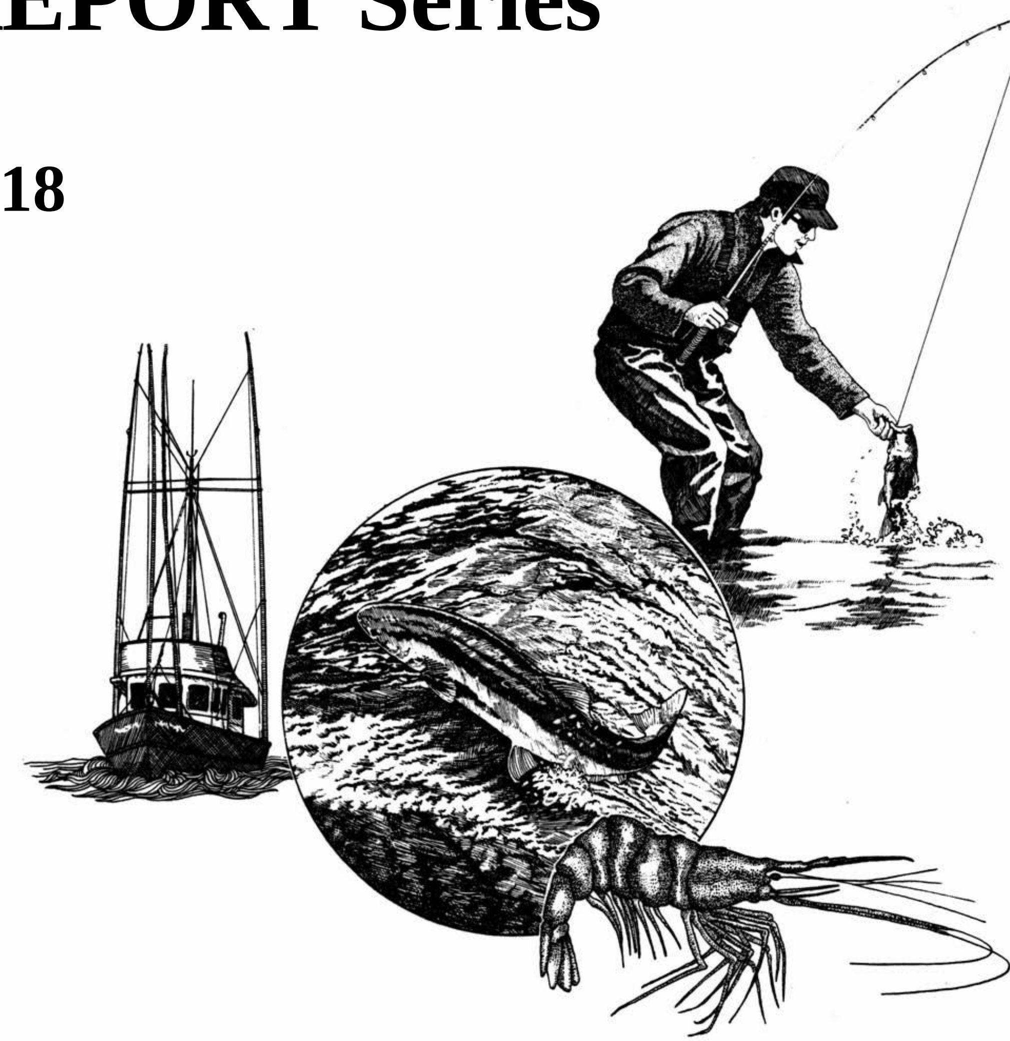
# ODFW PROGRESS REPORT Series

## 2018



## Oregon Department of Fish and Wildlife

*Juvenile Salmonid Monitoring in Coastal Oregon and Lower Columbia Streams, 2017 Field Season*

*Annual Monitoring Report No. OPSW-ODFW-2018-1*

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ANNUAL PROGRESS REPORT
FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Juvenile Salmonid Monitoring in Coastal Oregon and Lower Columbia Streams, 2017 Field Season

PROJECT NUMBER: OPSW-ODFW-2018-1

PROJECT PERIOD: 2017

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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 salmonid distribution and abundance, which inform conservation and recovery decisions. The analysis in this report spans the years 1998-2017. 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 2017 abundance estimate was 128,000 parr. This nearly doubled the 2016 estimate and nearly tripled the 2015 estimate but was low, relative to the average from all years. Abundance was highest from 2007-2009 and lowest from 1998-2000 and 2013-2017. Site occupancy improved from an average of 33% during 2012-2016 to 40% in 2017, but occupancies for these years were below the 1998-2011 average.

Oregon Coast Coho (OCC) ESU: The 2017 abundance estimate was 3.6 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 2017. This has been the average since 2000, after improving from the relatively low estimates in 1998-1999.

Lower Columbia River (LCR) ESU: The 2017 abundance estimate was 62,000 parr, nearly tripling the 2016 estimate. LCR parr abundance estimates were highest from 2007-2009 and lowest from 2016-2017. Site occupancy was 39%; an increase from the low of 24% in 2016, but below average for the ESU.

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. Adult data was insufficient to perform these analyses in the SONCC.

Steelhead

Klamath Mountains Provence (KMP) DPS: Abundance estimates averaged 74,000 parr from 2014-2017. This was low compared to the average for the DPS. Site occupancy averaged 81% from 2014-2017. This was low compared to the average from 2002-2005 and similar compared to the average from 2006-2013.

Oregon Coast (OC) DPS: Abundance estimates averaged 243,000 parr from 2014-2017, which was average for the DPS. Site occupancy averaged 77% from 2014-2017 and was similar relative to the average from 2002-2014.

Lower Columbia River (LCR) DPS: Abundance estimates averaged 6,700 parr from 2014-2017, which was low compared to the average for all years. Site occupancy was stable, averaging 61% from 2014-2017 and 66% from 2006-2013.

South West Washington (SWW) DPS: Abundance estimates averaged 8,600 from 2014-2017 with a degree of variation that prevented the detection of a trend. Site occupancy declined from an average of 77% during 2010-2013 to an average of 55% during 2014-2017.

## BACKGROUND AND METHODS

This project was initiated by Oregon Department of Fish and Wildlife (ODFW) in 1998 as part of larger monitoring program supporting the Oregon Plan for Salmon and Watersheds (State of Oregon 1997). The primary objective of the project is to inform conservation and recovery decisions related to Coho Salmon (*Oncorhynchus kisutch*) by providing data on 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 1$^{st}$-3$^{rd}$ order streams within the putative summer rearing distribution of Coho Salmon in the Oregon Coast Coho (OCC) and Southern Oregon Northern California Coho (SONCC) Evolutionarily Significant Units (ESUs) (Figure 1). In 2002 the sampling frame was expanded to include both (*i*) 4$^{th}$-6$^{th}$ order streams within the rearing distribution of Coho Salmon in these ESUs and (*ii*) 1$^{st}$-6$^{th}$ order streams within the rearing distribution juvenile steelhead (*Oncorhynchus mykiss*) in in the Klamath Mountain Province (KMP) and Oregon Coast (OC) Distinct Population Segments (DPS). In 2006, 1$^{st}$-6$^{th}$ 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 4$^{th}$-6$^{th}$ order streams were phased out by 2013. Analyses for all years and in all ESUs/DPSs are now based on data from 1$^{st}$-3$^{rd}$ order streams.

The scale of the sampling frame has changed over time. The original sampling frame was based on a 100k stream layer. The 100k layer was replaced by a 24k layer in 2007. The 24k layer refined and expanded the rearing distribution in the original frame. 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 SONCC. Until the 2012 (24k) frame is corroborated by field surveys, analyses in the SONCC/KMP will be based on the assumed 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 sample sites in a spatially balanced, random fashion from our sampling frame. Selected sample sites were surveyed by field crews using daytime snorkeling during the base flow period (mid-July to mid-October). Sample 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 sample site and proceeded upstream (Thurow 1994). The length of the sample site, and the length and average width of pools within the sample 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 ≥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 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 sample sites were resurveyed by supervisory staff.

Initially only 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, 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 ≥40cm maximum depth criterion and a secondary analysis of data based on pools meeting the ≥20cm maximum depth criterion.

From 1998-2016, sample 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 sample site for steelhead and cutthroat. Abundance was not estimated at these sample sites. Following the 2016 field season our electrofishing protocols were evaluated and, due to the small percentage (<6%) of sample sites electrofished and the limitations of the data relative to its cost and effort, electrofishing was discontinued in 2017.

Our sampling objective for Coho Salmon is to produce abundance estimates with 95% confidence intervals ≤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 sample 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, 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 sample sites where the target species was observed; calculated by dividing the number of sample sites where the target species was observed by the number of sampled sites that were surveyed for each stratum, ESU, or DPS.

- Pool frequency: The average percent of pools in a sample site that contain the target species. Pool frequency was first calculated at each sample 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 sample 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 sample site by averaging the pool densities within the sample site. Lastly, density was estimated for each stratum, ESU, and DPS by averaging the site densities within each respective region.

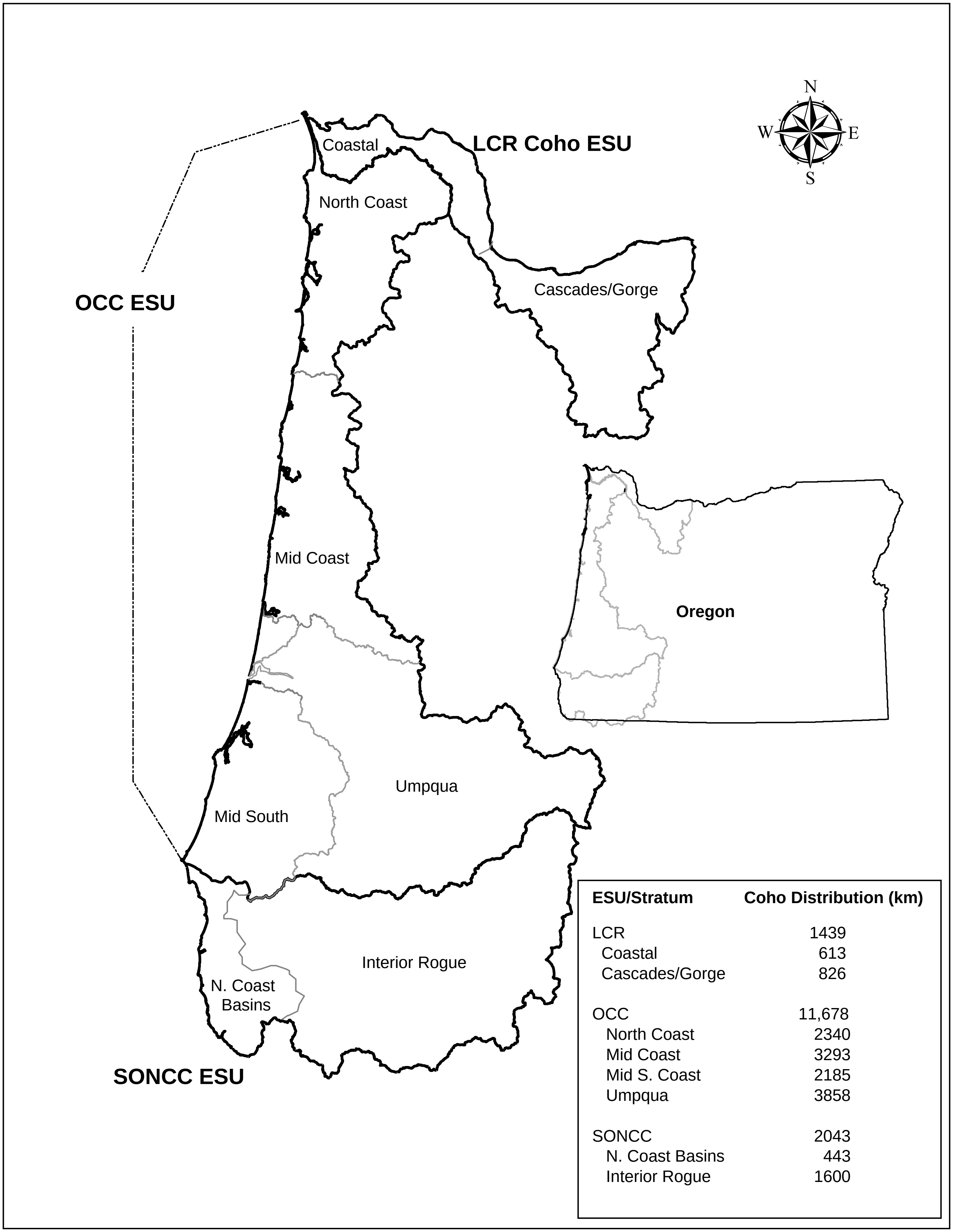
- Abundance: The estimate of the number of individuals of each target species in pools that met sampling criteria for each stratum, ESU, or DPS. Abundance was calculated by multiplying the count of target species individuals per kilometer at each sample site by the sample site weight. Target species individuals per kilometer is the sum of the snorkel count at the sample site divided by the length (in km) of the sample site. Sample site weight is the total length of the rearing distribution in the stratum, ESU, or DPS divided by the number of surveyed sample sites in the area. The sample site weight is adjusted for sample sites that were non-target, i.e. sample 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 sample sites within a stratum or ESU with a site density $\geq$0.7 Coho Salmon/$m^2$. This value is regarded as full seeding following Nickelson et al. (1992) and Rodgers et al. (1992). Nickelson et al. estimate full seeding to be 1.0 coho/$m^2$ 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 2017 field season, there are now 20 years of monitoring data for juvenile Coho Salmon in the OCC and SONCC. To compare metrics across this time span, we partitioned the first 18 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 six successive brood groups from 1998-2015. Monitoring data from 2016 and 2017 were analyzed as a partial 7$^{th}$ brood group in this report. 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. The Lower Columbia River Coho Salmon data was partitioned following the 2015 field season, resulting in three successive brood groups from 2007-2015. The 2016 and 2017 data were analyzed as a fourth, partial brood group. Steelhead data in the LCR and SWW were partitioned into three successive brood groups from 2006-2017.

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, as opposed 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).




| 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 | 2043 |
| N. Coast Basins | 443 |
| Interior Rogue | 1600 |

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
## 2017 Survey Effort and Resurveys

In 2017, 541 sample sites were selected by the GRTS process. Thirty-seven of these were determined to be non-target (beyond the potential rearing distribution of Coho Salmon and steelhead). Of the remaining 504 sample sites, 184 were not surveyed because of landowner access restrictions (99), visibility or water quality issues (27), unsafe or difficult access (29), or time restrictions (29). Sample sites that were not surveyed were defined as target, non-response. A total of 320 sample sites were snorkeled, comprising 4,355 pools in 316.9 km of streams.

We met our goals for survey effort in the North Coast, Mid Coast, and Cascades/Gorge strata (Table 1). Both the Interior Rogue stratum and the Coast stratum of the LCR had a high proportion of sample sites that were dry or where access was denied by landowners. Lack of visibility accounted for the high number of sample sites that could not be surveyed in the LCR. The 191,000 acre Chetco Bar wildfire and resulting closure prevented surveying in a large portion of the North Coast Basins stratum.

Table 1. Survey effort goals and status of sample sites for 2017.

| ESU | Stratum | Survey Goal | Snorkeled | Target -Non response | Non-Target |
|---|---|---|---|---|---|
| OCC | North Coast | 40 | 40 | 19 | 1 |
| | Mid Coast | 40 | 45 | 15 | 0 |
| | Mid-South Coast | 40 | 37 | 18 | 2 |
| | Umpqua | 40 | 37 | 20 | 3 |
| LCR | Coast | 40 | 38 | 24 | 3 |
| | Cascades/Gorge | 40 | 40 | 28 | 12 |
| SONCC | Interior Rogue | 60 | 54 | 37 | 13 |
| | N. Coast Basins | 40 | 29 | 23 | 3 |

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

Thirty-two (10%) of the snorkeled sample sites were resurveyed by supervisory staff. Six of the resurveys were used as an extension of training for less experienced crew members and were not used to examine the precision of our methodology. Counts of Coho Salmon in the remaining 26 sites had a significant relationship with counts from the resurveys (Figure 2, top left panel, $R^2$ = 0.991). These results were similar to previous years (bottom left panel, $R^2$ = 0.964) 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, $R^2$ = 0.945) relative to previous years (bottom right panel, $R^2$ = 0.780).

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 2017.

| | Distribution | | | Density | | |
|---|---|---|---|---|---|---|
| Stratum or ESU | 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 | 80% | 71% | ± 16% | 3% | 0.225 | ± 24% |
| Mid Coast | 89% | 81% | ± 10% | 7% | 0.318 | ± 33% |
| Mid-South Coast | 84% | 74% | ± 14% | 14% | 0.329 | ± 23% |
| Umpqua | 70% | 57% | ± 19% | 3% | 0.164 | ± 31% |
| SONCC | 40% | 31% | ± 24% | 1% | 0.075 | ± 40% |
| LCR | 39% | 22% | ± 23% | 1% | 0.050 | ± 42% |

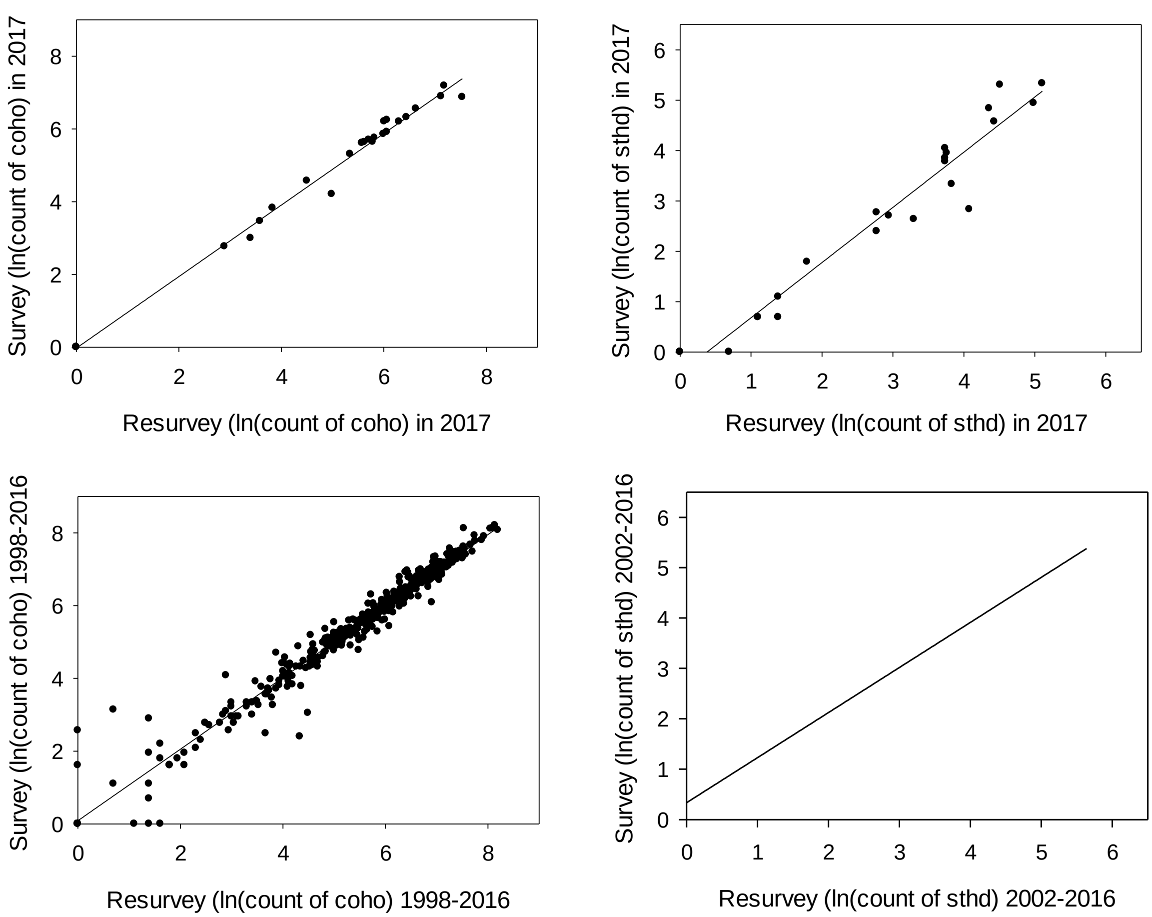



Figure 2. The relationship of Coho Salmon parr and steelhead (≥90mm in fork length) parr counts from surveys and resurveys of the same sampling sites for 2017 (top panels, n = 26) and for all years (bottom panels, n = 470 for Coho Salmon and n= 416 for steelhead, respectively). Data are log transformed 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 2016 to 2017. The 2017 abundance estimate was 128,000 parr. This nearly doubled the 2016 estimate and nearly tripled the 2015 estimate, but was low compared to the average abundance for all years. Abundance estimates for the 2016-2017 partial brood group were similar to those for the 1998-2000 and 2103-2015 brood groups, but low relative to those in the remaining brood groups (Figure 3). Site occupancy improved from an average of 30% for 2015-2016 to 40% in 2017, but was low relative to estimates for the 1998-2009 brood groups (Figure 4).

*OCC.*─ Density and the number of sites fully seeded in the ESU were similar from 2016 to 2017. The 2017 abundance estimate in the ESU was 3.6 million parr. Parr abundance has remained between 2.9 and 4.9 million since 2000, after improving from an average of 910,000 from 1998-1999. Abundance estimates for the 2016-2017 partial brood group were similar to those for the 2001-2015 brood groups and high relative to those for the 1998-2000 brood group. Site occupancy was 80% for 2017. Since 2008, site occupancy in the ESU has met a NMFS recovery criterion (Wainwright et al., 2008) of ≥80% of sites occupied. Site occupancy for the 2016-2017 partial brood group was high relative to estimates for the 1998-2003 brood groups and similar to estimates for the remaining brood groups.

In the OCC strata, CDF curves (based on density) were low for 2017 relative to the average from 1998-2016 in the North Coast, Mid South Coast, and Umpqua (Figure 5). In the Mid Coast the CDF curve for 2017 was similar to the curve for the average from 1998-2016. Abundance estimates in the Mid Coast for the 2016-2017 partial brood group were low compared to those for the 2013-2015 brood group (Figure 6). Abundance estimates in the remaining OCC strata for the 2016-2017 partial brood groups were similar to those for the 2013-2015 brood groups. Site occupancy estimates in the OCC strata for the 2016-2017 partial 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 64 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 2$^{nd}$ 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 et al., in prep.). 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/$m^2$) 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.

*LCR.*— Density estimates and the number of sites fully seeded were high for 2017 relative to 2016, but <2% of the sites were fully seeded in these years. The 2017 abundance estimate was 62,000 parr. Although this nearly tripled the estimate from 2016, the average abundance from 2016-2017 was less than half (44%) of the average abundance from 2006-2015. Abundance estimates for the 2016-2017 partial brood group were low relative to those for the 2006-2015 brood groups. Spawner abundances (see http://odfw.forestry.oregonstate.edu/spawn/cohoabund.htm) have been below average in the LCR for brood years 2015 and 2016, which likely contributed to the relatively low parr abundance estimates in ESU for 2016 and 2017. Site occupancy for 2017 was 39%; an increase from the low of 24% in 2016, but below the average from 2006-2016. Site occupancy for the 2016-2017 partial 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 54% 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 (spawners/km) in the LCR that average 38% of those in the OCC strata.

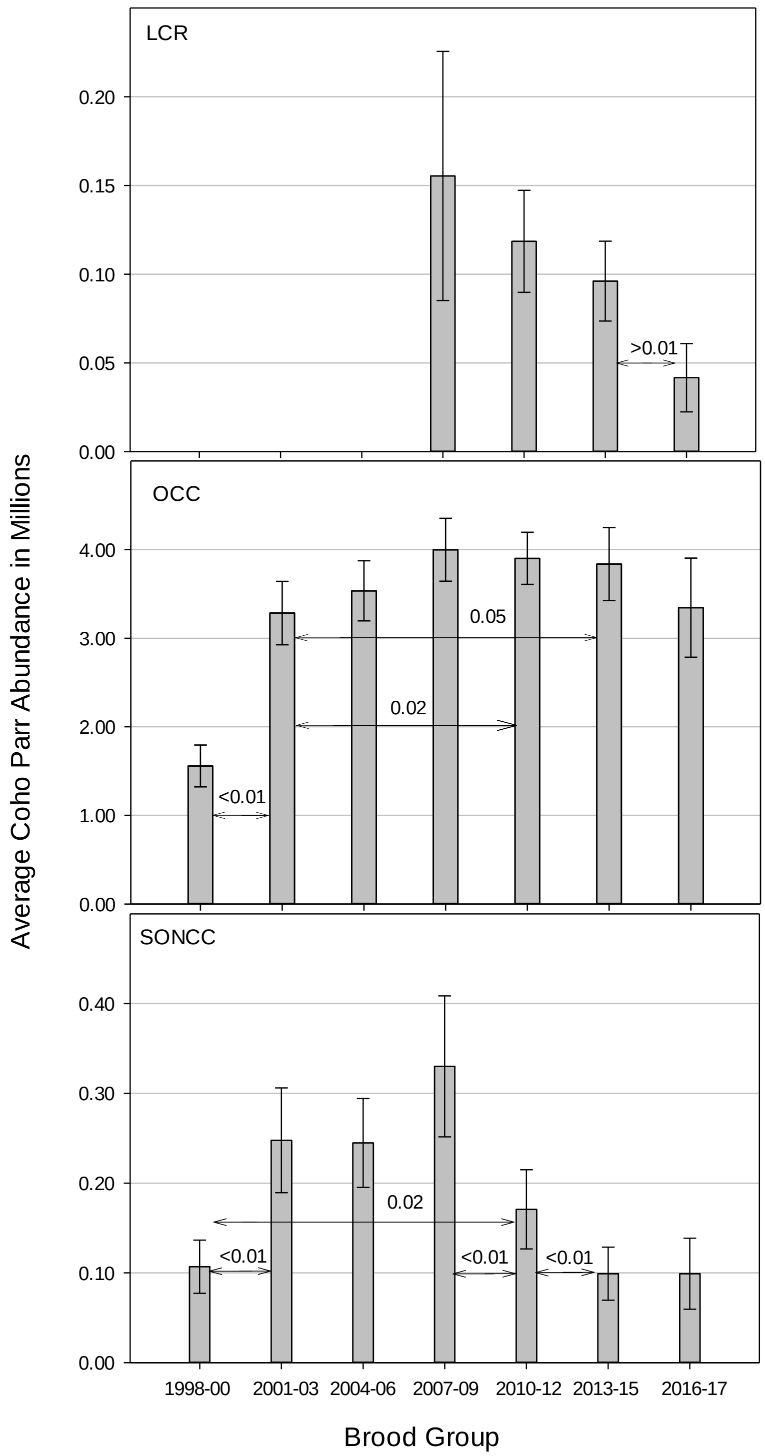



Figure 3. Three year (brood group) trends of Coho Salmon parr abundance estimates in the three western Oregon Coho ESUs, based on snorkel surveys in 1$^{st}$-3$^{rd}$ order streams for the years 1998-2017. The 2016-2017 data are presented as a partial brood group. Gray bars and error bars show the abundance 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.

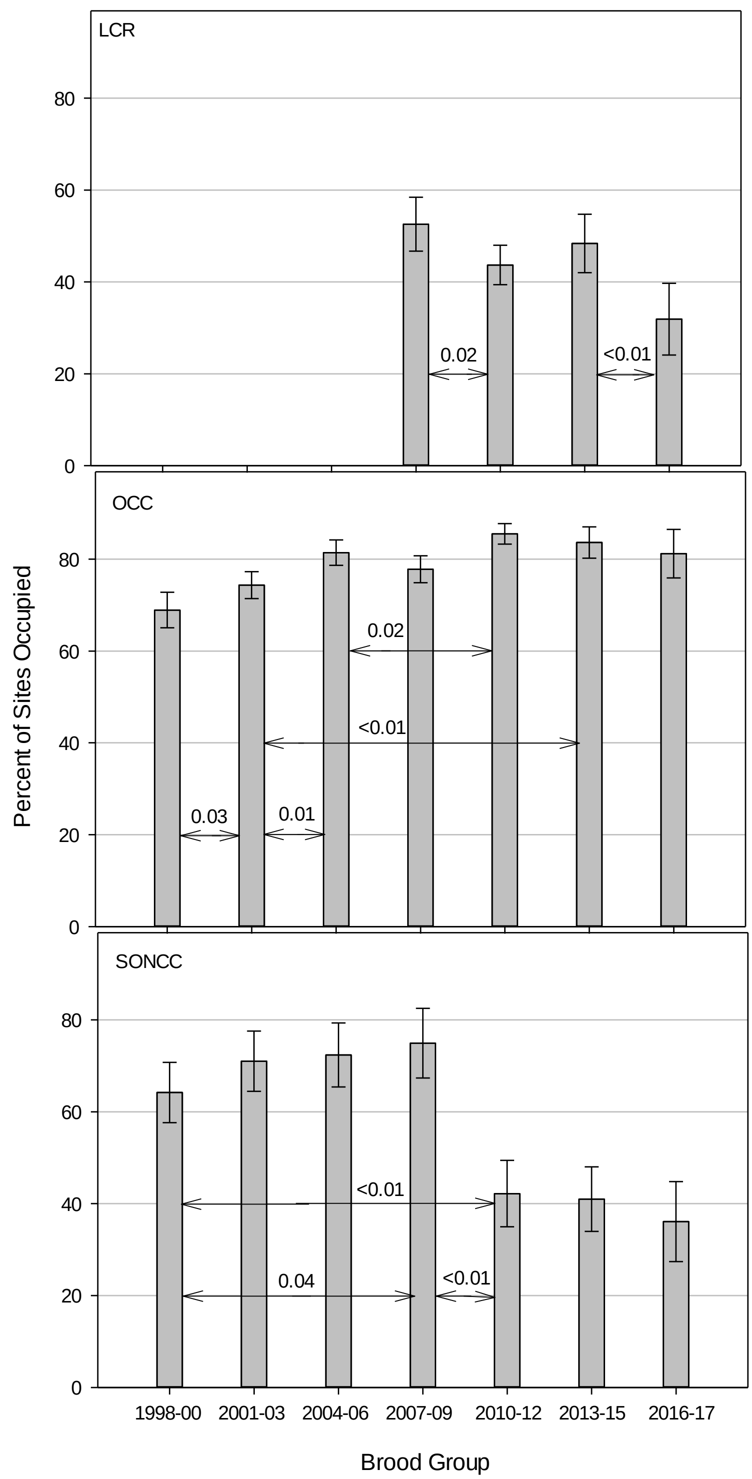



Figure 4. Three year (brood group) trends of Coho Salmon parr site occupancy in the three western Oregon Coho ESUs based on snorkel surveys in 1st-3rd order streams for the years 1998-2017. The 2016-2017 data are presented as a partial brood group. Gray bars and error bars show the percent of sites occupied with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where p ≤ 0.05.

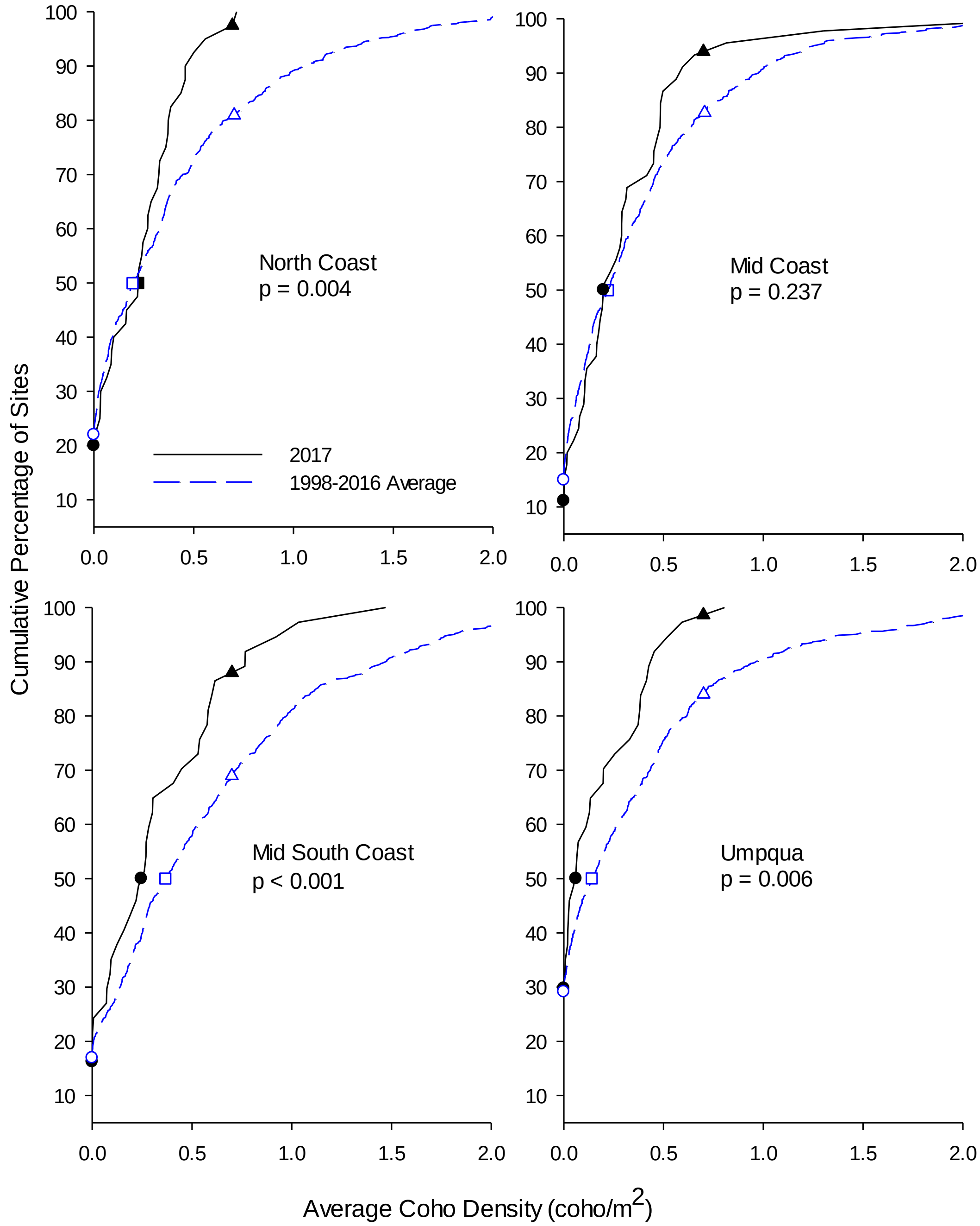



Figure 5. Average Coho Salmon parr density CDFs based on snorkel surveys in 1st-3rd order streams in the four strata of the Oregon Coast Coho ESU for survey years 1998-2017. The points shown on the curves are the percentage of unoccupied sites (circles), the median density (squares), and the percentage 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 2017 (black, solid line). P values are from the comparison test of the two curves.

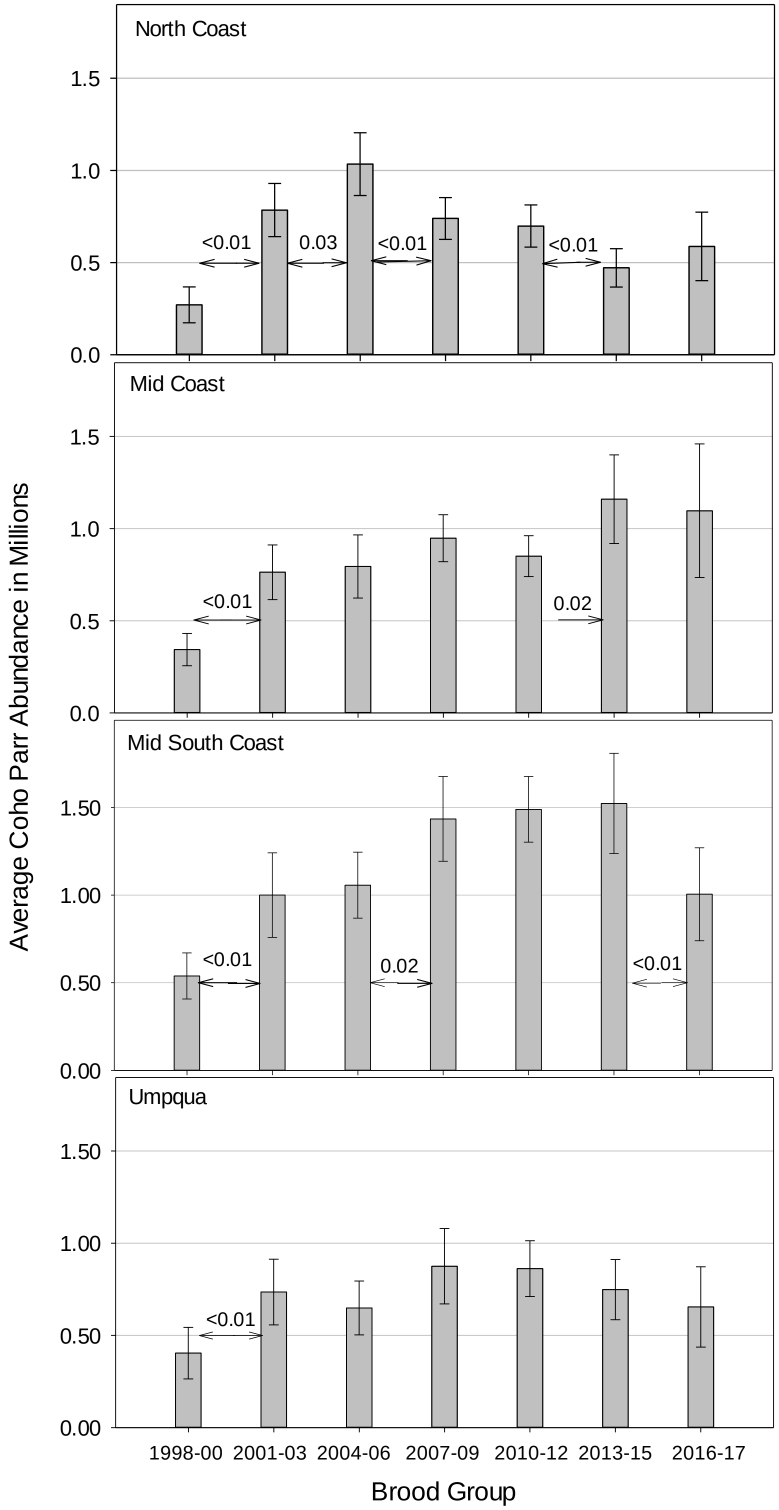



Figure 6. Three year (brood group) trends of Coho Salmon parr abundance estimates in the four strata of the Oregon Coast Coho ESU, based on snorkel surveys in $1^{st}$-$3^{rd}$ order streams for the years 1998-2017. The 2016-2017 data are presented as a partial brood group. Gray bars and error bars show the abundance estimate with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where p ≤ 0.05.

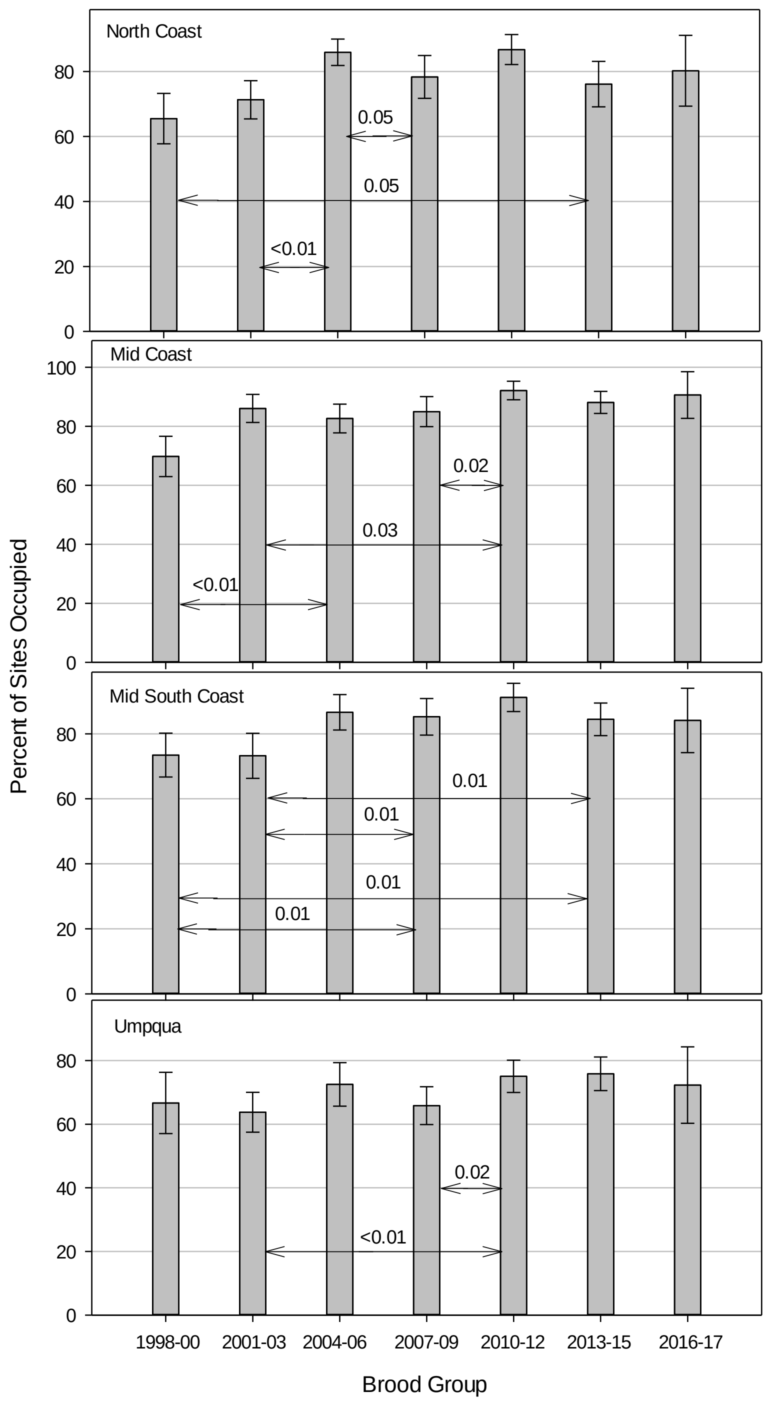



Figure 7. Three year (brood group) trends of Coho Salmon parr site occupancy in the four strata of the Oregon Coast Coho ESU, based on snorkel surveys in 1st-3rd order streams for the years 1998-2017. The 2016-2017 data are presented as a partial brood group. Gray bars and error bars show the percent of sites occupied with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$.

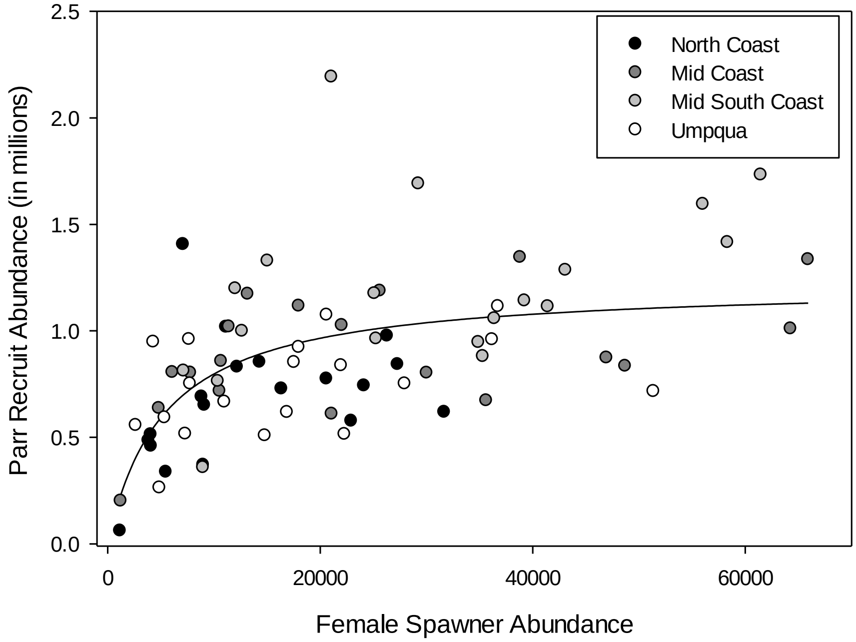



Figure 8. A Beverton-Holt model showing the relationship between the abundance of Coho Salmon parr recruits and female spawners in the strata of the Oregon Coast Coho ESU for brood years 1998-2016. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Female spawner abundance is from spawning ground surveys.

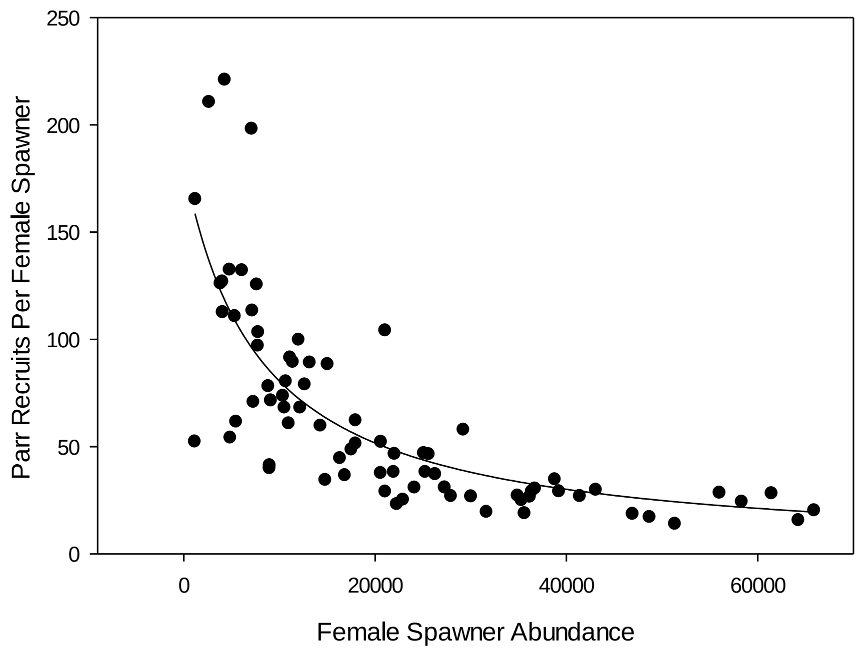



Figure 9. The relationship between the abundance of Coho Salmon female spawners and the number of parr recruits per female spawner in the Oregon Coast Coho ESU for brood years 1998-2016. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground surveys.

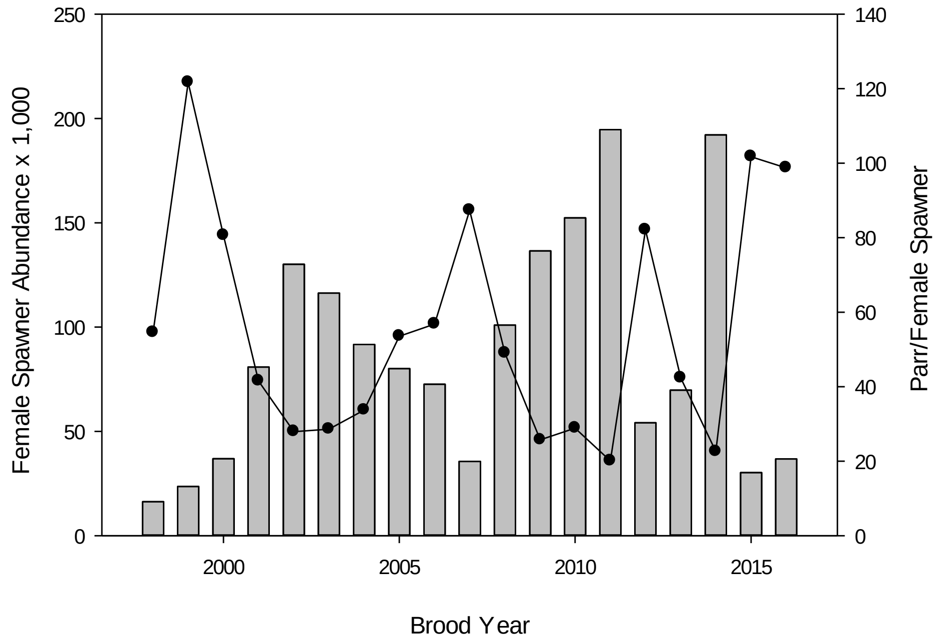



Figure 10. The abundance of Coho Salmon female spawners (gray bars) and the number of parr recruits per female spawner (black dots and line) over time in the Oregon Coast Coho ESU. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground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

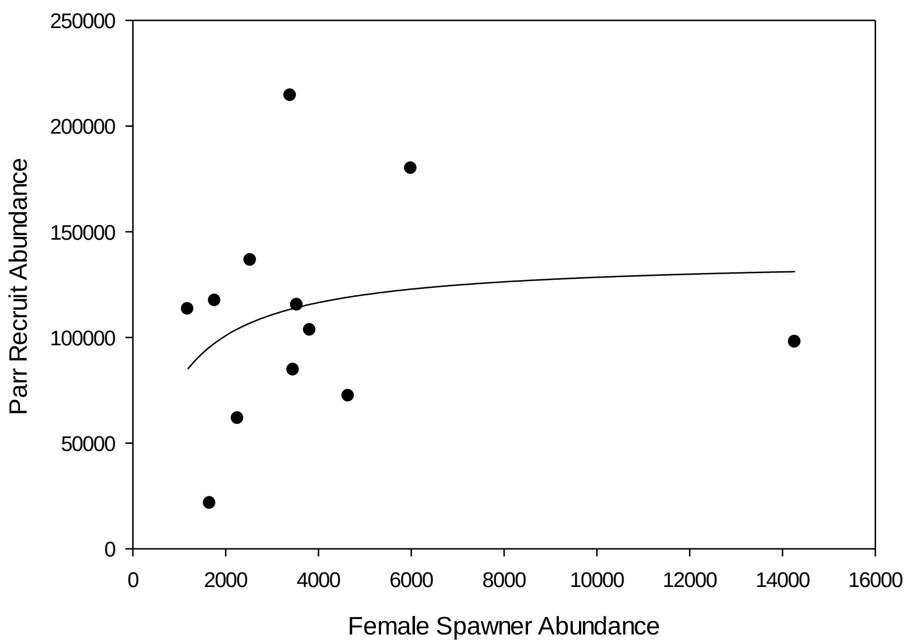



Figure 11. A Beverton-Holt model showing the relationship between the abundance of Coho Salmon parr recruits and female spawners in the Lower Columbia River ESU for brood years 2005-2016. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Female spawner abundance is from spawning ground surveys.

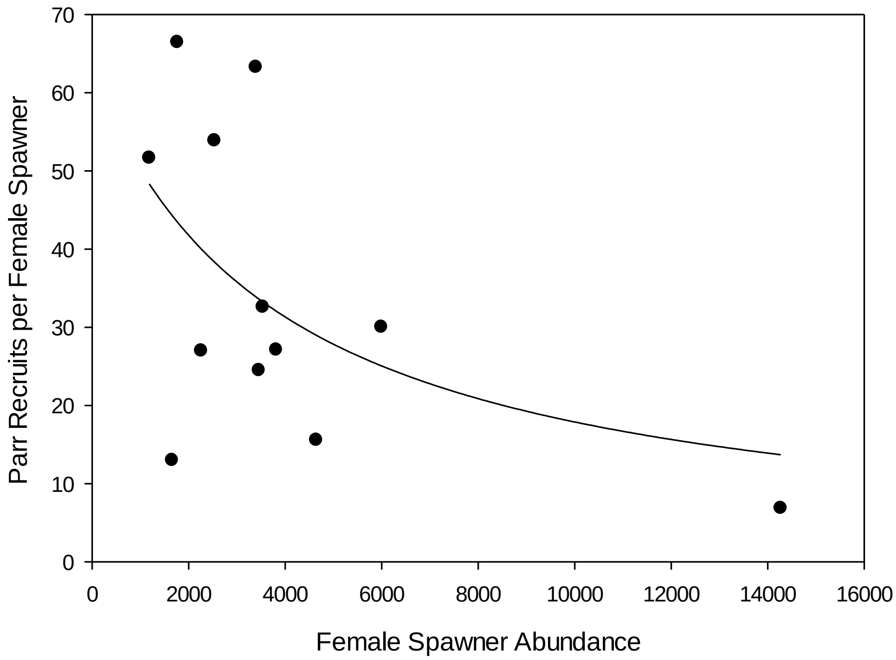



Figure 12. The relationship between the abundance of Coho Salmon female spawners and the number of parr recruits per female spawner in the Lower Columbia River ESU for brood years 2005-2016. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground surveys.

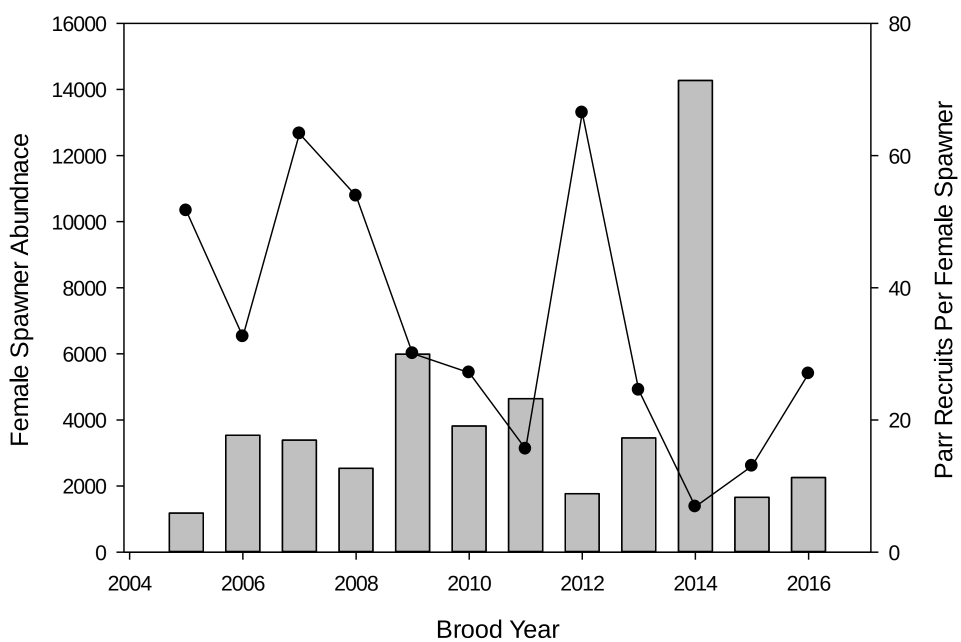



Figure 13. The abundance of Coho Salmon female spawners (gray bars) and the number of parr recruits per female spawner (black dots and line) over time in the Lower Columbia River ESU. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground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

***Steelhead***

*KMP.*— Density (Table 3) was similar from 2016 to 2017. The 2017 abundance estimate was 89,000 parr. Three of the four lowest abundance estimates were observed in the 2014-2017 brood group and abundance estimates were low for the 2014-2017 brood group relative to those for the 2010-2013 brood group (Figure 14). The 2017 site occupancy estimate was 84%. Site occupancy estimates for the 2014-2017 brood group were similar to those for the 2010-2013 brood group (Figure 15).

*OC.*— Density was similar from 2016 to 2017. The 2017 abundance estimate was 313,000 parr, which is the highest point estimate observed for the DPS since the start of our monitoring. Abundance estimates for the 2014-2017 brood group were similar to those for the previous brood groups. The 2017 site occupancy was 84%. Site occupancy estimates for the 2014-2017 brood group were similar to those for the 2010-2013 brood group.

*LCR.*— Density estimates for 2017 were similar to the 2016 estimates. The 2017 abundance estimate was 9,000 parr. Abundance estimates were lower for the 2014-2017 brood group relative to those for the 2010-2013 and 2006-2009 brood groups. The 2017 site occupancy estimate was 60%, which was high relative to the estimate from 2016 but similar to the average estimate for 2006-2016. Site occupancy estimates for the 2014-2017 brood group were similar to those for the previous brood groups.

*SWW.*— The density estimate for 2017 in the SWW was low relative to 2016. The 2017 abundance estimate was 2,000 parr. This was <10% of the estimate from 2016, but similar to the estimate from 2015. Four of the five lowest abundance estimates for the DPS have been observed in the last 5 years, but 95% confidence intervals that averaged 56% of the estimates have made comparisons among brood groups difficult. The 2017 site occupancy estimate was 42%. Site occupancies were at their lowest points in 2015 and 2017 and the estimates for the 2014-2017 brood group were low relative to those for the 2010-2013 brood group.

Table 3. Distribution and density estimates for juvenile steelhead (≥90cm in fork length) in the four strata of the Oregon Coast Steelhead DPS, based on snorkel surveys in 1st-3rd order streams for 2017.

| Stratum | Distribution | | | Density | |
|---|---|---|---|---|---|
| | Site Occupancy | Mean Pool Frequency | 95% CI | Mean Average Pool Density (sthd/$m^2$) | 95% CI |
| North Coast | 83% | 46% | ± 15% | 0.026 | ± 24% |
| Mid Coast | 89% | 41% | ± 18% | 0.026 | ± 32% |
| Mid-South | 92% | 52% | ± 14% | 0.020 | ± 34% |
| Umpqua | 76% | 36% | ± 24% | 0.013 | ± 33% |
| KMP Rogue | 81% | 35% | ± 17% | 0.023 | ± 33% |
| KMP South Coast | 92% | 80% | ± 13% | 0.060 | ± 26% |
| Lower Columbia | 60% | 24% | ± 31% | 0.013 | ± 67% |
| Southwest WA | 42% | 13% | ± 36% | 0.004 | ± 53% |

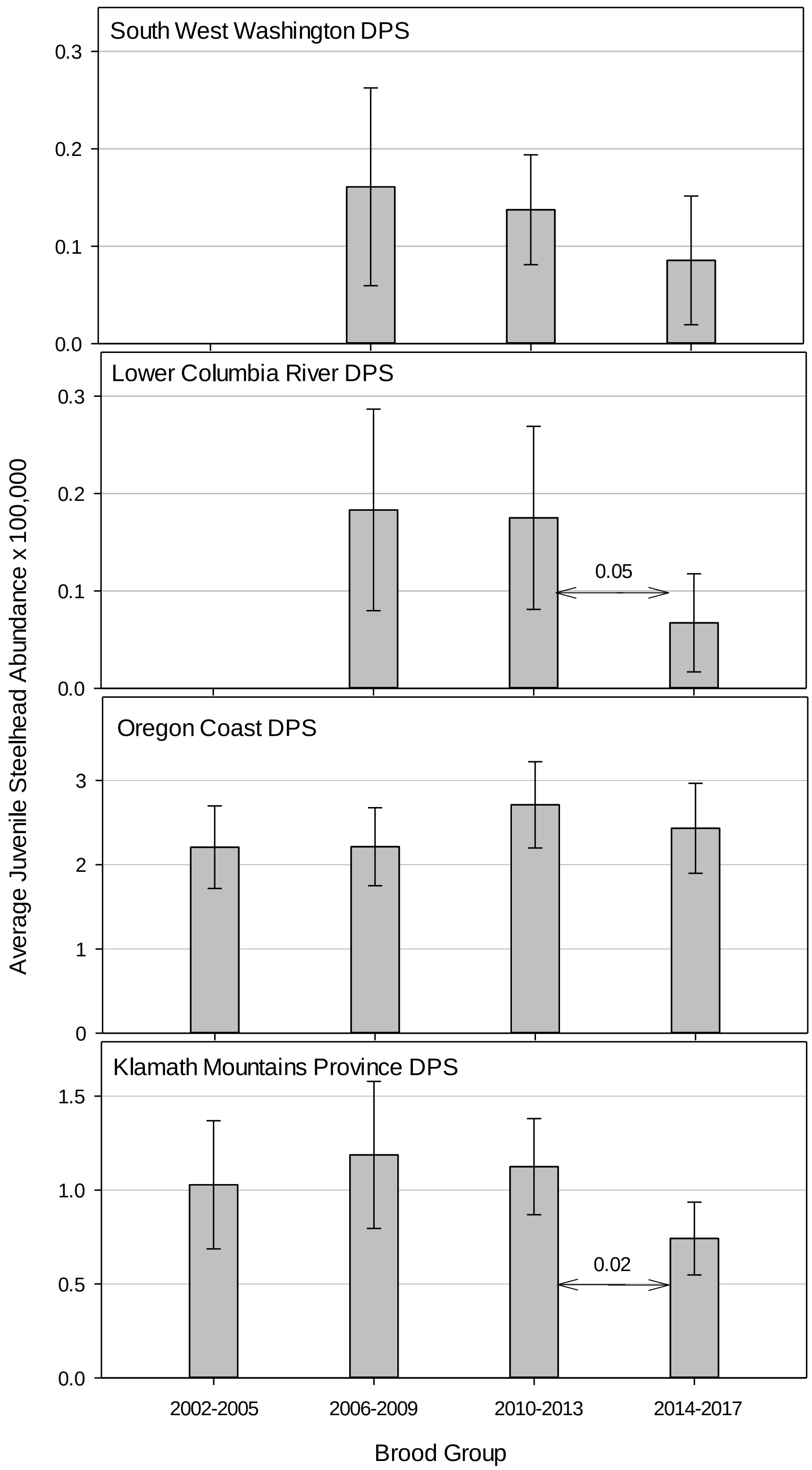



Figure 14. Four year (brood group) trends of juvenile steelhead (≥90cm in fork length) abundance estimates in the four western Oregon DPSs, based on snorkel surveys in 1st-3rd order streams for years 2002-2017. Gray bars and error bars show the abundance estimate with the 95% CI for the brood group. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$

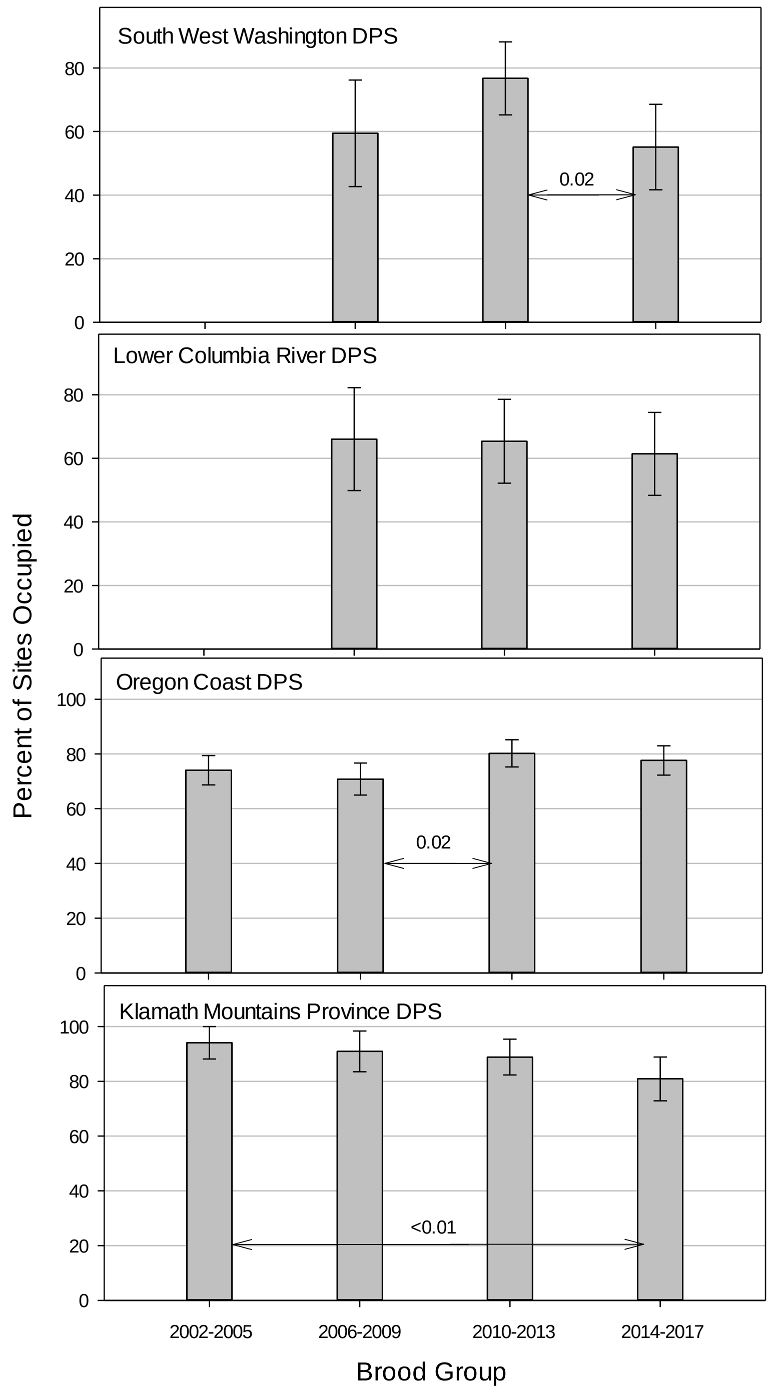



Figure 15. Four Year (brood group) trends of juvenile steelhead (≥90cm in fork length) site occupancy in four western Oregon DPS, based on snorkel surveys in 1st-3rd order streams for years 2002-2017. Gray bars and error bars show the percent of sites occupied with the 95%CI for each brood group. P-values 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 ≥40cm 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 ≥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 from 31-61% for Coho Salmon and from 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 lower criterion allowed an additional 861 pools (a 20% increase) to be surveyed in 2017. Six survey sites in 2017 did not have pools that were ≥40cm in maximum depth, but did have pools that were ≥20cm in maximum depth. Coho Salmon and/or steelhead were not observed in these survey sites, but this improved our survey effort over the results presented in Table 1. Additionally, there were five survey sites that contained pools that were ≥40cm in maximum depth, but where Coho Salmon and steelhead were only observed in pools that were <40cm in maximum depth. These changed site occupancy estimates. For Coho Salmon, site occupancy estimates decreased by <1% in LCR and OCC over those given in Table 2. For steelhead, site occupancy estimates increased by 2% in the SWW, 7% in the LCR, and 1% in the OC over those given in Table 3.

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 <40cm in maximum depth. From 2010-2015 and in 2017 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 2017 from pools ≥40cm and pools ≥20cm 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. 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). Results from resurveys indicate the lower criterion had little impact on the precision of Coho Salmon and steelhead counts between surveyors. The yearly variability for Coho Salmon abundance in each stratum and ESU estimated by surveys in pools ≥40cm in depth has tracked with the variability estimated by surveys in pools ≥20cm in depth (Figure 16).

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 | 2017 Coho Estimates | | | | |
|---|---|---|---|---|---|
| | Pools ≥ 20cm Max Depth | | Pools ≥40cm Max Depth | | 95% CI Difference |
| | Estimate | 95% CI | Estimate | 95% CI | |
| North Coast | 723,608 | 30% | 690211 | 30% | 0.8% |
| Mid Coast | 1,327,436 | 33% | 1,173,889 | 35% | 1.5% |
| Mid-South Coast | 1,264,794 | 24% | 1,198,942 | 25% | 1.2% |
| Umpqua | 660,162 | 39% | 556,851 | 45% | 6.6% |
| SONCC | 131,240 | 40% | 128,445 | 43% | 3.4% |
| Lower Columbia | 67,5760 | 40% | 61,780 | 40% | 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 | 2017 Steelhead Estimates | | | | |
|---|---|---|---|---|---|
| | Pools ≥ 20cm Max Depth | | Pools ≥ 40cm Max Depth | | 95% CI Difference |
| | Estimate | 95% CI | Estimate | 95% CI | |
| North Coast | 84,938 | 32% | 82,636 | 33% | 1.1% |
| Mid Coast | 93,503 | 35% | 88,425 | 37% | 1.6% |
| Mid-South Coast | 68,043 | 37% | 67,770 | 39% | 1.3% |
| Umpqua | 78,735 | 49% | 74,476 | 51% | 2.7% |
| KMP Rogue | 17,373 | 33% | 16,743 | 33% | 0.2% |
| KMP South Coast | 74,428 | 23% | 72,207 | 24% | 1.3% |
| Lower Columbia DPS | 8,534 | 87% | 8,870 | 88% | 0.9% |
| Southwest WA DPS | 2,104 | 40% | 2,026 | 42% | 1.5% |

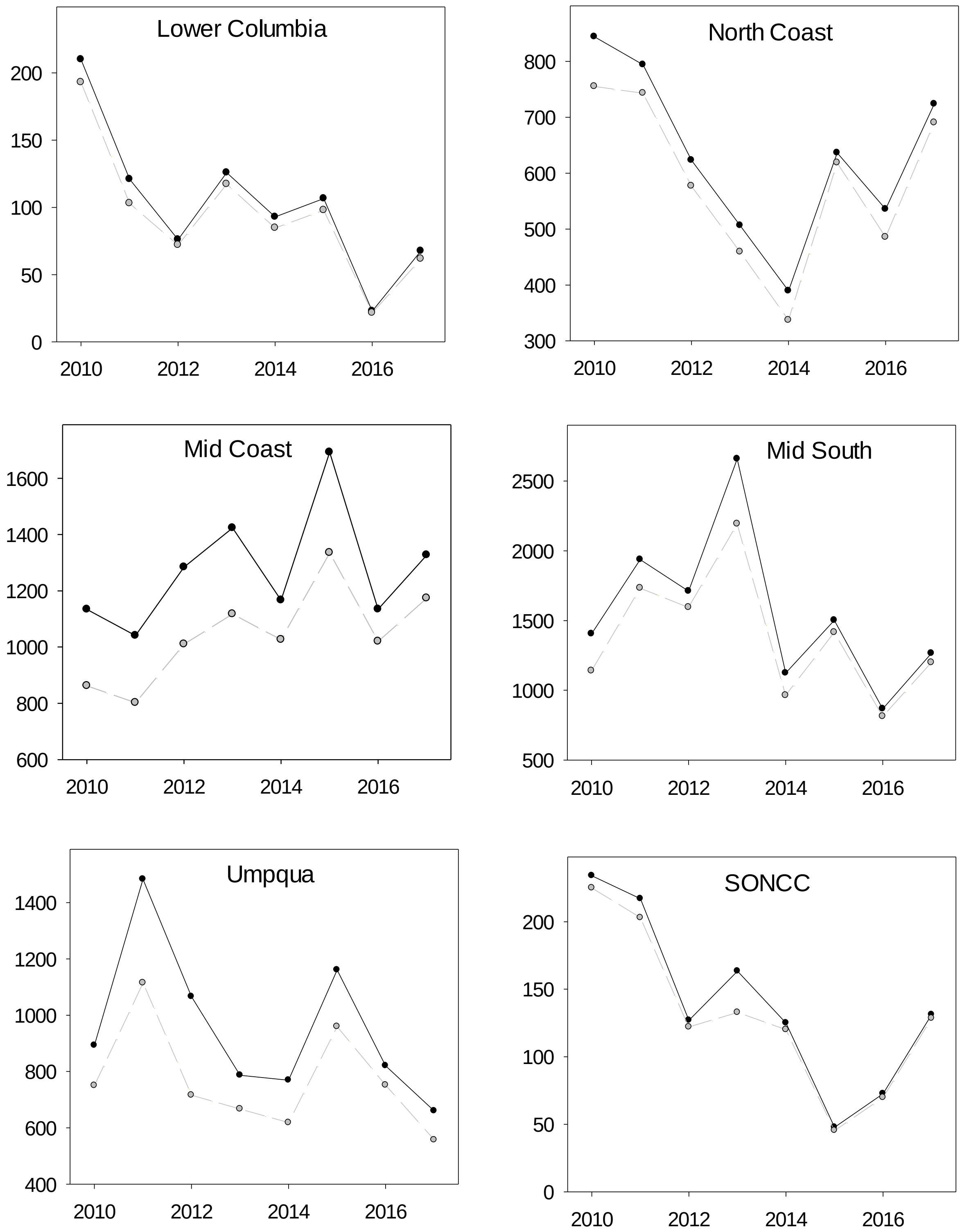



Figure 16. Annual differences in estimates of Coho Salmon parr abundance in western Oregon strata based on snorkel surveys in 1$^{st}$ -3$^{rd}$ order streams using (*i*) a ≥20cm pool depth criteria (solid black line) and (*ii*) a ≥40cm pool depth criteria (dashed gray line). Sample year is on the x-axis and parr abundance is on the y-axis in thousands. 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% |

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% |

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% |

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% |

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 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% |

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% |

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 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% |

## APPENDIX 2 STEELHEAD METRICS

Table 13. Estimated metrics and associated 95% Confidence Intervals for steelhead parr in the Oregon portion of the Klamath Mountains Provence 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 | 48% |
| 2013 | 120,995 | 20% | 0.036 | 18% | 86 | 43% |
| 2014 | 84,777 | 26% | 0.057 | 33% | 85 | 64% |
| 2015 | 46,111 | 29% | 0.025 | 24% | 86 | 49% |
| 2016 | 77,062 | 28% | 0.029 | 25% | 69 | 27% |
| 2017 | 88,951 | 21% | 0.032 | 22% | 84 | 43% |

Table 14. 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% |

Table 15. 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% |

Table 16. 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% |

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