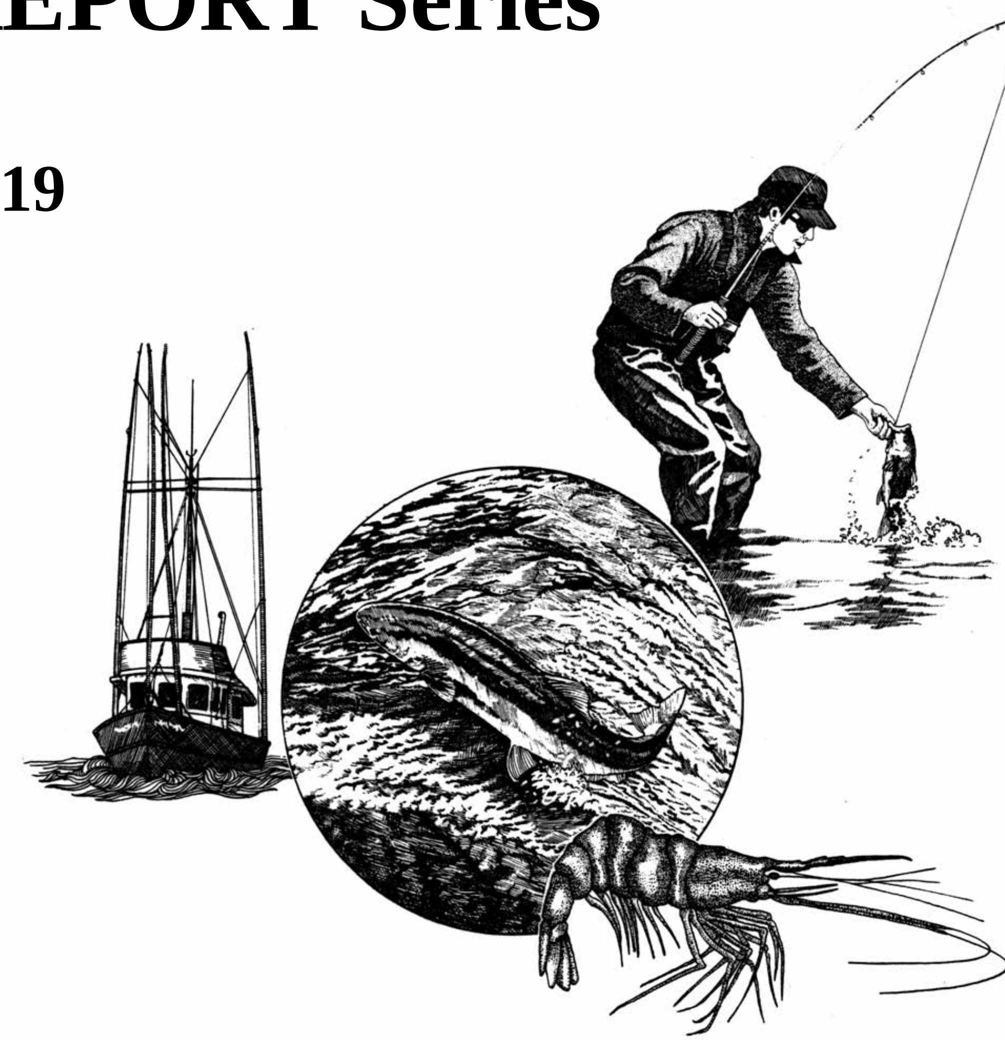
ODFW PROGRESS REPORT Series

2019



Oregon Department of Fish and Wildlife

Juvenile steelhead monitoring in the Chetco Bar Fire burn area, 2018.

Annual Monitoring Report No. OPSW-ODFW-2019-4

PROGRESS REPORT
FISH RESEARCH PROJECT
OREGON

PROJECT TITLE: Juvenile steelhead monitoring in the Chetco Bar Fire burn area, 2018.

PROJECT NUMBER: OPSW-ODFW-2019-4

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CONTENTS

FIGURES

TABLES

SUMMARY

This reports analyses Oregon Plan for Salmon and Watersheds (OPSW) monitoring data for juvenile steelhead in three nested regions within the Klamath Mountains Province steelhead Distinct Population Segment (KMP); the Chetco 4th Field HUC (Chetco HUC), the South Coast Stratum of the KMP, and the portion of the KMP within the state of Oregon. Its purpose is to evaluate trends in juvenile steelhead occupancy and abundance in these regions, with an emphasis on potential impacts of the 2017 Chetco Bar fire. To meet this purpose data was collected annually from OPSW snorkel surveys during base flows in 1st-3rd order streams in years 2002-2018 and supplemental data was collected in 2018 in the Chetco Bar Fire burn zone.

Yearly occupancy and abundance estimates have been higher in the Chetco HUC relative to the South Coast stratum and higher in the South Coast stratum relative to the KMP. Abundance estimates were low for all three regions in 2015, perhaps as a result of extreme drought conditions. Recent data (2014-2018) in the Chetco HUC suggests a decline in both abundance and occupancy relative to previous years. Recent data in the South Coast stratum also suggest declines in abundance, but occupancy has remained relatively stable. With the exception 2016, steelhead have been observed in ≥92% of the surveyed sites within the South Coast stratum. Recent data for the KMP suggest declines in both abundance and occupancy relative to previous years. Preliminary results from the 2018 field season did not indicate differences in fish condition or abundance between burned and unburned watersheds.

Supplemental data was also collected in the summer of 2018 to calibrate snorkel counts to mark-recapture (m-r) estimates of steelhead abundance. This data will examine *i)* variation in the percent of steelhead m-r estimates that is observed by snorkelers in pools that meet snorkeling criteria and *ii)* variation in the percent of total steelhead abundance that is distributed into habitat units that do and do not meet snorkeling criteria.

METHODS

Background

This report describes results from juvenile steelhead (*Oncorhynchus mykiss*) monitoring in the Oregon portion of the Klamath Mountains Province Distinct Population Segment (KMP), with an emphasis the Chetco 4th field HUC (Chetco HUC). This effort is part of a larger project initiated by Oregon Department of Fish and Wildlife (ODFW) in 1998 to support salmon and steelhead monitoring goals described in the Oregon Plan for Salmon and Watersheds (OPSW, State of Oregon 1997). The primary objective of this report is to inform conservation and recovery decisions related to KMP steelhead by providing data on trends in juvenile abundance and occupancy rates. Part of this objective is to monitor impacts of the 2017 Chetco Bar wildfire on steelhead juveniles within the Chetco HUC. The project used annual snorkel surveys during base flows at randomly selected sites to meet this objective. These surveys were conducted from 2002-2018.

Field Sampling

In 2002 a sampling frame was developed for survey site selection within the presumed rearing distribution juvenile steelhead. The scale of the sampling frame has changed over time. The original 100k layer was replaced by a 24k layer in 2012. The 24k layer refined and expanded the initial steelhead rearing distribution. First to sixth order streams within the frame were sampled from 2002-2013 but, due to funding constraints, surveys in 4th-6th order streams were discontinued in 2014. Analyses in this report for all years were based on data from 1st-3rd order streams. Our sampling frame and survey design are described in detail by Jepsen and Rodgers (2004) and Jepsen and Leader (2007). Annual OPSW monitoring reports are located at https://nrimp.dfw.state.or.us/crl/default.aspx?pn=WORP.

A Generalized Random Tessellation Stratified (GRTS, Stevens 2002) design was used to select potential survey sites in a spatially balanced, random fashion from our sampling frame. Selected sites were surveyed by field crews using daytime snorkeling during the base flow period (July 1 to early October). Sites were 1km in length and encompassed the GRTS point (x, y coordinates) provided by the selection process. Field crews were trained in fish ID and OPSW snorkel survey protocols described by Rodgers (2000). The length of the site, and the length and average width of pools within the site, were measured with a hip chain, open reel tape, depth staff, or range finder. Pool depth was measured using a depth staff. All pools ≥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 juvenile steelhead ≥90 mm in fork length (FL, visually estimated). Due to difficulties discerning steelhead and Cutthroat trout (*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). The presence or absence of trout <90 mm FL was noted. As a part of surveyor training and to evaluate observational differences among snorkelers 10-15% of sites were resurveyed by supervisory staff.

Data Analysis

The occupancy rate (hereafter site occupancy) and abundance of juvenile steelhead was estimated in three nested regions; the Chetco HUC, the South Coast stratum of the KMP, and for the Oregon portion of the KMP (Figure 1). Our sampling guideline was to produce abundance estimates with 95% confidence intervals of 30% or less of the estimate (Crawford and Rumsey, 2011). 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. Site occupancy and abundance were calculated following the below definitions:

- Site occupancy: The number of sites where at least one steelhead was observed divided by the number of sites that were surveyed within each region.

- Abundance: The count of steelhead per kilometer of survey. Steelhead per km is first calculated at each site by dividing the snorkel count by the site's length, then estimated for each nested region by averaging the steelhead per km of each site within the respective regions. Steelhead per km in this report was 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.

The completion of the 2018 field season yielded 17 years of monitoring data. To compare metrics across this time span, we partitioned these 17 years of data into four-year intervals, based on the conventional four-year steelhead life cycle (reviewed by Busby et al., 1996). This resulted in four successive brood groups from 2002-2017 and a 5th partial brood group that only included data from 2018. A (full) brood group contains one iteration of each of the four steelhead brood lines and, accordingly, is one complete cycle of the summer rearing segment of the steelhead population. The use of brood groups as an analysis unit, in addition to individual cohorts or years, can provide a useful way to monitor trends in distribution and abundance for this temporally large data set. We compared estimates of site occupancy and abundance among brood groups.

In years previous to 2018 data collected in the Chetco HUC was analyzed as part of the larger OPSW monitoring for the South Coast stratum/KMP and not as a separate region nested within the stratum (Constable and Suring, 2018). In 2018 OPSW monitoring continued in the South Coast Stratum as in previous years and an additional field crew was dedicated to the Chetco HUC to monitor the impacts of the 191,000 acre Chetco Bar fire (Figure 2). The duties of this field crew were to *i)* complete supplemental sites within the Chetco HUC in both burned and unburned areas, *ii)* use mark-recapture (m-r) estimates to calibrate snorkel survey counts, and *iii)* collect fish condition data from burned and unburned sites within the Chetco HUC. Supplemental sites were selected and surveyed using the OPSW protocols described above.

Stream segments for m-r estimates were selected from within the sites. Once the m-r segment was located, crews began by placing a block net at the top and bottom of the segment, then placing additional block nets at the transitional margin between 4 pool and 3 fastwater habitat units (defined by Moore et al 1997) within the segment, for a total of 8 block nets. The integrity of each block net was examined by snorkelers. This configuration of block nets allowed for a snorkel count in each pool habitat unit and a m-r estimate in each pool and fastwater habitat unit. Snorkeling was completed first and the stream segment was allowed to recover for 2 hours before m-r began. For m-r, each habitat unit was electrofished using one to three Smith Root, Inc. model 12-B backpack electrofishers. Mode switches were set at a standard I-5 (60Hz at 6ms) and voltage settings ranged from 100 to 300V; depending on stream depth, temperature, conductivity, and the reaction of fish. Each pool habitat unit was electrofished until the number of captured fish was at least 90% of the snorkel count and all areas of the pool were covered. Each fastwater habitat unit was electrofished by making at least two passes, capturing fish in each pass, and covering all areas of the unit. Captured fish were held in buckets within the habitat unit where they were captured, identified to species, and marked for recapture. Fish captured in pool habitat units were marked with a small clip to the upper lobe of the caudal fin whereas fish captured in fastwater habitat units were marked with a small clip to the lower lobe of the caudal fin. When captured fish had recovered from electrofishing and marking, and when electrofishing was completed in the subsequent habitat unit, fish were released back into the habitat unit where they were captured.

When the marking phase was complete, the stream segment was allowed to recover for 24 hours before the recapture phase. Block nets remained in place during the entire time and were checked periodically to remove debris. In the recapture phase, each pool or fastwater habitat unit was electrofished until at least 50% of the marked fish were recaptured and all areas of the habitat unit were covered. Numbers of marked and unmarked fish were recorded for each species. Mark location (upper or lower lobe of the caudal fin) was recorded to determine if fish had moved from the habitat unit of capture to a bordering habitat unit. As with the marking phase, fish were held in buckets within the habitat unit where they were captured and were released back into this habitat unit when they had recovered and when electrofishing was completed in the subsequent habitat unit. An estimate of steelhead abundance was made for each habitat unit using a Peterson method (Ricker 1975):

$$N = \frac{M\ x\ C}{R}$$

where:

M = number of fish captured, marked, and released for recapture

C = number of fish captured and observed for marks during the recapture phase

R = number of marked fish observed during the recapture phase

In the event that steelhead were not captured during the marking phase within a habitat unit, it was assumed that the m-r estimate for the unit was zero. After all mark-recapture data was gathered capture probability was calculated to assess the suitability of this assumption.

Condition factor was estimated by measuring the length and weight of fish from both burned and unburned watersheds and using the Fulton’s K formula to determine condition (Fulton 1911):

$$K = 100\ x\ \left(\frac{W}{L^3}\right)$$

Where:

W = weight of fish in grams

L= length of fish in millimeters

Burn intensity was rated as either unburned, light, moderate, or high. These categories were based on the percent of tree basal area mortality (BAM); areas with 0% BAM mortality were assigned to unburned, areas with 1-25% BAM were assigned to light, areas with 26-75% BAM were assigned to moderate, and areas with >75% BAM were assigned to high (USDA Forest Service 2017).

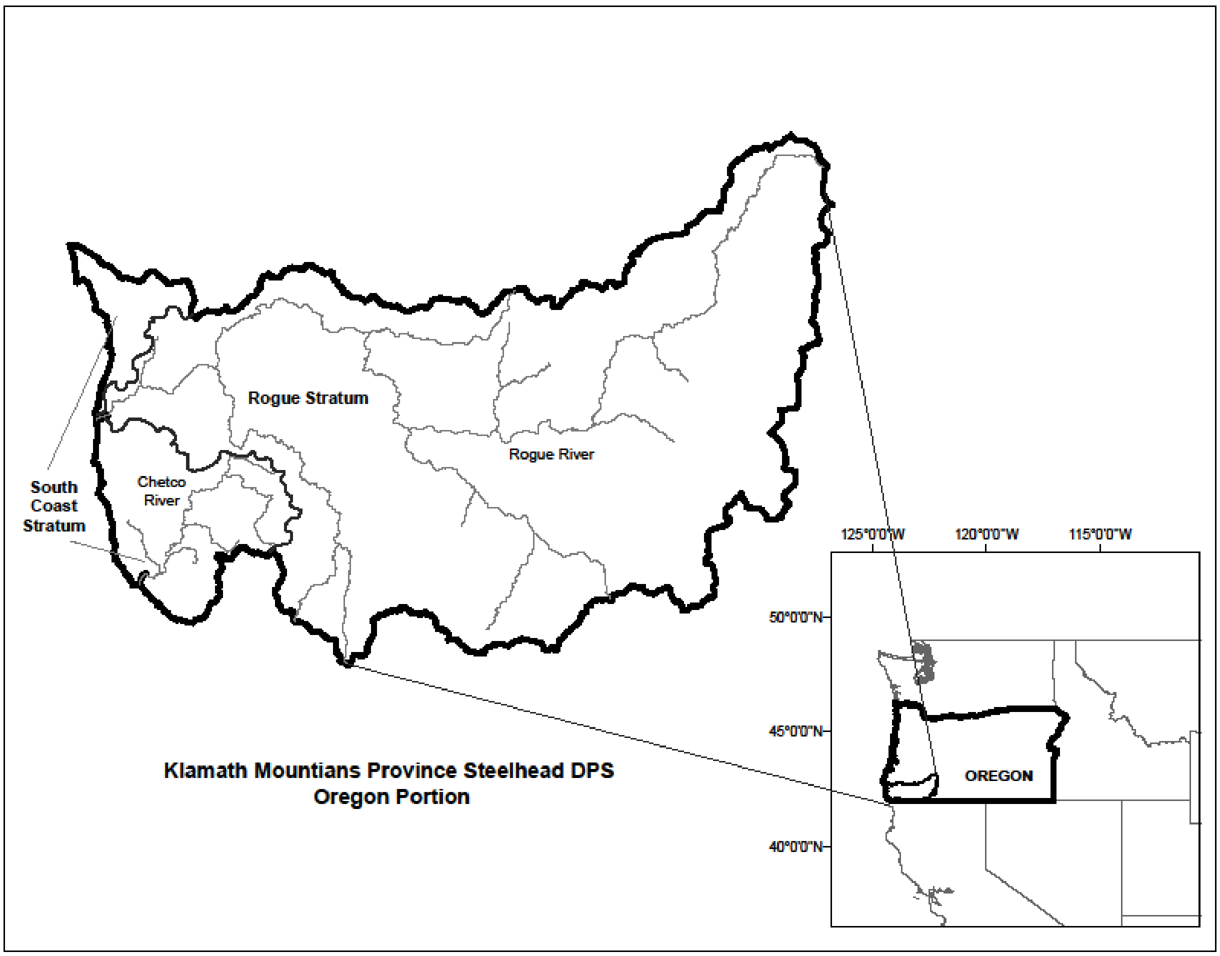

Figure 1. The South Coast and Rogue strata in the Oregon portion of the Klamath Mountains Province steelhead Distinct Population Segment.

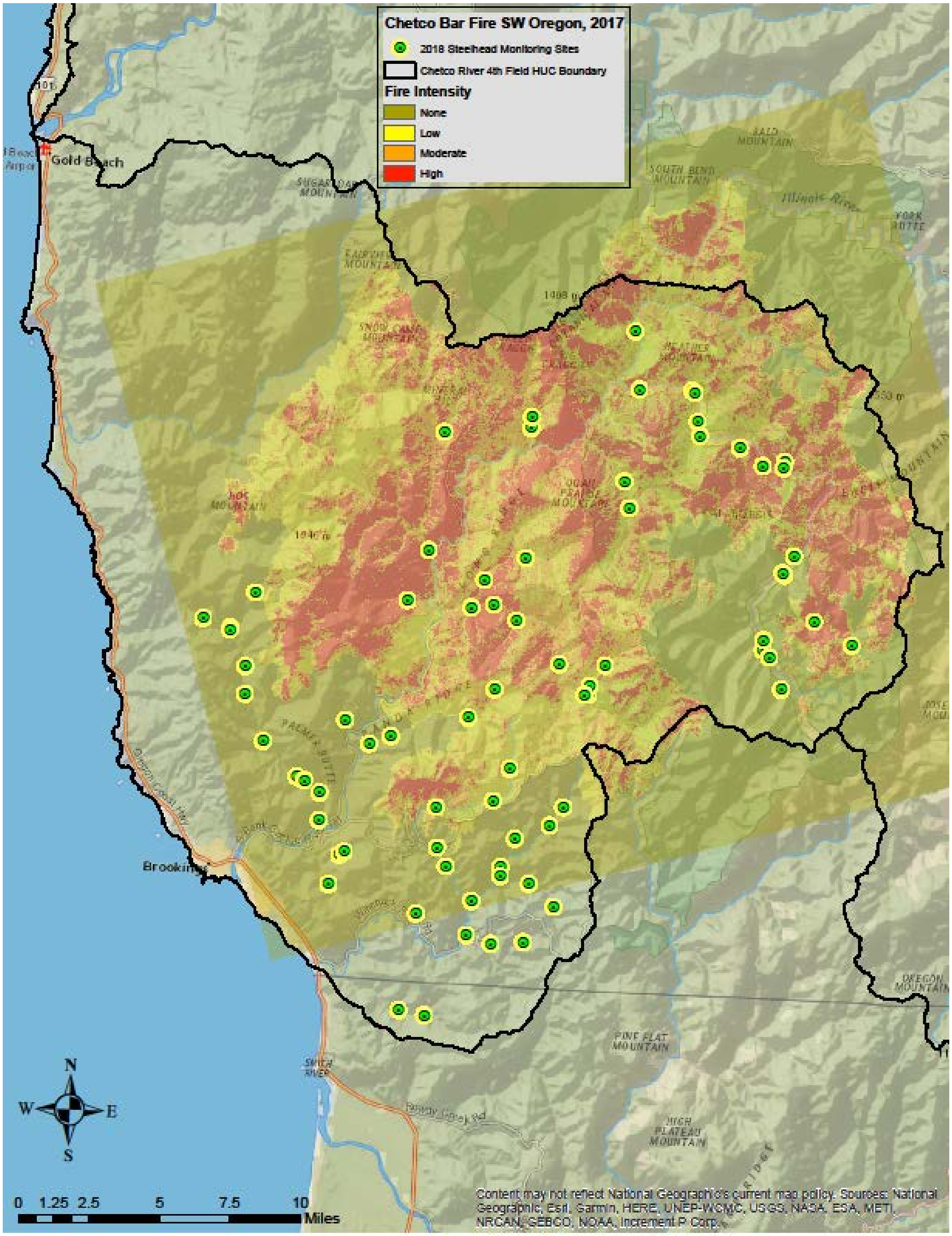

Figure 2. Map of the Chetco Bar Fire in SW Oregon and survey sites from the 2018 field season. Map is 1:250,000 scale

RESULTS AND DISCUSSION

Trends in juvenile steelhead distribution and abundance

One hundred thirty one of the sites in the KMP were resurveyed by supervisory staff from 2002-2018. In these sites counts of steelhead from the original survey correlated ($R^2 = 0.704$) with counts of steelhead from the resurvey (Figure 3). This degree of correlation was similar to that ($R^2 = 0.784$) from resurveys in the larger OPSW monitoring effort in the four Western Oregon steelhead DPSs (Constable and Suring 2018).

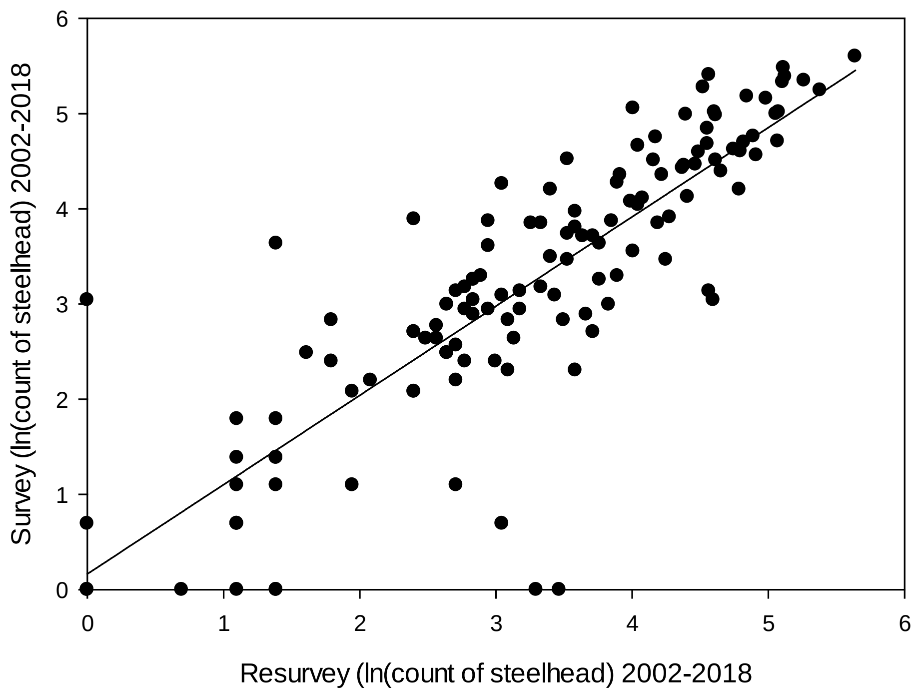

Figure 3. The relationship of steelhead parr (≥90mm in fork length) counts from surveys and resurveys in the Oregon portion of the Klamath Mountains Province Distinct Population Segment for the years 2002-2018 (N = 131). Data are log transformed to satisfy regression assumptions.

The guideline of a 95% confidence interval ≤30% of the abundance estimate was met in four of the 17 years for the South Coast stratum (Figure 4). In all three years when 40 or more OPSW sites were completed, the guideline was met. However, in 2018, 17 OPSW sites and 60 supplemental sites were completed in the Chetco HUC, yet the 95%CI was 31% of the abundance estimate. A single site where abundance was an order of magnitude higher than average was a primary driver of this lower than expected precision. Variance partitioning has indicated low precision in most years was due to such high variation of steelhead abundance among the sites (Anlauf-Dunn, ODFW, unpublished data) and suggests stratifying the sampling frame (following Liermann et al. 2015) may be an appropriate method of meeting variance guidelines.

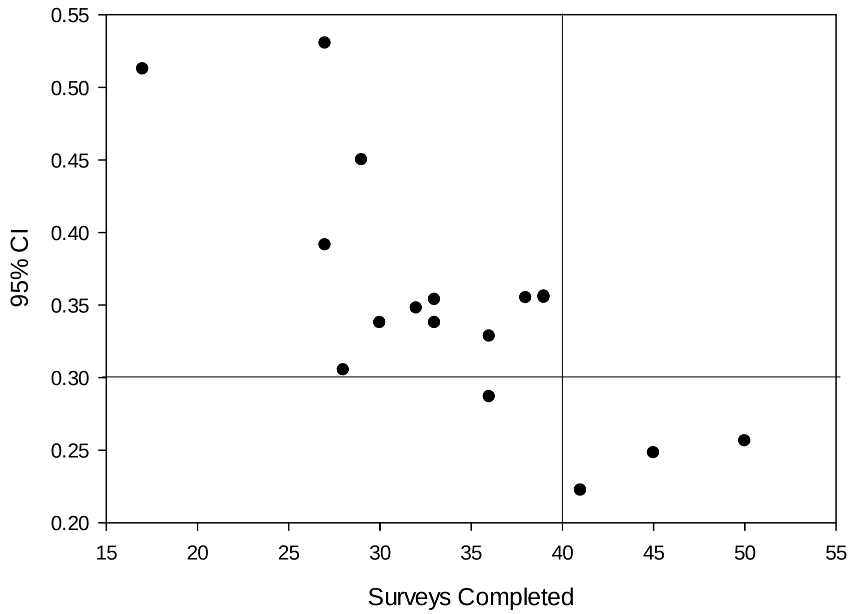

Figure 4. Scatter plot of the number of sites completed (x-axis) and the 95% confidence interval as a percent of the point estimate (y-axis) for the juvenile steelhead abundance. Data are from snorkel surveys in 1st-3rd order streams for the years 2002-2018 in the South Coast Stratum of the Klamath Mountains Province steelhead DPS.

In most years site occupancy and abundance have been higher in the Chetco HUC relative to the South Coast stratum and higher in the South Coast stratum relative to the KMP (Table 1). Annual abundance estimates were lowest for the Chetco HUC, South Coast stratum, and KMP in 2015 (Figure 5). Annual site occupancy estimates were lowest in these three regions in 2016 (the majority of these fish would have been spawned in the spring of 2015). These low estimates for 2015 and 2016 in all three regions may have in part resulted from drought conditions in 2015 (State of Oregon 2016). The 2015 drought was one of the worst on record and the three Oregon counties that encompass the KMP had emergency drought declarations. Data for the 2014-2017 brood group in the Chetco HUC suggests a decline in both abundance and site occupancy relative to previous brood groups (Figure 6). Data for the 2014-2017 brood group in the South Coast stratum also suggest a decline in abundance, but site occupancy remained relatively stable. With the exception 2016, site occupancy in the stratum has been above 92%. Data for the 2014-2017 brood group in the KMP suggest declines in both abundance and site occupancy relative to previous brood groups.

Table 1. Sites completed, occupancy rate, and the estimate of abundance in the Chetco 4th Field HUC, the South Coast stratum of the Klamath Mountains Province steelhead DPS, and in the Oregon portion of the Klamath Mountains Province steelhead DPS. Data are from snorkel surveys in 1st-3rd order streams for the years 2002-2018.

Year	Chetco 4th field HUC			South Coast stratum			Klamath Mountain Province		
	N Sites	occupancy	sthd/km	N Sites	occupancy	sthd/km	N Sites	occupancy	sthd/km
2002	8	100%	354	17	100%	241	84	96%	78
2003	37	100%	167	50	100%	148	114	92%	77
2004	33	97%	115	45	97%	105	100	97%	67
2005	29	97%	187	36	94%	165	97	92%	88
2006	22	100%	140	33	93%	114	91	83%	67
2007	25	100%	154	33	100%	156	85	91%	95
2008	30	100%	207	39	100%	194	96	97%	112
2009	27	100%	191	38	97%	182	104	94%	105
2010	31	100%	102	41	100%	102	108	94%	80
2011	28	100%	189	39	97%	153	100	89%	103
2012	21	100%	184	32	96%	175	97	86%	83
2013	27	96%	143	36	97%	161	91	86%	84
2014	18	100%	70	27	100%	82	58	85%	55
2015	19	100%	35	30	100%	32	82	86%	26
2016	22	73%	96	29	85%	91	91	69%	43
2017	16	94%	145	28	92%	133	92	84%	48
2018	17	100%	64	27	96%	102	80	82%	40

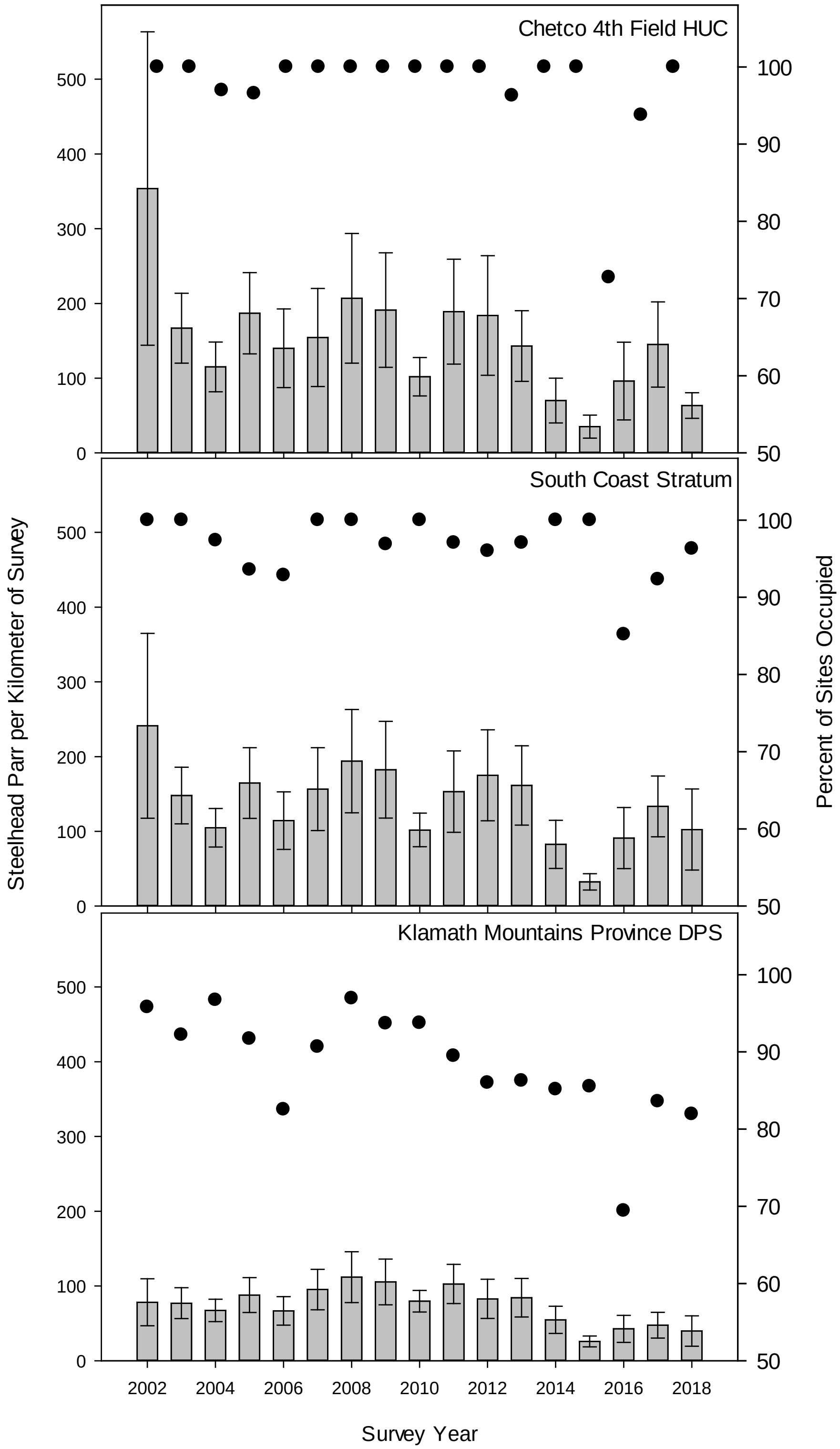

Figure 5. Annual estimates of juvenile steelhead (≥90mm fork length) abundance (gray bars with 95% confidence intervals) and the percent of sites occupied by juvenile steelhead (black dots) in the Chetco 4th field HUC, the South Coast stratum of the KMP, and the Oregon portion of the KMP. Data are from snorkel surveys in 1st-3rd order streams for years 2002-2018.

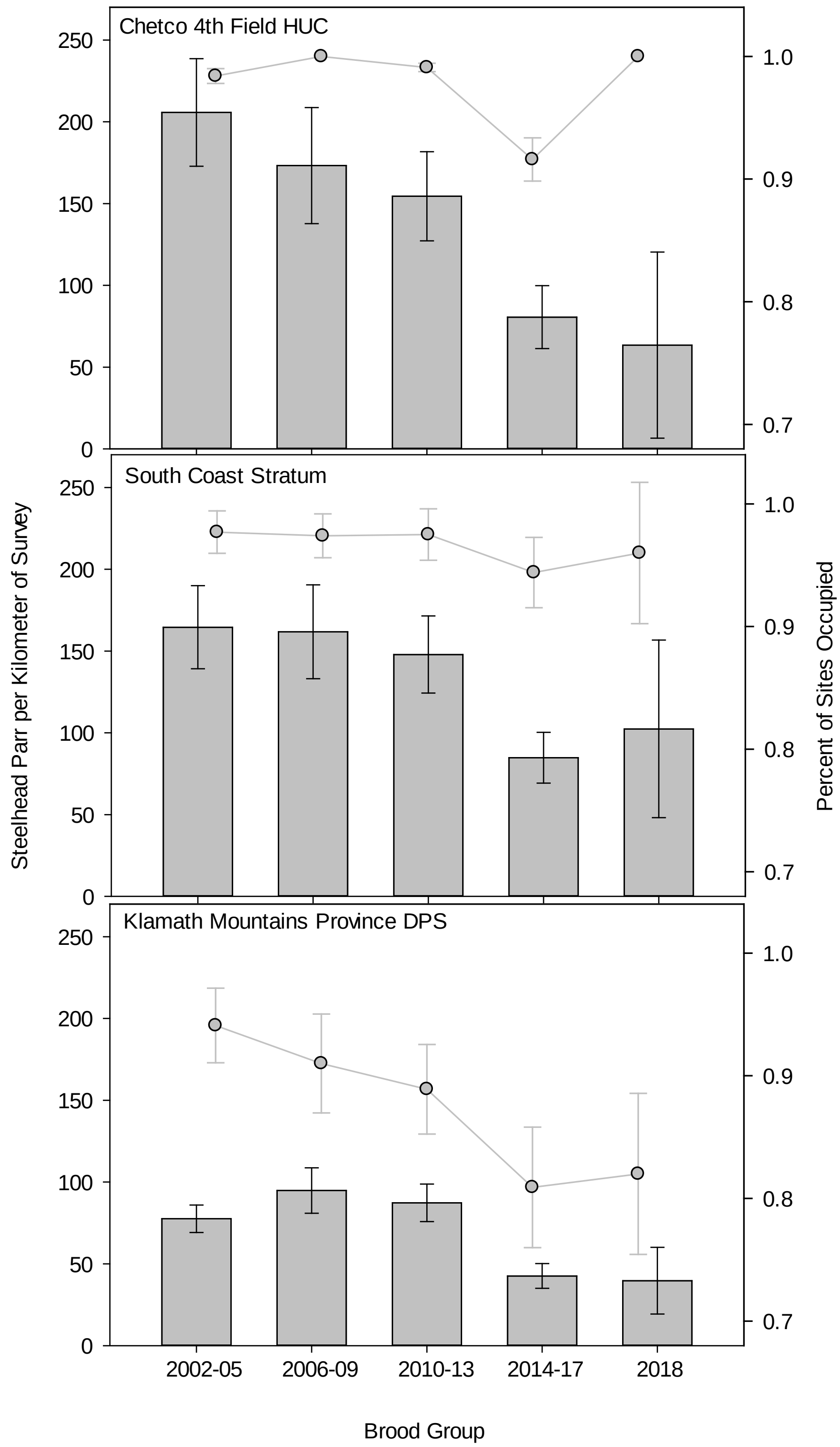

Figure 6. Four year (brood group) trends in juvenile steelhead (≥90mm fork length) abundance (gray bars with 95% confidence intervals) and the percent of sites occupied by juvenile steelhead (black dots) in the Chetco 4th field HUC, the South Coast stratum of the KMP, and the Oregon portion of the KMP. Data are from snorkel surveys in 1st-3rd order streams for years 2002-2018.

Impacts of the Chetco Bar wildfire – preliminary data

The following site occupancy, abundance, and condition comparisons in burned and unburned sites are from a single year of data and should be viewed as preliminary, not final. Additional years of data are needed and additional variables (such as slope) need examination when data collection is complete. Further, definitions of burn intensity may be modified when updated Landsat maps of the Chetco Bar Fire are released.

With the addition of 60 supplemental sites a total of 77 sites were completed in the Chetco HUC in 2018. Site occupancy in burned areas (BAM>0, estimate = 96.5%) was similar to site occupancy in unburned areas (BAM=0, estimate = 97.9%). A Welch's two sample t-test indicated abundance estimates from sites in burned areas (mean = 179.7 sthd/km) were not different than from sites in unburned areas (mean = 94.3 sthd/km), p value = 0.08 (Figure 7). The mean abundance estimate from sites in moderate to high intensity burn areas was 219.5 steelhead per km, which was also not different form sites in unburned areas (Welch's t-test, p value = 0.09).

Snorkel counts were calibrated to m-r estimates in stream segments within five sites. Thirty three habitat units were sampled; 19 were pools and 14 were fastwater units. Four of the 218 marked steelhead (1.8%) were captured in units where they were not marked, indicating that in one stream segment some movement past block nets may have occurred. However, marked steelhead data in the larger OPSW calibration sites have not indicated that steelhead were moving past block nets and that m-r assumption violations may have been minor. In pools where m-r abundance was >0, snorkelers observed 48% of the steelhead estimated by m-r. The 95% CI was 15% of this estimate (±0.7%). An average of 66% of the steelhead abundance, based on m-r, was found in pools that met snorkeling criteria, though this percentage varied 44-100% within the stream segments. An average of 77% of the steelhead abundance was found in pools meeting snorkel criteria from the 11 stream segments that were calibrated in the Oregon Coast DPS (Constable, unpublished data). This percentage varied 52-100%. Once additional calibration data is collected, it will be analyzed to assess *i)* variation in the percent of steelhead m-r estimates that is observed by snorkelers in pools and *ii)* variation in the percent of total steelhead abundance that is distributed into habitat units that do and do not meet snorkeling criteria. This assessment can inform the validity of our monitoring of abundance trends.

Length and weight measurements, used to examine fish condition, were taken from 361 steelhead parr in 2018. Of these measurements 99 were from steelhead in unburned sites, 63 were from steelhead in lightly burned sites, 121 were from steelhead in moderately burned sites, and 78 were from steelhead in highly burned sites. A Welch two sample t-test of Fulton's K fish condition and plots of weight to length (Figure 8) from this preliminary data showed no observable difference in fish condition among sites in areas that were un-burned, lightly burned, moderately burned, or highly burned.

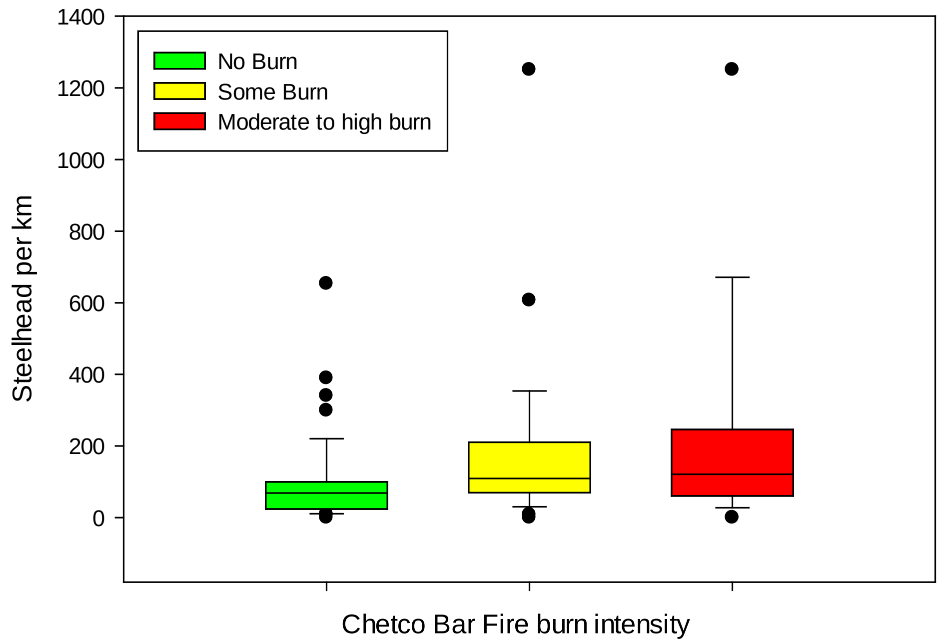

Figure 7. Estimates of juvenile steelhead (≥90mm fork length) abundance within the Chetco 4th field HUC from survey sites that were not burned (green box), had any degree of burning (yellow box), and had moderate to high intensity burning during the Chetco Bar Wildfire. Data are from snorkel surveys in 1st-3rd order streams in 2018.

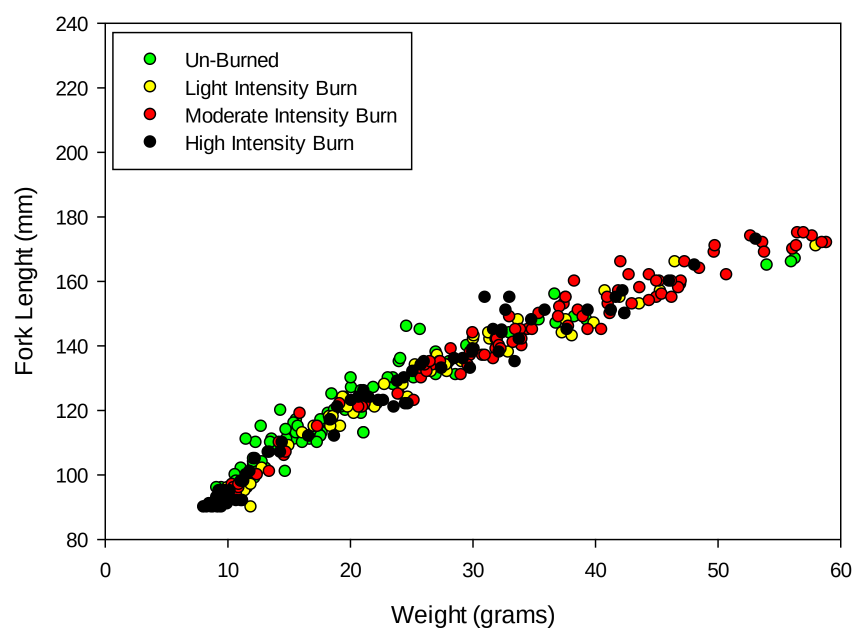

Figure 8. Condition factor of steelhead parr within the Chetco 4th field HUC from unburned or lightly burned survey sites (green dots), moderately burned survey sites (yellow dots) and highly burned survey sites (red dots) from the Chetco Bar Wildfire. Data are from snorkel surveys in 1st-3rd order streams in 2018.

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REFERENCES

Busby. P.J., T.C. Wainwright. G.J. Bryant, L.J. Lierheimer, R.S. Waples. F.W. Waknitz, and I.V. Agomarsino. 1996. Status review of West Coast steelhead from Washington, Oregon, and California. NOAA Technical Memorandum NMFS-NWFSC-27, U.S. Department of Commerce.

Constable, Jr, R.J. and E. Suring. 2018. Juvenile salmonid monitoring in Coastal Oregon and Lower Columbia streams, 2018 field season. ODFW Porgress Report 2018-01. Oregon Department of Fish and Wildlife, Salem.

Crawford, B. A. 2011. Methods for estimating instream juvenile salmonid abundance using snorkeling. Washington Salmon Recovery Funding Board. Olympia, Washington. P. 41-43.

Crawford, B. A. and S. M. Rumsey. 2011. Guidance for monitoring recovery of Pacific Northwest salmon & steelhead listed under the Federal Endangered Species Act. National Marine Fisheries Service, NW Region. U. S. Dept. of Commerce. P. 42-43, 50.

EPA. 2009. Aquatic Resource Monitoring. http://www.epa.gov/nheerl/arm/.

Fulton, T. W. 1911. The sovereignity of the sea. London: Edinburgh.

Hawkins, D. K. 1997. Hybridization between coastal cutthroat (Oncorhynchus clarki clarki) and Steelhead trout (O. mykiss). Doctoral dissertation. University of Washington, Seattle.

Jepsen, D. B. and K. Leader. 2007. Abundance monitoring of juvenile salmonids in Oregon coastal streams, 2006. Monitoring Program Report Number OPSW-ODFW-2007-1, Oregon Department of Fish and Wildlife, Salem.

Jepsen, D. B. and J. D. Rodgers. 2004. Abundance monitoring of juvenile salmonids in Oregon coastal streams, 2002-2003. Monitoring Program Report Number OPSW-ODFW-2003-1, Oregon Department of Fish and Wildlife, Salem.

Liermann M. C., D. Rawding, G. R. Pess, and B. Glaser. 2015. The spatial distribution of salmon and steelhead redds and optimal sampling design. Canadian Journal of Fisheries and Aquatic Science. 72:1-13.

Moore, K. M. S., K. K. Jones, and J. M. Dambacher. 1997. Methods for stream habitat surveys. Oregon Department of Fish and Wildlife, Information Report 97-4, Portland.

Ricker, W. E. 1975. Computation and Interpretation of Biological Statistics of Fish Populations. Department of Environment Fisheries and Marine Service, Ottawa, Bulletin 191, p.78.

Rodgers, J. D. 2000. Abundance of Juvenile Coho Salmon in Oregon Coastal Streams, 1998 and 1999. Monitoring Program Report Number OPSW-ODFW-2000-1, Oregon Department of Fish and Wildlife, Salem.

Roni, P. and A. Fayram. 2000. Estimating winter salmonid abundance in small western Washington streams: a comparison of three techniques. North American Journal of Fisheries Management 20: 682-691.

State of Oregon, J. W. Nicholas, principal writer. 1997. The Oregon Plan (Oregon Coastal Salmon Restoration Initiative). Oregon Governor’s Office, Salem, Oregon, USA.

State of Oregon. 2016. Report of the task force on drought emergency response. Salem, Oregon, USA.

Stevens, D.L., Jr. 2002. Sampling design and statistical analysis methods for the integrated biological and physical monitoring of Oregon streams. Monitoring Program Report Number OPSW-ODFW-2002-7, Oregon Department of Fish and Wildlife, Portland.

USDA Forest Service. 2017. RAVG data bundle for the CHETCO BAR Fire occurring on the Rogue River-Siskiyou National Forest - 2017 (OR4229712395420170712). Salt Lake City, Utah.

APPENDIX 2 STEELHEAD METRICS

Table 2. Estimated metrics and associated 95% confidence intervals for steelhead parr in the Oregon portion of the Klamath Mountains Province Steelhead DPS. Data are from un-calibrated snorkel surveys in 1st-3rd order streams. The 95% confidence interval is expressed as a percent of the estimate.

Klamath Mountains Province Steelhead DPS Steelhead Parr Estimates						
Year	Abundance	±95% CI	Density	±95% CI	Site Occupancy	±95% CI
2002	131,414	45%	0.129	25%	96	3%
2003	93,662	21%	0.078	24%	92	8%
2004	75,819	20%	0.079	24%	97	4%
2005	110,282	22%	0.077	20%	92	8%
2006	84,926	32%	0.066	35%	83	12%
2007	133,121	23%	0.115	30%	91	8%
2008	128,514	33%	0.075	20%	97	5%
2009	128,269	40%	0.069	27%	94	7%
2010	100,053	25%	0.068	27%	94	6%
2011	101,639	26%	0.072	22%	89	8%
2012	127,209	21%	0.043	25%	86	8%
2013	120,995	20%	0.036	18%	86	7%
2014	84,777	26%	0.057	33%	85	11%
2015	46,111	29%	0.025	24%	86	8%
2016	77,062	28%	0.029	25%	69	12%
2017	88,951	21%	0.032	22%	84	8%
2018	63,973	37%	0.021	35%	82	8%

Table 3. 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	21,237	39%	0.127	40%	92	8%
2003	24,260	53%	0.085	38%	86	15%
2004	28,084	42%	0.085	34%	96	7%
2005	52,521	38%	0.089	27%	91	12%
2006	42,503	59%	0.073	48%	77	19%
2007	48,846	34%	0.147	36%	85	14%
2008	60,752	62%	0.085	28%	95	9%
2009	59,163	78%	0.086	33%	92	11%
2010	52,328	43%	0.075	37%	90	11%
2011	48,419	36%	0.089	26%	85	14%
2012	54,911	28%	0.030	40%	83	10%
2013	45,169	24%	0.030	22%	83	9%
2014	45,810	44%	0.061	40%	81	15%
2015	31,081	41%	0.024	32%	81	11%
2016	30,410	44%	0.020	35%	65	16%
2017	16,743	33%	0.023	33%	81	11%
2018	14,176	39%	0.012	39%	77	10%

Table 4. 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	110,177	53%	0.130	32%	100	0%
2003	69,402	22%	0.069	20%	100	0%
2004	47,735	20%	0.068	24%	97	5%
2005	57,761	23%	0.056	20%	94	9%
2006	42,423	25%	0.054	18%	93	9%
2007	84,275	31%	0.058	35%	100	0%
2008	67,762	26%	0.060	24%	100	0%
2009	69,107	39%	0.043	36%	97	5%
2010	47,726	21%	0.056	24%	100	0%
2011	53,220	33%	0.042	25%	97	5%
2012	72,298	30%	0.081	26%	96	7%
2013	75,826	29%	0.054	27%	97	5%
2014	38,967	36%	0.043	23%	100	0%
2015	15,030	31%	0.027	23%	100	0%
2016	46,652	39%	0.060	35%	85	13%
2017	72,208	24%	0.060	26%	92	10%
2018	49,797	46%	0.050	53%	96	6%

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