oregon.gov

[2]Report completed while employed by Oregon Department of Fish and Wildlife
Chum Salmon Reintroduction Project
Coordinator (Jan 2012-Nov 2020)
17330 SE Evelyn Street
Clackamas, OR 97015
Current email: khomel@nwcouncil.org

December 2020

TABLE OF CONTENTS

Page

Page

Page

LIST OF FIGURES

Page

Page

Page

LIST OF APPENDICES

Page

Page

Page

Page

Page

INTRODUCTION

Beginning in the 1930's and extending into the 1940's, Chum Salmon *Oncorhynchus keta* experienced precipitous declines in abundance and distribution in the lower Columbia River (LCR). Causes for decline included loss of spawning habitat, loss of access to spawning habitat, altered hydrology in tributaries and the LCR from diking, channelization, and construction and operation of large dams, changes to estuarine ecology, predation, and over harvest. From historical returns of over a million adults (estimated in 1928; McElhany et al. 2004), currently, only hundreds to thousands of Chum Salmon return to the LCR each year, representing a loss of 90% of historical populations (Myers et al. 2006). Remaining populations primarily occur on the Washington side of the LCR, with Oregon returns so low that they are considered functionally extirpated (ODFW 2006; McElhany et al. 2007). Moreover, the historical distribution up to Celilo Falls has been reduced to isolated populations below Bonneville Dam. In response to these declines, Chum Salmon were listed as threatened under the Endangered Species Act in 1999 (NMFS 1999).

The loss of Chum Salmon has had important ecological consequences in the LCR. Chum Salmon typically spawn in the lowest reaches of tributaries to the LCR or in the mainstem LCR in shallow water, and their spawning activity can assist in important stream functions such as gravel cleaning and fine sediment transport. Additionally, Chum Salmon carcasses provide a substantial and important marine-derived nutrient addition to streams and riparian areas where healthy Chum Salmon populations occur. These nutrient additions primarily benefit other salmonid species, as Chum Salmon fry outmigrate rapidly from their natal stream and do not rely heavily on the nutrient inputs provided by adults.

Given the importance of Chum Salmon, it is a major priority of Oregon Department of Fish and Wildlife (ODFW) to rebuild historic populations on the Oregon side of the LCR. To this end, ODFW developed a Chum Salmon recovery strategy (ODFW 2010) with the objectives of (1) identifying and addressing limiting factors, (2) re-establishing self-sustaining, naturally reproducing Chum Salmon populations, and (3) monitoring the effectiveness of our strategy. Since 2012, one aspect of this effort has been to collect baseline data on juvenile Chum Salmon production in Oregon tributaries to the LCR to evaluate effectiveness efforts to reestablish populations.

Initial monitoring and recovery efforts were focused in the Scappoose Creek and Clatskanie River populations, as it was thought these watersheds had the greatest chance of successful reintroduction due to the absence of hatchery salmonid releases. The Clatskanie River population contains a significant amount of high quality spawning habitat and some Chum Salmon fry production has been observed in recent years. However, habitat in the Scappoose Creek population is highly degraded in the portions of the watershed where Chum Salmon could spawn and is not currently the target of monitoring efforts. Instead, those efforts have shifted towards quantifying current spawning and juvenile production that occurs in discrete locations within the Big Creek and Youngs Bay populations. This report covers all juvenile salmonid monitoring in the

four coastal stratum populations from 2012–2019.

GENERAL METHODOLOGY

To monitor the distribution and abundance of Chum Salmon fry production, rotary screw or fence panel traps were installed in tributary streams to the LCR in the Youngs Bay, Big Creek, Clatskanie River, and Scappoose Creek populations from 2012–2019 (Figure 1 and Table A.1). Specific monitoring sites from west to east included: Lewis and Clark River (Youngs Bay population), Bear and Big Creeks (Big Creek population), Graham Creek, Conyers Creek, Clatskanie River, Beaver Creek, and Stewart Creek (Clatskanie River population), and Milton and Scappoose Creeks (Scappoose Creek population).

Rotary screw or fence panel traps were used to capture outmigrating juvenile Chum Salmon fry and other fish species. Traps generally began fishing from mid to late February and fished continuously (24 hours/day and 7 days/week) through early to mid-June except during conditions associated with heavy rains, rising river levels, and high debris loads where operation of the trap could endanger personnel or result in fish losses. Traps were typically checked and cleared of fish and debris once a day, with visits more frequent during storm events and high debris loads. Odometers, rain gauges, temperature loggers, and staff gauges were installed at each trap site so that trap rotations (i.e., the actual amount of sampling in a 24 hour period by a screw trap) and environmental conditions could be correlated to daily abundance in future analyses.

During each trap check, all fish were transferred from the trap live box and placed into 5-gallon holding buckets. Thermometers were placed into each bucket of fish and the water was changed frequently to minimize physiological stress. Fish were held in buckets of stream water until they were anesthetized with MS-222 (tricaine methanesulfonate, concentration = 60 mg/l) buffered with baking soda (sodium bicarbonate, concentration = 125 mg/l). Once anesthetized, fish were enumerated by species and age or size group, all salmonids were examined for fin marks, and fork length (FL) and weight (g) were recorded for a trap-specific number of salmonids per day. Genetic samples were also collected from Chum Salmon fry, with selected results discussed in Small et al. (2014) and Homel et al. (2019).

Each species was categorized by size class and stage, depending on the life history of the species. All Chum Salmon and un-clipped Chinook Salmon *Oncorhynchus tshawytscha* were fry (age 0). Coho Salmon *Oncorhynchus kisutch* were identified as fry (age 0) or smolts (age 1+). Trout species were identified by size classes that roughly approximate age classes, with fry (< 60 mm) not differentiated by species. The largest size class of Steelhead *Oncorhynchus mykiss* (≥ 120 mm) was considered smolts as the majority of fish in this size class showed signs of smoltification. Steelhead were also identified into two smaller size classes (90−119 mm and 60−89 mm) and considered pre-smolts, although a small percentage of fish in the 90−119 mm size class may have

been in the early stages of smoltification. Coastal Cutthroat Trout *Oncorhynchus clarkii clarkii* were identified into five size classes (≥ 250 mm, 160−249 mm, 120−159 mm, 90−119 mm, and 60−89 mm), with a portion of the largest size class including adults and kelts that had recently spawned. Although not considered to be juveniles, this portion of the catch is shown in this report for inclusiveness. The other four juvenile Cutthroat Trout size classes are considered to be migrants, recognizing the complex life history diversity of the species.

Trap efficiency was evaluated for each species and size class by marking up to 100 individuals of each species and size class per day, depending on the characteristics of the trap site and vulnerability of a species size class to recapture. Marks were produced using a razor blade by removing a diagonal slice of the upper or lower caudal fin. Marked fish were then released in a location at least 100 m upstream from the trap site where fish could acclimate sufficiently before migrating downstream in a natural manner. Prior to 2015, marked fish were placed in time-release boxes that were set to release fish at twilight. In all other years, fish were manually released within 2 hours of marking to minimize overcrowding stress that sometimes occurred in the release boxes. All other fish not needed to evaluate trap efficiency were released safely downstream. Marking and recapture methods were adjusted iteratively throughout the year to maximize recapture rates without exceeding numbers allowed in our sampling take permit.

Hatchery salmonids were enumerated in the trap catch, but in most years estimates of total migrants were not made. Hatchery salmonids were measured and weighed, and in most cases interrogated for a coded-wire tag (CWT) with a metallic wand. Fish positively detected for a CWT were euthanized and later sent in to the Oregon Department of Fish and Wildlife (ODFW) CWT laboratory in Clackamas, OR. Hatchery Coho Salmon smolts were marked at the Bear Creek screw trap site in 2019 (except fish detected positive for a CWT), as sufficient hatchery strays were captured in that year for population estimation.

Non-salmonids were also enumerated in the trap catch, but no population estimates were made of total migrants. We used the Lamprey terminology described in Clemens (2019) to distinguish larva (non-eyed, immature, filter-feeding) from juveniles (eyed, transformed, ready to feed). However, we did not distinguish larva to species in areas where both Pacific Lamprey *Entosphenus tridentatus* and Western Brook Lamprey *Lampetra richardsoni* occur. Most non-salmonids were released downstream after processing, except for some non-native species (e.g., Common Goldfish *Carassius auratus*, Yellow Perch *Perca flavescens*, Oriental Weatherfish *Misgumus anguillicaudatus*, Golden Shiner *Notemigonus crysoleucas*, Goby spp. *Gobiidae* etc….) that were euthanized as voucher specimens or for positive identification.

A weekly stratified (Stratified) and non-stratified (Pooled) Petersen population estimate was made (Package BTSPAS version 2012.0219 in program R; Bonner and Schwarz 2012) for each species and size class when at least 10 recaptures were obtained for the trapping season. The Stratified Petersen estimator produced weekly population estimates using weekly catch, marks,

and subsequent recaptures. The weekly estimates were then summed to produce a total season estimate with standard error. The Pooled Petersen estimator produced a total season estimate with standard error using catch, marks, and recaptures for the entire season with no weekly stratification. We then divided the standard error by the population estimate (CV) for each estimator and calculated a 95% confidence interval (Standard Error * 1.96). In this report we show either the Stratified or Pooled Petersen estimate using the following criteria:

Estimator Selection

1. If Stratified CV = 0−20% , always use Stratified Estimator
2. If Stratified CV is > 20% and < 30% and Pooled CV is < 5% lower than Stratified CV, use Stratified Estimator
    a. If Stratified CV is > 20% and < 30% and Pooled CV is > 5% lower than Stratified CV, use Pooled Estimator
3. If Stratified CV ≥ 30% and Pooled CV is > Stratified CV, use Stratified Estimator
    a. If Stratified CV ≥ 30% and Pooled CV is < Stratified CV, use Pooled Estimator

RESULTS

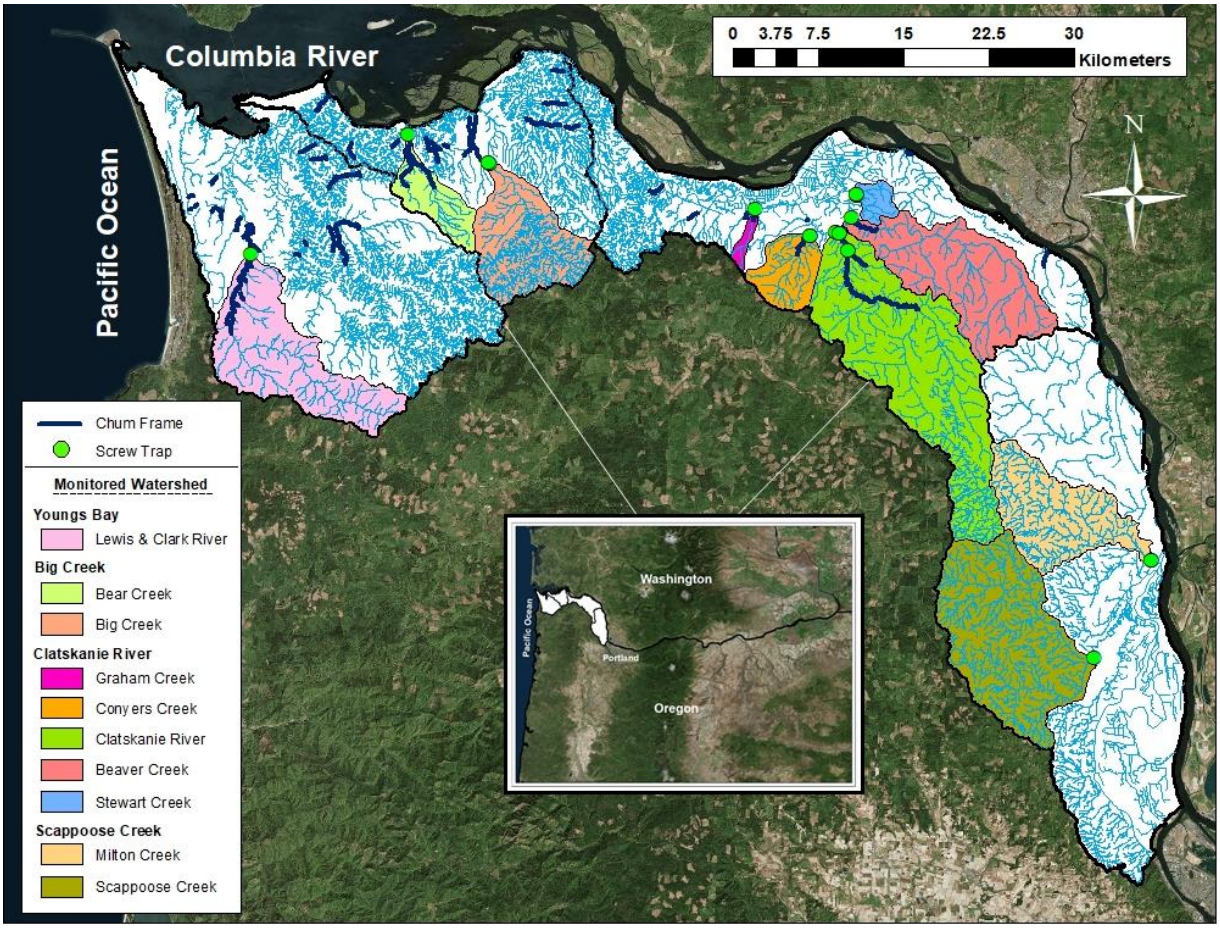

Figure 1. Watersheds monitored for juvenile salmonids *Oncorhynchus* spp. in the Lower Columbia River Basin from 2012−2019.

Lewis and Clark River (Youngs Bay Basin)

Description

The Lewis and Clark River is a tributary of Youngs Bay, entering the southern portion of the bay near Astoria Regional Airport and southwest of Youngs River (Figures 1 and 2). No hatchery releases occur in Lewis and Clark River, but spawning of wild and hatchery Chinook Salmon, Coho Salmon, and Steelhead are known to occur in the basin. Historically, the Lewis and Clark River may have supported up to 4,000 adult Chum Salmon spawners (based on habitat area-spawner density expansions from data in Fulton 1970 and ODFW spawn surveys). However, few chum have been observed on spawning surveys in recent years. The Lewis and Clark River contains 78 km of low gradient habitat in mainstem and tributary reaches (Bischoff et al. 2000a), with significant restoration potential that could provide high quality spawning habitat for Chum Salmon (Alfonse et al. 2017b).

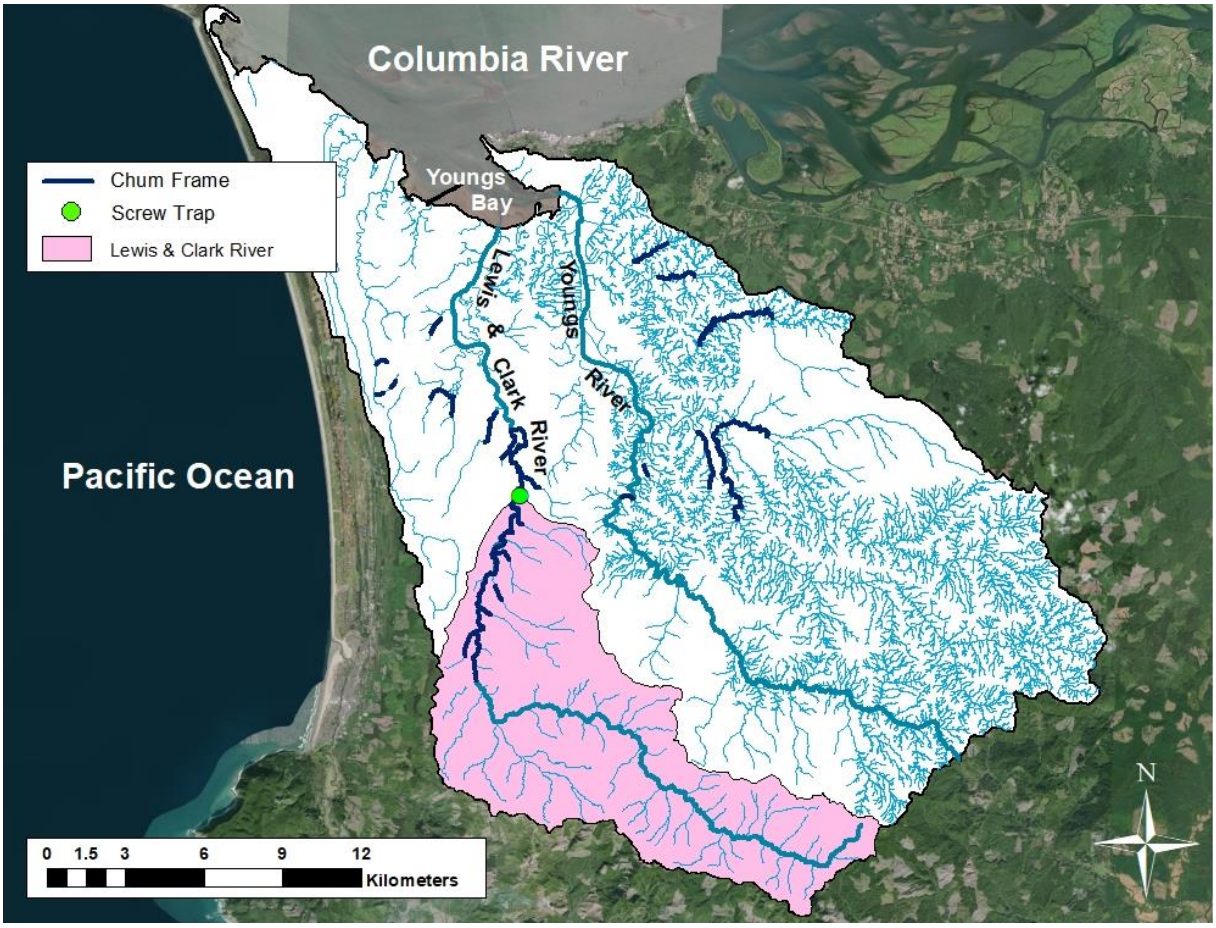

Figure 2. Watersheds monitored for juvenile salmonids *Oncorhynchus* spp. in the Youngs Bay Basin using rotary screw traps from 2012−2019.

Monitoring

Chum Salmon

The Lewis and Clark River was the only watershed monitored for juvenile Chum Salmon in the Youngs Bay River Basin from 2012 through 2019 (Figure 2). In 2017, a rotary screw trap was installed on the Lewis and Clark River between Stavebolt and Hortill Creeks, approximately 13.5 Rkm upstream of the confluence with Youngs Bay and 1 km downstream of Melville (Figure 3, Table A.1). The trap was operated between March 2nd and June 14th (Table A.1), with a significant gap in trap operation occurring in March and early April due to flooding from unusually heavy spring rains. These high, early season flows in combination with the large size of the Lewis and Clark River made trapping conditions challenging in 2017; trap efficiencies were low for most species and precluded population estimation for all but Chinook fry. A total of 28 Chum fry were captured between April 6th and April 27th (Table A.2), with 26 of these fish marked to evaluate weekly trap efficiency. However, none of these fish were later recaptured for population estimation. The extrapolated Chum fry catch (i.e., estimated total catch after accounting for

incomplete or non-fishing days) for the entire screw trapping period was 41 fish (Table A.2). Chum fry mean length and weight for the season was 40.5 mm and 0.47 g, respectively (Table A.2, Figures A.14 and A.15; Range = 37−44 mm and 0.3−0.6 g, respectively).

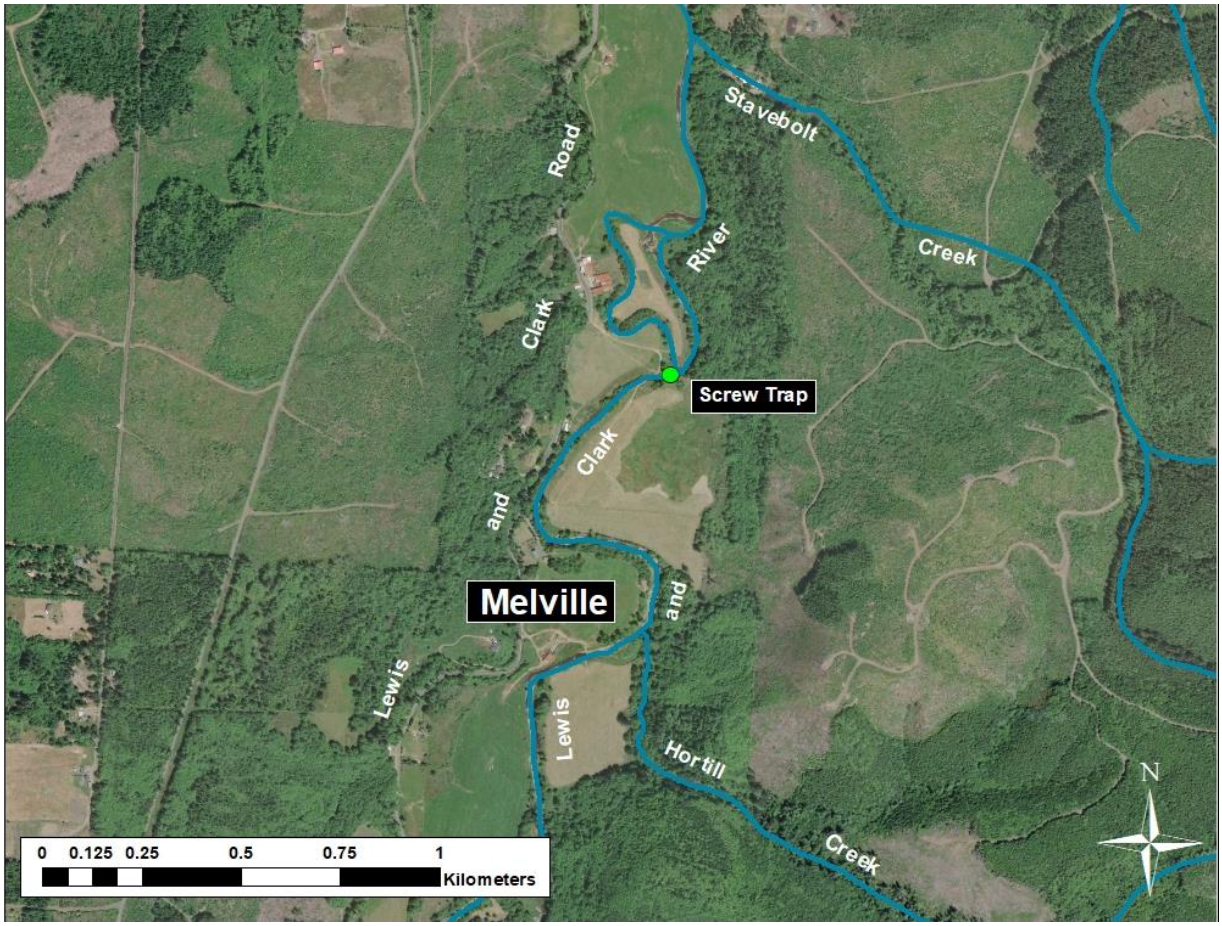

Figure 3. Location of the Lewis and Clark River screw trap operated in the Youngs Bay Basin in 2017.

Other Salmonids

Chinook Salmon, Coho Salmon, Steelhead, and Cutthroat Trout were all captured during trap operation in 2017. However, a population estimate could only be made for Chinook fry (6,530 ± 1,829 fry; Table A.3) due to insufficient recaptures of all other species. For species in which population estimation could not be made, extrapolated catch was highest for Coho fry (351 fry; Table A.4), Steelhead smolt (270 smolts; Table A.6), and Coho smolt (252 smolts; Table A.4), with modest catch of Cutthroat Trout in various size classes (Range 1−66 fish; Table A.8). No Steelhead or Cutthroat Trout were captured in the 60−89 mm size range.

Coho smolt were captured between April 6th and June 14th (Table A.5), with the highest catches occurring during the first week of May. Mean length and weight for the season was 121.9

mm and 18.81 g, respectively (Table A.5, Figures A.20 and A.21; Range = 61–155 mm and 2.7–37.6g, respectively). Steelhead smolt were captured between April 6th and June 6th (Table A.7), with the highest catches also occurring in early May. Mean length and weight for the season was 170.0 mm and 45.80 g, respectively (Table A.7, Figures A.22 and A.23; Range = 125–228 mm and 21.2–108.4 g, respectively). Catch, migration timing, and length and weight information for all other salmonids can be found in the Appendices.

Hatchery Salmonids

Although no hatchery releases occur in Lewis and Clark River, one hatchery Coho smolt was captured on April 6th. This smolt measured 142 mm and weighed 27.7 g (Table A.11), significantly larger than the majority of naturally produced Coho smolts captured at the site ($\bar{x}$ = 121.9 mm and 18.81 g, respectively, Table A.5, Figures A.20 and A.21). No juvenile hatchery Steelhead or Chinook were captured at the Lewis and Clark River screw trap site.

Non-Salmonids

Non-salmonid catch in decreasing abundance consisted of Three-Spined Stickleback *Gasterosteus aculeatus*, Northern Pikeminnow *Ptychocheilus oregonensis*, Peamouth *Mylocheilus caurinus*, Cottid *Cottus* spp., Largescale Sucker *Catostomus macrocheilus*, Lamprey Larva, Banded Killifish *Fundulus diaphanus*, Pacific Lamprey Adult, Western Brook Lamprey Adult, and Pumpkinseed *Lepomis gibbosus* (Table A.13). Catch of Three-Spined Stickleback, Northern Pikeminnow, Banded Killifish, and Pumpkinseed mostly occurred after mid-April, presumably as water temperature and fish activity increased. Peamouth were only trapped in the last several weeks of the season (May 27th–June 14th), as individuals were likely migrating into or out of mainstem and tributary spawning reaches in the watershed. Similarly, Largescale Sucker were also observed during their spawning run, with catches occurring between April 6th and May 24th.

Bear Creek (Big Creek Basin)

Description

Bear Creek is located 0.4 km west of the town of Svensen, OR and flows north into Svensen Slough and the Columbia River (Figures 1, 4, and 5). No hatchery releases occur in Bear Creek, but spawning of wild and hatchery Coho Salmon, Steelhead, and to a lesser extent Chinook Salmon are known to occur in the basin. Historically, Bear Creek may have supported up to 200 adult Chum Salmon spawners (based on habitat area-spawner density expansions from data in Parkhurst et al. 1950 and Fulton 1970). However, few Chum Salmon have been observed on spawning surveys in recent years other than during a large return to the Lower Columbia River in fall, 2016 and from outplanting efforts from Big Creek Hatchery in 2005 and 2006. The lower portion of Bear Creek is primarily rural residential and there is a water storage facility in the watershed that provides water

for the town of Astoria, OR. Water withdrawals during summer can result in significant temperature and dewatering issues (Bischoff et al. 2000b). Land use in the upper Bear Creek watershed is a mixture of industrial and non-industrial forest land. Bear Creek has approximately 3.2 km of low gradient habitat suitable for Chum Salmon (Bischoff et al. 2000b).

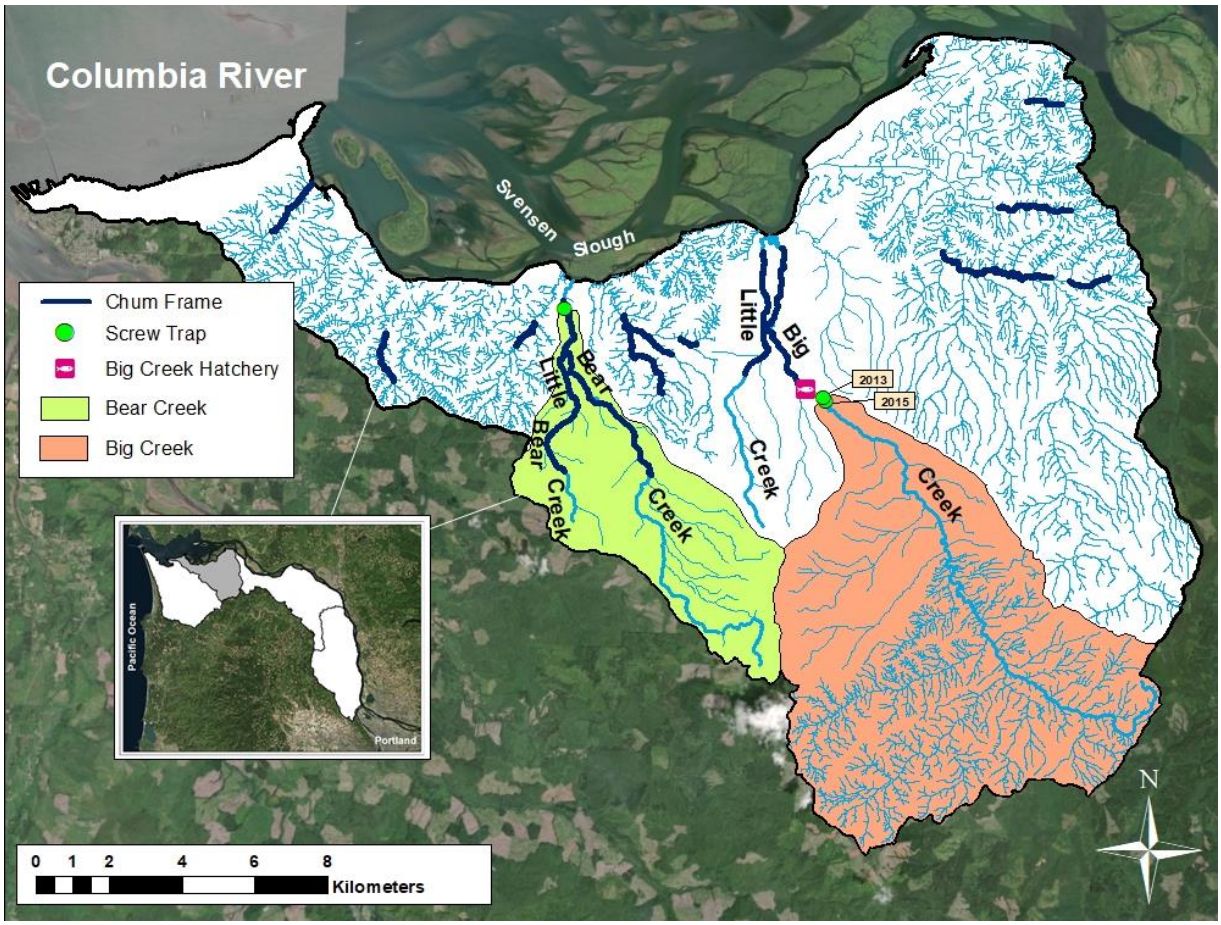

Figure 4. Watersheds monitored for juvenile salmonids *Oncorhynchus* spp. in the Big Creek Basin using rotary screw traps from 2012–2019.

Monitoring

Chum Salmon

The Bear Creek watershed was monitored for juvenile Chum Salmon from 2017 to 2019 and is one of two watersheds where juvenile fish monitoring occurred in the Big Creek River Basin after the project began in 2012 (Figure 4). A rotary screw trap was installed at the same location in all three years near head of tide, approximately 0.3 Rkm downstream of Old Highway 30 and 1.1 Rkm upstream of Svensen Slough (Figure 5, Table A.1). The trap was installed in late February and operated through the end of May or early June (Table A.1).

Chum fry were captured in all three years, however a population estimate could only be

made in 2017 following the large adult Chum Salmon return to the Lower Columbia River Basin in fall, 2016. Few adult Chum Salmon spawners returned to the Lower Columbia River Basin in fall, 2017 and 2018, and unsurprisingly very few Chum Salmon fry were captured in the spring following those two poor returns. In 2017, a total of 3,787 Chum fry were captured between February 27th and May 8th, with 2,233 of these fish marked to evaluate weekly trap efficiency. Sufficient recaptures were made (158 fry), yielding a weighted trap efficiency of 6.3% and population estimate of 61,802 ± 11,650 Chum fry (Table A.2, Figure 6). Peak catch of Chum fry occurred during the week of March 20th through March 26th and mean length and weight for the season was 39.8 mm and 0.46 g, respectively (Table A.2, Figures A.14 and A.15; Range = 32−44 mm and 0.2−0.6 g, respectively). Few Chum fry were observed in 2018 and 2019, with extrapolated catches of 17 and 25 fry, respectively (Table A.2, Figure 6). In 2018, most fry were captured between March 18th and March 31st (Range = February 25th–April 5th; Table A.2). However, most

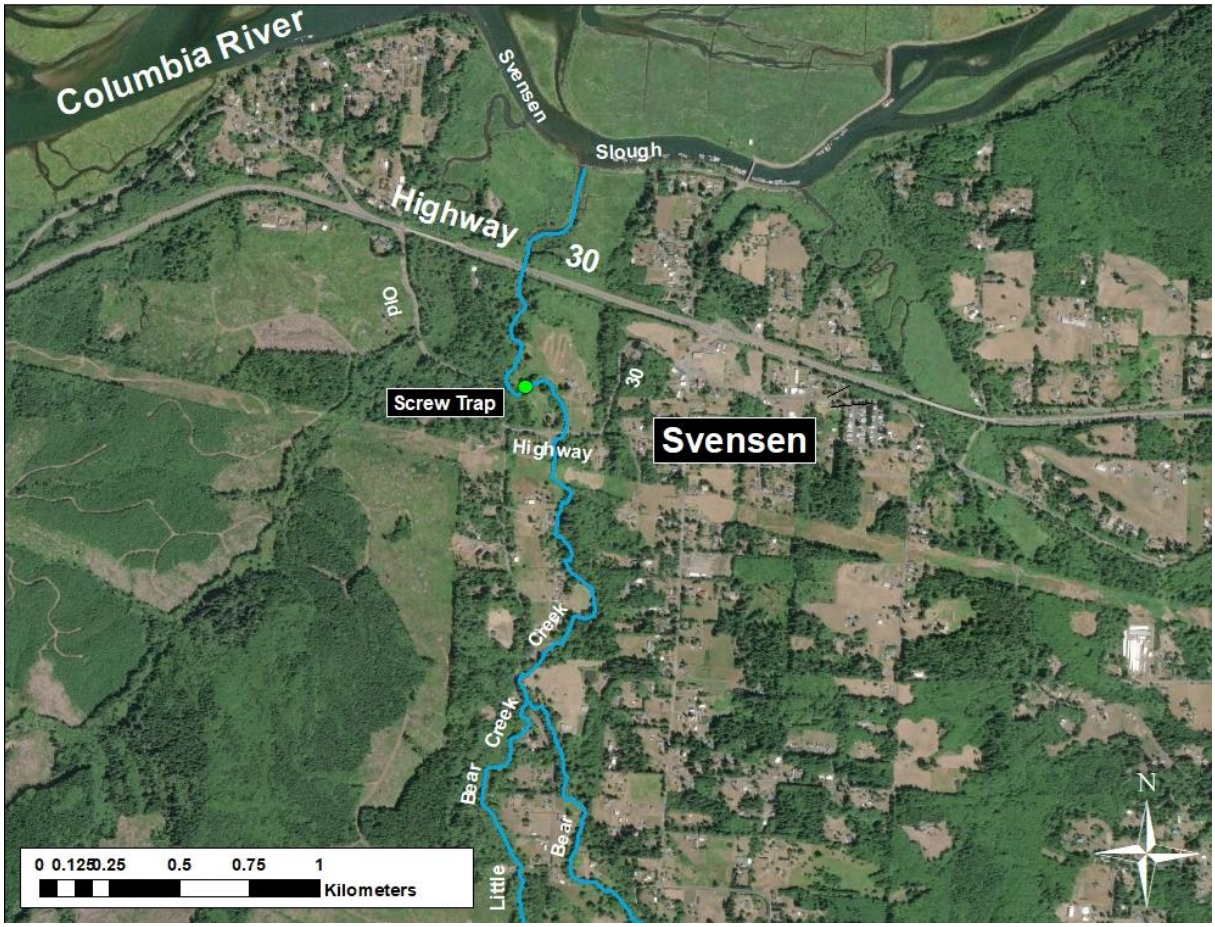

Figure 5. Location of the Bear Creek screw trap operated in the Big Creek Basin from 2017−2019.

fry were captured later in 2019 (April 1st–April 7th, Range = March 25th–April 22nd, Table A.2) likely due to abnormally cold temperatures in February through mid-March. Chum fry were smaller in 2019 (38.4 mm and 0.36 g) than in 2018 and 2017 (41.7 mm and 0.43 g and 39.8 mm and 0.46 g,

respectively), also likely due to colder spring temperatures (Table A.2, Figures A.14 and A.15).

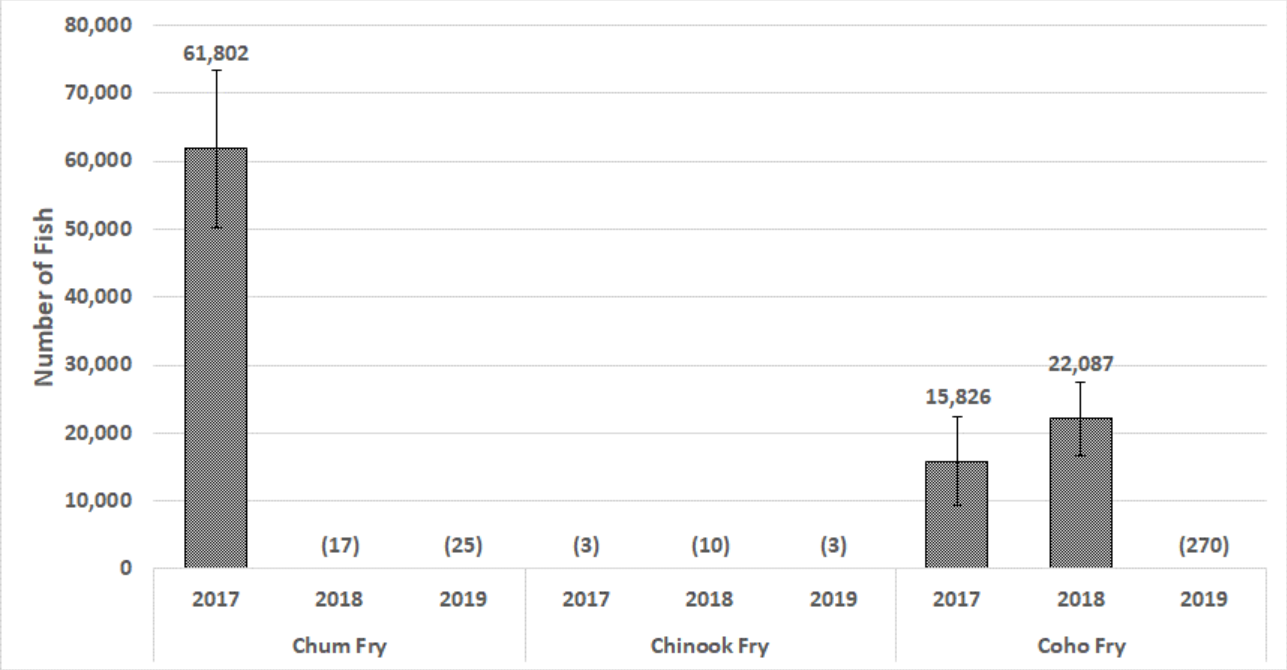

Figure 6. Population estimates of Chum *Oncorhynchus keta*, Chinook *O. tshawytscha*, and Coho *O. kisutch* fry outmigrants in Bear Creek from monitoring using a rotary screw trap, 2017–2019 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

Other Salmonids

Chinook Salmon, Coho Salmon, Steelhead, and Cutthroat Trout were captured in all years and population estimates could be made for most species and size classes after 2017. Exceptions were for Chinook fry (Table A.3, Figure 6), and the smaller size classes of Steelhead (Table A.6) and Cutthroat Trout (Table A.8) in which few individuals were captured in any year. In 2017, unusually heavy spring rains resulted in prolonged flooding and high water in March and early April. In addition, the screw trap was not paneled aggressively until late in the season, resulting in low trap efficiency for most species in that year. More favorable trapping conditions occurred in the following two years as generally lower flows persisted throughout the trapping season due to less spring rainstorms. In combination with significant efforts to install panels around the trap to increase trap efficiency, this resulted in higher catch and recaptures and allowed population estimates to be made for the majority of species. However, in these two years large numbers of Peamouth were captured at the trap in May (see Non-Salmonid section) in association with very low late season flows, resulting in several mortality events in the trap due to overcrowding. Consequently, in 2018 and 2019 the screw trap could only be operated through the third week in May. For these two years, we used capture data from our Clatskanie screw trap to complete our

Bear Creek population estimates. This was done by applying the same percentage of the total estimate observed for each species/size class at the Clatskanie screw trap from late May through mid-June (i.e., non-trapping period at Bear Creek) to our Bear Creek population estimates for each respective year.

In 2017, estimates could only be made for Coho fry (15,826 ± 6,515 fry; Table A.4), Steelhead smolts (1,153 ± 555 smolts; Table A.6), and 160−249 mm Cutthroat Trout (201 ± 108; Table A.8). However, confidence intervals for all three estimates were high due to either poor trap efficiency or minimal catch (Tables A.4, A.6, and A.8, Figures 6 and 7). An estimated 3,155 ± 431 and 2,908 ± 202 Coho smolts outmigrated from Bear Creek in 2018 and 2019, respectively (Table A.4, Figure 7) with peak catch occurring in early May in both years (Table A.5). Mean length and weight was largest in 2017 (120.2 mm and 19.88 g) and smallest in 2019 (114.7 mm and 15.73 g), with Coho smolts captured between 61 and 156 mm and 4.1 and 39.3 g over the three years (Table A.5, Figures A.20 and A.21). Mean length and weight of Coho smolts at Bear Creek for the three years combined (116.4 mm and 16.44 g; Figures A.20 and A.21) was slightly larger than the mean observed for all sites (114.2 mm and 15.78 g).

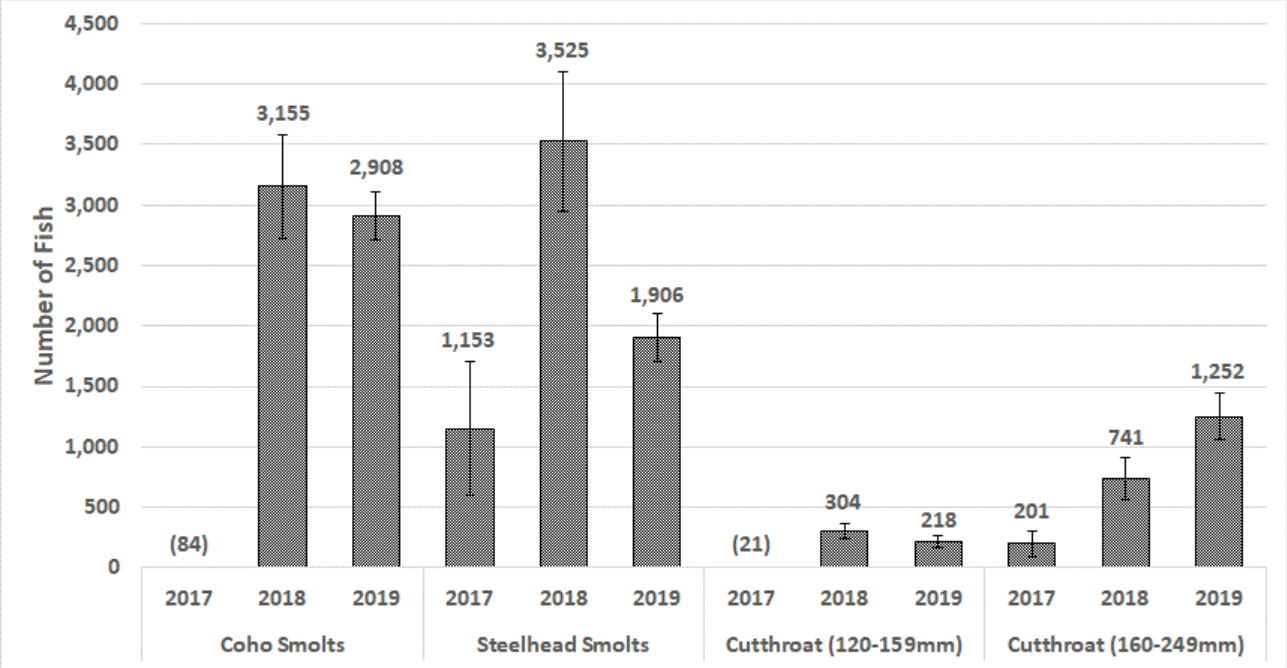

Figure 7. Population estimates of Coho *Oncorhynchus kisutch* smolt, Steelhead *O. mykiss* smolt, and Cutthroat Trout *O. clarkii clarkii* outmigrants in Bear Creek from monitoring using a rotary screw trap, 2017−2019 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

Steelhead smolt outmigrants were least abundant in 2017 (1,153 ± 555 smolts; Table A.6, Figure 7) and most abundant in 2018 (3,525 ± 582; Table A.6, Figure 7), with peak catches

occurring in early May (Table A.7). Mean length and weight was comparable in 2017 and 2019 (160.8 mm and 41.11 g and 159.5 mm and 40.35 g, respectively; Table A.7, Figures A.22 and A.23), but was significantly larger in 2018 (166.1 mm and 44.74 g; Table A.7, Figures A.22 and A.23). Mean length and weight of Steelhead smolts for the three years combined (162.1 mm and 42.05 g, Table A.7, Figures A.22 and A.23) was smaller than the mean observed for all sites (166.2 mm and 45.22 g).

Cutthroat Trout catch was dominated by the 160−249 mm size range, with estimates for the three years ranging from 201−1,252 fish (Table A.8, Figure 7). Significantly less fish were estimated as annual outmigrants in the 120−159 mm size range (< 350 fish annually; Table A.8, Figure 7). Additionally, a lesser number of ≥ 250 mm Cutthroat Trout were captured each year, with extrapolated catches of 2−45 fish observed annually (Table A.8). Catch of ≥ 250 mm Cutthroat Trout typically occurred throughout the season (Table A.9), whereas catch of 120−159 mm and 160−249 mm Cutthroat Trout generally peaked in late April to early May (Tables A.9 and A.10). Catch, migration timing, and length and weight information for all other salmonids including Cutthroat Trout can be found in the Appendices.

Hatchery Salmonids

Although no hatchery releases occur in Bear Creek, a significant number of hatchery salmonid juveniles were captured at the screw trap site (Table A.11). Hatchery fish were captured in all three years, but hatchery straying was more evident in 2018 and 2019 when trapping conditions were more favorable, trap efficiencies were higher, and greater attention was given to identifying hatchery fish in the catch. In 2017, only one hatchery Coho smolt was captured. However, catch in 2018 and 2019 was significantly higher at 49 and 221 fish, respectively (Table A.11). This included 15 hatchery Coho smolts recovered with coded wire tags (CWTs) of which 12 originated from net pen hatchery releases at Tongue Point and 3 were released from Big Creek Hatchery (Table A.12). The number of days from release to capture at the Bear Creek screw trap varied from 2 to 21 days (Days to Recap, Table A.12), although one fish apparently escaped the net pen at Tongue Point as it was captured 4 days prior to the documented release date. In 2019, a hatchery Coho smolt population estimate (524 ± 84 smolts) could be made due to sufficient catch and recaptures. Capture dates varied among years, with the only hatchery Coho smolt in 2017 caught in early March (Table A.11). However, catches occurred later in 2018 (April 24th–May 15th) and were consistent throughout the season in 2019 (February 25th–May 22nd). Mean size and weight of hatchery Coho smolts in each year (132−143 mm and 22.1−33.8 g; Table A.11) was always significantly larger than naturally-produced Coho smolts (115−120 mm and 15.7−19.9 g; Table A.5, Figures A.20 and A.21).

Hatchery Steelhead smolt catch occurred from mid-April through mid-May, with catches in 2018 and 2019 (6 and 38 smolts, respectively; Table A.11) more infrequent than for hatchery Coho

smolt. However, similar to hatchery Coho smolts, mean size and weight of hatchery Steelhead smolts in 2018 and 2019 (194 mm and 64.8 g and 196 mm and 66.9 g, respectively; Table A.11) was significantly larger than the annual mean size and weight of naturally-produced Steelhead smolts in the three trapping years (160−166 mm and 40.4−44.7 g; Table A.7, Figures A.22 and A.23). No hatchery Steelhead smolts were captured in 2017.

Hatchery Chinook were observed infrequently, with catches occurring early in the season in 2017 and 2019 (February 26th−March 22nd; Table A.11) and in early May in 2018 (May 6th; Table A.11). Mean size and weight of hatchery Chinook (132−157 mm and 23.8−40.2 g, respectively; Table A.11) was substantially larger than observed for naturally-produced Chinook captured in the three years (14 individuals, 40−77 mm and 0.6−4.9 g), with at least some of the hatchery Chinook catch consisting of precocial males that excreted milt during handling. No naturally produced Chinook were observed to be precocial. Interestingly, two hatchery spring Chinook with CWTs were captured in 2019 at the Bear Creek screw trap that originated from net pen releases in Youngs Bay (Table A.12).

Non-Salmonids

Non-salmonid catch (in decreasing abundance) consisted of Peamouth, Lamprey Larva, Cottid, Western Brook Lamprey Adult, and Largescale Sucker, and to a much lesser extent Pacific Lamprey Adult, Bluegill *Lepomis macrochirus*, Pacific Lamprey Juvenile, Banded Killifish, Three-Spined Stickleback, Speckled Dace *Rhinichthys osculus*, and Pumpkinseed (Table A.13). Significant catch of Lamprey Larva and Cottid were made in all years with catches occurring consistently throughout the season. Western Brook Lamprey Adult and Largescale Sucker were also frequently captured at the site, with Largescale Sucker catch occurring mostly between mid-April and mid-May. However, Peamouth were by far the most dominate non-salmonid catch despite a narrow capture period between early-May and the end of the trapping season (Table A.13).

A total of 1,197 Peamouth were captured in 2017, with a modest peak nightly catch of 255 fish. In 2018 and 2019, significantly more Peamouth were captured (3,686 and 24,792 Peamouth, respectively) as extremely low late spring flows occurred in both years and tight paneling was necessary to provide suitable water flows for trap operation, thereby increasing trap efficiency of all species. In 2018, nearly 2,500 Peamouth were captured in one night (May 16th) resulting in a significant mortality event due to overcrowding in the trap live box despite an early morning trap check. This required the trap be pulled for nearly one week as a precaution to avoid another overcrowding event. During re-deployment of the trap the following week, significant catch of Peamouth was made during daylight hours and observations upstream of the trap revealed approximately 5,000 Peamouth holding in the pool directly upstream of the trap. Walking surveys initiated between Highway 30 and Old Highway 30 to estimate Peamouth abundance revealed

large schools of Peamouth holding in various pools both upstream and downstream of the trap site and the trap was pulled for the season to avoid another significant mortality event. Consequently, our Peamouth count for 2018 only encompasses the first few days of the Peamouth migration.

In 2019, "overnight" checks with personnel stationed at the trap for the entirety of the night were initiated as the only way to avoid mortality events and to continue trapping during the significant Peamouth migration in Bear Creek. These overnight trap checks proved successful in eliminating mortality events and allowed for continued salmonid monitoring at the site when Peamouth abundance was moderately high or lower. During these times salmonids and Peamouth could be separated and removed from the trap safely before overcrowding could result in mortalities. Overnight trap checks will be a necessity for safe and effective juvenile monitoring in Bear Creek in future years, as these checks in 2019 revealed highly variable hourly and daily movement of Peamouth at the trap site.

Big Creek (Big Creek Basin)

Description

Big Creek is located near Knappa, OR and flows north into Knappa Slough and the Columbia River (Figures 1 and 4). It is the largest creek in the Big Creek population, with approximately 14.9 km of low gradient habitat (Bischoff et al. 2000b). Below Highway 30, Big Creek is tidal and flows through North Coast Land Conservancy owned land. Between Highway 30 and Big Creek Hatchery, Big Creek runs through rural residential and timber land. Upstream of Big Creek Hatchery, land use is primarily industrial forest. Historically, Big Creek may have supported significant Chum Salmon spawning; estimates exceed 5,000 adults based on collection of > 6.3 million eggs at the hatchery in 1942 (Wallis 1963), but returns are presently much lower and more variable. Gravel mining used to occur between Big Creek and Little Creek, and during a large storm event in the 1970s, Big Creek avulsed from the historical channel into the gravel quarry. Since that time, the creek has continued to migrate west toward Little Creek.

Big Creek Hatchery, located where Mill Creek enters Big Creek approximately 5 Rkm upstream of the confluence with Knappa Slough, currently releases hatchery Coho Salmon, Chinook Salmon, and Steelhead for commercial and recreational fisheries. The hatchery also produces Chum Salmon, as wild and hatchery Chum Salmon captured at the hatchery are currently euthanized and spawned for recovery efforts, with fry releases occurring directly into Big Creek downstream of the hatchery the following spring. Wild Coho Salmon, Steelhead, Coastal Cutthroat Trout, and, to a lesser extent, Chinook Salmon also occur in the basin and are passed upstream to spawn naturally when encountered in the hatchery trap.

Monitoring

Chum Salmon

The Big Creek watershed was monitored for juvenile Chum Salmon in 2013 and 2015 and is one of two watersheds where juvenile fish monitoring occurred in the Big Creek Basin after the project began in 2012 (Figures 4 and 8). In 2013, a rotary screw trap was installed approximately 50 meters downstream of the hatchery water intake (upstream of the hatchery) in a deep pool adjacent to a bedrock shelf (Figure 8). After operating the trap for one season it was apparent the pool depth and flow dynamics were not suitable for efficient trapping, and the trap was moved to a more suitable location (~50 meters upstream of the water intake) in 2015 (Figure 8). In both years, the trap was installed in mid to late February and fished through mid-June (Table A.1).

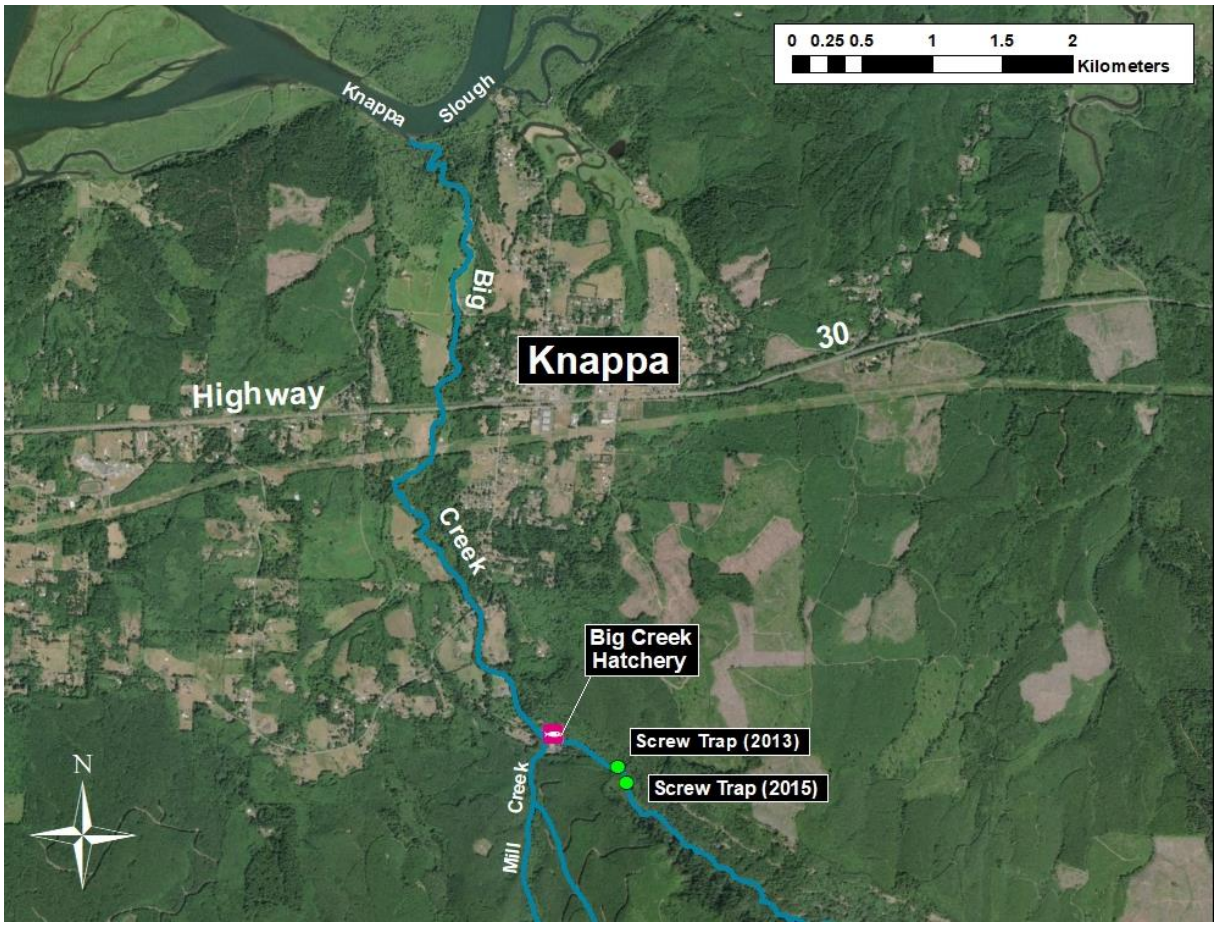

Figure 8. Location of the Big Creek screw traps operated in the Big Creek Basin in 2013 and 2015.

Chum fry were captured in both years, but a population estimate could only be made in 2015 after the trap was moved to a more productive trapping location (Table A.2, Figure 9). In 2013, Chum fry were only captured during a short window in April (April 4th–April 21st; Table A.2), with an extrapolated catch for the season of 45 fry. Catch occurred over a much broader time

frame in 2015 (February 26th–May 5th), with peak catch occurring during the week of April 6th–April 12th (Table A.2). In 2015, a total of 2,591 Chum fry were captured, with 1,671 of these fish marked to evaluate weekly trap efficiency. Sufficient recaptures were made (348 fry), yielding a weighted trap efficiency of 20.4% and population estimate of 12,649 ± 1,425 Chum fry (Table A.2, Figure 9). Mean length and weight of Chum fry for the season was 40.2 mm and 0.40 g (Table A.2, Figures A.14 and A.15; Range = 36−44 mm and 0.3−0.5 g). This was similar to Chum fry mean length and weight in 2013 ($\bar{x}$ = 38.6 mm and 0.46 g, Range = 37−41 mm and 0.3−0.6 g; Table A.2, Figures A.14 and A.15).

Other Salmonids

Coho Salmon, Steelhead, and Cutthroat Trout were captured in both years, however population estimates could only be made for Coho fry, Coho smolt, and Steelhead smolt in each year (Tables A.3, A.4, A.6, and A.8, Figures 9 and 10). Insufficient recaptures or low catch precluded population estimation for all other species in 2013 and for 120−159 mm and 160−249 mm Cutthroat Trout and those species mentioned above in 2015. An estimated 1,795 ± 304 and 3,166 ± 331 Coho smolts outmigrated from Big Creek in 2013 and 2015, respectively (Table A.4, Figure 10) with peak catch occurring in mid-May in both years (Table A.5). Mean length and weight was nearly identical in both years (114.3 mm and 15.95 g and 114.4 mm and 15.49 g, respectively; Table A.5, Figures A.20 and A.21), with Coho smolts captured between 75 and 165 mm and 4.9 and 27.5 g. Mean length and weight of Coho smolts at Big Creek for the two years combined (114.4 mm and 15.68 g; Figures A.20 and A.21) was nearly identical to the mean observed for all sites (114.2 mm and 15.78 g).

Steelhead smolt population estimates were similar in 2013 and 2015 (2,041 ± 1,196 and 2,101 ± 1,058 smolts, respectively; Table A.6, Figure 10), however trap efficiency was low in both years as reflected in the large confidence intervals. In 2013, Steelhead smolt peak catch was slightly earlier (April 29th–May 5th) and mean length and weight was smaller (164.6 mm and 41.75 g) than in 2015 (May 4th–May 10th and 174.2 mm and 49.45 g, respectively; Table A.7, Figures A.22 and A.23). Mean length of Steelhead smolts at Big Creek for the two years combined (169.4 mm) was larger than the mean for all sites (166.2 mm) although weight was similar (45.61 g compared to 45.22 g).

Extrapolated catch of 120−159 mm and 160−249 mm Cutthroat in 2013 was 42 and 32 fish, respectively (Table A.8, Figure 10). In 2015, estimates for the same size classes were 343 ± 112 and 855 ± 370 fish, respectively (Table A.8, Figure 10). Peak catch for 120−159 mm and 160−249 mm Cutthroat in 2015 occurred in May (May 25th–May 31st and May 11−May 17th, respectively) but overall catch was more variable for both size classes in 2013. Catch, migration timing, and length and weight information for all salmonids can be found in the Appendices.

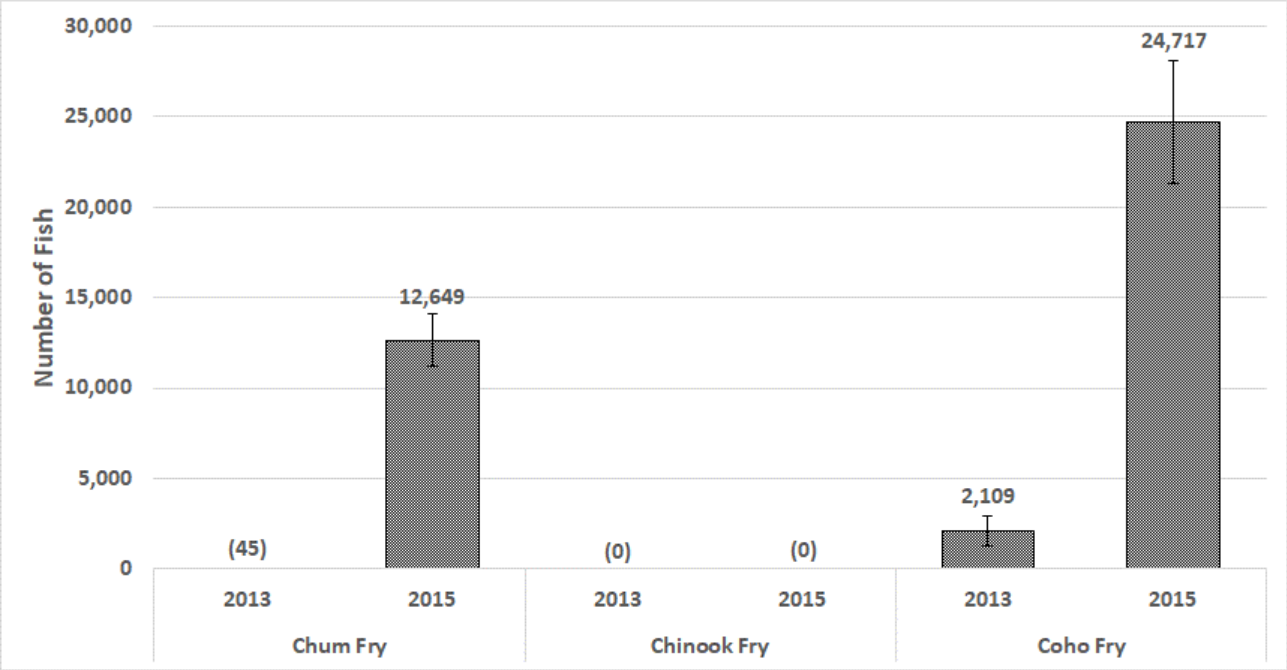

Figure 9. Population estimates of Chum *Oncorhynchus keta*, Chinook *O. tshawytscha*, and Coho *O. kisutch* fry outmigrants in Big Creek from monitoring using a rotary screw trap, 2013 and 2015 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

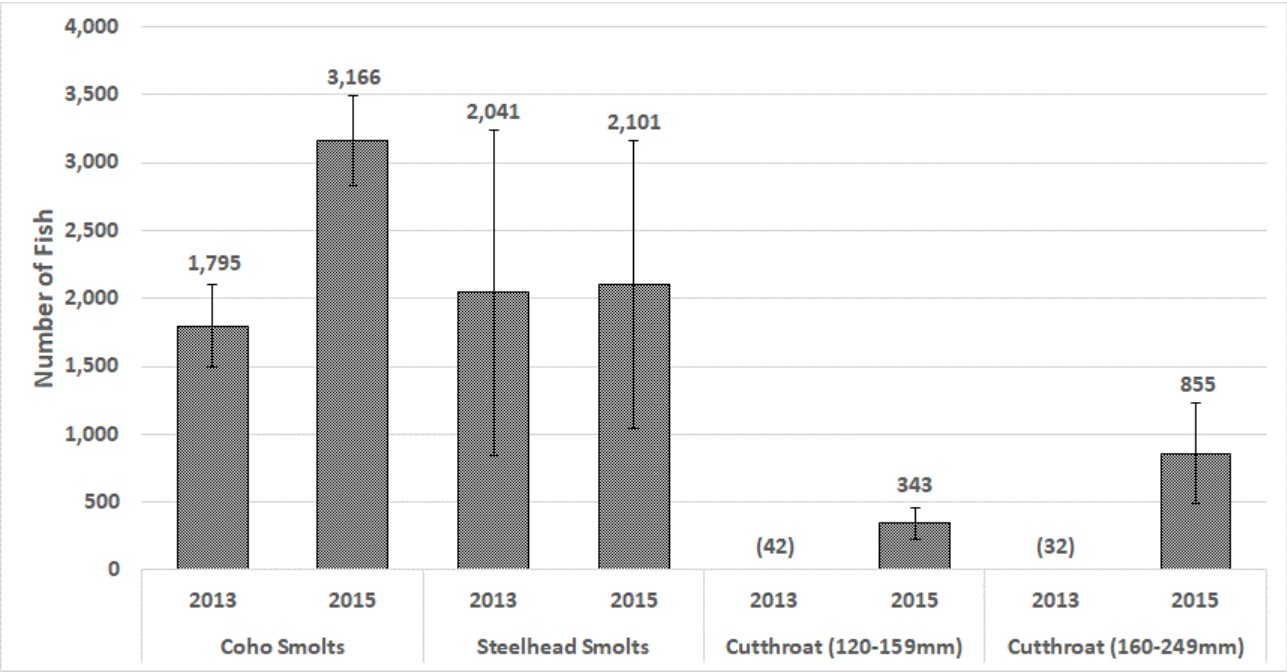

Figure 10. Population estimates of Coho *Oncorhynchus kisutch* smolt, Steelhead *O. mykiss* smolt, and Cutthroat Trout *O. clarkii clarkii* outmigrants in Big Creek from monitoring using a rotary screw trap, 2013 and 2015 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

Hatchery Salmonids

No hatchery salmonids were captured at the Big Creek screw trap locations in 2013 and 2015 (Table A.11), as both screw trap sites were upstream of Big Creek Hatchery and the hatchery weir likely does not provide adequate upstream passage for juvenile salmonids to migrate upstream into the basin.

Non-Salmonids

Non-salmonid catch (in decreasing abundance) consisted of Lamprey Larva, Cottid, and Western Brook Lamprey Adult, and to a lesser extent Pacific Lamprey Adult, and Dace (Table A.13). Overall, the diversity and abundance of non-salmonid species captured in both years at Big Creek was significantly lower than that observed at most other Chum Reintroduction project screw trap locations.

Graham Creek (Clatskanie River Basin)

Description

Graham Creek flows into Westport Slough approximately 3 miles west of the town of Clatskanie, OR (Figures 1 and 11). No estimate of historical abundance of Chum Salmon is available for this creek and no Chum Salmon have been observed in the creek in the last 20 years. The lower portion of the creek has been straightened and land use is agricultural. Above Colvin Road, the creek runs through a forest with timber operations. Habitat surveys in 2012 and 2013 identified suitable gravel and upwelling groundwater, although the simplified channel has little pool structure, cover, or large woody debris (Alfonse et al. 2017a).

Monitoring

Chum Salmon

Graham Creek was monitored for juvenile Chum Salmon in 2014 and is one of five watersheds where juvenile fish monitoring occurred in the Clatskanie River Basin after the project began in 2012 (Figure 11). Both a fence panel and incline plane trap were installed downstream of Hwy 30 and approximately 0.1 Rkm upstream of Westport Slough (Figure 12). The incline plane trap was installed on February 27th within tidal reach of Westport Slough, but could only be fished intermittently until the fence panel trap began operating on March 19th as daily tidal exchanges caused numerous trap stoppages. Consequently, due to the inefficiency of operating the incline plane trap within tidal reach, the fence panel trap was fished exclusively for most of the trapping season except for a high-water period from late March through early April.

A small number of Chum Salmon fry were captured during the trapping season (Table A.2),

with captures occurring only on two days (April 25th, 14 fry and May 4th, 1 fry). The modest amount of juvenile Chum fry production observed in Graham Creek during the 2014 monitoring season was likely produced from adult Chum outplanted into Graham Creek in fall, 2013 that were previously captured at Big Creek Hatchery (Small et al. 2014). Mean length and weight of Chum fry for the season was 39.5 mm and 0.40 g (Table A.2, Figures A.14 and A.15; Range = 38−41 mm and 0.4−0.4 g).

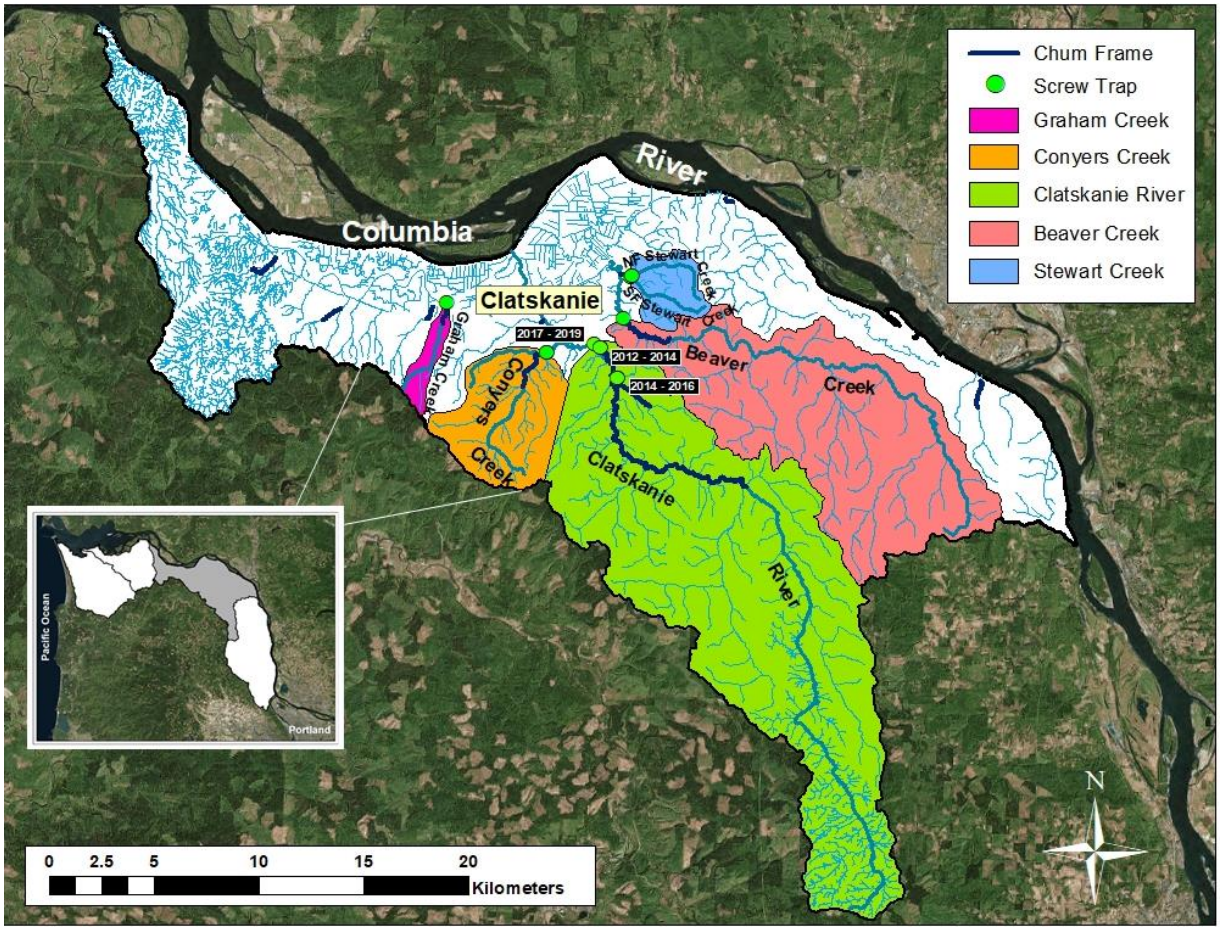

Figure 11. Watersheds monitored for juvenile salmonids *Oncorhynchus* spp. in the Clatskanie River Basin using rotary screw traps from 2012−2019.

Other Salmonids

Coho and Chinook Salmon, Steelhead, and Cutthroat Trout were all captured at the Graham Creek screw trap in 2014. However, population estimates could only be made for Coho fry and Coho smolt, as few captures were made for the other species. An estimated 22,769 ± 1,891 Coho fry and 299 ± 120 Coho smolt outmigrated from Graham Creek in 2014 (Table A.4), with peak catch for both fry and smolts occurring during the week of April 14th through April 20th (Table A.5). Mean length and weight of Coho fry for the season was 41.9 mm and 0.82 g (Table A.5, Figures A.18 and A.19; Range 35−88 mm, and 0.3−7.8 g). Mean length and weight of Coho

smolt for the season was 120.8 mm and 18.81 g (Table A.5, Figures A.20 and A.21; Range = 84−157 mm and 6.5−33.7 g). The mean length and weight of Coho smolts at the Graham Creek screw trap in 2014 was significantly larger than the mean observed for all sites combined (114.2 mm and 15.78 g). For species in which population estimation could not be made, extrapolated catch was highest for 120−159 mm Cutthroat (16 Trout; Table A.8) and Chinook fry (12 fry; Table A.3), with a small number of Cutthroat Trout > 90 mm and Steelhead smolt also captured (Tables A.6 and A.8). No Steelhead or Cutthroat Trout were captured in the 60−89 mm size range. Catch, migration timing, and length and weight information for all salmonids can be found in the Appendices.

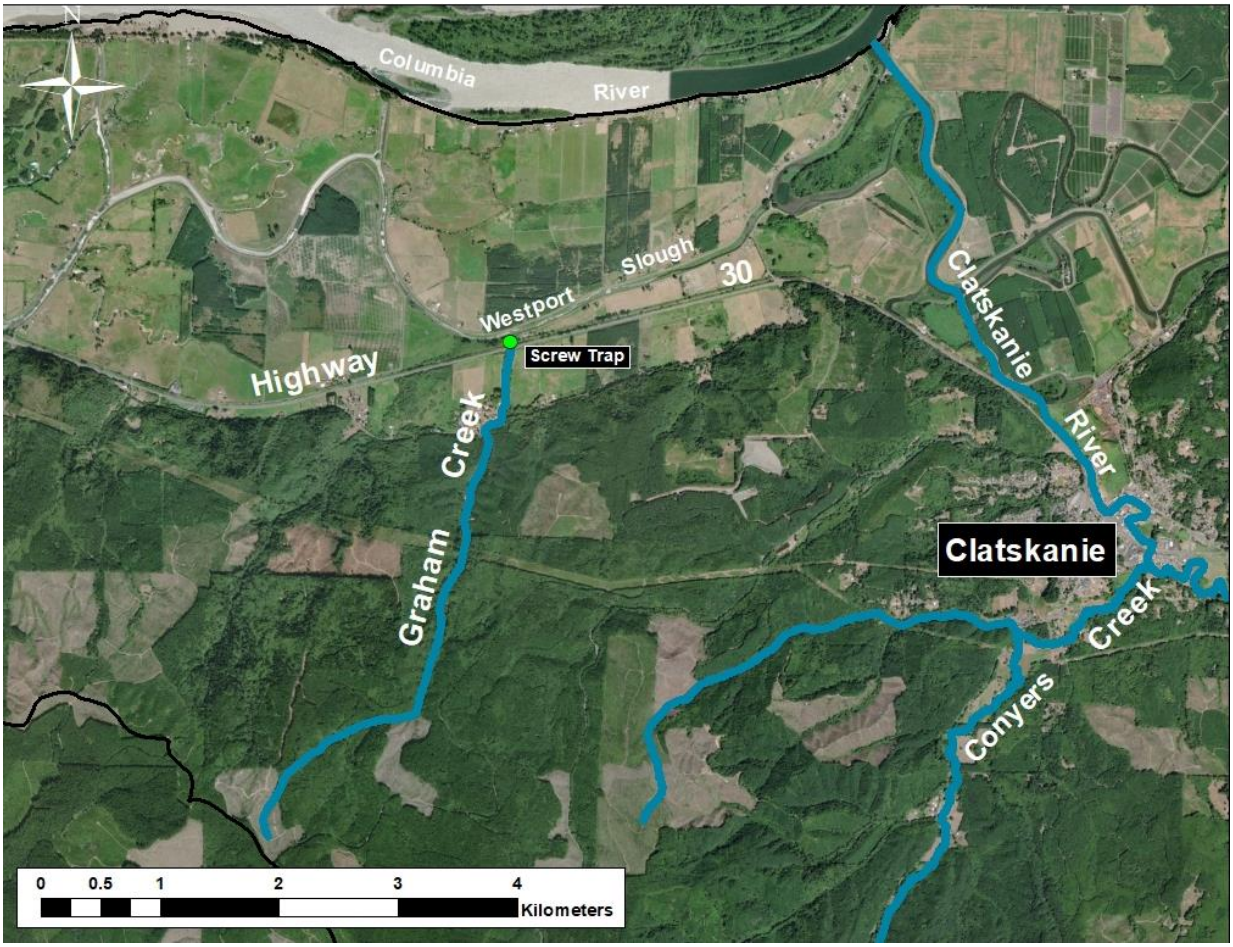

Figure 12. Location of the Graham Creek screw trap operated in the Clatskanie River Basin in 2014.

Hatchery Salmonids

No hatchery salmonids were captured at the Graham Creek screw trap in 2014 (Table A.11).

Non-Salmonids

Non-salmonid catch (in decreasing abundance) consisted of Western Brook Lamprey Adult, Three-Spined Stickleback, Sucker spp., Lamprey Larva, and Cottid spp., and to a lesser extent Pacific Lamprey Adult, Northern Pikeminnow, Banded Killifish, and Pumpkinseed (Table A.13)

Conyers Creek (Clatskanie River Basin)

Description

Conyers Creek is a small tributary stream that flows into the Clatskanie River within the town of Clatskanie, OR (Figures 1 and 11). Historically, Chum Salmon were known to occur in this creek (estimated number unknown), but currently only Coho Salmon, Steelhead, Coastal Cutthroat Trout and some Chinook Salmon are observed. Conyers Creek has a gradient less than 1% with no barriers present in the lower 3 km near the confluence with Clatskanie River. Within this section, land use is a mix of rural residential, residential, and industrial with substrate dominated by sand, silt, and small gravel and the stream channel is entrenched and disconnected from the floodplain (Alfonse et al. 2017a). Upstream of this section the gradient increases as the stream runs through agriculture, rural residential, and timber property.

Monitoring

Chum Salmon

The Conyers Creek watershed was monitored for juvenile Chum Salmon in 2012, 2013 and 2016 and is one of five watersheds where juvenile fish monitoring occurred in the Clatskanie River Basin after the project began in 2012 (Figure 11). A rotary screw trap was installed at the same location in all three years, immediately downstream of Thompson Drive and approximately 1 Rkm upstream of the confluence with Clatskanie River (Figure 13, Table A.1). The trap was installed in mid to late February and fished through early to mid-June, with some non-fishing days occurring in all three years due to high water and trap stoppages. No Chum Salmon were captured in any year at the Conyers Creek screw trap (Table A.2, Figure 14).

Other Salmonids

Coho Salmon, Steelhead, and Cutthroat Trout were captured in all years and population estimates could be made for most species and size classes except for Chinook fry in 2013 and 2016 (Table A.3, Figure 14), Steelhead smolts in 2013 (Table A.6, Figure 15), 90−119 mm Steelhead in 2013 and 2016 (Table A.6), and 90−119 mm Cutthroat in 2016 (Table A.8). Additionally, few 60−89 mm Steelhead or Cutthroat Trout were captured and no estimates could be made in any year (Tables A.6 and A.8).

Limited fry outmigration was observed in Conyers Creek, with Coho fry estimates for the three years ranging from 2,344−3,279 fish (Table A.4, Figure 14) and only a handful of Chinook fry estimated in 2012 (27 ± 12 fry; Table A.3, Figure 14). Coho fry peak catch occurred from late March to mid-April with mean length (36.4−41.2 mm) and weight (0.45−0.76 g) varying over the three years (Table A.5, Figures A.18 and A.19; all years combined 39.1 mm and 0.63 g). The small catch of Chinook fry in 2012 occurred mostly from mid to late May, with mean length and weight of 60.9 mm and 2.64 g, respectively (Table A.3, Figures A.16 and A.17; all years combined 60.7 mm and 2.62 g).

Figure 13. Location of the Conyers Creek screw trap operated in the Clatskanie River Basin in 2012, 2013, and 2016.

Coho smolt estimates ranged from 920 smolts in 2016 to 2,478 smolts in 2012 (Table A.4, Figure 15) with peak catch occurring in early to mid-May (Table A.5). Mean length and weight varied over the three years (105.1−113.6 mm and 12.44−16.06 g, respectively; Table A.5, Figures A.20 and A.21), with the largest smolts captured in 2016 and smallest in 2012 (Table A.5). Mean length and weight of Coho smolts at the Conyers Creek screw trap for the three years combined

(107.8 mm and 13.50 g) was significantly smaller than the mean for all other sites (Figures A.20 and A.21).

Steelhead smolt estimates were nearly identical in 2012 and 2016 (389 ± 141 and 392 ± 196 smolts, respectively; Table A.6, Figure 15). Extrapolated catch in 2013 was 81 fish (Table A.6), as no estimate could be made due to insufficient recaptures. Steelhead smolt peak catch occurred in mid to late April in 2012 and 2016, and mean length and weight over the three years ranged from 142.9−157.8 mm and 29.74−41.68 g, respectively (Table A.7, Figures A.22 and A.23). Mean length and weight of Steelhead smolts at the Conyers Creek screw trap for the three years combined (150.5 mm and 34.92 g) was also significantly smaller than the mean for all other sites (Figures A.22 and A.23).

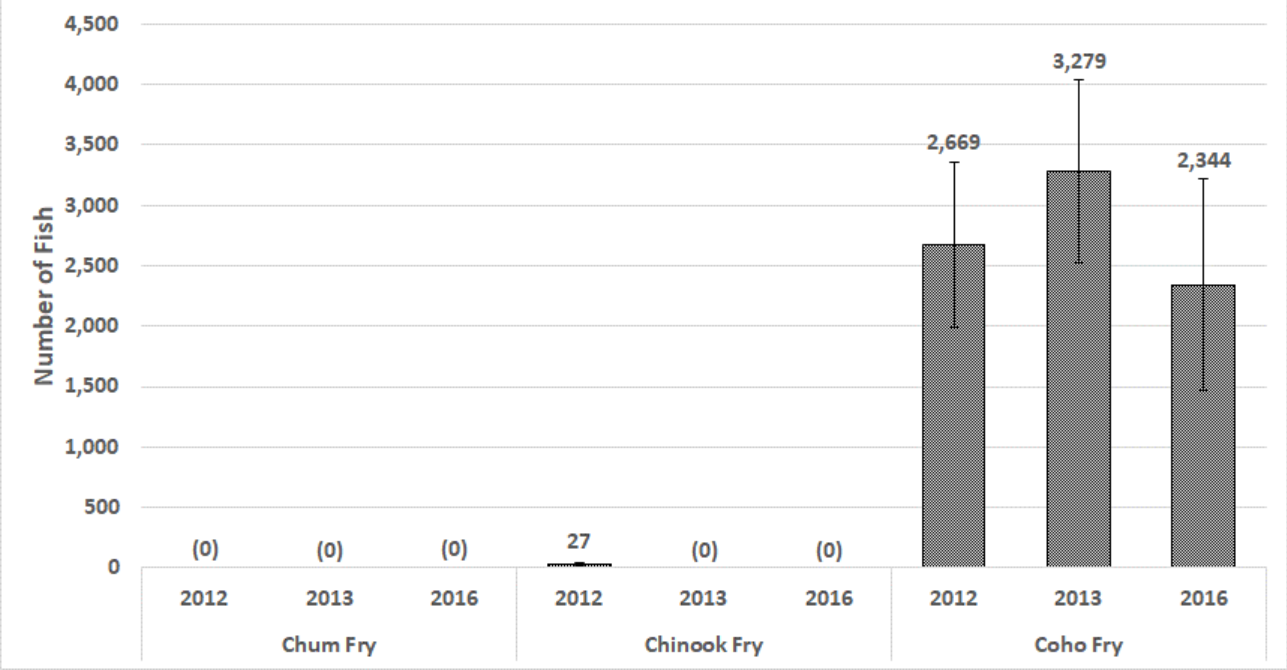

Figure 14. Population estimates of Chum *Oncorhynchus keta*, Chinook *O. tshawytscha*, and Coho *O. kisutch* fry outmigrants in Conyers Creek from monitoring using a rotary screw trap, 2012, 2013, and 2016 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

Cutthroat Trout estimates for the 120−159 mm (151 to 1,195 fish) and 160−249 mm (103 to 718 fish) size classes declined over the three years (Table A.8), with peak catches of the 120−159 mm size class occurring earlier (late March to early April; Table A.10) than the 160−249 mm size class (early to mid-May; Table A.9). Additional information on catch, estimates, timing, and size of Cutthroat Trout and other salmonids captured at the Conyers Creek screw trap can be found in the Appendices.

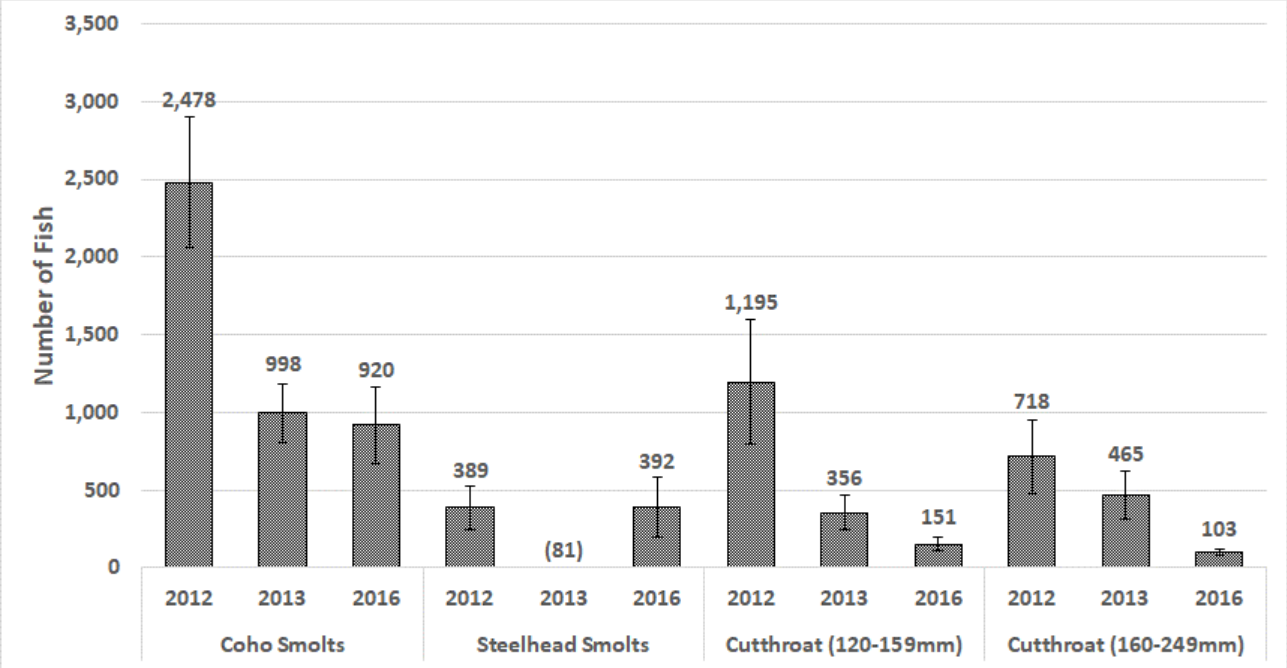

Figure 15. Population estimates of Coho *Oncorhynchus kisutch* smolt, Steelhead *O. mykiss* smolt, and Cutthroat Trout *O. clarkii clarkii* outmigrants in Conyers Creek from monitoring using a rotary screw trap, 2012, 2013, and 2016 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

Hatchery Salmonids

One hatchery Chinook Salmon was captured in 2013 on February 27th that measured 142 mm and weighed 31.2 g (Table A.11). In 2016, three hatchery Chinook Salmon were captured between February 18th and February 24th that were of similar length and weight (134−141 mm and 29.1−32.2 g, respectively, $\bar{x}$ = 137 mm and 30.3 g; Table A.11). The size of hatchery Chinook was significantly larger than that observed for naturally produced Chinook fry captured at Conyers Creek ($\bar{x}$ = 60.7 mm and 2.62 g; Table A.3). No hatchery Chinook were captured in 2012 or hatchery Coho or Steelhead smolts in any year.

Non-Salmonids

Non-salmonid catch (in decreasing abundance) consisted of Lamprey Larva, Western Brook Lamprey Adult, Cottid, Sucker, and Pacific Lamprey Adult, and to a lesser extent Northern Pikeminnow, Dace, and Three-Spined Stickleback (Table A.13). Lamprey Larva and Cottid were captured throughout the season whereas Western Brook Lamprey Adult, Pacific Lamprey Adult, and Sucker were generally captured from early to mid-April through the June.

Clatskanie River (Clatskanie River Basin)

Description

The Clatskanie River flows through the town of Clatskanie, OR, before entering Beaver Slough and Westport Slough and then the Columbia River (Figures 1, 11 and 16). Historically, the Clatskanie River may have supported spawning by up to 3,000 Chum Salmon based on expanded estimates of abundance (Parkhurst et al. 1950, Fulton 1970) and potential habitat availability. However, no Chum Salmon adults have been observed in this system for 20 years. Currently, Coho Salmon, Steelhead, Coastal Cutthroat Trout, and to a lesser extent Chinook Salmon are now observed with no hatchery releases occurring in the basin. Land use in the Clatskanie River is urban (in Clatskanie), rural residential, agriculture, and industrial timber. High quality spawning habitat currently exists in some areas of the watershed, and numerous additional restoration opportunities to improve lower quality spawning habitat throughout the Clatskanie River system are also possible (Alfonse et al. 2017a). Specific restoration needs include adding more large woody debris to the system, bank stabilization, restoration and reconnection of side channel complexes, and reducing excess fine sediment.

Monitoring

Chum Salmon

Clatskanie River was monitored for juvenile Chum Salmon from 2012−2019 and is one of five watersheds where juvenile fish monitoring occurred in the Clatskanie River Basin after the project began in 2012 (Figure 11). From 2012 through April, 2014, the screw trap site was located 3.5 Rkm upstream of the Highway 30 crossing (Table A.1, Figure 16) in a wide channel section with a pool on the river left bank a short distance from winter tidal extent (< 0.5 Rkm). Due to the difficulty of operating a trap efficiently in this location, particularly during high stream flows, the trap was moved upstream 1.5 Rkm in April, 2014 (Table A.1, Figure 16) and fished in this location through 2016. This new location was located upstream of two small tributaries, Perkins and Mill Creeks, in a pool on the river right bank. Following significant flooding in 2015, the channel at the upriver trap site changed in a way that decreased trap efficiency in 2016. As a result, the trap was moved downstream for the 2017 trapping season. From 2017 through 2019, the trap was installed at the head of tide, 0.4 Rkm downstream of the original trapping location (Table A.1, Figure 16). During high flows, trapping at this final location was also challenging due to the wide river channel and low trap efficiencies were observed during these times. However, this current trap location is near head of tide and immediately downstream of high quality spawning habitat, providing the best opportunity to detect the presence of Chum Salmon in the Clatskanie River basin. Additionally, the location of the trap in a pool immediately downstream of an extensive gravel bar

allows the trap to be paneled effectively as water level recedes throughout the trapping season, thereby providing sufficient catch and trap efficiency for normal spring water levels.

No Chum Salmon were observed in the Clatskanie River screw trap from 2012 through 2016 and in 2019. However, fry were captured in 2017 and 2018 (extrapolated catches of 19 and 20 fry, respectively; Table A.2). Due to the low catch and only one recapture among the two years, no Chum fry population estimate could be made in either year. Most Chum fry were captured in April (86%), with a few fish also caught in late March and early May (Range: March 30th–May 2nd; Table A.2). Mean length and weight was slightly smaller in 2017 than in 2018 (40.1 mm and 0.39 g compared to 41.8 mm and 0.40 g, respectively; Table A.2, Figures A.14 and A.15).

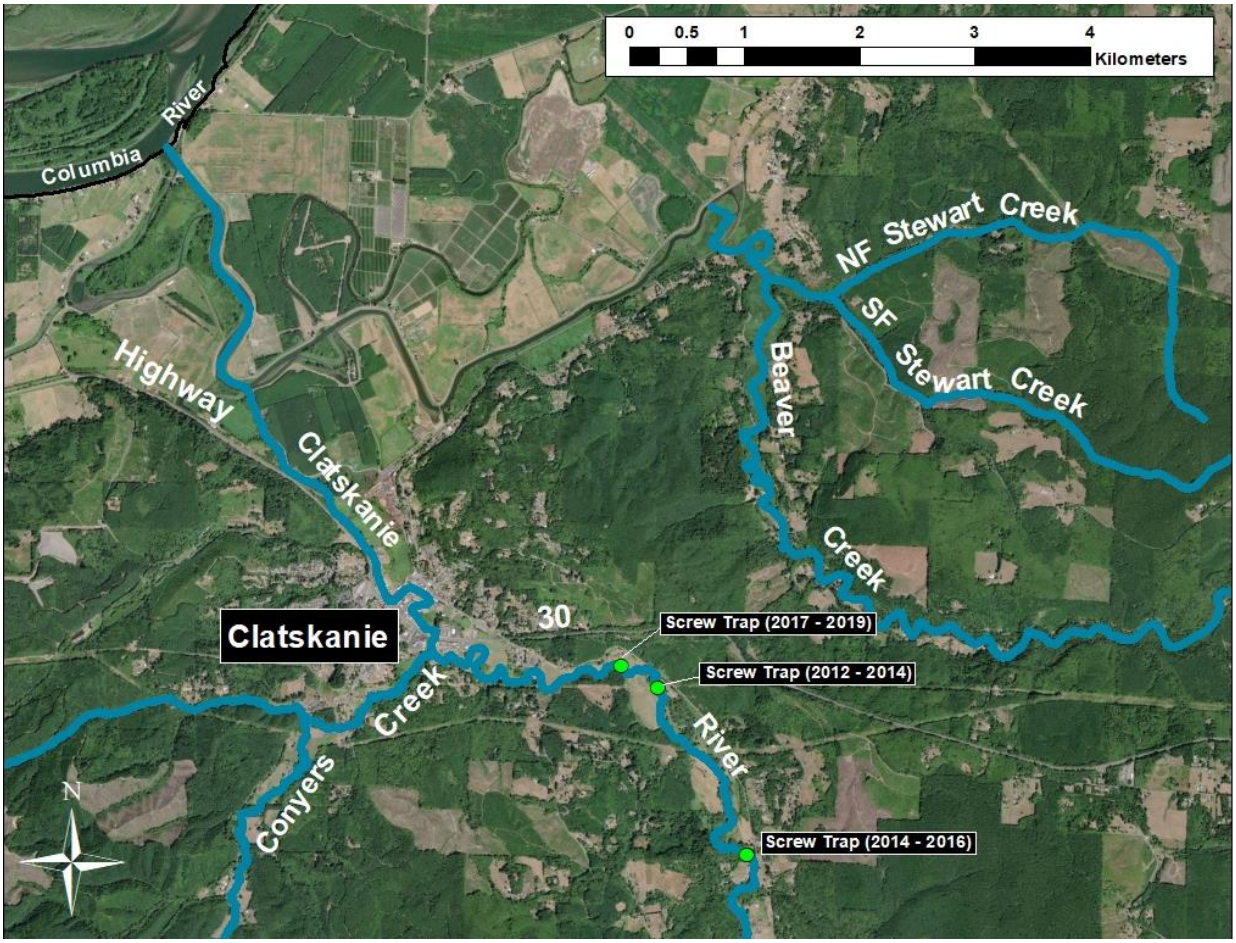

Figure 16. Location of the Clatskanie River screw traps operated in the Clatskanie River Basin from 2012−2019.

Other Salmonids

Estimates could be made for most salmonid species except for Coho fry in several years (2013, 2016, and 2019; Table A.4) and for Chinook fry in 2016 (Table A.3). Additionally few Steelhead and Cutthroat Trout less than 120 mm were captured, and no population estimates

could be made in any year (Tables A.6 and A.8). Coho fry outmigration in Clatskanie River was extremely variable in the five years estimates could be made, with estimates ranging from a high of 530,527 fry in 2015 to a low of 696 fry in 2017 (Table A.4, Figure 17). However, 2015 appears to be an anomaly as in all other years Coho fry estimates were less than 55,564 fry (Table A.4, Figure 17). Coho fry were captured throughout the trapping season, but catch typically peaked in March and April (Table A.5). Mean length and weight ranged from 39.1−51.6 mm and 0.60−2.80 g (Table A.5, Figures A.18 and A.19; all years combined 44.8 mm and 1.45 g). Chinook fry production was also variable (Range = 373−9,478 fry; Table A.3), although estimates were more similar among years than observed for Coho fry. Peak catch of Chinook fry was also variable, occurring in March in several years (2015, 2018, and 2019) but as late as May (2014) and even June (2017). Mean length and weight ranged from 38.8−80.5 mm and 0.52−6.05 g (Table A.3, Figures A.16 and A.17).

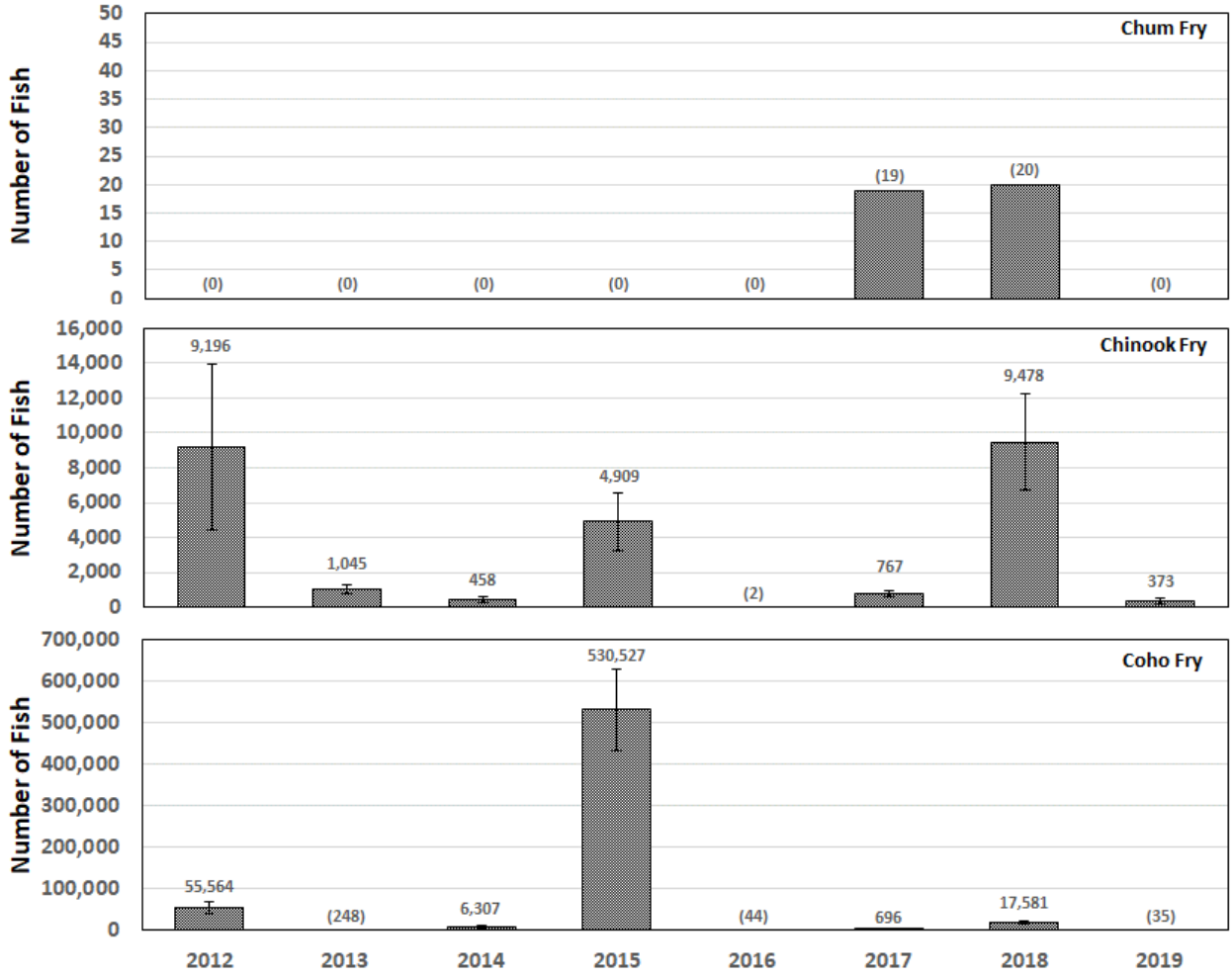

Figure 17. Population estimates of Chum *Oncorhynchus keta*, Chinook *O. tshawytscha*, and Coho *O. kisutch* fry outmigrants in Clatskanie River from monitoring using a rotary screw trap, 2012−2019 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

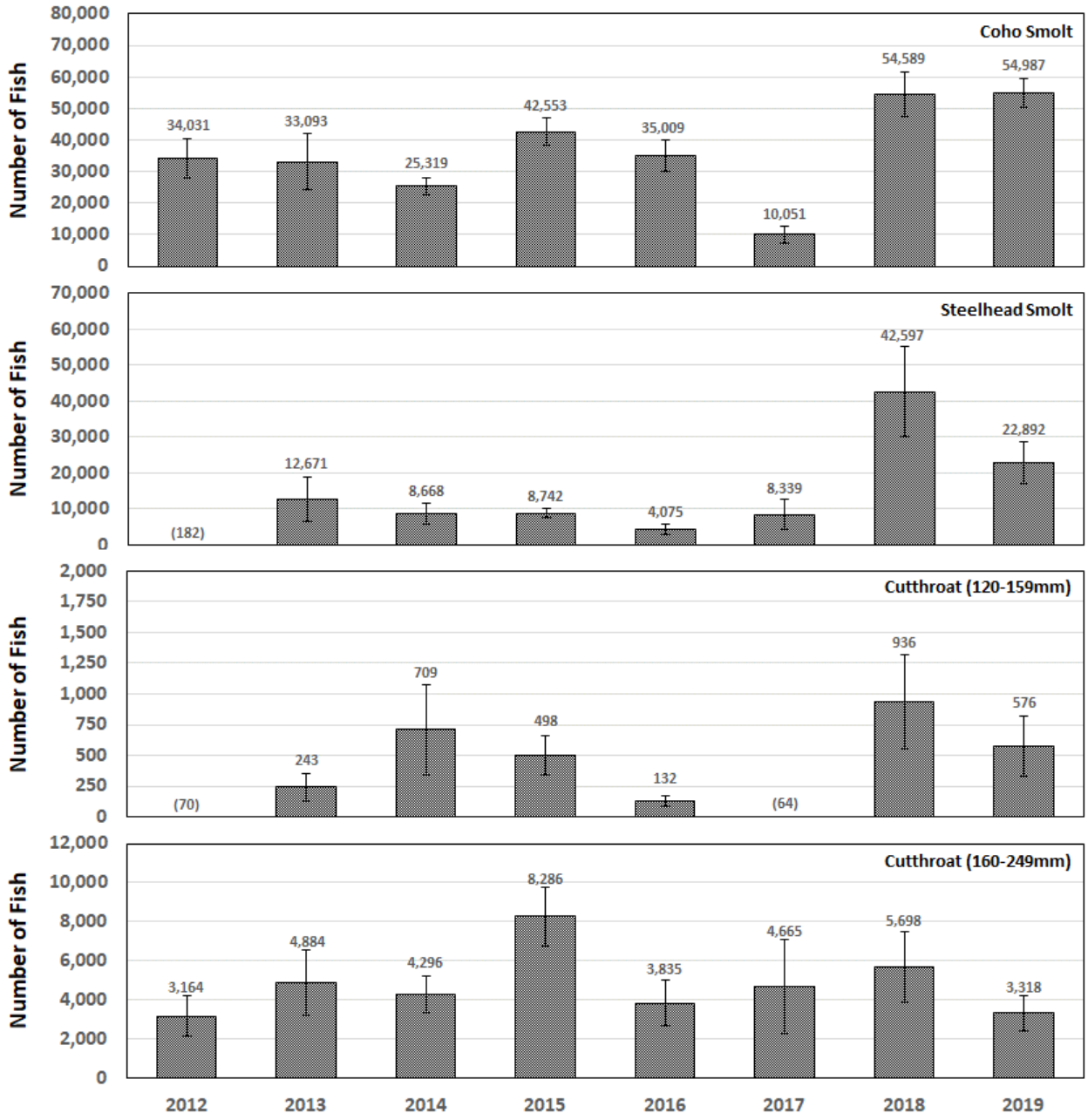

Figure 18. Population estimates of Coho *Oncorhynchus kisutch* smolt, Steelhead *O. mykiss* smolt, and Cutthroat Trout *O. clarkii clarkii* outmigrants in Clatskanie River from monitoring using a rotary screw trap, 2012−2019 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

Coho smolt estimates ranged from a high of 54,987 smolts in 2019 to a low of 10,051 smolts in 2017 ($\bar{x}$ = 36,204 smolts, Table A.4, Figure 18). However, the 2017 estimate is likely biased low due to early season high water that resulted in significant non-trapping days and low trap efficiency due to the lack of paneling at the trap until late in the season. Coho smolt peak

catch was consistent across years, with peak captures occurring during a short time period in the first two weeks of May (Table A.5). Mean length and weight ranged from 107.5−122.7 mm and 13.30−19.29 g, with smolts captured between 63 and 180 mm and 2.1 and 54.7 g (Table A.5, Figures A.20 and A.21). Mean length and size of Coho smolts captured at the Clatskanie River screw trap for the eight years combined (112.2 mm and 15.18 g) was slightly smaller than the mean observed for all sites (114.2 mm and 15.78 g).

No steelhead estimate could be made in 2012 (extrapolated catch = 182 smolts), but estimates could be made in all other years (Range = 4,075−42,597 smolts; Table A.6, Figure 18). However, the 2018 estimate (42,597 ± 12,624 smolts) is likely biased high, as poor trap efficiency resulted in low confidence in this estimate. Peak steelhead catch occurred from late April to mid-May, with mean length and weight ranging from 159.0 to 171.1 mm and 38.48 to 50.23 g (Table A.7, Figures A.22 and A.23). Steelhead smolts were captured between 120 and 223 mm and 36.5 and 52.8 g and mean length and weight for all years combined (166.2 mm and 44.93 g; Figures A.22 and A.23) was similar to the mean for all sites (166.2 mm and 45.22 g).

Significantly more 160−249 mm Cutthroat Trout (Range = 3,164−8,286 fish; Table A.8, Figure 18) were captured than Cutthroat Trout in the 120−159 mm size class (Range = 132−936 fish; Table A.8, Figure 18), with peak catches for both size classes typically occurring in May (Tables A.9 and A.10). Additional information on catch, estimates, timing, and size of Cutthroat Trout captured at the Clatskanie River screw trap can be found in the Appendices.

Hatchery Salmonids

Few hatchery salmonids were captured during juvenile monitoring in the Clatskanie River basin, especially when considering the relatively long monitoring time frame. Hatchery Coho Salmon were only captured in 2013 and 2018, with only one individual caught in each respective year (Table A.11). Both individuals were captured in early May and were significantly larger (118−126 mm and 16.7−21.2 g; Table A.11) than naturally produced Coho smolts observed in each respective year (107.5 mm and 13.81 g and 108.4 mm and 13.30 g, respectively; Table A.5). Hatchery Chinook were captured in five years, but two or fewer individuals were caught in each of those years (Table A.11). Most captures occurred before early April, except in 2018 when a hatchery Chinook was captured in late May (Table A.11). This fish was the smallest hatchery Chinook observed at the trap over the monitoring period (88 mm and 6.3 g, Table A.11). All other hatchery Chinook were significantly larger (Range = 139−152 mm and 24.3−41.6 g; Table A.11). In comparison, mean length and weight for naturally produced Chinook in the Clatskanie ranged from 38.8 to 80.5 mm and 0.52 to 6.05 g over the monitoring period (Table A.3). No hatchery Steelhead were captured in any year.

Non-Salmonids

The Clatskanie River had the largest diversity of non-salmonid species of any juvenile monitoring site on this project, with both native and non-native species captured at the screw trap (Table A.13). Non-salmonid catch (in decreasing abundance) consisted of Peamouth, Cottid, Three-Spined Stickleback, Lamprey Larva, Western Brook Lamprey Adult, Pacific Lamprey Adult, Northern Pikeminnow, Redside Shiner *Richardsonius balteatus*, Banded Killifish, Largescale Sucker, and to a lesser extent Pacific Lamprey juvenile, Speckled and Longnose Dace *Rhinichthys cataractae*, Common Goldfish, Goby spp., Mountain Whitefish *Prosopium williamsoni*, Chiselmouth *Acrocheilus alutaceus*, Bluegill, and Golden Shiner (Table A.13).

Both adult and larval Pacific and Western Brook Lamprey were more frequently encountered in the Clatskanie River than at any other sampling site, with spawning activity commonly observed both upstream and downstream of the current trapping location near head of tide. Interestingly, while releasing marked fish upstream of the current trap site, several observations were made of Pacific Lamprey and Western Brook Lamprey adults actively spawning within the same redd. Other interesting captures at the Clatskanie River screw trap included three Common Goldfish caught in 2018 and several Goby captured in 2018 and 2019 that could not be positively identified to species.

Beaver Creek (Clatskanie River Basin)

Description

Beaver Creek is located northeast of the Clatskanie River and flows into Beaver Slough and then the Columbia River (Figures 1, 11, and 19). Historically it is thought Beaver Creek may have supported 300−1,000 Chum Salmon spawners based on estimates of abundance (Parkhurst et al. 1950) expanded by habitat area; the only adult Chum Salmon reported recently was a single individual in Stewart Creek (a tributary) in the last 20 years. Land use in Beaver Creek is rural residential, agriculture, and industrial forest. Suitable spawning gravel exists in the system, but in many areas gravel is mixed with small cobble that is likely larger than that preferred by Chum Salmon (gravels 2−3cm in diameter). Excess fine sediment, a lack of large woody debris, and channel incision are also observed throughout the low gradient portion of the channel (Alfonse et al. 2017a). A large, impassable falls to upstream anadromous migration is located approximately 6.3 Rkm upstream of the confluence with Stewart Creek and reach of tide (Figure 19).

Monitoring

Chum Salmon

The Beaver Creek watershed was monitored for juvenile Chum Salmon in 2016 and is one of five watersheds where juvenile fish monitoring occurred in the Clatskanie River Basin after the

project began in 2012 (Figure 11). A rotary screw trap was installed immediately downstream of Kukkola Road and approximately 3.3 Rkm downstream of Beaver Falls, an impassable barrier to upstream anadromous migration (Figure 19). The trap was installed on March 9th and removed on May 30th (Table A.1), with a significant number of non-fishing days occurring during the first trapping week in March and for most of May. Early season stoppages were associated with high flows precluding trap operation and logs jammed in the cone. Non-fishing days in May were due to low water and the inability to keep the cone spinning sufficiently for proper trap operation. Due to the inconsistency of trap operation at this site in 2016, catch and population estimates reported below should be treated as incomplete and interpreted accordingly. No Chum Salmon were captured in the Beaver Creek screw trap in 2016 (Table A.2).

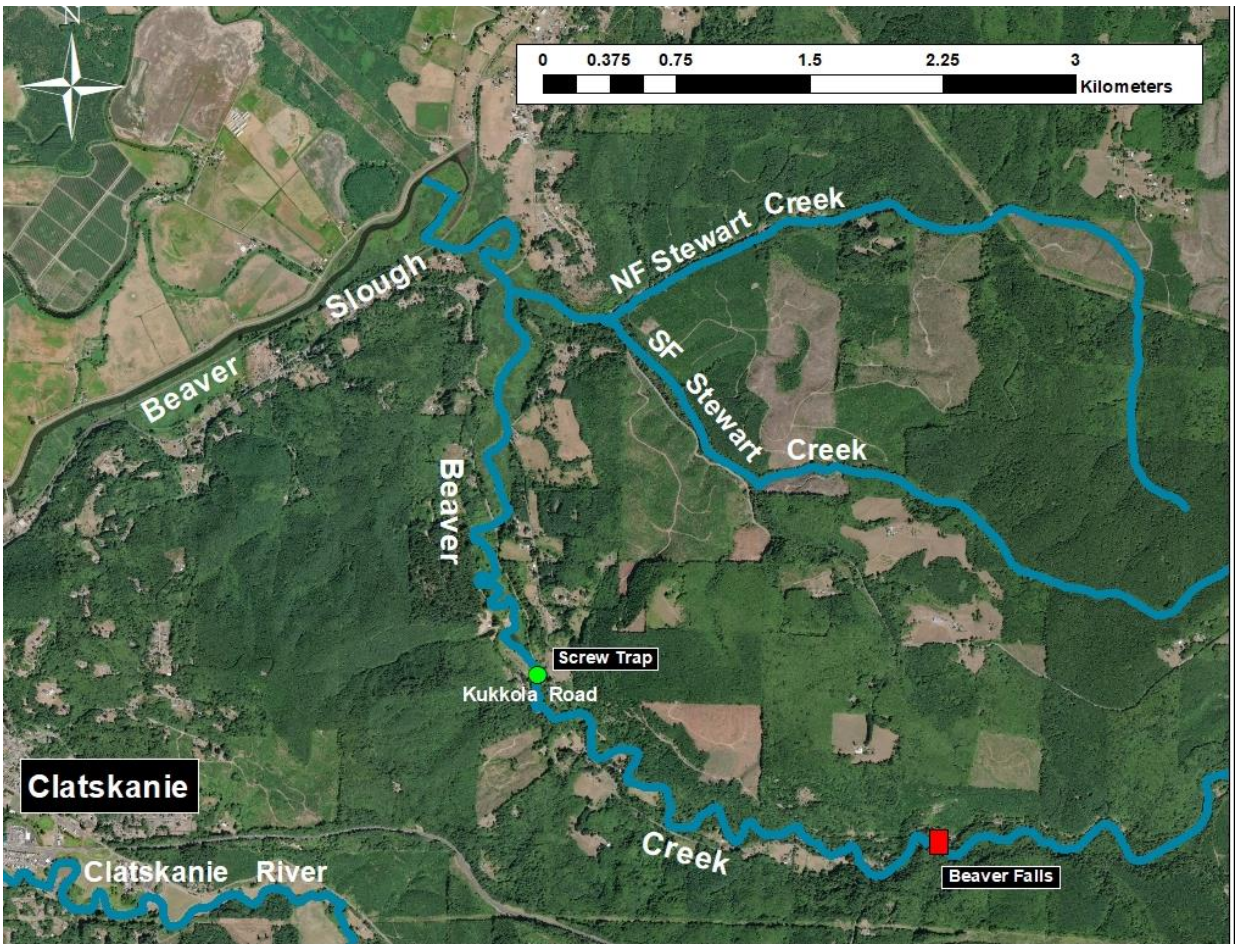

Figure 19. Location of the Beaver Creek screw trap operated in the Clatskanie River Basin in 2016.

Other Salmonids

Few salmonids were captured in the Beaver Creek screw trap in 2016, and a population estimate could only be made for Coho smolts (1,707 ± 343 smolts; Table A.4) due to insufficient recaptures or limited catch of all other species. Coho smolt catch peaked during the week of May

2nd–May 8th (Range: March 18th–May 5th), with a robust mean length and weight for the season of 127.4 mm and 22.05 g, respectively (Table A.5, Figures A.20 and A.21; Range: 104−185 mm and 11.8−69.0 g). Coho smolt mean length and weight was significantly larger at Beaver Creek than at all other sites (114.2 mm and 15.78 g, respectively; Figures A.20 and A.21), and Beaver Creek was the only site where no Coho smolts under 100 mm were measured as part of our weekly bio-sampling protocol. Steelhead smolts were the next most abundant catch (extrapolated catch, 64 smolts; Table A.6), with smolts captured between March 29th and May 5th (Table A.7). Steelhead smolt mean size and weight for the season was 179.0 mm and 58.91 g (Table A.7, Figures A.22 and A.23; Range: 127−230 mm and 22.4−112.6 g). Additional salmonid catch (in decreasing abundance) consisted of Coho fry, Trout fry, 160−249 mm Cutthroat Trout, Chinook fry, 120−159 mm Cutthroat Trout, and 250 mm Cutthroat Trout. However, few individuals were captured in all of these species size classes (extrapolated catch < 14 individuals, Tables A.3, A.4, and A.8).

Hatchery Salmonids

Although no hatchery releases occur in Beaver Creek, four hatchery Chinook were captured in the screw trap in 2016. These fish were captured on Mar 28th, Apr 7th, and May 2nd (2 fish) and mean length and weight was 123.3 mm and 22.0 g (Table A.11; Range = 73−143 mm and 4.4−33.9 g). The mean length and weight of hatchery Chinook was significantly larger than observed for wild Chinook captured at the Beaver Creek screw trap (Table A.3, Figures A.16 and A.17; $\bar{x}$ = 70.7 mm and 4.68 g, Range: 35−104 mm and 0.2−11.7 g). No hatchery Coho or Steelhead smolts were captured.

Non-Salmonids

Non-salmonid catch (in decreasing abundance) consisted of Western Brook Lamprey Adult, Pacific Lamprey Adult, Peamouth, Cottid, Sucker spp., and Lamprey Larva, and to a lesser extent Northern Pikeminnow, Pacific Lamprey Juvenile, Pumpkinseed, Banded Killifish, Brown Bullhead *Ameiurus nebulosus*, and Three-Spined Stickleback (Table A.13).

Stewart Creek (Clatskanie River Basin)

Description

Stewart Creek is a tributary to Beaver Creek and is located in the Clatskanie River Population (Figures 1 and 11). The creek flows into Beaver Slough immediately downstream of reach of tide and approximately 100 m upstream of Quincy Mayger Road crossing (Figure 20). No estimate of historical abundance of Chum Salmon is available for this creek, but it is the last location with anecdotal reports of Chum Salmon presence in the basin prior to reintroduction efforts. Coho Salmon, Steelhead, and Coastal Cutthroat Trout spawn naturally in Stewart Creek and the basin does not receive any hatchery salmonid releases. Land use is rural residential in the

lower section from Beaver Slough upstream to where the creek splits into two forks. Upstream of the forks, the primary land use is private timberlands. Suitable spawning gravels, pool habitat, and large woody debris exist in the system, most notably in a 500 m section of NF Stewart Creek from the confluence upstream to the first logging road crossing. However, no upwelling groundwater was detected in this system. A more comprehensive evaluation of habitat condition in Stewart Creek can be found in Alfonse et al. (2017a).

Monitoring

Chum Salmon

In 2014, a fence panel fry trap was operated in Stewart Creek 10 m downstream of the confluence of the north and south forks from March 1st through May 29th (Table A.1, Figure 20). This trap site was used to monitor juvenile salmonid outmigration from both NF and SF Stewart Creeks. In 2015 (February 28th–June 5th) and 2016 (February 17th–May 12th), the trap site was moved 30 m upstream to NF Stewart Creek and only monitored juvenile salmonid outmigration from this system (Table A.1, Figure 20). This new site was selected because Chum Salmon were observed to spawn almost entirely in NF Stewart Creek (with a few observations in the mainstem), and the trap could be fished more efficiently in this system.

Chum fry were captured and population estimates could be made in all three years (Table A.2, Figure 21). However significantly fewer fry were captured in 2016 (122 fry) than in 2014 and 2015 (743 and 3,107 fry, respectively) and the estimate for 2016 (334 ± 86 fry) was substantially lower than observed for the two previous years (4,109 ± 831 and 9,042 ± 939 fry, respectively; Table A.2, Figure 21). Chum fry capture dates in 2014 (Range = April 11th–May 13th) were much later than the peak catch week observed in 2015 and 2016 (March 23rd–March 29th and March 21st–March 27th, respectively; Table A.2). Chum fry mean length and weight was larger in 2016 (40.0 mm and 0.41 g) than in 2014 and 2015 (39.4 mm and 0.37 g and 37.8 mm and 0.39 g, respectively; Table A.2, Figures A.14 and A.15).

Other Salmonids

Few additional population estimates could be made for salmonids captured at the Stewart Creek fry trap sites as catch was generally small for most species, except Coho fry (Table A.4, Figure 21). Coho fry population estimates ranged from a low of 8,337 fry in 2016 to a high of 21,111 fry in 2015 with high trap efficiencies observed in all three years (27%−40%, respectively). Peak catch (mid to late March; Table A.5) and mean length and weight (35.5−37.3 mm and 0.37−0.43 g; Table A.5, Figures A.18 and A.19) was also similar among years. A Coho smolt estimate could only be made in 2015 (61 ± 24 fish; Table A.4, Figure 22), as few smolts were captured in each trapping season (Range = 15−32 fish). Most Coho smolt catch in all three years occurred in April and May and mean length and weight was significantly smaller in 2014 (102.9

mm and 13.01 g) than in 2015 and 2016 (115.2 mm and 15.45 g and 111.2 mm and 15.13 g, respectively; Table A.5, Figures A.20 and A.21).

The only other population estimate that could be made was for 60−89 mm Cutthroat in 2014 (232 ± 92 fish; Table A.8). Additional salmonid catch consisted mostly of Cutthroat Trout and Trout fry, as very few Steelhead of any size class and no un-clipped Chinook were captured at the Stewart Creek trap sites (Tables A.3, A.4, A.6, and A.8, Figures 21 and 22). The majority of Cutthroat Trout were < 120 mm, with few larger fish captured in all three years (Table A.8). Trout fry were caught frequently in 2014 and 2015 (89 and 52 fry, respectively) but none were captured in 2016.

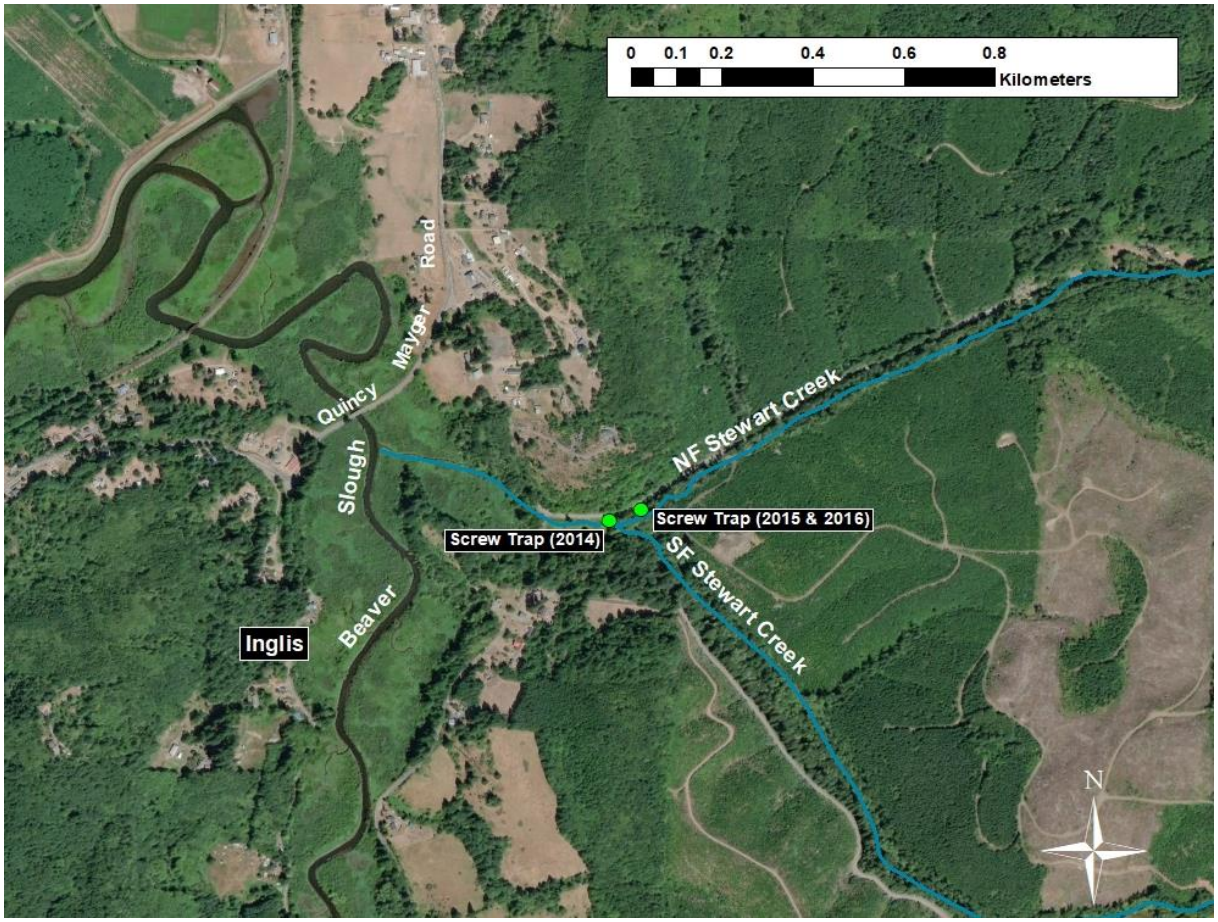

Figure 20. Location of the Stewart Creek fence panel traps operated in the Clatskanie River Basin from 2014−2016.

Hatchery Salmonids

One hatchery Chinook was captured at the Stewart Creek trap site in 2014 on May 19th, measuring 123 mm and weighing 19.7 g (Table A.11). No other hatchery fish were captured at the Stewart Creek juvenile traps in any other year (Table A.11).

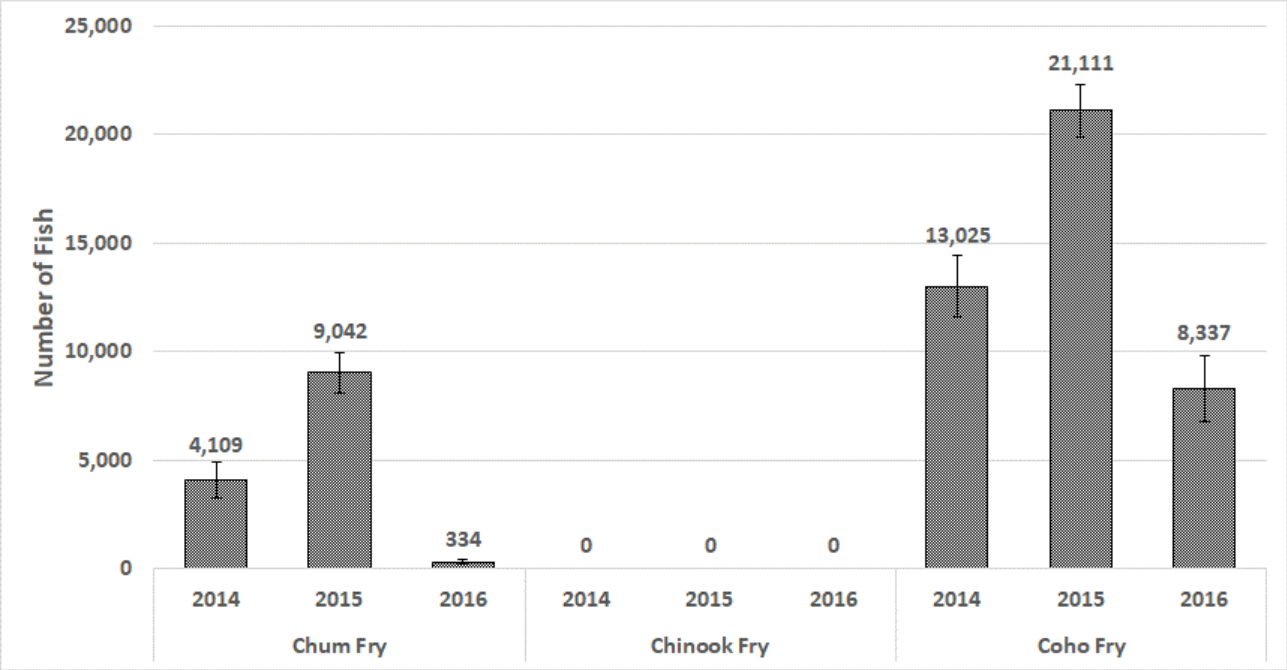

Figure 21. Population estimates of Chum *Oncorhynchus keta*, Chinook *O. tshawytscha*, and Coho *O. kisutch* fry outmigrants in Stewart Creek from monitoring using a fence panel trap, 2014–2016 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

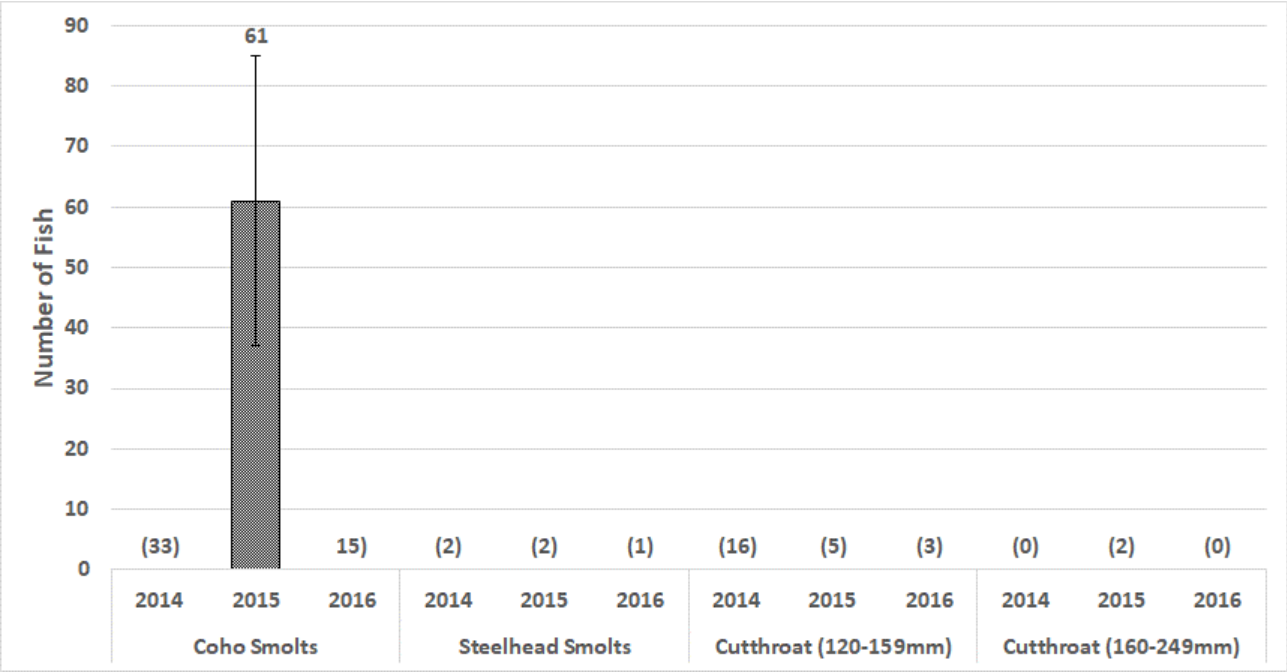

Figure 22. Population estimates of Coho *Oncorhynchus kisutch* smolt, Steelhead *O. mykiss* smolt, and Cutthroat Trout *O. clarkii clarkii* outmigrants in Stewart Creek from monitoring using a fence panel trap, 2014–2016 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

Non-Salmonids

Non-salmonid catch (in decreasing abundance) consisted of Northern Pikeminnow and Western Brook Lamprey Adult, and to a lesser extent Cottid, Lamprey Larva, Pacific Lamprey Adult, and Redside Shiner (Table A.13). Overall, the diversity and abundance of non-salmonid species captured in the three years at Stewart Creek was significantly lower than that observed at most other Chum Reintroduction project screw trap locations, similar to as described for Big Creek.

Milton Creek (Scappoose Creek Basin)

Description

Milton Creek flows through the town of St. Helens, OR and is located within the Scappoose Creek population (Figures 1, 23, and 24). Historically, this was the best Chum Salmon stream within the Scappoose population, with an estimated 200–1,000 Chum Salmon present based on historical estimates (Parkhurst et al. 1950, Willis et al. 1960, Fulton 1970, Myers et al. 2003) and habitat area. As was typical from the 1880s through 1950s, Milton Creek was splash dammed during early logging operations, resulting in the removal and transport of most large woody debris and spawning gravels. The current channel is primarily bedrock dominated, narrow, incised, and developed tight to the stream banks with little channel complexity, wood, or sufficiently deep pools (Alfonse et al. 2017a). Several low-head dams are in place throughout the river, with a drop height of about 1 m. Upstream of St. Helens the land use is rural residential with some agriculture. Here, the channel is narrow and deep, with predominantly fine sediment and eroding banks. There is no floodplain connection or side channel complexity. Upstream of a narrow canyon, there is more complex habitat, but the gradient increases, the substrate size is variable, and there are still excess fine sediments. No upwelling groundwater was detected in the lower portion of this system, but some was detected upstream of a canyon in an area where Coho Salmon are known to spawn (Alfonse et al. 2017a). Despite the poor habitat in the lower reaches, Coho Salmon and Steelhead do spawn in the upper reaches of Milton Creek (above the Chum Salmon distribution) and Coastal Cutthroat Trout are also present. No hatchery salmonid releases occur in the basin.

Monitoring

Chum Salmon

The Milton Creek watershed was monitored for juvenile Chum Salmon in 2012 and 2013 and is one of two watersheds where juvenile fish monitoring occurred in the Scappoose Creek Basin after the project began in 2012 (Figure 23). A rotary screw trap was installed downstream of Old Portland Road and just upstream of the winter extent of tide water and fished in that same location from late February through mid-June in both years (Figure 24; Table A.1). In 2013, the trap fished continuously throughout the season except for a few days in May. However, in 2012 a

period of high water precluded trapping for an extended period of time in mid to late March. No Chum Salmon were captured in either year at the Milton Creek trap site (Table A.2).

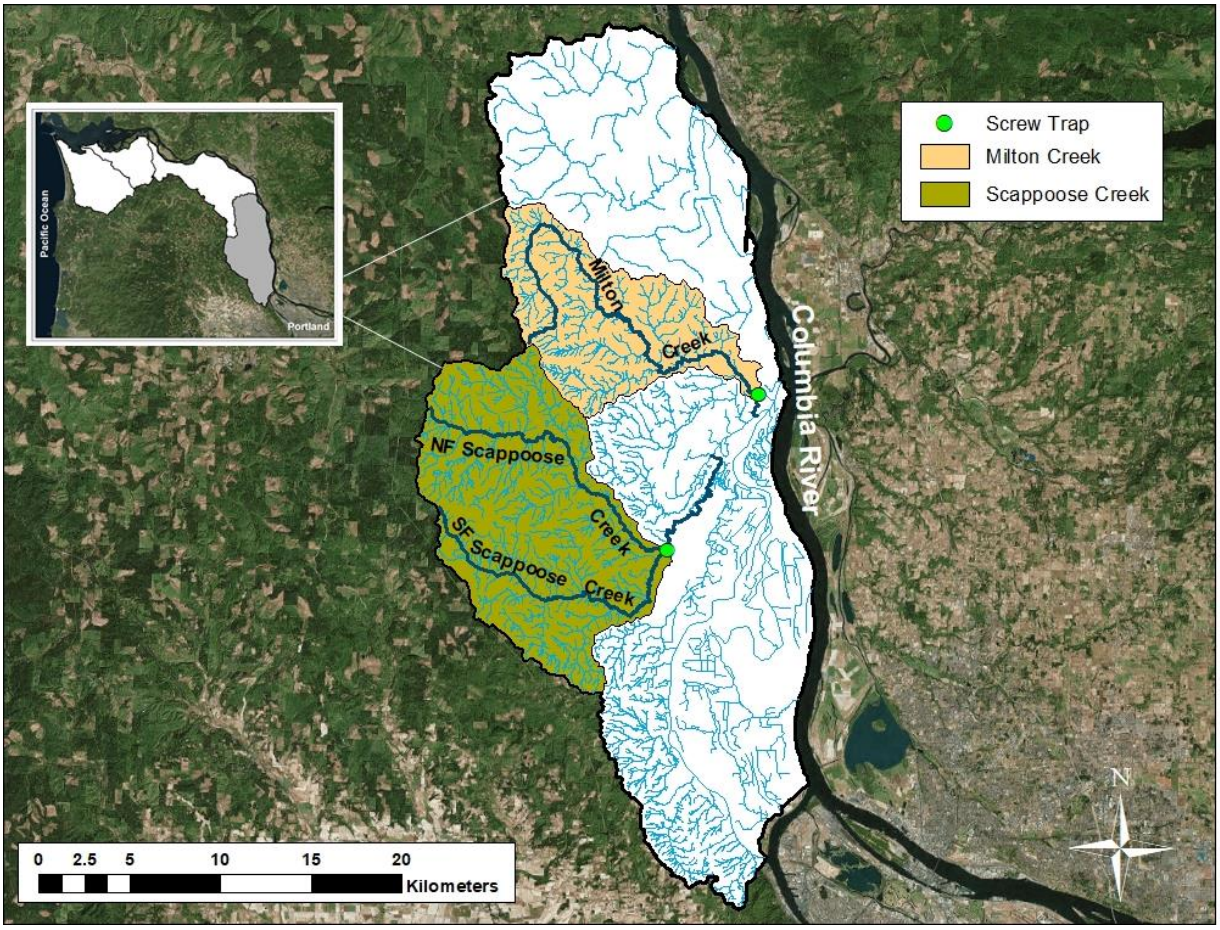

Figure 23. Watersheds monitored for juvenile salmonids *Oncorhynchus* spp. in the Scappoose Creek Basin using rotary screw traps from 2012–2019.

Other Salmonids

Few fry were observed outmigrating from Milton Creek (Tables A.3 and A.4, Figure 25), and a fry estimate could only be made for Coho in 2013 (679 ± 365 fry). Coho fry were captured sporadically after early April in 2012, but in 2013 peak catch occurred in late May (Table A.5) after a similar peak occurred at the beginning of that trapping season in late February. Mean length and weight of Coho fry was significantly larger in 2013 (59.2 mm and 3.28 g; Table A.5, Figures A.18 and A.19) than in 2012 (45.0 mm and 1.78 g; Table A.5, Figures A.18 and A.19). The small catch of Chinook fry in 2012 occurred mostly from mid-May to mid-June, whereas catch in 2013 occurred consistently throughout the entire trapping season (Table A.3). Chinook mean length and weight in 2013 (88.4 mm and 9.68 g; Table A.3, Figures A.16 and A.17) was significantly larger than in 2012 (69.7 mm and 3.72 g; Table A.3, Figures A.16 and A.17), similar to the pattern observed for Coho fry.

Figure 24. Location of the Milton Creek screw trap operated in the Scappoose Creek Basin in 2012 and 2013.

Coho smolt abundance was higher in 2012 (18,820 ± 2,570 smolts; Table A.4; Figure 26) than in 2013 (12,622 ± 1,464 smolts; Table A.4), with peak catch around mid-May in both years (Table A.5). Coho smolt mean length and weight was larger in 2013 than in 2012 (122.1 mm and 19.32 g compared to 116.7 mm and 15.93 g, respectively; Table A.5, Figures A.20 and A.21) and mean length and weight for the two years combined (117.5 mm and 16.53 g) was larger than the mean for all sites combined (114.2 mm and 15.78 g).

Steelhead smolt abundance was similar for the two years (619 ± 200 and 660 ± 249 smolts, respectively; Table A.6, Figure 26), with peak catch in 2013 occurring in early May (Table A.7) and most fish captured between mid-April and mid-May in 2012. Steelhead smolt mean length and weight over the two years (181.3 and 186.4 mm and 61.37 and 64.57 g, respectively; Table A.7) was the largest observed over all monitoring sites (Figures A.22 and A.23). Abundance of 160−249 mm Cutthroat Trout was also similar for the two years (2,681 ± 704 and 2,465 ± 839 fish, respectively, Table A.8, Figure 26), with peak catch in 2013 occurring in late April (Table A.9) and most fish captured between late April and mid-May in 2012. Additional information on catch,

estimates, timing, and size of Steelhead and Cutthroat Trout captured at the Milton Creek screw trap can be found in the Appendices.

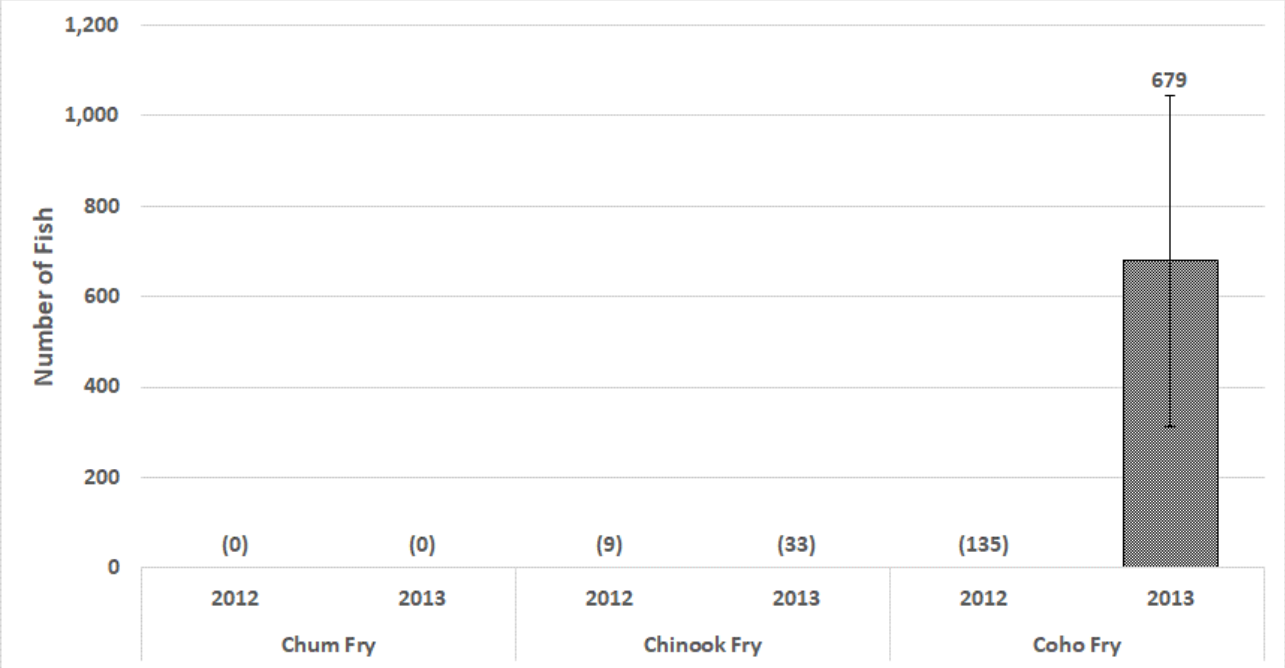

Figure 25. Population estimates of Chum *Oncorhynchus keta*, Chinook *O. tshawytscha*, and Coho *O. kisutch* fry outmigrants in Milton Creek from monitoring using a rotary screw trap, 2012 and 2013 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

Hatchery Salmonids

A significant number of hatchery salmonids were captured in Milton Creek in the two years a screw trap was operated at that site, with a similar number of Coho, Steelhead, and Chinook observed. A total of 13 hatchery Coho smolts were captured in the two years, with the majority of those fish caught in 2013 (10 fish; Table A.11) and in April (8 fish, 62%). The length ($\bar{x}$ = 132.0 mm, Range = 101–165 mm; Table A.11) and weight ($\bar{x}$ = 23.79 g, Range = 9.8–39.3 g; Table A.11) of hatchery Coho smolts was significantly larger than naturally produced Coho smolts captured at the Milton Creek screw trap in the two monitoring years (116.7 and 122.1 mm and 15.93 and 19.32 g, respectively; Table A.4, Figures A.20 and A.21).

Twelve hatchery Steelhead smolts were captured at Milton Creek, with all fish caught in 2013 between April 22nd and June 13th (Table A.11). All hatchery Steelhead smolts were large, with length ($\bar{x}$ = 208.6 mm, Range = 186–228 mm; Table A.11) and weight ($\bar{x}$ = 79.3 g, Range = 62.1–95.1 g; Table A.11) also larger than naturally produced Steelhead smolts captured at the Milton Creek screw trap in the two monitoring years (181.3 and 186.4 mm and 61.37 and 64.57 g, respectively; Table A.7, Figures A.22 and A.23), similar to that described for hatchery Coho smolts.

Thirteen hatchery Chinook were captured at Milton Creek, with the majority of those fish caught in 2013 (11 fish; Table A.11) and in March (8 fish, 62%). Compared to the size and weight of naturally produced Chinook captured at Milton Creek in 2012 and 2013 (69.7 mm and 3.72 g and 88.4 mm and 9.68 g, respectively; Table A.3, Figures A.16 and A.17) and similar to that described for both hatchery Coho and hatchery Steelhead, hatchery Chinook were significantly larger ($\bar{x}$ = 137.3 mm, Range = 111–158 mm and $\bar{x}$ = 27.76 g, Range = 16.4–36.2 g; Table A.11). Three hatchery Chinook captured in 2013 had CWTs, and were identified as spring Chinook that were released from three different hatcheries (McKenzie Hatchery, OR and Lewis River Hatchery and an unknown hatchery, WA).

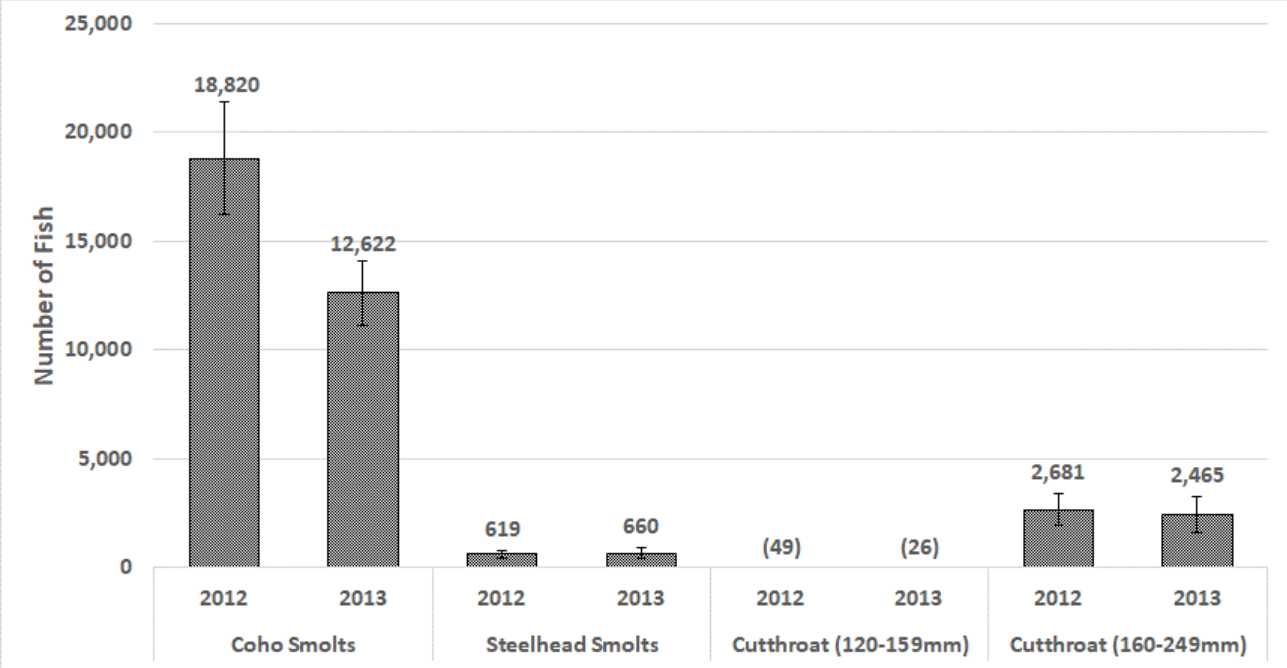

Figure 26. Population estimates of Coho *Oncorhynchus kisutch* smolt, Steelhead *O. mykiss* smolt, and Cutthroat Trout *O. clarkii clarkii* outmigrants in Milton Creek from monitoring using a rotary screw trap, 2012 and 2013 outmigration years. Extrapolated catch is shown in parentheses for years with insufficient recaptures precluding population estimation.

Non-Salmonids

Non-salmonid catch (in decreasing abundance) consisted of Peamouth, Lamprey Larva, Dace, Cottid, Sucker, and Redside Shiner, and to a lesser extent Pacific Lamprey juvenile, Western Brook Lamprey Adult, Three-Spined Stickleback, Pacific Lamprey Adult, Oriental Weatherfish, Yellow Perch, Banded Killifish, Brown Bullhead, and Mountain Whitefish (Table A.13). However, similar to observations at Bear Creek, Peamouth were by far the most dominant non-salmonid catch at Milton Creek (Table A.13) and on several occasions caused issues due to overcrowding in the trap live box during large nightly migrations. Night checks were employed at times during the

trapping season at Milton Creek to minimize the chance of overcrowding mortality in the trap live box. But these additional trap checks were largely ineffective as high variability in Peamouth nightly catch was observed, making it difficult to employ efforts during non-standard hours in a safe and effective manner. Peamouth arrived earlier in the trapping season at Milton Creek (early April) than at Bear Creek (early May), with the Peamouth migration slowly decreasing through mid-May before exhibiting another smaller increase later in the season. Other interesting non-salmonid catch included the capture of several non-native species including juvenile Yellow Perch, Brown Bullhead, and several Oriental Weatherfish. Fortunately, these species were captured in relatively low abundance (< 10 individuals each).

Scappoose Creek (Scappoose Creek Basin)

Description

Scappoose Creek flows into the south end of Scappoose Bay (Figures 1 and 23). Historically, Scappoose Creek may have supported spawning by 200 salmon, some of which may have been Chum Salmon (Parkhurst et al. 1950). However, no Chum Salmon have been observed in this system for at least 20 years. Coho Salmon, Steelhead, and Coastal Cutthroat Trout are present in the watershed and have been observed upstream of the distribution of Chum Salmon in an adult and juvenile fish trap operated on North Fork (NF) Scappoose Creek since 1999.

Very little suitable Chum habitat presently exists in Scappoose Creek (Alfonse et al. 2017a), much of which can be found intermittently between West Lane Bridge and the confluence of NF and South Fork (SF) Scappoose Creek. Habitat degradation associated with upstream hydrologic impacts, bank erosion, and excess sediment delivery and transport to lower reaches are significant issues in Scappoose Creek. The stream is also flashy and prone to flooding issues, with suitable spawning gravels generally lacking in this section.

SF Scappoose Creek flows under Highway 30 at the north edge of Scappoose, OR (Figure 27). Historically, this creek may have supported spawning by 1,000 salmon, but few of these are reported to have been Chum Salmon (Parkhurst et al. 1950). Land use in the lower section of SF Scappoose Creek is urban and developed, with a progression to rural residential and agriculture in the middle section, and industrial timber land in the upper watershed. Much of the channel is entrenched, with excess fine sediment, little to no large woody debris or gravel, few pools, no groundwater, and significant agricultural runoff (Alfonse et al. 2017a).

NF Scappoose Creek also flows under Highway 30 at the north edge of Scappoose, OR (Figure 27). Historically, this creek may have supported spawning by 600 salmon, but none of these are reported to have been Chum Salmon (Parkhurst et al. 1950). Land use in the lower section of NF Scappoose Creek is urban and developed, with a progression to rural residential in the middle section, and industrial timber land in the upper watershed. Similar to SF Scappoose

Creek, the channel in NF Scappoose Creek is also entrenched, with excess fine sediment, little to no large woody debris or gravel, and few pools (Alfonse et al. 2017a). However, NF Scappoose Creek has higher gradient, with generally larger substrate and some evidence of upwelling groundwater (Alfonse et al. 2017a).

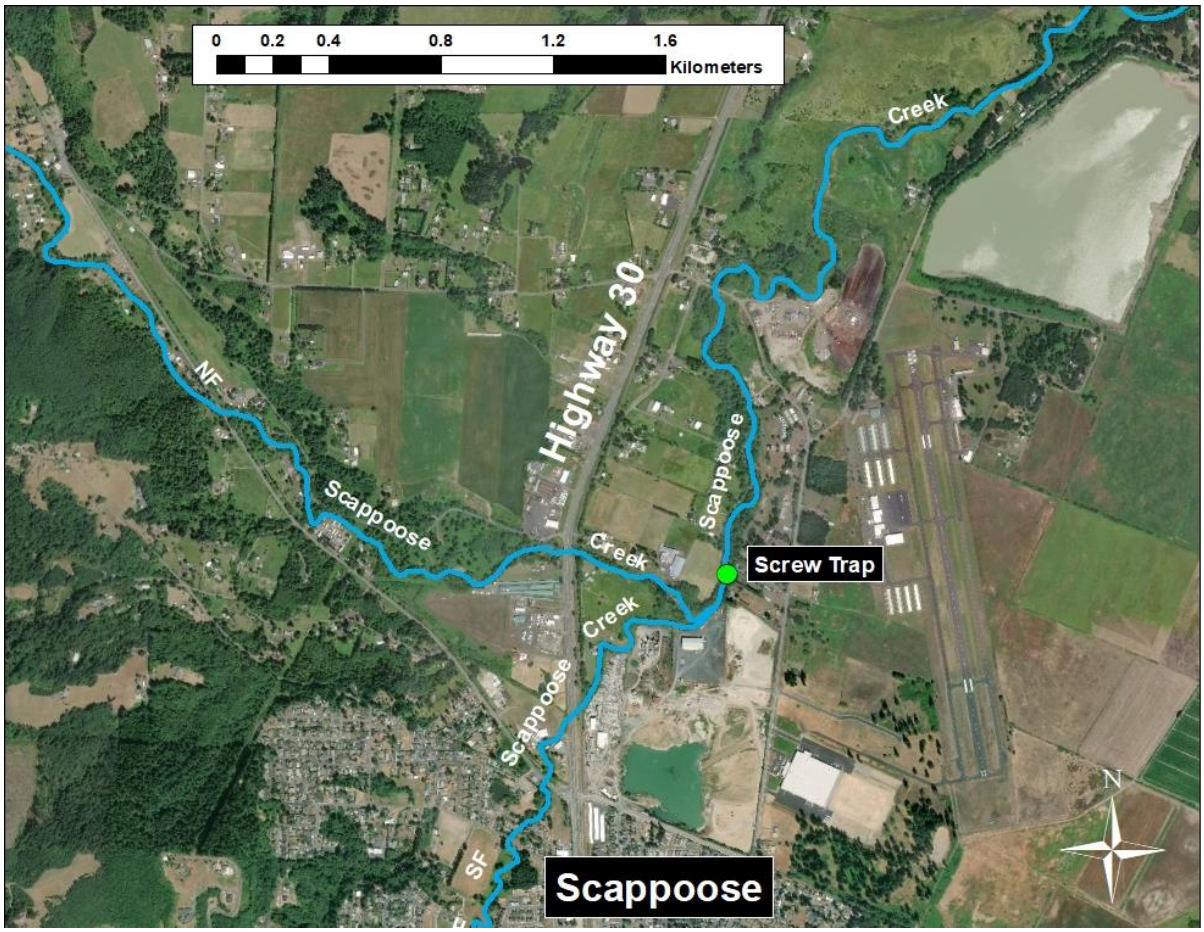

Figure 27. Location of the Scappoose Creek screw trap in the Scappoose Creek Basin in 2012.

Monitoring

Chum Salmon

The Scappoose Creek watershed was monitored for juvenile Chum Salmon in 2012 and is one of two watersheds where juvenile fish monitoring occurred in the Scappoose Creek Basin after the project began in 2012 (Figure 23). A rotary screw trap was installed immediately downstream of NF and SF Scappoose Creeks (Figure 27) on February 22nd and fished for the majority of the trapping season ending on June 21st (Table A.1). However, an extended period of high water in 2012 precluded trapping from mid-March through the beginning of April. No Chum Salmon were captured at the Scappoose Creek trap site (Table A.2).

Other Salmonids

Relatively few fish were captured at the Scappoose Creek screw trap, and population estimates could only be made for Coho smolts and 160−249 mm Cutthroat Trout due to low catch and recaptures of all other species. An estimated 5,956 ± 1,113 Coho smolts outmigrated from Scappoose Creek in 2012 (Table A.4), with peak catch occurring at the end of May (Table A.5). Coho smolt mean length and weight was 119.4 mm and 17.59 g, respectively (Table A.5), with Coho smolts captured between 61 and 188 mm and 2.6 and 39.8 g (Figures A.20 and A.21). An estimated 1,666 ± 678 160−249 mm Cutthroat Trout outmigrated past the screw trap location in 2012 (Table A.8), with peak catch occurring from May 21st through May 27th (Table A.9). No other size classes had sufficient recaptures for population estimation, with extrapolated catches for Coho fry (93 fry), 120−159 mm Cutthroat (61 fish), and Steelhead smolts (50 fish) significantly higher than extrapolated catch of all other size classes where insufficient recaptures precluded population estimation. Additional information on catch, estimates, timing, and size for all species and size classes can be found in the Appendices.

Hatchery Salmonids

One hatchery Coho smolt was captured at the Scappoose Creek screw trap in 2012 on April 16th, measuring 121 mm and weighing 18.5 g (Table A.11). No other hatchery fish were captured at the Scappoose Creek screw trap (Table A.11).

Non-Salmonids

Non-salmonid catch (in decreasing abundance) consisted of Longnose Dace, Lamprey Larva, Cottid, and Western Brook Lamprey Adult, and to a much lesser extent Three-Spined Stickleback, Peamouth, Sucker, Pacific Lamprey Adult, and Northern Pikeminnow (Table A.13). Dace and Western Brook Lamprey adults were primarily captured after late April, whereas Lamprey Larva and Cottids were captured sporadically throughout the trapping season. Few catches were made of all other non-salmonid species.

DISCUSSION

Chum Salmon

Chum Salmon fry were captured at six of the ten juvenile sampling sites operated from 2012 through 2019. However, fry production at three of the sites (i.e., Big, Graham, and Stewart Creeks) was directly attributable to adult Chum Salmon outplanting efforts by the Chum Salmon Reintroduction project. From 2009 to 2014, unmarked adults returning to Big Creek Hatchery were transported (i.e., outplanted) upstream of the hatchery and released in an area of low gradient habitat. This location is above two weirs and a steep canyon that function as a barrier to migration of adult Chum Salmon. In 2012 and 2014, the number of adults outplanted upstream of

the hatchery was sufficient to warrant an evaluation of fry production from these releases. Modest Chum fry production was observed in the two evaluation years, suggesting Chum spawning habitat is limited upstream of the hatchery and this section of Big Creek is unlikely to provide a significant benefit to recovery efforts unless habitat can be restored. Chum spawning has been observed on surveys conducted downstream of the hatchery in both Big and Little Creeks and these areas may be more suitable for recovery efforts. However, the number of naturally produced Chum fry outmigrating annually from both systems is currently unknown.

Few Chum fry were produced from outplanting efforts into Graham Creek in 2013, as the creek appears to have too little cover or suitable habitat to benefit Chum recovery efforts despite sufficient spawning gravel and some groundwater upwelling. The lower section of Graham Creek that would be most suitable for Chum spawning experiences substantial gravel movement due to a landslide upstream and sediment deposition occurs regularly during fall storms. These two impacts were likely a detriment to the spawning success of outplanted Chum Salmon in Graham Creek as spawning was only observed in an undersized culvert at the Highway 30 crossing. The Highway 30 culvert will need to be replaced and the landslide upstream repaired before any restoration activities could benefit Chum recovery efforts in Graham Creek.

Adult outplanting into Stewart Creek produced sufficient Chum fry production to achieve freshwater survival rates > 25% in some years. Minimal Chum fry production in 2016 (after fall floods in 2015) indicates fry production in the system can be limited by high flow events, which cause redd scour and gravel movement. This site has suitable spawning gravel, sufficient pool habitat, and woody debris is present throughout the section of creek where outplanted Chum Salmon were most often observed spawning, although upwelling groundwater has not been detected in this stream. Despite three years of outplanting with observed fry production, no adults have returned to Stewart Creek. As such, it appears that a combination of habitat restoration and further investigation of non-habitat limiting factors is needed to improve returns.

Substantial variation in juvenile Chum production was observed among sites not associated with adult outplanting, and among monitoring years. Bear Creek had the highest observed production of Chum fry, indicating this system is likely to be important in Chum recovery efforts. However, significant fry production was only observed in 2017 after an estimated 41,620 adult Chum Salmon returned to the LCR in 2016 (the largest return in over 50 years). In 2018 and 2019, few Chum fry were captured at the Bear Creek screw trap which is not surprising considering few adult Chum were observed in Oregon tributaries to the LCR in 2017 and 2018. A low level of Chum fry production was also observed in the Lewis and Clark and Clatskanie Rivers in 2017, following the large adult return to the LCR the previous fall. Unfortunately, unusual flooding occurred in the spring at both monitoring sites, resulting in low trap efficiencies. In addition, the large size of each system made trapping difficult. As a result, Chum catch for both sites in 2017 underrepresented

the total number of outmigrants and could not be used to assess juvenile production from the high abundance of adult spawners in 2016. Chum fry were only observed in the Clatskanie River in one other year (2018), but catch was low and no estimate of total outmigrants could be made. No Chum Salmon adults have been observed in the Clatskanie River on spawning surveys in recent years, but suitable spawning habitat exists in the river. A small number of Chum Salmon adults have been observed in the last several years in the Lewis and Clark River.

No Chum Salmon fry were observed at Milton and Scappoose Creeks (Scappoose Creek Population) or in Conyers or Beaver Creeks (Clatskanie River Population). Habitat conditions in these systems ranges from good Chum habitat in Beaver Creek to almost no Chum habitat in Milton and Scappoose Creeks (Alfonse et al. 2017a). Considering habitat availability, spawner observations, fry production, and outplanting efforts throughout the Clatskanie River population, this population remains a high priority for monitoring and recovery efforts. The Lewis and Clark River also remains a high priority for continued efforts as the basin has suitable habitat and Chum spawning and modest fry production have been observed in recent years.

Chum fry migration timing varied by site, with catch occurring as early as February 25th in Bear Creek, and as late as May 13th in Stewart Creek. For years where Chum fry estimates could be made, peak catch typically occurred from late March through early April. However, in years where peak estimates could not be made (i.e., insufficient recaptures for population estimation), Chum fry catch generally occurred from early April through late April and sometimes, into early May. Chum fry outmigrated at roughly the same size and weight (40 mm and 0.4 g) from all sites, with fry captured as small as 32 mm and as large as 50 mm.

Peak catch and size of Chum fry reported here are fairly consistent with that described for Grays River and Crazy Johnson Creek, WA (Hillson et al. 2017) and an Oregon coastal population (Little NF Wilson River, OR; D. J. Wiley, unpublished data). The percentage of Chum fry catch occurring in March was high in both Grays River ($\bar{x}$ = 75%, Range = 69−84%; 2008−2016 outmigration years) and Crazy Johnson Creek ($\bar{x}$ = 65%, Range = 37−79%; 2011−2016 outmigration years). This was consistent with peak Chum fry catch observed in March at some sites reported in this document (i.e., Bear Creek, 2017; Stewart Creek, 2015 and 2016) but was not consistent with other sites (e.g. Lewis and Clark River, 2017; Big Creek, 2013 and 2015; Clatskanie River, 2017 and 2018) where most Chum fry were captured in April. The mean annual size of Chum fry from both Grays River and Crazy Johnson Creek that were measured for size selectivity analyses (39−40 mm; Hillson et al. 2017) was consistent with the mean Chum fry size observed at Chum Reintroduction sampling sites (40 mm).

Monitoring data from screw trap operation in the Little NF Wilson River, OR from 1998 through 2013 showed peak Chum fry catch mostly occurred during the first two weeks in April (11

monitoring years; 68%) and to a lesser extent in late March (5 monitoring years; 32%). This was later than observed at Grays River and Crazy Johnson Creek and more similar to Chum fry outmigration timing observed at Chum Reintroduction Project sampling sites. However, in several years a few Chum fry were captured as late as early June in the Little NF Wilson River, significantly later than the last observation date for Chum Reintroduction Project sampling sites (Stewart Creek, 2014; May 13th). Mean annual size of Chum fry outmigrants in the Little NF Wilson River ($\bar{x}$ = 41.1 mm; Range 37.6 to 46.2 mm) was similar to Chum fry size reported from Grays River, Crazy Johnson Creek, and Chum Reintroduction Project sampling sites.

Other Salmonids

Chinook were absent in all years at Big and Stewart Creeks, but present in relatively small numbers at all other sites except for the Clatskanie and Lewis and Clark Rivers. However, considering the size of both the Clatskanie and Lewis and Clark Rivers, Chinook production was modest with less than 10,000 fry outmigrants estimated in all monitoring years. In the Clatskanie River, Chinook production was also inconsistent from year to year. In 2016, only two Chinook were captured for the entire season and in three other years (2014, 2017, and 2019) less than 1,000 fry outmigrants were estimated. Few individuals were captured at other sites and an estimate could only be made in 2012 at Conyers Creek (27 fish). Naturally produced Chinook outmigrated at a significantly smaller size than the size of hatchery Chinook captured at each site (134 mm and 27 g), with the mean outmigration size and weight of naturally produced fish across all sites around 53 mm and slightly over 2 g. No naturally produced Chinook were observed as residuals or to be precocial, unlike what was observed for some hatchery Chinook.

Coho were present in every year at all sampling sites, and were the most abundant of all salmonids captured. Coho fry production varied considerably by site and year. In the Clatskanie River in 2015 following a strong adult Coho return to the LCR the previous fall, over 500,000 Coho fry were estimated to have outmigrated past the screw trap site. Relatively few fry were estimated or caught in most other years in the Clatskanie River, suggesting the large outmigration in 2015 may have resulted from high spawner abundance in 2014. In years when few Coho fry were captured in the Clatskanie River it is likely that the available habitat in the basin was underutilized and most fish chose to remain in the system as opposed to outmigrating. In contrast, in Graham and Stewart Creeks significant Coho fry outmigrations occurred in all years. For instance, Coho fry outmigrant estimates in Stewart and Graham Creeks in 2014 (13,025 and 22,769 fry, respectively) were two to four times higher than the estimate for the entire Clatskanie River in that same year (6,307 fry). Very few Coho smolt outmigrants were estimated from Graham and Stewart Creeks despite significant fry production, suggesting most Coho fry outmigrate from these small systems to rear and then smolt in downstream sloughs or other habitats. This could result from limited rearing habitat in each creek or better rearing opportunities elsewhere.

Significant Coho smolt production was observed in the Clatskanie River and Milton Creek. In the Clatskanie River, smolt production was fairly consistent and typically ranged from 25,000 to 55,000 smolts except for 2017, when low trap efficiency likely underestimated the number of outmigrants. In Milton Creek, approximately 13,000 and 19,000 Coho smolts were estimated in 2012 and 2013, respectively. Despite poor habitat quality in the lower section of Milton Creek which is currently unsuitable for Chum use and recovery (as described earlier), upstream habitats appear to be suitable for successful Coho spawning and rearing. Very few Coho fry were observed outmigrating from Milton Creek in both monitoring years, suggesting sufficient rearing opportunities for fry to assume the typical one year freshwater residence before outmigrating as a smolt the following spring. Coho smolt production at other sites ranged from about 1,000 to 6,000 smolts annually.

Coho smolt size was variable across all sites, with the biggest smolts observed in Beaver Creek and the smallest smolts observed in Conyers Creek. Smolts were captured under 100 mm at all sites except Beaver Creek where the mean size for the entire trapping season (127 mm) was significantly larger than all other sites (108−121 mm). Coho smolt size at Chum Reintroduction project monitoring sites was also generally larger than the size of smolts observed outmigrating from Oregon streams monitored by the Life Cycle Monitoring (LCM) project from 1997 through 2014 (Suring et al. 2015). The only coastal site with larger smolts ($\bar{x}$ = 130.7 mm; Range 117.4−146.4 mm) was Mill Creek in the Yaquina Basin where smolts rear for part of the year in a reservoir environment. Additionally, Coho smolts from NF Scappoose Creek in the Lower Columbia River Basin were also larger ($\bar{x}$ = 132.0 mm; Range 120.6−142.3 mm) than most Chum Reintroduction project sampling sites. Interestingly, in 2012, Coho smolts from NF Scappoose Creek (Suring et al. 2015) and mainstem Scappoose Creek (Chum Reintroduction project site) were nearly identical in size (120.6 mm and 119.4 mm, respectively). This was the smallest mean annual Coho smolt size observed at NF Scappoose Creek in 14 years where size data were available.

Steelhead and Cutthroat Trout were present in every year at all sites, although generally few individuals less than 120 mm were captured as most fish this size and smaller were likely non-migratory. Steelhead smolts were most abundant in Clatskanie River, and to a lesser extent in Bear and Big Creeks and then Milton and Conyers Creeks. Only a few individuals were captured in Graham and Stewart Creeks, with adult Steelhead returns to each creek likely infrequent due to limited Steelhead spawning and rearing habitat. Clatskanie River Steelhead smolt estimates were consistently large, although the estimate in 2018 (42,597 smolts) was likely an overestimate due to poor trap efficiency in that year. Monitoring data for all other years demonstrate that the Clatskanie River Basin is capable of producing 4,000 to 20,000 smolts annually. Annual Steelhead smolt estimates for Bear and Big Creeks (1,000−3,500 smolts) and Milton and Conyers Creeks (400−700 smolts) were significantly smaller. Steelhead smolt size was extremely variable, even when excluding fish from Graham and Stewart Creeks where few fish were captured. Milton and

Beaver Creeks had significantly bigger Steelhead smolts than all other Chum Reintroduction project monitoring sites, with smolts averaging around 180 mm. This was also larger than the size of Steelhead smolts reported from coastal monitoring sites by the LCM project (Suring et al. 2015). Steelhead smolt size at other Chum Reintroduction project monitoring sites generally ranged from 160−169 mm, which was smaller than reported for LCM sites on the north Oregon Coast (i.e., NF Nehalem and EF Trask Rivers) but larger than southern sites (i.e., Mill Creek-Siletz River, Cascade Creek-Alsea River, WF Smith River; Suring et al. 2015). The one exception was in Conyers Creek, where Steelhead smolt mean size was small (150 mm) similar to that observed for Coho smolts.

Cutthroat Trout were common at most sites, except for Beaver, Graham, and Stewart Creeks and in the Lewis and Clark River. However, the modest catch in Lewis and Clark River is likely due in part to high flows and low trap efficiency in the one year monitored at this site. At most sites where Cutthroat Trout were frequently captured, 160−249 mm Cutthroat Trout were more abundant than 120−159 mm Cutthroat Trout, except for Conyers Creek where fairly equal numbers of the two size classes occurred. Cutthroat Trout were most abundant in Clatskanie River and Milton Creek, with estimates for 160−249 mm Cutthroat Trout ranging from about 3,000−8,000 migrants in Clatskanie River and 2,500 migrants in Milton Creek. Estimates for all other sites were generally less than 1,000 migrants except for Bear Creek in 2019 and Scappoose Creek in 2012. At least a few sea-run Cutthroat Trout (i.e., ≥ 250 mm) were observed at all sites except Stewart Creek, with fish as large as 435 mm captured. Visual inspection of these fish showed some were underweight and in poor condition, likely indicating a post-spawn migration downstream into the estuary. Other fish were observed to be relatively bright and in good condition and assumed to be migrating upstream to spawn.

Hatchery Salmonids

No hatchery salmonids were captured at the Big Creek screw trap site in 2013 or 2015, or in Graham Creek in 2014. However, hatchery fish were captured in at least one monitoring year at all other juvenile sampling sites. Hatchery steelhead were only observed at Bear Creek in 2018 and 2019 and at Milton Creek in 2013, with catches occurring from mid-April through early May in Bear Creek and mid-April through mid-June at Milton Creek. No hatchery Steelhead were detected with a CWT, so the origin of these fish could not be positively determined. However, hatchery Steelhead were captured at the Bear Creek screw trap within two to three weeks of direct releases of hatchery Steelhead into Big Creek (approximately 7 km upstream) from Big Creek Hatchery, so it is likely this is the source of at least some of these hatchery strays. The origin of Milton Creek hatchery Steelhead is unknown, and it is difficult to ascertain a possible origin as numerous hatcheries exist upstream in the LCR and its tributaries. The size and weight of hatchery steelhead at both sites was substantially larger than naturally produced steelhead in both systems.

Hatchery Chinook were observed frequently at juvenile monitoring sites, with strays captured at six of the ten sites. However, relatively few fish were captured in any given year. Hatchery Chinook were observed in Bear Creek (2017−2019), Beaver Creek (2016), Clatskanie River (2013, 2015, 2017−2019), Conyers Creek (2013 and 2016), Milton Creek (2012 and 2013) and Stewart Creek (2014), with three or fewer strays captured in most years (79%). In 2013, three hatchery Chinook were detected positive for a CWT and sourced to three separate hatcheries. All were spring Chinook, with individual origins to McKenzie River Hatchery (OR), Lewis River Hatchery (WA), and an unknown hatchery (WA). The Lewis River hatchery Chinook was released in 2013 between February 1st and February 15th, and later captured at the Milton Creek trap about one month later (March 4th). The McKenzie River hatchery Chinook was originally released in 2012 on November 2nd and several months later captured at the Milton Creek screw trap in 2013 on March 7th. No further information is available on the Chinook originating from the unknown hatchery in Washington. Two additional hatchery spring Chinook with CWTs were captured in Bear Creek in 2019. Interestingly, these fish were released in late February from net pens located in Youngs Bay and then captured at the Bear Creek screw trap in early to late March (5 and 22 days later). This required each fish to enter the Columbia River and then swim upstream approximately 25 Rkm before entering Svensen Slough and then Bear Creek. The size and weight of hatchery Chinook captured at juvenile monitoring sites was significantly larger than naturally produced Chinook, with several fish observed to be precocial males that released milt during handling.

Hatchery Coho were captured at five of the ten sampling sites, with only one capture occurring in the Lewis and Clark River (2017), Clatskanie River (2013 and 2018), and Scappoose Creek (2012). However, more hatchery Coho were captured in Milton Creek in 2012 (3 fish) and 2013 (10 fish) and a substantial number of strays were caught in Bear Creek from 2017 through 2019 (1−221 fish). The 2017 hatchery Coho catch in Bear Creek (1 fish) should be considered an underestimate, as trap efficiency was poor throughout the season. Additionally, 524 hatchery Coho were estimated from the 2019 catch, providing a better representation of how many hatchery Coho strayed into Bear Creek in that year. Most hatchery Coho were captured in April and May, although in 2019 at the Bear Creek screw trap hatchery Coho were captured throughout the entire trapping season from late February through May. A total of 15 hatchery Coho were recovered with CWTs, of which the majority were associated with Tongue Point net pen releases approximately 8 Rkm downstream in the Columbia River. Three other recoveries were associated with direct releases into Big Creek from Big Creek Hatchery, as suspected for the origin of hatchery Steelhead. Capture dates of hatchery Coho at the Bear Creek screw trap varied from as little as two days to nearly three weeks after initial release. However, one fish in 2019 appears to have escaped the Tongue Point net pens prior to the official release date. This fish was captured on April 20th, but the tag code associated with this hatchery fish indicated a release date of April 24th. Although the majority of hatchery Coho were captured after early April, a small number of strays

at the Bear Creek screw trap in 2019 were captured consistently from February through the end of March. However, none had CWTs to determine origin or other release information.

Non-Salmonids

At least twelve native fish species (not including salmonids) were captured at juvenile sampling sites from 2012–2019. Native species included Pacific and Western Brook Lamprey, Chiselmouth, Cottids, Largescale Sucker, Longnose Dace, Mountain Whitefish, Peamouth, Northern Pikeminnow, Redside Shiner, Speckled Dace, and Three-Spined Stickleback. Peamouth were by far the most abundant native species encountered, as nearly 50,000 individuals were captured from six of the ten monitoring sites. Peamouth were absent in Big Creek upstream of the hatchery and in Conyers, Graham, and Stewart Creeks in the Clatskanie River population. Abundance was highest in Bear Creek (Big Creek population) and Milton Creek (Scappoose Creek population) which accounted for roughly 90% of all captures.

Western Brook and Pacific Lamprey and Cottids were also commonly captured, with catches for all three species occurring at all sites in nearly every year. Pacific Lamprey adults were most common in the Clatskanie River population at Beaver Creek and in the Clatskanie River. Western Brook Lamprey adults were abundant in Bear Creek and in the Clatskanie River and Beaver, Conyers, and Graham Creeks (Clatskanie River population). Lamprey Larva and Cottids were also common at most sites but not differentiated to species. Three-Spined Stickleback were caught in abundance in the Clatskanie River from 2017 through 2019 when the screw trap was moved close to head of tide. Additionally, Three-Spined Stickleback were also abundant at the Lewis and Clark River trap in 2017. Dace were abundant at Milton and Scappoose Creeks, but not identified to species at either site. However, catches at another screw trap site on NF Scappoose Creek (Suring et al. 2015) suggest these fish were most likely Longnose Dace. Both Speckled and Longnose Dace were caught in small abundance at other Chum Reintroduction project juvenile sampling sites.

Northern Pikeminnow were absent at Bear, Big, and Milton Creeks, but at least a few individuals were captured at all other sites. Some large Northern Pikeminnow were captured in the Clatskanie River in late May to early June that were found to have predated on Coho smolts and Cutthroat Trout. Juvenile Northern Pikeminnow were also encountered in screw trap catch at some sites. Suckers were not differentiated to species in early monitoring years, but were most likely Largescale Suckers. No suckers were observed in Stewart or Big Creeks, with the highest catches occurring in Bear Creek. Other native species captured included a single individual Mountain Whitefish captured from both the Clatskanie River (2018) and Milton Creek (2012) and one Chiselmouth from the Clatskanie River in 2017.

Nine non-native fish species were captured at juvenile sampling sites from 2012–2019. However, catch was low for all species except Banded Killifish which were captured at six of the ten monitoring sites. Banded Killifish were present in Bear, Beaver, Graham, and Milton Creeks and the Clatskanie and Lewis and Clark Rivers. However, most Banded Killifish captures (142 fish, 83%) occurred in the Clatskanie River from 2017 through 2019 when the screw trap was located near head of tide. Bluegill and Pumpkinseed were both captured at juvenile sampling sites, with most sunfish catches occurring at Bear Creek in 2017 and 2018 (15 fish) after high water events likely flushed fish from upstream ponds into the creek. Additional captures occurred in Beaver and Graham Creeks (5 fish) and the Clatskanie and Lewis and Clark Rivers (3 fish). Oriental Weatherfish and Yellow Perch were only encountered in Milton Creek and Golden Shiner, Common Goldfish, and Goby (species unknown) only found in Clatskanie River. Brown Bullhead were observed in Milton and Beaver Creeks. Fortunately, less than ten individuals of each of these species were captured over the course of juvenile monitoring, with most fish euthanized as voucher specimens or for positive identification.

LITERATURE CITED

Alfonse, B., K. Homel, J. E. Nunnally, and E. Suring. 2017a. Chum Salmon Spawning Habitat Report for the Clatskanie River and Scappoose Creek Populations. Oregon Department of Fish and Wildlife. Clackamas, Oregon. 196 pages.

Alfonse, B., K. Homel, J. E. Nunnally, and E. Suring. 2017b. Chum Salmon Spawning Habitat Report for the Youngs Bay and Big Creek Populations. Oregon Department of Fish and Wildlife. Clackamas, Oregon. 134 pages.

Bischoff, J. M., R. B. Raymond, K. U. Snyder, J. Bergeron, and S. K. Binder. 2000a. Youngs Bay Watershed assessment final report. 199 pages. Available at: https://nrimp.dfw.state.or.us/web%20stores/data%20libraries/files/Watershed%20Councils/Watershed%20Councils_177_DOC_YngsBayassessment.pdf

Bischoff, J. M., R. B. Raymond, K. U. Snyder, J. Bergeron, and S. K. Binder. 2000b. Nicolai-Wickiup Watershed assessment final report. 172 pages. Available at: http://www.clatsopwatersheds.org/docs/pdf/assessments/nicolai-wickiup-watershed-assessment-2000.pdf

Bonner, S. J. and Schwarz, C. J. 2012. BTSPAS: Bayesian Time Stratified Petersen Analysis System. R Package Version 2012.0219.

Clemens, B. J. 2019. A call for standard terminology for lamprey life stages. Fisheries 44(5):243−245.

Fulton, L. A. 1970. Spawning areas and abundance of Steelhead Trout, Coho, Sockeye, and Chum Salmon in the Columbia River basin-past and present. NMFS Special scientific report-Fisheries 618. 37 pages.

Hillson, T., K. Bentley, D. Rawding, J. Grobelny. 2017. Lower Columbia River juvenile chum salmon monitoring: abundance estimates for chum, Chinook, coho, and steelhead. Washington Department of Fish and Wildlife, Olympia, Washington. FPT 17−02, 477 pages.

Homel, K. M., M. P. Small, and M. Kissler. 2019. Oregon Chum Reintroduction Monitoring 2019: juvenile genotyping. Washington Department of Fish and Wildlife, Olympia, Washington, 9 pages.

McElhany, P., T. Backman, C. Busack, S. Kolmes, J. Myers, D. Rawding, A. Steel, C. Steward, T. Whitesel, and C. Willis. 2004. Status evaluation of salmon and steelhead populations in the Willamette and LCR Basins. Willamette/ Lower Columbia Technical Recovery Team. NOAA Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington.

McElhany, P., M. Chilcote, J. Myers, and R. Beamesderfer. 2007. Viability status of Oregon salmon and steelhead populations in the Willamette and lower Columbia Basins. Willamette/ Lower Columbia Technical Recovery Team. NOAA Fisheries Service, Northwest Fisheries Science Center, Seattle, Washington. Available at: https://www.nwfsc.noaa.gov/research/divisions/cb/genetics/trt/wlc/trt_wlc_psr2007.cfm

Myers, J., C. Busack, D. Rawding, and A. Marshall. 2003. Historical population structure of Willamette and lower Columbia River basin Pacific salmonids. 92 Willamette/Lower Columbia River Technical Recovery Team report. (July 2003). Available at: https://www.salmonrecovery.gov/Files/BiologicalOpinions/2000/g_wlc_popid.pdf

Myers, J. C., C. Busack, D. Rawding, A. Marshal, D. Teel, D. M. Van Doornik, and M. T. Maher. 2006. Historical population structure of Pacific salmonids in the Willamette River and lower Columbia River basins. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-73, 311 pages. Available at: https://www.nwfsc.noaa.gov/assets/25/302_04042006_153011_PopIdTM73Final.pdf

NMFS National Marine Fisheries Service. 1999. Endangered and threatened species: Threatened status for two ESUs of chum salmon in Washington and Oregon. Federal Register 64 (57): 14508.

ODFW Oregon Department of Fish and Wildlife. 2006. 2005 Oregon native fish status report. Volume II. Assessment methods and population results. Oregon Department of Fish and Wildlife. Salem, Oregon.

ODFW. 2010. Lower Columbia River conservation and recovery plan for Oregon populations of salmon and steelhead. Appendix I: Oregon's Columbia River Chum Salmon recovery strategy. Available at: http://www.dfw.state.or.us/fish/CRP/docs/lower-columbia/OR_LCR_Plan_Appendices%20-%20Aug_6_2010_Final.pdf

Parkhurst, Z. E., F. G. Bryant, and R. S. Nielson. 1950. Survey of the Columbia River and its tributaries. Part 3. USFWS Special Scientific Report–Fisheries, No. 36, 103 pages.

Small, M. P., K. M. Homel, and V. Smilansky. 2014. Parentage analysis for Chum salmon fry captured below experimental adult outplanting site in Graham Creek, Oregon. Washington Department of Fish and Wildlife, Olympia, Washington, 14 pages.

Suring, E., P. Burns, R. J. Constable, C. M. Lorion, and D. J. Wiley. 2015. Salmonid Life Cycle Monitoring in Western Oregon streams, 2012−2014. Monitoring Program Report Number OPSW-ODFW-2015-2, Oregon Department of Fish and Wildlife, Salem, Oregon. Available at: https://odfwlcm.forestry.oregonstate.edu/sites/default/files/LCMRpt2014.pdf

Wallis, J. 1963. An evaluation of the Big Creek Salmon Hatchery. Res. Lab. Rept., Ore. Fish Comm., Clackamas, Oregon. 64 pages.

Willis, R. A., M. D. Collins, and R. E. Sams. 1960. Environmental survey report pertaining to salmon and steelhead in certain rivers of eastern Oregon and the Willamette River and its tributaries. Part II. Survey reports of the Willamette River and its tributaries. Fish Commission Oregon, Research Division, Clackamas, Ore. 554 pages.

APPENDICES

Table A.1. Coordinates and trapping period for juvenile sites sampled in the Lower Columbia River Basin from 2012–2019.

Basin	Site	Site Coordinates & Trapping Period							
		2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Youngs Bay	Lewis & Clark R						3/2–6/14 **Lat: 46.06583** **Lon: -123.840**		
Big Cr	Bear Cr						2/25–6/5	2/21–5/23	2/25–5/26
							Lat: 46.16462 **Lon: -123.668**		
	Big Cr		2/14–6/16 **Lat: 46.14499** **Lon: -123.575**		2/25–6/17 **Lat: 46.14394** **Lon: -123.574**				
Clatskanie R	Graham Cr			2/27–6/15 **Lat: 46.11614** **Lon: -123.270**					
	Conyers Cr	2/22–6/13	2/24–6/10			2/18–6/3			
		Lat: 46.09599 **Lon: -123.208**				**Same as 2012/2013**			
	Clatskanie R	2/22–6/21	2/19–6/16	3/1–6/15	2/25–6/18	2/17–6/14	3/2–6/14	2/21–6/11	2/27–6/9
		Lat: 46.09869 **Lon: -123.174**			**Lat: 46.08590** **Lon: -123.164**		**Lat: 46.10026** **Lon: -123.178**		
	Beaver Cr					3/9–5/30 **Lat: 46.11156** **Lon: -123.161**			
	Stewart Cr			3/1–5/29 **Lat: 46.12974** **Lon: -123.157**	2/28–6/5 **Lat: 46.12998** **Lon: -123.156**	2/17–5/12			
Scappoose Cr	Milton Cr	2/23–6/16	2/24–6/16						
		Lat: 45.84906 **Lon: -122.810**							
	Scappoose Cr	2/22–6/21 **Lat: 45.77054** **Lon: -122.872**							

Table A.2. Summary of annual catch (Catch), population estimate (Est.) with 95% confidence interval (CI), percentage trap efficiency (Eff.), population estimate method (PopEst Method), catch range and peak catch dates, and average length and weight with 95% confidence interval of Chum Salmon *Oncorhynchus keta* captured at juvenile sampling sites from 2012–2019. Numbers in parentheses indicate extrapolated catch due to insufficient recaptures for population estimation.

Trap	Chum Fry													
						PopEst	Catch		Length			Weight		
Year	Catch	Est.	±	CI	Eff.[a]	Method	Range	Peak[b]	Fork	±	CI	Grams	±	CI
Bear Cr														
2017	3,787	61,802	±	11,650	6%	Stratified	2/27–5/8	3/23	39.8	±	0.3	0.46	±	0.01
2018	(17)				0%		2/25–4/5		41.7	±	0.7	0.43	±	0.06
2019	(25)				0%		3/25–4/22		38.4	±	0.7	0.36	±	0.02
Beaver Cr														
2016	(0)													
Big Cr														
2013	(45)				0%		4/4–4/21		38.6	±	0.3	0.46	±	0.02
2015	2,591	12,649	±	1,425	20%	Stratified	2/26–5/5	4/9	40.2	±	0.2	0.40	±	0.01
Clatskanie R.														
2012	(0)													
2013	(0)													
2014	(0)													
2015	(0)													
2016	(0)													
2017	(19)				0%		4/4–5/2		40.1	±	1.4	0.39	±	0.05
2018	(20)				6%		3/30–4/16		41.8	±	0.4	0.40	±	0.02
2019	(0)													
Conyers Cr.														
2012	(0)													
2013	(0)													
2016	(0)													

Trap Year	Chum Fry													
	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch		Length			Weight		
							Range	Peak[b]	Fork	±	CI	Grams	±	CI
Graham Cr														
2014	(15)						4/25–5/4		39.5	±	0.4	0.39	±	0.01
Lewis & Clark R.														
2017	(41)				0%		4/6–4/27		40.5	±	0.6	0.47	±	0.03
Milton Cr														
2012	(0)													
2013	(0)													
Scappoose Cr														
2012	(0)													
Stewart Cr														
2014	743	4,109	±	831	19%	Pooled	4/11–5/13		39.4	±	0.2	0.37	±	0.01
2015	3,107	9,042	±	939	34%	Stratified	3/6–4/30	3/26	37.8	±	0.2	0.39	±	0.01
2016	122	334	±	86	33%	Stratified	2/29–4/23	3/24	40.0	±	0.4	0.41	±	0.01

[a] Weighted efficiency is shown for size classes with Petersen Stratified population estimates and overall efficiency for size classes with Petersen Pooled estimates or extrapolated catch.

[b] Peak migration timing is the date at the middle of the sampling week when outmigrant estimation was highest in a given year.

Table A.3. Summary of annual catch (Catch), population estimate (Est.) with 95% confidence interval (CI), percentage trap efficiency (Eff.), population estimate method (PopEst Method), catch range and peak catch dates, and average length and weight with 95% confidence interval of Chinook Salmon *Oncorhynchus tshawytscha* captured at juvenile sampling sites from 2012–2019. Numbers in parentheses indicate extrapolated catch due to insufficient recaptures for population estimation.

Trap Year	Chinook Fry													
	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch		Length			Weight		
							Range	Peak[b]	Fork	±	CI	Grams	±	CI
Bear Cr														
2017	(3)				0%		4/1–6/5		50.0	±	139.8	1.75	±	17.15
2018	(10)				10%		2/26–4/27		40.4	±	7.5	0.61	±	0.65
2019	(3)				0%		5/24–5/25		77.0	±	279.5	4.90	±	43.20
Beaver Cr														
2016	(9)				43%		4/4–5/30		70.7	±	15.4	4.68	±	2.42
Big Cr														
2013	(0)													
2015	(0)													
Clatskanie R.														
2012	288	9,196	±	4,749	5%	Pooled	2/22–6/20		42.6	±	1.3	1.27	±	0.20
2013	249	1,045	±	259	24%	Pooled	2/20–6/16		55.7	±	2.4	2.28	±	0.30
2014	130	458	±	159	22%	Stratified	3/3–6/15	5/1	56.1	±	2.4	2.32	±	0.31
2015	422	4,909	±	1,680	7%	Stratified	2/25–5/28	3/12	38.8	±	0.8	0.52	±	0.08
2016	(2)				0%		4/25–6/7		80.5	±	108.0	6.05	±	23.51
2017	205	767	±	192	23%	Stratified	3/31–6/14	6/15	65.1	±	2.5	3.67	±	0.42
2018	1,084	9,478	±	2,760	10%	Stratified	2/21–6/11	3/15	49.3	±	1.2	1.27	±	0.12
2019	83	373	±	165	15%	Stratified	2/27–6/8	3/7	52.2	±	2.9	1.49	±	0.31
Conyers Cr.														
2012	14	27	±	12	41%	Stratified	4/11–6/1	5/24	60.9	±	7.0	2.64	±	0.81
2013	(2)				0%		3/25–3/30		44.0			0.60		
2016	(1)				0%		4/30		75.0			4.40		

Trap Year	Chinook Fry													
	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch		Length			Weight		
							Range	Peak[b]	Fork	±	CI	Grams	±	CI
Graham Cr														
2014	(12)						3/14–5/1		43.9	±	3.2	0.94	±	0.18
Lewis & Clark R.														
2017	683	6,530	±	1,829	9%	Stratified	3/7–6/14	6/14	66.4	±	2.1	3.75	±	0.36
Milton Cr														
2012	(9)				11%		5/10–6/9		69.7	±	11.5	3.72	±	1.92
2013	(33)				31%		3/8–6/16		88.4	±	9.9	9.68	±	3.22
Scappoose Cr														
2012	(1)						6/21		76.0			5.00		
Stewart Cr														
2014	(0)													
2015	(0)													
2016	(0)													

[a] Weighted efficiency is shown for size classes with Petersen Stratified population estimates and overall efficiency for size classes with Petersen Pooled estimates or extrapolated catch.

[b] Peak migration timing is the date at the middle of the sampling week when outmigrant estimation was highest in a given year.

Table A.4. Summary of annual catch (Catch), population estimate (Est.) with 95% confidence intervals (CI), percentage trap efficiency (Eff.), and population estimate method (PopEst Method) of Coho Salmon *Oncorhynchus kisutch* captured at juvenile sampling sites from 2012–2019. Numbers in parentheses indicate extrapolated catch due to insufficient recaptures for population estimation.

Trap Year	Coho Smolts						Coho Fry					
	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch	Est.	±	CI	Eff.[a]	PopEst Method
Bear Cr												
2017	(84)				12%		840	15,826	±	6,515	4%	Stratified
2018	639	3,155	±	431	24%	Stratified	1,501	22,087	±	5,415	6%	Stratified
2019	1,380	2,908	±	202	58%	Stratified	(270)				3%	
Beaver Cr												
2016	394	1,707	±	343	26%	Stratified	(14)				0%	
Big Cr												
2013	545	1,795	±	304	28%	Stratified	201	2,109	±	858	8%	Stratified
2015	1,091	3,166	±	331	34%	Stratified	2,590	24,717	±	3,375	11%	Stratified
Clatskanie R.												
2012	3,369	34,031	±	6,194	9%	Stratified	2,266	55,564	±	14,414	4%	Stratified
2013	2,979	33,093	±	8,838	8%	Stratified	(248)				1%	
2014	5,976	25,319	±	2,560	24%	Stratified	296	6,307	±	3,387	5%	Pooled
2015	11,149	42,553	±	4,412	26%	Stratified	31,045	530,527	±	97,706	6%	Stratified
2016	4,270	35,009	±	4,806	12%	Stratified	(44)				6%	
2017	771	10,051	±	2,564	8%	Pooled	84	696	±	419	5%	Stratified
2018	10,199	54,589	±	7,146	19%	Stratified	1,409	17,581	±	3,787	8%	Pooled
2019	11,431	54,987	±	4,557	21%	Stratified	(35)				0%	
Conyers Cr.												
2012	601	2,478	±	419	24%	Stratified	483	2,669	±	682	16%	Stratified
2013	270	998	±	188	39%	Pooled	504	3,279	±	757	15%	Stratified
2016	223	920	±	247	30%	Stratified	239	2,344	±	874	9%	Stratified

Trap Year	Coho Smolts						Coho Fry					
	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch	Est.	±	CI	Eff.[a]	PopEst Method
Graham Cr												
2014	78	299	±	120	22%	Stratified	5,127	22,769	±	1,891	24%	Stratified
Lewis & Clark R.												
2017	(252)				4%		(351)				3%	
Milton Cr												
2012	5,178	18,820	±	2,570	27%	Stratified	(135)				2%	
2013	3,038	12,622	±	1,464	27%	Stratified	93	679	±	365	5%	Stratified
Scappoose Cr												
2012	910	5,956	±	1,113	14%	Stratified	(93)				5%	
Stewart Cr												
2014	(33)				17%		2,248	13,025	±	1,399	25%	Stratified
2015	32	61	±	24	58%	Pooled	8,016	21,111	±	1,194	39%	Stratified
2016	(15)				0%		1,954	8,337	±	1,515	27%	Stratified

[a] Weighted efficiency is shown for size classes with Petersen Stratified population estimates and overall efficiency for size classes with Petersen Pooled estimates or extrapolated catch.

Table A.5. Summary of catch range and peak catch dates, and average length and weight with 95% confidence interval of Coho Salmon *Oncorhynchus kisutch* captured at juvenile sampling sites from 2012–2019.

Trap Year	Coho Smolts								Coho Fry							
	Catch		Length			Weight			Catch		Length			Weight		
	Range	Peak[a]	Fork	±	CI	Grams	±	CI	Range	Peak[a]	Fork	±	CI	Grams	±	CI
Bear Cr																
2017	3/12–6/4		120.2	±	5.0	19.88	±	2.06	2/25–6/5	3/2	42.8	±	2.1	1.28	±	0.28
2018	2/22–5/22	5/10	117.4	±	1.7	16.32	±	0.69	2/21–5/22	2/22	44.5	±	2.1	1.12	±	0.24
2019	2/25–5/24	5/9	114.7	±	1.4	15.73	±	0.58	2/25–5/25		47.7	±	1.9	1.27	±	0.20
Beaver Cr																
2016	3/18–5/5	5/5	127.4	±	1.9	22.05	±	1.08	3/12–5/30		57.0	±	18.1	2.58	±	2.38
Big Cr																
2013	2/19–6/15	5/16	114.3	±	1.5	15.95	±	0.55	2/21–6/12	3/14	38.5	±	1.2	0.63	±	0.14
2015	2/25–6/17	5/21	114.4	±	1.4	15.49	±	0.47	2/25–6/15	3/19	43.9	±	2.2	1.35	±	0.32
Clatskanie R.																
2012	2/22–6/21	5/10	112.8	±	0.5	15.27	±	0.18	2/28–6/20	4/26	39.1	±	0.3	0.60	±	0.04
2013	2/22–6/16	5/2	107.5	±	1.6	13.81	±	0.59	2/21–6/15		42.7	±	2.2	0.99	±	0.26
2014	3/1–6/15	5/1	110.8	±	1.4	14.80	±	0.50	3/12–6/15		44.6	±	1.6	1.18	±	0.19
2015	2/25–6/18	5/7	111.2	±	1.4	15.27	±	0.52	2/25–6/18	3/26	51.5	±	2.1	2.29	±	0.31
2016	2/22–6/14	5/12	118.5	±	1.4	18.10	±	0.61	2/22–6/12		41.7	±	4.2	1.02	±	0.58
2017	3/25–6/14		122.7	±	1.4	19.29	±	0.61	3/2–6/14	3/2	51.6	±	4.8	2.80	±	0.84
2018	2/21–6/11	5/3	108.4	±	1.2	13.30	±	0.41	2/21–6/11		49.0	±	1.8	1.58	±	0.24
2019	3/1–6/9	5/9	109.0	±	1.2	13.42	±	0.44	3/25–6/6		47.1	±	5.1	1.34	±	0.71
Conyers Cr.																
2012	2/22–6/9	5/17	105.1	±	0.9	12.44	±	0.47	3/28–6/12	4/19	39.1	±	0.5	0.62	±	0.04
2013	2/25–6/1		111.7	±	1.6	14.84	±	0.59	2/25–6/9	3/28	41.2	±	1.4	0.76	±	0.16
2016	2/19–5/31	5/5	113.6	±	1.9	16.06	±	0.83	2/18–5/31	3/31	36.4	±	0.5	0.45	±	0.06

Trap Year	Coho Smolts								Coho Fry							
	Catch		Length			Weight			Catch		Length			Weight		
	Range	Peak[a]	Fork	±	CI	Grams	±	CI	Range	Peak[a]	Fork	±	CI	Grams	±	CI
Graham Cr																
2014	3/25–6/1	4/17	120.8	±	2.4	18.81	±	1.07	3/15–6/15	4/17	41.9	±	1.1	0.82	±	0.12
Lewis & Clark R.																
2017	4/6–6/14		121.9	±	1.9	18.81	±	0.84	3/2–6/14		45.5	±	2.1	1.32	±	0.30
Milton Cr																
2012	2/23–6/16	5/17	116.7	±	0.6	15.93	±	0.23	3/25–6/14		45.0	±	2.4	1.78	±	0.38
2013	3/5–6/16	5/9	122.1	±	1.7	19.32	±	0.83	2/24–6/16	5/23	59.2	±	4.3	3.28	±	0.62
Scappoose Cr																
2012	2/22–6/21	5/24	119.4	±	0.8	17.59	±	0.34	2/22–6/21		53.7	±	4.1	2.53	±	0.51
Stewart Cr																
2014	3/1–5/20		102.9	±	6.2	13.01	±	2.21	3/15–5/29	3/27	37.3	±	0.4	0.43	±	0.03
2015	4/27–5/17		115.2	±	4.1	15.45	±	1.38	2/28–5/2	3/12	35.5	±	0.4	0.37	±	0.01
2016	2/27–4/22		111.2	±	3.2	15.13	±	1.56	2/22–4/13	3/17	36.3	±	0.3	0.39	±	0.02

[a] Peak migration timing is the date at the middle of the sampling week when outmigrant estimation was highest in a given year.

Table A.6. Summary of annual catch (Catch), population estimate (Est.) with 95% confidence intervals (CI), percentage trap efficiency (Eff.), and population estimate method (PopEst Method) of Steelhead *Oncorhynchus mykiss* captured at juvenile sampling sites from 2012–2019. Numbers in parentheses indicate extrapolated catch due to insufficient recaptures for population estimation.

Trap Year	Steelhead													
	≥ 120						90–119						60–89	
	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch	Eff.[a]
Bear Cr														
2017	131	1,153	±	555	8%	Stratified	(9)				0%		(1)	
2018	665	3,525	±	582	21%	Stratified	88	473	±	216	16%	Stratified	(10)	40%
2019	765	1,906	±	196	43%	Stratified	53	192	±	74	21%	Stratified	(1)	100%
Beaver Cr														
2016	(64)				16%		(0)						(0)	
Big Cr														
2013	165	2,041	±	1,196	4%	Stratified	(11)				9%		(1)	0%
2015	224	2,101	±	1,058	7%	Stratified	(2)				0%		(0)	
Clatskanie R.														
2012	(182)				4%		(8)				0%		(3)	0%
2013	452	12,671	±	6,309	2%	Stratified	(17)				6%		(0)	
2014	654	8,668	±	2,975	8%	Stratified	(25)				21%		(2)	0%
2015	1,594	8,742	±	1,394	18%	Stratified	(30)				7%		(1)	0%
2016	340	4,075	±	1,441	6%	Stratified	(3)				67%		(51)	5%
2017	370	8,339	±	4,120	3%	Stratified	(4)				25%		(0)	
2018	2,006	42,597	±	12,624	4%	Stratified	(77)				7%		(6)	17%
2019	1,697	22,892	±	5,807	7%	Stratified	(27)				15%		(0)	
Conyers Cr.														
2012	93	389	±	141	19%	Stratified	84	369	±	125	14%	Stratified	(18)	6%
2013	(81)				10%		(48)				11%		(2)	0%
2016	74	392	±	196	11%	Stratified	(19)				20%		(0)	

Trap Year	Steelhead													
	≥ 120						90–119						60–89	
	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch	Eff.[a]
Graham Cr														
2014	(5)						(0)						(0)	
Lewis & Clark R.														
2017	(270)				4%		(4)				0%		(0)	
Milton Cr														
2012	143	619	±	200	24%	Pooled	(0)						(0)	
2013	116	660	±	249	15%	Stratified	(1)				0%		(1)	0%
Scappoose Cr														
2012	(50)				10%		(2)				0%		(1)	0%
Stewart Cr														
2014	(2)						(1)				0%		(0)	
2015	(2)				0%		(2)				0%		(0)	
2016	(1)				0%		(1)				0%		(0)	

[a] Weighted efficiency is shown for size classes with Petersen Stratified population estimates and overall efficiency for size classes with Petersen Pooled estimates or extrapolated catch.

Table A.7. Summary of catch range and peak catch dates, and average length and weight with 95% confidence interval of Steelhead *Oncorhynchus mykiss* captured at juvenile sampling sites from 2012–2019.

Trap Year	Steelhead (≥ 120)								Steelhead (90–119)							
	Catch		Length			Weight			Catch		Length			Weight		
	Range	Peak[a]	Fork	±	CI	Grams	±	CI	Range	Peak[a]	Fork	±	CI	Grams	±	CI
Bear Cr																
2017	3/8–6/3	5/4	160.8	±	3.5	41.11	±	2.60	3/1–5/30		104.2	±	5.1	13.92	±	3.25
2018	3/6–5/22	5/3	166.1	±	3.4	44.74	±	2.83	3/7–5/22	5/17	106.6	±	1.9	12.34	±	0.67
2019	2/25–5/25	5/2	159.5	±	2.8	40.35	±	2.17	3/31–5/25	5/16	106.5	±	2.1	12.72	±	0.77
Beaver Cr																
2016	3/29–5/5		179.0	±	6.2	58.91	±	5.62								
Big Cr																
2013	2/25–6/16	5/2	164.6	±	2.8	41.75	±	2.04	4/11–6/12		107.8	±	5.9	13.15	±	2.10
2015	3/3–6/12	5/7	174.2	±	3.1	49.45	±	2.83	4/9–5/11		106.0	±	12.7	11.45	±	6.99
Clatskanie R.																
2012	3/24–6/14		167.3	±	1.9	45.99	±	1.67	4/9–5/30		100.8	±	7.0	13.43	±	6.03
2013	3/19–6/12	5/9	168.0	±	2.6	46.54	±	2.09	3/14–6/15		109.4	±	5.1	14.59	±	2.15
2014	3/21–6/9	5/1	166.6	±	2.6	43.85	±	1.91	3/5–6/9		108.0	±	3.6	14.20	±	1.45
2015	2/28–6/12	4/30	171.1	±	2.7	49.05	±	2.28	3/6–6/11		110.4	±	2.4	14.85	±	0.89
2016	3/21–6/14	5/5	169.4	±	2.8	50.23	±	2.55	4/9–5/25		103.2	±	15.1	12.14	±	4.47
2017	3/31–6/14	5/11	159.0	±	2.6	38.48	±	1.97	4/23–5/17		104.0	±	12.9	12.68	±	6.87
2018	3/10–6/11	5/3	162.8	±	2.4	41.85	±	1.83	3/11–6/11		105.4	±	1.8	12.52	±	0.68
2019	3/3–6/6	4/25	164.9	±	2.4	43.50	±	1.93	2/28–5/26		105.7	±	2.9	12.21	±	1.19
Conyers Cr.																
2012	2/23–6/6	4/26	149.5	±	3.1	32.89	±	2.11	2/27–6/13	5/31	103.7	±	1.7	11.98	±	0.61
2013	3/2–6/9		142.9	±	3.7	29.74	±	2.09	3/23–6/6		109.7	±	2.2	14.33	±	0.89
2016	2/24–6/3	4/21	157.8	±	4.6	41.68	±	3.78	3/22–5/3		109.0	±	5.1	13.98	±	1.90

Trap Year	Steelhead (≥ 120)								Steelhead (90–119)							
	Catch		Length			Weight			Catch		Length			Weight		
	Range	Peak[a]	Fork	±	CI	Grams	±	CI	Range	Peak[a]	Fork	±	CI	Grams	±	CI
Graham Cr																
2014	4/18–5/21		169.8	±	31.1	49.05	±	18.54								
Lewis & Clark R.																
2017	4/6–6/6		170.0	±	2.4	45.80	±	1.98	4/18–5/4		107.5	±	10.5	12.30	±	2.37
Milton Cr																
2012	3/29–6/11		181.3	±	4.6	61.37	±	5.54								
2013	3/17–6/8	5/2	186.4	±	5.3	64.57	±	5.79	3/3		103.0			9.40		
Scappoose Cr																
2012	4/3–6/1		160.0	±	4.9	42.21	±	3.62	4/7–5/19		103.0	±	114.4	15.40		
Stewart Cr																
2014	3/16								3/23		115.0			20.50		
2015	5/3–5/12		178.0	±	139.8	45.90	±	166.45	3/24		106.0	±	101.6	12.85	±	41.29
2016	3/30		140.0			31.30			3/30		116.0			18.90		

[a] Peak migration timing is the date at the middle of the sampling week when outmigrant estimation was highest in a given year.

Table A.8. Summary of annual catch (Catch), population estimate (Est.) with 95% confidence intervals (CI), percentage trap efficiency (Eff.), and population estimate method (PopEst Method) of Cutthroat Trout *Oncorhynchus clarkii clarkii* captured at juvenile sampling sites from 2012–2019. Numbers in parentheses indicate extrapolated catch due to insufficient recaptures for population estimation.

	Cutthroat														
	≥ 250	**160–249**						**120–159**						**90–119**	**60–89**
Trap Year	Catch	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch	Catch
Bear Cr															
2017	(2)	47	201	±	108	16%	Stratified	(21)				22%		(6)	(0)
2018	(13)	167	741	±	174	24%	Stratified	86	304	±	63	34%	Stratified	(8)	(0)
2019	(45)	322	1,252	±	192	33%	Stratified	71	218	±	51	32%	Stratified	(4)	(0)
Beaver Cr															
2016	(2)	(10)				20%		(4)				0%		(0)	(0)
Big Cr															
2013	(0)	(32)				13%		(42)				24%		(9)	(4)
2015	(2)	150	855	±	370	13%	Stratified	79	343	±	112	13%	Stratified	(10)	(2)
Clatskanie R.															
2012	(1)	338	3,164	±	1,029	8%	Stratified	(70)				13%		(11)	(0)
2013	(12)	444	4,884	±	1,644	7%	Stratified	56	243	±	110	12%	Stratified	(4)	(0)
2014	(15)	585	4,296	±	917	14%	Pooled	110	709	±	368	8%	Stratified	(15)	(1)
2015	(38)	1,416	8,286	±	1,501	16%	Stratified	131	498	±	157	20%	Stratified	(11)	(0)
2016	(13)	396	3,835	±	1,162	10%	Pooled	42	132	±	41	19%	Stratified	(2)	(6)
2017	(6)	282	4,665	±	2,399	4%	Stratified	(64)				8%		(28)	(4)
2018	(35)	661	5,698	±	1,823	10%	Stratified	134	936	±	384	8%	Stratified	(22)	(2)
2019	(42)	463	3,318	±	894	12%	Stratified	115	576	±	241	15%	Stratified	(30)	(3)
Conyers Cr.															
2012	(1)	163	718	±	237	16%	Stratified	215	1,195	±	400	13%	Stratified	102[b]	(25)
2013	(4)	105	465	±	155	32%	Pooled	101	356	±	112	32%	Pooled	31[c]	(7)
2016	(2)	36	103	±	22	59%	Stratified	47	151	±	45	43%	Stratified	(35)	(3)

Trap Year	Cutthroat														
	≥ 250	160–249						120–159						90–119	60–89
	Catch	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch	Est.	±	CI	Eff.[a]	PopEst Method	Catch	Catch
Graham Cr															
2014	(2)	(4)						(16)						(2)	(0)
Lewis & Clark R.															
2017	(1)	(66)				9%		(20)				6%		(16)	(0)
Milton Cr															
2012	(20)	373	2,681	±	704	14%	Pooled	(49)				14%		(8)	(2)
2013	(17)	280	2,465	±	839	10%	Stratified	(26)				16%		(1)	(0)
Scappoose Cr															
2012	(2)	168	1,666	±	678	6%	Stratified	(61)				10%		(8)	(0)
Stewart Cr															
2014	(0)	(0)						(16)				0%		(140)	45[d]
2015	(0)	(2)						(5)				20%		(26)	(4)
2016	(0)	(0)						(3)				0%		(13)	(2)

[a] Weighted efficiency is shown for size classes with Petersen Stratified population estimates and overall efficiency for size classes with Petersen Pooled estimates or extrapolated catch.

[b] A Stratified Petersen population estimate made in this year (513 ± 220).

[c] A Stratified Petersen population estimate made in this year (90 ± 31).

[d] A Stratified Petersen population estimate made in this year (232 ± 92).

Table A.9. Summary of catch range and peak catch dates, and average length and weight with 95% confidence interval of ≥ 250 mm and 160–249 mm Cutthroat Trout *Oncorhynchus clarkii clarkii* captured at juvenile sampling sites from 2012–2019.

Trap	Cutthroat (≥ 250)								Cutthroat (160–249)							
	Catch		Length			Weight			Catch		Length			Weight		
Year	Range	Peak[a]	Fork	±	CI	Grams	±	CI	Range	Peak[a]	Fork	±	CI	Grams	±	CI
Bear Cr																
2017	3/22–4/27		267.0	±	216.0	78.85	±	643.56	3/15–6/5	5/25	184.8	±	4.9	56.70	±	5.08
2018	3/13–5/14		330.3	±	41.3	336.48	±	126.84	2/24–5/22	5/10	192.0	±	3.8	62.19	±	3.98
2019	2/26–5/8		332.6	±	11.8	318.26	±	36.61	2/25–5/25	5/2	184.2	±	2.4	54.86	±	2.41
Beaver Cr																
2016	3/22		290.5	±	438.4	218.35	±	750.29	3/25–4/30		214.4	±	12.9	95.88	±	18.01
Big Cr																
2013									4/11–6/12		174.1	±	3.5	44.76	±	2.85
2015	5/19–6/17		331.5	±	19.1	341.65	±	107.37	3/21–6/17	5/14	177.5	±	2.5	47.07	±	2.36
Clatskanie R.																
2012	3/7		257.0			135.00			3/3–6/13	5/24	181.7	±	1.7	53.48	±	1.65
2013	3/3–5/17		317.7	±	25.1	286.09	±	63.35	3/15–6/15	5/9	189.6	±	2.9	61.95	±	3.08
2014	3/23–6/5		278.5	±	21.7	195.68	±	41.66	3/1–6/11		187.6	±	3.0	59.61	±	3.18
2015	2/26–5/20		287.6	±	12.1	218.49	±	27.55	3/7–6/13	4/30	193.1	±	2.8	66.44	±	3.21
2016	4/5–6/14		293.4	±	29.3	210.47	±	52.72	3/28–6/14		192.8	±	2.6	65.06	±	2.84
2017	3/25–6/12		274.3	±	40.8	170.33	±	11.41	3/2–6/14	5/18	189.0	±	3.1	61.36	±	3.26
2018	2/21–6/10		303.7	±	14.3	235.26	±	29.85	2/25–6/11	5/3	187.7	±	2.7	58.61	±	2.67
2019	3/5–6/1		327.5	±	15.4	287.63	±	34.55	3/4–6/9	5/30	187.8	±	2.8	58.47	±	2.95
Conyers Cr.																
2012	3/10		334.0			346.60			2/22–6/11	5/17	175.4	±	2.0	46.33	±	1.92
2013	3/22–5/14		264.5	±	69.9	151.90	±	20.33	2/24–6/8		173.4	±	2.5	45.46	±	2.63
2016	3/27–4/14		257.0			147.40			2/24–6/3	5/5	183.9	±	4.8	55.63	±	4.31

Trap Year	Cutthroat (≥ 250)								Cutthroat (160–249)							
	Catch		Length			Weight			Catch		Length			Weight		
	Range	Peak[a]	Fork	±	CI	Grams	±	CI	Range	Peak[a]	Fork	±	CI	Grams	±	CI
Graham Cr																
2014	4/17–4/18		308.0	±	533.7	239.6	±	1199.5	4/18–5/22		185.5	±	34.5	59.13	±	33.67
Lewis & Clark R.																
2017	5/3		272.0	±		175.5	±		4/6–6/11		182.3	±	4.0	54.27	±	3.94
Milton Cr																
2012	2/23–4/24		294.8	±	16.5	217.68	±	41.45	3/24–6/4		187.4	±	1.7	59.71	±	1.78
2013	2/25–5/3		323.2	±	17.8	266.20	±	53.37	3/3–6/16	4/25	193.4	±	2.9	65.63	±	3.21
Scappoose Cr																
2012	5/25–6/10		273.3	±	66.7	202.40	±	186.76	3/2–6/17	5/24	184.4	±	2.6	56.59	±	2.45
Stewart Cr																
2014																
2015									3/3–3/15		194.0	±	266.8	62.20		
2016																

[a] Peak migration timing is the date at the middle of the sampling week when outmigrant estimation was highest in a given year.

Table A.10. Summary of catch range and peak catch dates, and average length and weight with 95% confidence interval of 120–159 mm and 90–119 mm Cutthroat Trout *Oncorhynchus clarkii clarkii* captured at juvenile sampling sites from 2012–2019.

Trap Year	Cutthroat (120–159)								Cutthroat (90–119)							
	Catch		Length			Weight			Catch		Length			Weight		
	Range	Peak[a]	Fork	±	CI	Grams	±	CI	Range	Peak[a]	Fork	±	CI	Grams	±	CI
Bear Cr																
2017	4/18–6/3		142.6	±	5.4	28.05	±	2.56	4/13–6/1		108.4	±	10.8	14.34	±	4.11
2018	3/8–5/22	5/10	147.3	±	2.1	28.05	±	1.04	3/11–5/12		108.0	±	12.8	15.41	±	9.20
2019	3/2–5/24	5/2	145.2	±	2.4	27.89	±	1.19	3/12–4/18		106.5	±	7.8	10.93	±	1.43
Beaver Cr																
2016	4/19–5/30		143.8	±	13.5	29.90	±	8.48								
Big Cr																
2013	2/14–6/15		142.2	±	3.7	26.54	±	2.02	2/28–6/3		107.4	±	7.2	11.71	±	2.40
2015	2/27–6/17	5/28	146.5	±	2.5	27.32	±	1.16	3/13–6/15		110.2	±	5.6	13.88	±	2.03
Clatskanie R.																
2012	2/24–6/16		148.0	±	2.4	30.83	±	2.11	3/5–6/7		110.0	±	7.4	18.13	±	9.06
2013	2/25–6/14	5/23	146.6	±	3.0	28.14	±	1.45	2/26–5/23		106.4	±	5.3	13.73	±	5.52
2014	3/5–6/10	5/15	147.1	±	2.1	28.40	±	1.03	3/14–6/13		106.3	±	4.6	11.97	±	1.49
2015	2/28–6/14	5/21	148.8	±	1.6	30.20	±	0.89	4/18–5/29		113.7	±	3.4	14.18	±	1.26
2016	2/18–6/13	5/12	146.0	±	3.1	29.73	±	2.02	3/27–4/10		114.0	±	63.5	13.65	±	13.34
2017	3/3–6/2		145.4	±	2.8	28.97	±	1.69	3/5–5/29		109.2	±	2.7	13.62	±	2.14
2018	2/28–6/11	3/29	146.0	±	1.9	27.77	±	0.94	3/6–6/11		110.2	±	3.2	13.74	±	1.90
2019	3/8–6/9	5/9	140.2	±	2.2	24.65	±	1.07	3/4–5/17		108.8	±	3.0	12.05	±	0.95
Conyers Cr.																
2012	2/22–6/13	3/29	142.5	±	1.5	26.89	±	0.99	2/22–6/13	2/23	105.4	±	1.7	11.49	±	0.54
2013	2/24–6/10		142.4	±	2.2	26.54	±	1.12	2/25–6/2	5/30	104.9	±	3.2	11.68	±	1.12
2016	3/5–6/3	4/7	138.4	±	3.2	25.99	±	2.14	2/19–6/3		104.1	±	2.7	11.26	±	0.88

Trap Year	Cutthroat (120–159)								Cutthroat (90–119)							
	Catch		Length			Weight			Catch		Length			Weight		
	Range	Peak[a]	Fork	±	CI	Grams	±	CI	Range	Peak[a]	Fork	±	CI	Grams	±	CI
Graham Cr																
2014	4/10–5/25		135.0	±	6.4	23.95	±	4.46	4/12–5/8		115.5	±	19.1	16.85	±	6.99
Lewis & Clark R.																
2017	4/10–6/14		146.5	±	4.8	29.92	±	2.74	4/11–6/5		109.9	±	4.9	13.75	±	1.94
Milton Cr																
2012	2/26–6/6		147.0	±	3.1	31.86	±	3.76	2/25–5/28		101.1	±	7.9	16.89	±	16.63
2013	4/27–6/10		148.1	±	4.2	29.08	±	2.16	5/11		116.0			15.40		
Scappoose Cr																
2012	3/5–6/12		145.3	±	3.3	28.40	±	1.69	3/28–5/17		106.8	±	7.4	11.05	±	1.69
Stewart Cr																
2014	3/21–5/15		128.4	±	5.9	25.48	±	5.44	3/1–5/26		99.7	±	1.5	11.60	±	0.66
2015	3/14–5/13		132.2	±	9.0	25.66	±	4.40	3/15–5/14		102.2	±	3.3	12.43	±	1.36
2016	3/26–4/6		130.0	±	43.0	22.97	±	21.23	3/12–4/22		104.1	±	8.4	12.91	±	4.18

[a] Peak migration timing is the date at the middle of the sampling week when outmigrant estimation was highest in a given year.

Table A.11. Summary of catch and capture date range, and average length and weight of hatchery salmonids captured at juvenile sampling sites from 2012–2019.

Trap Year	Coho Smolts				Steelhead Smolts				Chinook			
	Catch		Length	Weight	Catch		Length	Weight	Catch		Length	Weight
	#	Range	Fork ± CI	Grams ± CI	#	Range	Fork ± CI	Grams ± CI	#	Range	Fork ± CI	Grams ± CI
Bear Cr												
2017	1	3/8	143	33.8	0				8	2/26–3/7	134 ± 15	27.1 ± 9.4
2018	49	4/24–5/15	132 ± 2	22.1 ± 1.1	6	4/24–5/8	194 ± 25	64.8 ± 20.7	1	5/6	157	40.2
2019	221[a]	2/25–5/22	133 ± 1	22.9 ± 0.6	38	4/16–5/10	196 ± 5	66.9 ± 4.9	3	3/5–3/22	132 ± 13	23.8 ± 6.6
Beaver Cr												
2016	0				0				4	3/28–5/22	123 ± 55	22.0 ± 24.8
Big Cr												
2013	0				0				0			
2015	0				0				0			
Clatskanie R.												
2012	0				0				0			
2013	1	5/1	126	21.2	0				2	2/25–3/17	149 ± 38	36.1 ± 69.9
2014	0				0				0			
2015	0				0				1	3/2	139	27.5
2016	0				0				0			
2017	0				0				1	3/7	140	24.3
2018	1	5/5	118	16.7	0				1	5/21	88	6.3
2019	0				0				1	4/1	147	35.2
Conyers Cr.												
2012	0				0				0			
2013	0				0				1	2/27	142	31.2
2016	0				0				3	2/18–2/24	137 ± 9	30.3 ± 4.1

Trap Year	Coho Smolts				Steelhead Smolts				Chinook			
	Catch		Length	Weight	Catch		Length	Weight	Catch		Length	Weight
	#	Range	Fork ± CI	Grams ± CI	#	Range	Fork ± CI	Grams ± CI	#	Range	Fork ± CI	Grams ± CI
Graham Cr												
2014	0				0				0			
Lewis & Clark R.												
2017	1	4/6	142	27.7	0				0			
Milton Cr												
2012	3	3/11–5/9	112 ± 36	10.5 ± 2.5	0				2	2/27–4/3	120 ± 114	19.0 ± 32.4
2013	10	3/23–5/4	141 ± 17	27.6 ± 8.1	12	4/22–6/13	209 ± 8	79.3 ± 6.8	11	3/2–5/2	141 ± 6	29.4 ± 2.3
Scappoose Cr												
2012	1	4/18	121	18.5	0				0			
Stewart Cr												
2014	0				0				1	5/19	123	19.7
2015	0				0				0			
2016	0				0				0			

[a] A Stratified Petersen population estimate made in this year (524 ± 84).

Table A.12. Capture date, length (mm), and weight (g) of hatchery salmonids captured at juvenile fish sampling sites from 2012–2019 with coded-wire tags (CWTs). Origin information including tag code, stock, origin, release location, brood year, and release date(s) is shown for each capture. The number of days between hatchery release date and capture at a sampling site (Days to Recap) for hatchery releases with multiple dates was calculated using the average of the two release dates.

Trap Year	Capture Information				Origin Information							
	Species	Date	Length	Weight	Tag Code	Stock	Origin	Release Location	Brood Year	Release Dates 1st	Release Dates 2nd	Days To Recap
Bear Cr												
2018	Coho	4/30/18	140	25.4	091158	Tanner Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2016	4/12/18	4/27/18	11
2018	Coho	5/7/18	134	22.2	091158	Tanner Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2016	4/12/18	4/27/18	18
2019	Coho	5/2/19	141	25.1	090909	Big Cr (OR)	Big Cr Hatch	Big Cr (OR)	2017	4/18/19	4/19/19	14
2019	Coho	5/5/19	150	32.0	090909	Big Cr (OR)	Big Cr Hatch	Big Cr (OR)	2017	4/18/19	4/19/19	17
2019	Coho	5/9/19	136	23.9	090909	Big Cr (OR)	Big Cr Hatch	Big Cr (OR)	2017	4/18/19	4/19/19	21
2019	Coho	4/20/19	126	20.5	091201	Big Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2017	4/24/19		-4
2019	Coho	4/26/19	133	21.7	091201	Big Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2017	4/24/19		2
2019	Coho	4/27/19	140	25.8	091201	Big Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2017	4/24/19		3
2019	Coho	5/3/19	133	22.0	091201	Big Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2017	4/24/19		9
2019	Coho	5/4/19	132	21.9	091201	Big Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2017	4/24/19		10
2019	Coho	5/5/19	129	20.8	091201	Big Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2017	4/24/19		11
2019	Coho	5/6/19	127	19.4	091201	Big Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2017	4/24/19		12
2019	Coho	5/9/19	129	22.6	091201	Big Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2017	4/24/19		15
2019	Coho	5/9/19	119	17.3	091201	Big Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2017	4/24/19		15
2019	Coho	5/13/19	143	30.0	091201	Big Cr (OR)	CEDC Net Pens	Tongue Pt. (OR)	2017	4/24/19		19
2019	Chinook	3/5/19	138	26.9	091203	S Santiam R (OR)	CEDC Net Pens	Youngs R/Bay (OR)	2017	2/28/19		5
2019	Chinook	3/22/19	129	22.2	091203	S Santiam R (OR)	CEDC Net Pens	Youngs R/Bay (OR)	2017	2/28/19		22
Milton Cr												
2013	Chinook	3/4/13	145	31.4	636274	Unknown	Lewis R Hatch	NF Lewis R (WA)	2011	2/1/13	2/15/13	24
2013	Chinook	3/7/13	139	28.5	090674	McKenzie R (OR)	McKenzie R Hatch	McKenzie R (OR)	2011	11/2/12		125
2013	Chinook	3/18/13	151	36.2	626274	Unknown	Unknown	Unknown R (WA)				

Table A.13. Number of non-salmonid fish species captured at juvenile sampling sites from 2012–2019. Numbers represent actual catch and are not adjusted for trap efficiency or non-fishing days. Larval lamprey are immature, filter-feeding individuals without eyes and juvenile lamprey are transformed individuals with eyes that are ready to feed as described by Clemens (2019).

Trap Year	Lamprey				Banded Killifish	Bluegill	Brown Bullhead	Chiselmouth	Common Goldfish	Cottid spp.	Dace spp.	Goby spp.	Golden Shiner	Largescale Sucker	Mountain Whitefish	Northern Pikeminnow	Oriental Weatherfish	Peamouth	Pumpkinseed	Redside Shiner	Sucker spp.	Three-Spine Stickleback	Yellow Perch
	Pacific Adult	Western Brook Adult	Larva	Juvenile																			
Bear Cr																							
2017	1	121	293		6	2				162								1,197			12		
2018	8	116	407	4		12				426	1			181				3,686	1				
2019	16	471	391	5	2					370				368				24,792				4	
Beaver Cr																							
2016	256	291	76	7	4		3			104						30		252	4		84	1	
Big Cr																							
2013	4	13	8							39	1												
2015	2	31	161							104													
Clatskanie R.																							
2012	22	147	236							264	4					2		19			3	66	
2013	145	327	84	1						329			1			15		69			10	123	
2014	158	122	418	4						325								413			28	1	
2015	116	61	391		1					477	6					60		969			57	2	
2016	142	130	69							315	2					1		1,948			5	3	
2017	35	259	246		9			1	1	160						91		15		14	7	997	
2018	112	403	493	25	110	1				652	2	1		55	1	40		391		94		569	
2019	106	460	490	4	23				3	860	4	2		43		15		715		65		907	

Trap Year	Lamprey				Banded Killifish	Bluegill	Brown Bullhead	Chiselmouth	Common Goldfish	Cottid spp.	Dace spp.	Goby	Golden Shiner	Largescale Sucker	Mountain Whitefish	Northern Pikeminnow	Oriental Weatherfish	Peamouth	Pumpkinseed	Redside Shiner	Sucker spp.	Three-Spine Stickleback	Yellow Perch
	Pacific Adult	Western Brook Adult	Larva	Juvenile																			
Conyers Cr																							
2012	20	350	331							150	3					4					42	2	
2013	19	122	235							115						2					42		
2016	29	188	147							116						18					54		
Graham Cr																							
2014	4	177	62		2					58						3			1		149	156	
Lewis & Clark R.																							
2017	7	5	18		13					43						172		155	2		28	585	
Milton Cr																							
2012	22	31	220							148	222				1			4,910		76	13	13	6
2013	7	14	338	61	1		1			119	163						9	6,838		24	101	24	1
Scappoose Cr																							
2012	3	35	206							39	439					1		8			4	8	
Stewart Cr																							
2014	7	79	6							6						13							
2015	1	83	9							15						228				1			
2016		45	1							4						13							

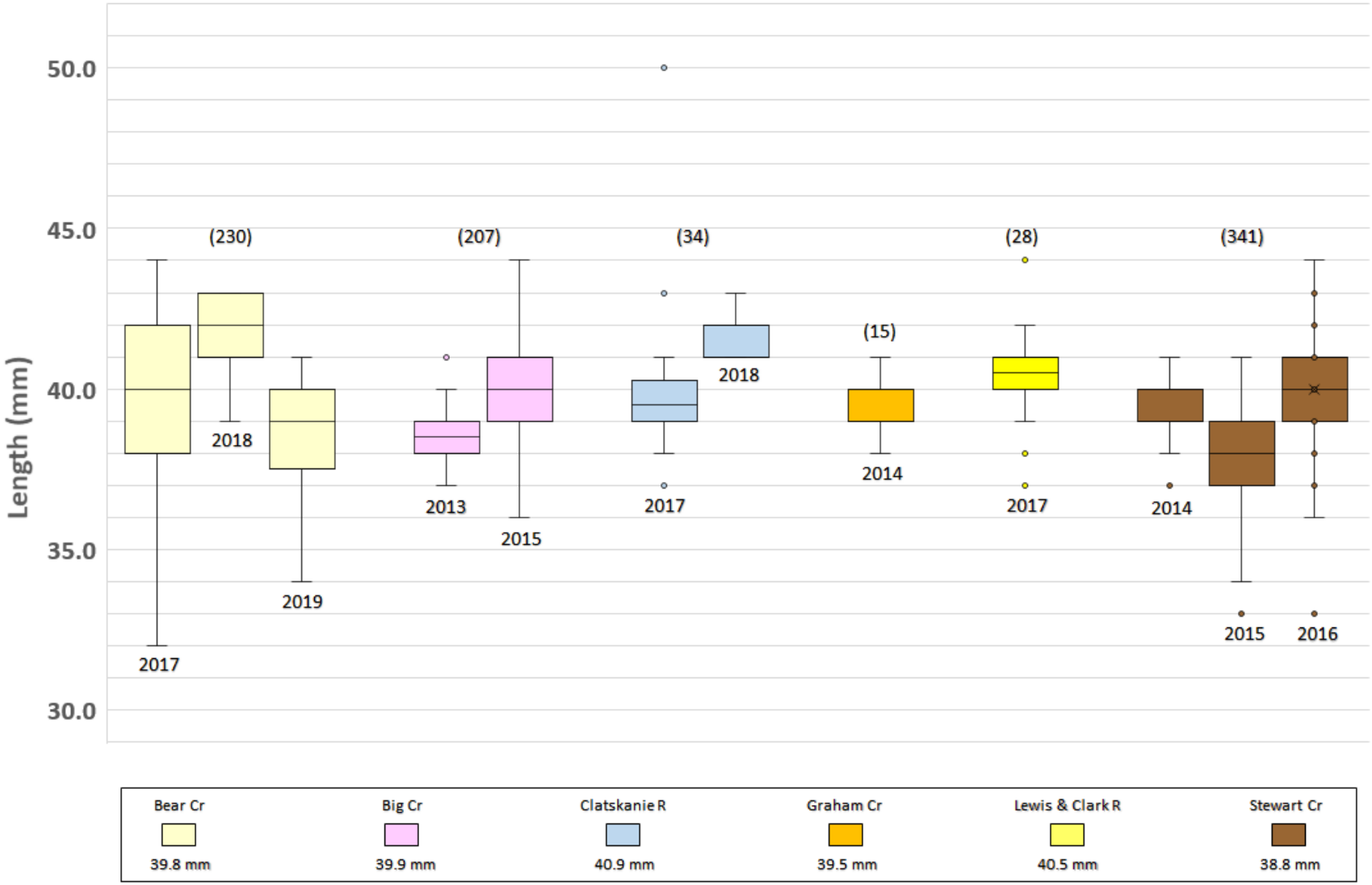

Figure A.14. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) length (mm) of Chum *Oncorhynchus keta* fry captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent lengths > 1.5 times interquartile range (i.e., outliers). Mean Chum fry length for all years sampled at each site is shown in the legend. Total number of fry measured for all years sampled at each site is shown in parentheses.

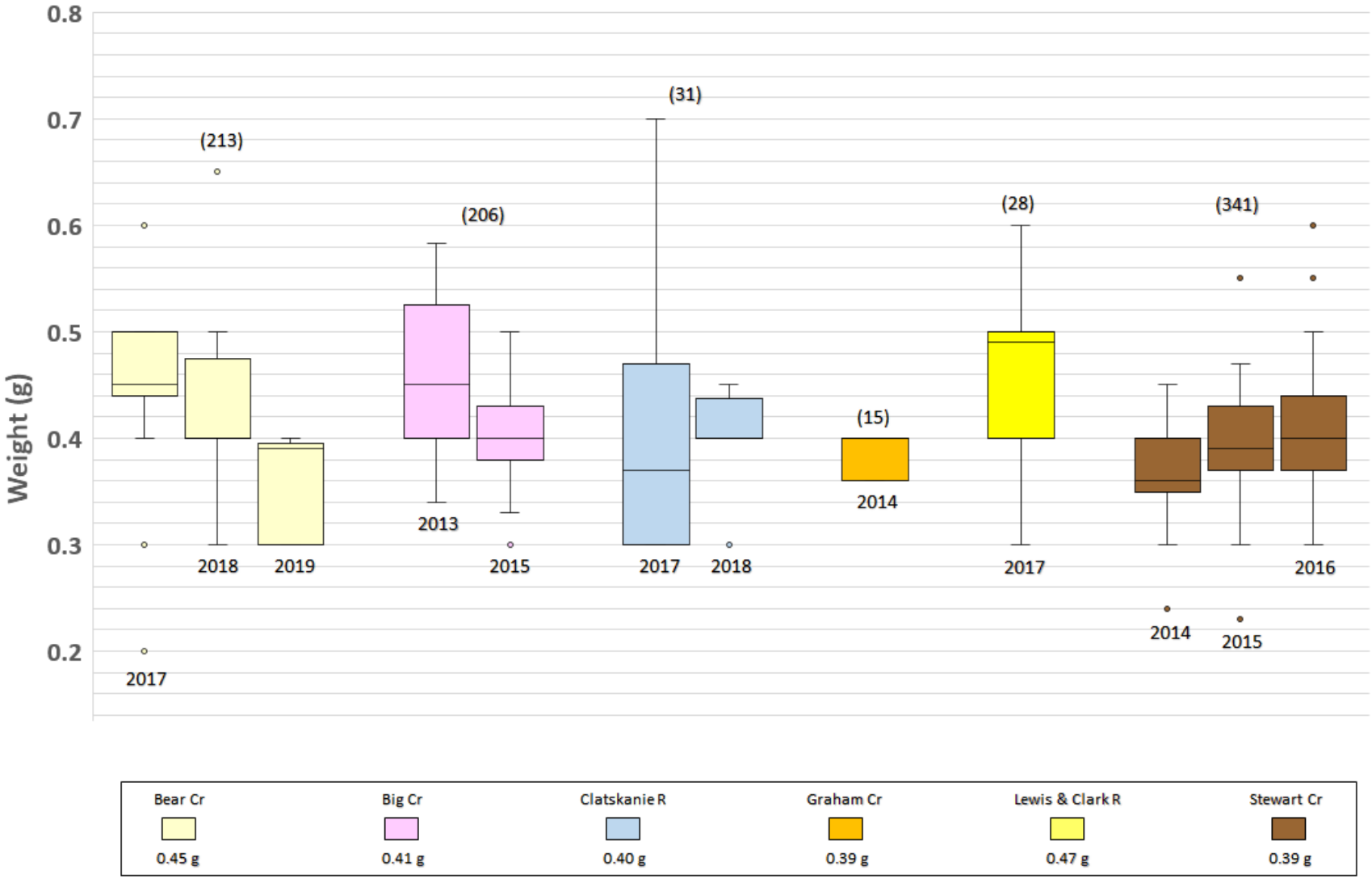

Figure A.15. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) weight (g) of Chum *Oncorhynchus keta* fry captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent weights > 1.5 times interquartile range (i.e., outliers). Mean Chum fry weight for all years sampled at each site is shown in the legend. The total number of fry weighed for all years sampled at each site is shown in parentheses.

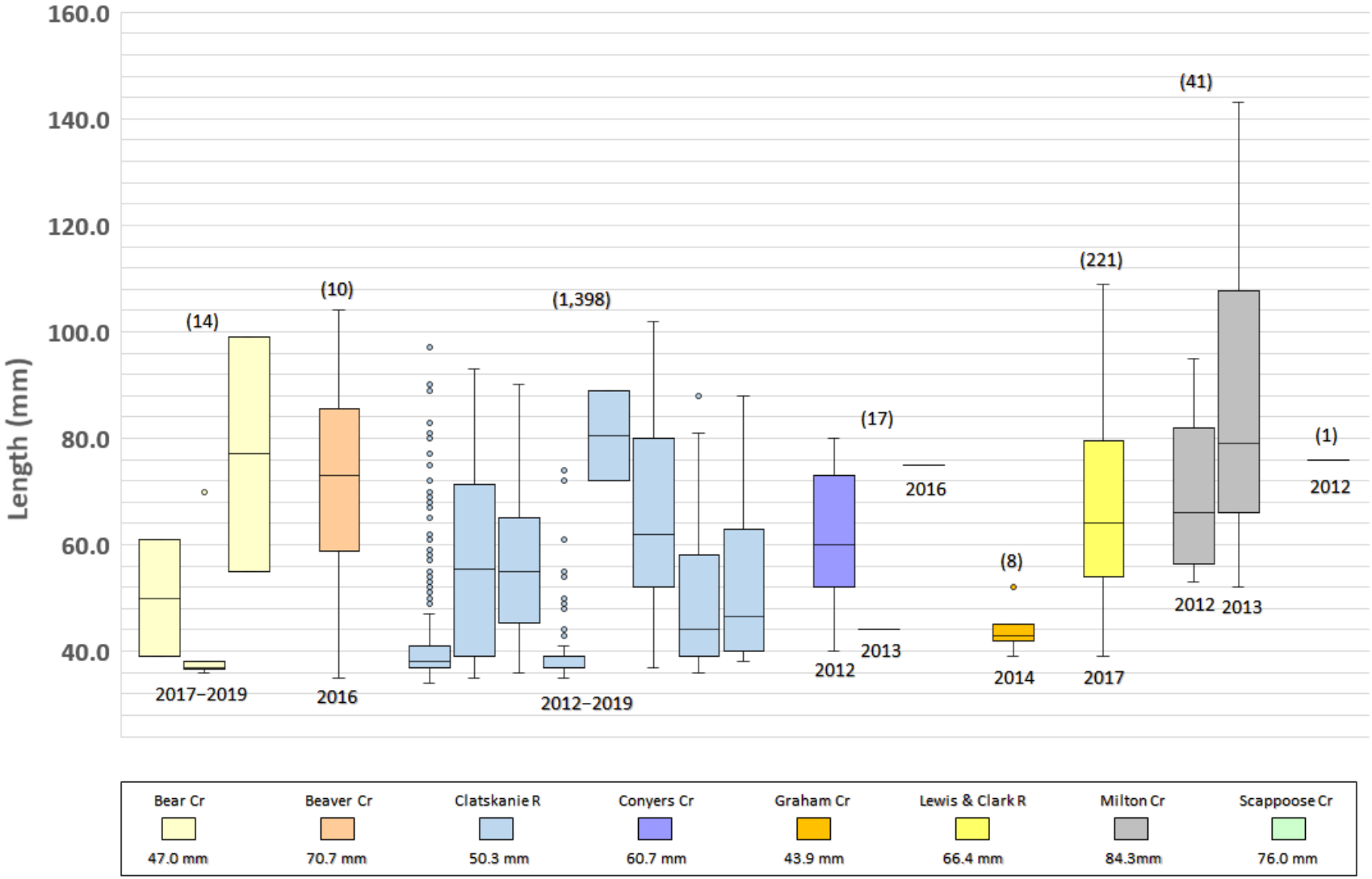

Figure A.16. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) length (mm) of Chinook *Oncorhynchus tshawytscha* fry captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent lengths > 1.5 times interquartile range (i.e., outliers). Mean Chinook fry length for all years sampled at each site is shown in the legend. Total number of fry measured for all years sampled at each site is shown in parentheses.

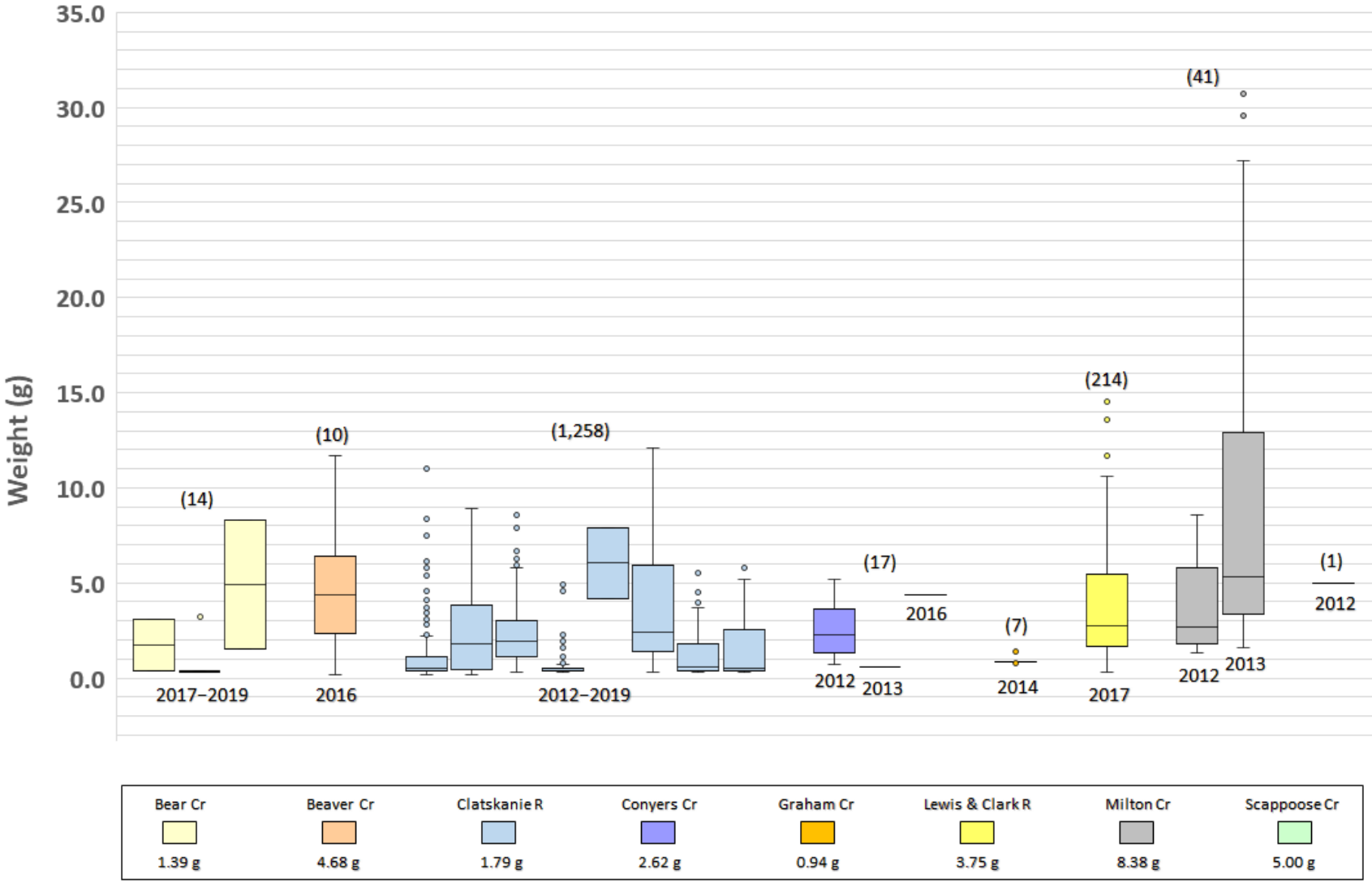

Figure A.17. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75% Percentile (box top), and Maximum (top whisker) weight (g) of Chinook *Oncorhynchus tshawytscha* fry captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent weights > 1.5 times interquartile range (i.e., outliers). Mean Chinook fry weight for all years sampled at each site is shown in the legend. The total number of fry weighed for all years sampled at each site is shown in parentheses.

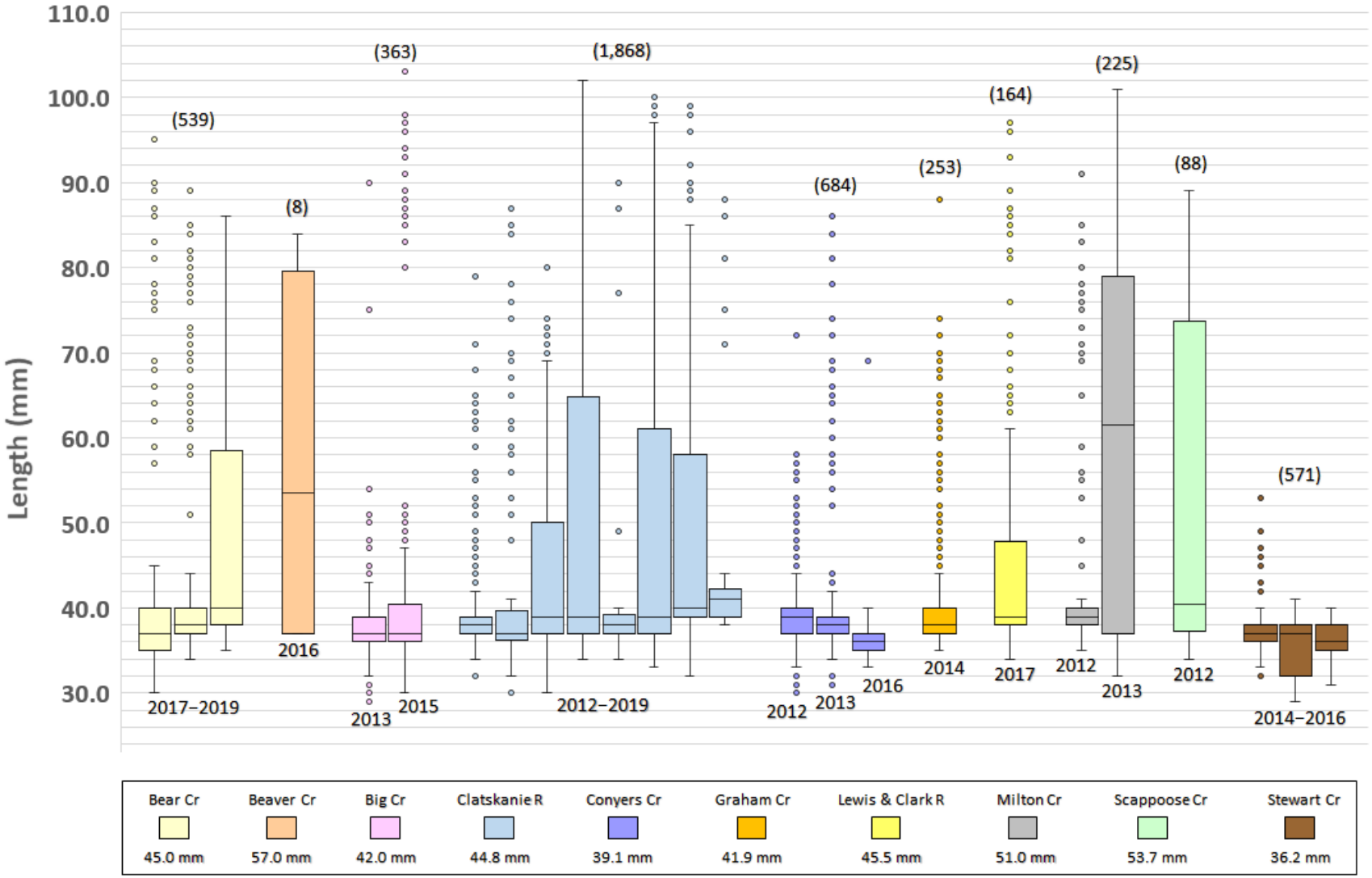

Figure A.18. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) length (mm) of Coho *Oncorhynchus kisutch* fry captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent lengths > 1.5 times interquartile range (i.e., outliers). Mean Coho fry length for all years sampled at each site is shown in the legend. The total number of fry measured for all years sampled at each site is shown in parentheses.

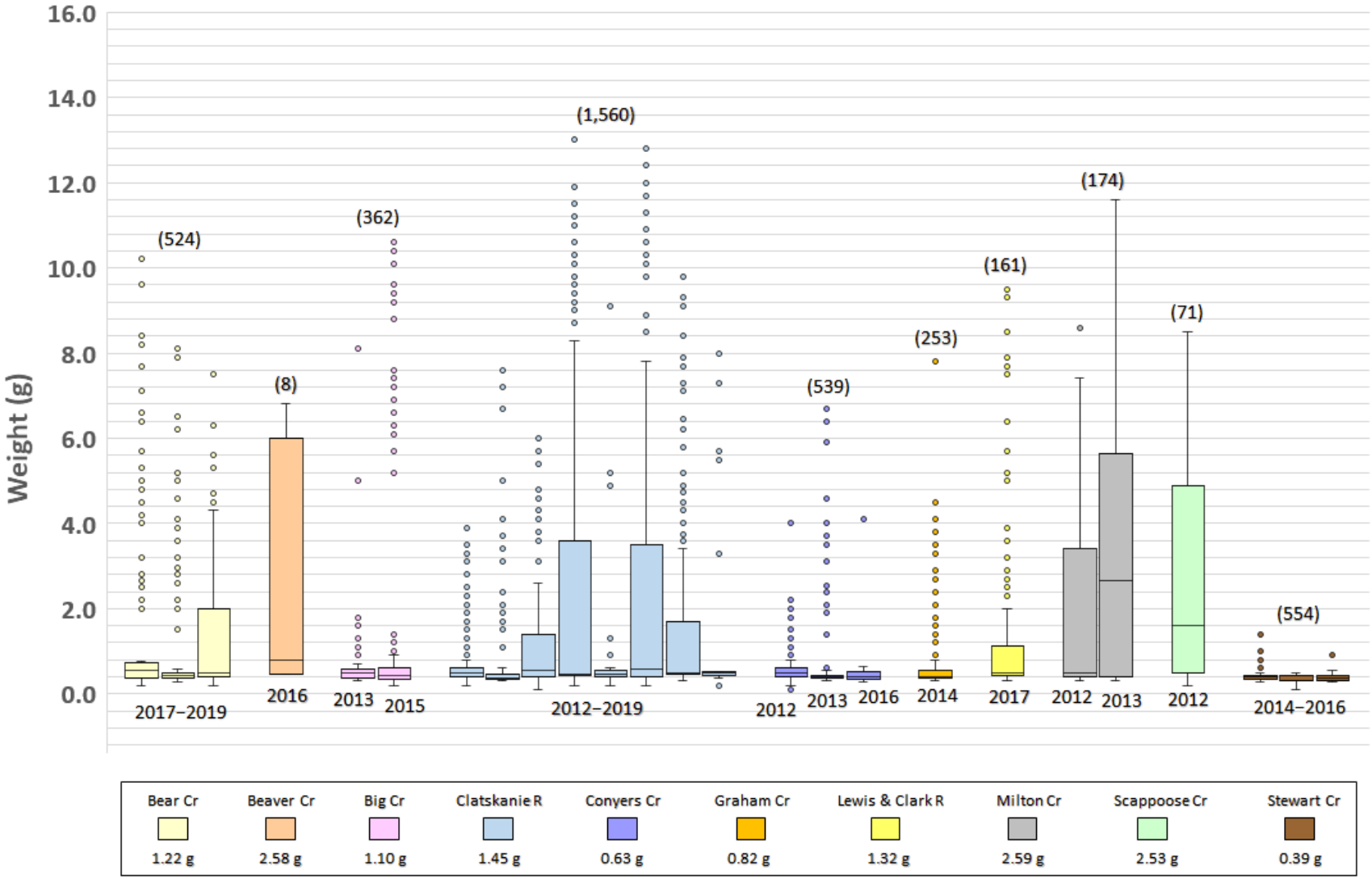

Figure A.19. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) weight (g) of Coho *Oncorhynchus kisutch* fry captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent weights > 1.5 times interquartile range (i.e., outliers). Mean Coho fry weight for all years sampled at each site is shown in the legend. The total number of fry weighed for all years sampled at each site is shown in parentheses.

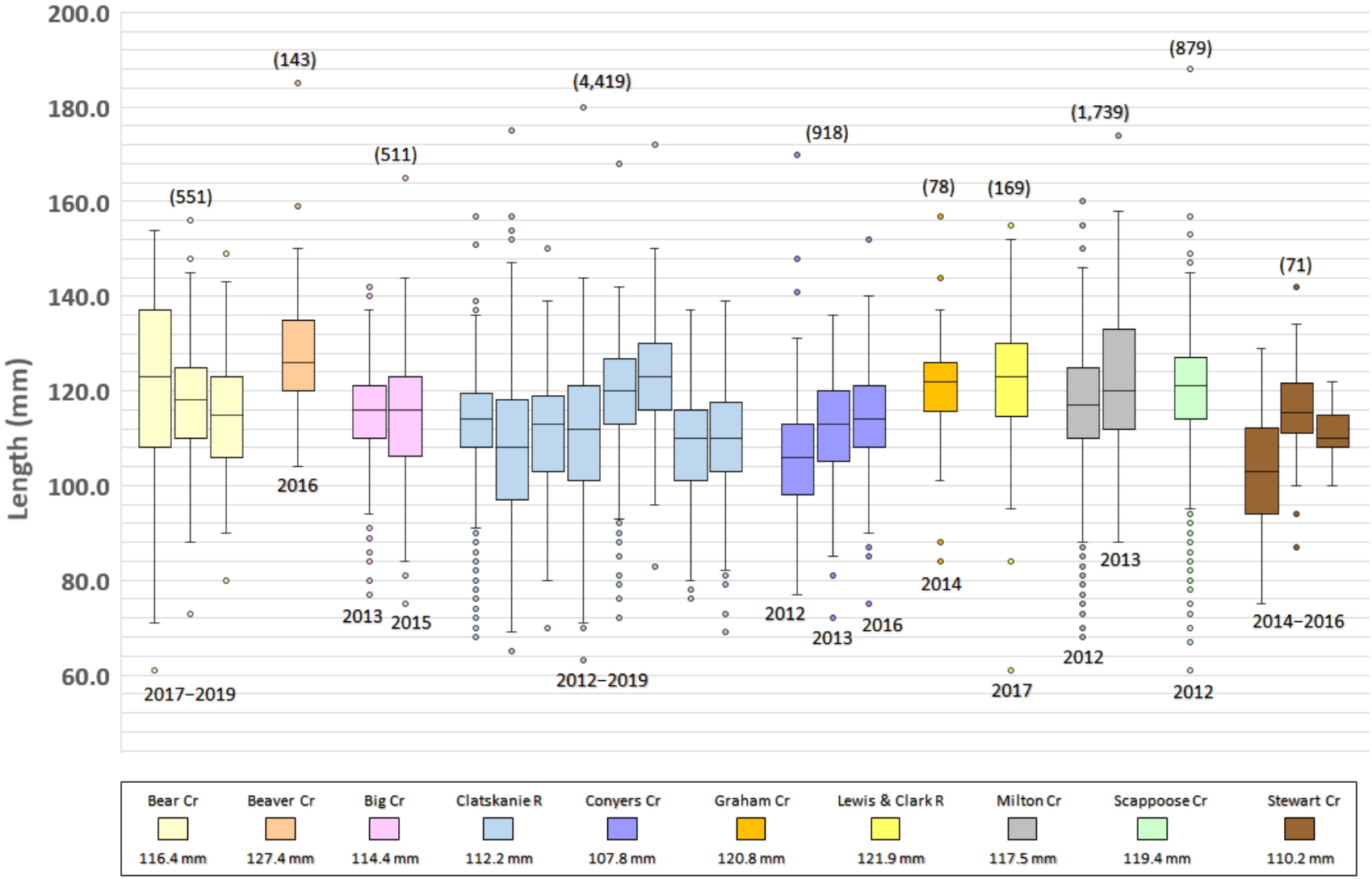

Figure A.20. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) length (mm) of Coho *Oncorhynchus kisutch* smolts captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent lengths > 1.5 times interquartile range (i.e., outliers). Mean Coho smolt length for all years sampled at each site is shown in the legend. The total number of smolts measured for all years sampled at each site is shown in parentheses.

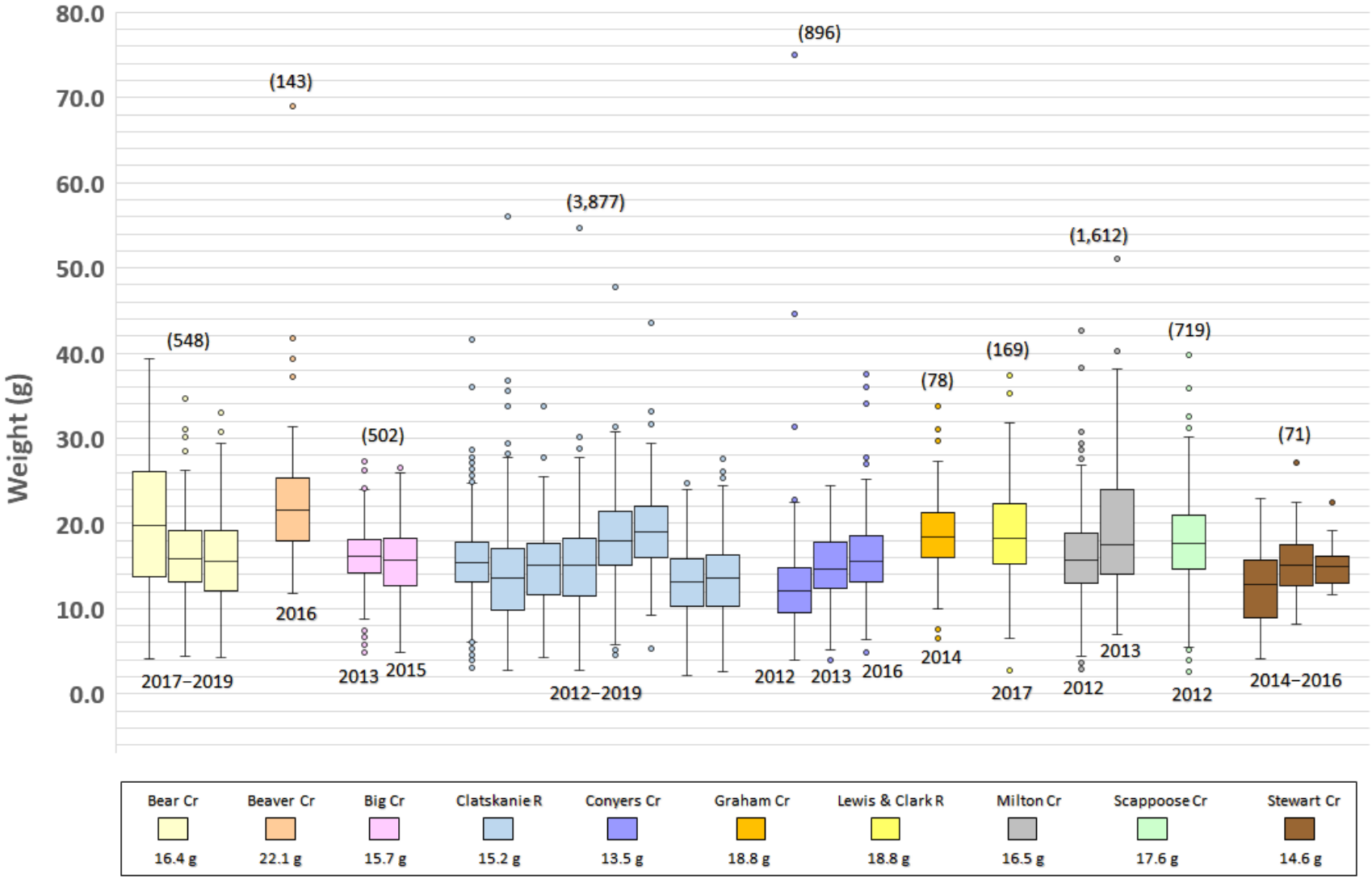

Figure A.21. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) weight (g) of Coho *Oncorhynchus kisutch* smolts captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent weights > 1.5 times interquartile range (i.e., outliers). Mean Coho smolt weight for all years sampled at each site is shown in the legend. The total number of smolts weighed for all years sampled at each site is shown in parentheses.

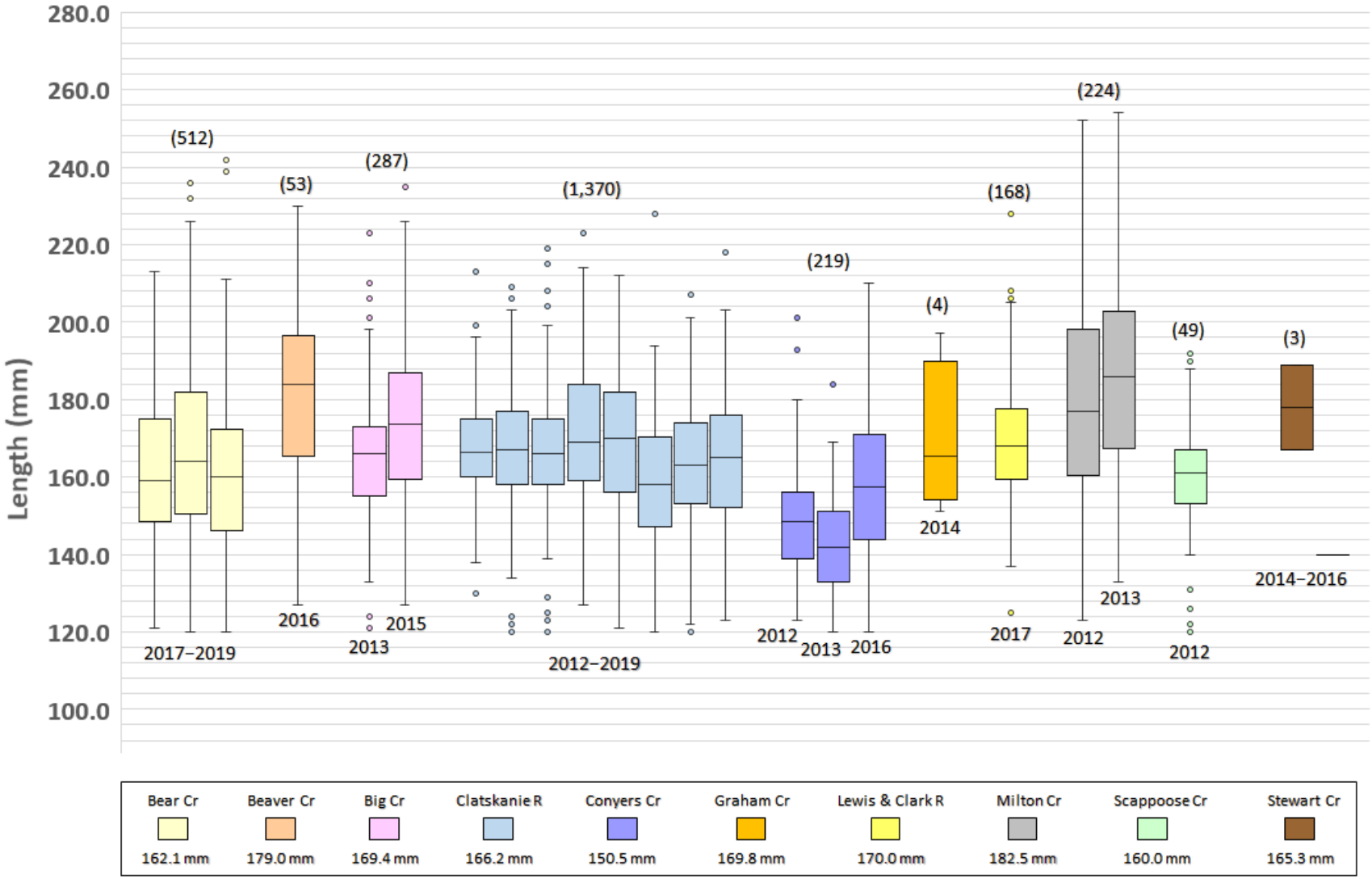

Figure A.22. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) length (mm) of Steelhead *Oncorhynchus mykiss* smolts captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent lengths > 1.5 times interquartile range (i.e., outliers). Mean Steelhead smolt length for all years sampled at each site is shown in the legend. The total number of smolts measured for all years sampled at each site is shown in parentheses.

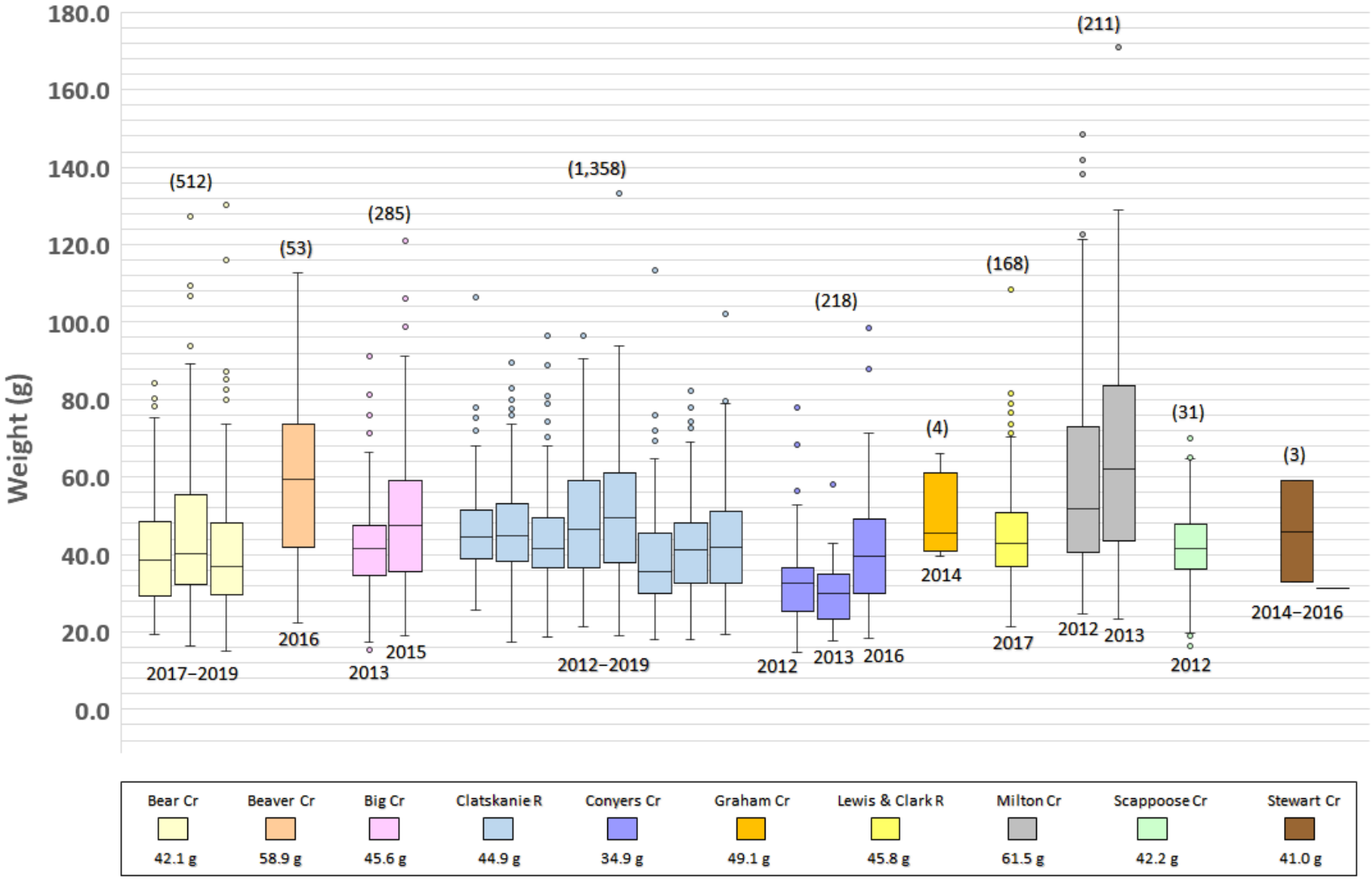

Figure A.23. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) weight (g) of Steelhead *Oncorhynchus mykiss* smolts captured juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent weights > 1.5 times interquartile range (i.e., outliers). Mean Steelhead smolt weight for all years sampled at each site is shown in the legend. The total number of smolts weighed for all years sampled at each site is shown in parentheses.

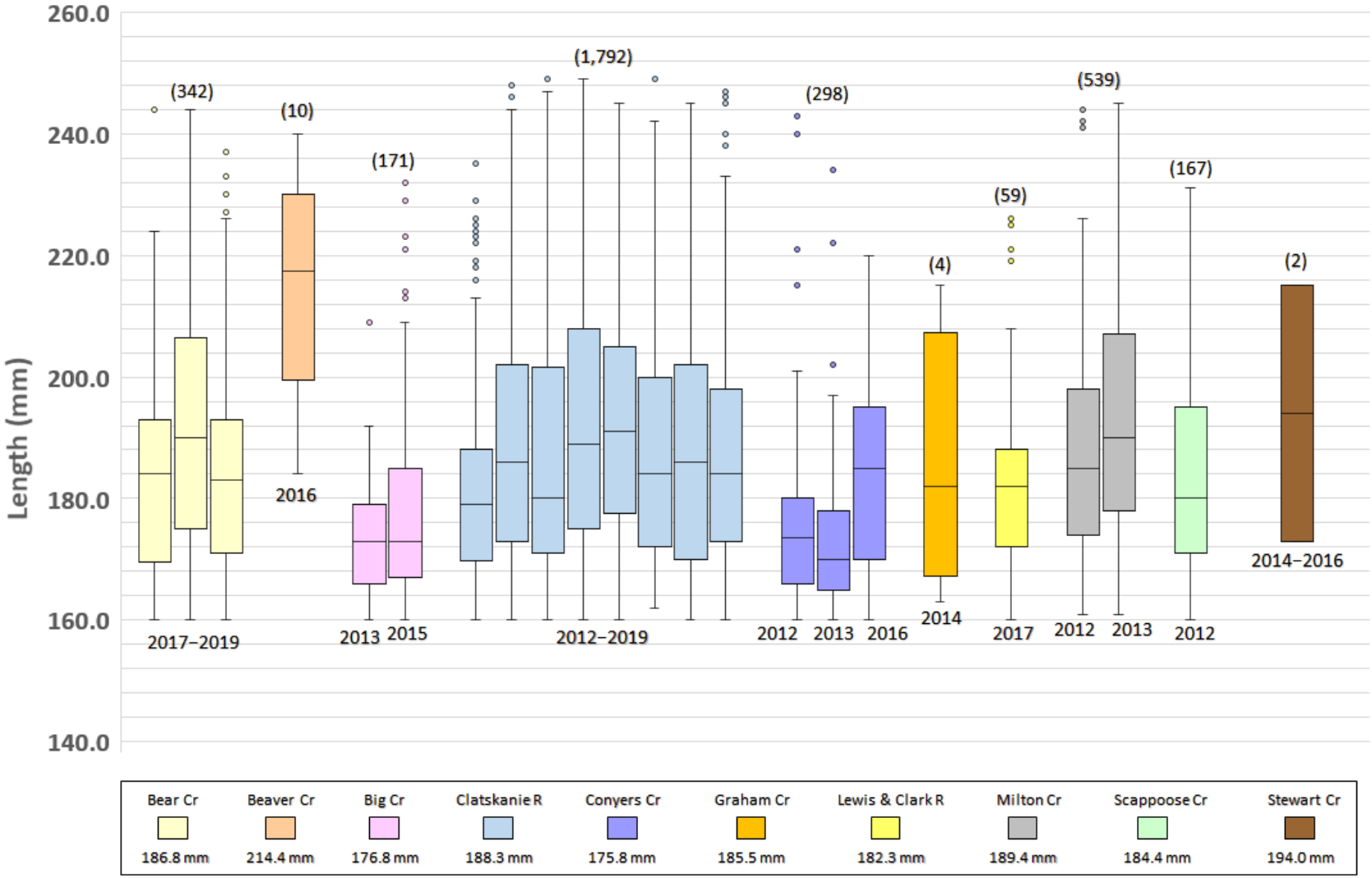

Figure A.24. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) length (mm) of 160–249 mm Cutthroat Trout *Oncorhynchus clarkii clarkii* captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent lengths > 1.5 times interquartile range (i.e., outliers). Mean 160–249 mm Cutthroat Trout length for all years sampled at each site is shown in the legend. The total number of trout measured for all years sampled at each site is shown in parentheses.

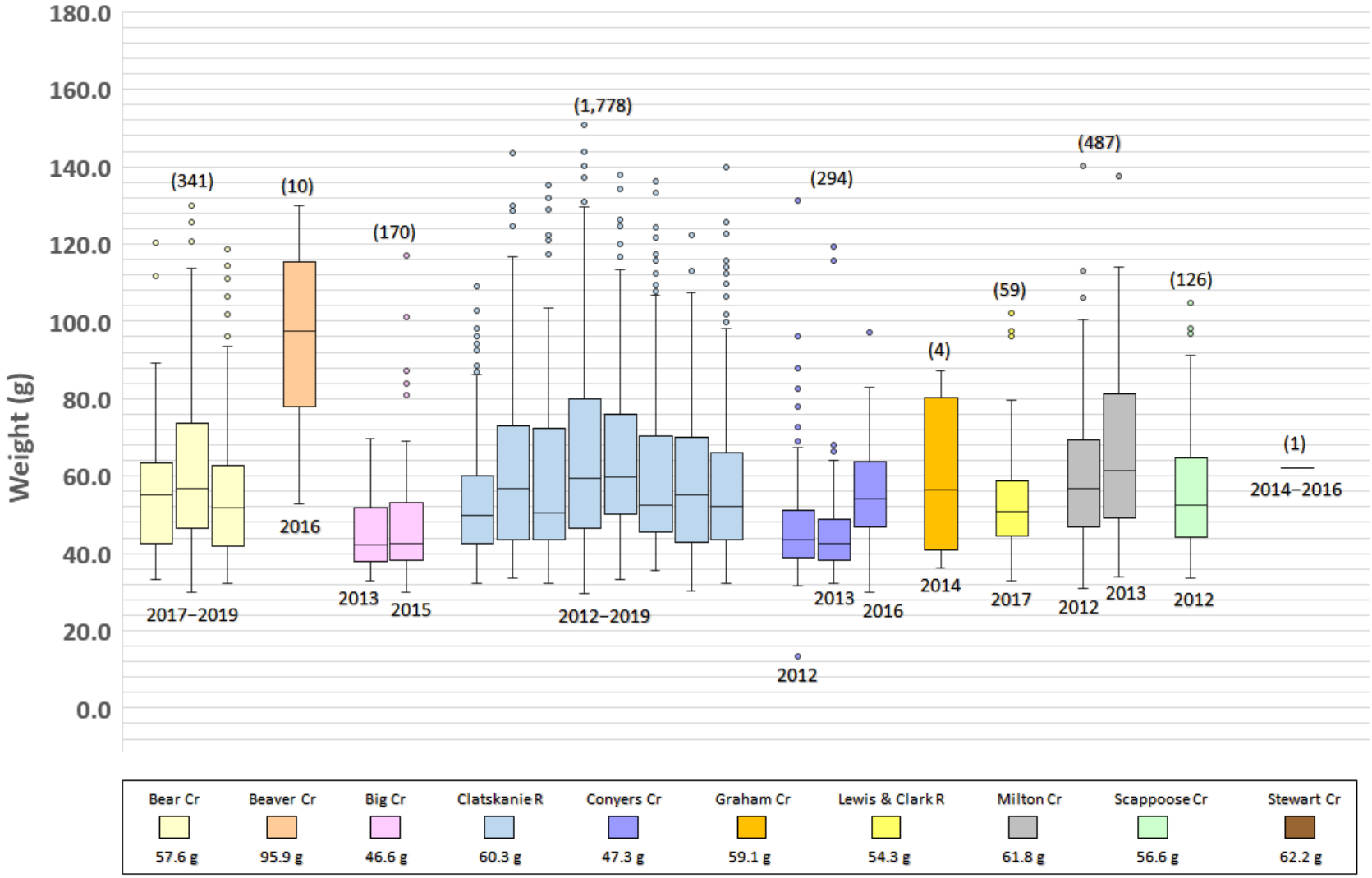

Figure A.25. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) weight (g) of 160–249 mm Cutthroat Trout *Oncorhynchus clarkii clarkii* captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent weights > 1.5 times interquartile range (i.e., outliers). Mean 160–249 mm Cutthroat Trout weight for all years sampled at each site is shown in the legend. The total number of trout weighed for all years sampled at each site is shown in parentheses.

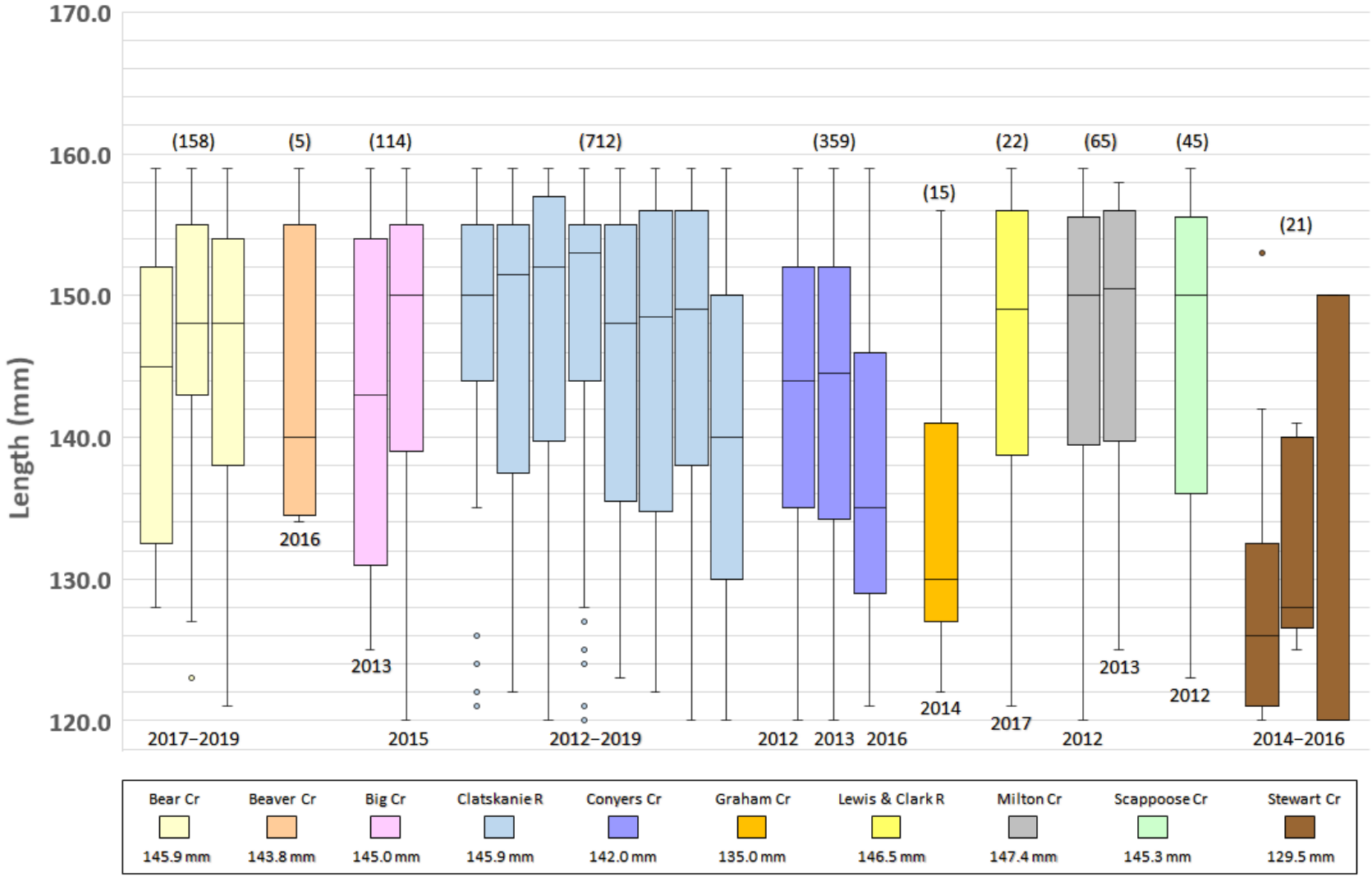

Figure A.26. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) length (mm) of 120–159 mm Cutthroat Trout *Oncorhynchus clarkii clarkii* captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent lengths > 1.5 times interquartile range (i.e., outliers). Mean 120–159 mm Cutthroat Trout length for all years sampled at each site is shown in the legend. The total number of trout measured for all years sampled at each site is shown in parentheses.

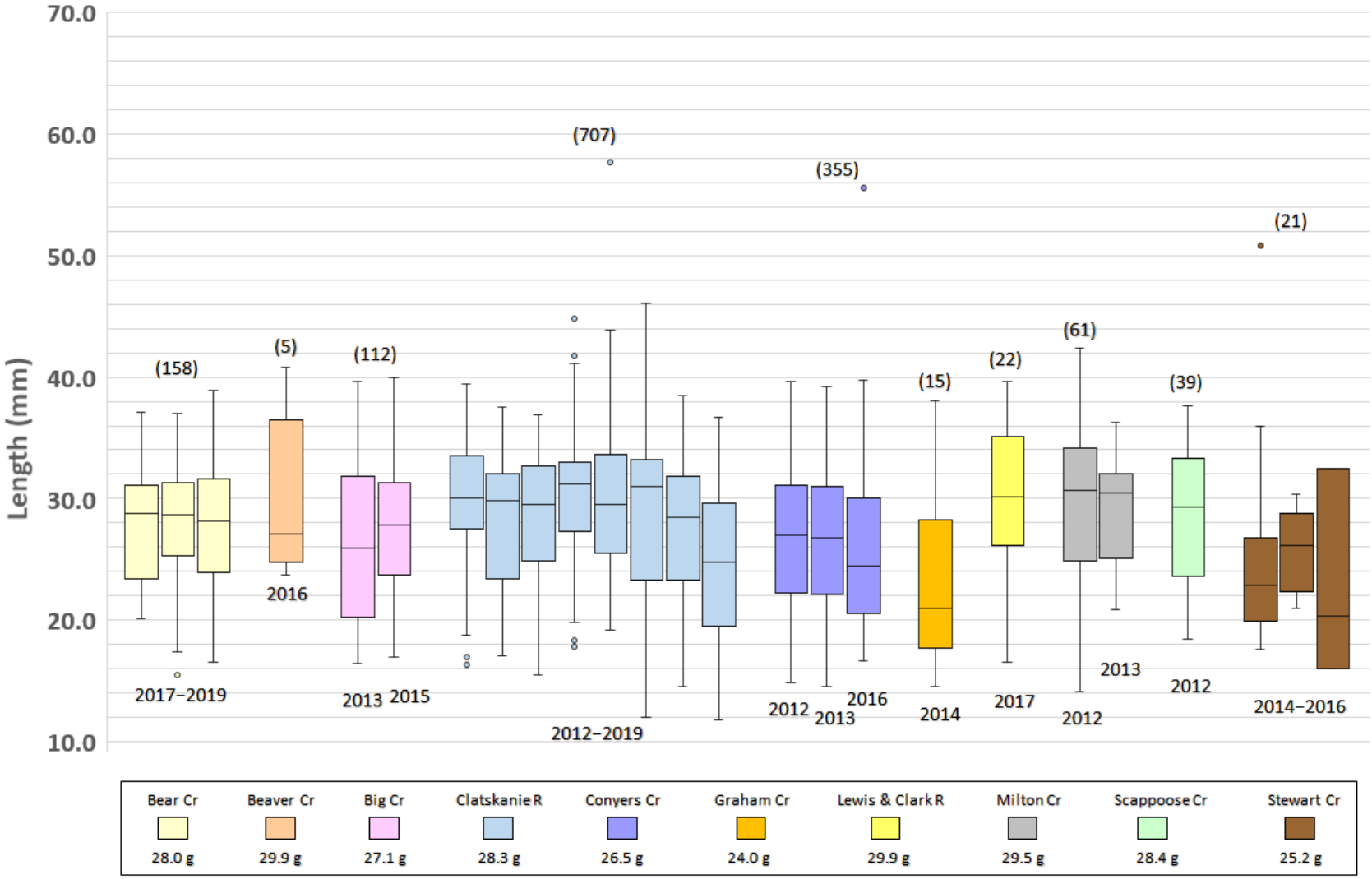

Figure A.27. Minimum (bottom whisker), 25th Percentile (box bottom), Median (middle bar), 75th Percentile (box top), and Maximum (top whisker) weight (g) of 120–159 mm Cutthroat Trout *Oncorhynchus clarkii clarkii* captured at juvenile traps operated from 2012–2019 in the Lower Columbia River Basin. Dots represent weights > 1.5 times interquartile range (i.e., outliers). Mean 120–159 mm Cutthroat Trout weight for all years sampled at each site is shown in the legend. The total number of trout weighed for all years sampled at each site is shown in parentheses.