THE OREGON PLAN *for Salmon and Watersheds*

Assessment of Western Oregon Adult Winter Steelhead and Lamprey – Redd Surveys 2015

Report Number: OPSW-ODFW-2015-09

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October, 2015

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SUMMARY

This report provides a summary of results from winter steelhead spawning ground surveys conducted in Oregon Coast and Lower Columbia (Oregon side) basins in 2015. 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 steelhead estimates in the Oregon Coast Distinct Population Segment (DPS) and Southwest Washington (SWW) Evolutionarily Significant Units (ESU), but not in the Lower Columbia River (LCR) ESU nor the Klamath Mountains Province (KMP) DPS. Winter steelhead redd estimates for the 2015 spawning year were very close to both the 5-year and 10-year averages for the Oregon Coast DPS. Estimates in the KMP DPS were the lowest recorded since monitoring began in 2003. We do not have long-term data on winter steelhead redd abundance in the Lower Columbia, but 2015 estimates in the SWW ESU and LCR ESU are higher than those in 2012 and 2013. Indices for Pacific Lamprey were generally improved in 2015 compared to recent years. Weather and stream flows made for very good survey conditions during the 2015 season. Regional patterns are apparent for redd density, proportion of hatchery 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, abundance, proportion of hatchery fish, and distribution of winter steelhead spawners. Monitoring currently occurs in the Oregon Coast and KMP DPSs at the monitoring area (MA) scale, though monitoring does not encompass the Rogue River MA. The Southwest Washington and Lower Columbia ESUs are currently monitored at the population scale, though funding limited efforts in 2015 to only the Clatskanie, Scappoose, Clackamas, and Sandy populations.

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 of biologists 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; North Fork Clackamas, Marmot, Winchester and Gold Ray dams, Bonnie Falls Trap, 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 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 2015).

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).

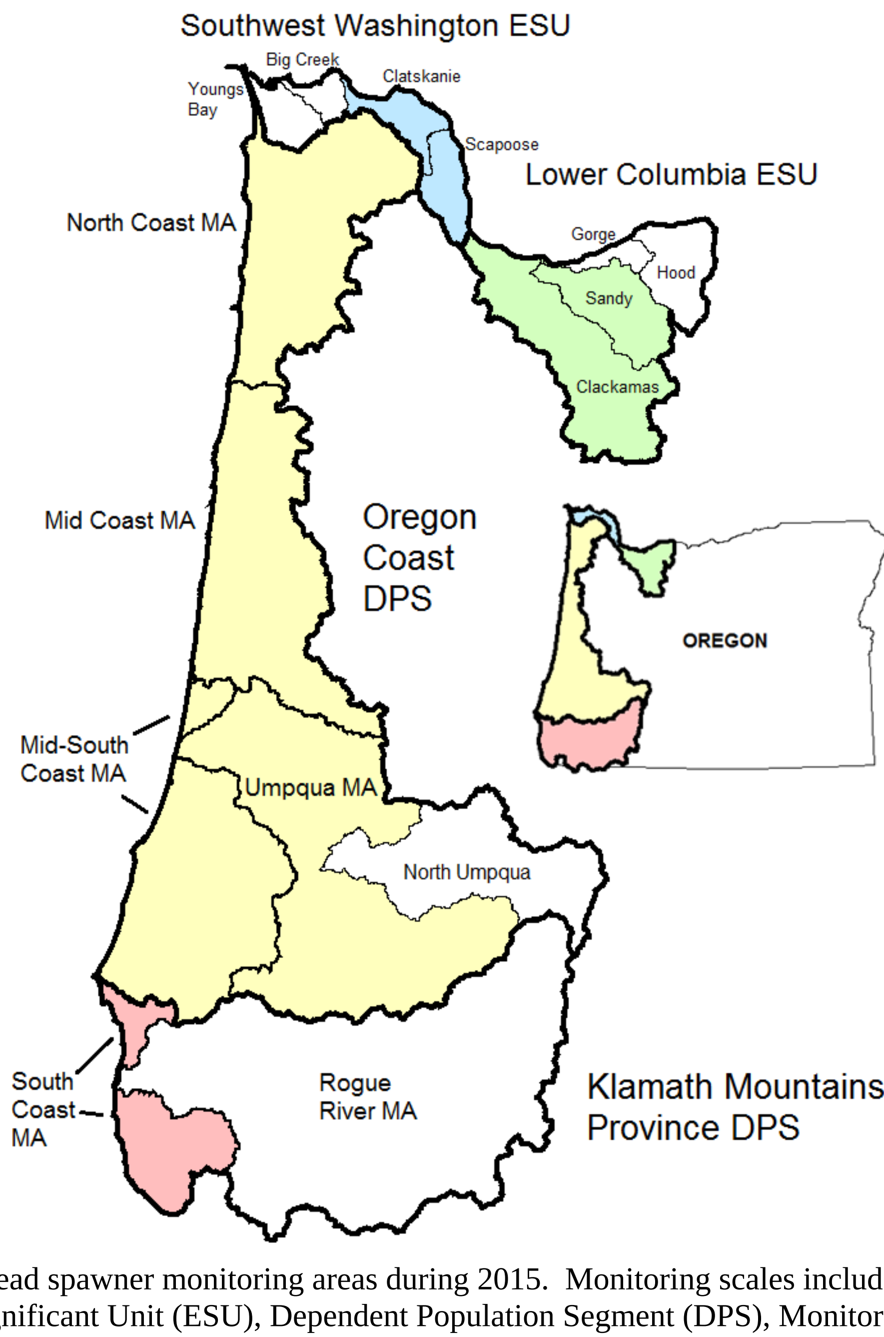


Figure 1. Steelhead spawner monitoring areas during 2015. Monitoring scales include: Evolutionary Significant Unit (ESU), Dependent Population Segment (DPS), Monitoring Areas (MA), and population. Areas without color were not monitored in 2015.

RESULTS AND DISCUSSION

This report contains monitoring area level summaries for each steelhead DPS along the Oregon Coast, as well population level summaries for the LCR and SWW ESUs. 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 263 sites were successfully surveyed in 2015, split between the four steelhead DPS/ESU areas monitored (Table 1). Successful surveys represent 62% of the 421 total sites selected for 2015. Sites were selected at a rate of 1/24 miles of habitat in the Oregon Coast DPS. Selection densities were greater in the KMP DPS (1/19) and the two Lower Columbia ESU's (1/4). Ten percent of sites in 2015 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 12.6%, ranging from 6.8% in the Oregon Coast DPS to 16.7% in the KMP DPS. The percentage of sites that were outside of steelhead spawning habitat averaged 4.5% across the four DPS/ESU areas, ranging from 0% in the KMP DPS to 14.0% in the Oregon Coast DPS.

Table 1. Site status by monitoring area or population in 2015. 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
Oregon Coast	North Coast	41	12	14
	Mid Coast	44	12	11
	Mid South Coast	38	19	3
	Umpqua	39	23	9
	Total	**162**	**66**	**37**
Klamath Mountains Province	South Coast	13	5	0
	Rogue River[a]	-	-	-
	Total	**13**	**5**	**0**
Southwest Washington	Young's Bay[a]	-	-	-
	Big Cr[a]	-	-	-
	Clatskanie	22	4	0
	Scappoose	15	15	1
	Total	**37**	**19**	**1**
Lower Columbia River	Clackamas	27	6	0
	Sandy	24	22	2
	Gorge[a]	-	-	-
	Total	**51**	**28**	**2**

a = Surveys in the Rogue River, Young's Bay, Big Cr and Gorge MA's were not conducted in the 2015 season due to budget constraints.

The target level of precision for steelhead redd estimates is a 95% confidence interval within ±30% of the point estimate. In 2015, this goal was achieved for the Oregon Coast DPS and SWW ESU, as well as in the Mid Coast and Mid-South Coast MA's, and the Clatskanie population (Table 2). Precision goals were not met in the LCR ESU or any of its populations. The Scappoose population, the North Coast, Umpqua, and South Coast MA's also did not meet precision goals. 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.

Table 2. Oregon winter steelhead redd abundance estimates in 2015. 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	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Oregon Coast	North Coast	41	33	25,761	13,529	24,641	12,941
	Mid Coast	44	36	19,786	5,349	15,443	4,175
	Mid South Coast	38	33	13,054	3,545	11,548	3,136
	Umpqua	39	34	10,975	3,878	10,975	3,878
	Total	**162**	**136**	**69,576**	**15,468**	**62,607**	**14,483**
Klamath Mountains Province	South Coast	13	10	2,329	1,235	1,682	892
	Rogue River	-	-	-	-	-	-
	Total	**13**	**10**	**2,329**	**1,235**	**1,682**	**892**
Southwest Washington	Young's Bay	-	-	-	-	-	-
	Big Cr	-	-	-	-	-	-
	Clatskanie	22	21	1,145	283	1,145	283
	Scappoose	15	13	107	64	107	64
	Total	**37**	**33**	**1,252**	**290**	**1,252**	**290**
Lower Columbia River	Clackamas	27	27	1,414	574	1,247	507
	Sandy	24	30	3,050	1,259	2,745	1,133
	Gorge	-	-	-	-	-	-
	Total	**51**	**57**	**4,464**	**1,384**	**3,993**	**1,241**

Oregon Coast DPS

The 2015 estimate of 62,607 wild winter steelhead redds in the Oregon Coast DPS approximates the long term average; it is within 1% of both the 5-year average and the average since this monitoring began in 2003 (Figure 2). While the 2015 redd estimate for the DPS as a whole was about average, there is a distinct geographic pattern across MAs: North Coast at 139% of average, Mid Coast at 103%, and the Mid-South and Umpqua just under 80% (Appendix Table A-1). While the estimated abundance of wild steelhead redds in the Oregon Coast DPS has ranged from about 41,000 to 95,000 across the 13 years of monitoring (2003 through 2015), 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 larger 95% confidence intervals) currently limit the ability to detect long-term trends in abundance.

Density of redds (steelhead redds/mile of spawning habitat) also varied across monitoring areas, ranging from the 5.5 redds/mile observed in the Umpqua MA to the 22.7 redds/mile in the North Coast MA (Table 3 and Figure 3). Geographic patterns in redd density matched that of the redd abundance estimates; North and Mid Coast MAs were above average while Mid-South and Umpqua MAs were below average.

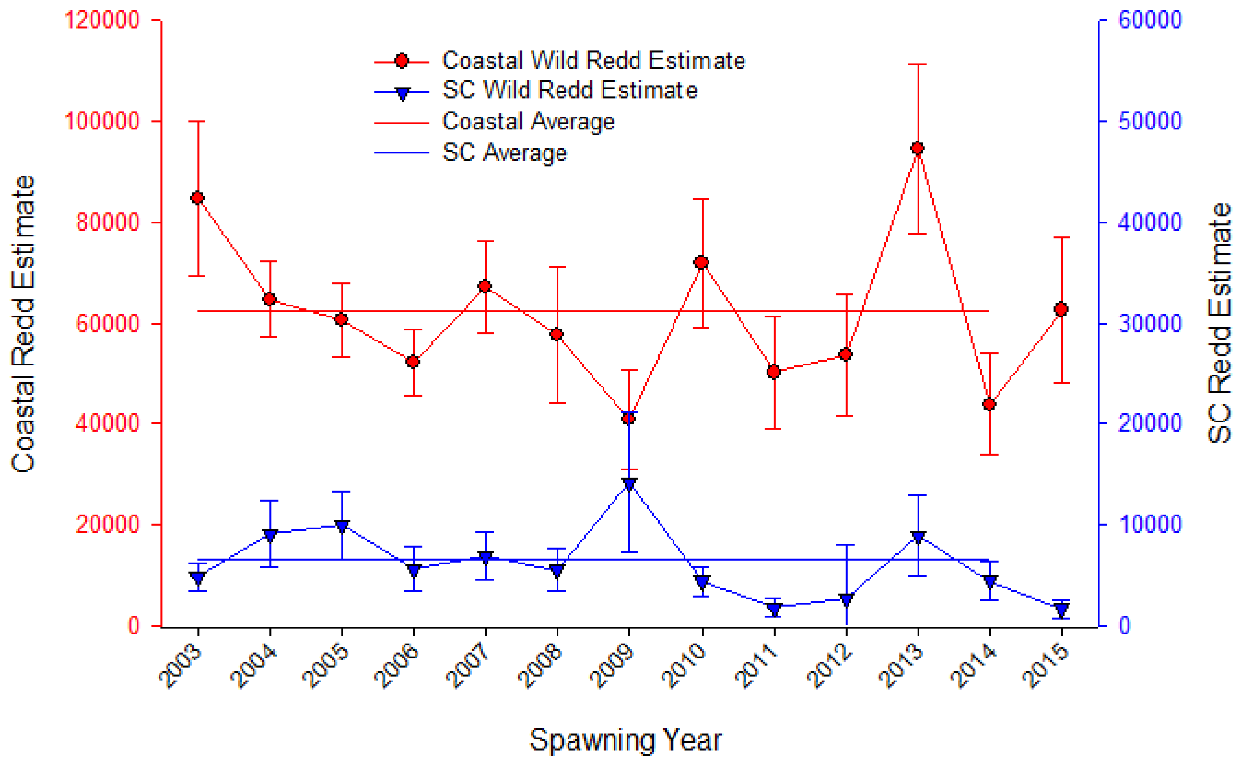


Figure 2. Estimated number of wild winter steelhead redds in the Oregon Coast DPS and South Coast MA, 2003 to 2015. Error bars represent 95% confidence intervals, and horizontal lines show the previous 12-year average.

An occupied site was defined as having at least one steelhead redd recorded during the season. The proportion of occupied sites in 2015 in the Oregon Coast DPS was 11 percent lower than the previous 12-year average (Table 3). The North and Mid-South Coast monitoring areas had the most notable decreases in occupancy. Geographic patterns in occupancy rates for 2015 were consistent with the 12 year average, being highest in the Mid-South Coast MA and lowest in the Umpqua MA (Table 3). The unusually low occupancy rate for the North Coast MA in 2015 was an exception to this pattern. It is worth noting that low stream flow conditions can reduce occupancy, and that stream flows in 2015 were generally lower than normal.

The proportion of hatchery origin spawners (pHOS) in the naturally spawning steelhead populations of the Oregon Coast DPS was 10% in 2015, below the 2003-2014 average of 14% (Table 4). The 2015 proportion is near the lowest observed in the 13 years of monitoring in the Oregon Coast ESU. There have only been four years (2003, 2005, 2012 and 2013) with a lower pHOS rate, all at 9%. The proportion of hatchery origin spawners varied among the monitoring areas in 2015 (Figure 4), ranging from 0% in the Umpqua MA to 22% in the Mid Coast MA. All four MAs had 2015 pHOS rates at or below their previous 12 year average pHOS rates (Table 4). Geographic patterns in pHOS rates for 2015 were similar to the previous 12 year average; the Mid Coast and Mid-South Coast MAs tend of have higher pHOS rates than the Umpqua and North Coast MAs (Table 4).

Table 3. Oregon winter steelhead redd density and percent occupancy in 2015.

DPS/ESU	Monitoring Area or Population	Redds / Mile		% Sites With Redds	
		2015	Average *	2015	Average *
Oregon Coast	North Coast	22.7	17.9	61%	80%
	Mid Coast	12.6	11.2	74%	81%
	Mid-South Coast	12.7	18.6	79%	90%
	Umpqua	5.5	9.4	64%	73%
	Total	**12.2**	**13.4**	**70%**	**81%**
KMP	South Coast	6.8	19.0	77%	97%
	Rogue River	-	9.6	-	82%
	Total	**6.9**	**14.8**	**77%**	**90%**
Southwest Washington	Young's Bay	-	6.3	-	56%
	Big Creek	-	5.7	-	59%
	Clatskanie	19.5	10.2	76%	63%
	Scappoose	1.7	2.3	46%	42%
	Total	**10.4**	**6.2**	**65%**	**55%**
Lower Columbia River	Clackamas	7.4	6.0	54%	57%
	Sandy	17.9	8.7	71%	61%
	Gorge	-	-	-	-
	Total	**12.4**	**7.2**	**62%**	**55%**

* = Average for period of monitoring: Oregon Coast and KMP is 2003-2014; SWW is 2012-2013; SWW is 2012-2014.

In the recent years, there have been a small handful of survey sites that were adjacent to hatcheries or hatchery acclimation sites. These surveys tend to have a higher proportion of hatchery fish and redd densities, which can bias estimates of abundance and pHOS. The new ODFW Coastal Multi-Species Conservation and Management Plan allows for higher maximum pHOS rates in areas adjacent to hatchery release sites. Identification of which areas meet the criteria in the plan, and methods for separate monitoring of those areas are under development. One option under consideration is stratification of future steelhead spawner abundance estimates to account for these areas with different allowable pHOS rates.

Oregon Coast DPS winter steelhead spawning began somewhat earlier in 2015 compared to previous years, with generally above average redd counts in Mid-January (Figure 5). The earlier start is most notable in the Umpqua MA, with the remaining MA's more similar to previous year averages. In spite of the earlier start to spawning in 2015, the peak spawning time (defined as maximum number of new redds observed) was comparable to previous years. Over the 13 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 (Figure 5). Spawn timing differences between the monitoring areas suggest differences between the steelhead populations, but may also be impacted by weather and stream flow events. Aside from moderately high flow events in mid-January and mid-February, river discharge on the Oregon Coast held at fairly low levels throughout the remainder of winter steelhead spawning survey season (Figure 6). Much of the peak spawning occurred during this February event and as those flows receded.

Table 4. Number of known fin-mark status steelhead observed on spawning grounds, and resulting percent hatchery fish in 2015. 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 2015	Number Known Fish Average *	Percent Hatchery 2015	Percent Hatchery Average *
Oregon Coast	North Coast	92	102	4%	11%
	Mid Coast	123	70	22%	22%
	Mid South Coast	104	102	12%	17%
	Umpqua	44	54	0%	6%
	Total	**363**	**328**	**10%**	**14%**
Klamath Mountains Province	South Coast	18	69	28%	5%
	Rogue River	-	50	-	7%
	Total	**18**	**94**	**28%**	**4%**
Southwest Washington	Young's Bay	-	11	-	46%
	Big Cr	-	12	-	95%
	Clatskanie	29	17	0%	3%
	Scappoose	-	3	-	0%
	Total	**29**	**42**	**0%**	**41%**
Lower Columbia River	Clackamas	17	29	12%	6%
	Sandy	60	28	10%	3%
	Gorge	-	0	-	-
	Total	**77**	**57**	**11%**	**5%**

* = Average for period of monitoring: Oregon Coast and KMP is 2003-2014; SWW is 2012-2013; SWW is 2012-2014.

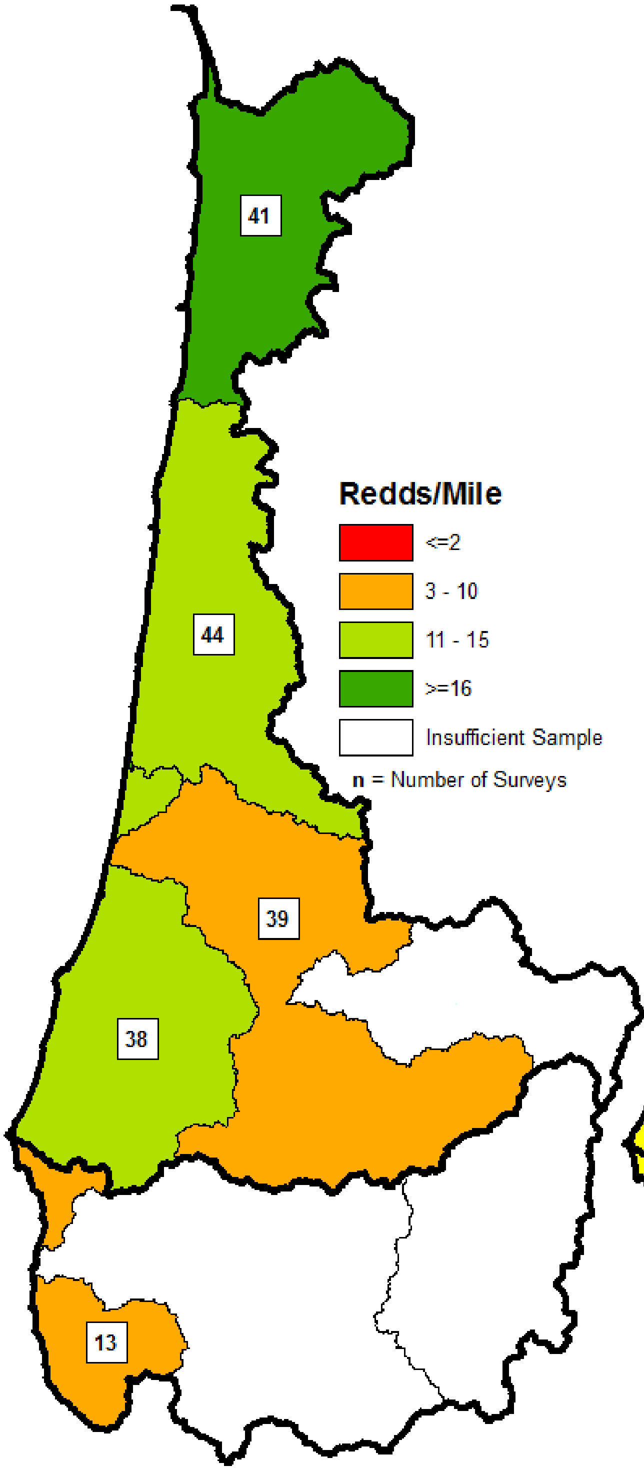


Figure 3. Total steelhead redds/mile in random surveys in 2015 by monitoring area in the Coastal and KMP DPSs, with the number of surveys in each monitoring area.

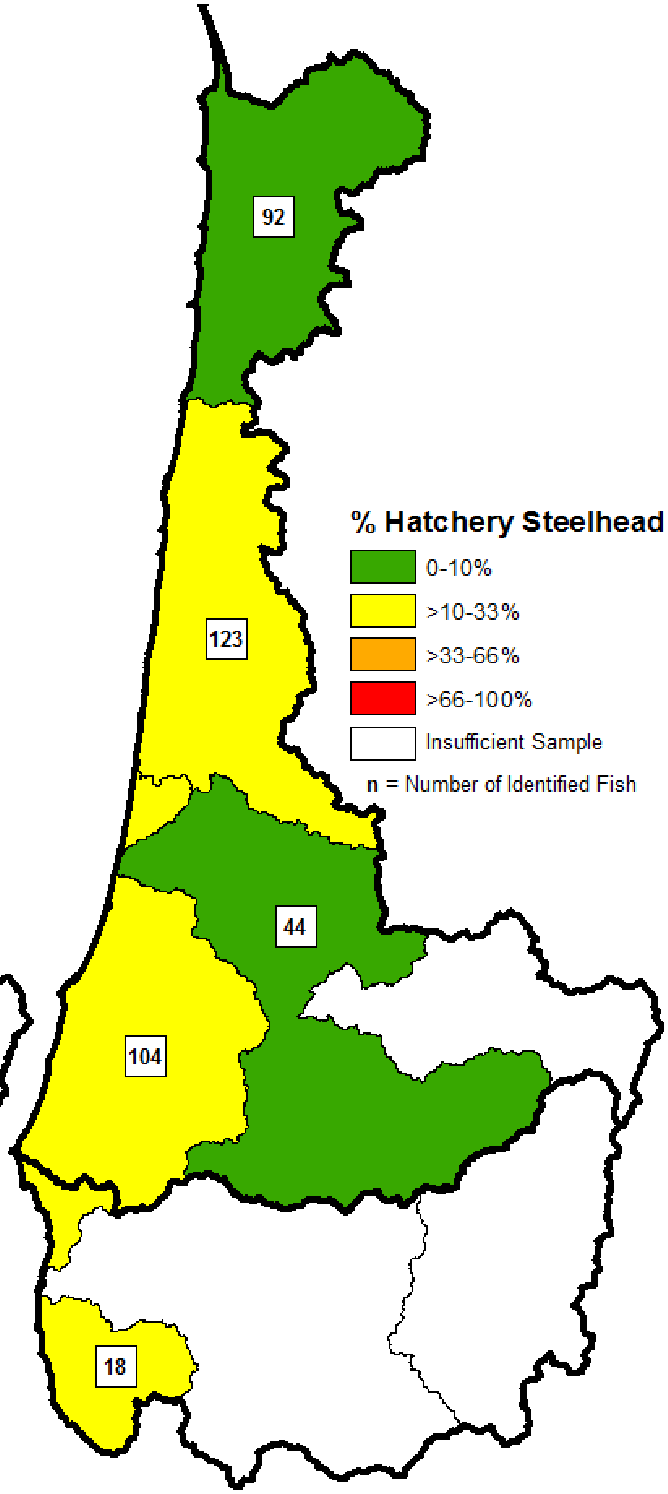


Figure 4. Percentage hatchery steelhead found on random surveys in each of the five Coastal and KMP monitoring areas in 2015 based on adipose fin clip observations of live and dead steelhead, with the number of identified steelhead in each monitoring area.

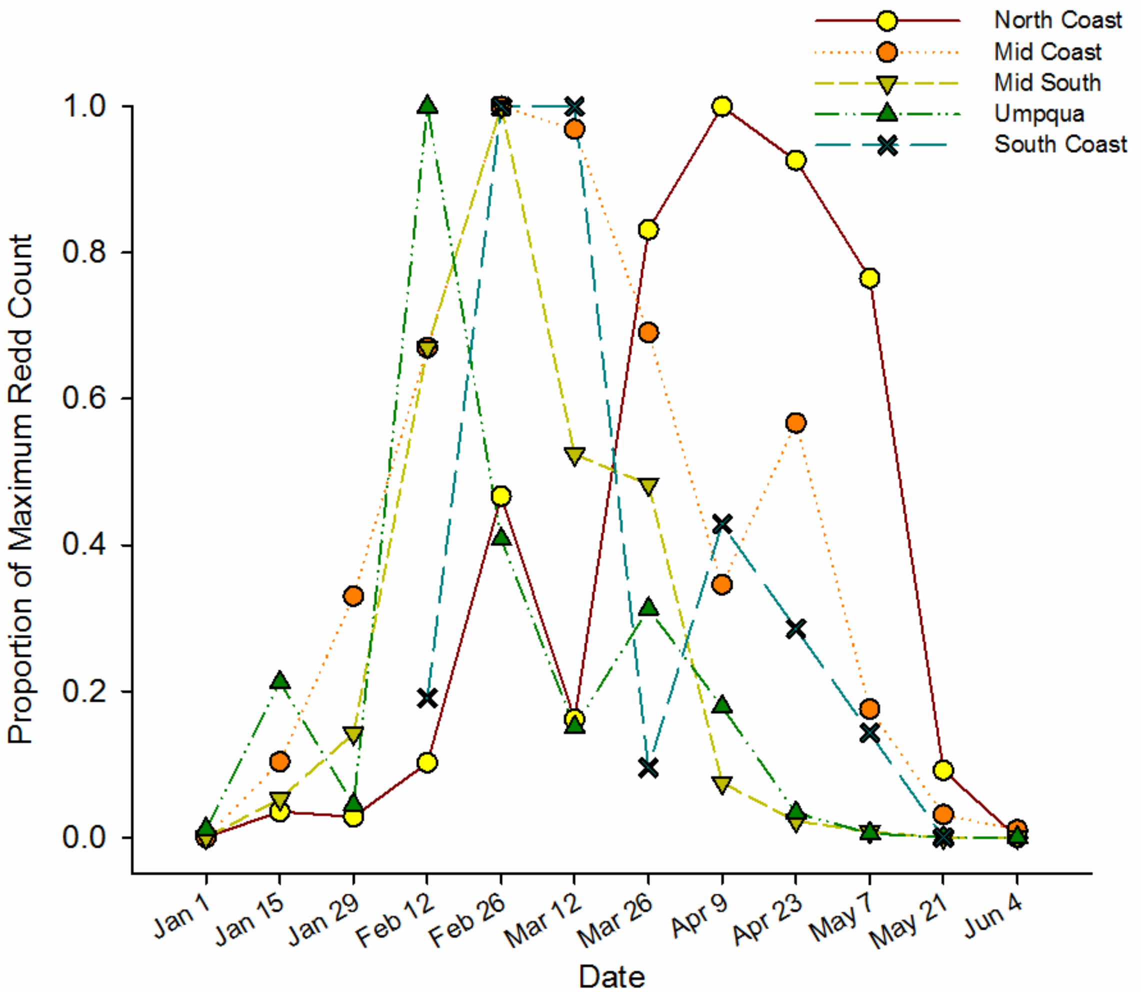


Figure 5. Proportions of the maximum winter steelhead redd count in each of the five Coastal and KMP monitoring areas by two-week period in 2015.

Klamath Mountains Province DPS

No surveys have been conducted in the Rogue MA since 2009 due to budget constraints. Thirteen of the 18 sites selected in the South Coast MA were successfully surveyed in 2015, four sites more than the average of nine successfully surveyed sites over the past 5 years. Survey conditions in the South Coast MA were similar to those experienced in other Western Oregon winter steelhead spawning survey areas in 2015. This likely contributed to the better than average rate of successful surveys in 2015.

In the South Coast MA we estimated 1,682 wild steelhead produced redds (Table 2). The 2015 estimate was 38% of the previous 5-year average estimate of 4,477 redds (Figure 2). Redd density and percent of surveys with at least one steelhead redd observed were also well below the 2003 through 2014 average in the South Coast MA (Table 3 and Figure 3). Estimated pHOS in the South Coast MA in 2015 was 28% (Table 4 and Figure 4). This is the first year in the South Coast since 2009 that there has been a pHOS greater than 0%. The sample size for calculating pHOS was much lower that average in 2015, 18 versus an average of 69 for the period 2003 through 2014. Also, it is worth noting that the five adipose clipped fish of the 18 total steelhead with known adipose fin clip status observed this season in the South Coast were observed on a single survey visit on the Elk River. Spawn timing in 2015 peaked from late-February through mid-March, which is about average for the South Coast MA. Steelhead monitoring in the South Coast MA will not be conducted by this project next season, as surveyors will no longer be located in the area.

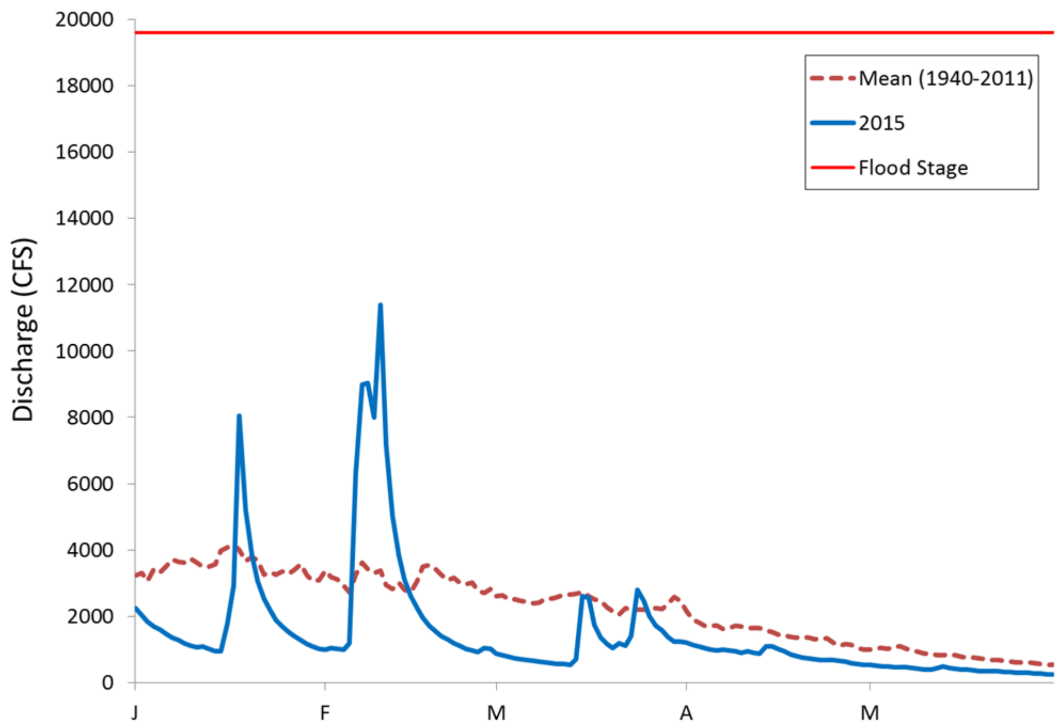


Figure 6. Stream discharge at Alsea River near Tidewater during 2015, compared to mean discharge from 1940 to 2011. (Flood stage = 19,500 CFS)

Southwest Washington ESU

The 2015 estimate of wild winter steelhead redds in the Oregon portion of the SWW ESU was 1,252 (Table 2). This is higher than the 2012 estimate and similar to the 2004 and 2013 estimates (Figure 7). The Clatskanie population accounted for 91% of the 2015 wild winter steelhead redds within this ESU, although only 2 of 4 populations were sampled in 2015. Redd densities ranged from 1.7 redds per mile in the Scappoose population to 19.5 redds per mile in the Clatskanie population (Table 3 and Figure 8). Average density across the ESU was 10.4 redds per mile, which is slightly higher than the ESU average of 6.2 (Table 3). The percentage of sites with at least one redd observed ranged from 46% in the Scappoose population to 76% in the Clatskanie population, higher than the averages from previous years (Table 3).

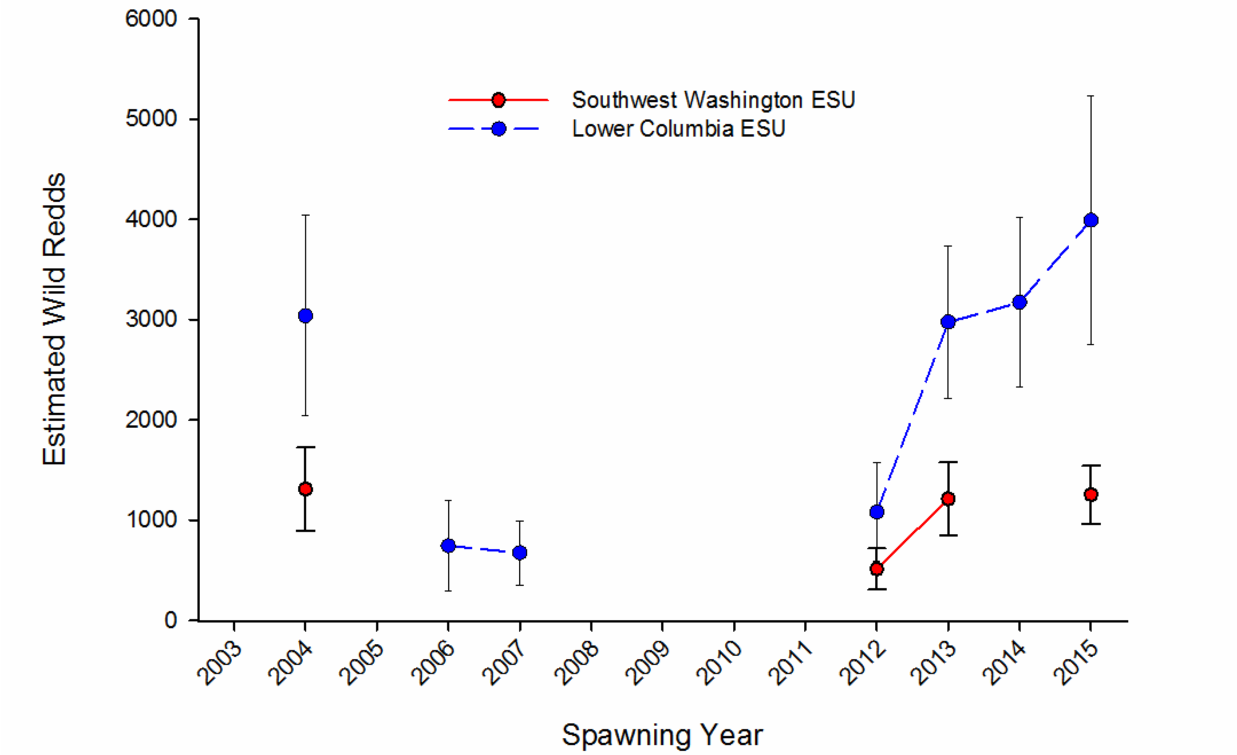


Figure 7. Winter steelhead wild redd estimates in the Oregon portions of the LCR and SWW ESUs based on random surveys, 2004 to 2015. Error bars represent 95% confidence intervals. Inclusion of survey data from specific populations and from above counting stations has varied across years, see Appendix Table A-2.

On average the Scappoose population has had only three steelhead observations with known fin-mark status, but none were observed in 2015 (Table 4 and Figure 9). In contrast, sample size for calculating hatchery proportion in the Clatskanie population was 29, better than average from prior years (Table 3). Ideal stream conditions throughout the season likely contributed to the high sample size of known fish for the ESU. The Clatskanie population had a 0% pHOS rate in 2015, lower than the prior average of 3% (Table 4 and Figure 9). This is the second year of 0% pHOS in three years of sampling in the Clatskanie population.

Spawn timing was fairly consistent across the SWW ESU populations in 2015. The Clatskanie and Scappoose populations experienced bi-modal peaks in late February and late March (Figure 10). Another small peak was observed in the Scappoose population in late April. This spawn timing is consistent with years past. Consistently favorable survey conditions during the 2015 spawning season enhanced the ability to detect peaks in redd deposition. More years of data will be required to explore similarities and differences in winter steelhead spawn timing between these populations, and across years.

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 2015. Spawning ground survey effort was limited to the Sandy population, and the portion of the Clackamas population located below River Mill Dam. The following results are for those two areas.

The 2015 estimate of wild winter steelhead redds in the LCR ESU was 3,993 (Table 2). This is the highest LCR ESU redd estimate in the seven 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 long continuous time series (Figure 7). Redd distribution across the ESU in 2015 was slightly disproportionate, with 69% and 31% of estimated redds located in the Sandy and Clackamas populations, respectively. The 2015 Clackamas estimate of 1,247 wild redds is similar to recent estimates, though much lower than the 2004 estimate (Figure 11). Part of this difference is that the 2004 estimate is for the entire Clackamas population and all subsequent estimates are only for the area below River Mill Dam. The 2015 Sandy population estimate of 2,745 wild redds is the highest estimate observed since 2004 (Figure 11). 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.

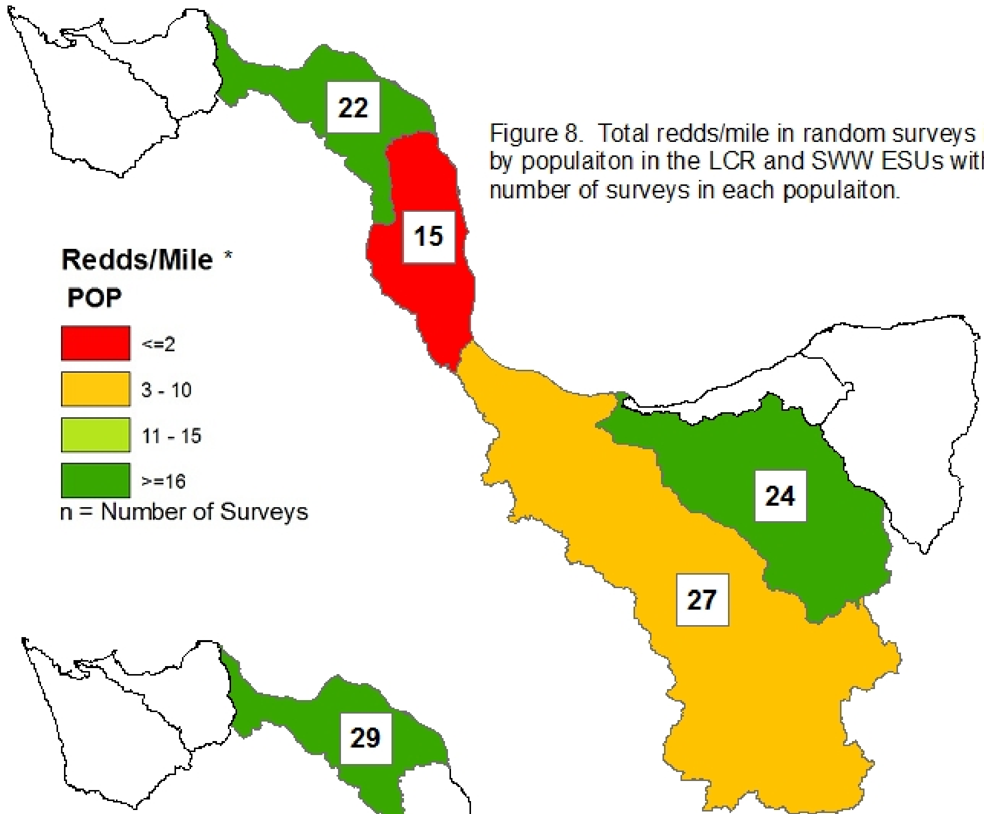
Survey effort in the Sandy population in 2013 through 2015 differed from all other populations reported, in that surveys were conducted weekly rather than bi-weekly. This was done primarily to improve the sample size of known fin-marked adults in the basin, but also to maintain a higher number of successfully surveyed sites. In the Sandy population, 75% of the sites surveyed in 2015 met protocols for inclusion in the estimate calculation. Increased survey visits during the spawning season were a likely factor in the high proportion of valid surveys completed in 2015 compared to previous years. The combination of increased survey effort and excellent survey conditions may be a factor in the higher abundance estimates (i.e. increased rate of redd observation) in recent years.

Redd density for the LCR ESU was 12.4 redds per mile; ranging from 7.4 redds per mile in the Clackamas to 17.9 redds per mile in the Sandy (Table 3 and Figure 8). Both the Clackamas and Sandy redd densities are above average (Table 3). The percentage of sites having at least one redd also varied between the two populations, with 54% of sites occupied in the Clackamas and 71% of sites occupied in the Sandy population (Table 3). Site occupancy rate in the Clackamas was slightly below average in 2015, and in the Sandy was well above average.

The proportion of naturally spawning hatchery steelhead in the LCR ESU was 11% in 2015. The 2015 pHOS rate was 10% in the Sandy population and 12% in the Clackamas population, both well above average (Table 4). Increased survey frequency in the Sandy improved the number of known fin-clip status steelhead from three in 2012 to 60 in 2015.

The Sandy River contains a hatchery summer steelhead program; 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

Figure 8. Total redds/mile in random surveys in 2015 by populaiton in the LCR and SWW ESUs with the number of surveys in each populaiton.



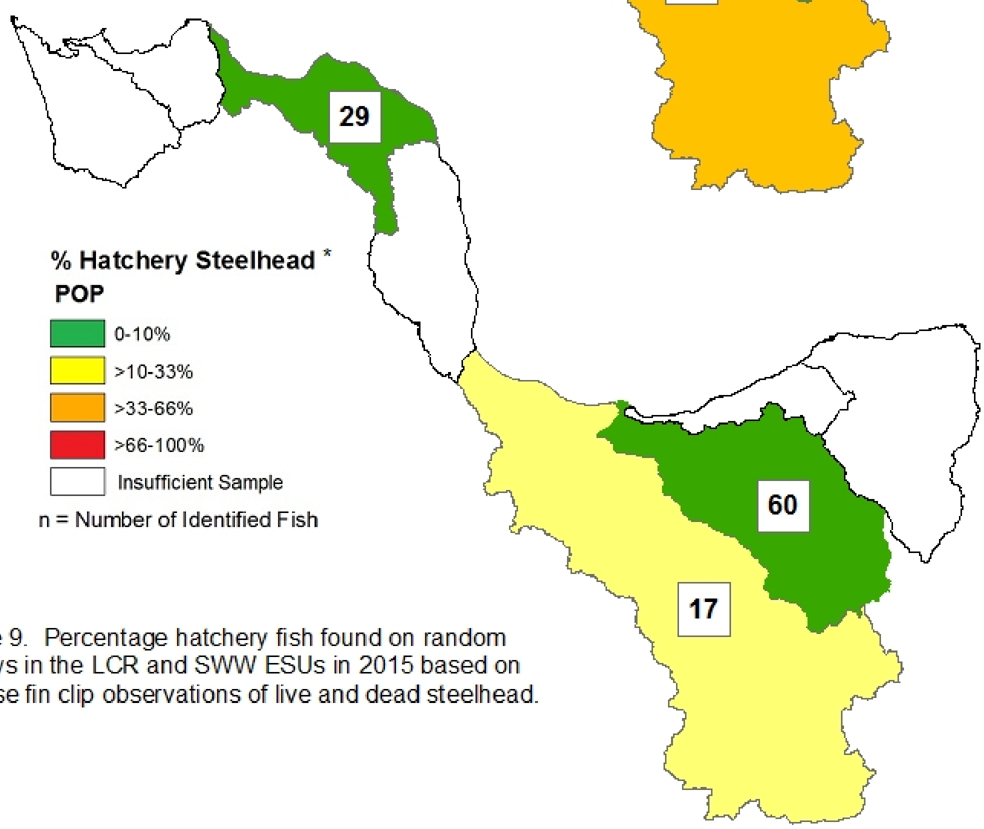


Figure 9. Percentage hatchery fish found on random surveys in the LCR and SWW ESUs in 2015 based on adipose fin clip observations of live and dead steelhead.

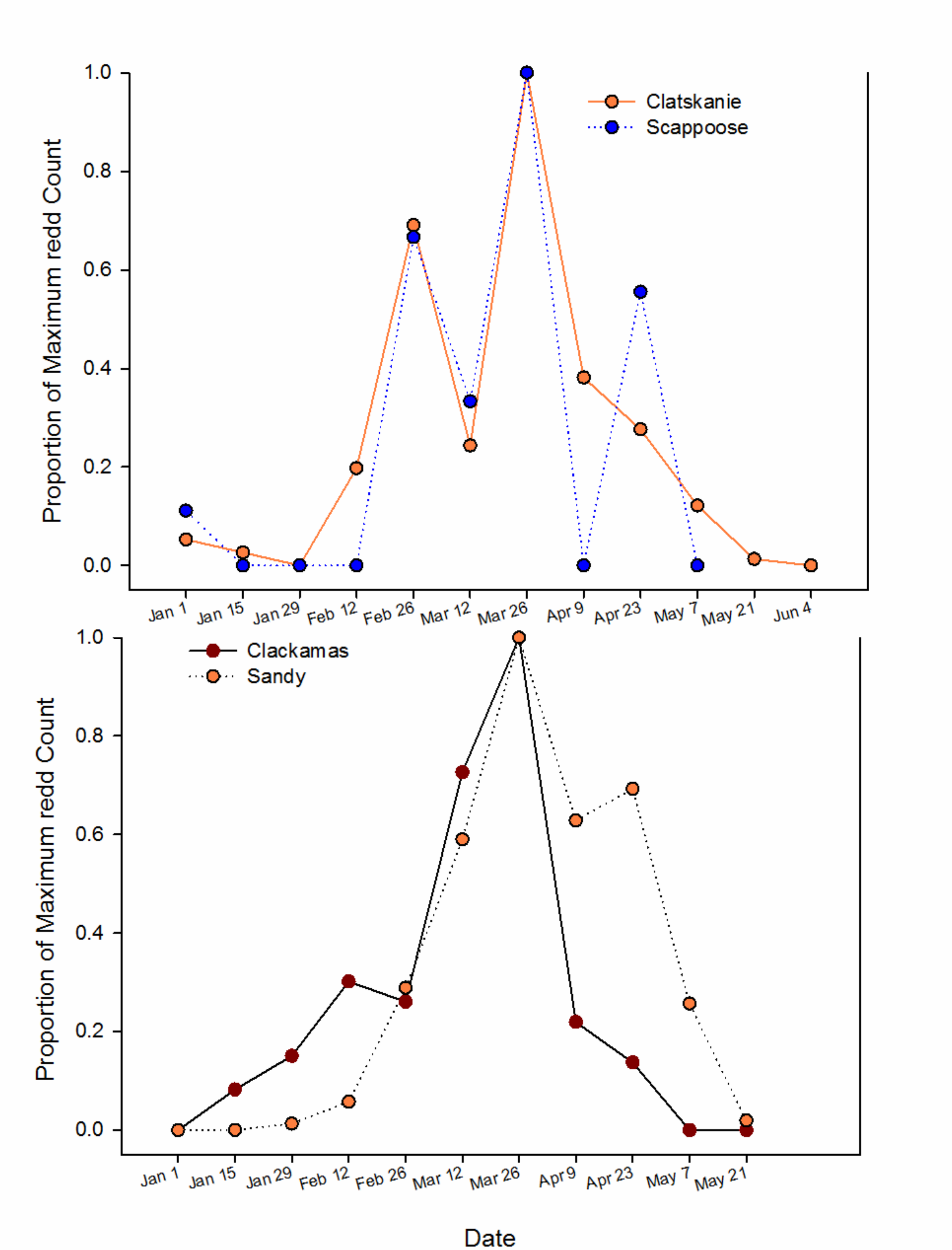


Figure 10. Proportion of the maximum winter steelhead redd count in each of the Lower Columbia populations by week of the year in 2015.

February, and winter runs spawning February through May. Management plans for wild winter steelhead in the Sandy 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 10% total pHOS rate for the Sandy in 2015 triggered the calculation of a summer steelhead pHOS. The estimated pHOS for the period before March 1st, 2015 in the Sandy population is 2.3%.

Peak spawn timing was similar across the two surveyed populations within this ESU, with the peak occurring during late March in both populations (Figure 10). Exceptions to the pattern were a small mid-February increase in spawning in the Clackamas population, and the Sandy population continued relatively high spawning activity into late April. Survey conditions were relatively ideal and consistent in the LCR ESU, and there was no indication that these timing signatures were the product of survey conditions or any other surveying affect.

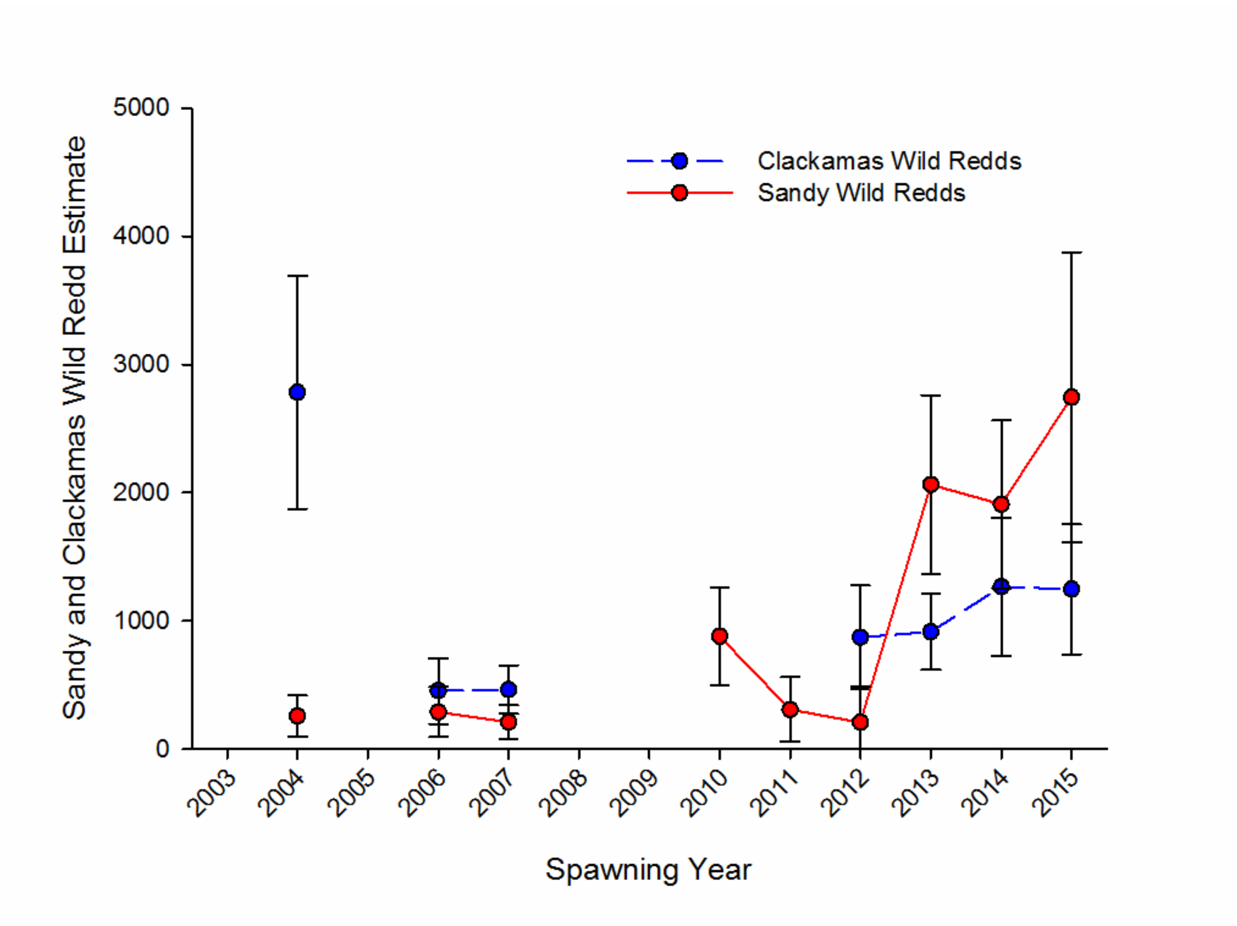


Figure 11. Winter steelhead wild redd estimates in the Clackamas and Sandy River populations based on random surveys, 2004 to 2015. Error bars represent 95% confidence intervals.

Inclusion of survey data from above North Fork Clackamas and Marmot dams has varied across years, see Appendix Table A-2.

Steelhead Escapement

In recent years there has been an increased emphasis on a redd-to-fish conversion factor so that estimates can be reported in terms of fish rather than redds. In 2013 we conducted a re-analysis of previous calibration efforts, 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).

$$\textit{Total steelhead} = (1.70 * \textit{Redds}) + 3.74$$

Estimates of winter steelhead escapement in 2015, 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.

Table 5. Oregon winter steelhead fish abundance estimates in 2015. 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.

		Winter Steelhead Abundance			
		Total		Wild	
DPS/ESU	Monitoring Area or Population	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Oregon Coast	North Coast	43,798	23,003	41,894	22,003
	Mid Coast	33,641	9,097	26,257	7,101
	Mid South Coast	22,195	6,031	19,635	5,335
	Umpqua	18,661	6,596	18,661	6,596
	Total	**118,284**	**26,299**	**106,435**	**24,625**
Klamath Mountains Province	South Coast	3,963	2,103	2,863	1,520
	Rogue River	-	-	-	-
	Total	**3,963**	**2,103**	**2,863**	**1,520**
Southwest Washington	Young's Bay	-	-	-	-
	Big Cr	-	-	-	-
	Clatskanie	1,949	484	1,949	484
	Scappoose	186	113	186	113
	Total	-	-	-	-
Lower Columbia River	Clackamas	2,407	980	2,124	865
	Sandy	5,189	2,144	4,671	1,930
	Gorge	-	-	-	-
	Total	**7,593**	**3,121**	**6,791**	**2,792**

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. Abundance estimates for lamprey are not available because the cumulative number of redds deposited over a spawning season is not accounted for and because there is no reliable information on the ratio of redds to fish. However, peak redd counts do 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.

Oregon Coast Pacific Lamprey

Over the past 13 years, Pacific Lamprey peak redd density on the Oregon Coast has fluctuated from 1 to 9 redds/mile in random steelhead surveys, averaging about 4.2 redds/mile (Figure 12). The proportion of sites occupied by Pacific Lamprey (sites with at least one Pacific Lamprey redd) has ranged from about 25% to 54% (avg. = 39%); with increases and decreases in occupancy often tracking similar increases and decreases in peak redd density (Figure 12).

Beginning in 2010, thirteen annual random 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 April (2014), and the latest occurring in early-June (2011) (Figure 13). Pacific Lamprey spawning timing in 2015 was very similar to the 5-year average timing. Results so far from the index sites suggest surveys should be continued through mid to late July to encompass the entire Pacific Lamprey spawn timing.

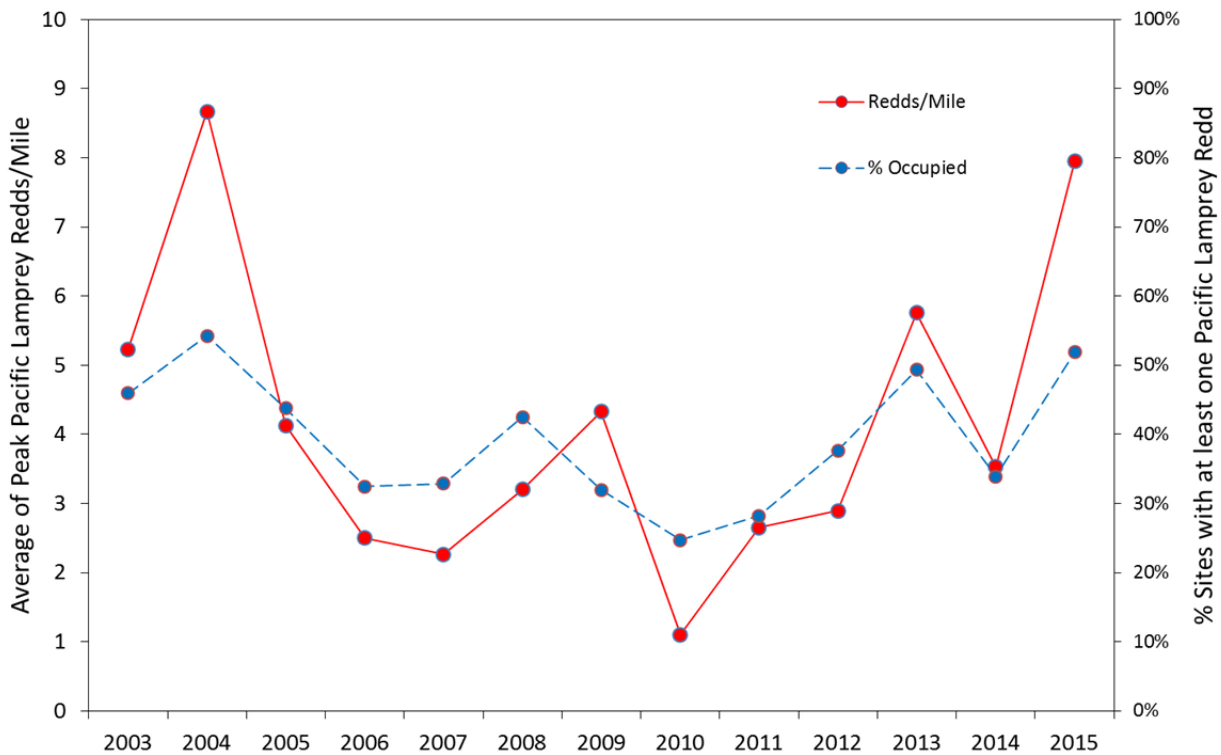


Figure 12. Oregon coast Pacific Lamprey peak redd density and percent of sites occupied in random steelhead spawning surveys, 2003 to 2015.

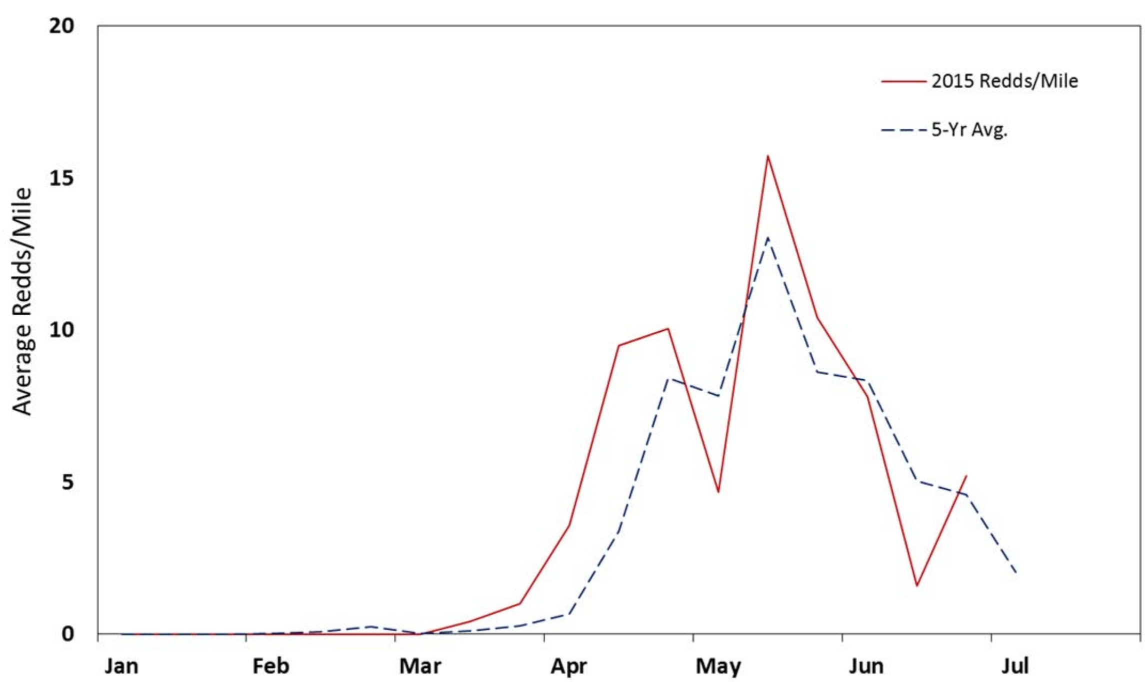


Figure 13. Oregon coast Pacific Lamprey spawn timing in index surveys.

Lower Columbia Pacific Lamprey

During the 2015 monitoring season, Pacific Lamprey redd densities were higher than last year in most areas of the Lower Columbia with the exception of the Sandy River. While the Pacific Lamprey redd density in 2015 was higher than redd density in 2014, it was generally well below redd densities in 2013, which are the highest observed in this short time series (Figure 14). Pacific Lamprey redds were identified in 54% of random steelhead surveys sampled in the Lower Columbia River ESU in 2015. By population in 2015, Pacific Lamprey redd occupancy ranged from 59% for the Clackamas to 30% for the Sandy.

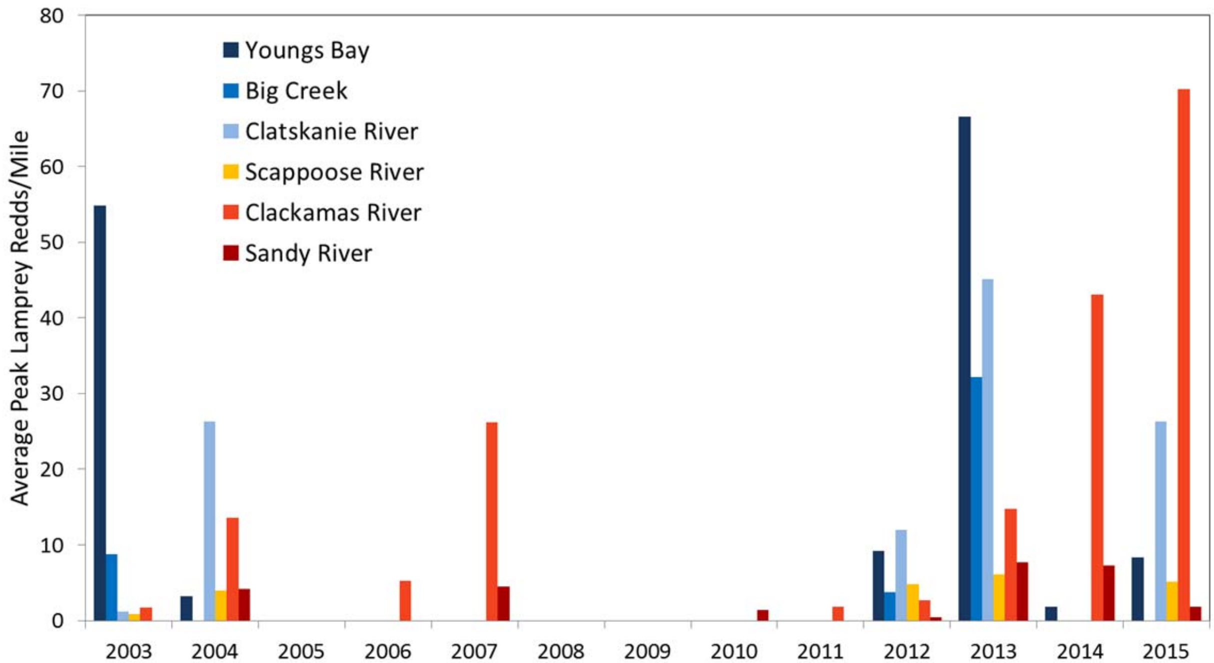


Figure 14. Lower Columbia Pacific Lamprey Peak Redd Density in Random Steelhead Spawning Surveys, 2003-2015. Note that not all populations were monitored in all years.

Pacific Lamprey redds in the Scappoose and Sandy were observed almost exclusively between late April and late May, however the generally low numbers of Pacific Lamprey redds observed in these populations in 2015 preclude analysis outside of a general sense of spawn timing. Higher numbers of Pacific Lamprey redds in the Clatskanie and Clackamas populations allow for a more complete review of spawning timing. In the Clackamas, spawning occurred mainly between late April and the end of May, with a distinct peak in early May (Figure 15). Pacific Lamprey spawn timing in the Clatskanie was much more protracted, with substantial numbers of redds observed from late April through the end of the sampling season in late June (Figure 15). There appears to have been a generally increasing trend in the Clatskanie through May, followed by a peak in early June at a time when Pacific Lamprey redds per mile in the Clackamas had declined substantially. This late peak is likely positively biased, as the only sites remaining active beyond the last week of May are either lamprey index sites (which are hand-selected for high lamprey abundance), or steelhead sites having continued steelhead spawning activity.

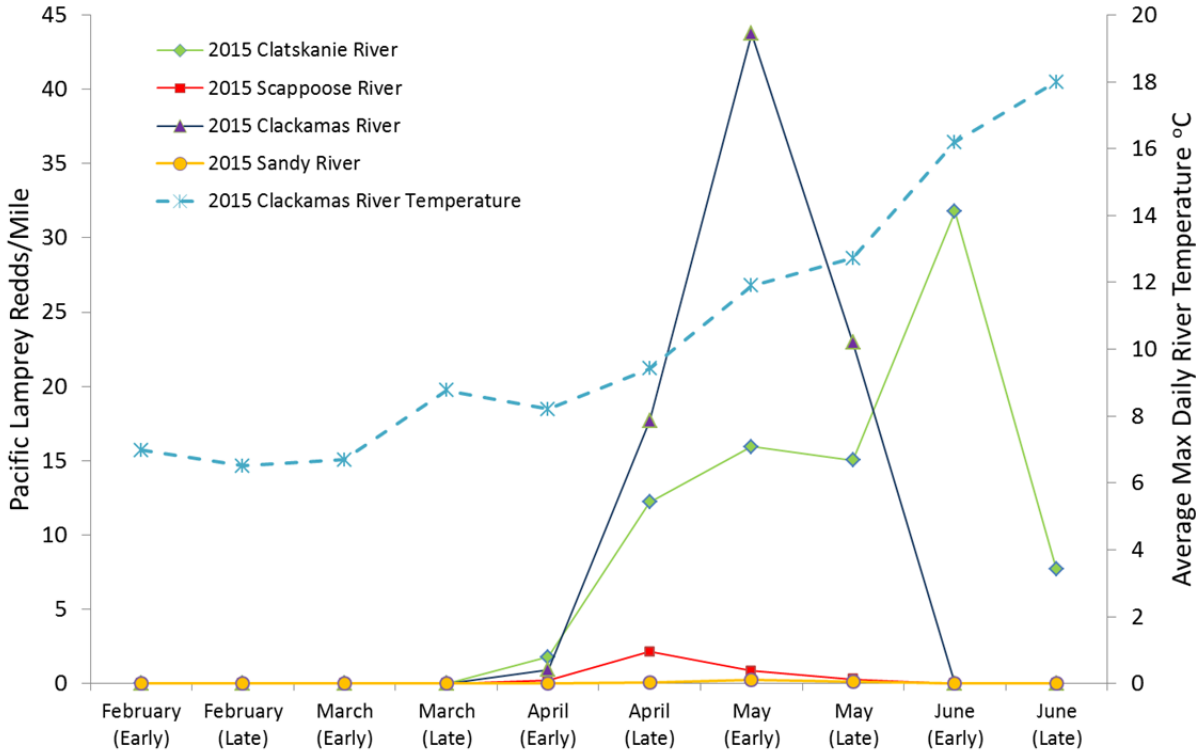


Figure 15. Lower Columbia Pacific Lamprey spawn timing in random steelhead surveys in 2015 and average daily water temperature in the Clackamas River.

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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 2015. 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.

Table A-2. Annual redd abundance estimates of naturally spawning wild steelhead by Population, in Lower Columbia Steelhead ESUs, run years 2003 to 2015. 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

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

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