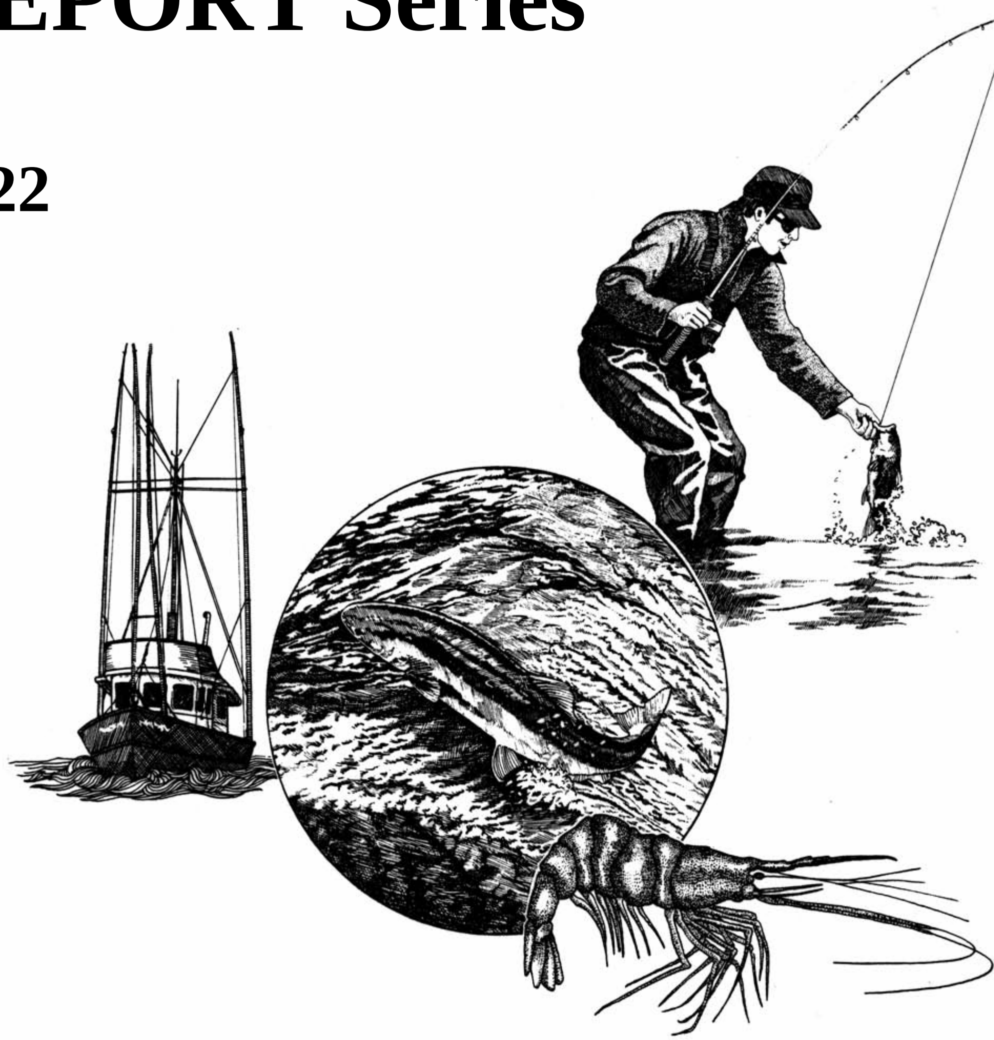
ODFW PROGRESS REPORT Series

2022



Oregon Department of Fish and Wildlife

Juvenile Salmonid Monitoring in Coastal Oregon and Lower Columbia Streams, 2021 Field Season

Annual Monitoring Report No. OPSW-ODFW-2022-1

ANNUAL PROGRESS REPORT
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PROJECT TITLE: Juvenile Salmonid Monitoring in Coastal Oregon and Lower Columbia Streams, 2021 Field Season

PROJECT NUMBER: OPSW-ODFW-2022-1

PROJECT PERIOD: 2021

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SUMMARY

This report analyzes data from snorkel surveys for Coho Salmon (*Oncorhynchus kisutch*) and steelhead (*O. mykiss)* juveniles in western Oregon streams. Trends in the distribution and abundance of the species are presented in the respective Evolutionarily Significant Units (ESUs) and Distinct Population Segments (DPSs) from 1998-2021 for Coho Salmon and from 2002-2021 for steelhead. For previous reports see: https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=149 and search by author.

Coho Salmon

Southern Oregon Northern California (SONCC) ESU: In 2021 abundance was 115,541 parr and site occupancy was 30%. This was the lowest observed site occupancy for the ESU during the project period. Abundance has declined from estimates averaging 236,000 parr from 2001-2009 to estimates averaging 102,000 parr from 2013-2021. Site occupancy has been more stable, although the metric was higher in 2007-2009 than 2019-2021.

Oregon Coast Coho (OCC) ESU: In 2021 abundance was 2.6 million parr, the lowest estimate in the project record since 1999, and site occupancy was 78%. The 2021 decline was driven by low abundance estimates in the Mid-South Coast and Umpqua strata. Abundance has been between 2.9 and 4.9 million parr after increasing from lows averaging 910,000 in 1998-1999. Abundance was higher in 2007-2015 than 2016-2021. Site occupancy has averaged 80% after increasing from low estimates in 1998-1999.

Lower Columbia River (LCR) ESU: In 2021 abundance was 72,295 parr and site occupancy was 33%. Though abundance and site occupancy were low relative to the average for the ESU, both metrics improved in 2019-2021 compared to 2016-2018.

Spawner:parr recruit curves in the OCC were asymptotic at current spawner abundances and parr/spawner rates suggested freshwater productivity was regulated by compensatory density dependence at early life stages. Data did not suggest this phenomenon in the LCR. Adult data were insufficient for these analyses in the SONCC.

Steelhead

Klamath Mountains Province (KMP) DPS: In 2021 abundance was 120,542 parr and site occupancy was 88%. The 2021 abundance was one of the seven lowest estimates for the DPS in the project record, all of which were recorded in the last seven years. Abundance was lower in 2014-2021 than in 2006-2013. Site occupancy has been more stable, but lower in 2018-2021 than 2002-2013. Over the last six years both metrics have been higher in the South Coast stratum compared to the Rogue stratum.

Oregon Coast (OC) DPS: In 2021 abundance was 213,708 parr and site occupancy was 77%. Both metrics have been stable in the DPS over the duration of the project. Abundance was typically higher in the Mid Coast and more variable in the Umpqua, relative to other strata.

Lower Columbia River (LCR) DPS: In 2021 abundance was 3,474 parr and site occupancy was 44%. Site occupancy appears stable and abundance was lower in 2014-2021 than 2006-2013, though trend detection was hampered by high variation.

Southwest Washington (SWW) DPS: In 2021 the abundance estimate was 9,157 parr and site occupancy was 64%. Similar to the LCR high variation has hampered trend detection. Abundance was lower in 2018-2021 than 2010-2013. Site occupancy was more stable, though lower in 2014-2017 than 2010-2013.

BACKGROUND AND METHODS

Background and study design

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

Sites were selected using a Generalized Random Tessellation Stratified (GRTS, Stevens 2002) design which produced a random, spatially balanced sample from within Coho Salmon and steelhead rearing distribution. To evaluate status and trend a rotating panel design was incorporated into the site selection process. The design emulated the Coho Salmon three-year life cycle (reviewed by Weitkamp et. al 1995); a quarter of selected sites were placed on an annual survey rotation, a quarter were placed on a three-year survey rotation, a quarter were placed on a nine-year survey rotation, and a quarter were surveyed only once (Stevens 2002). Sites on an annual rotation provided trend detection capability and contributed to the representation of the area needed to estimate status. Sites on three and nine-year rotations augmented trend detection capability over time and contributed to the sample size for status. Sites that were visited only once contributed to sample size for status and improved the representation of the rearing distribution. Sites were selected and apportioned among the three Coho Salmon Evolutionarily Significant Units (ESUs), the four steelhead Distinct Population Segments (DPSs), and their strata in Western Oregon (Figures 1 and 2, respectively).

The spatial scope and scale of digital stream distribution network (sampling frame) employed in the site selection process have changed since 1998. In the Oregon portion of the Southern Oregon Northern California Coast Coho ESU (SONCC), sites were originally selected from a 1:100,000 (100k) scale sampling frame of 1st-3rd order streams within presumed high quality Coho Salmon rearing habitat. In 2002, the scope was expanded to include the presumed steelhead rearing distribution in 1st-6th order streams within the Oregon portion of the Klamath Mountains Province DPS (KMP). In 2012, the frames were revised based on surveys from 1998-2012 and converted to 1:24,000 (24k) scale. The revision attempted to include all Coho Salmon and steelhead habitat upstream of tidal areas. Surveys in 4th-6th order streams were phased out in 2012 due to funding constraints. In 2019 the frames were again revised based on the previous 7 years of survey work. The 2019 revision stratified the frame into high- and low-quality habitats for Coho Salmon based on Species Distribution Modeling (SDM) (Julie Firman, ODFW, personal communication). Data in this report were analyzed to reflect the 2019 revised frame. Coho Salmon metrics on the ESU scale and those based on high quality habitats in the Interior Rogue were comparable for all years. Steelhead metrics were comparable from 2002 to present in both strata of the DPS. Juvenile steelhead in the Rogue Stratum are likely the progeny of both summer and winter run adults. Juvenile steelhead in the South Coast Stratum and the three northern DPSs in the project area are likely the progeny of winter run adults. A more detailed description of the SONCC/KMP frame history is given by Constable and Suring (2020).

In the Oregon Coast Coho ESU (OCC), sites were originally selected from a 100k sampling frame of 1st-3rd order streams within the putative Coho Salmon summer rearing distribution. This original sampling frame was designed to include all Coho Salmon rearing habitat in these streams upstream of tidal areas. In 2002, the scope was expanded to include 4th-6th order streams within steelhead distribution. In 2007 the sampling frame was revised based primarily on 1998-2006 field work and converted to 24k scale. Due to funding constraints, surveys in 4th-6th order streams were discontinued in 2009. The frame was again revised in 2012 and data in this report were based on the 2012 revision. Annual distribution and abundance metrics for both species were comparable for all years, beginning in 1998 for Coho Salmon and 2002 for steelhead. OCC sampling frame and survey design processes before 2007 were described in detail by Jepsen and Rodgers (2004) and Jepsen and Leader (2007).

The Oregon portion of the Lower Columbia River (LCR), which includes LCR ESU, the LCR DPS, and the Southwest Washington DPS (SWW), were added to the scope of the project in 2006. Sites were originally selected from a 100k sampling frame for 1st-3rd order streams within the putative Coho Salmon rearing distribution and for 4th-6th orders streams within the putative steelhead rearing distribution. In 2007 the sampling frame was revised and converted to a 24k digital stream network scale. In 2012, due to budget restrictions, surveys in 4th-6th order streams were discontinued in the region. The frame was again revised in 2012 and data in this report were based on this revision. Annual distribution and abundance metrics for both species in the region were comparable for all years, beginning in 2006 to the present year.

Field Sampling

Selected sites were surveyed during the base flow period, usually mid-July to early October. Sites were ~1 kilometer in length, surveyed in an upstream manner (Thurow 1994), and encompassed the GRTS point (x, y coordinates provide by GRTS process). Site length, pool length, and average pool width were measured with either a hip chain, open reel tape, depth staff, or range finder. Pool depth was measured using a depth staff. All pools ≥6m^2 in surface area and ≥20cm in maximum depth were snorkeled using a single pass during daylight hours. Dive lights were used to improve visibility. Visibility was subjectively based on factors that impede the ability to observe fish, including snorkeler health concerns (Rodgers 2000; Crawford 2011). In sites with adequate visibility (>90% of sites) counts were made of Coho Salmon parr, juvenile steelhead ≥90 mm in fork length (FL, visually estimated), and cutthroat trout (*O. clarki*) ≥90 mm FL. Due to difficulties distinguishing O. *mykiss* and *O. clarki* <90mm FL, all trout in this range were classified as 0-aged trout and were not identified to species or used in analyses (Hawkins 1997, Roni and Fayram 2000). Approximately 10% of sites are resurveyed by supervisory staff to evaluate adherence to survey protocols, observational difference among snorkelers, and the precision of counts.

Initially pools that were ≥40cm in maximum depth were snorkeled. In 2010, this criterion was lowered to include pools ≥20cm in maximum depth. This change was based on results from the Smith River Verification Study which suggested the lower criterion would allow larger and more consistent portions of juvenile salmonid rearing abundances to be sampled (Constable and Suring, under review) and the recommendation of O'Neal (2007). Reports following the 2010 field season provide a primary analysis based the ≥40cm criterion and a secondary analysis based on the ≥20cm criterion.

Survey effort goals were to snorkel ≥40 sites in each stratum, except in the Interior Rogue, where the goal was to snorkel ≥60 sites. Analysis has shown this level of effort was required to produce abundance estimates with 95% confidence intervals ≤30% of the estimate and to detect a 15% change in occupancy with 80% certainty for Coho Salmon, as recommended by Crawford and Rumsey (2011).

Data Analysis

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

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

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

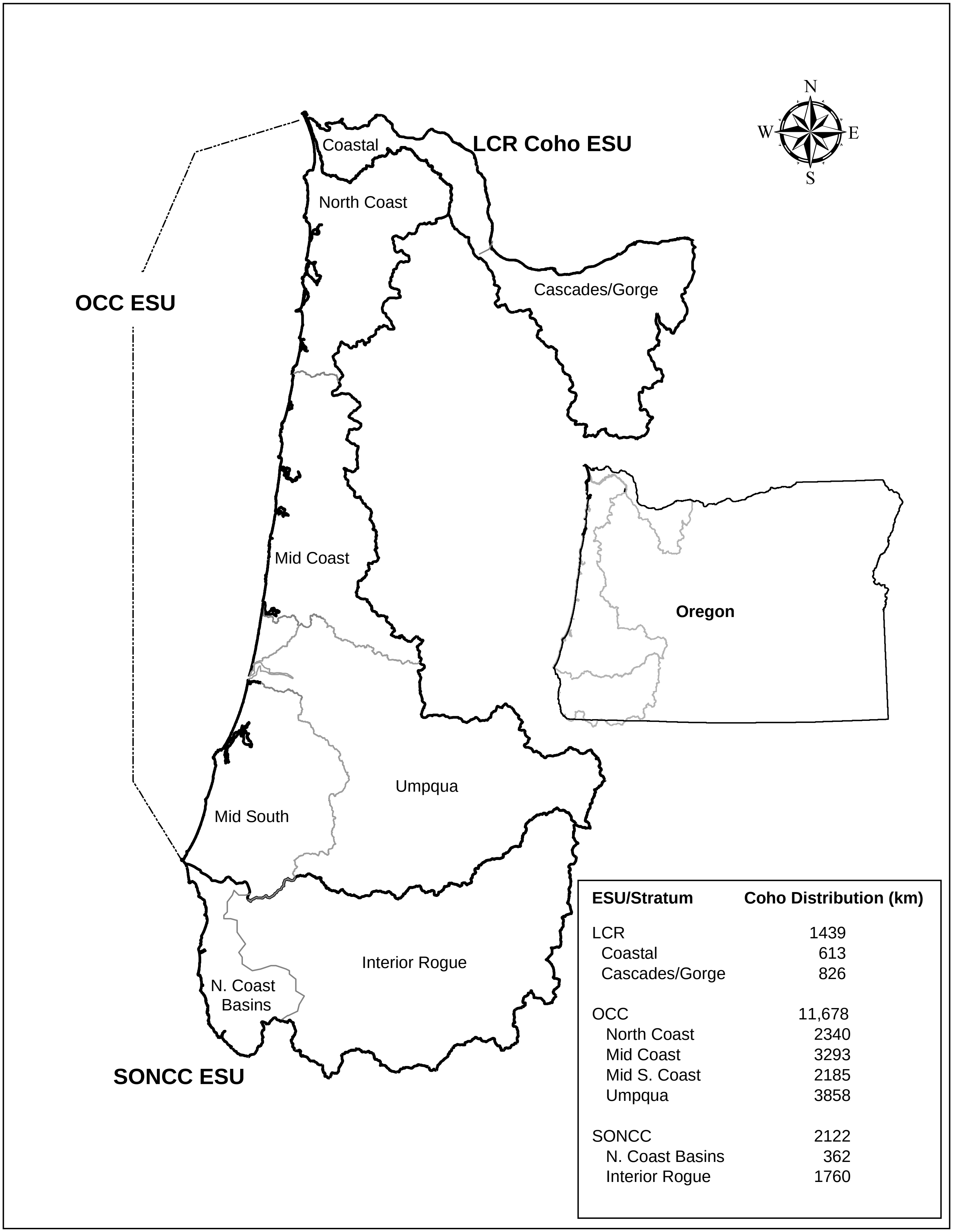
- Density: The number of target species individuals divided by the surface area of the pool in which they were observed. Density was first calculated in each pool. Second, each site's density was estimated by averaging the pool densities within the site. Lastly, density was estimated for each stratum,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

- Abundance: The estimate of the quantity of each target species within a 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 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 were based on snorkel counts in pools that meet size criteria; they were appropriate for assessing trends but did not represent total abundance (i.e., counts were not calibrated for detection efficiency or fish occupying habitats that were not snorkeled).

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

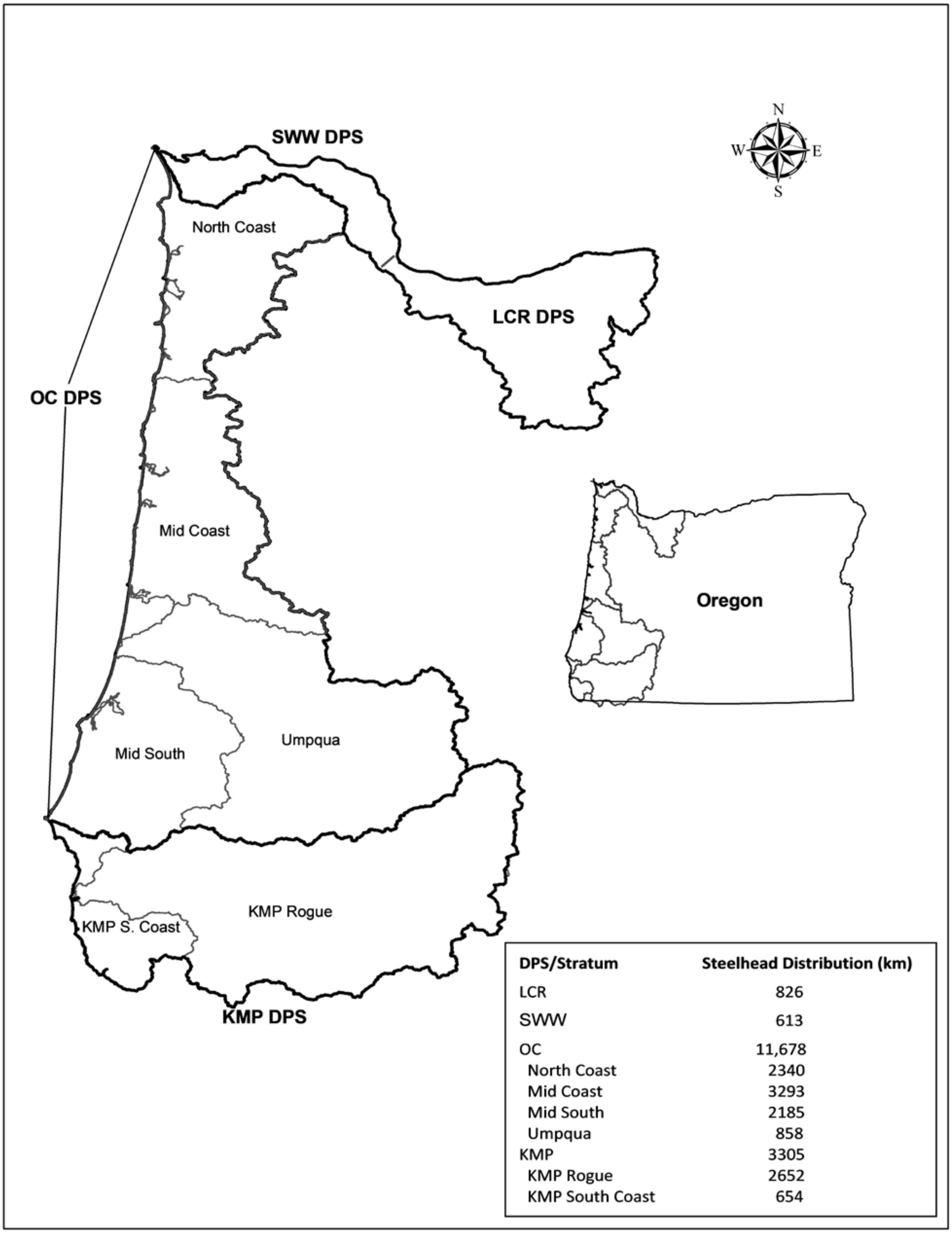
To compare metrics across the 24-year time span of the project in the OCC and SONCC/KMP, annual data were binned into brood groups. Each brood group for Coho Salmon contained three consecutive years of data, based on the conventional three-year Coho Salmon life cycle (reviewed by Weitkamp et al. 1995); the first brood group was from 1998-2000, the second was from 2001-2003, etc. Each brood group for steelhead contained four consecutive years of data, based on the presumptive four-year steelhead life cycle (reviewed by Busby et al., 1996). LCR Coho Salmon and steelhead data were also binned, beginning in 2007 and 2006, respectively, for consistency with the brood groups in the OCC and SONCC/KMP. A brood group contains one iteration of each brood line and is one complete cycle of the summer rearing phase of the population.

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



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

Figure 1. Coho Salmon ESUs and strata within Western Oregon. Length of rearing distribution for 1st-3rd order streams for each ESU and stratum are given in the table.



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

Figure 2. Steelhead DPSs and strata in Western Oregon. project area. Length of rearing distribution for 1st-3rd order streams for each ESU and stratum are given in the table.

2021 Survey Effort and Resurveys

In 2021, 572 sites were selected within the Coho Salmon and steelhead sampling frames. Thirty-four sites were determined to be non-target (beyond the potential rearing distribution of Coho Salmon and steelhead). Of the remaining 538 sites, 167 were not surveyed; 94 due to lack of landowner permission, 23 because of visibility or water quality issues, 14 due to unsafe or difficult access, and 36 due to time restrictions. Landowner denials and lack of visibility accounted for the high number of sites that could not be surveyed in the LCR and Interior Rogue. Sites that were not surveyed were defined as target, non-response. A total of 341 sites were snorkeled, comprising, 4,268 pools in 332.3 km of streams. We met our 2021 survey effort goals in five of the eight strata (Table 1).

Table 1. Survey effort goals and status of sites for 2021.

ESU	Stratum	Survey Goal	Snorkeled	Target -Non response	Non-Target
OCC	North Coast	40	43	15	3
	Mid Coast	40	50	9	1
	Mid-South Coast	40	35	15	6
	Umpqua	40	40	19	0
LCR	Coast	40	40	19	8
	Cascades/Gorge	40	36	28	6
SONCC	Interior Rogue	60	55	37	9
	N. Coast Basins	40	42	25	1

The goal of a 95% confidence interval ≤30% of the density estimate was met in the North Coast, Mid Coast, and Mid-South Coast strata for 2020 (Table 2). Variance partitioning has indicated low precision was primarily due to the high variation of Coho Salmon counts among the survey sites (Anlauf-Dunn, ODFW, unpublished data). This variation was likely a natural condition resulting from the distribution of parental spawners and the diversity of habitat quality and land use practices within our sampling frame (Anlauf-Dunn and Jones 2012). Resurveys in 2021 indicated Coho Salmon counts from initial surveys had a significant relationship to counts from resurveys (Figure 3, top left panel, R^2 = 0.991). Previous years (bottom left panel, R^2 = 0.974) had similar results, indicating that counts were precise and repeatable for the species. Resurvey counts of steelhead in 2021 (top right panel, R^2 = 0.928) showed lower precision relative to Coho Salmon but were improved over previous years (bottom right panel, R^2 = 0.805). Resurveys were not conducted in 2020 due to staffing changes related to the COVID-19 pandemic.

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 2021.

	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	81%	71%	± 14%	30%	0.471	± 22%
Mid Coast	96%	17%	±12%	10%	0.243	± 27%
Mid-South Coast	71%	64%	± 20%	17%	0.294	± 35%
Umpqua	65%	55%	± 18%	3%	0.202	± 40%
SONCC	30%	24%	± 43%	1.2%	0.080	± 63%
LCR	33%	28%	± 26%	4%	0.079	± 49%

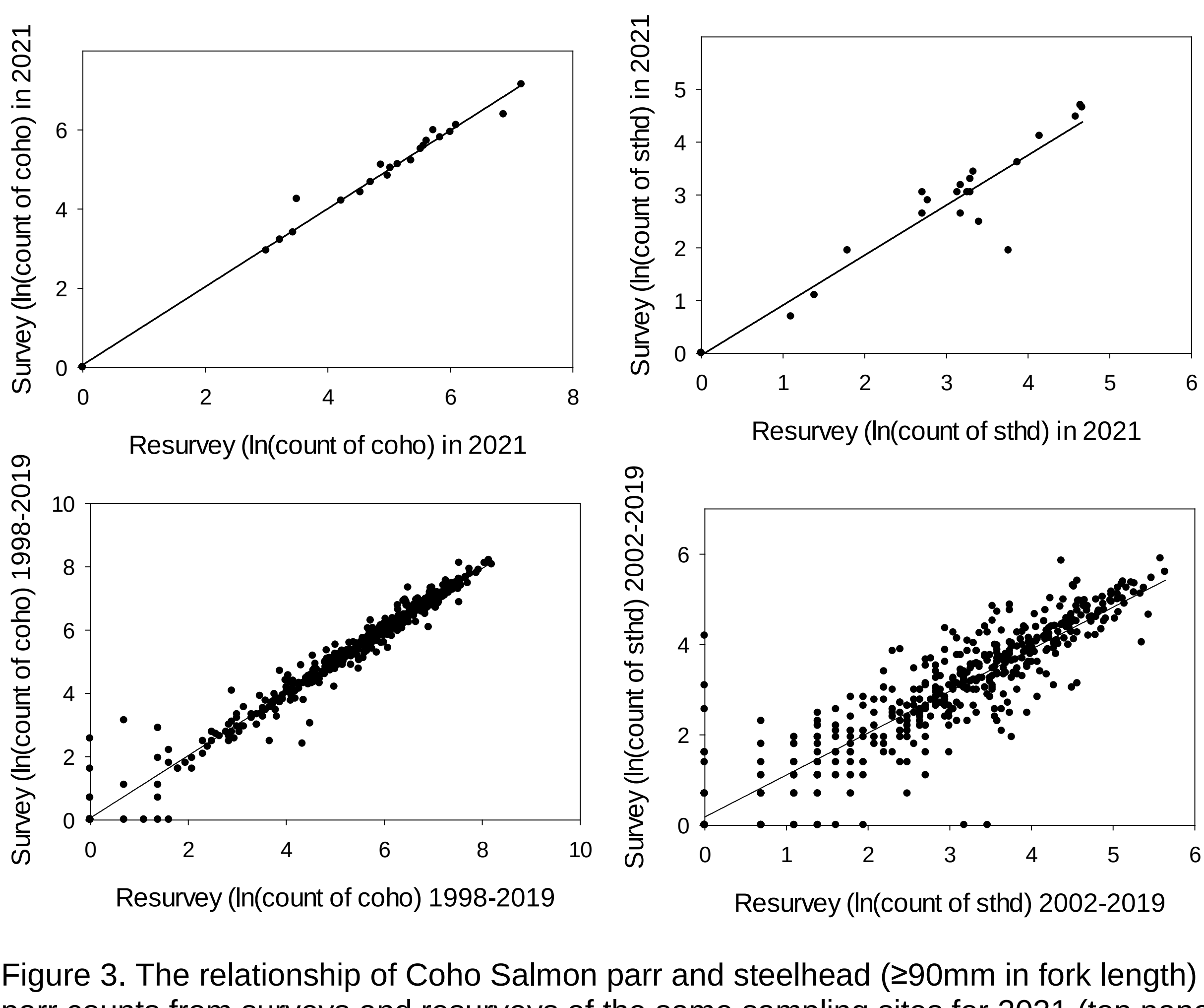


Figure 3. The relationship of Coho Salmon parr and steelhead (≥90mm in fork length) parr counts from surveys and resurveys of the same sampling sites for 2021 (top panels, n = 25) and for all previous years (bottom panels, n = 566 for Coho Salmon and n= 512 for steelhead, respectively; resurveys were not conducted in 2020). Data are log transformed to satisfy regression assumptions.

Trends in Salmonid Distribution and Abundance

Coho Salmon

Southern Oregon Northern California Coast

The 2021 abundance estimate was 115,541 parr. Of these 79% were in high quality habitats of the Interior Rogue stratum, 16% were in low quality habitats of the Interior Rogue stratum, and 5% were in the North Coast Basins stratum. Abundance estimates from the 2013-2021 brood groups were similar to each other and low relative to the 2001-2012 brood groups (Figure 4). The lowest and third lowest abundance estimates during the project period have been observed in the last three years. The 2021 density estimate was 0.08 fish/m², which was below average, and one site was fully seeded. Site occupancy in 2021 was 30%, the lowest recorded by the project. Site occupancies for the 2019-2021 brood group and the 2010-2018 brood groups were similar but the metric was lower for 2019-2021 brood group relative to the 2007-2009 brood group (Figure 5).

Oregon Coast Coho

The 2.6 million parr estimated in 2021 was the lowest since 1999 and a departure from annual estimates that have remained between 2.9 and 4.9 million since 2000. This low estimate was driven by below average counts in the Mid-South Coast and Umpqua strata, while counts in the Mid Coast and North Coast strata were near average. Abundance for the 2019-2021 brood group and 2016-2018 brood group was similar, but abundance over these years was low, relative to the 2007-2015 brood groups (Figure 4). The density estimate of 0.292 fish/m² and the 13% full seeding estimate in 2021 were below average for the ESU. Site occupancy in 2021 was 78%. Site occupancies for the 2019-2021 brood group and the 2013-2018 brood groups were similar, but the estimates for the 2016-2021 brood groups were low, relative to the 2010-2012 brood group (Figure 5). National Marine Fishery Service (NMFS) recovery criterion is to have ≥80% of available habitat occupied (Wainwright et al., 2008). This criterion is assessed by aggregating site occupancy data from our project by 5th field HUC and averaging across the most recent 12-year period. In 13 of the last 21 years site occupancy was ≥80% on the ESU scale, though this rate was more variable on the 5th field HUC scale.

CDF curves for the Mid-South Coast and Umpqua strata in 2021 were low compared to the average of CDF curves in the strata from previous years (Figure 6). In the Mid and North Coast strata the 2021 CDF curve was similar to the average curve from previous years. Abundance estimates in the 2019-2021 brood group were similar to those in the 2016-2018 brood groups for all OCC strata (Figure 7). The 2021 abundance estimates in the Mid-South and Umpqua were the lowest recorded since 1999. Density estimates in 2021 and 2020 were similar for the strata, except in the North Coast, where density increased. Site occupancy estimates in the strata for the 2019-2021 brood group and the three preceding brood groups were similar (Figure 8). Site occupancy continues to be lower in the Umpqua relative to the other strata.

Female spawner:parr recruit plots for the OCC strata suggested parr production was asymptotic near current spawner abundances, indicating a density-dependent effect on rearing capacity at this early life stage (Figure 9). Data suggest the rearing capacity may be slightly higher in the Mid-South Coast relative to the other strata. The five highest (and 13 of the 20 highest) parr abundance estimates were in the Mid-South Coast. Plots of residuals also suggested the Mid-South Coast had a positive trend and did not suggest a trend for the 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 10 and 11). The average number of parr per female was 62 and ranged from 14 (in the Umpqua, when female spawner abundance was at its highest) to 221 (in the Umpqua, when female spawner abundance was at its 2nd lowest). The number of parr per female was below average in 2021 for the strata, apart from the North Coast. Similar density-dependent effects on recruits per spawner in the OCC have been described by Nickelson and Lawson (1998) and Wainwright et al. (2008). As described in the Methods section, parr numbers were from un-calibrated visual estimates conducted only in pools meeting protocol criteria. Actual parr abundance was likely ~185% higher (Constable and Suring, 2018).

Lower Columbia River

The 2021 abundance estimate was 72,295 parr. Abundance for the 2019-2021 brood group was higher than the estimate for the 2016-2018 brood group, but lower than the estimate for the 2007-2009 brood group. High variance, relative to the other ESUs, has confounded the comparison of abundance estimates among brood groups in the ESU. Density in 2021 was 0.079 fish/m^2 and one site was fully seeded. The 2021 and 2020 density estimates were similar. The site occupancy estimate of 33% in 2021 was lower than the 3 preceding years and the average for the ESU. Site occupancy for the 2019-2021 brood group and the preceding 3 brood groups were similar.

Spawner abundance was not estimated for the ESU in 2020 due to complications associated with the COVID-19 pandemic. Unlike the OCC, plots of female spawner and parr recruits for the LCR did not suggest an asymptote in parr production at current spawner abundances and there was a weaker indication of density-dependent effects on parr production (Figure 12). A plot of residuals did not suggest a trend. The average number of parr produced per female spawner was 37. This was 40% lower and appeared to be less influenced by female spawner abundance (Figures 13 and 14), compared to results in the OCC. The number of parr per female ranged from 7, when female spawner abundance was highest, to 71, when female spawner abundance was lowest, but data suggest any compensatory effect in the LCR was weaker and less consistent than what was observed in the OCC (Figure 13). Differences between the ESUs are perhaps due to 8 additional years of monitoring in the OCC and spawner densities (female spawners/km) in the LCR that average 33% of those in the OCC strata.

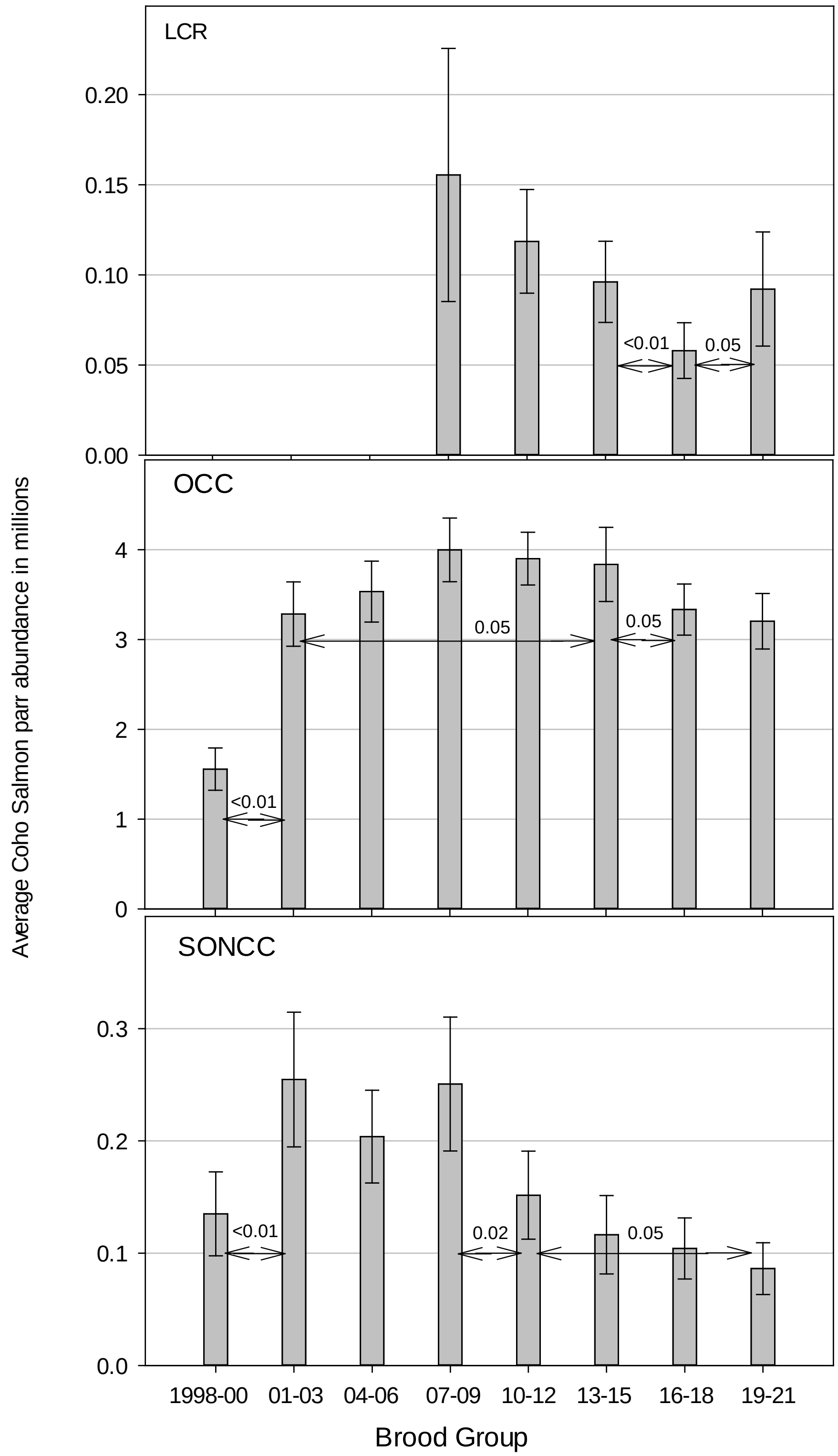


Figure 4. Three-year (brood group) trends of Coho Salmon parr abundance estimates in the three western Oregon Coho ESUs, based on snorkel surveys in 1st-3rd order streams for the years 1998-2021. Gray bars and error bars show the abundance estimate with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$. Note the differences in Y-axis scales among panels.

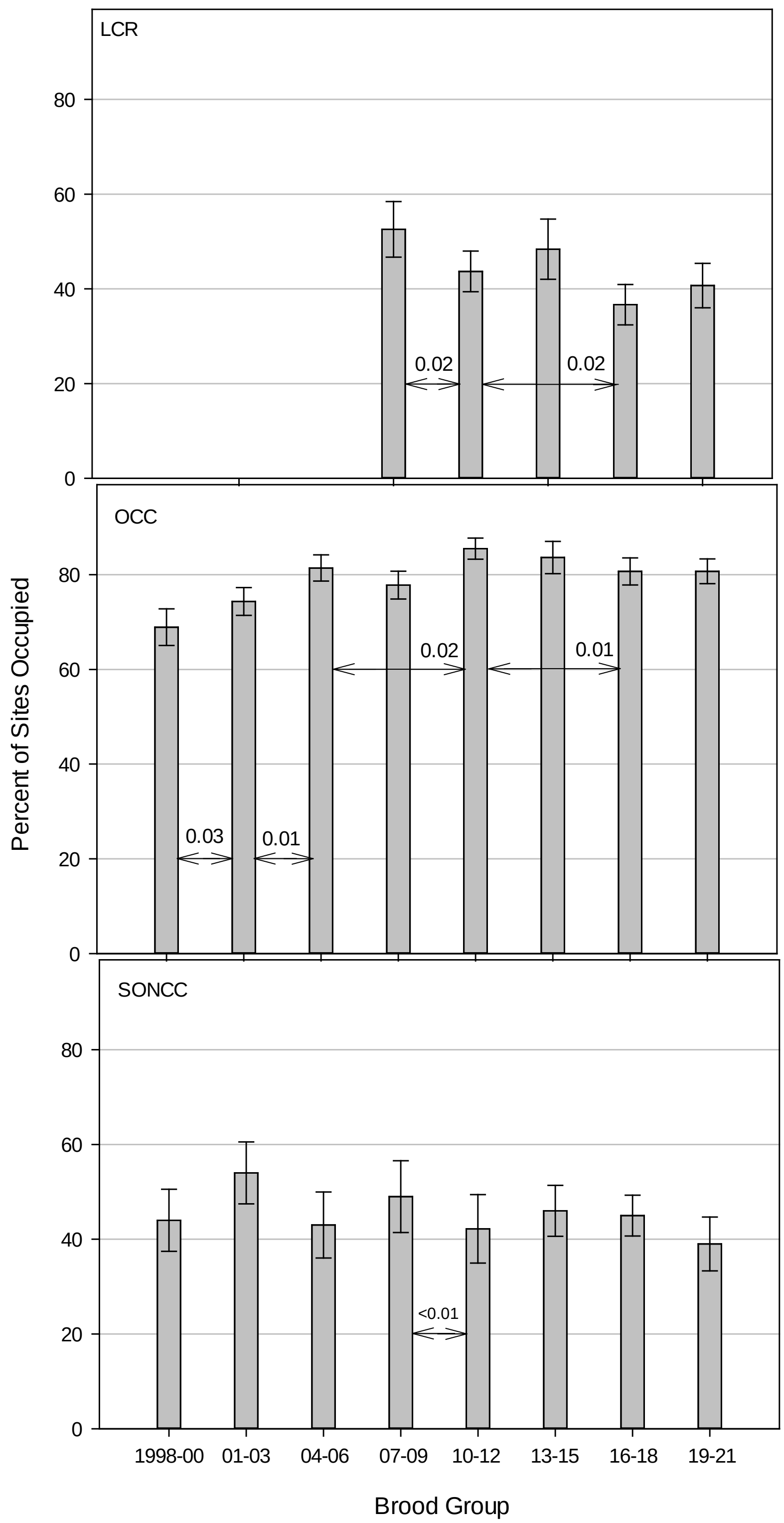


Figure 5. Three-year (brood group) trends of Coho Salmon parr site occupancy in the three western Oregon Coho ESUs based on snorkel surveys in 1st-3rd order streams for the years 1998-2021. Gray bars and error bars show the percent of sites occupied with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$.

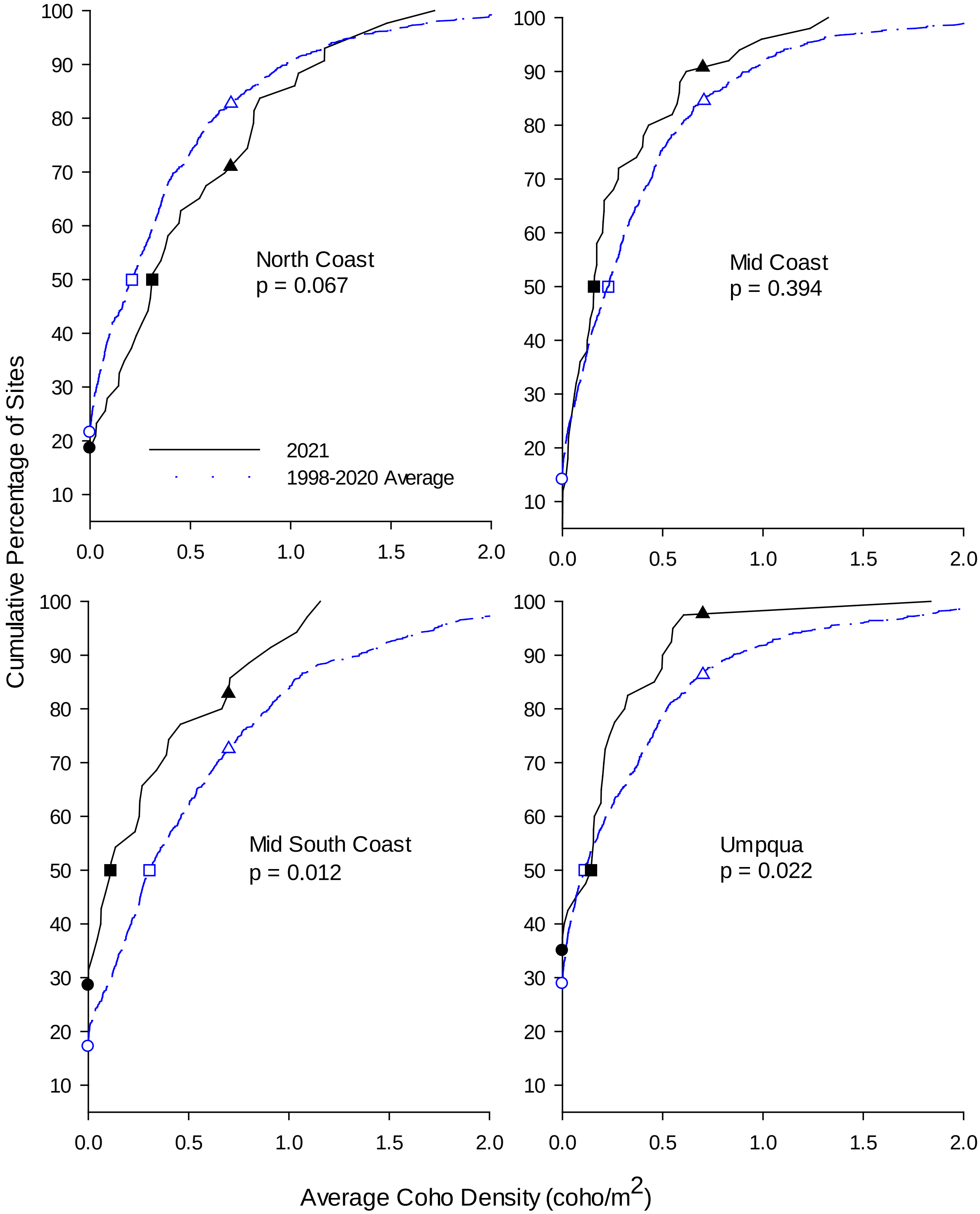


Figure 6. Average Coho Salmon parr density CDFs based on snorkel surveys in 1st-3rd order streams in the four strata of the Oregon Coast Coho ESU for survey years 1998-2021. The points shown on the curves are the percentage of unoccupied sites (circles), the median density (squares), and the percentage 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 2021 (black, solid line). P values are from the comparison test of the two curves.

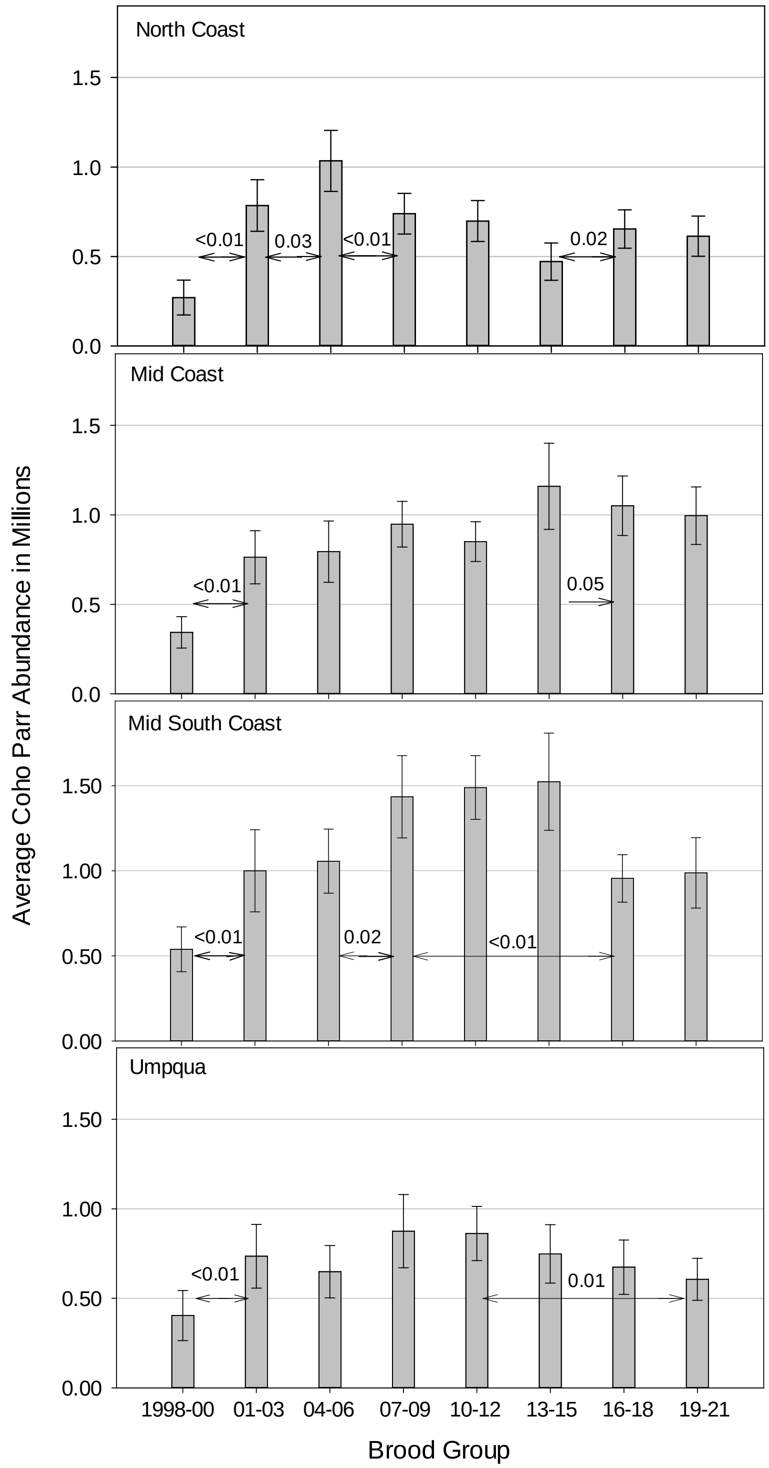


Figure 7. Three-year (brood group) trends of Coho Salmon parr abundance estimates in the four strata of the Oregon Coast Coho ESU, based on snorkel surveys in 1st-3rd order streams for the years 1998-2021. Gray bars and error bars show the abundance estimate with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where p ≤ 0.05.

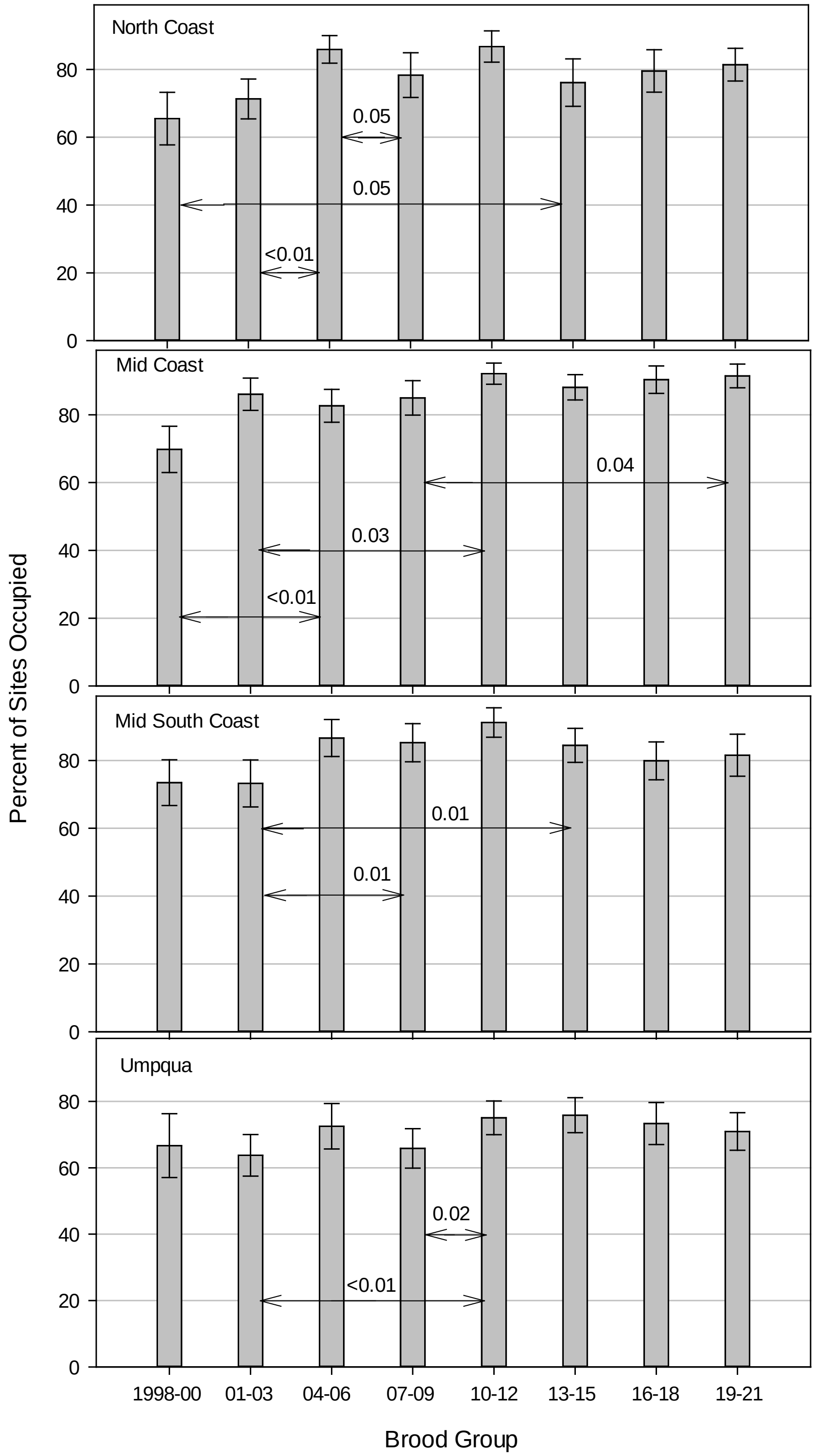


Figure 8. Three-year (brood group) trends of Coho Salmon parr site occupancy in the four strata of the Oregon Coast Coho ESU, based on snorkel surveys in 1st-3rd order streams for the years 1998-2021. Gray bars and error bars show the percent of sites occupied with the 95%CI. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$.

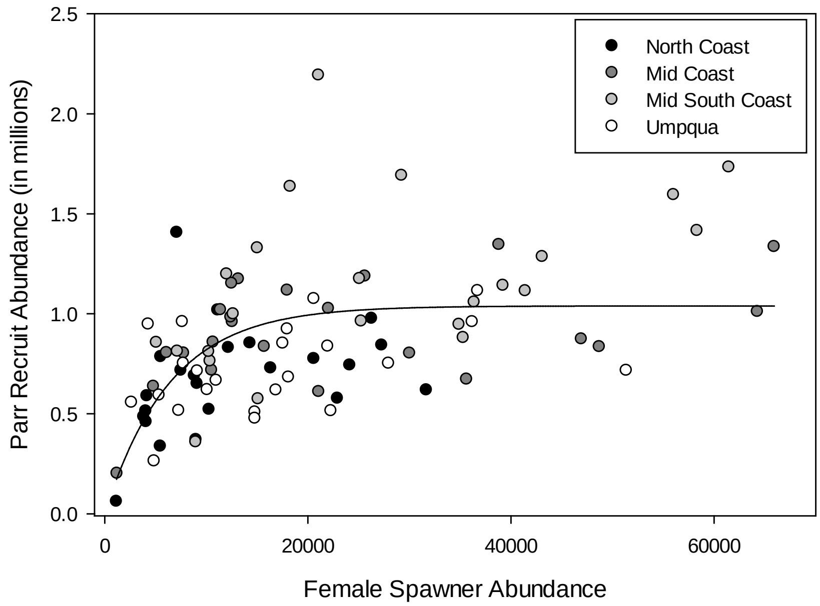


Figure 9. A Beverton-Holt model showing the relationship between the abundance of Coho Salmon parr recruits and female spawners in the strata of the Oregon Coast Coho ESU for brood years 1998-2020. Parr abundance is from un-calibrated snorkel surveys in 1^{st}-3^{rd} order streams. Female spawner abundance is from spawning ground surveys.

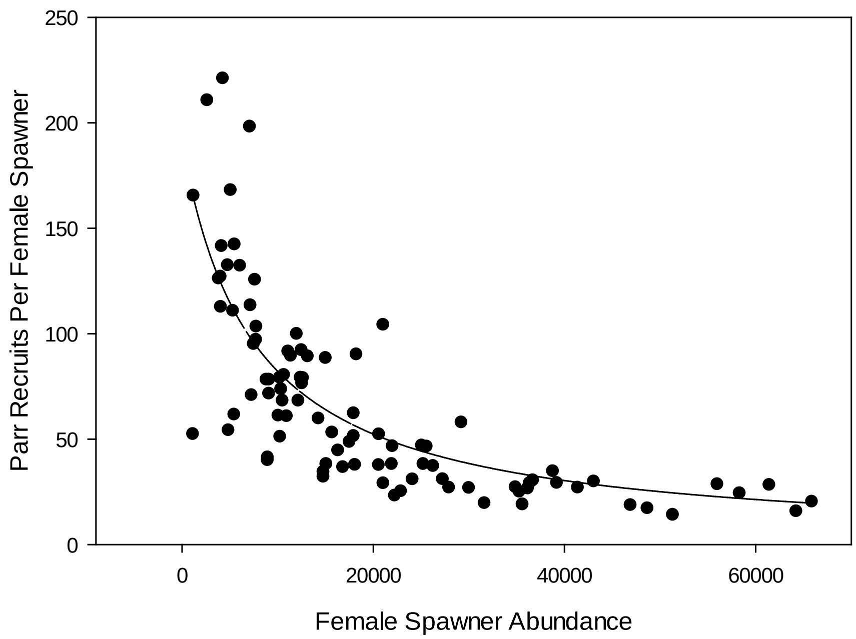


Figure 10. The relationship between the abundance of Coho Salmon female spawners and the number of parr recruits per female spawner in the Oregon Coast Coho ESU for brood years 1998-2020. Parr abundance is from un-calibrated snorkel surveys in 1^{st}-3^{rd} order streams. Spawner abundance is from spawning ground surveys.

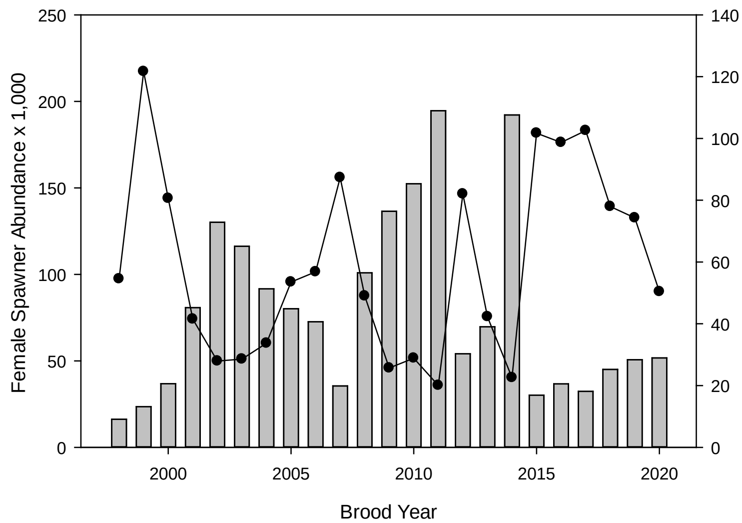


Figure 11. The abundance of Coho Salmon female spawners (gray bars) and the number of parr recruits per female spawner (black dots and line) over time in the Oregon Coast Coho ESU. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Spawner abundance is from spawning ground surveys.

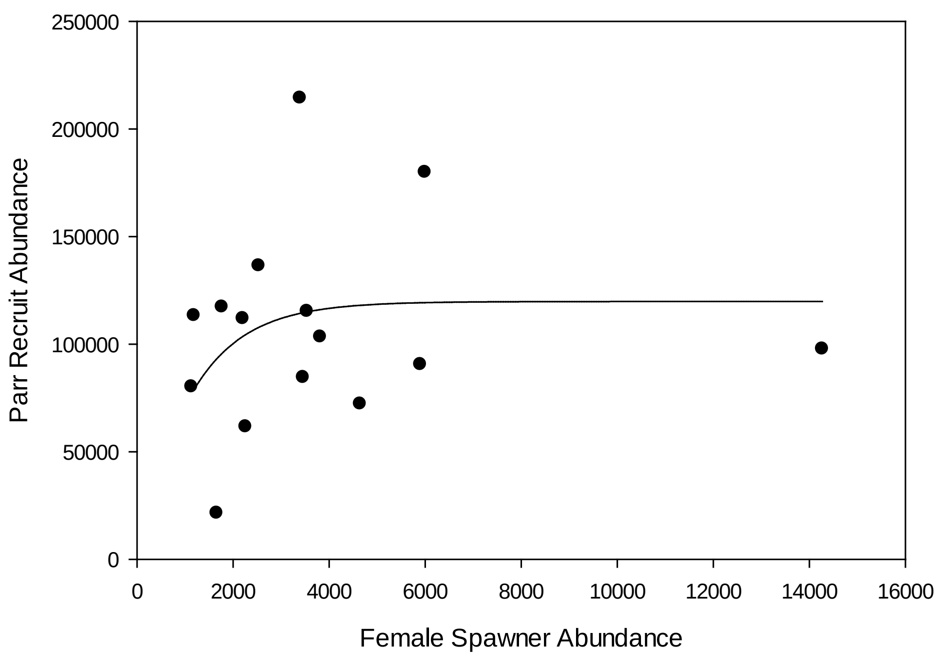


Figure 12. A Beverton-Holt model showing the relationship between the abundance of Coho Salmon parr recruits and female spawners in the Lower Columbia River ESU for brood years 2005-2019. Parr abundance is from un-calibrated snorkel surveys in 1st-3rd order streams. Female spawner abundance is from spawning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

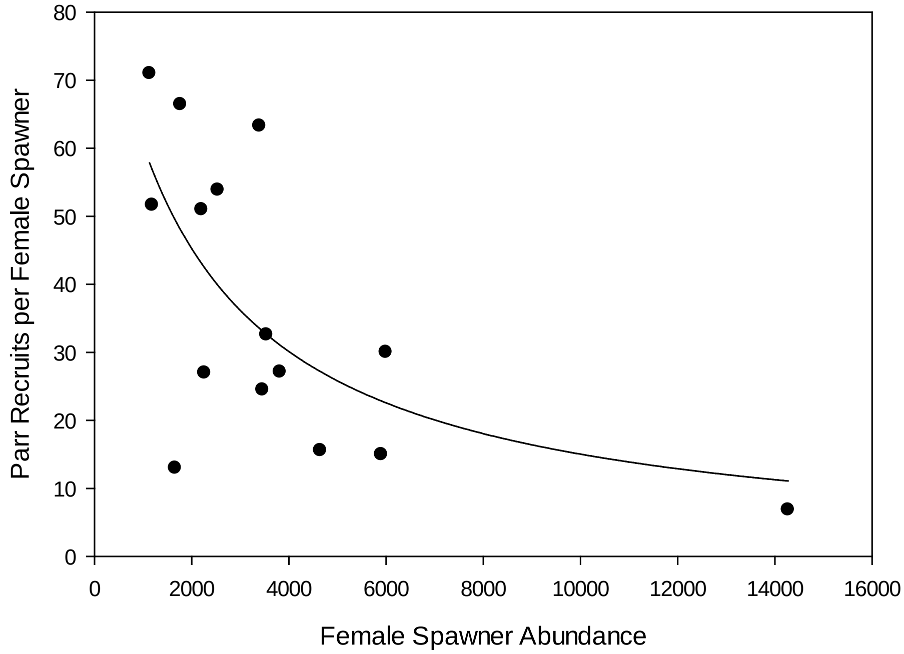


Figure 13. The relationship between the abundance of Coho Salmon female spawners and the number of parr recruits per female spawner in the Lower Columbia River ESU for brood years 2005-2019. Parr abundance is from un-calibrated snorkel surveys in 1^{st}-3^{rd} order streams. Spawner abundance is from spawning ground surveys.

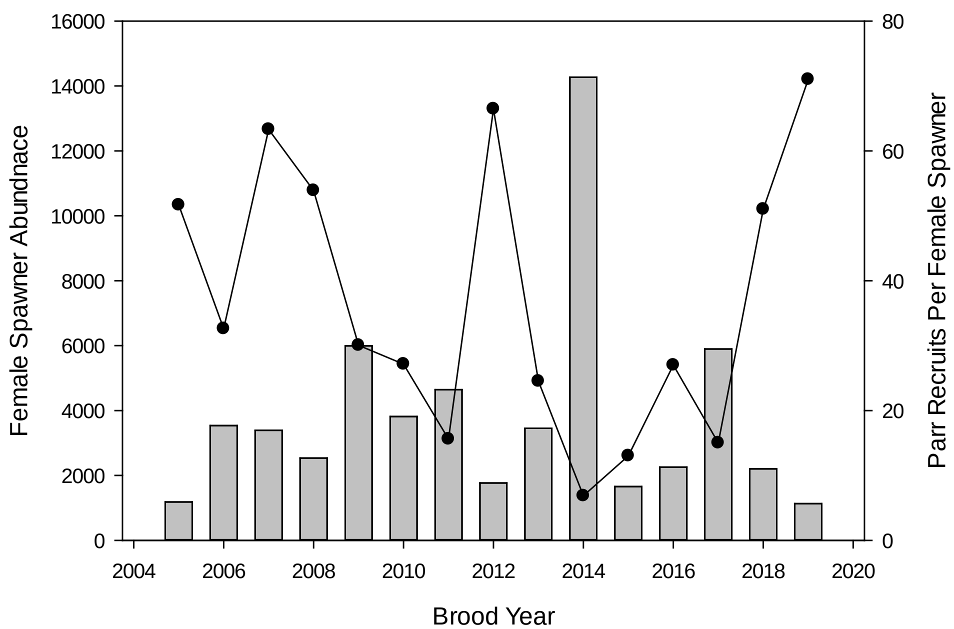


Figure 14. The abundance of Coho Salmon female spawners (gray bars) and the number of parr recruits per female spawner (black dots and line) over time in the Lower Columbia River ESU. Parr abundance is from un-calibrated snorkel surveys in 1^{st}-3^{rd} order streams. Spawner abundance is from spawning ground surveys.

Steelhead

Klamath Mountain Province

The 2021 density estimate of 0.029 fish/m^2 was similar to the 2020 estimate but below average for the DPS (Table 3). Survey year 2021 was one of only three years where density estimates were lower in the KMP than in the OC. The 2021 abundance estimate of 120,542 parr was similar to the average estimate for the DPS, yet the seven lowest abundance estimates in the DPS were recorded in the last seven years. Abundance estimates for the 2018-2021 and 2014-2017 brood groups were similar, but these years were low relative to the first three brood groups (Figure 15). Below average estimates have been observed for the last seven years in the Rogue Stratum. Abundance estimates in the South Coast Stratum during the same period were close to or above average, apart from the estimates in 2015 and 2019, which were the two lowest recorded. The 2021 site occupancy estimate of 88% was above average for the DPS. Site occupancy for the 2018-2021 brood group was similar to the estimate for the 2014-2017 brood group, but lower than the estimate for the first three brood groups (Figure 16). Akin to abundance, declines in site occupancy for the DPS were driven by low rates in the Rogue Stratum where three of the last four years were below average. In the South Coast stratum site occupancies have improved over the last four years, relative to the lowest recorded estimates in 2016 and 2017. Only one site was not occupied in the South Coast in 2021.

Oregon Coast

The density estimate of 0.031 fish/m^2 in 2021 was similar to the 2020 estimate and to the average for the DPS. The 2021 steelhead abundance estimate was 213,708 parr, which was low, relative to 2020 and the average estimate for the DPS. Abundance estimates for the 2018-2021 brood group and previous brood groups were similar. Abundance estimates have been typically higher in the Mid Coast and have shown the most variation in the Umpqua, relative to the other strata. The 2021 site occupancy estimate of 77%, was average for the DPS. Site occupancy for the 2018-2021 brood group and preceding brood groups were similar. Among the strata, site occupancy has typically been highest in either the Mid-South or Mid Coast, lowest in the Umpqua, and most variable in the North Coast. In 2021 the estimate was lowest in the Mid-South relative to the other strata.

Lower Columbia River

The density estimate of 0.006 fish/m^2 in 2021 was one of the four lowest for the DPS. Abundance in 2021 was 3,474 parr, which was higher than in 2020, but below average for the DPS. Abundance for the 2018-2021 brood group and the 2014-2017 brood group was similar, but lower than abundances from 2006-2013. Confidence intervals that were >50% of the estimate have hindered the comparisons of abundance estimates in the DPS but a declining trend is suggested by estimates in the last four years that were <25% of average. The 2021 site occupancy estimate of 44% was the lowest recorded. Site occupancy was similar for all brood groups in the DPS.

Southwest Washington

The 2021 density estimate of 0.013 fish/m^2 was similar to the 2020 estimate and to the average for the DPS. The 2021 abundance estimate of 9,157 parr was also similar to the 2020 estimate and to the average for the DPS. Abundance for the 2018-2021 brood group was low compared to the 2006-2013 brood groups and similar to the 2014-2017 brood group. Average abundance for the most recent eight years was half the average abundance of the initial eight years but confidence intervals >50% of the estimate have hindered comparisons during this period. The 2021 site occupancy estimate of 78% was higher than the 2020 estimate and the average for the DPS. Site occupancy for the 2018-2021 brood group was similar to the previous three brood groups.

Table 3. Distribution and density estimates for juvenile steelhead (≥90cm in fork length) in eight strata of Western Oregon Steelhead DPS, based on snorkel surveys in 1st-3rd order streams for 2021.

Stratum	Distribution			Density	
	Site Occupancy	Mean Pool Frequency	95% CI	Mean Average Pool Density (sthd/m^2)	95% CI
North Coast	72%	40%	± 23%	0.028	± 34%
Mid Coast	82%	41%	± 17%	0.029	± 28%
Mid-South	71%	43%	± 22%	0.035	± 51%
Umpqua	79%	39%	± 19%	0.033	± 85%
KMP Rogue	85%	47%	± 13%	0.021	± 22%
KMP South Coast	97%	81%	± 8%	0.057	± 28%
Lower Columbia	44%	15%	±41%	0.006	± 44%
Southwest WA	78%	32%	± 22%	0.013	± 46%

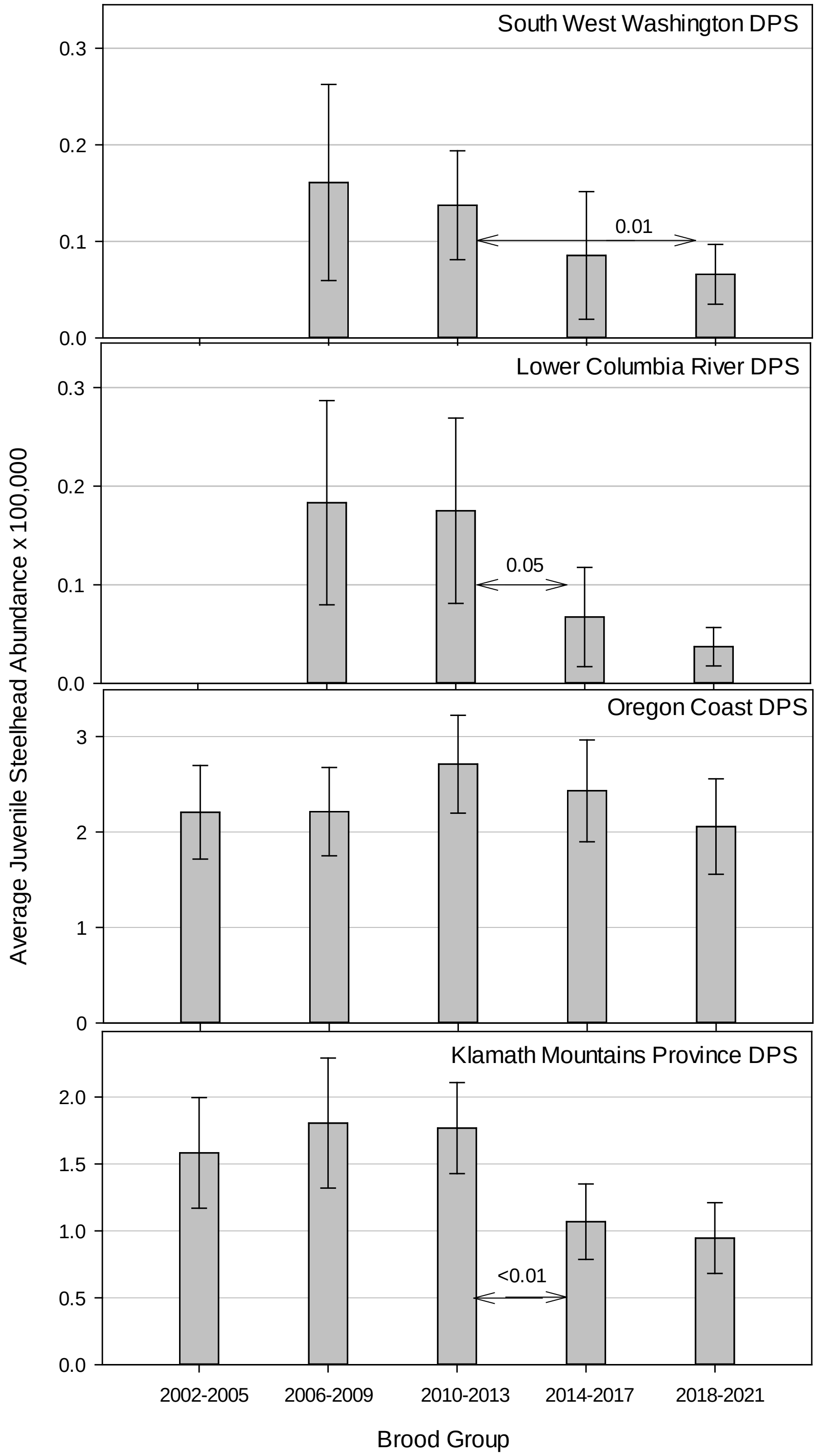


Figure 15. Four-year (brood group) trends of juvenile steelhead (≥90cm in fork length) abundance estimates in the four western Oregon DPSs, based on snorkel surveys in 1st-3rd order streams in years 2002-2021.Gray and error bars show the abundance estimate with the 95% CI for the brood group. P-values for selected comparisons among brood groups are given above the horizontal arrows where p ≤ 0.05. Note differences in Y-axis scales among panels.

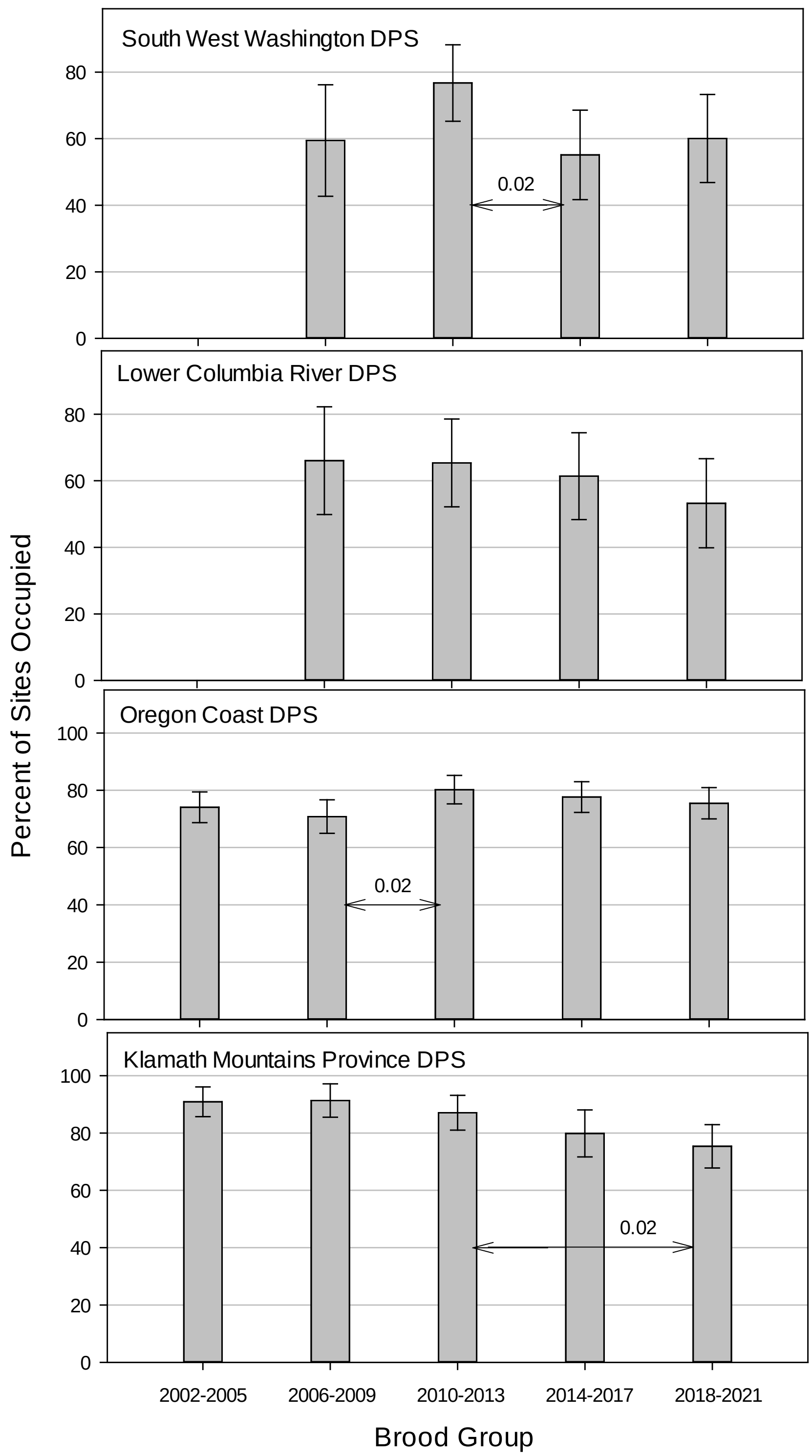


Figure 16. Four-year (brood group) trends of juvenile steelhead (≥90cm in fork length) site occupancy in four western Oregon DPS, based on snorkel surveys in 1st-3rd order streams for years 2002-2021. Gray bars and error bars show the percent of sites occupied with the 95%CI for each brood group. P-values for selected comparisons among brood groups are given above the horizontal arrows where $p \leq 0.05$.

Effects of Pool Depth on Snorkel Counts

The application of the ≥20 cm maximum depth criterion increased the number of surveyed pools to 5335 (a 25% increase) the number of snorkeled sites to 350 (a 3% increase). Seven additional sites contained pools ≥40cm in maximum depth, but only had Coho Salmon or steelhead observations in pools <40cm in maximum depth. Coho Salmon site occupancy estimates in 2021 changed by <1% in most strata when ≥20cm was used in place of ≥40cm as the maximum depth criterion. In the Mid-South Coast site occupancy decreased by 5% and in the SONCC the metric increased by 16%. Steelhead site occupancy changed by <3% in most strata, but the estimate decreased by 5% in the Mid-South and the SWW DPS when the lower criterion was used. As in previous years paired t-tests in 2021 comparing abundance estimates from pools ≥40cm to pools ≥20cm indicated the lower criterion produced higher abundance estimates of Coho Salmon (Table 4) and steelhead (Table 5) with proportionally smaller 95% confidence intervals in most strata. When the ≥20cm maximum depth criterion was applied a more negative trend in Coho Salmon abundance was observed from 2010-2021, relative to the ≥40cm criteria, but differences were <4% within each stratum.

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	2021 Coho Estimates				
	Pools ≥40cm Max Depth		Pools ≥20cm Max Depth		95% CI Difference
	Estimate	95% CI	Estimate	95% CI	
North Coast	716,662	32%	793,654	30%	2.1%
Mid Coast	835,531	28%	1,029,897	25%	2.7%
Mid-South Coast	574,107	34%	630,832	35%	-0.8%
Umpqua	476,275	31%	608,647	26%	5.0%
SONCC	115,541	34%	130,509	37%	-3.2%
Lower Columbia	72,295	38%	80,312	39%	-0.9%

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	2021 Steelhead Estimates				
	Pools ≥ 40cm Max Depth		Pools ≥ 20cm Max Depth		95% CI Difference
	Estimate	95% CI	Estimate	95% CI	
North Coast	43,266	52%	47,003	48%	4.3%
Mid Coast	69,100	33%	77,471	31%	2.7%
Mid-South Coast	60,655	36%	63,891	34%	1.5%
Umpqua	40,687	35%	44,596	33%	2.1%
KMP Rogue	52,730	21%	54,989	22%	-1.1%
KMP South Coast	67,812	22%	69,517	21%	0.4%
Lower Columbia DPS	3,474	71%	3,479	70%	0.9%
Southwest WA DPS	9,157	36%	9,116	37%	-0.8%

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APPENDIX 1 COHO SALMON METRICS

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

Southern Oregon Northern Californian Coho ESU Coho Parr Estimates								
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI	Pct Full Seeding	±95% CI
1998	176,522	51%	0.051	49%	30	35%	2	3%
1999	116,557	51%	0.218	73%	52	37%	10	9%
2000	112,029	37%	0.061	78%	51	56%	2	3%
2001	223,607	45%	0.265	46%	53	29%	12	10%
2002	325,508	37%	0.442	37%	58	23%	38	8%
2003	215,030	28%	0.413	34%	50	20%	22	8%
2004	157,239	36%	0.148	40%	42	28%	9	6%
2005	286,009	30%	0.296	37%	51	27%	23	9%
2006	168,501	34%	0.110	42%	37	28%	4	4%
2007	276,186	51%	0.227	40%	52	26%	11	8%
2008	285,760	26%	0.360	43%	57	21%	17	8%
2009	190,112	46%	0.141	42%	38	29%	4	3%
2010	140,949	43%	0.056	41%	43	23%	2	2%
2011	185,972	38%	0.114	50%	49	25%	5	5%
2012	128,124	65%	0.045	52%	33	37%	0	0%
2013	166,543	50%	0.323	95%	51	22%	7	6%
2014	118,403	46%	0.062	52%	48	35%	0	0%
2015	64,231	55%	0.026	68%	39	30%	0	0%
2016	89,967	38%	0.083	53%	45	27%	1	2%
2017	120,803	37%	0.074	46%	42	26%	1	2%
2018	101,893	46%	0.053	53%	47	26%	2	3%
2019	54,890	51%	0.040	47%	42	23%	0	0%
2020	88,396	50%	0.075	54%	46	35%	0	0%
2021	115,541	34%	0.080	63%	30	38%	1	1%

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	5%
2019	3,232,929	16%	0.241	15%	78	7%	11	4%
2020	3,760,165	18%	0.258	19%	83	6%	6	3%
2021	2,602,575	16%	0.292	15%	78	6%	13	4%

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%
2019	588,926	39%	0.290	28%	78	14%	15	11%
2020	521,331	27%	0.236	28%	85	11%	3	5%
2021	716,662	0.325	0.471	22%	81	11%	30	15%

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%
2019	1,151,923	27%	0.389	22%	84	11%	18	12%
2020	982,718	36%	0.245	20%	91	8%	0	0%
2021	835,531	28%	0.273	27%	96	5%	10	8%

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%
2018	855,895	36%	0.314	35%	71	17%	14	12%
2019	809,809	25%	0.171	31%	82	13%	5	5%
2020	1,636,225	30%	0.337	30%	87	12%	18	14%
2021	574,107	34%	0.294	35%	71	19%	17	13%

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%
2019	682,272	40%	0.128	38%	71	14%	5	6%
2020	619,890	36%	0.237	53%	72	14%	6	8%
2021	476,275	31%	0.203	40%	65	16%	3	4%

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%
2018	90,675	41%	0.069	38%	45	20%	2	3%
2019	112,044	61%	0.096	59%	46	19%	3	3%
2020	80,242	63%	0.065	45%	41	26%	0	0%
2021	72,295	38%	0.079	49%	33	25%	4	4%

APPENDIX 2 STEELHEAD METRICS

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

Klamath Mountains Province Steelhead DPS Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2002	202,091	34%	0.091	28%	83	8%
2003	121,823	19%	0.059	20%	90	6%
2004	131,678	18%	0.069	20%	97	4%
2005	177,326	18%	0.062	16%	94	5%
2006	133,153	28%	0.052	23%	90	7%
2007	196,727	20%	0.098	29%	93	7%
2008	200,838	27%	0.057	21%	93	5%
2009	191,378	31%	0.057	22%	89	7%
2010	205,008	20%	0.065	24%	94	5%
2011	188,466	18%	0.060	19%	92	6%
2012	146,020	20%	0.038	27%	80	9%
2013	167,523	18%	0.034	18%	83	7%
2014	131,396	26%	0.059	34%	87	11%
2015	71,675	30%	0.026	25%	85	8%
2016	109,079	28%	0.028	26%	70	12%
2017	115,284	21%	0.029	22%	79	10%
2018	79,917	35%	0.018	32%	81	8%
2019	59,402	26%	0.014	24%	57	13%
2020	118,462	32%	0.022	21%	77	13%
2021	120,542	15%	0.029	17%	88	6%

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

Klamath Mountains Province Rouge Stratum Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2002	76,150	23%	0.080	38%	78	10%
2003	42,583	32%	0.056	26%	87	8%
2004	76,930	27%	0.069	25%	96	5%
2005	105,148	26%	0.064	19%	94	5%
2006	86,038	42%	0.052	28%	90	8%
2007	107,054	26%	0.107	33%	91	9%
2008	125,545	41%	0.056	25%	92	7%
2009	116,343	44%	0.061	24%	87	8%
2010	149,522	25%	0.067	28%	93	6%
2011	122,431	20%	0.065	21%	90	8%
2012	74,258	27%	0.028	41%	77	12%
2013	71,877	23%	0.028	23%	78	10%
2014	77,646	42%	0.063	40%	83	14%
2015	51,751	40%	0.025	31%	80	11%
2016	48,920	47%	0.020	37%	66	16%
2017	25,358	33%	0.022	32%	76	12%
2018	22,670	39%	0.012	39%	77	10%
2019	22,006	51%	0.007	34%	45	21%
2020	41,849	85%	0.017	35%	71	18%
2021	52,730	21%	0.021	22%	85	8%

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

Klamath Mountains Province South Coast Stratum Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2002	125,941	53%	0.130	32%	100	0%
2003	79,240	22%	0.069	20%	100	0%
2004	54,748	19%	0.070	23%	100	5%
2005	72,178	24%	0.057	20%	93	9%
2006	47,115	24%	0.053	18%	93	8%
2007	89,672	32%	0.058	33%	100	0%
2008	75,293	27%	0.061	24%	100	0%
2009	75,035	39%	0.043	35%	97	5%
2010	55,486	21%	0.057	24%	100	0%
2011	66,034	35%	0.042	27%	97	5%
2012	71,762	31%	0.073	30%	90	11%
2013	95,646	28%	0.055	25%	100	0%
2014	53,750	35%	0.044	22%	100	0%
2015	19,924	31%	0.027	23%	100	0%
2016	60,159	39%	0.060	35%	85	13%
2017	89,926	24%	0.058	27%	89	13%
2018	57,247	46%	0.045	50%	94	8%
2019	37,396	28%	0.039	33%	100	0%
2020	76,612	27%	0.047	21%	100	0%
2021	67,812	22%	0.057	29%	97	5%

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

Oregon Coast Steelhead DPS Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2002	183,127	20%	0.035	26%	68	9%
2003	241,263	22%	0.035	17%	79	7%
2004	169,713	21%	0.032	17%	73	7%
2005	288,482	22%	0.047	26%	77	6%
2006	204,924	17%	0.028	19%	72	8%
2007	219,687	25%	0.030	21%	71	8%
2008	229,564	20%	0.030	21%	68	9%
2009	230,839	21%	0.043	19%	72	8%
2010	290,410	19%	0.034	20%	78	7%
2011	275,137	19%	0.038	14%	83	5%
2012	226,411	14%	0.032	15%	81	25%
2013	292,388	21%	0.047	17%	79	24%
2014	274,672	24%	0.029	18%	88	34%
2015	136,759	23%	0.015	28%	65	18%
2016	247,939	19%	0.020	17%	73	22%
2017	313,308	20%	0.021	16%	84	29%
2018	166,980	20%	0.018	19%	71	19%
2019	185,529	22%	0.014	17%	72	8%
2020	349,654	24%	0.030	23%	82	7%
2021	213,708	20%	0.031	34%	77	6%

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

Lower Columbia River Steelhead DPS Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2006	30,142	47%	0.045	30%	78	18%
2007	21,259	51%	0.036	43%	67	26%
2008	9,965	47%	0.010	88%	61	31%
2009	11,920	80%	0.015	56%	58	24%
2010	23,497	55%	0.034	31%	66	19%
2011	16,102	53%	0.036	51%	67	23%
2012	12,148	64%	0.024	40%	61	31%
2013	18,283	40%	0.023	40%	68	40%
2014	12,495	49%	0.015	32%	89	93%
2015	2,676	52%	0.007	37%	50	30%
2016	2,905	42%	0.006	39%	46	29%
2017	8,870	88%	0.013	67%	60	33%
2018	5,067	41%	0.011	46%	57	28%
2019	4,441	45%	0.011	50%	60	21%
2020	1,913	44%	0.004	60%	52	28%
2021	3,474	71%	0.006	44%	44	32%

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

Southwest Washington Steelhead DPS Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2006	6,333	74%	0.014	71%	53	39%
2007	10,874	103%	0.017	75%	54	31%
2008	30,671	50%	0.023	43%	62	27%
2009	16,540	35%	0.027	44%	69	18%
2010	20,996	38%	0.036	35%	79	18%
2011	10,815	41%	0.029	41%	66	17%
2012	13,339	45%	0.024	30%	80	50%
2013	9,824	30%	0.023	37%	83	59%
2014	9,411	82%	0.021	46%	68	49%
2015	2,422	74%	0.007	80%	42	23%
2016	20,362	52%	0.022	28%	69	41%
2017	2,026	42%	0.004	54%	42	20%
2018	2,525	48%	0.003	54%	45	24%
2019	3,524	52%	0.003	39%	54	27%
2020	11,209	42%	0.012	36%	64	22%
2021	9,157	36%	0.013	46%	78	14%

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