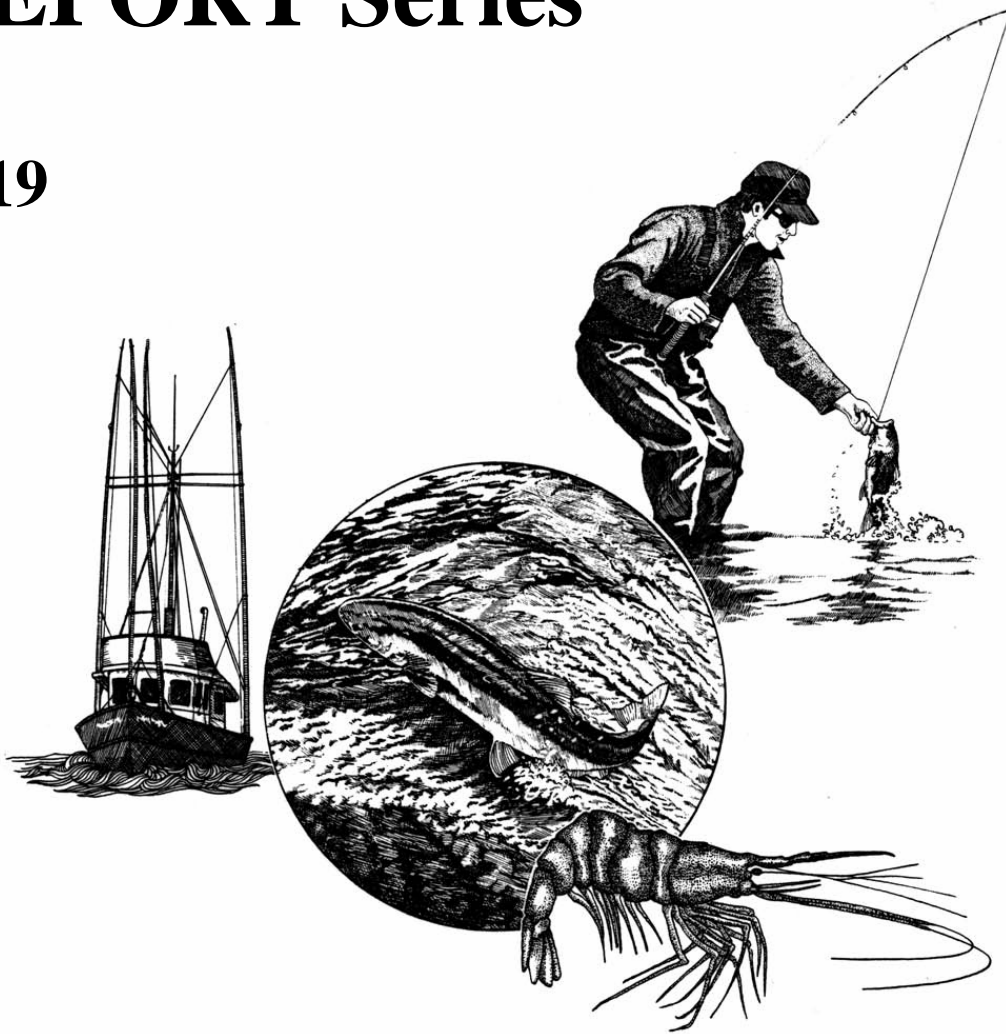


ODFW PROGRESS REPORT Series

2019



Oregon Department of Fish and Wildlife

*Juvenile Salmonid Monitoring in Coastal Oregon and Lower Columbia
Streams, 2018 Field Season*

Annual Monitoring Report No. OPSW-ODFW-2019-3

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SUMMARY

This report analyzes monitoring data for juvenile Coho Salmon in three Evolutionarily Significant Units (ESUs) and juvenile steelhead in four Distinct Population Segments (DPSs) in western Oregon. Monitoring data are used to evaluate trends in distribution and abundance for these species, which inform conservation and recovery decisions. The analysis in this report spans the years 1998-2018. Previous annual reports can be found at: <https://nrimp.dfw.state.or.us/crl/default.aspx?pn=WORP>.

Coho Salmon:

Southern Oregon Northern California Coho (SONCC) ESU: The 2018 abundance estimate was 103,000 parr. This was similar to the 2017 estimate but low, relative to the average from all years. Abundance was highest from 2007-2009 and lowest from 1998-2000 and from 2013-2018. Site occupancy has been low over the past 9 years, relative to site occupancy from 1998-2009.

Oregon Coast Coho (OCC) ESU: The 2018 abundance estimate was 3.3 million parr. Parr abundance has been between 2.9 and 4.9 million since 2000, after improving from lows averaging 910,000 during 1998-1999. Site occupancy was 80% in 2018. This has been the average since 2000, after improving from low estimates in 1998-1999.

Lower Columbia River (LCR) ESU: The 2018 abundance estimate was 91,000 parr. Parr abundance estimates suggest a declining trend in the ESU since the start of monitoring in 2007. Site occupancy estimates also indicate a declining trend.

In the OCC female spawner:parr recruit curves asymptote near current spawner abundances and parr/female spawner rates declined as spawner abundances increased. These data suggest that freshwater productivity rates were regulated by compensatory density dependence at early life stages. This pattern was not observed in the LCR, although the average number of parr per female in the LCR is half of that from the OCC. Adult data was insufficient to perform these analyses in the SONCC.

Steelhead:

Klamath Mountains Province (KMP) DPS: The 2018 abundance estimate was 64,000 parr. Abundance estimates were low from 2014-2018 compared to the estimates from 2002-2013. The 2018 site occupancy estimate was 82%. Site occupancy was lower in 2014-2018 than in 2002-2013. The relatively low abundance and occupancy estimates recorded in 2014-2018 were more pronounced in the Rogue Stratum of the DPS.

Oregon Coast (OC) DPS: The 2018 abundance estimate was 167,000 parr, which was lower than the average estimate for the DPS. The 2018 site occupancy estimate was 70%, which was similar to the average estimate from 2014-2017, but lower than the average estimate from 2010-2013.

Lower Columbia River (LCR) DPS: The 2018 abundance estimate was 5,100 parr. Abundance estimates in the DPS from 2006-2013 are higher than those from 2014-2018, suggesting a declining trend. The 2018 site occupancy estimate was 57%. Site occupancy estimates in the DPS suggest a stable trend.

South West Washington (SWW) DPS: The 2018 abundance estimate was 2,500 parr, similar to the lowest recorded estimate in 2017. Abundance estimates have been low in recent years for the DPS, but were coupled with a degree of variation that prevented the detection of a trend. The 2018 site occupancy estimate was 45%. Site occupancy estimates from 2014-2018 have been low, relative to those from 2010-2013 and similar to those from 2006-2009.

BACKGROUND AND METHODS

This project was initiated by 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 inform conservation and recovery decisions related to Coho Salmon (*Oncorhynchus kisutch*) by describing trends in the abundance and distribution of Coho Salmon parr in coastal Oregon streams. The project uses snorkel surveys at randomly selected sites to meet this objective.

The project's original sampling frame was 1st-3rd order streams within the putative summer rearing distribution of Coho Salmon in the Oregon Coast Coho (OCC) and the Oregon portion of the Southern Oregon Northern California Coho (SONCC) Evolutionarily Significant Units (ESUs) (Figure 1). The scope of this sampling frame has changed over time. In 2002 the sampling frame was expanded to include both (i) 4th-6th order streams within the rearing distribution of Coho Salmon in these ESUs and (ii) 1st-6th order streams within the rearing distribution juvenile steelhead (*Oncorhynchus mykiss*) in the Klamath Mountain Province (KMP) and Oregon Coast (OC) Distinct Population Segments (DPS). In 2006, 1st-6th order streams within the rearing distribution of Coho Salmon and steelhead in the Oregon portions of the Lower Columbia River (LCR) Coho Salmon ESU and South West Washington (SWW) and LCR steelhead DPSs were included. Due to funding constraints surveys in 4th-6th order streams were phased out by 2013. Analyses for all years and in all ESUs/DPSs are now based on data from 1st-3rd order streams.

The scale of the sampling frame has also changed over time. The original 100k layer was replaced by a 24k layer in 2007, which refined and expanded the presumed summer rearing distribution of Coho Salmon and steelhead. Analyses for all years in the ESUs/DPSs for the Oregon Coast and Lower Columbia River regions are currently based on the 24k layer. In 2012 a sampling frame based on a 24k stream layer was developed for the SONCC/KMP. This 24K-based frame also refined and expanded the original Coho Salmon and steelhead rearing distribution within the Oregon portions of the SONCC/KMP. Until the 2012 (24k) frame is corroborated by field surveys, analyses in the SONCC/KMP will be based on the presumed former distribution. Our sampling frame and survey design are described in detail by Jepsen and Rodgers (2004) and Jepsen and Leader (2007).

Field Sampling

A Generalized Random Tessellation Stratified (GRTS, Stevens 2002) design was used to select survey sites in a spatially balanced, random fashion from the sampling frame. Selected sites were surveyed by field crews using daytime snorkeling during the base flow period (mid-July to mid-October). Sites were 1km in length and encompassed the GRTS point (x, y coordinates) provided by the selection process. Field crews were trained in fish ID and snorkel survey protocols described by Rodgers (2000). Surveys began at the downstream end of the site and proceeded upstream (Thurow 1994). The length of the site, and the length and average width of pools within the site, were measured with a hip chain, open reel tape, depth staff, or range finder. Pool depth was measured using a depth staff. All pools $\geq 6\text{m}^2$ in surface area and $\geq 20\text{cm}$ in maximum depth were snorkeled with a single pass to identify and count juvenile salmonids. Dive lights were used to improve visibility in shaded areas. 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, of juvenile steelhead ≥ 90 mm in fork length (FL, visually estimated), and cutthroat trout (*O. clarki*) ≥ 90 mm FL. Due to difficulties discerning *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 noted. As a part of surveyor training and to evaluate observational differences among snorkelers 10-15% of sites were resurveyed by supervisory staff.

Initially only pools that were ≥ 40 cm in maximum depth were snorkeled. In 2010, this criterion was expanded to include pools ≥ 20 cm in maximum depth based on results from the Smith River Verification Study (Constable and Suring, unpublished report). The Smith River Verification Study suggested the lower criterion would allow surveyors to sample larger and more consistent portions of Coho Salmon and steelhead summer 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 ≥ 40 cm maximum depth criterion and a secondary analysis of data based on pools meeting the ≥ 20 cm maximum depth criterion.

From 1998-2016, sites that could not be snorkeled due to poor water clarity or quality were electrofished using a single pass without block nets to determine occupancy in each pool for Coho Salmon and occupancy at the site for steelhead and cutthroat. Abundance was not estimated at these sites. Following the 2016 field season our electrofishing protocols were evaluated and, due to the small percentage ($< 6\%$) of sites electrofished, the limitations of the data relative to its cost and effort, and impacts on fish, electrofishing was discontinued in 2017.

Our sampling objective for Coho Salmon is to produce abundance estimates with 95% confidence intervals $\leq 30\%$ of the estimate and to be able to detect a 15% change in occupancy with 80% certainty (Crawford and Rumsey, 2011). Analysis of our data has shown that completing 40 sites per stratum is typically sufficient to reach this objective.

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 (Coho Salmon and steelhead):

- Site occupancy: The percent of sites where at least one individual of the target species was observed; 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, a site density was calculated for each site by averaging the pool densities within the site. Lastly, density was estimated for each stratum, ESU, and DPS by averaging the site densities within each 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 provided in this report were based on un-calibrated snorkel counts in pools that meet size criteria. As such they did not represent total abundance estimates, 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 ≥ 0.7 Coho Salmon/m². This value is regarded as full seeding following Nickelson et al. (1992) and Rodgers et al. (1992). Nickelson et al. estimate full seeding to be 1.0 coho/m² from electrofishing removal estimates and Rodgers et al. report that snorkelers observed 70% of the Coho Salmon in electrofishing removal estimates.

With the completion of the 2018 field season, there are now 21 years of monitoring data for juvenile Coho Salmon in the OCC and SONCC. To compare metrics across this time span, we partitioned these 21 years of the data into three-year intervals, based on the conventional three-year Coho Salmon life cycle (reviewed by Weitkamp et al., 1995). This resulted in seven successive brood groups from 1998-2018. Juvenile steelhead data were partitioned into brood groups based on a presumptive four-year life cycle (reviewed by Busby et al., 1996). This resulted in four successive brood groups from 2002-2017. Data from the 2018 field season is presented as a 5th partial brood group in this report. The Lower Columbia River Coho Salmon data was partitioned following the 2015 field season, resulting in four successive brood groups from 2007-2018. Steelhead data in the LCR and SWW were partitioned into three successive brood groups from 2006-2017. Steelhead data from the 2018 field season is presented as a 4th partial brood group.

A brood group contains one iteration of each of the three Coho Salmon brood lines (likewise, a brood group for steelhead contains one iteration of each of the four brood lines), and thus is one complete cycle of the summer rearing segment of the Coho Salmon population. The use 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 for this temporally large data set. We compared estimates of site occupancy fish abundance among these brood groups.

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>).

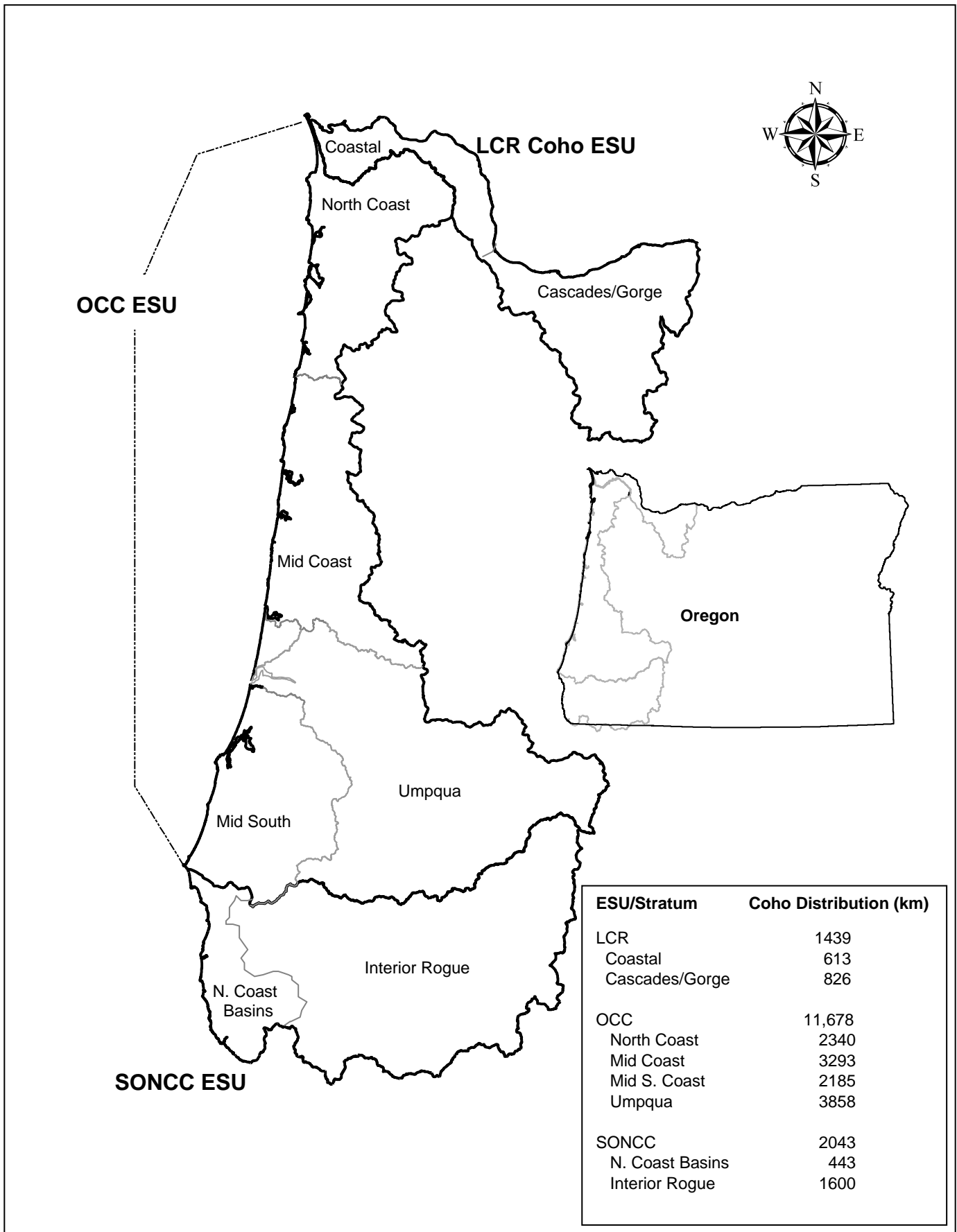


Figure 1. The project area showing western Oregon Coho ESUs and strata. The table gives the length of Coho Salmon rearing distribution in 1st-3rd order streams in each area.

RESULTS

2018 Survey Effort and Resurveys

In 2018, 537 sites were selected by the GRTS process. Forty-six of these were determined to be non-target (beyond the potential rearing distribution of Coho Salmon and steelhead). Of the remaining 491 sites, 180 were not surveyed because of landowner access restrictions (101), visibility or water quality issues (26), unsafe or difficult access (17), or time restrictions (36). Sites that were not surveyed were defined as target, non-response. A total of 311 sites were snorkeled, comprising 4,093 pools in 303.7 km of streams.

We met our goals for survey effort in the North Coast, Mid Coast, and LCR Coast strata (Table 1). Both the Interior Rogue the North Coast Basins strata had a high proportion of sites that were dry or did not have pools that met snorkel criteria. Landowner denials were also disproportionately higher in the Interior Rogue. Lack of visibility accounted for the high number of sites that could not be surveyed in the LCR. The 228,000 acre Klondike-Taylor Creek wildfire prevented surveying in a large portion of the SONCC and the South Umpqua Fire Complex prevented access to several sites in the Umpqua stratum.

Table 1. Survey effort goals and status of sites for 2018.

ESU	Stratum	Survey Goal	Snorkeled	Target -Non response	Non-Target
OCC	North Coast	40	41	15	3
	Mid Coast	40	40	18	2
	Mid-South Coast	40	38	17	3
	Umpqua	40	37	14	8
LCR	Coast	40	40	33	0
	Cascades/Gorge	40	35	35	3
SONCC	Interior Rogue	60	46	37	16
	N. Coast Basins	40	34	11	11

The goal of a 95% confidence interval $\leq 30\%$ of the density estimate was met in the North Coast and Mid Coast strata (Table 2). Variance partitioning has indicated low precision in most years was due to the high variation of Coho Salmon abundance among the survey sites (Anlauf-Dunn, ODFW, unpublished data).

Thirty-seven (12%) of the snorkeled sites were resurveyed by supervisory staff. Two of the resurveys were an extension of training for less experienced crew members and these were not used to examine the precision of our methodology. Counts of Coho Salmon in the remaining 35 sites had a significant relationship with counts from the resurveys (Figure 2, top left panel, $R^2 = 0.993$). These results were similar to previous years (bottom left panel, $R^2 = 0.966$) and indicated our snorkel counts of Coho Salmon were precise and repeatable. Resurvey counts of steelhead in 2017 showed increased precision and repeatability (top right panel, $R^2 = 0.917$) relative to previous years (bottom right panel, $R^2 = 0.784$).

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 2018.

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	78%	68%	± 16%	19%	0.413	± 24%
Mid Coast	90%	71%	±13%	8%	0.278	± 27%
Mid-South Coast	71%	64%	± 19%	14%	0.314	± 35%
Umpqua	76%	57%	± 19%	8%	0.226	± 34%
SONCC	42%	21%	± 33%	2%	0.052	± 53%
LCR	45%	28%	± 23%	2%	0.069	± 38%

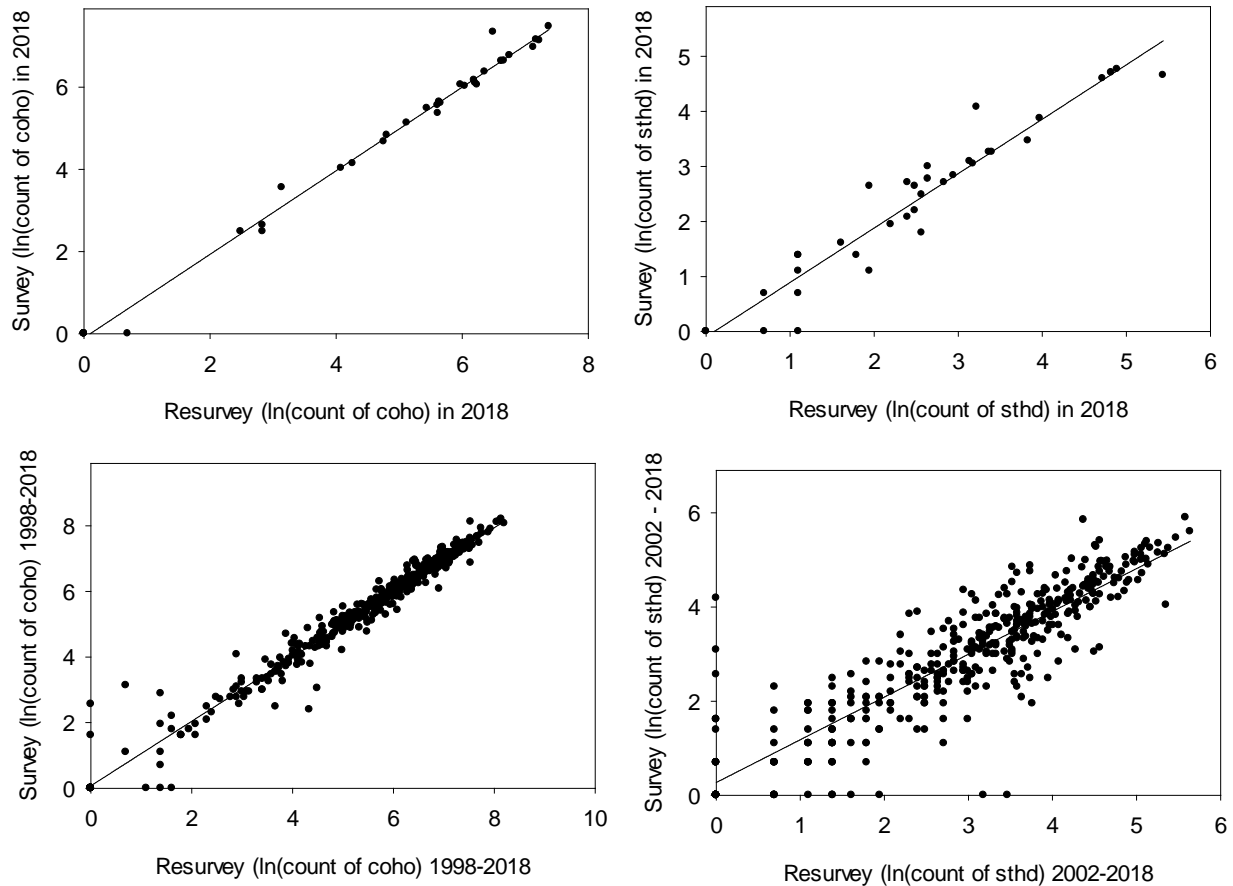


Figure 2. The relationship of Coho Salmon parr and steelhead (≥ 90 mm in fork length) parr counts from surveys and resurveys of the same sampling sites for 2018 (top panels, $n = 35$) and for all years (bottom panels, $n = 496$ for Coho Salmon and $n = 442$ for steelhead, respectively). Data are log transformed to satisfy regression assumptions.

Trends in Salmonid Distribution and Abundance

Coho Salmon

SONCC.— Density and the number of sites fully seeded (Table 2) were similar from 2017 to 2018. The 2017 abundance estimate was 103,000 parr. This was similar to the 2017 estimate, but low compared to the average abundance for all years. Abundance estimates for the 2016-2018 brood group were similar to those for the 1998-2000 and 2010-2015 brood groups, but low relative to the remaining brood groups (Figure 3). Site occupancy was similar in 2017-2018, but low for the 2016-2018 brood group relative to the 1998-2015 brood groups (Figure 4).

OCC.— Density in the ESU was similar from 2017 to 2018. The number of sites fully seeded increased from 5.8% in 2017 to 11.4% in 2018. The 2018 abundance estimate was 3.3 million parr. Parr abundance has remained between 2.9 and 4.9 million since 2000, after improving from an average of 910,000 from 1998 to 1999. The abundance estimate for the 2016-2018 brood group was lower than those for the 2007-2015 brood groups and higher than the estimate for the 1998-2000 brood group. Site occupancy was 80% for 2018. Since 2008, site occupancy in the ESU has met a NMFS recovery criterion (Wainwright et al., 2008) of $\geq 80\%$ of sites occupied. Site occupancy for the 2016-2018 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.

In the Mid South Coast stratum of the OCC, the 2018 CDF curve was low relative to the 1998-2017 average CDF curve (Figure 5). In the remaining strata the 2018 CDF curves were similar to the 1998-2017 average. Abundance estimates for the 2016-2018 brood groups were high in the North Coast, similar in the Mid Coast and Umpqua and low in the Mid South Coast when compared to 2013-2015 brood groups within the strata (Figure 6). Site occupancy estimates in the OCC strata for the 2016-2018 brood groups were similar to those for the 2013-2015 brood groups (Figure 7).

Female spawner:parr recruit plots for the OCC strata suggested parr production began to asymptote 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 12 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 ($P=0.05$), while 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 66 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). This effect was observed in other strata; the North Coast and Mid South Coast had their lowest number of parr per female when female abundance was highest and the Mid Coast and Mid South Coast had their highest number of parr per female when female abundance was lowest. Density-dependent effects on recruits per spawner in the OCC have 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 increases 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/m²) 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 and 2018.

LCR.— Density estimates and the number of sites fully seeded were similar in 2017-2018. In both of these years <2% of the sites in the ESU were fully seeded. The 2018 abundance estimate was 91,000 parr. Although this quadrupled the estimate from 2016, the 2016-2018 brood group had lower abundance the preceding brood groups. Spawner abundances have been below average in the LCR for brood years 2015 and 2016, which likely contributed to the relatively low parr abundance in the current brood group. Site occupancy was similar in 2017-2018. Site occupancy for the 2016-2018 brood group was low relative to the estimates for the preceding brood groups.

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 much weaker indication of a density-dependent effect on parr production (Figure 11). A plot of residuals did not suggest a trend. The number of parr produced per female spawner in the LCR appeared to be less influenced by female spawner abundance, and was an average of 50% lower than in the OCC (Figures 12 and 13). The number of parr per female ranged from 7, when female spawner abundance was highest, to 66, when female spawner abundance was the 2nd lowest, but any compensatory effect in the LCR seems weaker than this effect in the OCC (Figure 13). These 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 36% of those in the OCC strata for the 2005-2017 brood years.

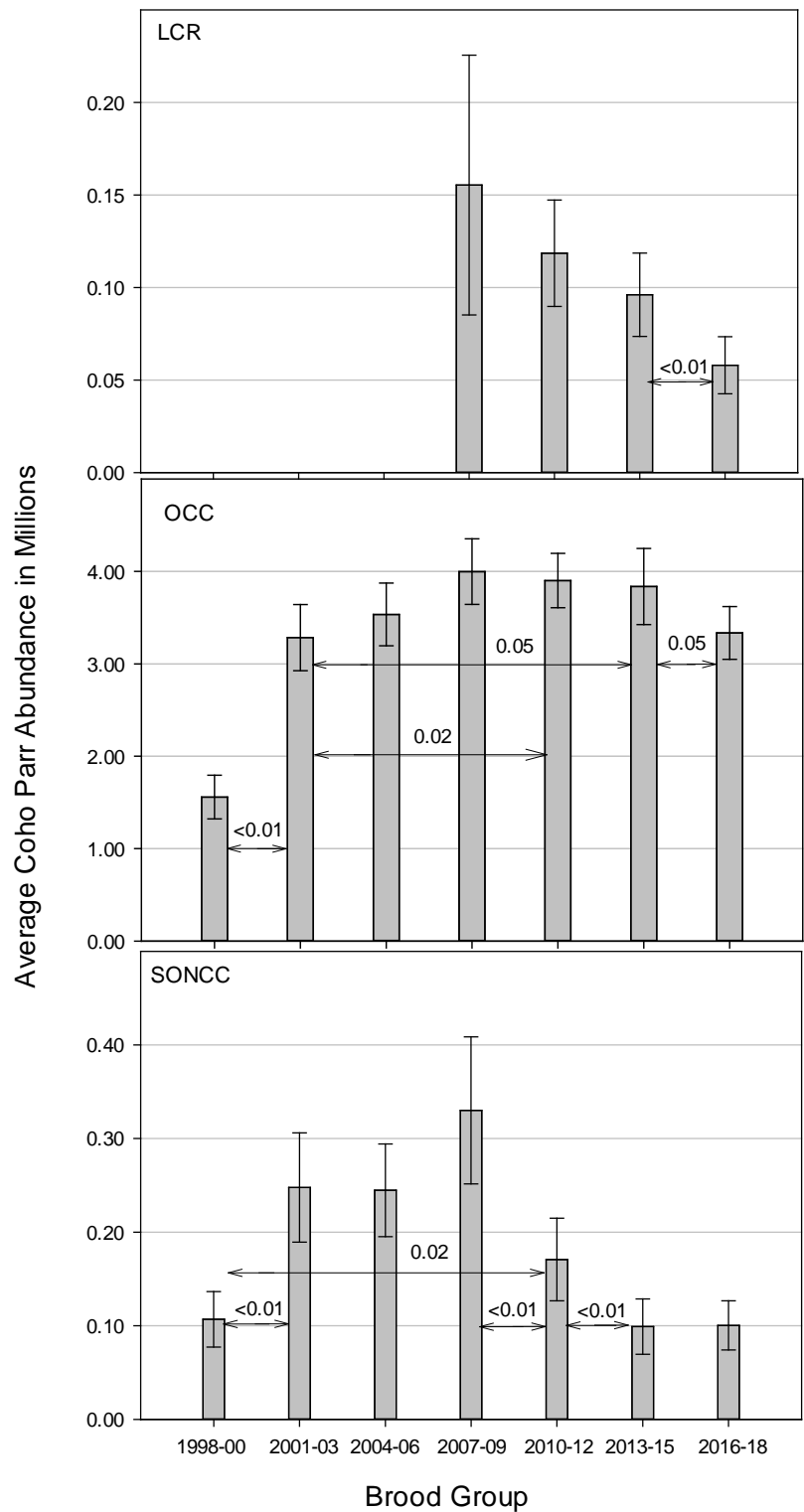


Figure 3. Three year (brood group) trends of Coho Salmon parr abundance estimates in the three western Oregon Coho ESUs, based on snorkel surveys in 1st-3rd order streams for the years 1998-2018. Gray bars and error bars show the abundance estimate with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$. Note the differences in Y-axis scales among panels.

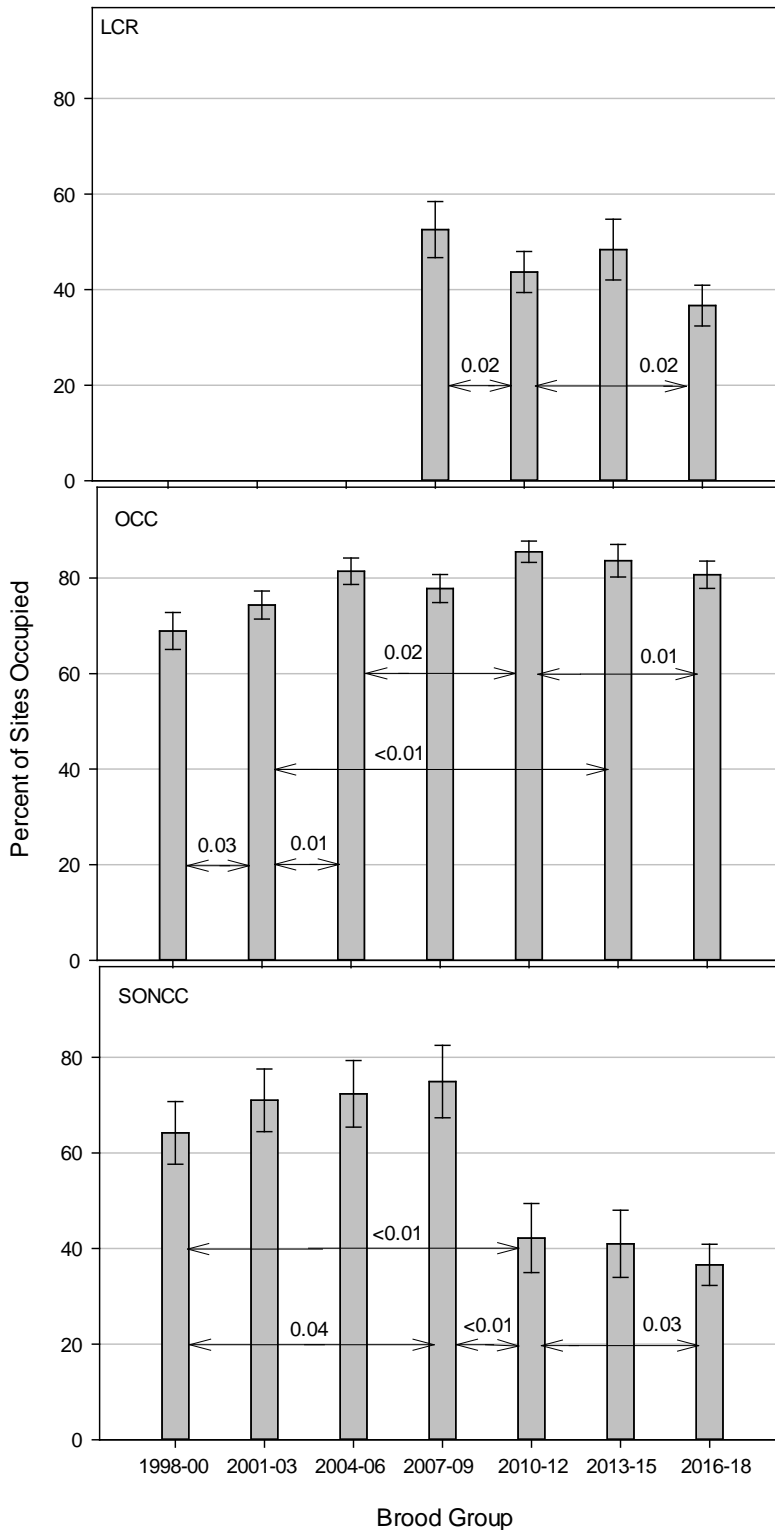


Figure 4. Three year (brood group) trends of Coho Salmon parr site occupancy in the three western Oregon Coho ESUs based on snorkel surveys in 1st-3rd order streams for the years 1998-2018. Gray bars and error bars show the percent of sites occupied with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$.

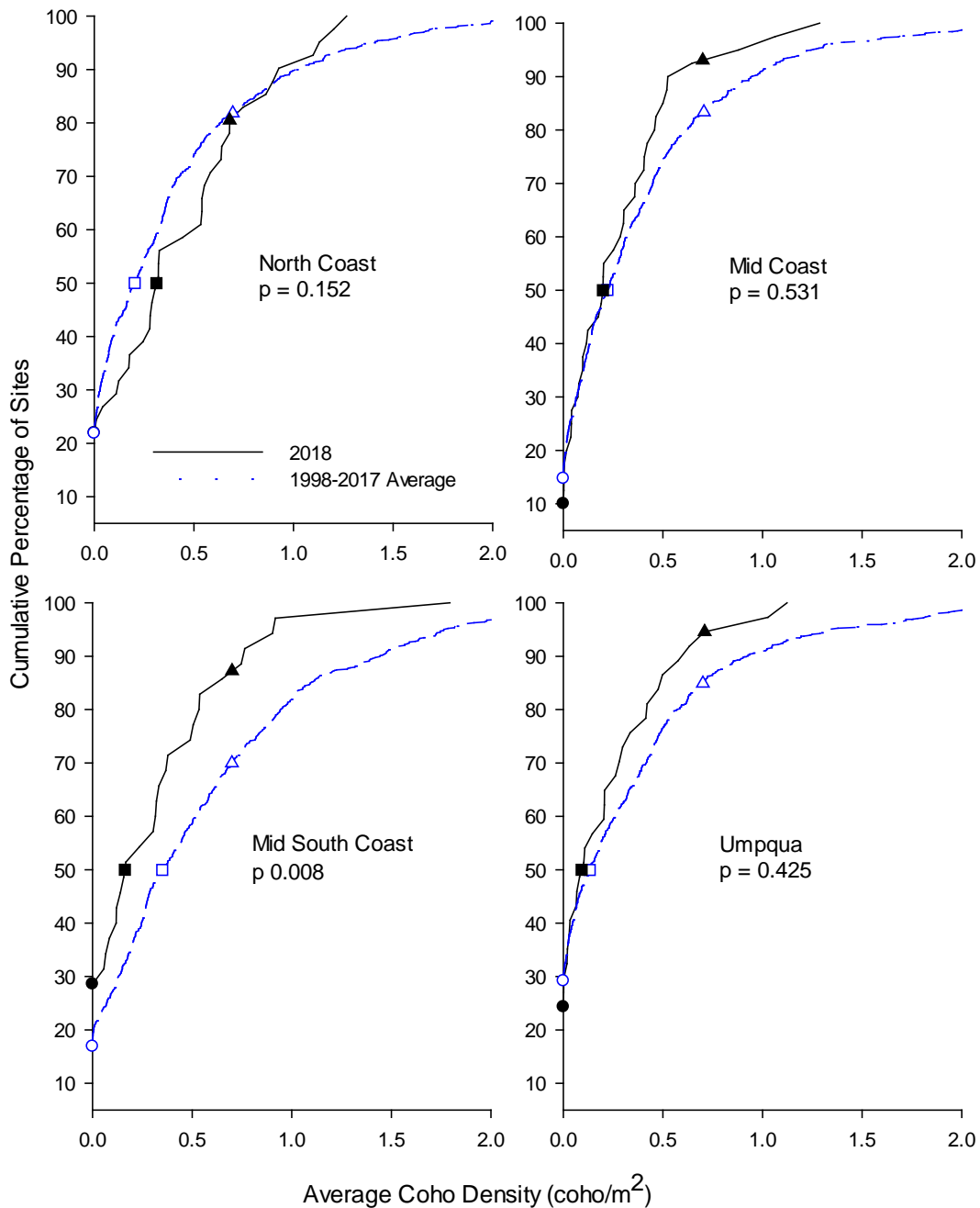


Figure 5. Average Coho Salmon parr density CDFs based on snorkel surveys in 1st-3rd order streams in the four strata of the Oregon Coast Coho ESU for survey years 1998-2018. The points shown on the curves are the percentage of unoccupied sites (circles), the median density (squares), and the percentage 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 2018 (black, solid line). P values are from the comparison test of the two curves.

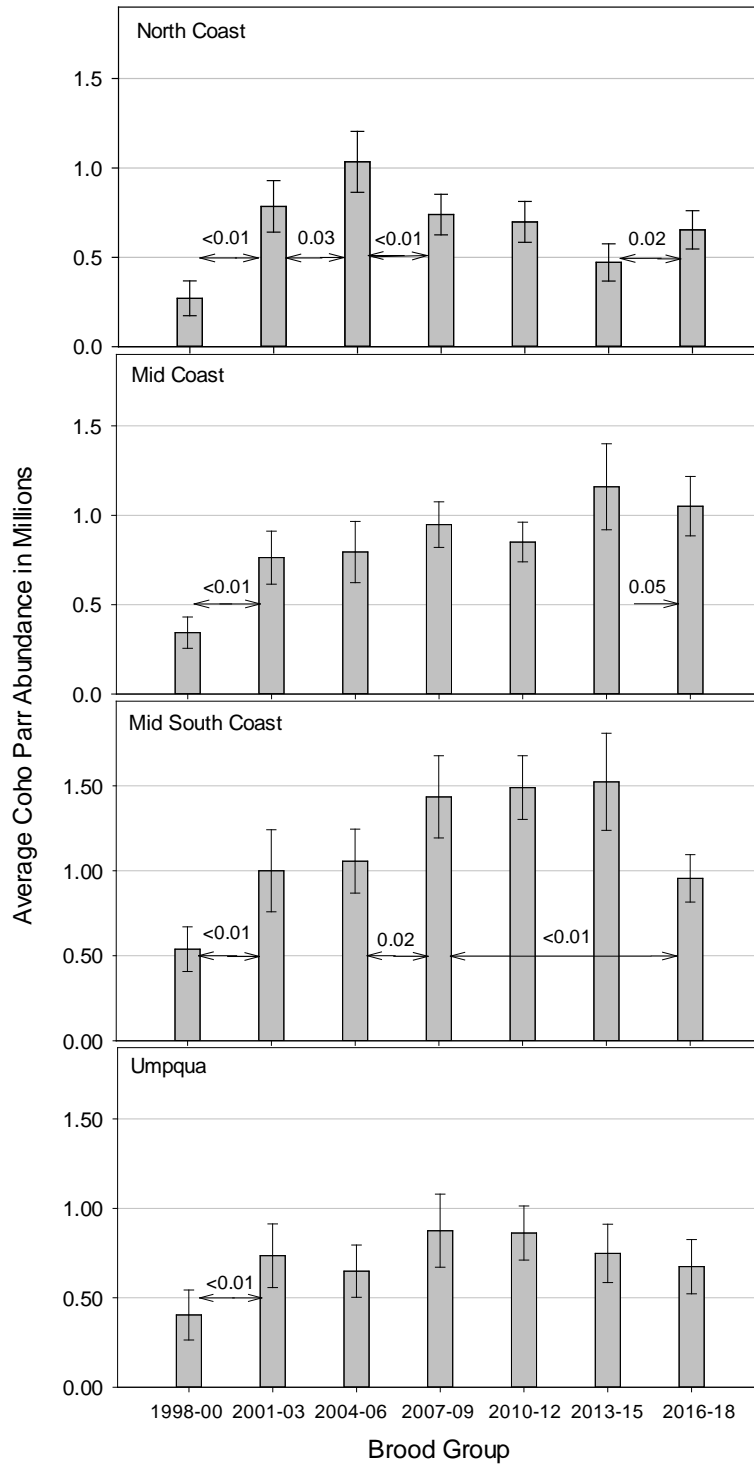


Figure 6. Three year (brood group) trends of Coho Salmon parr abundance estimates in the four strata of the Oregon Coast Coho ESU, based on snorkel surveys in 1st-3rd order streams for the years 1998-2018. Gray bars and error bars show the abundance estimate with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$.

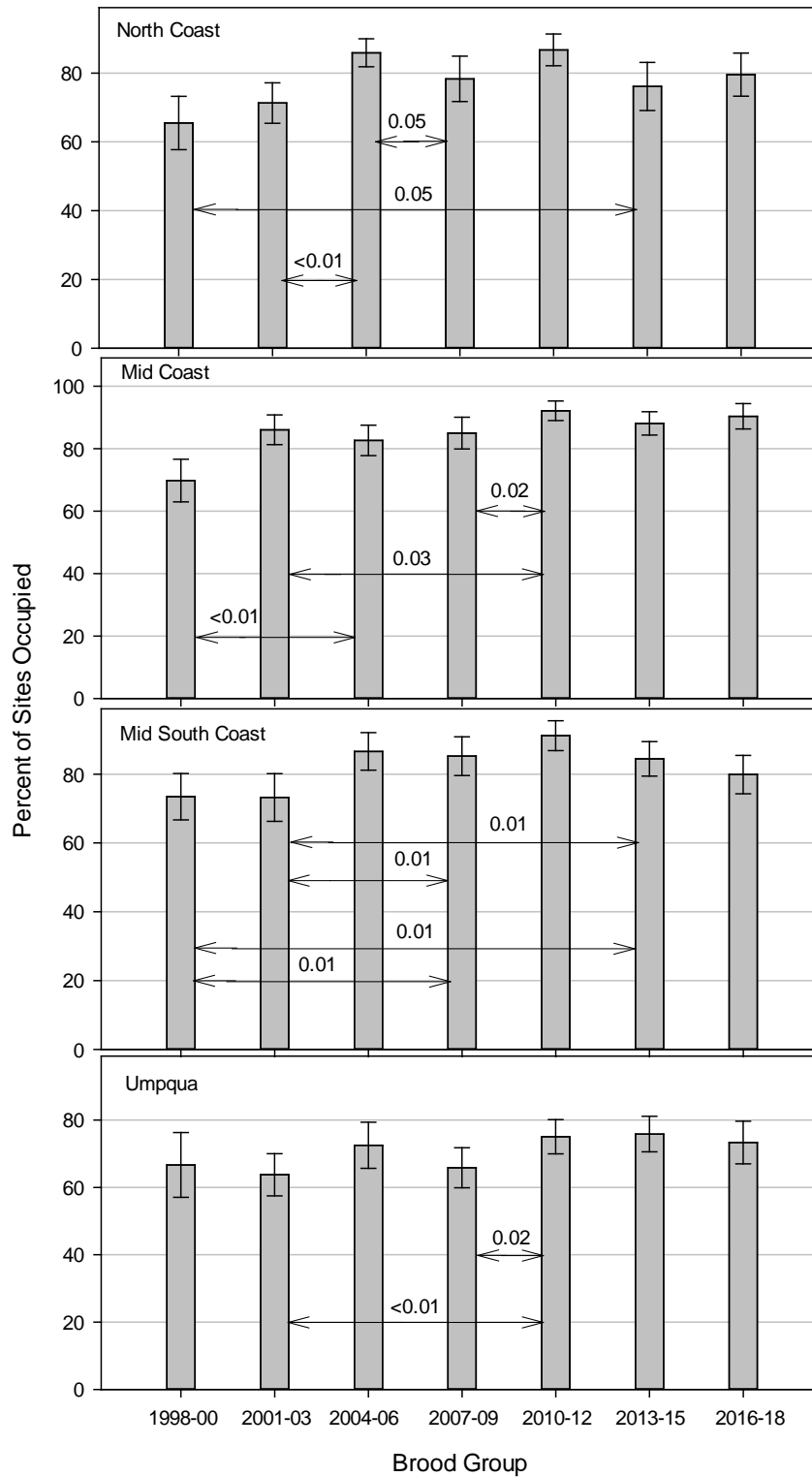


Figure 7. Three year (brood group) trends of Coho Salmon parr site occupancy in the four strata of the Oregon Coast Coho ESU, based on snorkel surveys in 1st-3rd order streams for the years 1998-2018. Gray bars and error bars show the percent of sites occupied with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$.

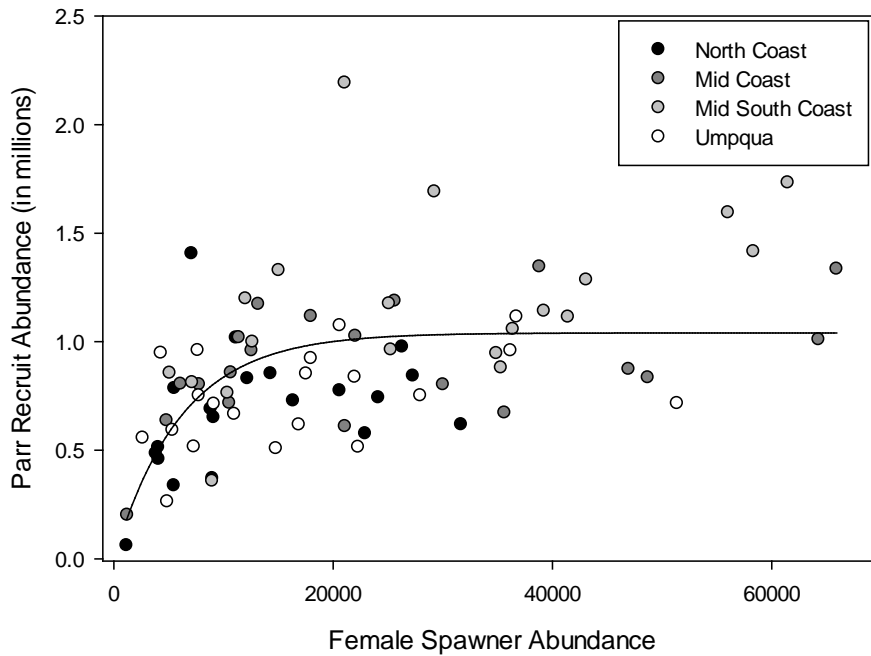


Figure 8. A Beverton-Holt model showing the relationship between the abundance of Coho Salmon parr recruits and female spawners in the strata of the Oregon Coast Coho ESU for brood years 1998-2017. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Female spawner abundance is from spawning ground surveys.

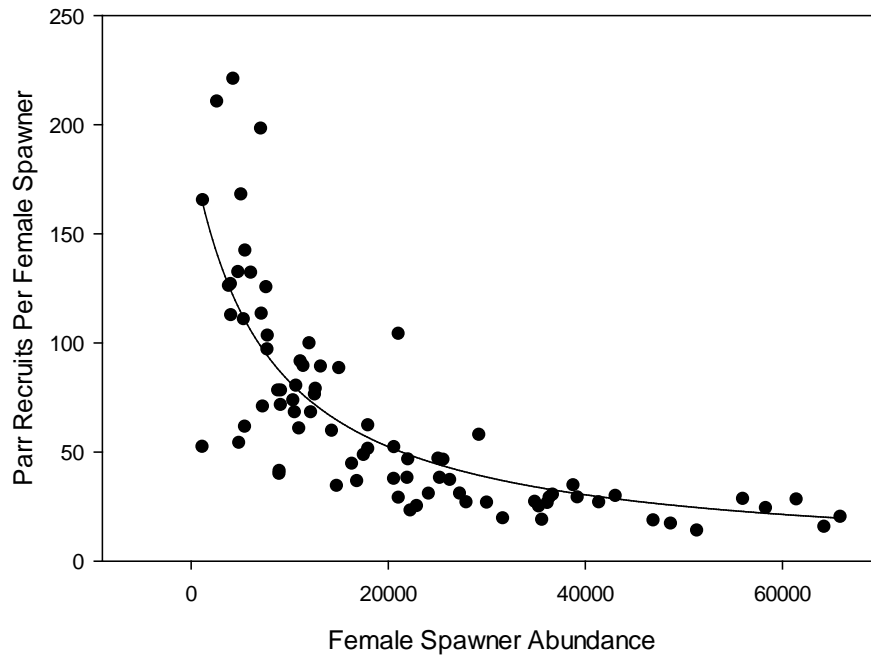


Figure 9. The relationship between the abundance of Coho Salmon female spawners and the number of parr recruits per female spawner in the Oregon Coast Coho ESU for brood years 1998-2017. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground surveys.

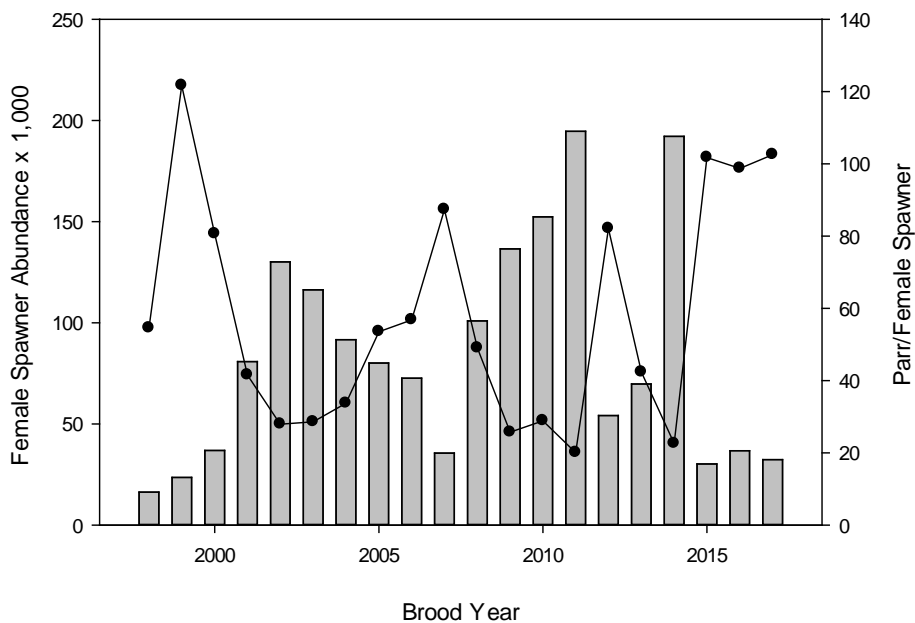


Figure 10. The abundance of Coho Salmon female spawners (gray bars) and the number of parr recruits per female spawner (black dots and line) over time in the Oregon Coast Coho ESU. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground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

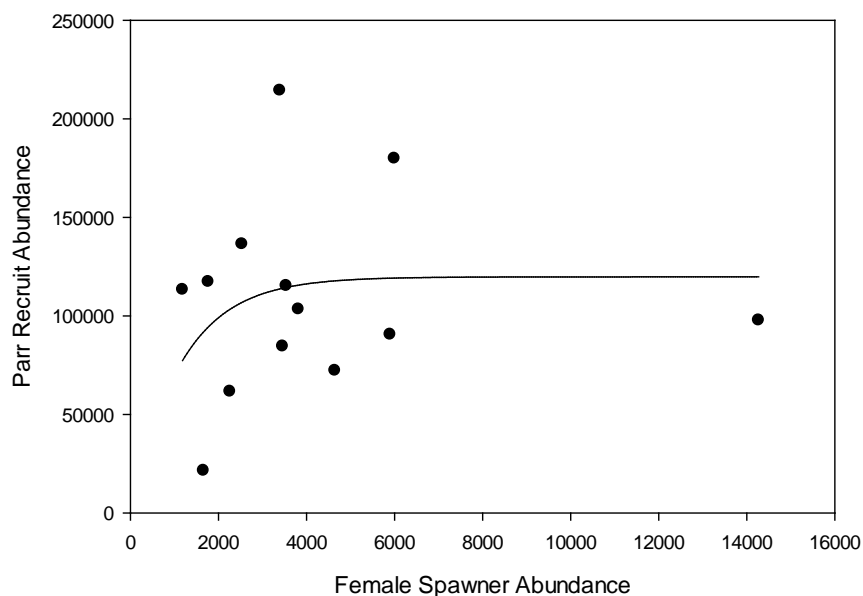


Figure 11. A Beverton-Holt model showing the relationship between the abundance of Coho Salmon parr recruits and female spawners in the Lower Columbia River ESU for brood years 2005-2017. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Female spawner abundance is from spawning ground surveys.

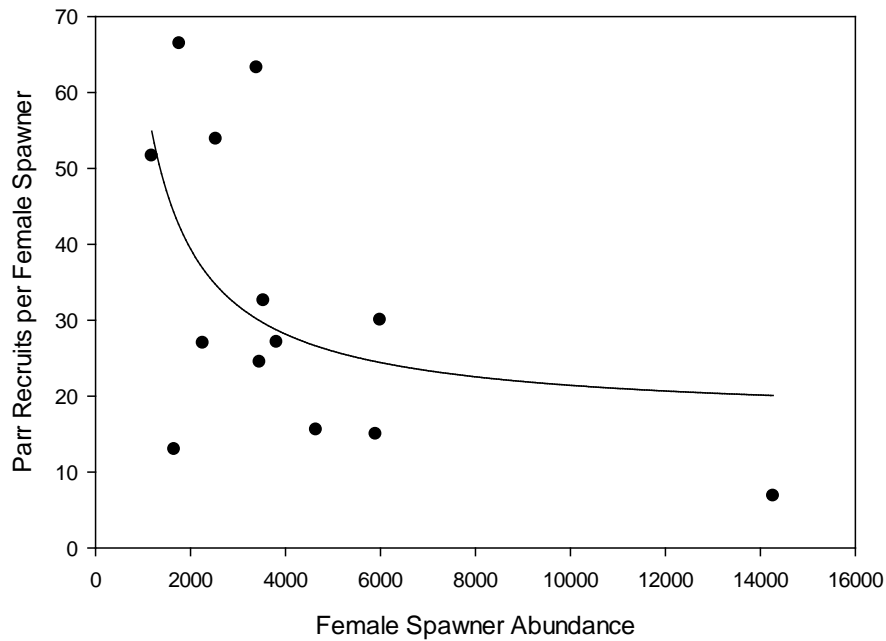


Figure 12. The relationship between the abundance of Coho Salmon female spawners and the number of parr recruits per female spawner in the Lower Columbia River ESU for brood years 2005-2017. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground surveys.

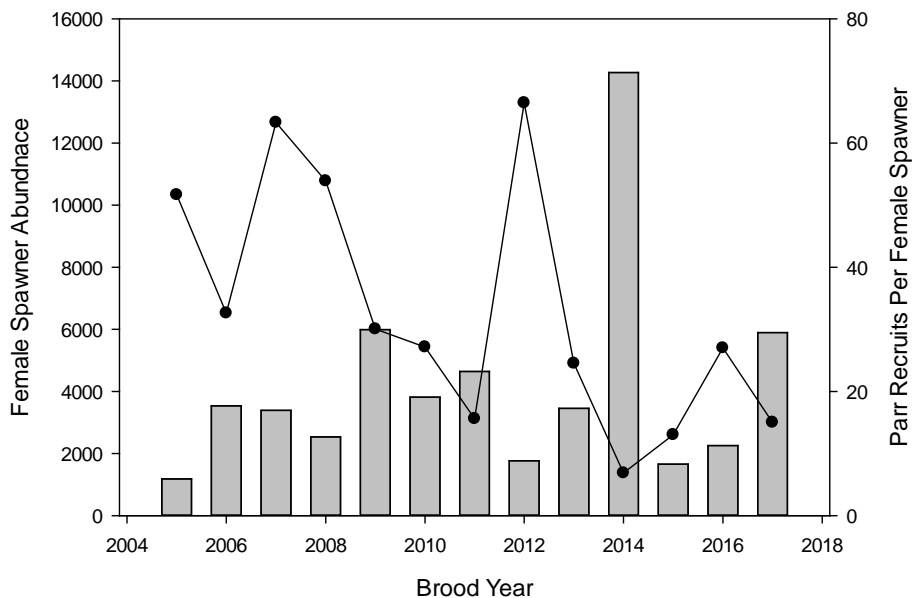


Figure 13. The abundance of Coho Salmon female spawners (gray bars) and the number of parr recruits per female spawner (black dots and line) over time in the Lower Columbia River ESU. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground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

Steelhead

KMP.— Density (Table 3) was higher in 2017 than in 2018. The 2018 abundance estimate was 64,000 parr. The three lowest abundance estimates were observed in the last four years and abundance estimates were low for the 2014-2017 brood group relative to those for the 2010-2013 brood group (Figure 14). The 2018 abundance estimate in the Rogue stratum of the DPS was the lowest recorded. In the South Coast stratum the 2018 abundance estimate was similar to average. In 2018 the site occupancy estimate was 82%. Site occupancy estimates for the 2014-2017 brood group and for 2018 were similar to those for the 2010-2013 brood group (Figure 15).

OC.— Density was similar from 2017 to 2018. The 2018 abundance estimate was 167,000 parr, which lower than the (highest recorded) estimate from 2017 and lower than the average abundance of the 2014-2017 brood group. The 2018 site occupancy estimate was 70%, which was similar to the site occupancy of the 2014-2017 brood group, but lower than that of the 2010-2013 brood group.

LCR.— Density was similar from 2017 to 2018. The 2017 abundance estimate was 5,100 parr, which was lower than the estimate from 2018 but similar to the abundance of the 2014-2017 brood group. Abundance estimates were lower for the 2014-2017 brood group relative to those for the 2009-2013 brood groups. The 2018 site occupancy estimate was 57%, which was similar to the estimate for 2017 and for the 2014-2017 brood group. Site occupancy estimates for the 2014-2017 brood group were similar to those for the previous brood groups.

SWW.— Density was similar from 2017 to 2018. The 2018 abundance estimate was 2,500 parr. This was similar to the (lowest recorded) estimate for 2017. The three lowest abundance estimates have been observed in the last four years, but 95% confidence intervals that averaged 55% of the estimates have made comparisons among brood groups difficult. The 2018 site occupancy estimate was 45%, which was similar to the lowest and second lowest estimates observed in 2015 and 2017, respectively. Site occupancy for the 2014-2017 brood group was low relative to that for the 2010-2013 brood group and the 2018 site occupancy indicates a continuation of this decline.

Table 3. Distribution and density estimates for juvenile steelhead (≥ 90 cm in fork length) in the four strata of the Oregon Coast Steelhead DPS, based on snorkel surveys in 1st-3rd order streams for 2018.

Stratum	Distribution			Density	
	Site Occupancy	Mean Pool Frequency	95% CI	Mean Average Pool Density (sthd/m ²)	95% CI
North Coast	83%	46%	± 18%	0.033	± 27%
Mid Coast	78%	34%	± 26%	0.017	± 32%
Mid-South	58%	27%	± 32%	0.008	± 45%
Umpqua	65%	27%	± 27%	0.013	± 47%
KMP Rogue	77%	30%	± 22%	0.012	± 39%
KMP South Coast	96%	77%	± 11%	0.050	± 53%
Lower Columbia	57%	24%	±30%	0.011	± 46%
Southwest WA	45%	10%	± 41%	0.003	± 54%

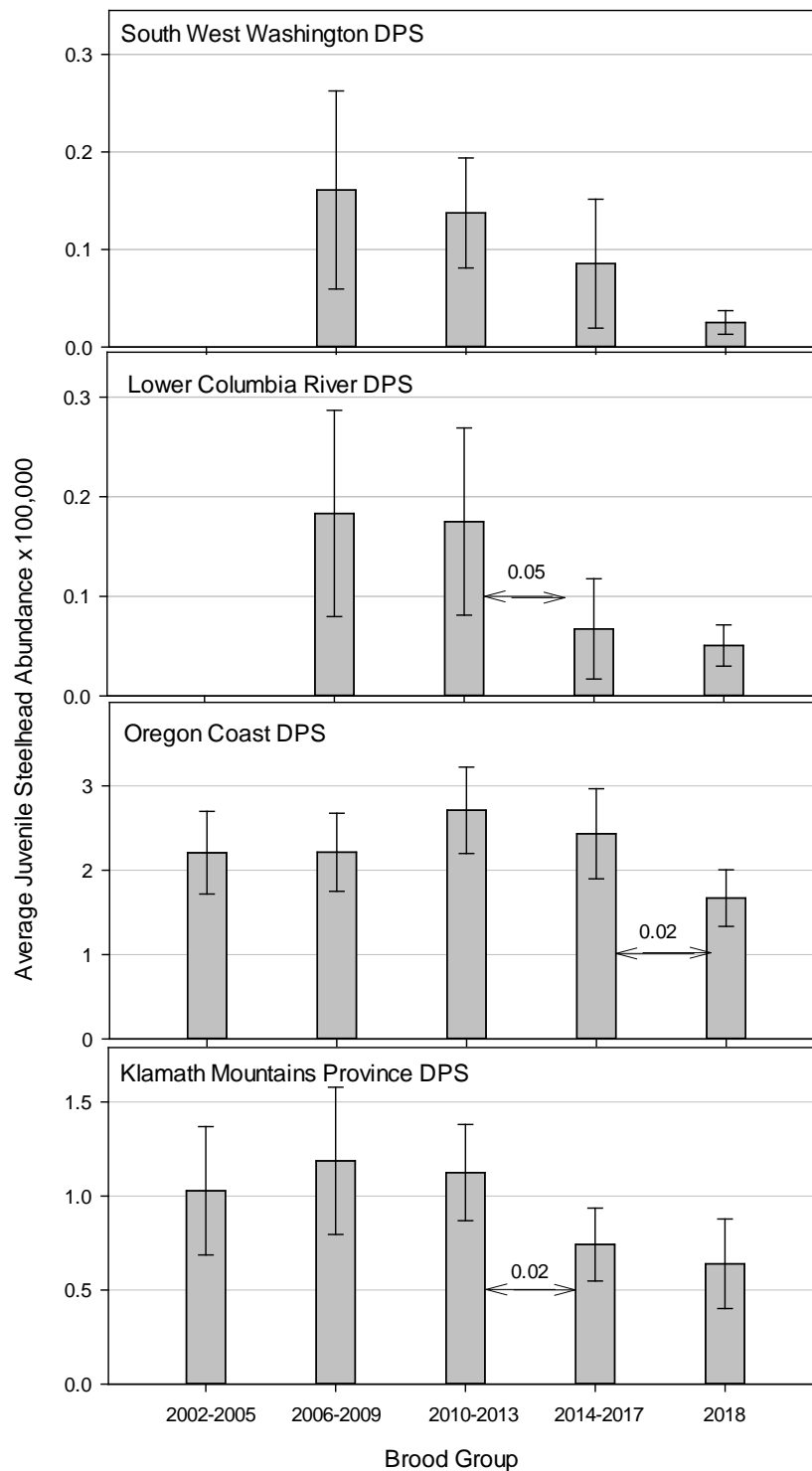


Figure 14. Four year (brood group) trends of juvenile steelhead (≥ 90 cm in fork length) abundance estimates in the four western Oregon DPSs, based on snorkel surveys in 1st-3rd order streams for years 2002-2018. The 2018 data are presented as a partial brood group. Gray bars and error bars show the 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 $p \leq 0.05$

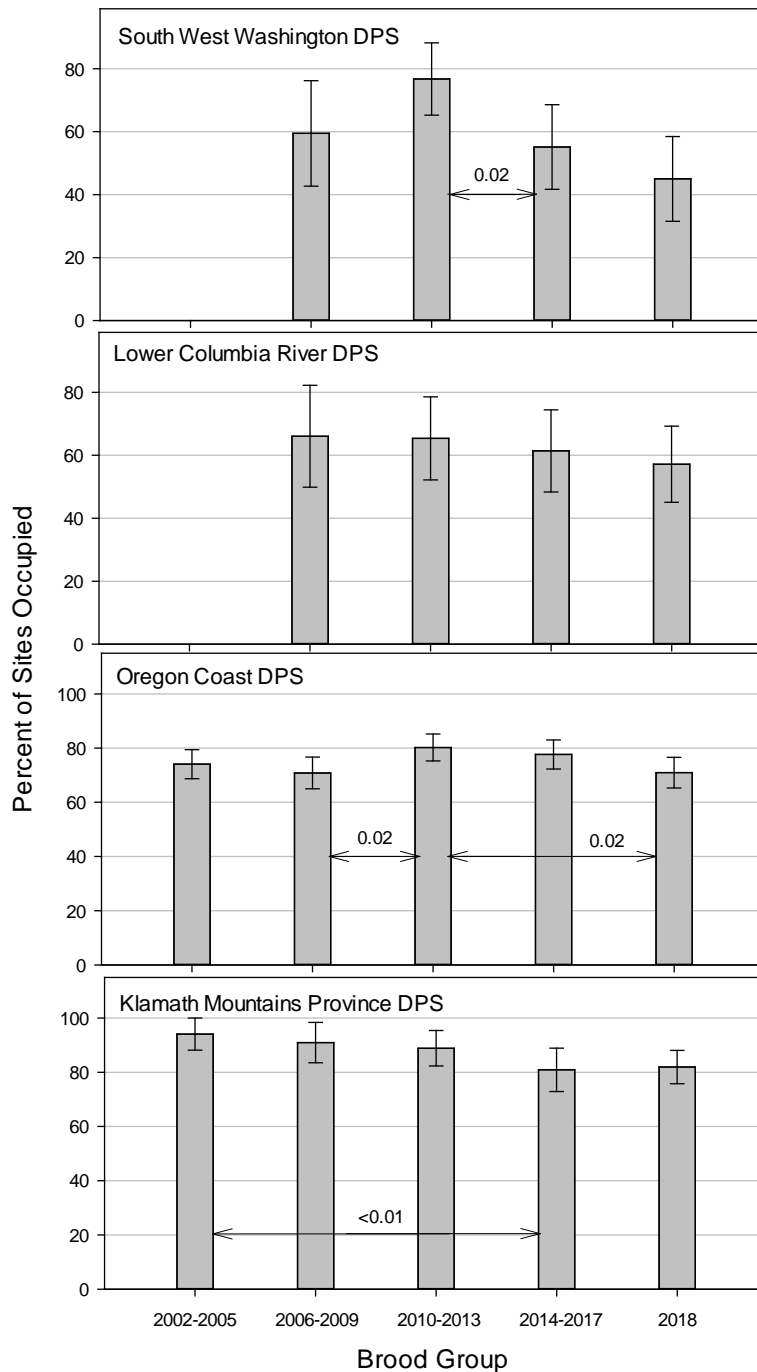


Figure 15. Four year (brood group) trends of juvenile steelhead (≥ 90 cm in fork length) site occupancy in four western Oregon DPS, based on snorkel surveys in 1st-3rd order streams for years 2002-2018. The 2018 data are presented as a partial brood group. Gray bars and error bars show the percent of 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 $p \leq 0.05$.

Effects of Pool Depth on Snorkel Counts

Initially, only pools that were ≥ 40 cm in maximum depth were surveyed. The Smith River Verification Study (Constable and Suring, unpublished report.) used electrofishing removal estimates (Amour 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 this criterion. In the Smith River study area results indicated pools ≥ 40 cm 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 ≥ 20 cm 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 ≥ 40 cm 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 ≥ 20 cm 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 ≥ 20 cm in 2010.

The lower criterion allowed an additional 1015 pools (a 20% increase) to be surveyed in 2018. One survey site did not have pools that were ≥ 40 cm in maximum depth, but did have pools that were ≥ 20 cm in maximum depth. Both Coho Salmon and steelhead were observed in this site and it slightly improved our survey effort over the results presented in Table 1. Additionally, there were nine sites that contained pools that were ≥ 40 cm in maximum depth, but where Coho Salmon or steelhead were only observed in pools that were < 40 cm in maximum depth. These changed site occupancy estimates. For Coho Salmon, site occupancy estimates decreased by 2% in Mid South and increased by 2% in the North Coast over those given in Table 2. In the remaining strata site occupancy changed by $< 1\%$. For steelhead, site occupancy estimates increased by 2% in the KMP, and 4% in the OC over those given in Table 3. In the remaining DPS site occupancy rates changed by $< 1\%$.

From 2010-2013 and in 2016-2017 Coho Salmon density estimates decreased in most strata when the lower criterion was applied. In most cases this was less than a 10% decrease. In 2014 Coho Salmon densities increased by 1-5% in most strata when the lower criterion was applied. In 2015 densities did not change by more than 2% except in the SONCC. In the SONCC in 2015 densities increased over 60%, primarily due to extremely high densities in one site with a single pool < 40 cm in maximum depth. In 2018 densities increased by 4% and 5% in the LCR and Umpqua, respectively, and in the remaining strata changed by $< 2\%$. From 2010-2015 and in 2017-2018 steelhead density estimates decreased by $< 10\%$ with the lower criterion in each DPS. For 2016 a similar decrease was observed in the KMP and in the OC, but the LCR increased by 16% and the SWW decreased by 12%.

Paired t-tests from abundance estimates in 2018 from pools ≥ 40 cm and pools ≥ 20 cm indicate that applying the lower criterion produced significant differences in the 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 to 2014 and in 2017. 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). Resurveys since the adoption of the lower criterion (n=242) have indicated the precision of Coho Salmon counts using the ≥ 20 cm maximum depth criterion ($R^2=0.967$) was similar to the precision of Coho Salmon counts using the ≥ 40 cm maximum depth criterion ($R^2=0.968$) (Figure 16). Resurvey results for steelhead since the adoption of the lower criterion also indicated similar precision in counts when the ≥ 20 cm maximum depth criterion was used ($R^2=0.750$) and when the ≥ 40 cm maximum depth criterion was used ($R^2=0.763$). The yearly variability for Coho Salmon abundance in each stratum and ESU estimated by surveys in pools ≥ 40 cm in depth has tracked with the variability estimated by surveys in pools ≥ 20 cm in depth (Figure17).

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	2018 Coho Estimates				
	Pools ≥ 40 cm Max Depth		Pools ≥ 20 cm Max Depth		95% CI Difference
	Estimate	95% CI	Estimate	95% CI	
North Coast	784,995	28%	878,269	29%	-0.7%
Mid Coast	959,349	28%	1,088,451	26%	1.8%
Mid-South Coast	855,895	36%	920,986	36%	0%
Umpqua	713,140	38%	858,366	34%	3.9%
SONCC	102,816	51%	113,349	50%	1.2%
Lower Columbia	90,675	42%	94,085	41%	1.0%

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	2018 Steelhead Estimates				
	Pools ≥ 40 cm Max Depth		Pools ≥ 20 cm Max Depth		95% CI Difference
	Estimate	95% CI	Estimate	95% CI	
North Coast	56,101	35%	58,830	34%	0.9%
Mid Coast	56,095	36%	58,999	34%	2.7%
Mid-South Coast	21,626	43%	22,389	42%	1.1%
Umpqua	33,158	47%	37,221	45%	2.5%
KMP Rogue	14,176	39%	14,841	38%	0.4%
KMP South Coast	49,797	46%	50,512	45%	0.6%
Lower Columbia DPS	5,067	41%	5,139	40%	0.5%
Southwest WA DPS	2,525	48%	2,541	47%	0.3%

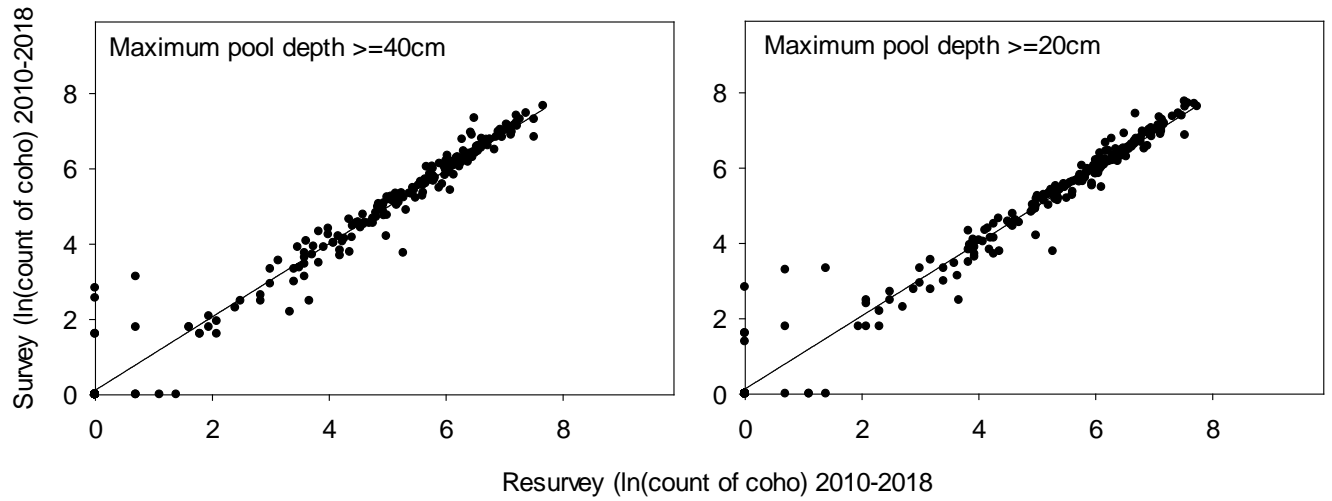


Figure 16. The relationship of Coho Salmon parr counts from surveys and resurveys (n=242) using a maximum pool depth criterion of ≥ 40 cm (left panel) and using a maximum depth criterion of ≥ 20 cm (right panel). Data are log transformed to satisfy regression assumptions.

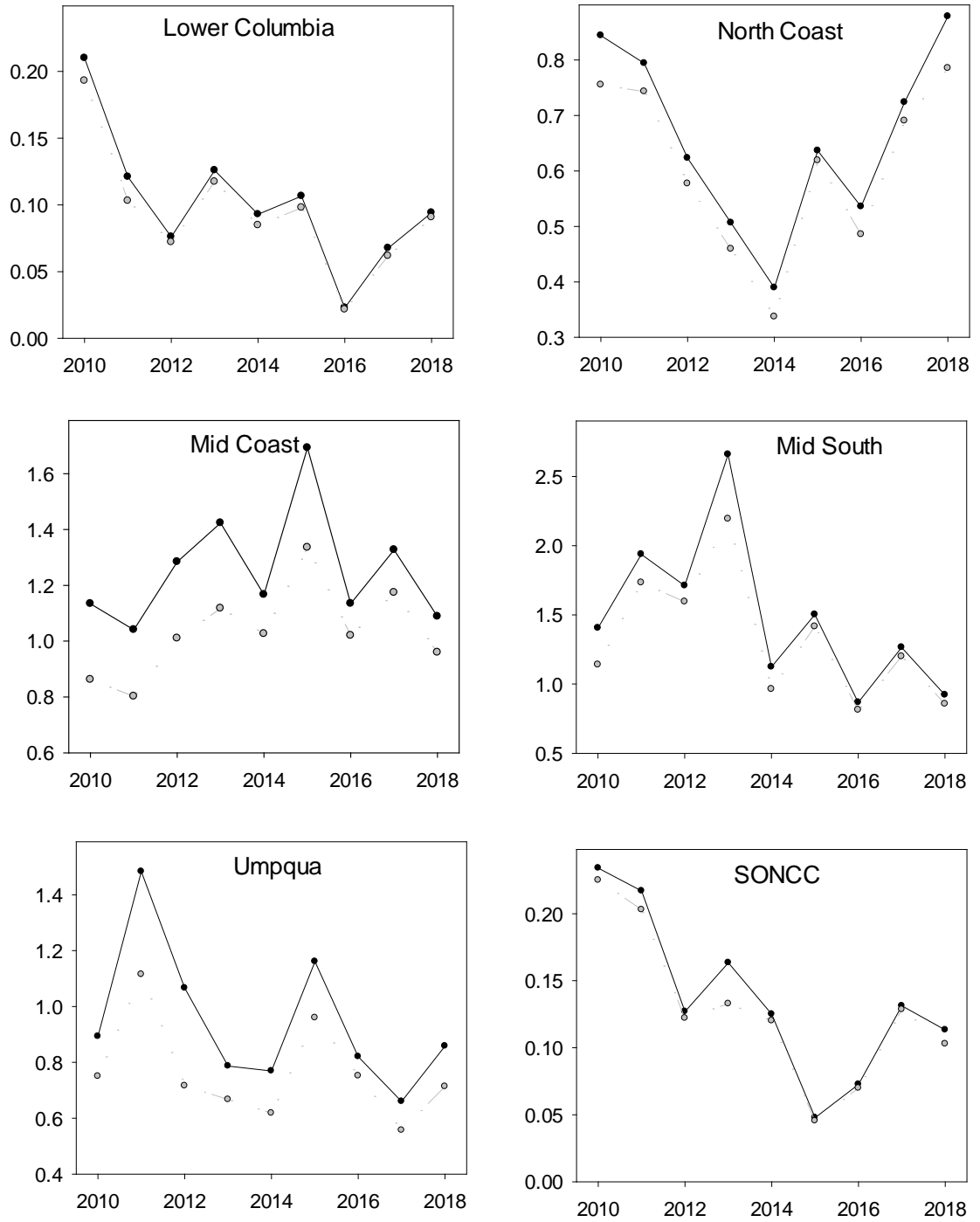


Figure 17. Annual differences in estimates of Coho Salmon parr abundance in western Oregon strata based on snorkel surveys in 1st-3rd order streams using (i) a $\geq 20\text{cm}$ pool depth criterion (solid black line) and (ii) a $\geq 40\text{cm}$ pool depth criterion (dashed gray line). Sample year is on the x-axis and parr abundance is on the y-axis in millions. Note differences in the y-axis scale for each graph.

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APPENDIX 1 COHO 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 Parr Estimates								
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI	Pct Full Seeding	±95% CI
1998	145,399	52%	0.114	43%	54	19%	5	6%
1999	62,609	40%	0.271	44%	64	19%	14	10%
2000	109,165	38%	0.180	54%	76	19%	7	8%
2001	121,385	50%	0.382	41%	58	22%	18	13%
2002	376,199	42%	0.477	34%	80	12%	20	8%
2003	246,644	27%	0.413	29%	74	16%	20	8%
2004	174,880	43%	0.127	43%	70	23%	8	6%
2005	385,386	30%	0.381	32%	81	15%	21	9%
2006	173,821	34%	0.093	42%	67	24%	3	4%
2007	347,176	57%	0.204	39%	84	17%	11	8%
2008	413,449	28%	0.421	43%	71	16%	15	8%
2009	229,648	46%	0.137	40%	70	18%	5	3%
2010	201,274	40%	0.065	39%	56	23%	1	2%
2011	203,452	41%	0.091	43%	60	24%	4	5%
2012	121,781	68%	0.038	53%	25	37%	0	0%
2013	132,795	51%	0.232	86%	39	22%	7	6%
2014	120,085	48%	0.071	49%	42	31%	0	0%
2015	45,308	53%	0.019	66%	28	28%	0	0%
2016	69,839	39%	0.060	42%	32	26%	1	2%
2017	128,445	40%	0.075	40%	40	22%	1	2%
2018	102,816	51%	0.052	54%	42	23%	2	3%

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 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	2%

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 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%

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 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%

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 uncalibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Mid South Coast Stratum Coho 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%

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 Parr 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%

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 uncalibrated 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 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%

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	131,414	45%	0.129	25%	96	3%
2003	93,662	21%	0.078	24%	92	8%
2004	75,819	20%	0.079	24%	97	4%
2005	110,282	22%	0.077	20%	92	8%
2006	84,926	32%	0.066	35%	83	12%
2007	133,121	23%	0.115	30%	91	8%
2008	128,514	33%	0.075	20%	97	5%
2009	128,269	40%	0.069	27%	94	7%
2010	100,053	25%	0.068	27%	94	6%
2011	101,639	26%	0.072	22%	89	8%
2012	127,209	21%	0.043	25%	86	8%
2013	120,995	20%	0.036	18%	86	7%
2014	84,777	26%	0.057	33%	85	11%
2015	46,111	29%	0.025	24%	86	8%
2016	77,062	28%	0.029	25%	69	12%
2017	88,951	21%	0.032	22%	84	8%
2018	63,973	37%	0.021	35%	82	8%

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 expressed 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	21,237	39%	0.127	40%	92	8%
2003	24,260	53%	0.085	38%	86	15%
2004	28,084	42%	0.085	34%	96	7%
2005	52,521	38%	0.089	27%	91	12%
2006	42,503	59%	0.073	48%	77	19%
2007	48,846	34%	0.147	36%	85	14%
2008	60,752	62%	0.085	28%	95	9%
2009	59,163	78%	0.086	33%	92	11%
2010	52,328	43%	0.075	37%	90	11%
2011	48,419	36%	0.089	26%	85	14%
2012	54,911	28%	0.030	40%	83	10%
2013	45,169	24%	0.030	22%	83	9%
2014	45,810	44%	0.061	40%	81	15%
2015	31,081	41%	0.024	32%	81	11%
2016	30,410	44%	0.020	35%	65	16%
2017	16,743	33%	0.023	33%	81	11%
2018	14,176	39%	0.012	39%	77	10%

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 expressed 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	110,177	53%	0.130	32%	100	0%
2003	69,402	22%	0.069	20%	100	0%
2004	47,735	20%	0.068	24%	97	5%
2005	57,761	23%	0.056	20%	94	9%
2006	42,423	25%	0.054	18%	93	9%
2007	84,275	31%	0.058	35%	100	0%
2008	67,762	26%	0.060	24%	100	0%
2009	69,107	39%	0.043	36%	97	5%
2010	47,726	21%	0.056	24%	100	0%
2011	53,220	33%	0.042	25%	97	5%
2012	72,298	30%	0.081	26%	96	7%
2013	75,826	29%	0.054	27%	97	5%
2014	38,967	36%	0.043	23%	100	0%
2015	15,030	31%	0.027	23%	100	0%
2016	46,652	39%	0.060	35%	85	13%
2017	72,208	24%	0.060	26%	92	10%
2018	49,797	46%	0.050	53%	96	6%

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%

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 uncalibrated 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%

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 uncalibrated 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%



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