THE OREGON PLAN *for Salmon and Watersheds*

Assessment of Western Oregon Adult Winter Steelhead and Lamprey – Redd Surveys 2017

Report Number: OPSW-ODFW-2017-09

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Eric Brown
Ryan Jacobsen
Jonathan Nott
Matt Weeber
Mark Lewis

Oregon Adult Salmonid Inventory and Sampling Project
Western Oregon Research and Monitoring Program
Oregon Department of Fish and Wildlife
28655 Highway 34
Corvallis, OR 97333

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SUMMARY

This report provides a summary of results from winter steelhead spawning ground surveys conducted in Lower Columbia (Oregon side) and Oregon Coast basins in 2017. Also included is a brief summary of lamprey data collected from the same monitoring efforts. Precision goals were met (95% C.I. ± 30% of point estimate) for the steelhead estimate in the Oregon Coast (OC) Distinct Population Segment (DPS), but precision goals were not met in the Southwest Washington (SWW) Evolutionarily Significant Unit (ESU) nor in the Lower Columbia River (LCR) ESU. Surveys were not conducted in the Klamath Mountains Province (KMP) DPS for 2017. Winter steelhead redd estimates for the 2017 spawning year were less than 50% of both the 5-year and 10-year averages for the Oregon Coast DPS. We do not have long-term data on winter steelhead redd abundance in the Lower Columbia, but 2017 estimates in the SWW ESU and LC ESU were lower than the five year average. Indices for Pacific Lamprey were lower in 2017 compared to recent years. Weather and stream flows made for challenging survey conditions throughout the 2017 season. Regional patterns are apparent for redd density, proportion of hatchery origin spawners and spawn timing.

INTRODUCTION AND METHODS

As part of the Oregon Plan for Salmon and Watersheds, the Oregon Department of Fish and Wildlife (ODFW) initiated a project to monitor spawning winter steelhead (*Oncorhynchus mykiss*) in coastal Oregon streams in 2003 under the Oregon Adult Salmonid Inventory and Sampling (OASIS) project. The project is designed to assess yearly status and trend in abundance, proportion of hatchery origin spawners (pHOS), and distribution of winter steelhead spawners in four Oregon ESU/DPS units (Figure 1). The Southwest Washington and Lower Columbia ESU's are currently monitored at the population scale, though funding limited efforts in 2017 to only the Clatskanie, Scappoose, Clackamas, and Sandy populations. No monitoring occurred in the Youngs Bay, Big Creek, Gorge, or Hood populations. In the Oregon Coast DPS, monitoring is evaluated at the monitoring area (MA) scale, and at the population scale in the Nestucca population. The KMP DPS was not monitored in 2017.

A spatially balanced probabilistic sampling design (Stevens 2002) was used to randomly select survey sites across a stream network of winter steelhead spawning habitat. The selection frame was developed using professional knowledge from a variety of private and governmental biologists. Within the sampling frame there are/were dams or fish traps where counts of fish are available, including: River Mill (Clackamas River), Marmot (Sandy River), Winchester (North Umpqua River) and Gold Ray (Rogue River) dams, Bonnie Falls Trap (Scappoose River), and Big Creek Hatchery Weir. Counts of steelhead passed upstream are used for monitoring these areas rather than spawning surveys. This report provides results for surveys outside those areas. In accordance with prior work conducted by ODFW in coastal streams, monitoring of winter steelhead abundance is based on counts of redds, with rearing origin determined from live and dead fish (Susac and Jacobs 1999). Repeat visits to each site from at least February through May generate a total redd count for each survey. Sites are visited at least once every fourteen days (Susac and Jacobs 1999). Redds are marked with colored rocks and flagging to prevent re-counting during subsequent surveys. Specific descriptions of project protocols can be found in the annual survey procedures manual (ODFW 2017).

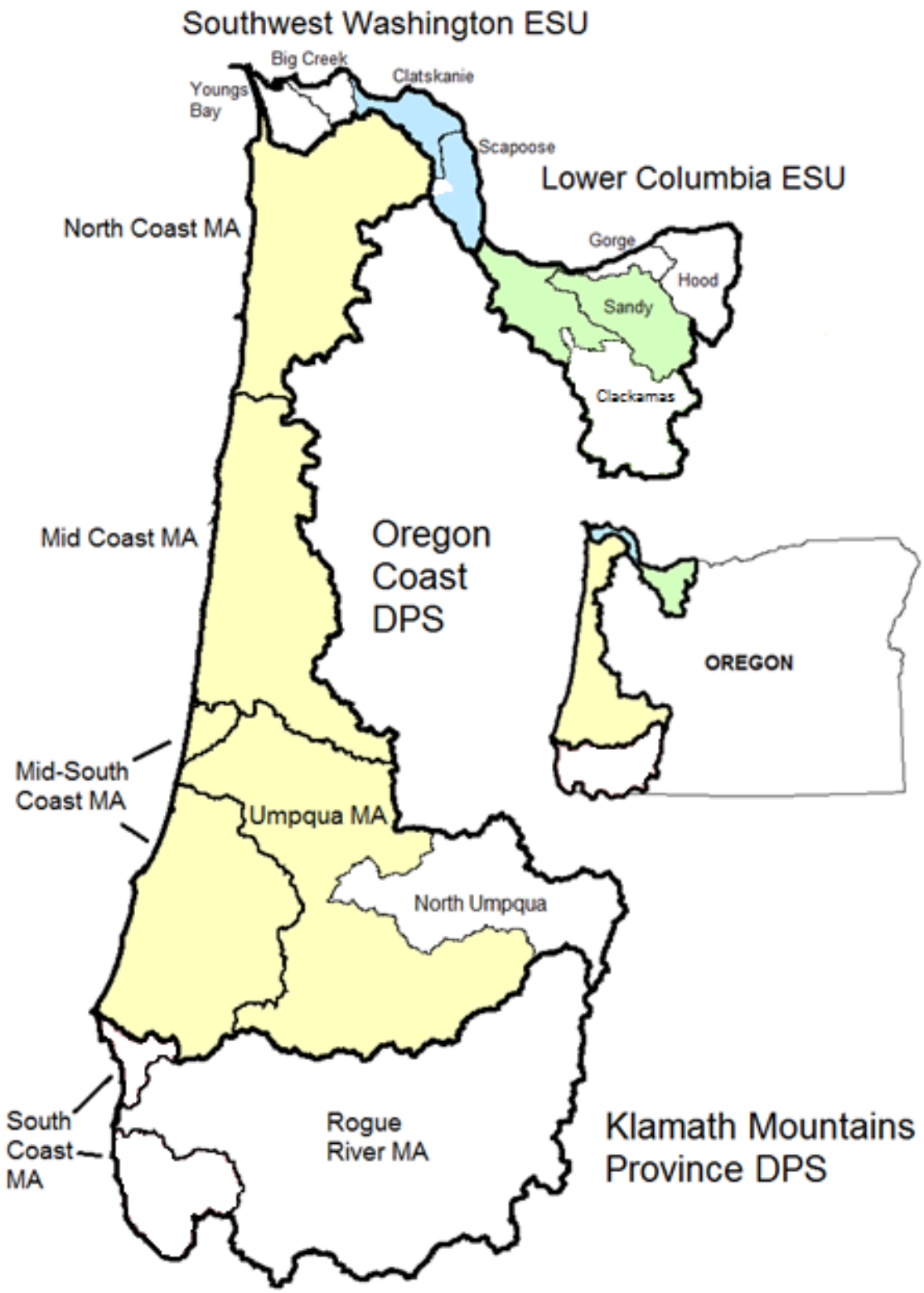

Figure 1. Geographic scope of steelhead spawner monitoring, 2017. Monitoring scales include: Evolutionary Significant Unit (ESU), Dependent Population Segment (DPS), Monitoring Areas (MA), and population. Areas without color were not monitored in 2017.

The geographic scale of monitoring used in this report (Figure 1) is based on a variety of sources. Boundaries for the four ESU/DPS units are as determined by the National Oceanic and Atmospheric Administration (Busby et.al. 1996). Population boundaries are based on Myers et al. (2006) for the LCR ESU population structure and the 2005 Oregon Native Fish Status Report (ODFW 2005) for other populations. Monitoring area boundaries match those used for Coho salmon monitoring by the OASIS project (Lewis et. al. 2009).

Sites adjacent to hatcheries and/or their acclimation areas tend to have a higher proportion of both hatchery fish and redd densities. This uneven distribution of hatchery fish can bias estimates of abundance and pHOS unless accounted for in sampling protocols. In order to reduce bias and increase accuracy within our winter steelhead estimates, we initiated the use of a stratified approach to sampling protocols for steelhead monitoring in 2017. These efforts differ slightly between the Lower Columbia ESU's and Oregon Coast DPS.

In the SWW ESU stratification will be conducted in the Clatskanie population, but will be divided into two strata: Plympton Creek and the remaining Clatskanie basin. There are no hatchery steelhead releases in the Clatskanie population and hatchery fish are typically abundant only in Plympton Creek. In the LCR ESU, in each of the Sandy and Clackamas populations, strata will be defined as migration corridors, areas adjacent to hatchery releases, and the remaining portions of each population (i.e. areas outside of direct hatchery influence). All three strata will initially be calculated individually, but subsequently rolled up into the final population and ESU estimates.

In the OC DPS, the ODFW Coastal Multi-Species Conservation and Management Plan (CMP) allows for higher maximum pHOS rates in areas adjacent to acclimated hatchery release sites (ODFW 2014). These areas are known as hatchery Hot-Spots. Stratification of Hot-Spots aids in reducing estimate bias associated with acclimated hatchery releases within the MA. It also allows ODFW to assess the management goals for both the MA and the Hot-Spots separately, as prescribed by the CMP. Implementation of this stratification will result in abundance and pHOS estimates for the areas of each MA that are outside of these Hot-Spots. Estimates within the Hot-Spots are presented in Appendix Table A-3 for those MA's where two or more sites are successfully surveyed.

RESULTS AND DISCUSSION

This report contains population level summaries for the SWW and LCR ESU's and a monitoring area level summary for the OC steelhead DPS. Counts of adult lamprey and lamprey redds are recorded during steelhead surveys and the results are included in a brief summary at the end of this report.

A total of 223 sites were successfully surveyed in 2017, split between the three steelhead DPS/ESU areas monitored (Table 1). Successful surveys represent 47% of the 473 total sites selected for 2017. Sites were selected at a rate of 1/24 miles of habitat in the Oregon Coast DPS. Selection densities were greater in the two Lower Columbia ESU's (1/4 in the LCR, and 1/2 in the SWW). Twelve percent of sites in 2017 were not surveyed because of landowner access

restrictions. The proportion of sites that were surveyed, but were not used in final estimates due to turbidity and/or large gaps between survey dates averaged 25.5%, ranging from 0.9% in the North Coast MA to 43.3% in the Lower Columbia ESU. The percentage of sites that were outside of steelhead spawning habitat averaged 7% across the three DPS/ESU areas, ranging from 2.2% in the Lower Columbia ESU to 13.1% in the Oregon Coast DPS.

Table 1. Site status by monitoring area or population in 2017. Target sites were within and non-target sites were outside of steelhead spawning habitat. Response sites were successfully surveyed. Non-response sites couldn't be surveyed, or were not successfully surveyed.

DPS/ESU	Monitoring Area or Population	Target Response	Target Nonresponse	Nontarget
Southwest Washington	Youngs Bay [a]	-	-	-
	Big Cr [a]	-	-	-
	Clatskanie[c]	22	2	3
	Scappoose	12	16	0
	Total	**34**	**18**	**3**
Lower Columbia River	Clackamas[c]	7	38	0
	Sandy[c]	21	21	2
	Gorge [a]	-	-	-
	Total	**28**	**59**	**2**
Oregon Coast [b]	North Coast	78	18	15
	Nestucca [d]	*40*	*9*	*9*
	Mid Coast	42	15	10
	Mid South Coast	22	43	7
	Umpqua	19	49	11
	Total	**161**	**125**	**43**
Klamath Mountains Province [a]	South Coast	-	-	-
	Rogue River	-	-	-
	Total	**-**	**-**	**-**

a = Surveys in the Klamath Mountains Province DPS, and in the Youngs Bay, Big Cr and Gorge populations were not conducted in the 2017 season due to budget constraints.

b = Oregon Coast DPS does not include sites that were within hatchery hotspots.

c = Surveys in the Clatskanie, Clackamas and the Sandy River basin are shown here as the sum of all components.

d = Estimate obtained for Nestucca population, which is included in the North Coast estimate.

The target level of precision for steelhead redd estimates is a 95% confidence interval within ±30% of the point estimate. Steelhead spawning survey effort has been dramatically reduced on the Oregon Coast since 2008, resulting in not meeting precision goals at most spatial monitoring scales. In 2017, this goal was achieved only for the Oregon Coast DPS (Table 2). Precision goals were not met in the Clatskanie, Scappoose, Clackamas, Sandy and Nestucca

populations. The North Coast, Mid Coast, Mid-South Coast and Umpqua MA's also did not meet precision goals.

Table 2. Oregon winter steelhead redd abundance estimates, 2017. Wild proportions are derived from fin-mark observation rates on live and dead steelhead.

DPS/ESU	Monitoring Area or Population	Survey Effort		Winter Steelhead Redd Abundance			
				Total		Wild	
		Number of Surveys	Miles	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Southwest Washington	Youngs Bay	-	-	-	-	-	-
	Big Cr	-	-	-	-	-	-
	Clatskanie [ab]	22	19	179	58	170	-
	Scappoose [b]	12	9	17	30	17	-
	Total	**34**	**29**	**196**	**65**	**187**	**-**
Lower Columbia River	Clackamas [a]	7	8	858	614	842	-
	Sandy [a]	21	23	1,249	822	1,248	-
	Gorge	-	-	-	-	-	-
	Total	**28**	**31**	**2,107**	**1,027**	**~~2,090~~**	**~~1,024~~**
Oregon Coast [c]	North Coast	78	66	12,296	3,894	10,720	3,395
	Nestucca [d]	*40*	*33*	*1,064*	*325*	*1,029*	*315*
	Mid Coast	42	32	7,796	3,614	5,522	2,560
	Mid South Coast	22	19	7,070	3,610	6,909	3,528
	Umpqua	19	13	5,982	2,288	5,982	2,288
	Total	**161**	**130**	**33,144**	**6,840**	**29,133**	**5,980**
Klamath Mountains Province	South Coast	-	-	-	-	-	-
	Rogue River	-	-	-	-	-	-
	Total	**-**	**-**	**-**	**-**	**-**	**-**

a = Estimates for these populations are derived from stratified samples. See intro/method section for stratification overview.

b = Not Adequate Sample. No known-fin-clip-status (live or dead) fish were observed, therefore no wild estimate could be derived.

c = Oregon Coast DPS does not include sites that were within hatchery hot-spots.

d = Estimate obtained for Nestucca population, which is included in the North Coast estimate.

* = Wild estimates in red are incomplete totals. See appendix for a full wild estimate.

* =Wild estimates in green were derived from an alternate estimate method using an average of percent of hatchery origin spawners from previous years due to small 2017 sample sizes.

Southwest Washington ESU

The 2017 estimate of wild winter steelhead redds in the Oregon portion of the SWW ESU was 187, although this total includes estimates from only the Clatskanie and Scappoose populations due to a lack of funding for monitoring in the Youngs Bay and Big Cr. populations

(Table 2). The redd estimates in the SWW ESU and both populations sampled in 2017 (Clatskanie and Scappoose) are the lowest in the six years of record (Figure 2 and Appendix Table A-2). Redd densities ranged from 0.3 redds per mile in the Scappoose population to 3.6 redds per mile in the Clatskanie population (Table 3 and Figure 4). Average density across the ESU was 2.0 redds per mile, which is well under the ESU average of 7.1 (Table 3). The percentage of sites with at least one redd observed ranged from 8% in the Scappoose population to 75% in the Clatskanie population. This is well below the average in the Scappoose population and slightly above the average in the Clatskanie population (Table 3).

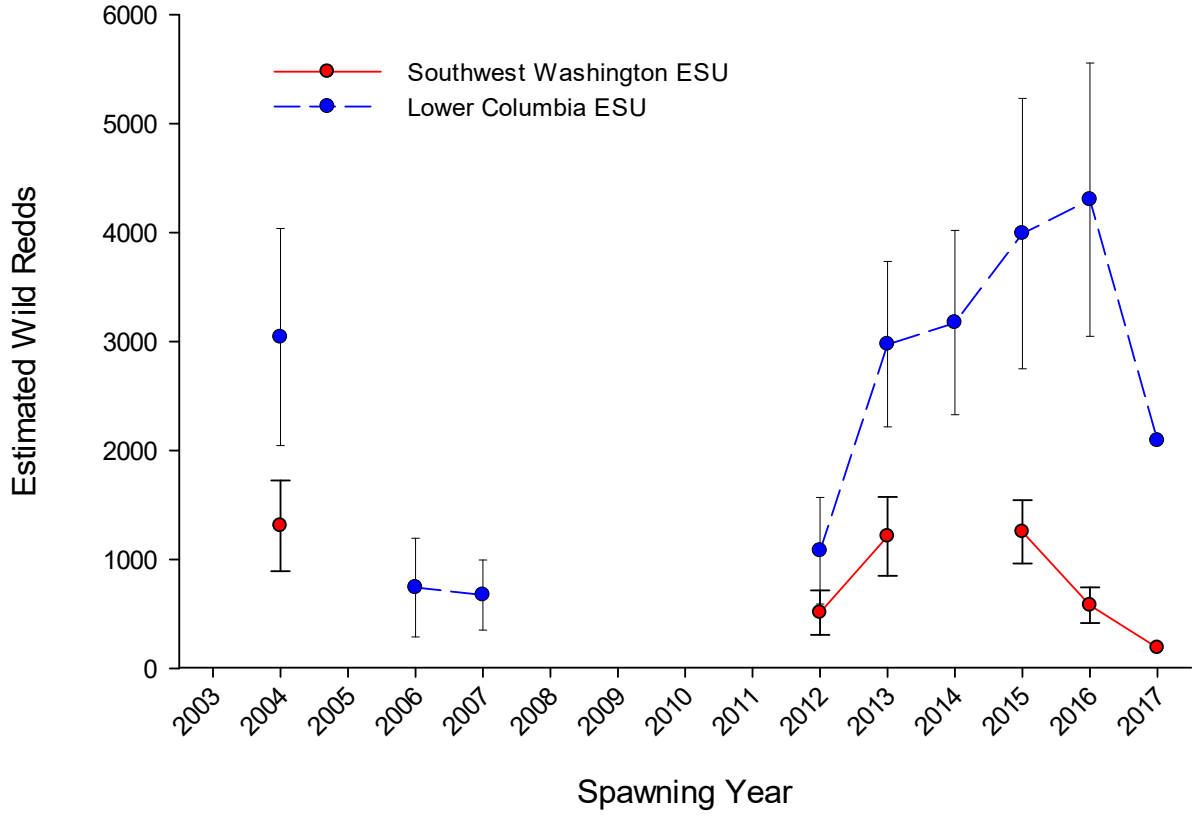

Figure 2. Winter steelhead wild redd estimates in the Oregon portions of the LCR and SWW ESUs based on random surveys, 2004 to 2017. Error bars represent 95% confidence intervals. Inclusion of survey data from specific populations and from above counting stations has varied across years, see Appendix Table A-2. Note that in 2017 error bars were not available given that estimates were calculated with alternative methods.

On average the Scappoose population has only three steelhead observations with known fin-mark status, which was down slightly in 2017 with two observed (Table 4 and Figure 5). In contrast, the number of known fin-mark observations for calculating hatchery proportion in the Clatskanie population (2) is well below the average of 21 (Table 4). When pHOS sample size is less than 10 in a year, prior year's data is used. Surveying conditions were marginal across the region and likely contributed to low numbers of fish observations with known adipose fin clip

status for the ESU. The Clatskanie population had a 5% pHOS rate in 2017 (Table 4 and Figure 5). Spawn timing varied across the SWW ESU populations in 2017, with peak spawning being observed in late February in the Scappoose, and in late March in the Clatskanie (Figure 6).

Table 3. Oregon winter steelhead redd density and percent occupancy in 2017.

DPS/ESU	Monitoring Area or Population	Redds / Mile		% Sites With Redds	
		2017	Average [a]	2017	Average [a]
Southwest Washington	Young's Bay	-	6.3	-	56%
	Big Creek	-	5.7	-	59%
	Clatskanie	3.6	12.5	75%	68%
	Scappoose	0.3	2.0	8%	42%
	Total	**2.0**	**7.1**	**42%**	**59%**
Lower Columbia River	Clackamas	5.7	6.5	71%	54%
	Sandy	8.4	13.5	68%	65%
	Gorge	-	-	-	-
	Total	**7.1**	**9.7**	**70%**	**61%**
Oregon Coast	North Coast	10.6	18.2	60%	79%
	Mid Coast	5.5	11.6	54%	81%
	Mid-South Coast	7.5	18.3	64%	89%
	Umpqua	3.5	8.8	67%	72%
	Total	**6.8**	**13.3**	**61%**	**80%**
Klamath Mountians Province	South Coast	-	18.0	-	95%
	Rogue River	-	9.6	-	82%
	Total	**-**	**14.2**	**-**	**89%**

a = Average for period of monitoring: Oregon Coast is 2003-2016; SWW and LCR is 2012-2016.

Lower Columbia ESU

The Oregon portion of the Lower Columbia Steelhead ESU includes four populations. However, due to budgetary and logistical issues no surveys were conducted in the Lower Gorge or Hood River populations in 2017. Spawning ground survey effort was limited to the Sandy population, excluding the portion above Sandy Hatchery on Cedar Creek, and the Clackamas population located below River Mill Dam.

The 2017 estimate of wild winter steelhead redds in the LCR ESU was 2,090 (Table 2). This is the fourth lowest LCR ESU redd estimate in the nine years of monitoring that include both the Sandy and Clackamas populations (Appendix Table A-2). However, trend analysis is not possible considering the lack of a continuous time series. The 2017 Clackamas estimate of 842 wild redds is the third lowest estimate in nine years of monitoring began (Figure 3). It should be noted that the 2004 estimate included the entire Clackamas population, and all

subsequent estimates are only for the area below River Mill Dam. For comparison, areas above the dam have provided an average of 43% of the estimated winter steelhead in the Clackamas basin during the seven years of record available for comparison. The 2017 Sandy population estimate of 1,248 wild redds is the lowest estimate observed since 2012 (Figure 3). However, the 2004 through 2007 estimates in the Sandy are only for the area below Marmot Dam, while all subsequent estimates are for the whole Sandy population. Survey conditions in 2017 for both the Clackamas and Sandy populations were challenging, which could have impacted redd estimates.

Table 4. Number of known fin-mark status steelhead observed on spawning grounds, and resulting percent hatchery fish in 2017. Hatchery percentage based on adipose fin clip observations of live and dead steelhead in successfully conducted surveys.

DPS/ESU	Monitoring Area or Population	Number Known Fish		Percent Hatchery	
		2017	Average [a]	2017	Average [a]
Southwest Washington	Young's Bay	-	-	-	-
	Big Cr	-	-	-	-
	Clatskanie	2	21[c]	5%	5%
	Plympton	0	-	-	-
	Scappoose	2	3	0%	0%
	Total	**4**	**3**	**5%**	**-**
Lower Columbia River	Clackamas Population	12	28	2%	19%
	Clackamas	11	-	0%	-
	Migration Corridor	-	-	-	-
	Eagle Creek	1	-	25%	-
	Sandy Population	11	33	1%	5%
	Sandy	11	-	0%	-
	Migration Corridor	-	-	12%	-
	Cedar Creek	-	-	-	-
	Gorge	-	0	-	-
	Total	**34**	**-**	**1%**	**4%**
Oregon Coast [b]	North Coast	112	100	13%	11%
	Nestucca [d]	*61*	-	*3%*	-
	Mid Coast	24	74	29%	21%
	Mid South Coast	44	99	2%	18%
	Umpqua	12	54	0%	5%
	Total	**253**	**326**	**12%**	**14%**
Klamath Mountains Province	South Coast	-	65	-	6%
	Rogue River	-	50	-	7%
	Total	**-**	**88**	**-**	**6%**

a = Average for period of monitoring: Oregon Coast is 2003-2016; SWW and LCR is 2012-2016.

b = Oregon Coast DPS does not include sites that were within hatchery hotspots.

c = Average includes samples from whole population including Plympton Cr.

d= Estimate obtained for Nestucca population, which is included in the North Coast estimate.

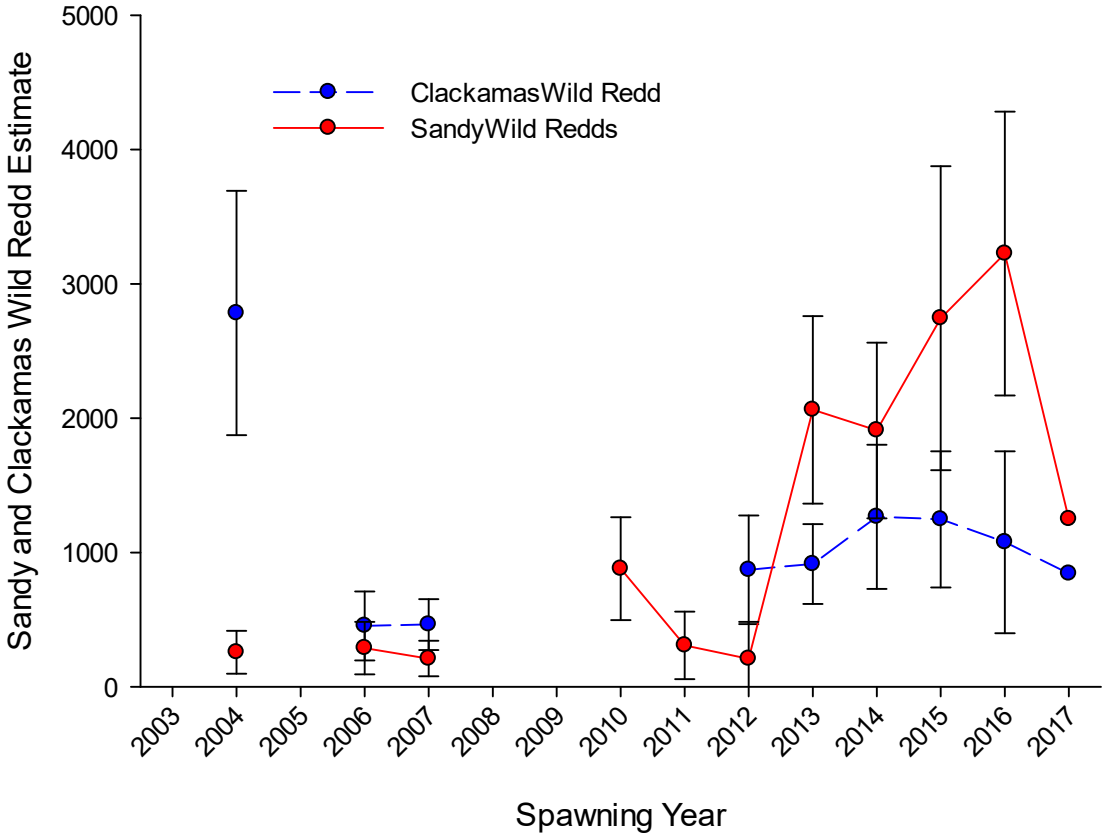

Figure 3. Winter steelhead wild redd estimates in the Clackamas and Sandy River populations based on random surveys, 2004 to 2017. Error bars represent 95% confidence intervals. Note that in 2017 error bars were not available given that estimates were calculated with alternative methods.

Survey frequency in the Sandy population for the 2013 through 2017 spawning survey seasons differed from all other populations reported. In these seasons surveys were conducted weekly, rather than the bi-weekly survey frequency in previous seasons. The more frequent survey rotation was done primarily to improve the sample size of known fin-marked adults in the basin, but also to maintain a higher number of successfully surveyed sites because of chronically high/turbid water issues. In the Sandy population, 62% of the sites surveyed in 2017 met protocols for inclusion in the estimate calculation. This site completion rate is relatively high given survey conditions, which were the most challenging since 2012. The increased rate of survey visits during the spawning season were a likely factor in the high proportion of valid surveys completed in 2017.

Redd density for the LCR ESU was 7.1 redds per mile; ranging from 5.7 redds per mile in the Clackamas to 8.4 redds per mile in the Sandy (Table 3 and Figure 4). Both the Clackamas

and Sandy redd densities were below their respective averages (Table 3). The percentage of sites having at least one redd were similar within the two populations, with 71% of sites occupied in the Clackamas and 68% of sites occupied in the Sandy population (Table 3). Site occupancy was above average in both the Sandy and Clackamas populations in 2017.

The proportion of naturally spawning hatchery steelhead in the LCR ESU was 1% in 2017. The 2017 pHOS rate of 1% in the Sandy population is below average. The sample size (11) for the 2017 estimate of pHOS in the Sandy is lower than the long term average (33), but relatively strong given the difficult survey conditions. The increased rate of survey visits in the Sandy population is likely to have contributed to achieving our sampling goals for 2017.

In the Clackamas population the pHOS for the population estimate for areas below River Mill Dam is 2%, which is well below the average of 19% for this area (Table 4). It should be noted that the pHOS for the entire Clackamas population (including fish passed above River Mill Dam) is lower (1%).

The Sandy and Clackamas Rivers contain hatchery summer steelhead programs. Differentiating summer and winter steelhead on the spawning grounds is difficult. The two runs differ somewhat in spawn timing, with most summer-run fish spawning from late December into February, and winter runs spawning February through May. Management plans for wild winter steelhead in the Sandy and Clackamas Rivers set different maximum allowable pHOS rates for the two steelhead runs. When the Sandy total hatchery steelhead pHOS rate is less than the lower of the two run specific pHOS limits, both are in compliance. If the total exceeds the lower limit (5% for summer steelhead), then a separate pHOS calculation is made for the period of spawning overlap between wild winter and hatchery summer steelhead runs. This calculation is based on redds and known fin clip status steelhead observed before March 1st. The overall 1% estimated pHOS in the Sandy population for 2017 is lower than the goals for summer-run hatchery fish (5%) and winter-run hatchery fish (10%), and thus did not trigger the calculation of a separate summer steelhead pHOS.

Peak spawn timing in the Clackamas population occurred in early April, which is typical of this population (Figure 6). Peak spawn timing in the Sandy population was also within that population's normal range, peaking in early April (Figure 6). Survey conditions were difficult throughout most of the 2017 spawning season in the LCR ESU, and timing signatures may have been altered as a result of challenges to surveying methods.

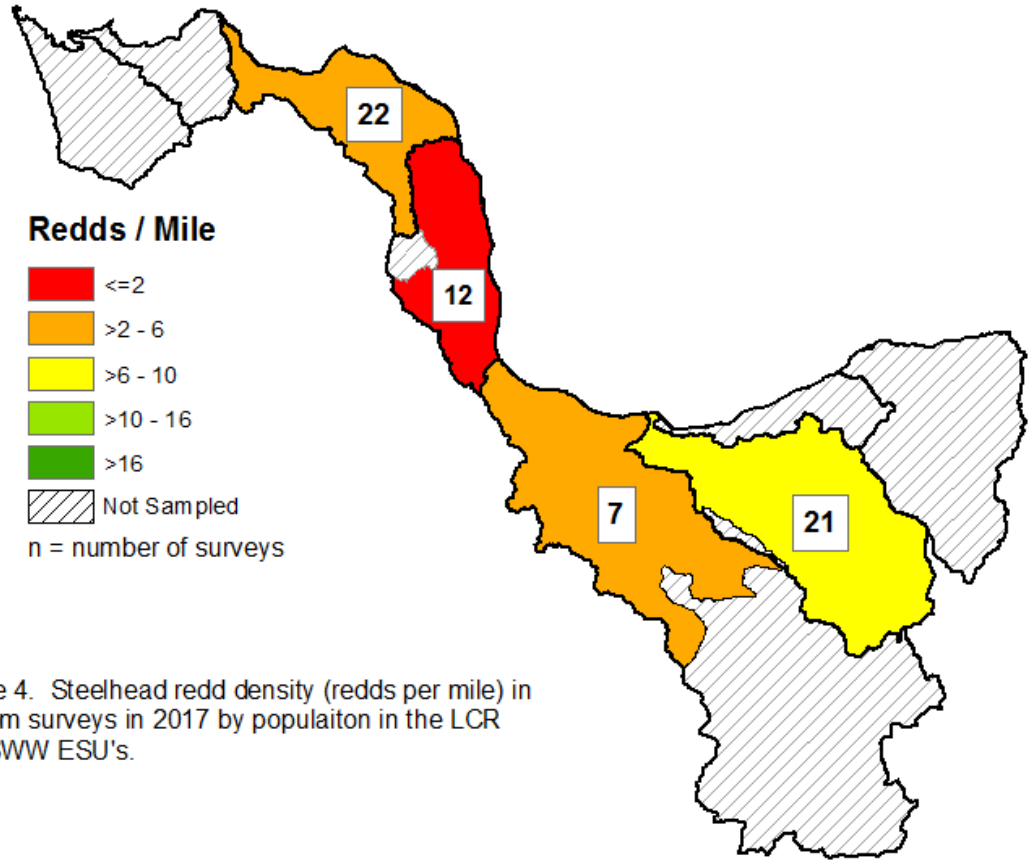

Figure 4. Steelhead redd density (redds per mile) in random surveys in 2017 by populaiton in the LCR and SWW ESU's.

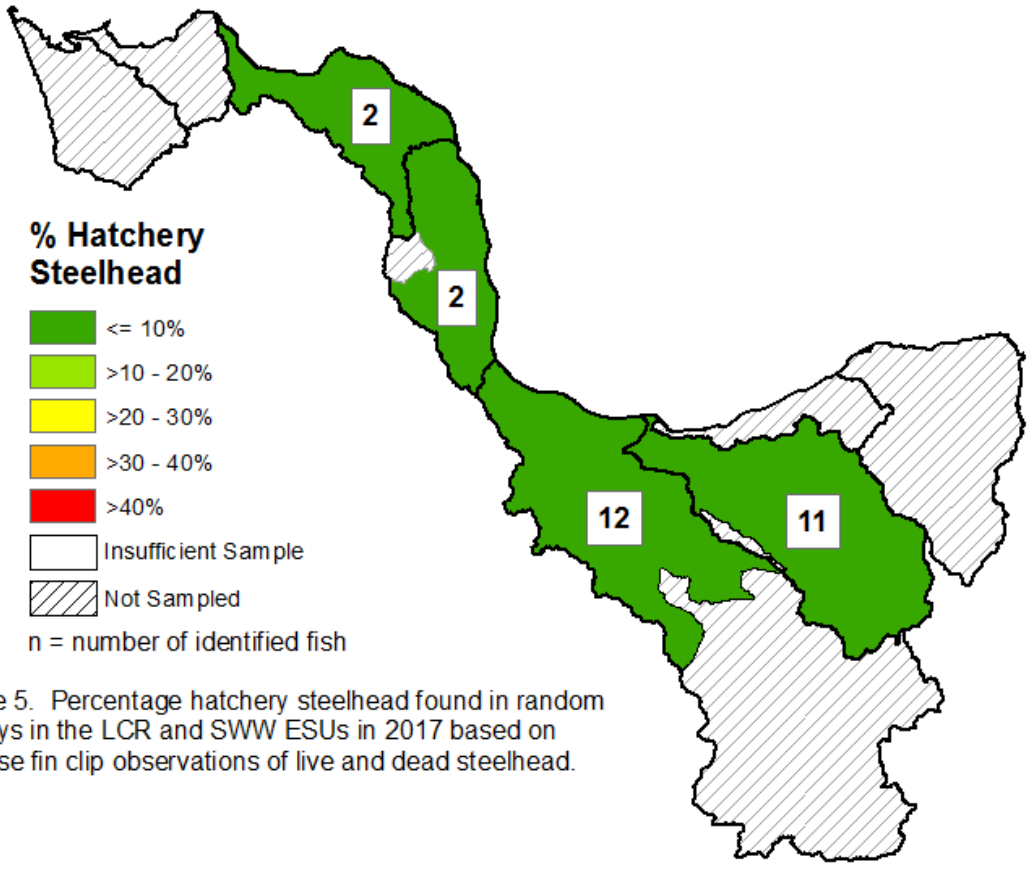

Figure 5. Percentage hatchery steelhead found in random surveys in the LCR and SWW ESUs in 2017 based on adipose fin clip observations of live and dead steelhead.

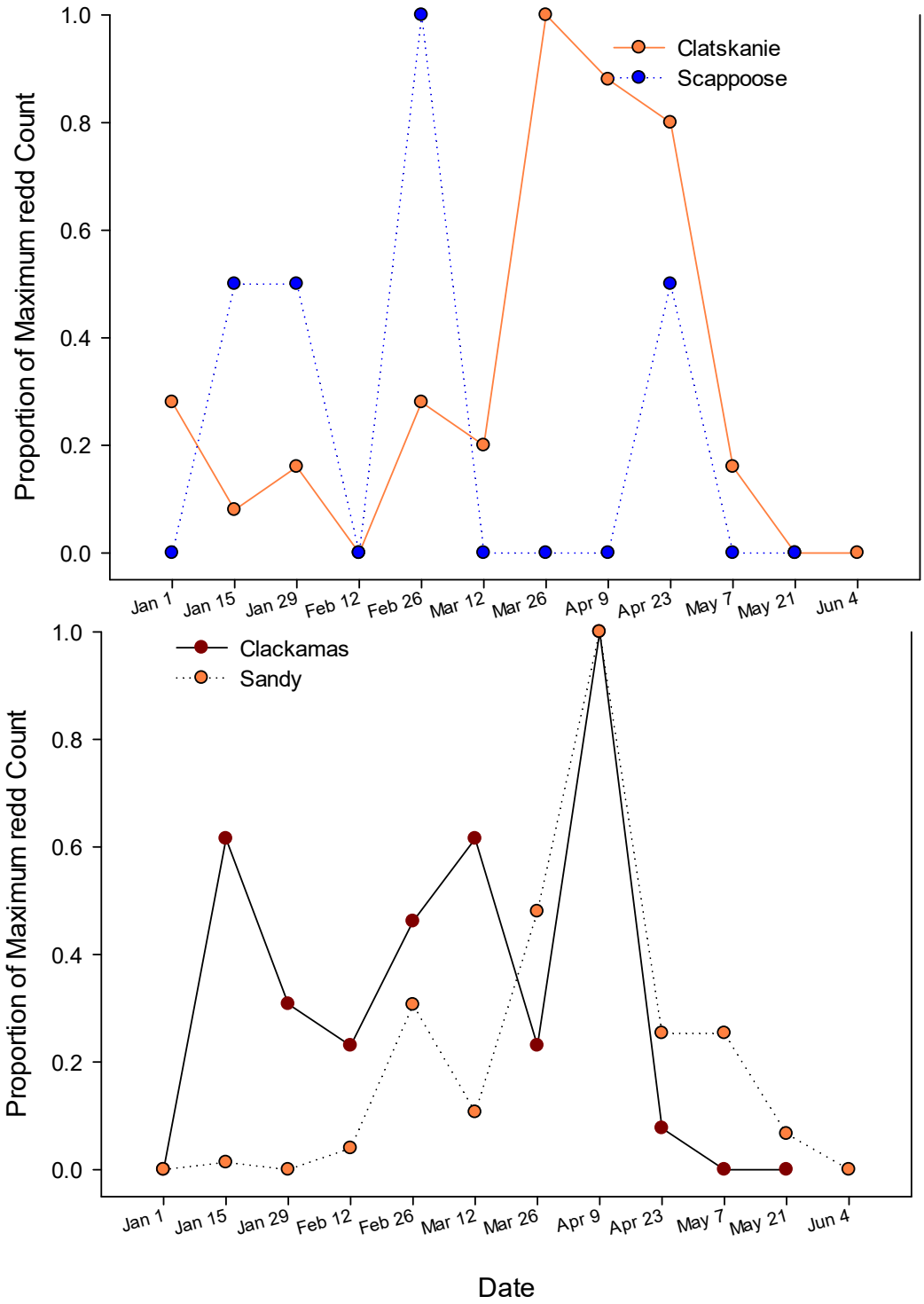

Figure 6. Proportion of the maximum winter steelhead redd count in each of the Lower Columbia populations by week of the year in 2017.

Oregon Coast DPS

The 2017 estimate of 29,133 wild winter steelhead redds in the Oregon Coast DPS is the lowest estimate since this monitoring began in 2003 and 48% of average (Figure 7). Results in individual MA's are all similarly below average with the North Coast being 53% of the long term average, the Mid Coast (37%), Mid-South (49%) and Umpqua (47%) (Appendix Table A-1). While the estimated abundance of wild steelhead redds in the Oregon Coast DPS has ranged from 29,133 to 94,616 across the 15 years of monitoring (2003 through 2017), there does not appear to be any clear trend in abundance over this time period. The relatively short time period of monitoring and the reduced effort in recent years (and thus generally larger 95% confidence intervals) currently limit the ability to detect long-term trends in abundance.

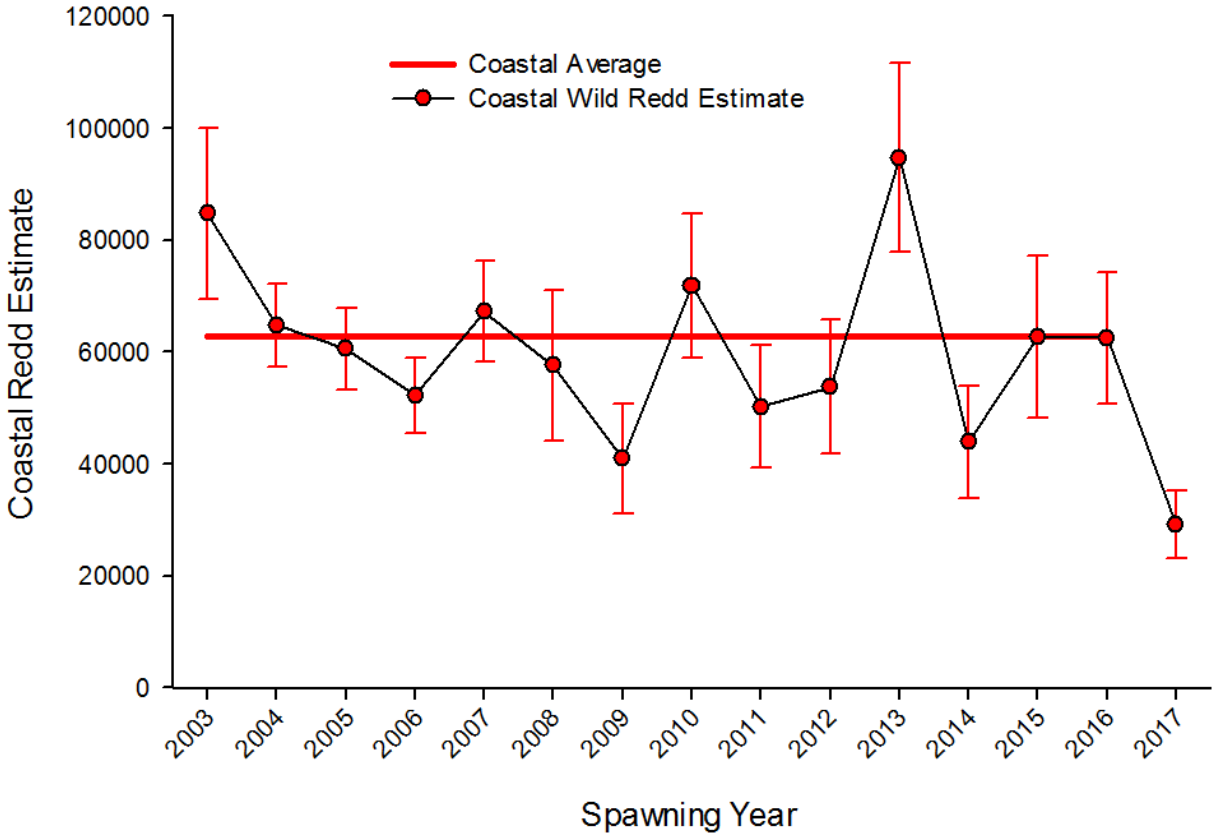

Figure 7. Estimated number of wild winter steelhead redds in the Oregon Coast DPS, 2003 to 2017. Error bars represent 95% confidence intervals, and horizontal lines show the previous 14-year average.

Density of redds (steelhead redds/mile of spawning habitat) also varied across monitoring areas, ranging from 3.5 redds/mile in the Umpqua MA to 10.6 redds/mile in the North Coast MA (Table 3 and Figure 8). Similar to the redd abundance estimates, redd densities were well below average, being only 51% of the previous 14-year average in the Oregon Coast DPS.

An occupied site is defined as having at least one steelhead redd recorded during the season. The proportion of occupied sites in 2017 in the Oregon Coast DPS was 61%, which is well below the 14 year average of 80% (Table 3). Occupancy in individual MA's ranged from 54% in the Mid Coast MA (28 percentage points less than average) to 67% in the Umpqua MA (five percentage points less than average). While there were plenty of moderate to high flow events across the majority of the steelhead migration and spawning season, which should enable steelhead to reach even the upper reaches of their spawning distribution, low abundance seems to have had an impact on the lower occupancy rates observed in 2017.

The proportion of hatchery origin spawners in the naturally spawning steelhead population of the Oregon Coast DPS was 12% in 2017, which is near the 2003-2016 average of 14% (Table 4). The proportion of hatchery origin spawners varied among the monitoring areas in 2017 (Figure 9), ranging from 0% in the Umpqua MA to nearly 29% in the Mid Coast MA. The Umpqua and Mid-South MA's had 2017 pHOS rates below their respective 14 year averages, with the Mid-South MA considerably lower at 2% than average of 18% (Table 4). In contract the North Coast and Mid-Coast had 2017 pHOS rates that were slightly higher than their previous 14 year age raves. Sample size for pHOS calculations in 2017 were above our 10 fish minimum in all four monitoring areas, ranging from 12 in the Umpqua MA to 112 in the North Coast MA (Figure 9).

Oregon Coast DPS peak spawning time (defined as maximum number of new redds observed) occurred later as compared to previous years. This is likely a result of stream flows which were higher than typical for the first half of the season (Figure 10 and Figure 11). Over the 14 years of monitoring, typical peak spawning time for the four monitoring areas are: early April in the North Coast MA; a bi-modal peak in late February and early April in the Mid Coast MA; and late February for both the Mid-South Coast MA and Umpqua MA. This year in Mid-South and Umpqua MA's, peak spawn timing was 2-4 weeks later than average. In the Mid Coast the majority of spawning occurred during March and early April, with almost no activity recorded during February's normal first peak. North-Coast peak spawn timing was comparable to previous years, but spawning did not start until much later than normal and was consolidated to mid-March through mid-May (Figure 10). The pattern of recurrent high flow events present from early-February through March (Figure 11) may have either delayed spawning or inhibited/delayed our ability to detect redds during that time. If the later occurred, it would result in an underestimate of redd abundance in 2017.

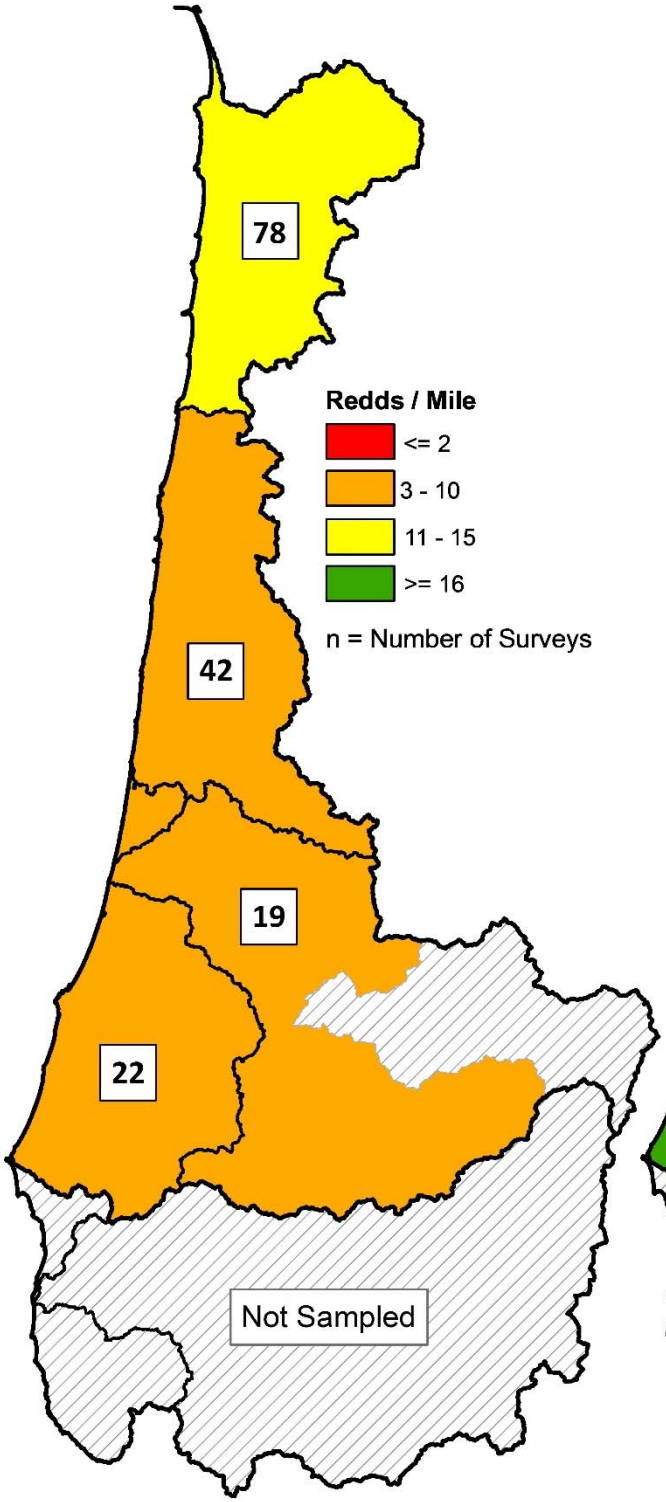

Figure 8. Steelhead redd density (redds per mile) in random surveys in 2017 by monitoring area in the Coastal and KMP DPS's.

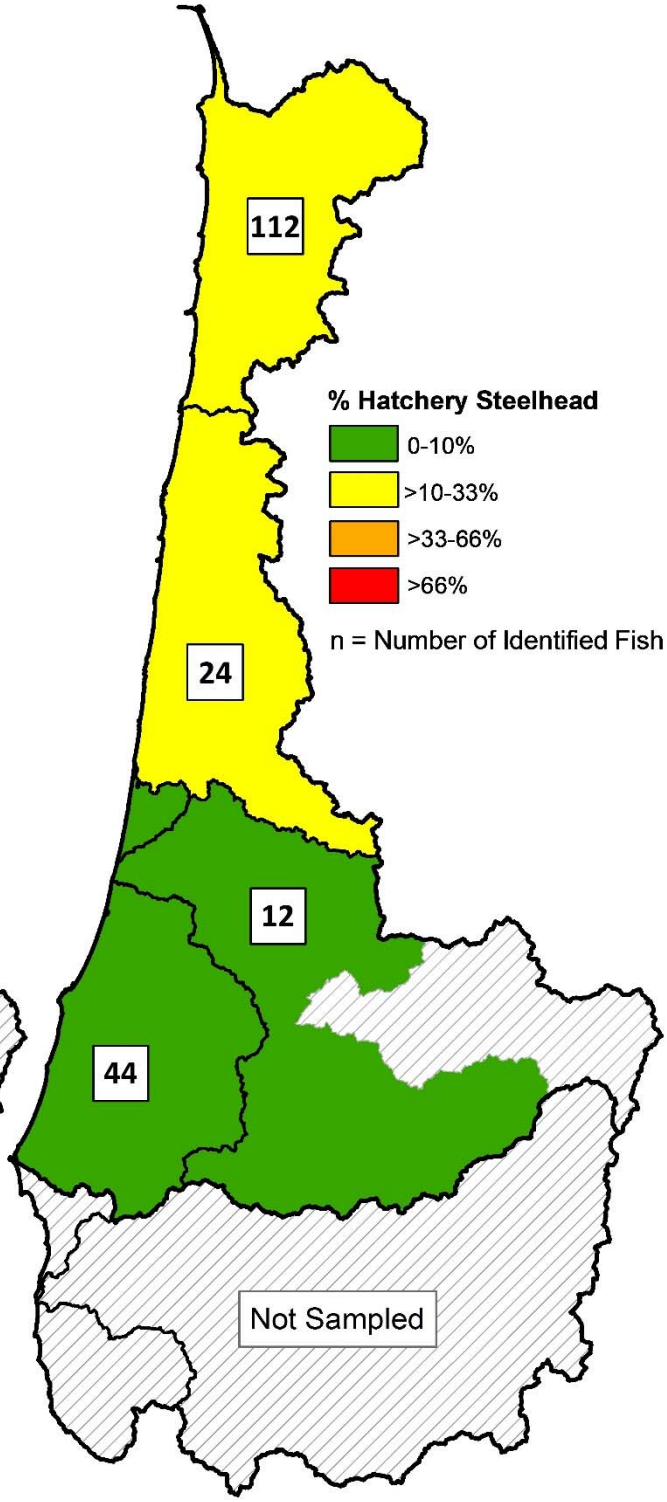

Figure 9. Percentage hatchery steelhead found in random surveys in each of the six Coastal and KMP monitoring areas in 2017 based on adipose fin clip observations of live and dead steelhead.

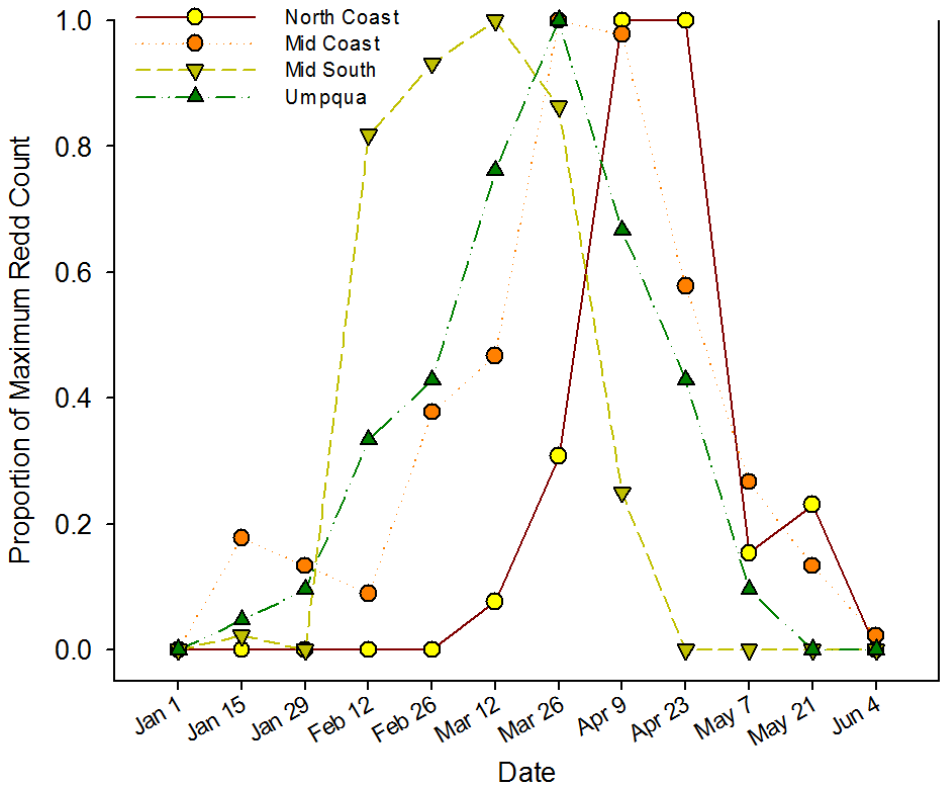

Figure 10. Proportions of the maximum winter steelhead redd count in each of the four Coastal areas by two-week period in 2017.

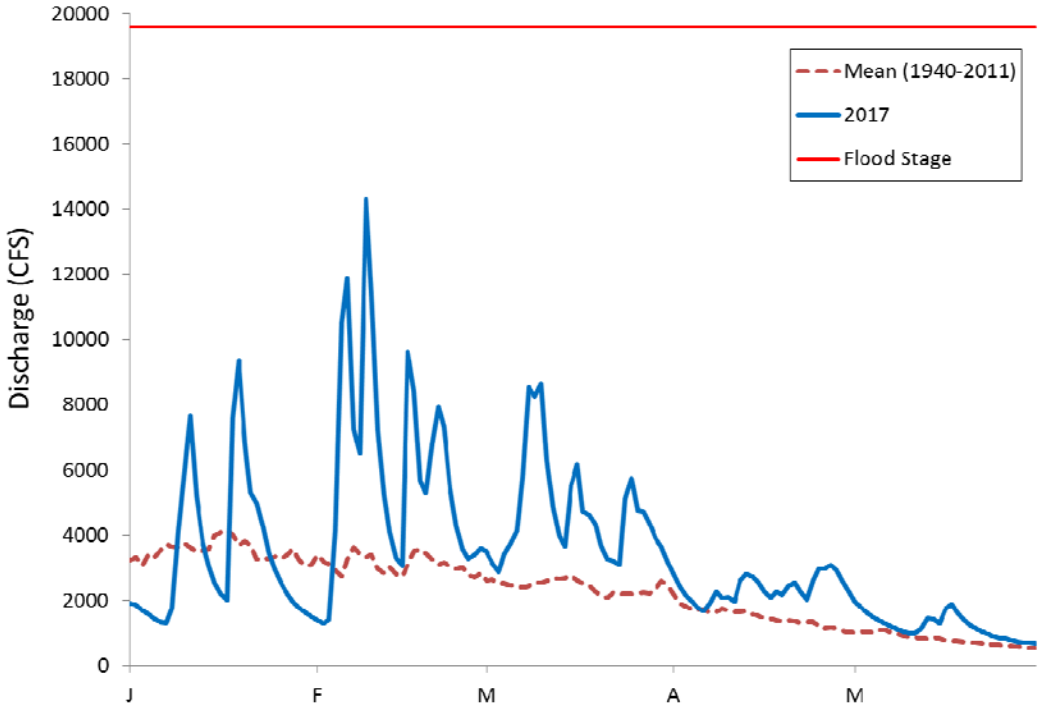

Figure 11. Stream discharge at Alsea River near Tidewater during 2017, compared to mean discharge from 1940 to 2011. (Flood stage = 19,500 CFS)

Steelhead Escapement

In recent years there has been an increased emphasis on a redd-to-fish conversion so that estimates can be reported in terms of fish rather than redds. In 2013 a re-analysis of previous year's redd-to-fish regression efforts was conducted, based on four calibration sites over a five-year time span (1998-2002). This re-analysis resulted in a conversion rate which is intended to be used across all of the monitoring areas and populations included in this report (ODFW 2013).

Total steelhead = (1.70 * Redds) + 3.74

Estimates of winter steelhead escapement in 2017, derived from redd counts and then converted with the above equation are reported in Table 5. Starting in 2014, we began exploring additional calibration sites using similar methods and a mix of new and repeated calibration sites. However, those results are not yet reported nor used for conversions. These calibration efforts are intended to be an ongoing, annual component of these monitoring efforts. Some variation does exist between sites and between years, so the goal is to build on previous calibration work by exploring the feasibility of producing a redd-to-fish conversion on an annual basis.

LAMPREY MONITORING

Over the course of steelhead monitoring, ancillary data recorded on each survey include the counts of Pacific Lamprey (*Entosphenus tridentatus*) redds, as well as counts of observed live and dead lamprey. In addition, Western Brook Lamprey (*Lampetra richardsoni*) are observed and data recorded, but that data is not summarized in this report. While these data do provide information for lamprey coast-wide and in the Lower Columbia, it is worth noting that survey sites are selected from the known distribution of steelhead spawning habitat, which does not necessarily cover lamprey spawning distribution. Furthermore, while live lamprey are observed spawning on surveys, we do not survey often enough nor when lamprey are most active (at night) to use live lamprey counts for abundance estimates. As a result, lamprey density on spawning surveys is summarized in this report by peak redds per mile. The peak redd count is the highest number of lamprey redds visible during any one survey date within a given spawning season. Peak redd counts provide information on the distribution and timing of lamprey spawning activity, as well as some indication of relative density (and by proxy, relative abundance). Lamprey redd counts also provide occupancy information, though survey methods have not been precision tested. So, while a lamprey redd likely proves lamprey presence in a given survey, the lack of recorded redds does not necessarily mean lamprey were absent. Despite the many caveats, this lamprey data set has grown quite large, and contains some information that may begin to provide a method of tracking Pacific Lamprey trends and relative abundance.

Table 5. Oregon winter steelhead fish abundance estimates in 2017. Estimates do not include steelhead above counting stations and are thus not complete population estimates in all areas, see Appendix Tables A-1 and A-2.

DPS/ESU	Monitoring Area or Population	Winter Steelhead Abundance			
		Total		Wild	
		Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Southwest Washington	Youngs Bay	-	-	-	-
	Big Cr	-	-	-	-
	Clatskanie [a]	309	103	N.A.S.	-
	Scappoose [b]	32	54	N.A.S.	-
	Total	**337**	**114**	-	-
Lower Columbia River	Clackamas [a]	1,462	1,047	1,357	1,038
	Sandy [a]	2,127	1,401	2,108	1,400
	Gorge	-	-	-	-
	Total	**3,586**	**1,750**	**3,462**	**1,745**
Oregon Coast [c]	North Coast	20,907	6,624	18,228	5,775
	Nestucca [d]	*1,813*	*556*	*1,753*	*539*
	Mid Coast	13,257	6,148	9,391	4,356
	Mid South Coast	12,023	6,141	11,749	6,001
	Umpqua	10,173	3,893	10,173	3,893
	Total	**56,349**	**11,632**	**49,530**	**10,170**
Klamath Mountains Province	South Coast	-	-	-	-
	Rogue River	-	-	-	-
	Total	**-**	**-**	**-**	**-**

a = Estimates for these populations are derived from stratified samples. See intro/method section for

b = Not Adequate Sample. No known-fin-clip-status (live or dead) fish were observed, therefore no wild

c = Oregon Coast DPS does not include sites that were within hatchery hot-spots.

d = Estimate obtained for Nestucca population, which is included in the North Coast estimate.

Lower Columbia Pacific Lamprey

The available time series for Pacific lamprey in the Lower Columbia is more limited than in the Oregon Coast, but many populations now have at least six consecutive years of effort available for analysis. Redd densities during the 2017 monitoring season were much lower compared to previous records in each of the monitored populations (Figure 12), and as such were also below previous five-year population averages. Pacific lamprey redds were identified in 27% of random steelhead surveys sampled in the Lower Columbia River ESU in 2017. Pacific lamprey redd occupancy varied in 2017 by population; 50% in the Clatskanie, 0% in the Scappoose, 43% in the Clackamas and 14% in the Sandy. All of these are below normal.

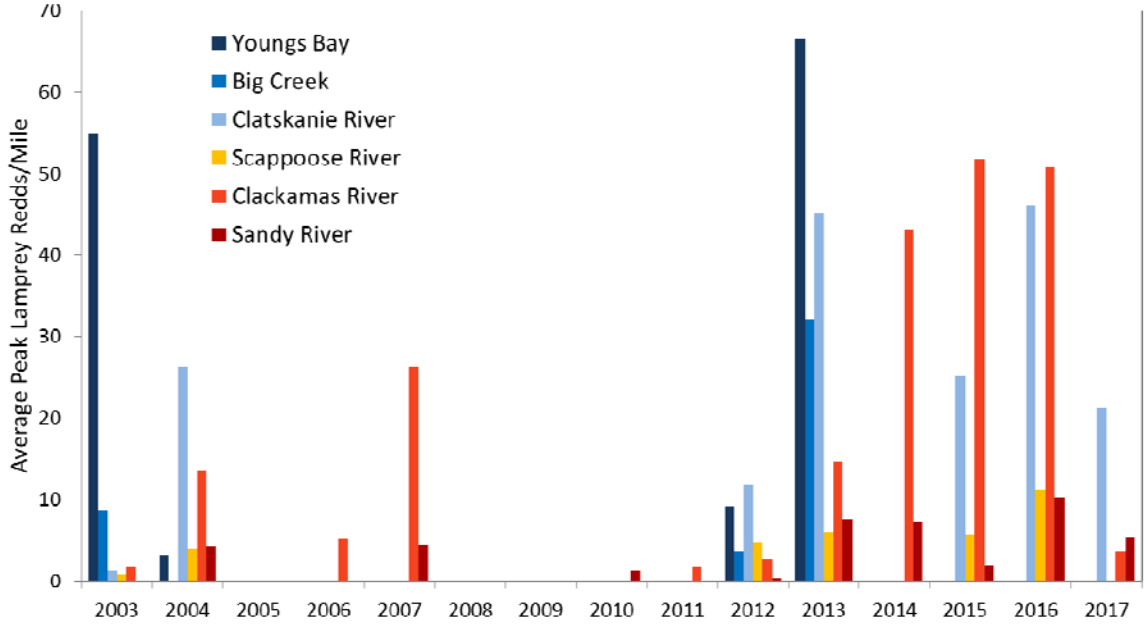

Figure 12. Lower Columbia Pacific Lamprey Peak Redd Density in Random Steelhead Spawning Surveys, 2003-2017. Note that not all populations were monitored in all years.

Pacific lamprey redds were first observed across the Lower Columbia in late March, which is slightly earlier than typical. Lamprey were not seen this year in the Scappoose population, which is concerning given the average peak density of 6.9 redds per mile in that population. A peak in lamprey activity was seen in the Clatskanie population in both early May and also in late June. The Clackamas population saw peak lamprey observations into late May, however, no surveys were conducted in the Clackamas after that date, so the full extent of Pacific lamprey spawn timing is not clear for Pacific Lamprey in this population for 2017 (Figure 13). Lamprey redd counts are conducted as peak counts, and thus these patterns may reflect observation of redds that are many weeks old, as opposed to counting new redds deposited at this late time of the spawning season.

Oregon Coast Pacific Lamprey

Over the past 15 years, Pacific Lamprey peak redd density on the Oregon Coast has fluctuated from 1 to 10 redds/mile in random steelhead surveys, averaging about 4.6 redds/mile (Figure 14). The proportion of sites occupied by Pacific Lamprey (sites with at least one Pacific Lamprey redd) has ranged from about 25% to 56% (mean = 39%); with increases and decreases in occupancy often tracking similar increases and decreases in peak redd density (Figure 14).

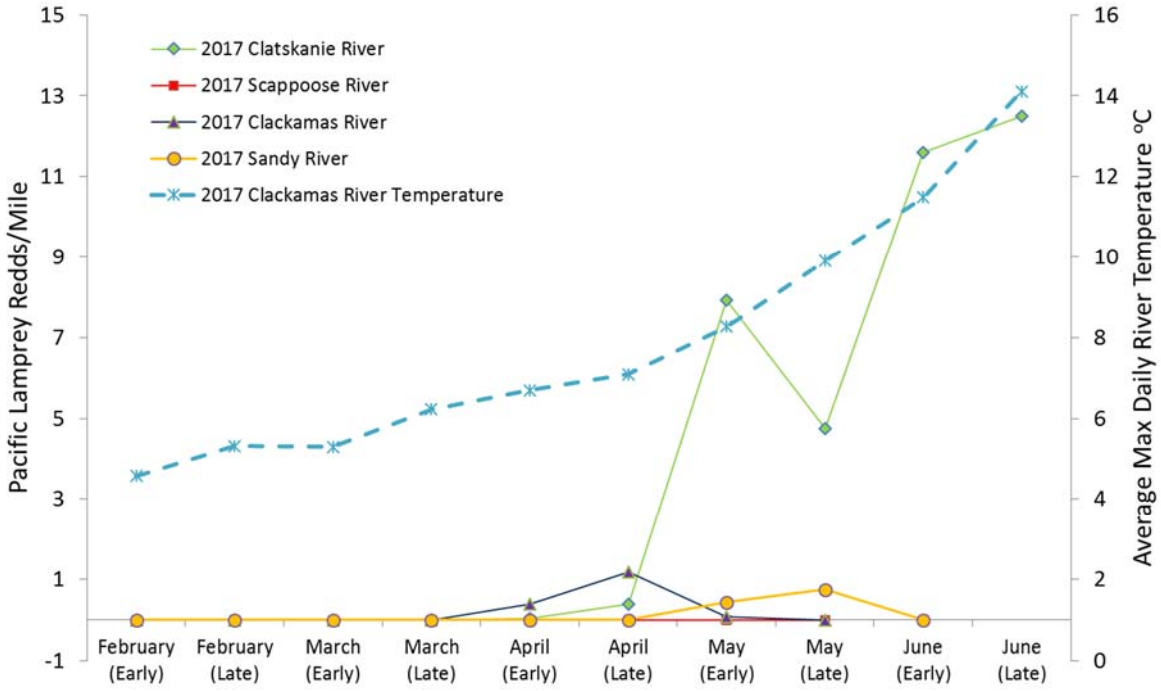

Figure 13. Lower Columbia Pacific Lamprey spawn timing in random steelhead surveys in 2017 and average daily max water temperature in the Clackamas River.

Beginning in 2010, thirteen annual steelhead surveys across the Oregon Coast were selected to be index surveys for the monitoring of Pacific Lamprey through their full spawn timing. These index surveys were picked with consideration to the following: (a) consistent presence of lamprey spawning activity across years; (b) a mix of smaller and larger streams in each steelhead monitoring area; and (c) the feasibility of conducting these surveys with limited staff availability. Index surveys are visited during each steelhead spawning season (February-May), and while steelhead surveys are primarily discontinued by the end of May, lamprey index surveys continue through late June (some years even into early July) in an attempt to capture the full lamprey spawn timing. The average spawn timing among index sites over the past five years peaked in mid-May, with the earliest peak occurring in late April (2014), and the latest occurring in early-June (2011 & 2017) (Figure 15). Pacific Lamprey spawn timing in 2017 was later than average, and only the second season since 2010 to peak in June. In addition, Pacific Lamprey spawning in 2017 both, started later than normal and continued later than normal, with new redds observed through late June in some surveys. Peak redd density on index surveys was above average, which contradicts the density of redds across randomly selected steelhead surveys, which was slightly below average. Occupancy in Pacific Lamprey among Oregon Coast populations appears to relate to overall abundance of adult spawners, and occupancy was about average for 2017 across the ESU.

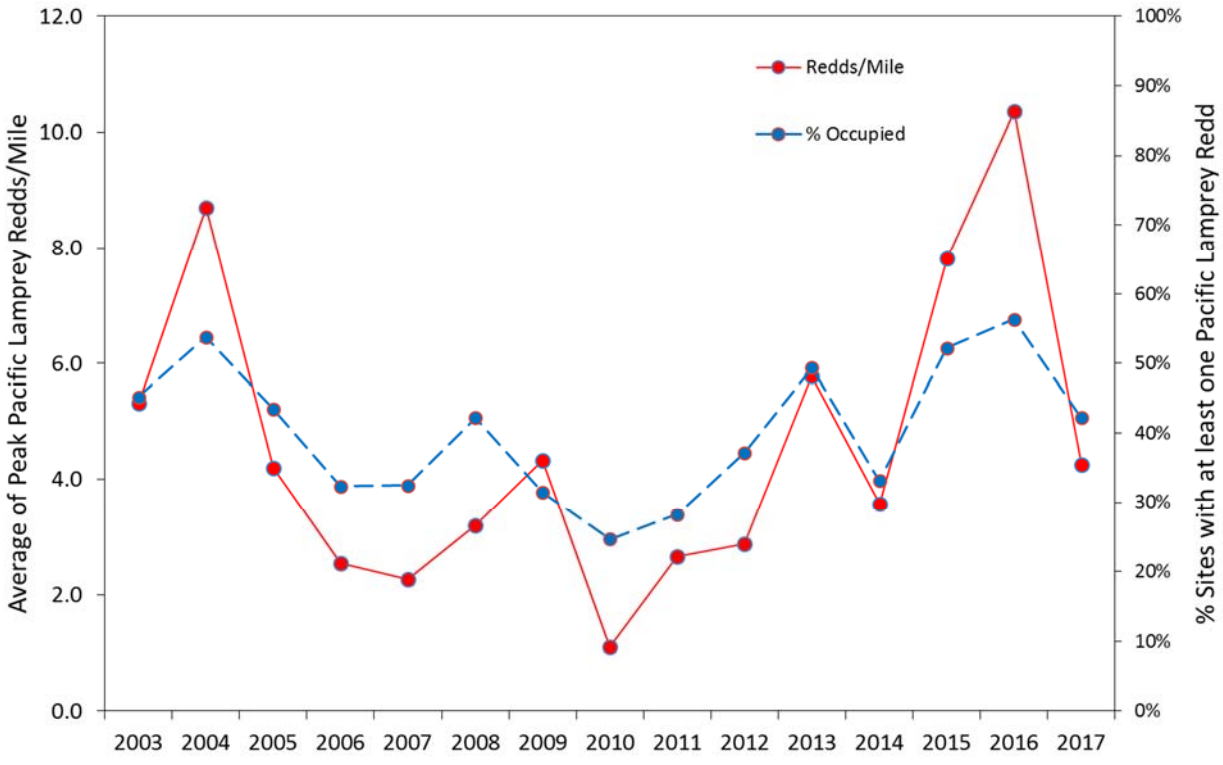

Figure 14. Oregon coast Pacific Lamprey peak redd density and percent of sites occupied in random steelhead spawning surveys, 2003 to 2017.

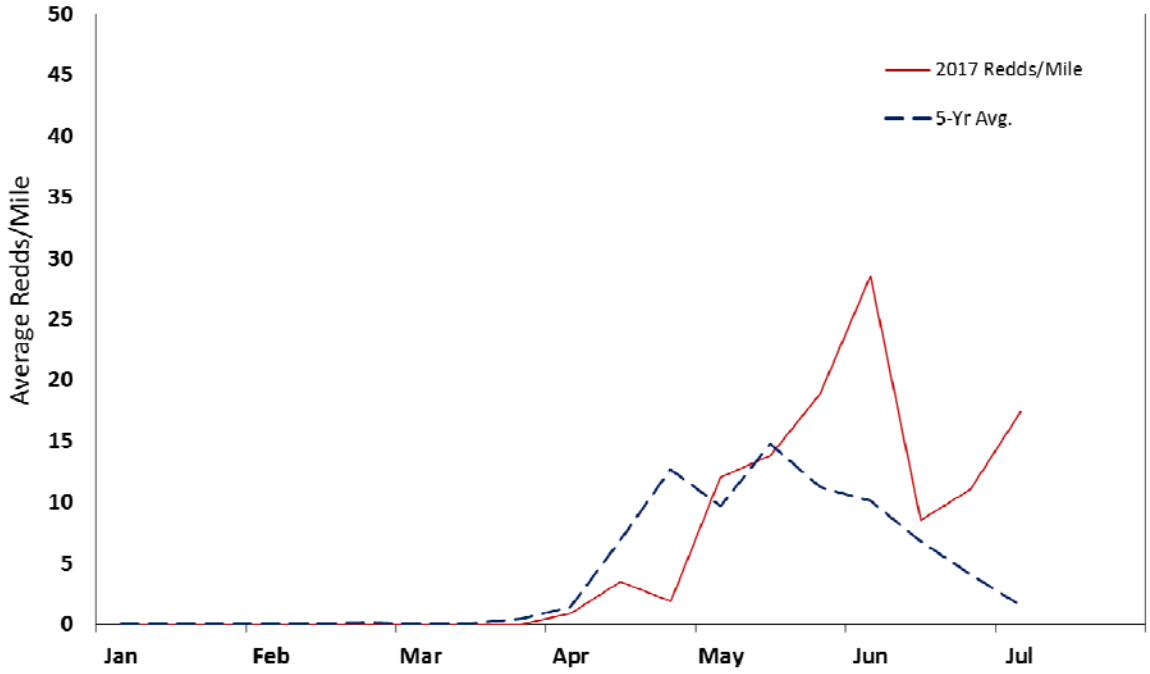

Figure 15. Oregon coast Pacific Lamprey spawn timing in index surveys.

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APPENDIX

Table A-1. Annual redd abundance estimates of naturally spawning wild steelhead by Monitoring Area (MA), in Oregon Coast Steelhead DPSs, run years 2003 to 2017. n.a. = not available. Highlighted cells do not include estimates for areas above counting stations.

	Oregon Coast DPS				Klamath Mountains Province DPS	
Year	North Coast MA	Mid Coast MA	Mid-South Coast MA	Umpqua MA	South Coast MA	Rogue River MA
2003	28,726	18,092	11,853	26,044	4,852	7,105
2004	28,599	14,043	10,195	11,922	9,093	n.a.
2005	19,125	7,890	22,871	10,628	10,035	4,995
2006	21,065	13,496	19,550	8,786	5,667	7,372
2007	20,592	10,133	24,312	13,900	6,917	6,986
2008	11,859	12,628	18,806	15,556	5,520	5,822
2009	10,433	12,080	9,136	9,282	14,268	12,352
2010	18,928	16,684	19,927	16,266	4,430	n.a.
2011	9,961	19,347	9,504	11,394	1,808	n.a.
2012	15,864	19,074	7,414	11,416	2,738	n.a.
2013	29,371	27,927	15,423	21,895	8,961	n.a.
2014	14,185	9,012	10,877	9,791	4,449	n.a.
2015	24,641	15,443	11,548	10,975	1,682	n.a.
2016[a]	15,491	23,776	14,049	9,120	n.a.	n.a.
2017[a]	10,720	5,522	6,909	5,982	n.a.	n.a.

a = Oregon Coast DPS does not include sites that were within hatchery hot-spots after 2015.

Table A-2. Annual redd abundance estimates of naturally spawning wild steelhead by Population, in Lower Columbia Steelhead ESUs, run years 2003 to 2017. n.a. = not available. Highlighted cells do not include estimates for areas above counting stations.

	Southwest Washington ESU				Lower Columbia ESU	
Year	Youngs Bay	Big Creek	Clatskanie	Scappoose	Clackamas	Sandy
2003	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2004 *					2,784	257
2005	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2006	n.a.	n.a.	n.a.	n.a.	453	288
2007	n.a.	n.a.	n.a.	n.a.	463	210
2008	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2009	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
2010	n.a.	n.a.	n.a.	n.a.	n.a.	879
2011	n.a.	n.a.	n.a.	n.a.	n.a.	308
2012	197	0	242	72	871	208
2013	94	14	898	205	914	2,062
2014	n.a.	n.a.	n.a.	n.a.	1,265	1,909
2015	n.a.	n.a.	1,145	107	1,247	2,745
2016	n.a.	n.a.	485	94	1,076	3,227
2017	n.a.	n.a.	170	17	842	1,248

* = Random surveys were conducted in 2004, but population scale estimates have not been done

Table A-3. Oregon winter steelhead redd abundance estimates within Oregon Coast Hotspot areas. Hotspots are areas located within 4 stream miles of acclimated hatchery release sites, and are not included within population, monitoring area, ESU estimates. Wild proportions are derived from fin-mark observation rates on live and dead steelhead.

		Survey Effort			Winter Steelhead Redd Abundance			
					Total		Wild	
DPS/ESU	Monitoring Area or Population	Number of Surveys	Miles	Spawning Miles within Hotspots	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Oregon Coast	North Coast Hotspots	3	2	49	891	876	873	858
	Mid Coast Hotspots	4	3	89	730	1,075	467	688
	Mid South Coast Hotspots	0	0	61	NA	NA	NA	NA
	Umpqua Hotspots	1	1	42	NA	NA	NA	NA
	Total	**8**	**6**	**241**	**NA**	**NA**	**NA**	**NA**

Table A-4. Oregon winter steelhead redd abundance estimates within strata in 2017. Strata estimates are components of monitoring area and/or population estimates shown in Table 2. Wild proportions are derived from fin-mark observation rates on live and dead steelhead.

Table A-4. Orgon Winter steelhead redd abundance estimates within stratified samples, 2017.

		Survey Effort			Winter Steelhead Redd Abundance			
					Total		Wild	
DPS/ESU	Monitoring Area or Population	Number of Surveys	Miles	Aproximate Spawning Miles	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Southwest Washington	*Clatskanie Strata*	22	19	53	179	58	170	-
	Plympton Cr.Strata	-	-	-	-	-	-	-
	Clatskanie Total	22	19	53	179	58	170	-
Lower Columbia River	*Clackamas Strata*	5	6	141	796	609	796	609
	Clackamas Migration Strata	-	-	-	-	-	46	-
	Eagle Cr. Hatchery	2	2	10	62	79	-	-
	Lower Clackamas Total	7	8	151	858	614	796	609
	Sandy Strata	18	19	125	1,238	822	1,238	822
	Sandy MigrationStrata	3	4	22	11	11	10	-
	Cedar Cr. HatcheryStrata	-	-	-	-	-	-	-
	Sandy Total	21	23	148	1,249	822	1,248	822
	Lower Columbia ESU Total	**62**	**59**	**299**	**2,303**	**1,028**	**2,034**	**1,022**

4034 Fairview Industrial Drive SE
Salem, OR 97302