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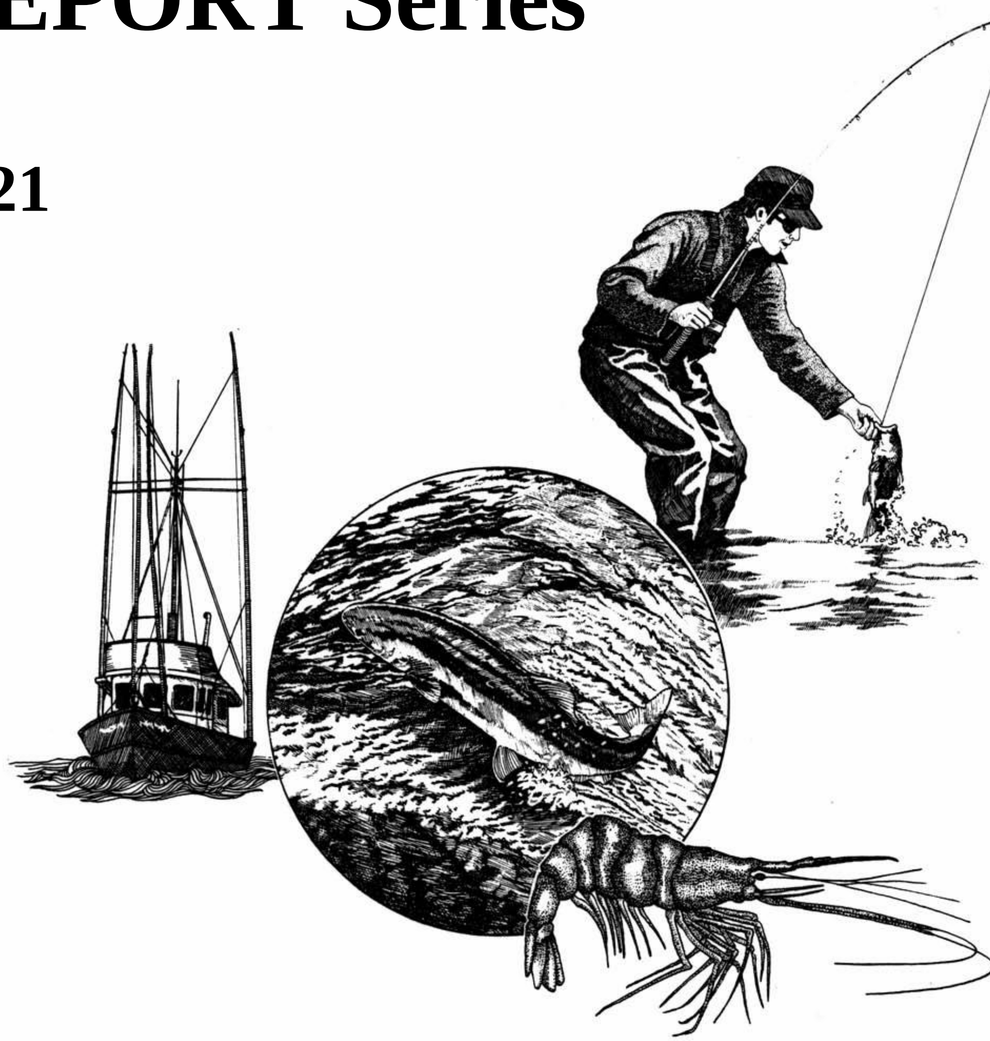
2021



Oregon Department of Fish and Wildlife

Juvenile Salmonid Monitoring in Coastal Oregon and Lower Columbia Streams, 2020 Field Season

Annual Monitoring Report No. OPSW-ODFW-2021-1

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ANNUAL PROGRESS REPORT
FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Juvenile Salmonid Monitoring in Coastal Oregon and Lower Columbia Streams, 2020 Field Season

PROJECT NUMBER: OPSW-ODFW-2021-1

PROJECT PERIOD: 2020

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CONTENTS

Contents

FIGURES

TABLES

SUMMARY

This report analyzed data from snorkel surveys for Coho Salmon (*Oncorhynchus kisutch*) and steelhead (*O. mykiss)* juveniles in their respective Evolutionarily Significant Units (ESUs) and Distinct Population Segments (DPSs) in western Oregon. Results were used to evaluate trends in distribution and abundance of the species from 1998-2020. For previous reports see: https://nrimp.dfw.state.or.us/crl/default.aspx?pn=WORP.

Coho Salmon

Southern Oregon Northern California (SONCC) ESU: The 2020 abundance estimate was 88,396 parr. The majority (78%) of these fish were within high quality habitats of the Interior Rogue Stratum. This estimate was the second lowest recorded and the continuation of a downward trend in the SONCC, where five of the six lowest abundance estimates have been observed in the last six years. Site occupancy was 46% in 2020, which is the average for the ESU.

Oregon Coast Coho (OCC) ESU: The 2020 abundance estimate was 3.8 million parr. Parr abundance has been between 2.9 and 4.9 million after improving from lows averaging 910,000 in 1998-1999. Site occupancy was 83% in 2020. Site occupancy has averaged 80% since 2000, after improving from lower estimates during 1998-1999.

Lower Columbia River (LCR) ESU: The 2020 abundance estimate was 80,242 parr and site occupancy was 41%. Though abundance and site occupancy were low compared to the average for the ESU, both suggested continued improvement over the estimates from 2016-2017.

In the OCC female spawner:parr recruit curves were asymptotic at current spawner abundances and parr/female spawner rates decreased as spawner abundances increased and increased as spawner abundances decreased. These data suggest that freshwater productivity was regulated by compensatory density dependence at early life stages in the ESU. Data do not indicate such regulation in the LCR. Adult data were insufficient to perform these analyses in the SONCC.

Steelhead

Klamath Mountains Province (KMP) DPS: The 2020 abundance estimate was 118,462 parr. This estimate nearly doubled that of 2019, but was below average for the DPS, where the six lowest abundance estimates have been recorded in the last six years. The 2020 site occupancy estimate was 77%, also an improvement from 2019 but low relative to the average. The below average metrics over the last six years have been more pronounced in the Rogue stratum of the DPS; occupancy and abundance in the South Coast stratum were above average in 2020.

Oregon Coast (OC) DPS: The 2020 abundance estimate was 349,654 parr, which was the highest recorded for the DPS. The 2020 site occupancy estimate was 82%, which was above average for the DPS.

Lower Columbia River (LCR) DPS: The 2020 abundance estimate was 1,913 parr, the lowest recorded and the continuation of a downward trend in the LCR, where the six lowest abundances estimates have been recorded in the last six years. The 2020 site occupancy estimate was 52%, below average for the DPS. Large confidence intervals for abundance estimates in the DPS have hampered trend detection.

South West Washington (SWW) DPS: In 2020 the abundance estimate was 11,209 parr and site occupancy was 64%. Both abundance and site occupancy in 2020 were average for the DPS and improvements over the estimates from 2017-2019.

BACKGROUND AND METHODS

Background and study design

This project was initiated by the Oregon Department of Fish and Wildlife (ODFW) in 1998 as one of the Oregon Plan for Salmon and Watersheds (OPSW) monitoring programs (State of Oregon 1997). Its primary objective is to monitor Coho Salmon (*Oncorhynchus kisutch*) parr distribution and abundance in Western Oregon to inform related conservation and recovery decisions. Monitoring steelhead (*Oncorhynchus mykiss)* parr distribution and abundance was added in 2002. Snorkel surveys at selected sites were used to meet these objectives.

Sites were selected using a Generalized Random Tessellation Stratified (GRTS, Stevens 2002) design which produced a random, spatially balanced sample from within Coho Salmon and steelhead rearing distribution. To assess both status and trend, site selection was incorporated with a rotating panel design. The design emulated the Coho Salmon three year life cycle (reviewed by Weitkamp et. al 1995); a quarter of selected sites were placed on an annual survey rotation, a quarter were placed on a three year survey rotation, a quarter were placed on a nine year survey rotation, and a quarter were surveyed only once (Stevens 2002). Sites on an annual rotation provided trend detection capability and contributed to the representation of the area needed to estimate status. Sites on three and nine year rotations augmented trend detection capability over time and contributed to the sample size for status. Sites that were visited only once contributed to sample size for status and improved the representation of the rearing distribution. Using GRTS and the rotating panel, sites were selected and apportioned among the three Coho Salmon Evolutionarily Significant Units (ESUs), the four steelhead Distinct Population Segments (DPSs), and their strata in Western Oregon (Figures 1 and 2, respectively). Both the spatial scope and the scale of digital stream distribution network (sampling frame) employed in the site selection process have changed since 1998. These changes differed among the ESUs/DPSs and are described below.

In the Oregon portion of the Southern Oregon Northern California Coast Coho ESU (SONCC), sites were originally selected from a 1:100,000 (100k) scale sampling frame of 1^{st}-3^{rd} order streams that were within the presumed higher quality Coho Salmon rearing habitat distribution. In 2002, the scope was expanded to include the presumed steelhead rearing distribution in 1^{st}-3^{rd} and 4^{th}-6^{th} order streams within the Oregon portion of the Klamath Mountains Province DPS (KMP). In 2012, the frames were revised and converted to a 1:24,000 (24k) scale. The revision endeavored to include all Coho Salmon and steelhead habitat, regardless of quality, upstream of tidal areas. The revision retained the Rogue and non-Rogue steelhead strata, but renamed them to KMP Rogue and KMP South Coast, respectively, for consistency with federal management plans. The revision also partitioned the Coho Salmon frame into two strata, the Interior Rogue and North Coast Basins. Surveys in 4^{th}-6^{th} order streams were phased out in 2012 due to funding constraints. In 2019, the frames were again revised based on the previous 7 years of survey work. The 2019 revision stratified the frame into high quality and low quality habitats for Coho Salmon based on Species Distribution Modeling (SDM) (Julie Firman, ODFW, personal communication). Data in this report, including previous years, were analyzed and presented to reflect the 2019 revised frame. Coho Salmon metrics were comparable for all years on the ESU scale. Metrics based only on high quality habitats were comparable for all years in the Interior Rogue. Steelhead metrics were comparable from 2002 to present in both strata and for the DPS. A more detailed description of the SONCC/KMP frame history is given by Constable and Suring (2020).

In the Oregon Coast Coho ESU (OCC), sites were originally selected from a 100k sampling frame of 1^{st}-3^{rd} order streams that were within the putative Coho Salmon summer rearing distribution. This original sampling frame was designed to include all Coho Salmon rearing habitat in these lower order streams, upstream of tidal areas. In 2002, the scope was expanded to include 4^{th}-6^{th} order streams within steelhead distribution. In 2007 the sampling frame was revised, based primarily on 1998-2006 field work, and converted to a 24k scale. In 2009, due to funding constraints, surveys in 4^{th}-6^{th} order streams were discontinued. In 2012 the frame was again revised based on field work. Annual distribution and abundance metrics for both species were comparable for all years, beginning in 1998 for Coho Salmon and 2002 for steelhead. Data in this report were analyzed and presented based on the revised 2012 frame.

The Oregon portion of the Lower Columbia River (LCR), which includes LCR ESU, the LCR DPS, and the South West Washington DPS (SWW), were added to the scope of the project in 2006. Sites were originally selected from a 100k sampling frame for 1^{st}-3^{rd} order streams within the putative Coho Salmon rearing distribution and for 4^{th}-6^{th} orders streams within the putative steelhead rearing distribution. In 2007 the sampling frame was revised and converted to a 24k digital stream network scale. In 2012, due to budget restrictions, surveys in 4^{th}-6^{th} order streams were discontinued in the region. Similar to the OCC, the frame was again revised in 2012. Annual distribution and abundance metrics for both species in the region were comparable for all years, beginning in 2006 to the present year. Data in this report were analyzed and presented based on the revised 2012 frame. Sampling frame and survey design processes previous to 2007 for all ESUs/DPSs are described in detail by Jepsen and Rodgers (2004) and Jepsen and Leader (2007).

Field Sampling

Selected sites were surveyed by field crews using daytime snorkeling during the base flow period (mid-July to early October). Sites were ~1 kilometer in length and encompassed the GRTS point (x, y coordinates) provided by the selection process. Field crews were trained in fish identification and survey protocols described by Rodgers (2000). Surveys began at the downstream end of the site and proceeded upstream (Thurow 1994). Site length, pool length, and average pool width were measured with either a hip chain, open reel tape, depth staff, or range finder. Pool depth was measured using a depth staff. All pools $\geq 6m^2$ in surface area and ≥20cm in maximum depth were snorkeled with a single pass to identify and count juvenile salmonids. Dive lights were used to improve visibility. Visibility was rated by considering factors that could impede the ability to observe fish (Rodgers 2000; Crawford 2011). Counts were made of Coho Salmon parr regardless of length, juvenile steelhead ≥90 mm in fork length (FL, visually estimated), and cutthroat trout (*O. clarki*) ≥90 mm FL. Due to difficulties distinguishing O. *mykiss* and *O. clarki* when under 90mm FL, all trout in this range were assumed to be age 0 and were not identified to species or used in analysis (Hawkins 1997, Roni and Fayram 2000). Fish presence was noted for dace, shiners, and trout <90 mm FL.

Freshwater mussel relative abundance and beaver activity were also recorded. In previous years 10-15% of surveys were resurveyed by supervisory staff to evaluate adherence to survey protocols, and the precision of the counts. Resurveys were not conducted in 2020 due to constraints related to the COVID-19 pandemic.

Initially pools that were ≥40cm in maximum depth were snorkeled. In 2010, this criterion was expanded to include pools ≥20cm in maximum depth based on results from the Smith River Verification Study (Constable and Suring, under review), which suggested that the lower criterion would allow surveyors to sample larger and more consistent portions of juvenile salmonid rearing abundances. In order to compare current data to that from previous years, reports following the 2010 field season primarily provide an analysis of data based on pools meeting the ≥40cm maximum depth criterion and a secondary analysis of data based on pools meeting the ≥20cm maximum depth criterion.

Our sampling objective for Coho Salmon is to produce abundance estimates with 95% confidence intervals ≤30% of the estimate and to detect a 15% change in occupancy with 80% certainty (Crawford and Rumsey, 2011). Data analysis has shown that completing 40 sites per stratum (60 in the Interior Rogue) is typically sufficient to reach this objective. In 2020 the goal of completing 40 sites per stratum was reduced by 25% due to a hiring freeze resulting from the COVID pandemic.

Data Analysis

Data are summarized by ESU or DPS and stratum. Cumulative Distribution Function (CDF) graphs (based on density), variances, and confidence intervals were created using tools developed by the EMAP Design and Analysis Team (EPA 2009). In comparison tests a p-value ≤ 0.05 was considered to indicate a significant difference. The following metrics of fish distribution and abundance were estimated for each of the two target species:

- Site occupancy: The percent of sites where at least one individual of the target species was observed. Site occupancy was calculated by dividing the number of sites where the target species was observed by the number of sites that were surveyed for each stratum, ESU, or DPS.

- Pool frequency: The average percent of pools in a site that contain at least one individual of the target species. Pool frequency was first calculated at each site by dividing the number of pools where the target species was observed by the total number of surveyed pools. The resulting percent at each site was then averaged to obtain the pool frequency estimate within the stratum, ESU, or DPS.

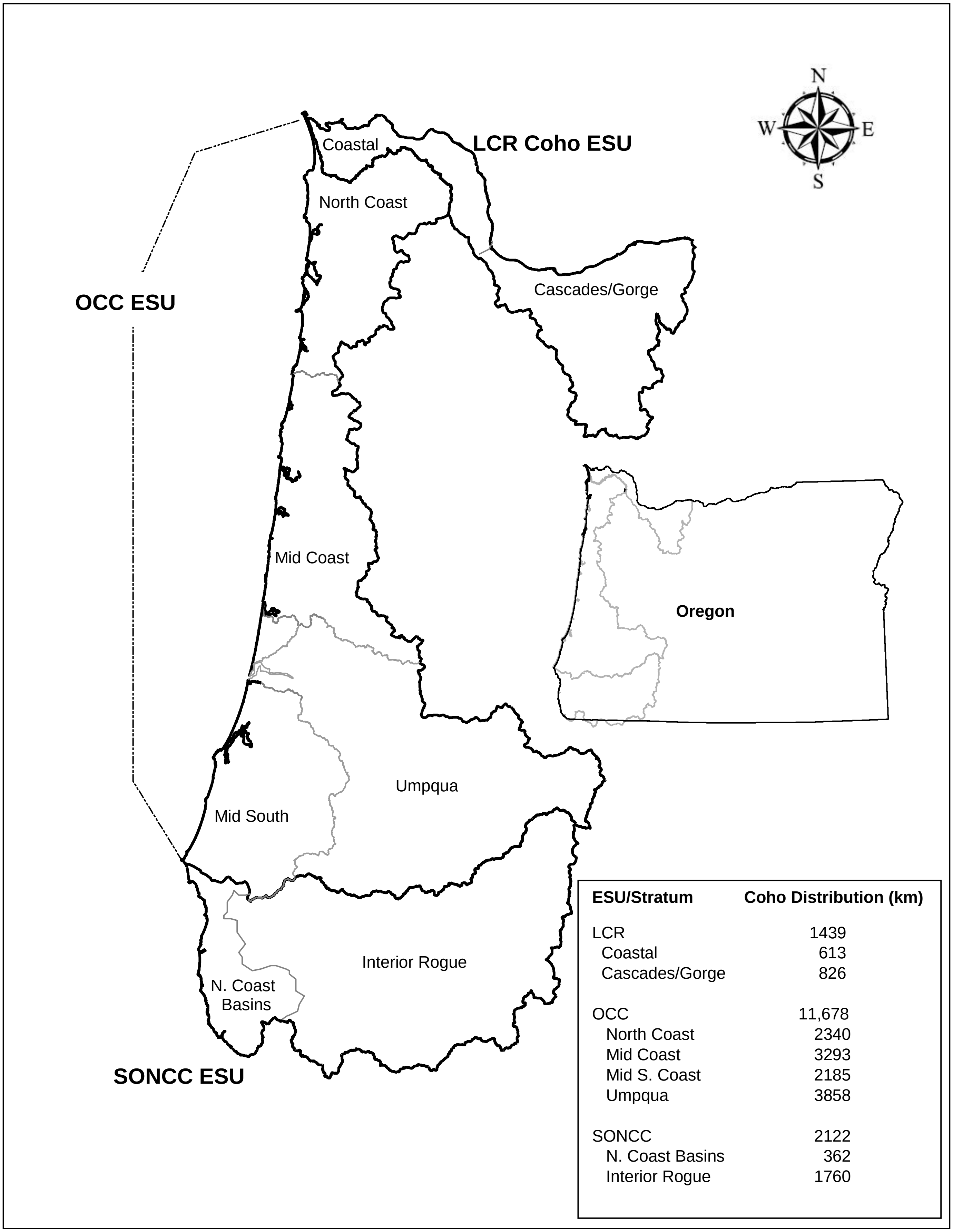
- Density: The number of target species individuals divided by the surface area of the pool in which they were observed. Density was first calculated in each pool. Second, each site’s density was estimated by averaging the pool densities within the site. Lastly, density was estimated for each stratum, ESU, and DPS by averaging the site densities within the respective region.

- Abundance: The estimate of the number of individuals of each target species in pools that met sampling criteria for each stratum, ESU, or DPS. Abundance was calculated by multiplying the count of target species individuals per kilometer at each site by the site weight. Target species individuals per kilometer is the sum of the snorkel count at the site divided by the length (in km) of the site. Site weight is the total length of the rearing distribution in the stratum, ESU, or DPS divided by the number of surveyed sites in the area. The site weight is adjusted for sites that were non-target, i.e. sites that were dry, in tidal zones, or above fish passage barriers, (Stevens 2002). Abundance estimates in this report were based on un-calibrated snorkel counts in pools that meet size criteria. They did not represent total abundance, but were appropriate for assessing trends.

- Percent full seeding: This metric is the percent of sites within a stratum or ESU with a site density $\geq$0.7 Coho Salmon/m^2. This value is regarded as full seeding following Nickelson et al. (1992), where full seeding was estimated to be 1.0 fish/m^2 from electrofishing removal estimates, and Rodgers et al. (1992), where snorkelers observed 70% of the Coho Salmon in electrofishing removal estimates.

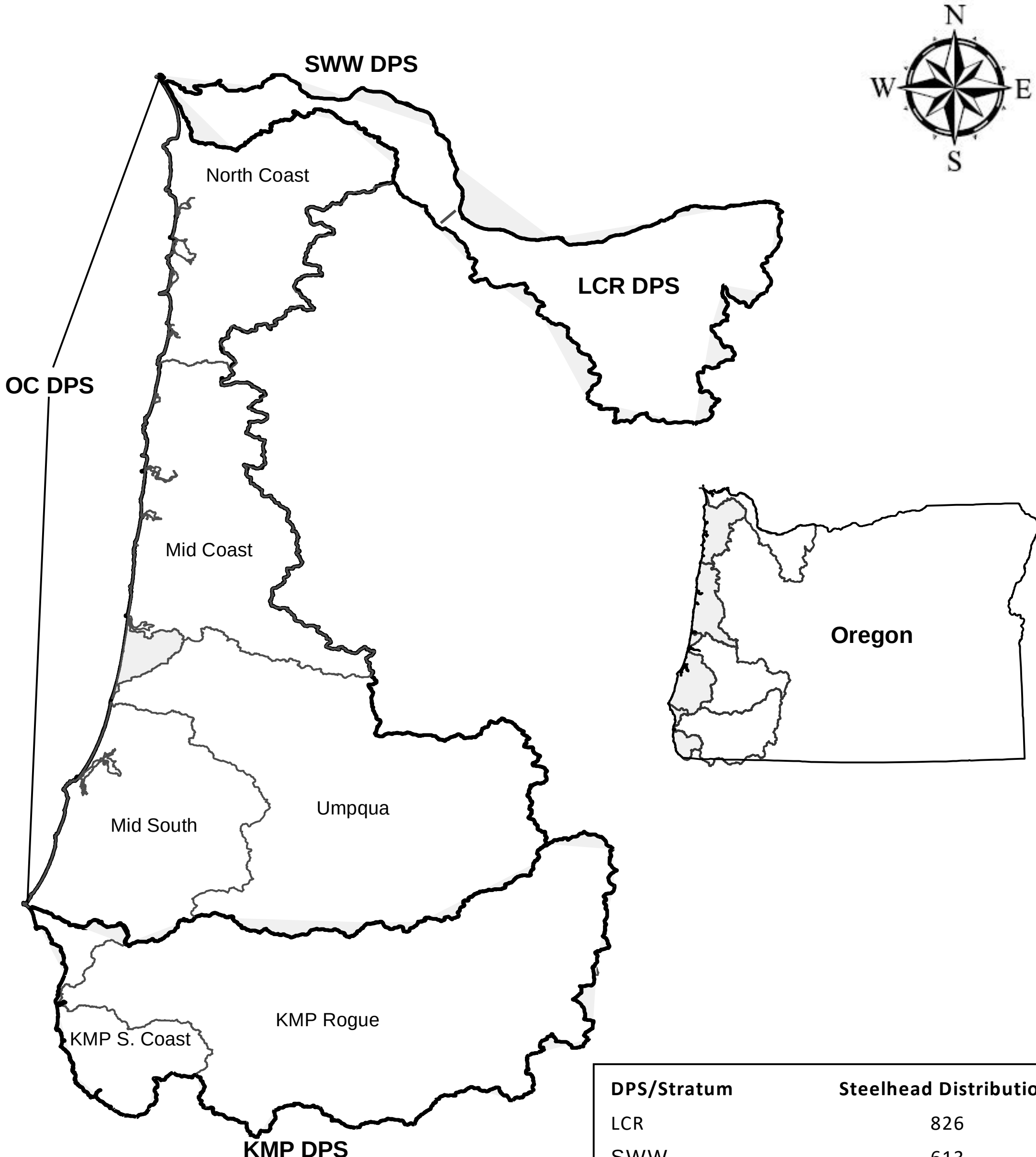
To compare metrics across the 23 year time span of the project in the OCC and SONCC/KMP, annual data was binned into brood groups. Each brood group for Coho Salmon, beginning in 1998, contained three consecutive years of data, based on the conventional three-year Coho Salmon life cycle (reviewed by Weitkamp et al. 1995), i.e. the first brood group was from 1998-2000, the second was from 2001-2003, etc. Each brood group for steelhead, beginning in 2002, contained four consecutive years of data, based on the presumptive four-year steelhead life cycle (reviewed by Busby et al., 1996). LCR Coho Salmon and steelhead data were also binned, beginning in 2007 and 2006, respectively, for consistency with the brood groups in the OCC and SONCC/KMP. A brood group contains one iteration of each of the brood lines for these species and is one complete cycle of the summer rearing segment of the population. The application of brood groups as an analysis unit, in addition to individual cohorts or years, can provide a useful way to monitor trends in distribution and abundance. Estimates of site occupancy and fish abundance were analyzed and compared for Coho Salmon and steelhead brood groups within strata and ESUs/DPSs.

Female spawner:parr recruit plots were produced using Beverton-Holt models in R version 3.4.0 (2017). AICs from models using a single line to fit all data and models with strata-specific asymptotes were compared to select the best model. Residuals were plotted to determine trend. Female spawner data used in these plots were from the ODFW Oregon Adult Salmonid Inventory and Sampling (OASIS) project (available at http://odfw.forestry.oregonstate.edu/spawn/cohoabund.htm). Trend analysis comparing pools with a ≥20cm maximum depth criterion to pools with a ≥40cm maximum depth criterion was performed using Bayesian posterior distribution models of the geometric mean inter-annual changes in abundance. Models assumed a log-linear effect and a lognormal distribution of abundances.



ESU/Stratum	Coho Distribution (km)
LCR	1439
Coastal	613
Cascades/Gorge	826
OCC	11,678
North Coast	2340
Mid Coast	3293
Mid S. Coast	2185
Umpqua	3858
SONCC	2122
N. Coast Basins	362
Interior Rogue	1760

Figure 1. Coho Salmon ESUs and strata within the Western Oregon project area. The table gives the length of rearing distribution in 1st-3rd order streams in each area.



DPS/Stratum	Steelhead Distribution (km)
LCR	826
SWW	613
OC	11,678
North Coast	2340
Mid Coast	3293
Mid South	2185
Umpqua	858
KMP	3305
KMP Rogue	2652
KMP South Coast	654

Figure 2. Steelhead DPSs and strata within the Western Oregon project area. The table gives the length of rearing distribution in 1st-3rd order streams in each area.

2020 Survey Effort and Resurveys

In 2020, 455 sites were selected by the GRTS process within the Coho Salmon and steelhead sampling frames. Twenty sites were determined to be non-target (beyond the potential rearing distribution of Coho Salmon and steelhead). Of the remaining 435 sites, 175 were not surveyed because of landowner access restrictions (n=88), visibility or water quality issues (n=9), unsafe or difficult access (n=6), or time restrictions (n=72). Landowner denials and lack of visibility accounted for the high number of sites that could not be surveyed in the LCR and Interior Rogue. Large wildfires across Western Oregon prevented surveying for nearly two weeks, accounting for a large number of sites that were not visited. Sites that were not surveyed were defined as target, non-response. A total of 260 sites were snorkeled, comprising 3,373 pools in 254.4 km of streams. We met our 2020 survey effort goals in five of the eight strata (Table 1).

Table 1. Survey effort goals and status of sites for 2020.

ESU	Stratum	Survey Goal	Snorkeled	Target -Non response	Non-Target
OCC	North Coast	30	34	11	1
	Mid Coast	30	35	9	1
	Mid-South Coast	30	31	6	0
	Umpqua	30	32	11	1
LCR	Coast	30	33	37	6
	Cascades/Gorge	30	27	34	9
SONCC	Interior Rogue	45	39	51	0
	N. Coast Basins	30	29	16	2

The goal of a 95% confidence interval ≤30% of the density estimate was met in the North Coast, Mid Coast, and Mid-South Coast strata for 2020 (Table 2). Variance partitioning has indicated low precision in most years due to the high variation of Coho Salmon abundance among the survey sites (Anlauf-Dunn, ODFW, unpublished data). Results from resurveys in previous years have shown a significant relationship (R^2 = 0.970) between counts of Coho Salmon in surveys and resurveys. Counts of steelhead in surveys and resurveys from previous years have also been correlated, but to a lesser degree (R^2 = 0.795). These results indicated that our counts of these species were precise and repeatable.

Table 2. Distribution and density estimates of Coho Salmon parr in the four strata of the Oregon Coast Coho ESU and in the LCR and SONCC. Estimates are from snorkel surveys in 1st-3rd order streams from 2020.

Stratum or ESU	Distribution			Density		
	Site Occupancy	Mean Pool Frequency	95% CI	Percent Sites > 0.7 coho/m^2	Mean Average Pool Density (coho/m^2)	95% CI
North Coast	85%	69%	± 15%	3%	0.235	± 28%
Mid Coast	91%	82%	±8%	0%	0.245	± 20%
Mid-South Coast	87%	79%	± 14%	18%	0.337	± 30%
Umpqua	72%	55%	± 16%	6%	0.237	± 53%
SONCC	46%	35%	± 41%	0%	0.075	± 54%
LCR	41%	28%	± 27%	0%	0.065	± 45%

Trends in Salmonid Distribution and Abundance

Coho Salmon

Southern Oregon Northern California Coast

The 2020 abundance estimate was 88,396 parr. The majority of these fish (78%) were in high quality habitats within the Interior Rogue stratum, 6% were in low quality habitats within the Interior Rouge stratum and 16% were in the North Coast Basins stratum. Abundance estimates for the brood groups from 2013 to present were similar to the 1998-2000 brood group, but low relative to the 2007-2009 and the 2001-2003 groups (Figure 3). Five of the six lowest abundance estimates in the ESU have been observed in the last six years. The 2020 density estimate was 0.08 fish/m^2 and no sites were fully seeded. The density estimate was similar to that of 2019, but below the average of all years in the ESU. Site occupancy in 2020 was 46%, which was similar to that of the previous brood groups and average for the ESU (Figure 4). Annual metrics for the ESU and its strata are presented in Appendix I.

Oregon Coast Coho

The 2020 abundance estimate was 3.8 million parr, which was average for the ESU. Parr abundance has remained between 2.9 and 4.9 million since 2000, after improving from an average of 910,000 in 1998-1999. The abundance estimate for the partial brood group from 2019-2020 was similar to the abundance estimates for six preceding brood groups (Figure 3). Density was 0.258 fish/m^2, which was below average, and 6% of the sites were fully seeded, which was also below average. Site occupancy was 83% for 2020. Site occupancy has met the National Marine Fishery Service recovery criterion (Wainwright et al., 2008) of ≥80% of sites occupied in the ESU in all but 2 of the last 12 years. Site occupancy for the partial 2019-2020 brood group was low relative to estimate for the 2010-2012 brood group and high relative to the estimates for the 1998-2003 brood groups. Annual metrics for the ESU and its strata are presented in Appendix I.

In the North Coast and the Mid Coast strata of the OCC, the 2020 CDF curve was low relative to the average CDF curve from previous years (Figure 5). Abundance estimates in the 2019-2020 partial brood group were similar to those in the 2016-2018 brood groups, within the North Coast, Mid Coast, and Umpqua strata (Figure 6). In the Mid-South Coast stratum the abundance estimate for the 2019-2020 partial brood group was higher than that of the 2016-2018 brood group; this was driven by the 2020 abundance estimate, which was the 3rd highest observed. Density estimates in 2020 were similar to those in 2019 for the North Coast and the Umpqua strata. Density estimates in the Mid Coast for 2020 were lower than in 2019 and density estimates in the Mid-South Coast were higher in 2020 than in 2019. Site occupancy estimates in the strata for the 2019-2020 partial brood group were similar to those for preceding 5 brood groups (Figure 7). Site occupancy continues to be lower in the Umpqua, relative to the other strata.

Female spawner:parr recruit plots for the OCC strata suggested parr production was asymptotic near current spawner abundances, indicating a density-dependent effect on rearing capacity at this early life stage (Figure 8). Data suggest the rearing capacity may be slightly higher in the Mid-South Coast relative to the other strata. The 5 highest (and 13 of the 20 highest) parr abundance estimates were in the Mid-South Coast. Plots of residuals also suggested the Mid-South Coast had a positive trend; a trend was not observed in other strata. In the OCC, the number of parr produced per female increased when female spawner abundance decreased and, conversely, decreased when female spawner abundance increased, suggesting a compensatory effect (Figures 9 and 10). The average number of parr per female was 62 and ranged from 14 (in the Umpqua, when female spawner abundance was at its highest) to 221 (in the Umpqua when, female spawner abundance was at its 2nd lowest). Density-dependent effects on recruits per spawner in the OCC have been also been described by Nickelson and Lawson (1998) and Wainwright (2008).

As stated in the Methods section, the parr numbers given here were from un-calibrated visual estimates conducted only in pools meeting protocol criteria. Actual parr abundance was likely ~185% higher (Constable and Suring, 2018). We assumed that the lack of a corresponding linear increase in parr abundance with increased female spawner abundance was not an effect of parr “spilling over” into less optimal habitats, such as riffles, where they would not be observed with our protocols. Supporting this assumption are data that indicate pool densities have been relatively low to moderate (<0.7 Coho Salmon/m^2) in the majority of sites in high spawner abundance years. We also assume that the bias of snorkeler counts of parr in pools is similar across the range of parr abundances we have observed. Initial work of testing these assumptions began in the 2016 field season and continued in 2017-2019. This work was not conducted in 2020 due to COVID-19 pandemic impacts.

Lower Columbia River

The 2020 abundance estimate was 80,242 parr. The abundance estimate for the partial 2019-2020 brood group is similar to that of the preceding three brood groups, but lower than that of the 2007-2009 brood group. Large confidence intervals in the ESU have confounded the comparison of abundance estimates among the brood groups. The density estimate in 2020 was 0.65 fish/m^2 and no sites were fully seeded. The 2020 density estimates was similar to that of 2019. The 2020 site occupancy estimate was 41%, and this was similar to the estimate in 2019 and to the average for the ESU. Site occupancy for the 2019-2020 partial brood group was similar to the preceding 3 brood groups, but lower than the estimate for the 2007-2009 brood group. Annual metrics for the ESU are presented in Appendix I.

Unlike the OCC, the plot of female spawner and parr recruits for the LCR did not suggest an asymptote in parr production at current spawner abundances, and there was a weaker indication of a density-dependent effect on parr production (Figure 11). A plot of residuals did not suggest a trend. The average number of parr produced per female spawner was 37. This was 40% lower than in the OCC and appeared to be less influenced by female spawner abundance (Figures 12 and 13), relative to the OCC. The number of parr per female ranged from 7, when female spawner abundance was highest (in brood year 2014), to 71, when female spawner abundance was lowest, but data suggest any compensatory effect in the LCR was weaker and less consistent than what was observed in the OCC (Figure 13). This was evident in the 2015-2016 brood years when female spawner abundance was low but there was little compensatory effect. Differences between the ESUs are perhaps due to a later start of monitoring in the LCR (fewer data points) and spawner densities (female spawners/km) in the LCR that average 33% of those in the OCC strata for the 2005-2019 brood years. In 2020 an average of 71 parr were produced per female spawner. This was the highest recorded in the ESU and may have contributed to the average abundance and occupancy metrics for parr in a brood year when the estimated number of spawners (in 2019) was the lowest on record.

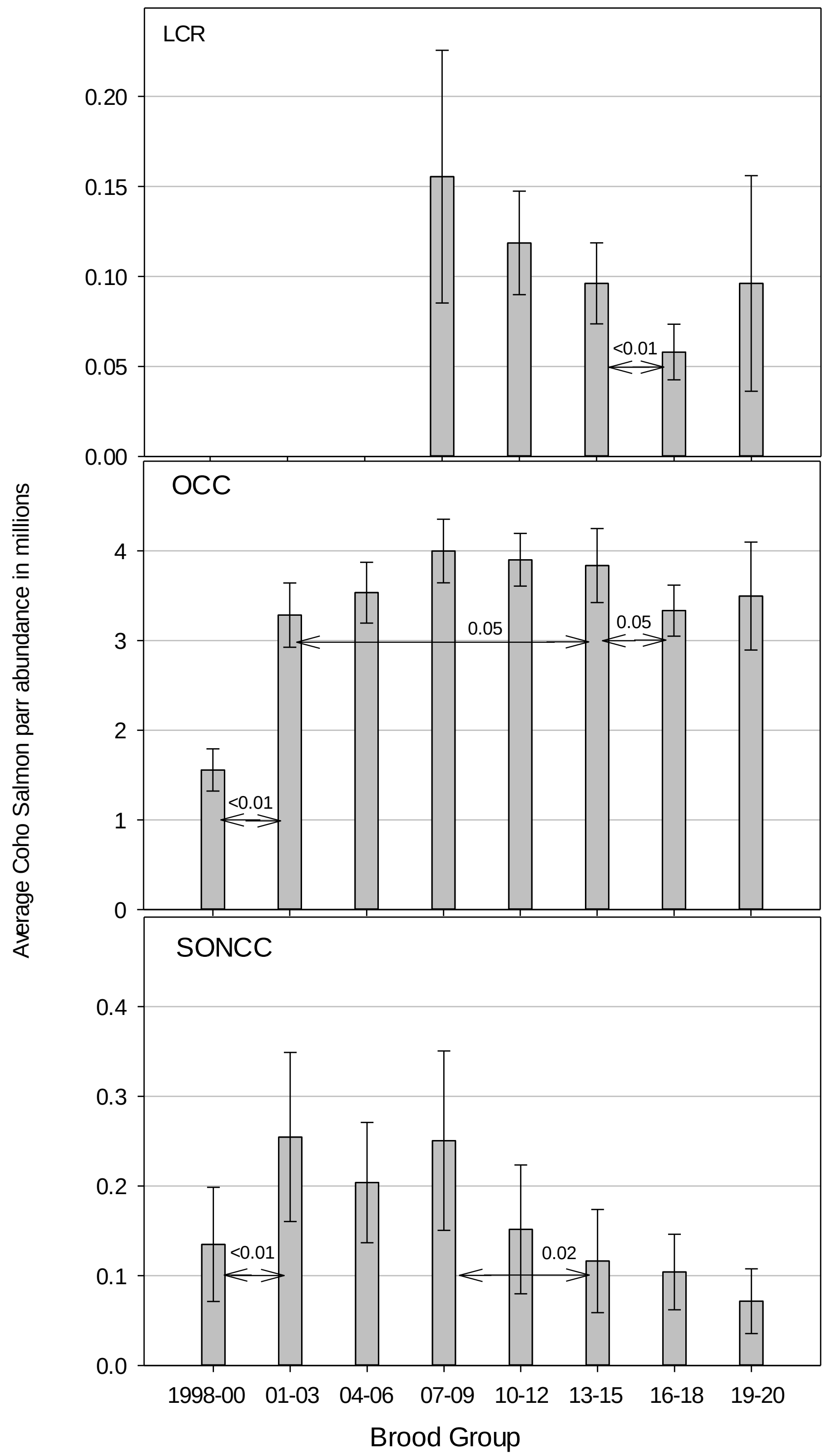


Figure 3. Three year (brood group) trends of Coho Salmon parr abundance estimates in the three western Oregon Coho ESUs, based on snorkel surveys in 1^{st}-3^{rd} order streams for the years 1998-2020. Gray bars and error bars show the abundance estimate with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$. Note the differences in Y-axis scales among panels.

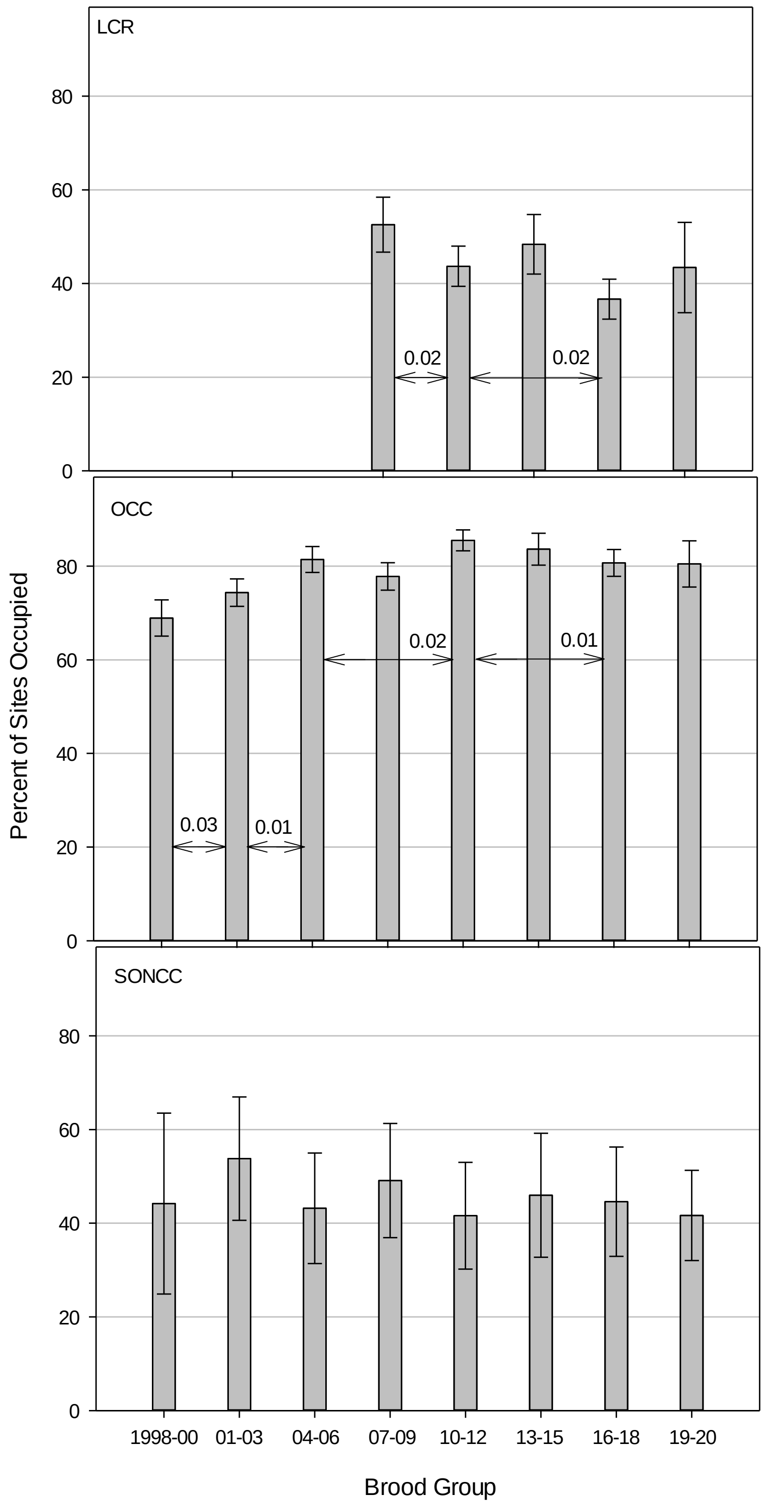


Figure 4. Three year (brood group) trends of Coho Salmon parr site occupancy in the three western Oregon Coho ESUs based on snorkel surveys in 1st-3rd order streams for the years 1998-2020. Gray bars and error bars show the percent of sites occupied with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$.

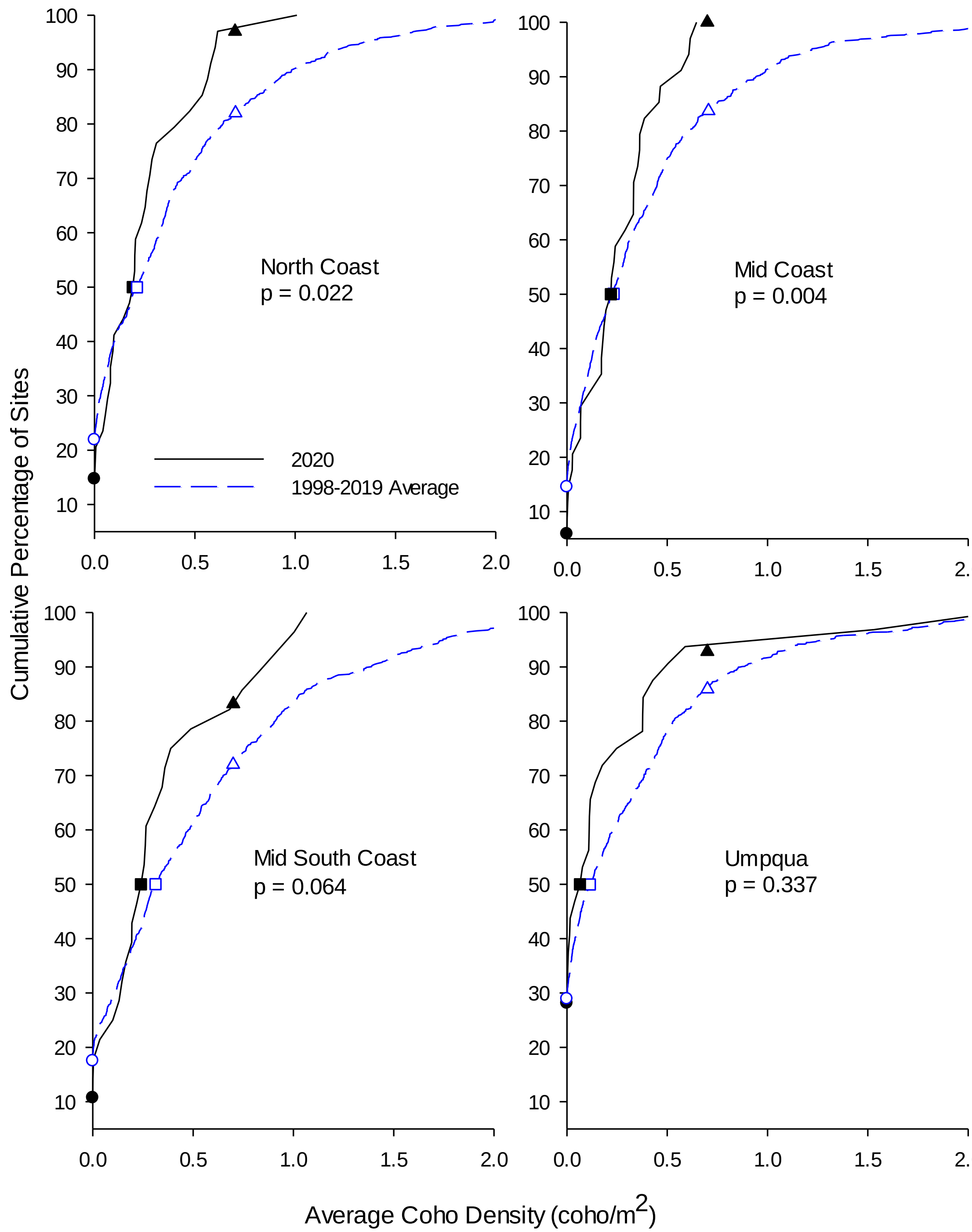


Figure 5. Average Coho Salmon parr density CDFs based on snorkel surveys in 1st-3rd order streams in the four strata of the Oregon Coast Coho ESU for survey years 1998-2020. The points shown on the curves are the percentage of unoccupied sites (circles), the median density (squares), and the percentage of sites below full seeding (triangles). The average condition of each stratum based on the CDF of these three metrics (blue, dashed line) is compared to the condition in 2020 (black, solid line). P values are from the comparison test of the two curves.

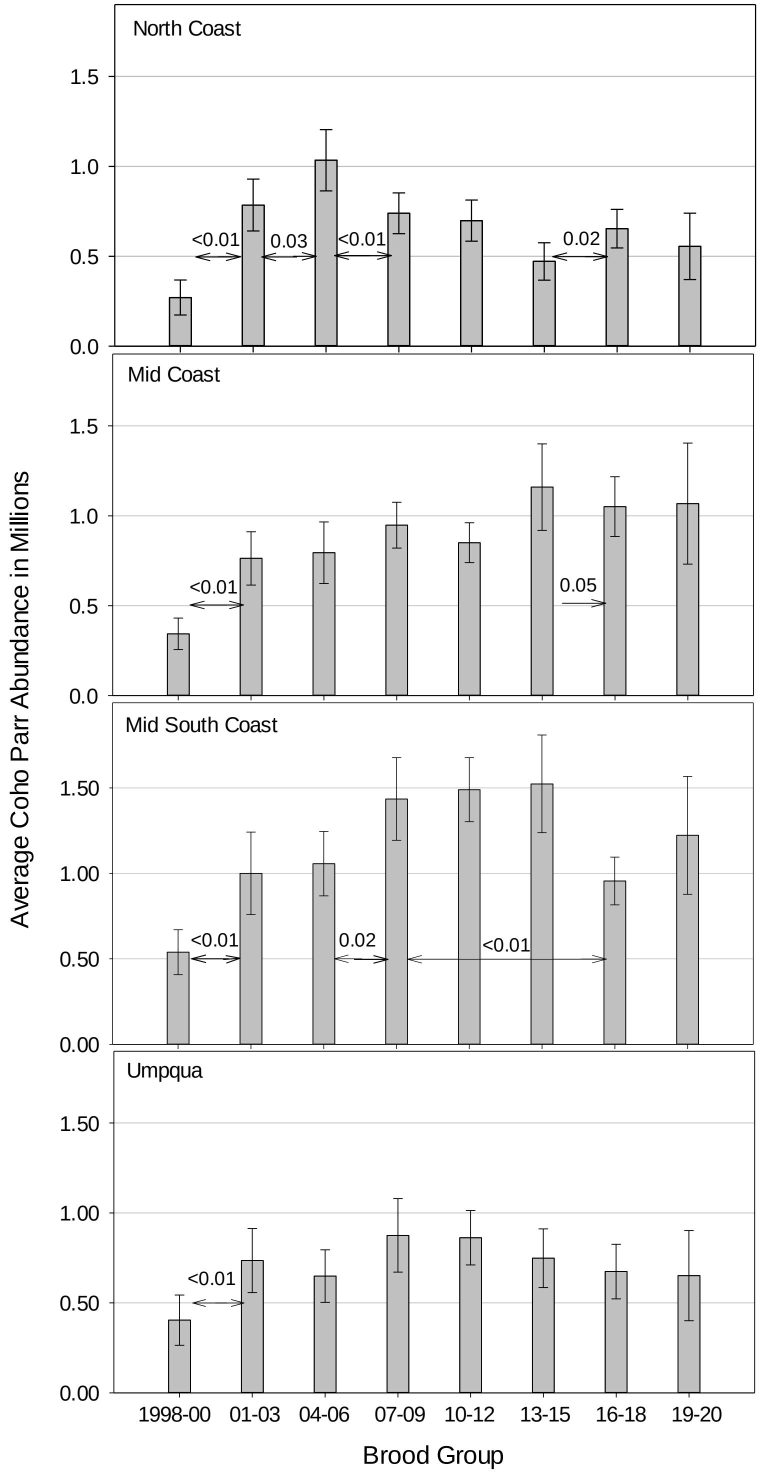


Figure 6. Three year (brood group) trends of Coho Salmon parr abundance estimates in the four strata of the Oregon Coast Coho ESU, based on snorkel surveys in 1st-3rd order streams for the years 1998-2020. Gray bars and error bars show the abundance estimate with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$.

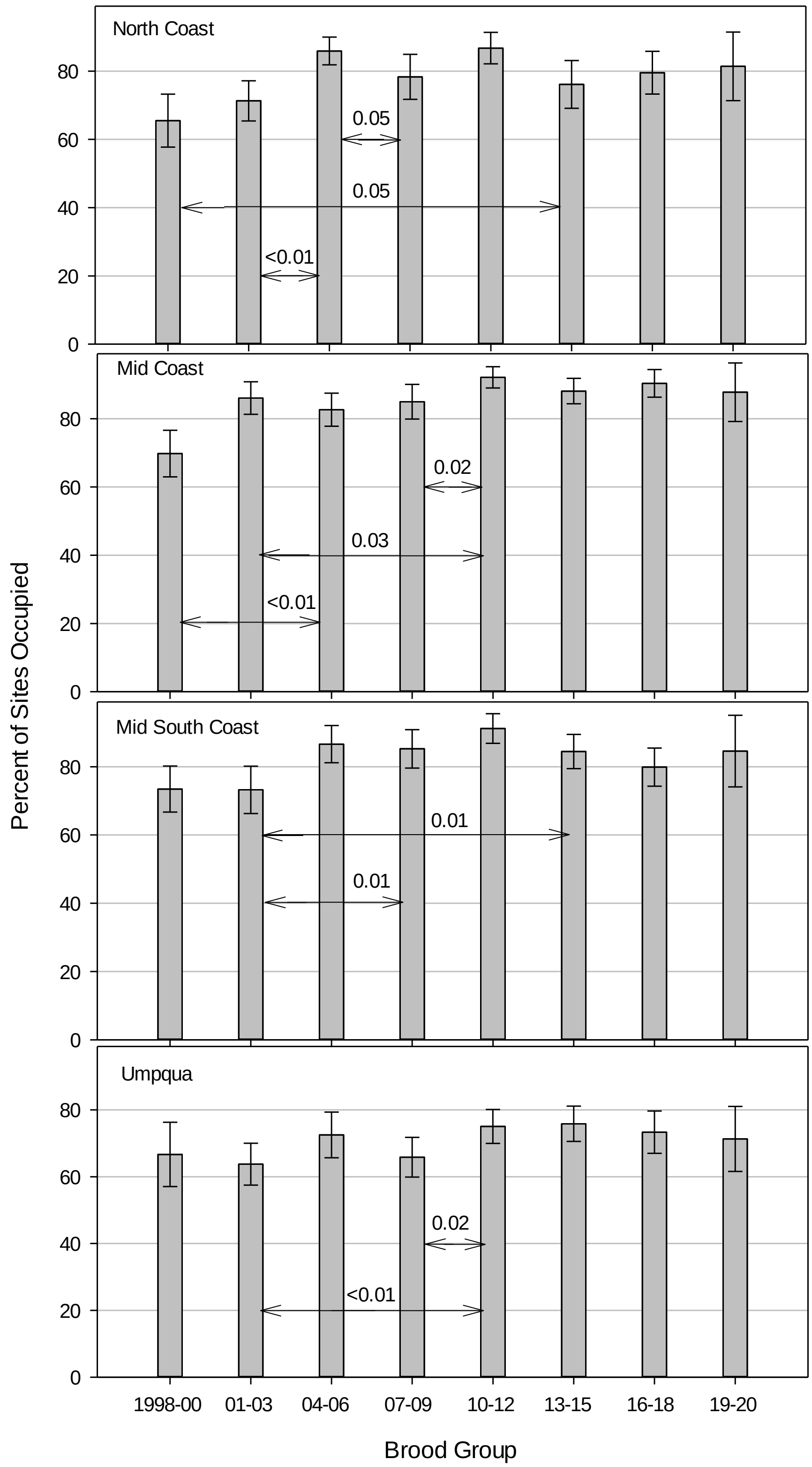


Figure 7. Three year (brood group) trends of Coho Salmon parr site occupancy in the four strata of the Oregon Coast Coho ESU, based on snorkel surveys in 1st-3rd order streams for the years 1998-2020. Gray bars and error bars show the percent of sites occupied with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where p ≤ 0.05.

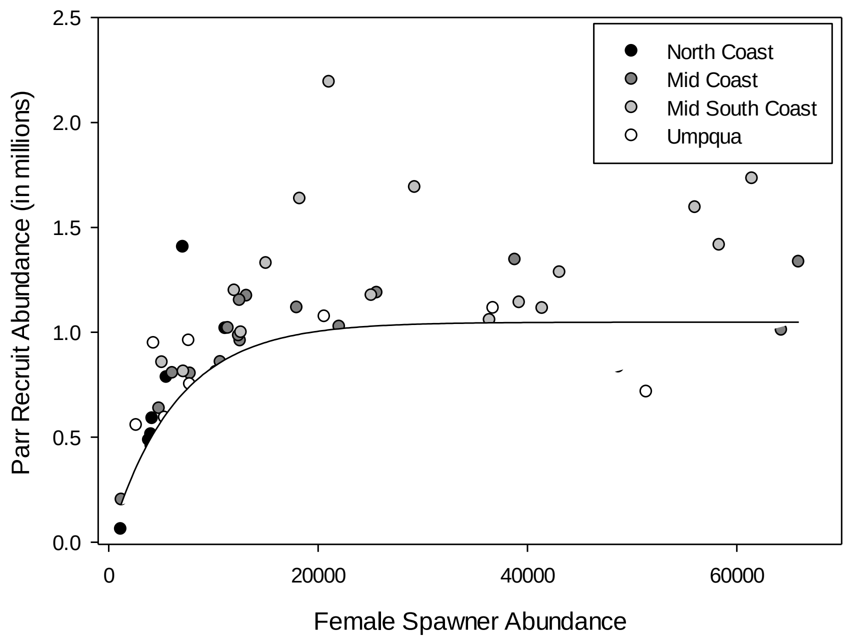


Figure 8. A Beverton-Holt model showing the relationship between the abundance of Coho Salmon parr recruits and female spawners in the strata of the Oregon Coast Coho ESU for brood years 1998-2019. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Female spawner abundance is from spawning ground surveys.

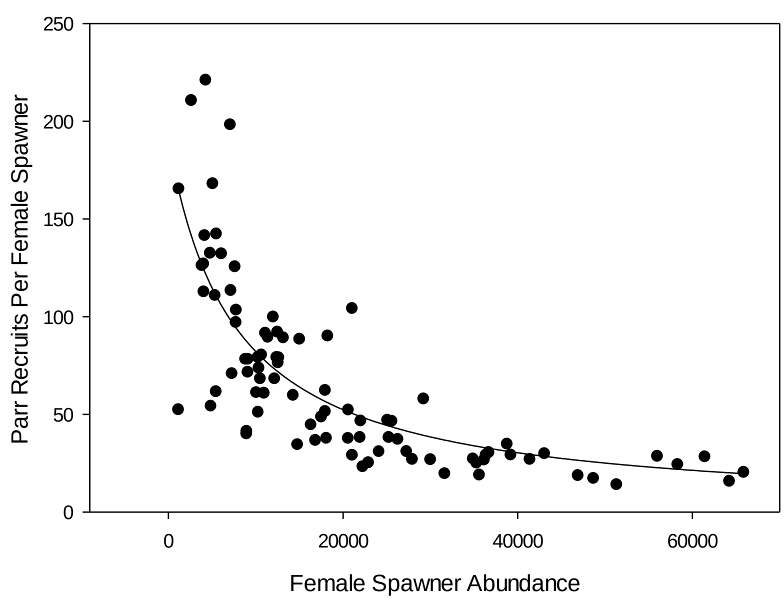


Figure 9. The relationship between the abundance of Coho Salmon female spawners and the number of parr recruits per female spawner in the Oregon Coast Coho ESU for brood years 1998-2019. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground surveys.

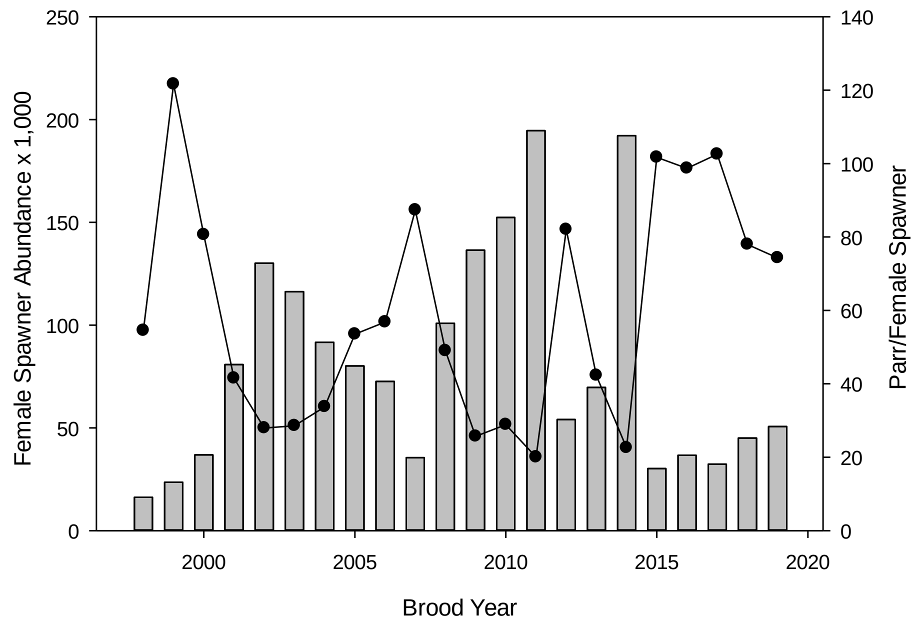


Figure 10. The abundance of Coho Salmon female spawners (gray bars) and the number of parr recruits per female spawner (black dots and line) over time in the Oregon Coast Coho ESU. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground surveys.

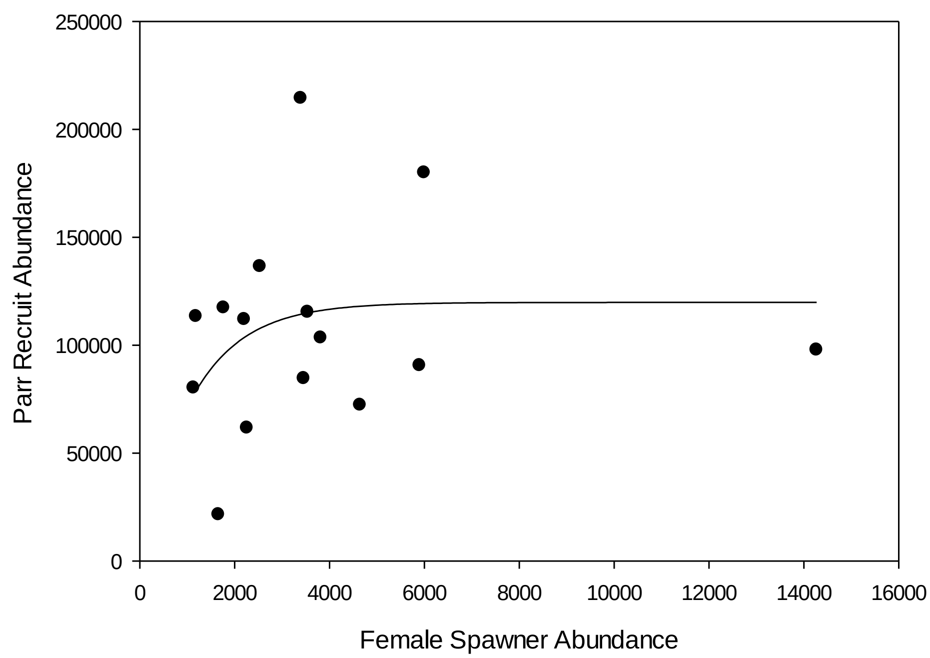


Figure 11. A Beverton-Holt model showing the relationship between the abundance of Coho Salmon parr recruits and female spawners in the Lower Columbia River ESU for brood years 2005-2019. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Female spawner abundance is from spawning ground surveys.

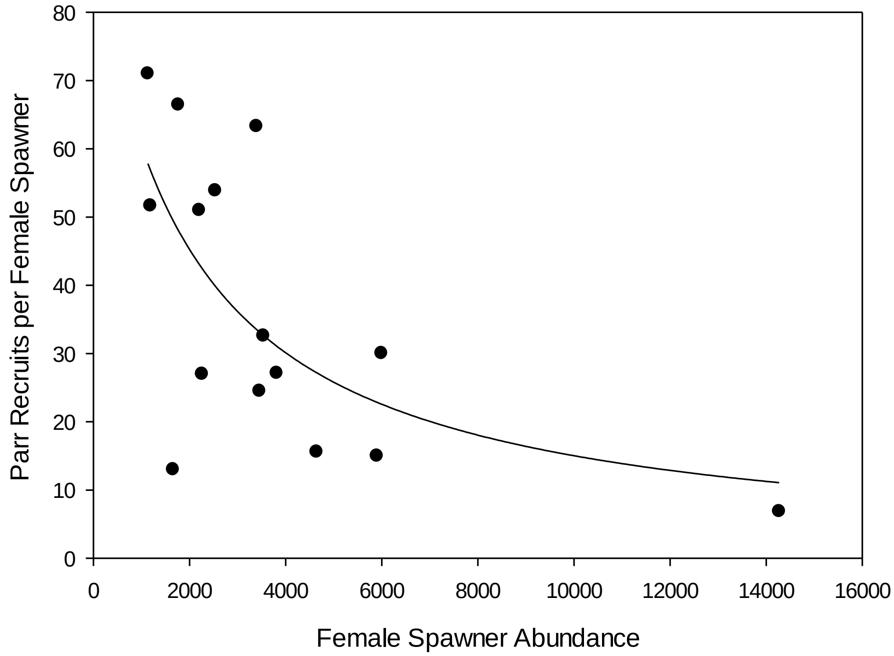


Figure 12. The relationship between the abundance of Coho Salmon female spawners and the number of parr recruits per female spawner in the Lower Columbia River ESU for brood years 2005-2019. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground surveys.

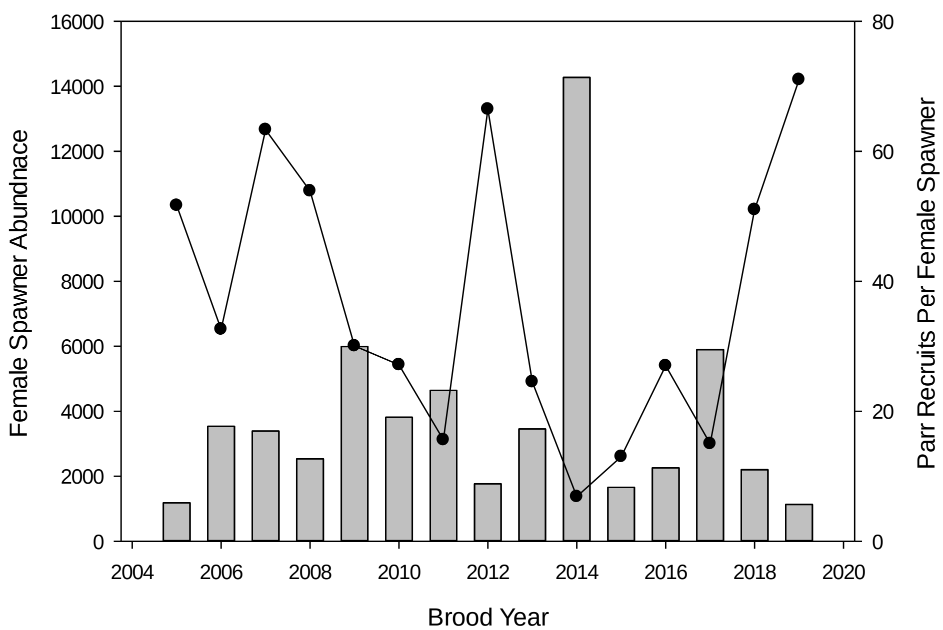


Figure 13. The abundance of Coho Salmon female spawners (gray bars) and the number of parr recruits per female spawner (black dots and line) over time in the Lower Columbia River ESU. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground surveys.

Steelhead

Klamath Mountain Province

The 2020 density estimate was 0.022 fish/m^2. This estimate was higher than that of 2019, which was the lowest recorded, but below average for the DPS (Table 3). In 2020, for only the second time since the start of steelhead monitoring, density was lower in the KMP than in the OCC. The 2020 abundance estimate was 118,462 parr, which was similar to the average estimate for the DPS and higher than the lowest recorded estimate in 2019. The six lowest abundance estimates recorded in the DPS were in the last six years. Average abundance for the partial brood group from 2018-2020 was similar to the 2014-2017 brood group, but lower than the first three brood groups (Figure 15). Most of the declining abundance in the past five years for the DPS was due to low abundance in the Rogue Stratum, where point estimates in 2017-2019 were less than one-third of the average point estimate for the stratum. Abundance estimates in the South Coast Stratum during the same time period were the lowest and second lowest recorded in 2015 and 2019, respectively, but these were over half of the average point estimate, and point estimates from 2016-2018 and 2020 were near or above the average point estimate. In 2020 the site occupancy estimate was 77%. This was the higher than the estimate in 2019 and similar to the average for the DPS. Site occupancy estimates for the partial 2018-2020 brood group were lower than those of the four preceding brood groups for the DPS (Figure 16). Similar to abundance, declines in site occupancy were driven by low rates in the Rogue Stratum, where the five lowest site occupancies were recorded in the last six years. In the South Coast stratum the lowest site occupancies were recorded in 2016 and 2017, but 100% of the sites were occupied in the last two years. Annual metrics for the DPS are presented in Appendix II.

Oregon Coast

The density estimate was 0.030 fish/m^2 in 2020. This was higher than the estimate in 2019 and similar to the average for the DPS. The 2020 steelhead abundance estimate was 349,654 parr, which was the highest recorded. Abundance for the partial brood group from 2018-2020 was similar to the preceding brood groups. Abundance estimates have been typically higher in the Mid Coast and have shown the most variation in the Umpqua, relative to the other strata. In 2020 the estimate was highest in the Umpqua. The 2020 site occupancy estimate was 82%, which was higher than the estimate in 2019. Site occupancy for the partial brood group from 2018-2020 was similar to the preceding brood groups. Among the strata, site occupancy has typically been highest in either the Mid-South or Mid Coast, lowest in the Umpqua, and most variable in the North Coast. In 2020 the estimate was lowest in the Mid Coast. Annual metrics for the DPS and its strata are presented in Appendix II.

Lower Columbia River

The density estimate was 0.004 fish/m^2 in 2020; the lowest estimate recorded. Five of the six lowest estimates in the DPS have been recorded in the last six years. The 2020 abundance estimate was 1,913 parr, which was the lowest estimate recorded in the DPS. The six lowest abundance estimates in the DPS have been recorded in the last six years. Abundance for the partial brood group from 2018-2020 was similar to the brood group from 2014-2017, but abundance for these brood groups was low compared to the first two brood groups. Confidence intervals in excess of 50% of the estimate have hindered the comparisons of abundance estimates in the DPS, but average point estimates in the last six years have been less than 30% of the average point estimates in the first nine years. The 2020 site occupancy estimate was 52%, which was lower than the estimate for 2019 and below average for the DPS. Although five of the six lowest site occupancy estimates were recorded in the last six years, site occupancy is similar for all brood groups in the DPS. Annual metrics for the DPS and its strata are presented in Appendix II.

South West Washington

The density estimate was 0.012 fish/m^2 in 2020. This was higher than the estimates for the past three years and similar to the average estimate for the DPS. The 2020 abundance estimate was 11,209 parr. This was also higher than the estimates for the last three years and similar to the average estimate in the DPS. Abundance for the partial brood group from 2018-2020 was low compared to the first two brood groups and similar to the 2014-2017 brood group. Confidence intervals that averaged 55% of their respective abundance estimates have made comparisons of abundance estimates in the DPS difficult, though four of the six lowest abundance estimates have been recorded in the last six years. The 2020 site occupancy estimate was 64%, which is higher than the estimates from the last three years and similar to average for the DPS. Site occupancy for the partial brood group from 2018-2020 and for the brood group from 2014-2017 was lower than it was for the 2010-2013 brood group. Four of the six lowest site occupancies were recorded in the last six years. Annual metrics for the DPS and its strata are presented in Appendix II.

Table 3. Distribution and density estimates for juvenile steelhead (≥90cm in fork length) in eight strata of Western Oregon Steelhead DPS, based on snorkel surveys in 1st-3rd order streams for 2020.

Stratum	Distribution			Density	
	Site Occupancy	Mean Pool Frequency	95% CI	Mean Average Pool Density (sthd/m^2)	95% CI
North Coast	85%	46%	± 15%	0.046	± 50%
Mid Coast	77%	38%	± 23%	0.026	± 47%
Mid-South	87%	46%	± 21%	0.014	± 44%
Umpqua	81%	44%	± 23%	0.032	± 34%
KMP Rogue	71%	30%	± 27%	0.017	± 35%
KMP South Coast	100%	86%	± 7%	0.047	± 21%
Lower Columbia	52%	21%	±27%	0.004	± 60%
Southwest WA	64%	30%	± 26%	0.012	± 36%

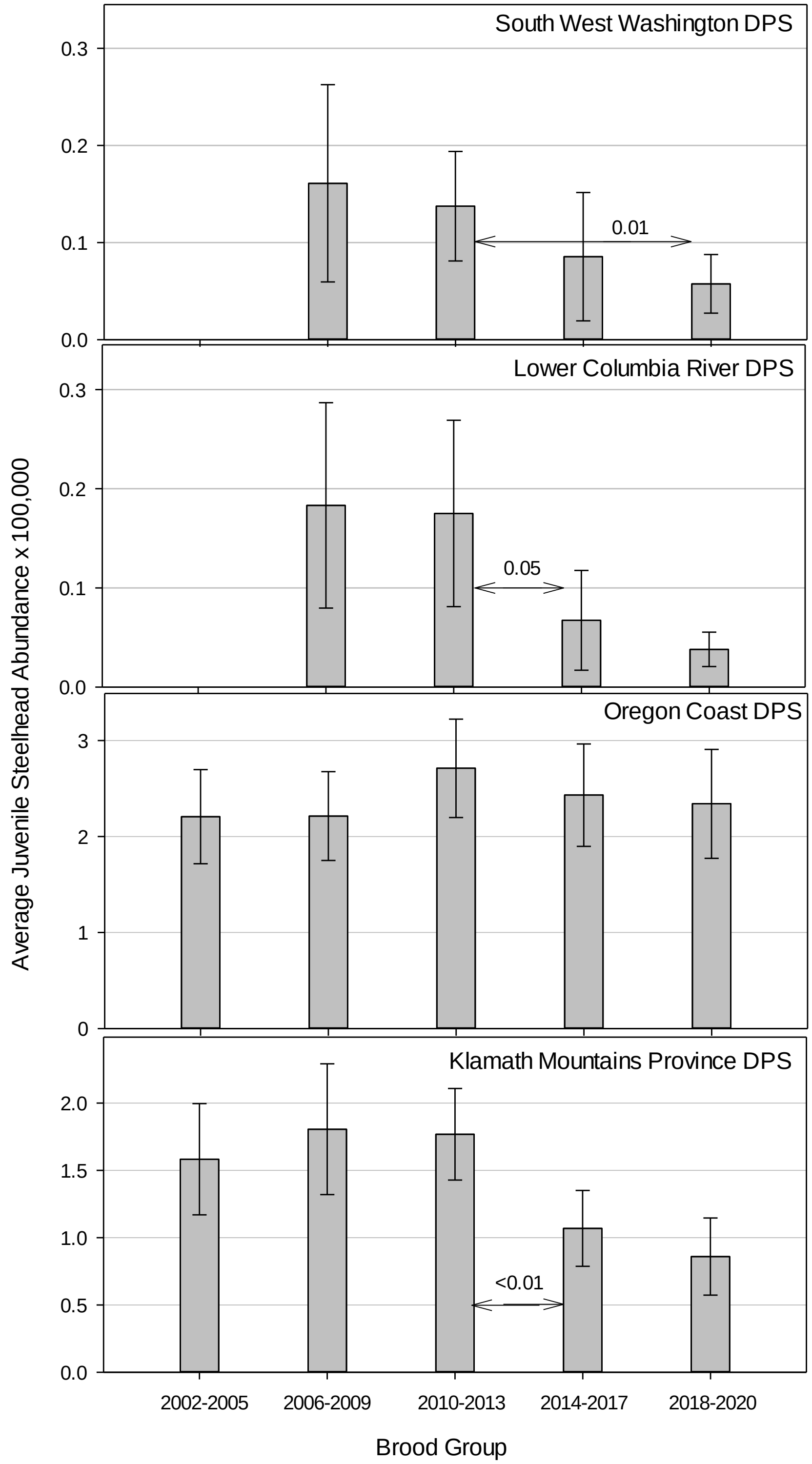


Figure 14. Four year (brood group) trends of juvenile steelhead (≥90cm in fork length) abundance estimates in the four western Oregon DPSs, based on snorkel surveys in 1st-3rd order streams in years 2002-2020. The 2018-2020 data are presented as a partial brood group. Gray and error bars show the abundance estimate with the 95% CI for the brood group. P-values for selected comparisons among brood groups are given above the horizontal arrows where p ≤ 0.05. Note differences in Y-axis scales among panels.

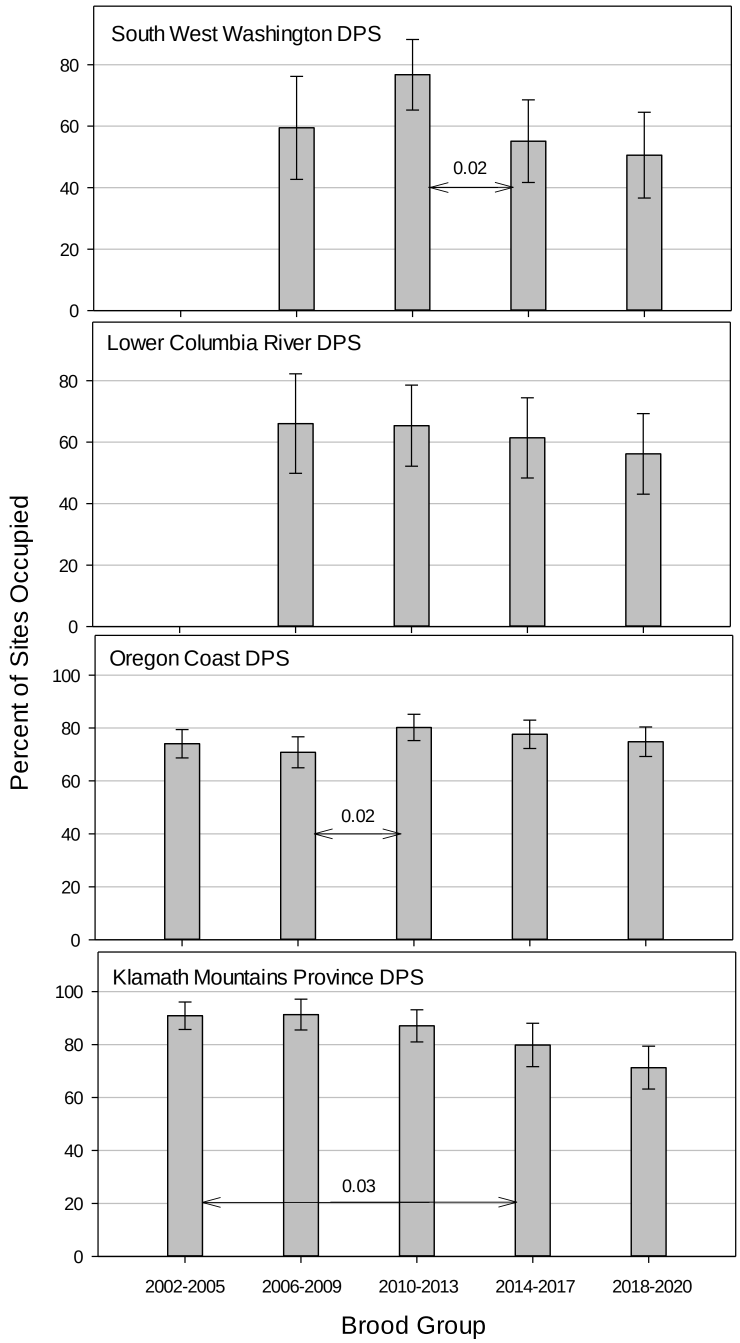


Figure 15. Four year (brood group) trends of juvenile steelhead (≥90cm in fork length) site occupancy in four western Oregon DPS, based on snorkel surveys in 1st-3rd order streams for years 2002-2020. The 2018-2020 data are presented as a partial brood group. Gray bars and error bars show the percent of sites occupied with the 95%CI for each brood group. P-values for selected comparisons among brood groups are given above the horizontal arrows where p ≤ 0.05.

Effects of Pool Depth on Snorkel Counts

At the onset of the project only pools that were ≥40cm in maximum depth were surveyed. This criterion was refined as an outcome of The Smith River Verification Study (Constable and Suring, under review). This study used electrofishing removal estimates (Armour et al. 1983) to determine the portion of the total (from all habitats) summer rearing abundances of Coho Salmon and steelhead that was contained in pools that met the ≥40cm in maximum depth criterion. Results of this study indicated pools ≥40cm maximum depth contained an average of 46% of the Coho Salmon and 68% of the steelhead summer rearing abundances. The percentage varied annually over the six-year study; ranging 31-61% for Coho Salmon and 49-82% for steelhead. Pools in the Smith River study area that were ≥20cm in maximum depth, the lowest depth recommended for snorkel surveys (O'Neal 2007), contained an average of 74% of the Coho Salmon and 79% of the steelhead summer rearing distribution. The annual variation in pools this size was 61-82% for Coho Salmon and 54-91% for steelhead. Abundance estimates in pools ≥40cm in maximum depth related moderately to abundance estimates in all habitats for Coho Salmon ($R^2 = 0.791$, $p = 0.007$) and strongly to abundance estimates in all habitats for steelhead ($R^2 = 0.918$, $p = 0.001$). Abundance estimates in pools ≥20cm in maximum depth related strongly to abundance estimates in all habitats for both species (Coho Salmon $R^2 = 0.974$, $p < 0.001$; steelhead $R^2 = 0.936$, $p < 0.001$). Due to these results, the maximum depth criterion was lowered to ≥20cm in 2010.

The in 2020, application of the lower criterion increased survey effort by 576 pools and five sites. Additionally, there were seven sites that contained pools that were ≥40cm in maximum depth, but where Coho Salmon or steelhead were only observed in pools that were <40cm in maximum depth. These additions allowed the survey effort goal in the LCR Cascade/Gorge stratum to be met and changed site occupancy estimates. Coho Salmon site occupancy estimates increased by 1% in the Interior Rogue and by 3% in the Mid-South Coast strata compared to those given in Table 2. In the remaining strata, site occupancy changed by <1%. Steelhead site occupancy estimates increased by 2% in the KMP Rogue stratum and by 6% in the Mid Coast but decreased by 5% in the LCR Coast stratum (three of the sites that did not have pools ≥40cm in maximum depth were unoccupied) relative to those presented in Table 3. In the remaining DPS site occupancy rates changed by less than 1%.

Paired t-tests from abundance estimates in 2020 from pools ≥40cm and pools ≥20cm indicate that applying the lower criterion produced higher abundance estimates of Coho Salmon (Table 4) and steelhead (Table 5) parr in the Oregon Coast ESU/DPS. This was similar to results from 2010-2014 and 2017-2018. As in past years, abundance estimates based on the lower criterion produced proportionally smaller 95% confidence intervals for Coho Salmon and steelhead estimates in most strata (Tables 4 and 5). When the ≥20cm maximum depth criterion was applied a more negative trend in Coho Salmon abundance was observed from 2010-2020, relative to when the ≥40cm criteria was applied, but the differences were <4% within each strata.

Table 4. Comparison of estimates of Coho Salmon abundance in pools using a maximum depth of ≥20 cm and in pools using a maximum depth of ≥40 cm.

Stratum	2020 Coho Estimates				
	Pools ≥40cm Max Depth		Pools ≥20cm Max Depth		95% CI Difference
	Estimate	95% CI	Estimate	95% CI	
North Coast	521,331	27%	554,140	25%	1.8%
Mid Coast	982,718	36%	1,067,248	33%	3.4%
Mid-South Coast	1,636,225	30%	1,664,830	29%	0.5%
Umpqua	619,890	36%	755,022	37%	-0.3%
SONCC	88,396	50%	91,424	48%	1.6%
Lower Columbia	80,242	63%	79,229	62%	1.5%

Table 5. Comparison of estimates of steelhead abundance in pools using a maximum depth of ≥20 and in pools using a maximum depth of ≥40 cm.

Stratum	2020 Steelhead Estimates				
	Pools ≥ 40cm Max Depth		Pools ≥ 20cm Max Depth		95% CI Difference
	Estimate	95% CI	Estimate	95% CI	
North Coast	66,189	39%	68,573	40%	-1.2%
Mid Coast	92,358	51%	95,728	49%	2.1%
Mid-South Coast	70,142	45%	70,284	45%	0.0%
Umpqua	120,965	46%	127,865	43%	2.9%
KMP Rogue	41,849	85%	42,846	83%	1.9%
KMP South Coast	76,612	27%	76691	27%	0.1%
Lower Columbia DPS	1,913	44%	1,802	46%	-1.6%
Southwest WA DPS	11,208	42%	11,323	42%	0.0%

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Thank you to the field crews and supporting cast for their professionalism and persistence during this difficult year. Our 2020 field season was hampered by COVID, which reduced the hiring of staff by 40%, and wildfires, which prevented access to surveys for two weeks. Our dedicated crews were still able to complete nearly 75% of our normal survey goals; a herculean task, especially in Southwest Oregon where our crew of 6 was reduced to a crew of zero. The list of people we would like to acknowledge is long, but we feel obligated to mention each by name: Kelsey Anderson, Aaron Truesdall, Tirk Pardello, NEERMAN!, Jesus Vargas, “rock solid” Ryan Emig, Wild Bill Ratliff, Jenn King, the other EB, Maria Farinacci, the intrepid Pete Cole, Mike Koranda, the salubrious Brandon Smith, Commander Kirby, Brah Josh, Professor Davies (slinky brothers rule!), Sharon Crowley, Courtney Jackson, Kate Huber, Matt Strickland, Peggy Kavanagh, and the return of the king, Trevan Cornwell. Thanks for watching over us, Chiefy. Thank you Matt Falcy for supporting our data analysis and Erin Gilbert for the GIS expertise. Thank you Julie Firman for all your help with the south coast frame. Also a big thank you to the many private landowners who granted us permission to survey creeks on their property; your cooperation is invaluable.

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APPENDIX 1 COHO SALMON METRICS

Table 6. Estimated metrics and associated 95% confidence intervals for Coho Salmon parr in the Oregon portion of the Southern Oregon Northern California Coho ESU. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Southern Oregon Northern Californian Coho ESU Coho Salmon Parr Estimates								
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI	Pct Full Seeding	±95% CI
1998	176,522	51%	0.051	49%	30	35%	2	3%
1999	116,557	51%	0.218	73%	52	37%	10	9%
2000	112,029	37%	0.061	78%	51	56%	2	3%
2001	223,607	45%	0.265	46%	53	29%	12	10%
2002	325,508	37%	0.442	37%	58	23%	38	8%
2003	215,030	28%	0.413	34%	50	20%	22	8%
2004	157,239	36%	0.148	40%	42	28%	9	6%
2005	286,009	30%	0.296	37%	51	27%	23	9%
2006	168,501	34%	0.110	42%	37	28%	4	4%
2007	276,186	51%	0.227	40%	52	26%	11	8%
2008	285,760	26%	0.360	43%	57	21%	17	8%
2009	190,112	46%	0.141	42%	38	29%	4	3%
2010	140,949	43%	0.056	41%	43	23%	2	2%
2011	185,972	38%	0.114	50%	49	25%	5	5%
2012	128,124	65%	0.045	52%	33	37%	0	0%
2013	166,543	50%	0.323	95%	51	22%	7	6%
2014	118,403	46%	0.062	52%	48	35%	0	0%
2015	64,231	55%	0.026	68%	39	30%	0	0%
2016	89,967	38%	0.083	53%	45	27%	1	2%
2017	120,803	37%	0.074	46%	42	26%	1	2%
2018	101,893	46%	0.053	53%	47	26%	2	3%
2019	54,890	51%	0.040	47%	42	23%	0	0%
2020	88,396	50%	0.075	54%	46	35%	0	0%

Table 7. Estimated metrics and associated 95% confidence intervals for Coho Salmon parr in the Oregon Coast Coho ESU. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Oregon Coast Coho ESU Coho Salmon Parr Estimates								
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI	Pct Full Seeding	±95% CI
1998	935,199	30%	0.212	26%	67	11%	12	6%
1999	884,929	26%	0.158	24%	60	13%	6	4%
2000	2,861,072	20%	0.265	16%	79	7%	11	5%
2001	2,969,004	24%	0.407	18%	65	9%	24	8%
2002	3,355,610	21%	0.511	20%	81	6%	25	8%
2003	3,632,891	18%	0.556	19%	78	6%	28	8%
2004	3,319,231	16%	0.454	14%	77	6%	28	9%
2005	3,086,536	15%	0.461	19%	85	5%	20	7%
2006	4,285,481	18%	0.462	14%	82	6%	26	7%
2007	4,120,906	17%	0.470	17%	76	7%	26	8%
2008	3,097,981	18%	0.341	17%	75	8%	15	6%
2009	4,941,814	16%	0.600	14%	83	6%	33	9%
2010	3,503,440	13%	0.392	17%	86	5%	18	6%
2011	4,393,927	13%	0.478	14%	88	5%	22	7%
2012	3,898,052	15%	0.383	12%	83	5%	18	6%
2013	4,436,290	17%	0.613	15%	82	6%	33	9%
2014	2,944,019	24%	0.250	20%	84	7%	8	5%
2015	4,329,397	17%	0.407	16%	77	6%	17	6%
2016	3,069,097	17%	0.273	18%	82	6%	11	5%
2017	3,619,893	17%	0.252	16%	80	7%	6	3%
2018	3,313,424	16%	0.297	14%	80	7%	11	5%
2019	3,232,929	16%	0.241	15%	78	7%	11	4%
2020	3,760,165	18%	0.258	19%	83	6%	6	3%

Table 8. Estimated metrics and associated 95% confidence intervals for Coho Salmon parr in the North Coast Stratum of the Oregon Coast Coho ESU. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

North Coast Stratum Coho Salmon Parr Estimates								
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI	Percent Full Seeding	±95% CI
1998	238,372	71%	0.117	45%	64	25%	0	0%
1999	61,228	57%	0.064	73%	53	29%	3	5%
2000	513,448	39%	0.236	30%	79	14%	9	9%
2001	650,882	40%	0.411	39%	53	23%	27	16%
2002	728,083	39%	0.352	31%	80	12%	17	10%
2003	976,142	33%	0.485	26%	80	13%	29	16%
2004	842,367	30%	0.454	22%	87	9%	26	14%
2005	853,247	28%	0.394	27%	82	9%	15	10%
2006	1,406,547	28%	0.597	23%	88	7%	26	11%
2007	1,017,969	24%	0.717	27%	83	13%	42	26%
2008	370,797	48%	0.156	53%	70	22%	4	6%
2009	829,855	30%	0.627	29%	82	13%	32	17%
2010	775,036	25%	0.394	21%	93	7%	22	15%
2011	742,914	30%	0.476	28%	85	12%	25	16%
2012	577,017	33%	0.331	25%	82	12%	22	12%
2013	459,220	29%	0.317	33%	78	14%	15	13%
2014	337,136	28%	0.223	47%	79	18%	8	11%
2015	618,560	47%	0.492	32%	71	18%	30	20%
2016	485,460	33%	0.219	32%	80	13%	6	7%
2017	690,210	30%	0.225	24%	80	14%	3	4%
2018	784,995	28%	0.413	24%	78	13%	20	13%
2019	588,926	39%	0.290	28%	78	14%	15	11%
2020	521,331	27%	0.236	28%	85	11%	3	5%

Table 9. Estimated metrics and associated 95% confidence intervals for Coho Salmon parr in the Mid Coast Stratum of the Oregon Coast Coho ESU. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Mid Coast Stratum Coho Salmon Parr Estimates								
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI	Pct Full Seeding	±95% CI
1998	201,219	46%	0.173	57%	63	18%	12	10%
1999	201,765	49%	0.076	46%	58	26%	0	0%
2000	636,561	34%	0.215	35%	88	11%	5	6%
2001	803,171	31%	0.497	27%	80	12%	28	15%
2002	717,782	35%	0.288	28%	88	10%	10	9%
2003	873,357	35%	0.336	30%	89	9%	17	12%
2004	672,677	32%	0.385	26%	74	16%	26	16%
2005	610,126	27%	0.230	30%	86	8%	2	4%
2006	1,187,999	39%	0.440	26%	87	9%	26	15%
2007	857,588	29%	0.494	35%	78	14%	26	15%
2008	805,066	27%	0.350	31%	83	12%	15	12%
2009	1,345,667	21%	0.578	28%	93	7%	33	18%
2010	834,439	24%	0.480	27%	92	9%	19	13%
2011	802,427	27%	0.336	22%	93	7%	9	8%
2012	1,009,801	23%	0.447	21%	91	8%	24	14%
2013	1,117,548	29%	0.706	20%	89	9%	43	21%
2014	1,025,977	51%	0.202	32%	90	10%	3	6%
2015	1,335,493	22%	0.348	30%	85	10%	8	8%
2016	1,019,727	31%	0.423	29%	92	8%	18	11%
2017	1,173,889	35%	0.318	33%	89	9%	7	6%
2018	959,394	28%	0.278	27%	90	9%	8	7%
2019	1,151,923	27%	0.389	22%	84	11%	18	12%
2020	982,718	36%	0.245	20%	91	8%	0	0%

Table 10. Estimated metrics and associated 95% confidence intervals for Coho Salmon parr in the Mid-South Coast Stratum of the Oregon Coast Coho ESU. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Mid South Coast Stratum Coho Salmon Parr Estimates								
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI	Pct Full Seeding	±95% CI
1998	495,608	40%	0.370	33%	76	17%	24	15%
1999	358,029	46%	0.404	36%	70	18%	22	17%
2000	763,557	40%	0.442	27%	74	15%	29	20%
2001	998,651	56%	0.470	43%	63	24%	30	22%
2002	1,057,355	45%	0.958	33%	81	12%	58	35%
2003	946,047	34%	1.074	41%	75	16%	50	28%
2004	880,565	31%	0.631	32%	85	10%	39	26%
2005	1,114,794	29%	0.643	34%	94	8%	32	23%
2006	1,176,018	37%	0.472	26%	82	14%	30	20%
2007	1,285,252	38%	0.482	32%	84	12%	28	19%
2008	1,329,052	31%	0.698	26%	88	11%	43	27%
2009	1,691,157	30%	0.843	26%	84	11%	44	26%
2010	1,141,767	20%	0.431	28%	90	9%	25	15%
2011	1,733,106	21%	0.699	32%	88	9%	39	21%
2012	1,595,194	28%	0.394	16%	88	9%	10	6%
2013	2,192,920	29%	0.943	24%	85	10%	51	26%
2014	963,062	35%	0.272	36%	93	10%	7	10%
2015	1,415,931	33%	0.426	25%	76	14%	17	12%
2016	812,154	28%	0.293	31%	84	11%	16	13%
2017	1,198,942	25%	0.329	23%	84	12%	14	9%
2018	855,895	36%	0.314	35%	71	17%	14	12%
2019	809,809	25%	0.171	31%	82	13%	5	5%
2020	1,636,225	30%	0.337	30%	87	12%	18	14%

Table 11. Estimated metrics and associated 95% confidence intervals for Coho Salmon parr in the Umpqua Stratum of the Oregon Coast Coho ESU. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Umpqua Stratum Coho SalmonParr Estimates								
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI	Pct Full Seeding	±95% CI
1999	263,907	44%	0.144	46%	61	25%	4	6%
2000	947,507	40%	0.213	33%	73	16%	7	8%
2001	516,299	47%	0.265	40%	58	17%	13	11%
2002	852,391	44%	0.558	46%	74	14%	23	16%
2003	837,345	35%	0.458	27%	67	14%	23	13%
2004	923,622	36%	0.404	26%	67	15%	22	16%
2005	508,369	35%	0.645	39%	80	14%	34	22%
2006	514,918	39%	0.368	33%	73	17%	23	13%
2007	960,097	34%	0.275	41%	65	15%	13	11%
2008	593,066	41%	0.223	33%	63	19%	5	7%
2009	1,075,136	42%	0.453	30%	73	15%	26	16%
2010	752,199	39%	0.291	54%	72	13%	9	9%
2011	1,115,480	28%	0.477	26%	80	11%	22	15%
2012	716,040	29%	0.349	30%	73	13%	15	10%
2013	666,602	27%	0.498	42%	75	13%	24	15%
2014	617,845	44%	0.295	37%	78	15%	13	12%
2015	959,413	43%	0.401	33%	74	12%	19	12%
2016	751,757	39%	0.174	45%	74	16%	6	7%
2017	556,851	45%	0.164	31%	70	18%	3	5%
2018	713,140	38%	0.226	34%	76	16%	8	8%
2019	682,272	40%	0.128	38%	71	14%	5	6%
2020	619,890	36%	0.237	53%	72	14%	6	8%

Table 12. Estimated metrics and associated 95% confidence intervals for Coho Salmon parr in the Oregon portion of the Lower Columbia River Coho ESU. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Lower Columbia River Coho ESU Coho Salmon Parr Estimates								
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI	Pct Full Seeding	±95% CI
2006	113,374	54%	0.103	69%	43	28%	4	7%
2007	115,289	39%	0.130	39%	72	13%	3	5%
2008	214,467	96%	0.076	73%	44	26%	3	6%
2009	136,558	41%	0.068	48%	41	22%	0	0%
2010	179,989	42%	0.108	41%	49	18%	2	4%
2011	103,458	45%	0.188	97%	44	22%	5	6%
2012	72,323	33%	0.066	26%	45	17%	0	0%
2013	117,372	39%	0.078	36%	52	15%	0	0%
2014	84,705	57%	0.052	42%	44	23%	0	0%
2015	97,896	28%	0.116	34%	46	19%	2	3%
2016	21,627	55%	0.011	57%	24	31%	0	0%
2017	61,780	43%	0.050	42%	39	20%	1	2%
2018	90,675	41%	0.069	38%	45	20%	2	3%
2019	112,044	61%	0.096	59%	46	19%	3	3%
2020	80,242	63%	0.065	45%	41	26%	0	0%

APPENDIX 2 STEELHEAD METRICS

Table 13. Estimated metrics and associated 95% confidence intervals for steelhead parr in the Oregon portion of the Klamath Mountains Province Steelhead DPS. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Klamath Mountains Province Steelhead DPS Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2002	202,091	34%	0.091	28%	83	8%
2003	121,823	19%	0.059	20%	90	6%
2004	131,678	18%	0.069	20%	97	4%
2005	177,326	18%	0.062	16%	94	5%
2006	133,153	28%	0.052	23%	90	7%
2007	196,727	20%	0.098	29%	93	7%
2008	200,838	27%	0.057	21%	93	5%
2009	191,378	31%	0.057	22%	89	7%
2010	205,008	20%	0.065	24%	94	5%
2011	188,466	18%	0.060	19%	92	6%
2012	146,020	20%	0.038	27%	80	9%
2013	167,523	18%	0.034	18%	83	7%
2014	131,396	26%	0.059	34%	87	11%
2015	71,675	30%	0.026	25%	85	8%
2016	109,079	28%	0.028	26%	70	12%
2017	115,284	21%	0.029	22%	79	10%
2018	79,917	35%	0.018	32%	81	8%
2019	59,402	26%	0.014	24%	57	13%
2020	118,462	32%	0.022	21%	77	13%

Table 14. Estimated metrics and associated 95% confidence intervals for steelhead parr in the Rouge Stratum of the Klamath Mountains Province steelhead DPS. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is express as a percentage of the estimate.

Klamath Mountains Province Rouge Stratum Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2002	76,150	23%	0.080	38%	78	10%
2003	42,583	32%	0.056	26%	87	8%
2004	76,930	27%	0.069	25%	96	5%
2005	105,148	26%	0.064	19%	94	5%
2006	86,038	42%	0.052	28%	90	8%
2007	107,054	26%	0.107	33%	91	9%
2008	125,545	41%	0.056	25%	92	7%
2009	116,343	44%	0.061	24%	87	8%
2010	149,522	25%	0.067	28%	93	6%
2011	122,431	20%	0.065	21%	90	8%
2012	74,258	27%	0.028	41%	77	12%
2013	71,877	23%	0.028	23%	78	10%
2014	77,646	42%	0.063	40%	83	14%
2015	51,751	40%	0.025	31%	80	11%
2016	48,920	47%	0.020	37%	66	16%
2017	25,358	33%	0.022	32%	76	12%
2018	22,670	39%	0.012	39%	77	10%
2019	22,006	51%	0.007	34%	45	21%
2020	41,849	85%	0.017	35%	71	18%

Table 15. Estimated metrics and associated 95% confidence intervals for steelhead parr in the South Coast Stratum of the Klamath Mountains Province steelhead DPS. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is express as a percentage of the estimate.

Klamath Mountains Province South Coast Stratum Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2002	125,941	53%	0.130	32%	100	0%
2003	79,240	22%	0.069	20%	100	0%
2004	54,748	19%	0.070	23%	100	5%
2005	72,178	24%	0.057	20%	93	9%
2006	47,115	24%	0.053	18%	93	8%
2007	89,672	32%	0.058	33%	100	0%
2008	75,293	27%	0.061	24%	100	0%
2009	75,035	39%	0.043	35%	97	5%
2010	55,486	21%	0.057	24%	100	0%
2011	66,034	35%	0.042	27%	97	5%
2012	71,762	31%	0.073	30%	90	11%
2013	95,646	28%	0.055	25%	100	0%
2014	53,750	35%	0.044	22%	100	0%
2015	19,924	31%	0.027	23%	100	0%
2016	60,159	39%	0.060	35%	85	13%
2017	89,926	24%	0.058	27%	89	13%
2018	57,247	46%	0.045	50%	94	8%
2019	37,396	28%	0.039	33%	100	0%
2020	76,612	27%	0.047	21%	100	0%

Table 16. Estimated metrics and associated 95% confidence intervals for steelhead parr in the Oregon Coast Steelhead DPS. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Oregon Coast Steelhead DPS Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2002	183,127	20%	0.035	26%	68	9%
2003	241,263	22%	0.035	17%	79	7%
2004	169,713	21%	0.032	17%	73	7%
2005	288,482	22%	0.047	26%	77	6%
2006	204,924	17%	0.028	19%	72	8%
2007	219,687	25%	0.030	21%	71	8%
2008	229,564	20%	0.030	21%	68	9%
2009	230,839	21%	0.043	19%	72	8%
2010	290,410	19%	0.034	20%	78	7%
2011	275,137	19%	0.038	14%	83	5%
2012	226,411	14%	0.032	15%	81	25%
2013	292,388	21%	0.047	17%	79	24%
2014	274,672	24%	0.029	18%	88	34%
2015	136,759	23%	0.015	28%	65	18%
2016	247,939	19%	0.020	17%	73	22%
2017	313,308	20%	0.021	16%	84	29%
2018	166,980	20%	0.018	19%	71	19%
2019	185,529	22%	0.014	17%	72	8%
2020	349,654	24%	0.030	23%	82	7%

Table 17. Estimated metrics and associated 95% confidence intervals for steelhead parr in the Oregon portion of the Lower Columbia River Steelhead DPS. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Lower Columbia River Steelhead DPS Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2006	30,142	47%	0.045	30%	78	18%
2007	21,259	51%	0.036	43%	67	26%
2008	9,965	47%	0.010	88%	61	31%
2009	11,920	80%	0.015	56%	58	24%
2010	23,497	55%	0.034	31%	66	19%
2011	16,102	53%	0.036	51%	67	23%
2012	12,148	64%	0.024	40%	61	31%
2013	18,283	40%	0.023	40%	68	40%
2014	12,495	49%	0.015	32%	89	93%
2015	2,676	52%	0.007	37%	50	30%
2016	2,905	42%	0.006	39%	46	29%
2017	8,870	88%	0.013	67%	60	33%
2018	5,067	41%	0.011	46%	57	28%
2019	4,441	45%	0.011	50%	60	21%
2020	1,913	44%	0.004	60%	52	28%

Table 18. Estimated metrics and associated 95% confidence intervals for steelhead parr in the Oregon portion of the Southwest Washington Steelhead DPS. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Southwest Washington Steelhead DPS Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2006	6,333	74%	0.014	71%	53	39%
2007	10,874	103%	0.017	75%	54	31%
2008	30,671	50%	0.023	43%	62	27%
2009	16,540	35%	0.027	44%	69	18%
2010	20,996	38%	0.036	35%	79	18%
2011	10,815	41%	0.029	41%	66	17%
2012	13,339	45%	0.024	30%	80	50%
2013	9,824	30%	0.023	37%	83	59%
2014	9,411	82%	0.021	46%	68	49%
2015	2,422	74%	0.007	80%	42	23%
2016	20,362	52%	0.022	28%	69	41%
2017	2,026	42%	0.004	54%	42	20%
2018	2,525	48%	0.003	54%	45	24%
2019	3,524	52%	0.003	39%	54	27%
2020	11,209	42%	0.012	36%	64	22%

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