THE OREGON PLAN *for Salmon and Watersheds*

Western Oregon Adult Winter Steelhead and Lamprey, 2018 Redd Survey Data Report

Report Number: OPSW-ODFW-2018-09

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Ryan Jacobsen
Jonathan Nott
Eric Brown
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 only) and Oregon Coast basins in 2018. Also included is a brief summary of lamprey data collected from the same monitoring efforts. Total winter steelhead redd estimates in the Southwest Washington (SWW) Evolutionary Significant Unit (ESU) were below the 5-year average, while estimates in the Lower Columbia River (LCR) ESU were above the 5-year average. Total winter steelhead redd estimates were approximately 98% of both the 5- and 10-year averages for the Oregon Coast (OC) Distinct Population Segment (DPS). Estimate precision goals were met for steelhead redd estimates in the LCR ESU, the OC DPS and the Nestucca River population. Precision goals were not met in the SWW ESU, nor in any of the four OC Monitoring Areas. Surveys were not conducted in the Klamath Mountains Province (KMP) DPS. Regional patterns are apparent for winter steelhead redd density, proportion of hatchery origin spawners and spawn timing. Indices for Pacific Lamprey were lower in 2018 in the Lower Columbia compared to recent years, but above average in the Oregon Coast.

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 SSW and LCR ESU's are currently monitored at the population scale, though funding limited efforts in 2018 to only the Clatskanie, Scappoose, Clackamas, and Sandy populations. No monitoring occurred in the Youngs Bay, Big Creek, Gorge, or Hood populations. In the OC DPS, monitoring is evaluated at the monitoring area (MA) scale, and in 2018 at the population scale in the Nestucca River basin. The KMP DPS was not monitored in 2018 and has not been monitored since 2015.

A spatially balanced, probabilistic sampling design (Stevens 2002) was used to randomly select survey sites across a stream network of winter steelhead spawning habitat. Within the sampling frame there are (or were) dams or fish traps where counts of winter steelhead 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 of these sites are used for monitoring these areas and are not included in this report. In accordance with prior work (Susac and Jacobs 1999) conducted by ODFW in coastal streams, monitoring of winter steelhead abundance is based on counts of redds; rearing origin is determined from live and dead fish observations. Repeat visits to each site, at least once every 14 days, from February through May generate a total redd count for each survey site. Specific descriptions of project protocols can be found in the annual survey procedures manual (ODFW 2018).

Estimates of steelhead redd abundance are converted to estimates of fish abundance using a standard conversion redd to fish factor developed in the OC ESU (ODFW 2013). Steelhead

abundance estimates are reported in Table 5, but do not include data for areas where counts are available and spawning ground surveys are not conducted.

Standard procedures for pHOS estimation require at least 10 fish with known adipose fin status (clipped or not clipped). Preference is given to using data from dead fish. If the number of dead fish is less than 10, then live and dead fish samples are combined. If this still results in a sample of less than 10 fish, results from recent years are used.

Survey sites adjacent to hatcheries and/or their acclimation areas typically have a higher proportion of both hatchery fish and redd densities and can therefore bias estimates of abundance and pHOS. In order to reduce bias and increase accuracy of winter steelhead estimates use of a stratified approach was initiated in 2017. These efforts differ slightly between the various monitoring units. In the SWW ESU the Clatskanie population is divided into two strata: Plympton Creek and the remaining Clatskanie basin. There are no hatchery steelhead releases in the Clatskanie population, but hatchery fish are abundant in Plympton Creek. In the LCR ESU, in each of the Sandy and Clackamas populations, strata are defined as migration corridors, areas adjacent to hatchery releases, and the remaining portions of each population (i.e. areas outside of direct hatchery influence). In each case, strata estimates are calculated individually, then rolled up to 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. Implementation of this stratification results 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 Table 7 as a conglomerate for the Oregon Coast DPS.

RESULTS

Survey Effort

SWW & LCR ESU's

- Survey effort in the SWW and LCR ESU's was similar to recent years (Table 1).
- The percentage of sites which were successfully surveyed in the SWW ESU (47%) was below the 5-year average (62%). Survey success in the LCR ESU (59%) was slightly above the 5-year average (50%).
- Due to budget constraints, surveys in the Young's Bay and Big Creek populations have not been conducted since 2013 and surveys in the Gorge and Hood populations have not been conducted since 2012.
- Conditions in the SWW and LCR ESU's were generally challenging, but amenable to survey protocols in 2018.

Oregon Coast DPS

- Survey effort in the OC DPS was similar to recent years.
- The percentage of sites successfully surveyed (46%) was somewhat below the 15-year average (53%).

- Survey success by MA was near average for three of the four MA's. Only 12 of 45 (27%) attempted sites were successfully surveyed in the Mid-South Coast MA.
- Survey conditions in the OC DPS were generally challenging, but amenable to survey protocols in 2018, though extended periods of high and turbid flows contributed to poor site performance in the Mid-South Coast MA.

Redd Abundance

SWW & LCR ESU's

- The 2018 wild winter steelhead redd abundance in the SWW ESU (224 redds) was among the lowest recorded in the seven years of record (Figure 2).
- In contrast, the wild redd abundance for the LCR ESU (4,424 redds) was one of the highest in that period (Figure 2).
- The 2018 wild estimate in the Sandy River population is the highest of any observed in that population over the seven years of record (3,516 redds), while the Clackamas River population estimate of 908 redds remains slightly below the 5-year average of 1,086 redds (Table 2).

Oregon Coast DPS

- The 2018 wild winter steelhead redd abundance in the OC DPS (54,938 redds) was just below average (91% of the 15-year average).
- The wild winter steelhead redd abundance estimate was above average in the Mid-Coast and Umpqua MA's, while the North Coast and Mid-South Coast MA's were below average. The North Coast MA wild winter steelhead redd abundance estimate was the lowest of the four MA's (49% of the 15-year average).

Hatchery Proportion

SWW & LCR ESU's

- In the SWW ESU, pHOS was comparable to that observed in recent years, and below 10% in all populations.
- In the LCR ESU, pHOS was higher than the prior 5-year average, was still below 10% in the Sandy population, and slightly higher than 10% in the whole-basin Clackamas population (11.6%) which includes North Fork Clackamas dam counts.
- In 2018, nearly all populations had a sample size below the 10 live/dead fish-observation target, with the exception of the Sandy and Cedar creek sub-strata in the Sandy population (Table 3).
- Given that the 2018 pHOS estimate exceeded 5% in the Sandy and Clackamas basins, an estimate of Summer Steelhead hatchery percentage was calculated. The February pHOS for the Sandy and Clackamas River basins was 0.7% and 2.5% respectively.

Oregon Coast DPS

- In the OC DPS, pHOS was about average for the DPS, but above 10% for the DPS and in three of the four MAs (North Coast, Mid Coast, and Mid-South MAs).

- pHOS was above the prior 15-year average in the North Coast MA, about average in the Mid-South Coast MA and below average in the Mid Coast and Umpqua MAs.
- In 2018, nearly all areas had a sample size above the threshold 10 live/dead fish-observation target, with only the Mid-South MA not meeting the goal (Table 3).

Distribution and Timing

LCR & SWW ESU's

- SWW ESU site occupancy (percent of sites with at least one steelhead redd) was aproximately half of average, while occupancy in the LCR ESU was above average (Table 4).
- 2018 steelhead redd timing in the SWW and LCR ESUs (Figure 6) was slightly later than average compared to the 2013 -2017 averages.

Oregon Coast DPS

- The percentage of occupied sites in the OC DPS was near average, with the exception of the Mid Coast MA which had only 58% sites occupied (average = 80%, Table 3).
- Winter steelhead spawn timing was fairly normal, though the North Coast MA peaked earlier than usual. All four MA's peaked during the month of March (Figure 10).

Pacific Lamprey Information

SWW & LCR ESU's

- In the LCR and SWW ESUs, Pacific Lamprey redd densities (peak redds per mile) appeared to be below average, with the exception of the Clatskanie River where densities were close to average (Figure 12).

Oregon Coast DPS

- In the OC DPS, Pacific Lamprey redd densities were well above the 15-year average during the 2018 spawning season (Figure 14).
- Within Pacific Lamprey index surveys on the Oregon Coast, 2018 spawn timing had the typical peak in May, though spawning began a little later than average as very few redds were observed in April (Figure 15). This later timing is likely due to stream conditions and water temperature, as flows were relatively high in April (Figure 11).
- Pacific Lamprey redd counts continue to track occupancy metrics in the OC DPS random sites. These results suggest that occupancy may provide a valuable index of abundance (Figure 14).

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APPENDIX

Table 1. Sites status in Oregon winter steelhead ESU/ DPS's by monitoring area or population, 2018. Target sites were within and non-target sites were outside of steelhead spawning habitat. Response sites were successfully surveyed. Non-response sites were not successfully surveyed because of issues such as: lack of landowner permission, site inaccessibility, or gaps in survey effort typically due to stream turbidity. ns = no surveys conducted.

ESU/DPS	Population or Monitoring Area	Target Response	Target Nonresponse	Nontarget
Southwest Washington	Youngs Bay	ns	ns	ns
	Big Cr	ns	ns	ns
	Clatskanie [b]	15	12	1
	Scappoose	17	21	2
	Total	**32**	**33**	**3**
Lower Columbia River	Clackamas [b]	30	16	0
	Sandy [b]	28	21	4
	Gorge	ns	ns	ns
	Total	**58**	**37**	**4**
Oregon Coast [a]	North Coast	64	24	18
	Nestucca [c]	*36*	*7*	*5*
	Mid Coast	38	16	6
	Mid South Coast	12	49	8
	Umpqua	31	34	14
	Total	**145**	**123**	**46**
Klamath Mountains Province	South Coast	ns	ns	ns
	Rogue River	ns	ns	ns
	Total	**ns**	**ns**	**ns**

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

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

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

Table 2. Oregon winter steelhead redd abundance estimates, 2018. Wild proportions are derived from fin-mark observations on live and dead steelhead. ns = no surveys conducted.

ESU/DPS	Population or Monitoring Area	Survey Effort		Winter Steelhead Redd Abundance			
				Total		Wild	
		Number of Surveys	Miles	Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Southwest Washington	Youngs Bay	ns	ns	ns	ns	ns	ns
	Big Cr	ns	ns	ns	ns	ns	ns
	Clatskanie [ab]	15	14	229	169	**216**	-
	Scappoose [b]	17	12	8	11	**8**	-
	Total	**33**	**25**	**237**	**170**	**224**	-
Lower Columbia River	Clackamas [ab]	30	31	1,142	385	**908**	-
	Sandy [a]	28	35	3,844	1,225	**3,516**	-
	Gorge	ns	ns	ns	ns	**ns**	ns
	Total	**59**	**65**	**4985**	**1282**	**4,424**	**-**
Oregon Coast [c]	North Coast	64	51	13,066	4,738	9,104	3,385
	Nestucca [d]	*36*	*30*	*2,820*	*820*	*1,757*	*511*
	Mid Coast	38	24	22,791	7,240	18,992	6,034
	Mid South Coast [b]	12	10	13,161	5,906	**10,882**	-
	Umpqua	31	21	15,960	6,052	15,960	6,052
	Total	**145**	**107**	**64,978**	**12,099**	**54,938**	**-**
Klamath Mountains Province	South Coast	ns	ns	ns	ns	ns	ns
	Rogue River	ns	ns	ns	ns	ns	ns
	Total	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**

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

b = Not Adequate Sample. Less than 10 known-fin-clip-status (live or dead) fish were observed, therefore a special case wild estimate was calculated.

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.

* = Due to small sample sizes in 2018, wild estimates in orange are derived from an alternate estimate method using a cumulative pHOS calculation from from all years sampled.

* = Due to small sample sizes in 2018, wild estimates in green are derived from an alternate estimate method. A 5-year average was used in the Mid South MA, and the OC DPS total is the sum of the MA estimates.

Table 3. Number of known adipose fin-mark status steelhead observed on spawning grounds, and resulting percent hatchery fish in 2018. Hatchery percentage based on adipose fin clip observations of live and dead steelhead in successfully conducted surveys. ns = no surveys conducted.

ESU/DPS	Population or Monitoring Area	Number Known Fish		Percent Hatchery	
		2018	Average [a]	2018	Average [a]
Southwest Washington	Young's Bay	ns	ns	ns	ns
	Big Cr	ns	ns	ns	ns
	Clatskanie	2	21[c]	4%	9%
	Plympton	8	-	0%	-
	Scappoose	1	3	0%	0%
	Total	**11**	**3**	**0%**	**-**
Lower Columbia River	Clackamas Population (area below North Fk. Clackamas Dam)	16	19	20%	4%
	Clackamas	4	-	15%	-
	Migration Corridor	5	-	22%	-
	Eagle Creek	7	-	55%	-
	Sandy Population	129	41	9%	4%
	Sandy	35	-	6%	-
	Migration Corridor	6	-	22%	-
	Cedar Creek	88	-	68%	-
	Gorge	ns	ns	ns	ns
	Total	**290**	**-**	**-**	**-**
Oregon Coast [b]	North Coast	122	101	30%	11%
	Nestucca [d]	*69*	-	*38%*	-
	Mid Coast	48	71	17%	22%
	Mid South Coast	8	95	17%	17%
	Umpqua	21	51	0%	5%
	Total	**199**	**321**	**15%**	**14%**
Klamath Mountains Province	South Coast	ns	ns	ns	ns
	Rogue River	ns	ns	ns	ns
	Total	**nn**	**ns**	**ns**	**ns**

a = Average for period of monitoring: Oregon Coast is 2003-2017; SWW and LCR is 2012-2017.
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.
* = Due to small sample sizes in 2018, wild estimates in orange are derived from an alternate estimate method using a cumulative pHOS calculation from from all years sampled.
* = Due to small sample sizes in 2018, wild estimates in green are derived from an alternate estimate method. A 5-year average was used in the Mid South MA.

Table 4. Oregon winter steelhead redd density and site occupancy, 2018. Sites must have at least one confirmed redd to be considered occupied. ns = no surveys conducted.

ESU/DPS	Population or Monitoring Area	Redds / Mile		% Sites With Redds	
		2018	Average [a]	2018	Average [a]
Southwest Washington	Young's Bay	ns	6.3	ns	56%
	Big Creek	ns	5.7	ns	59%
	Clatskanie	3.6	10.5	33%	69%
	Scappoose	0.1	1.7	13%	35%
	Total	**1.9**	**6.0**	**23%**	**57%**
Lower Columbia River	Clackamas	6.9	7.2	65%	57%
	Sandy	26.2	12.6	82%	66%
	Gorge	ns	ns	ns	ns
	Total	**16.6**	**9.2**	**74%**	**63%**
Oregon Coast	North Coast	12.0	17.7	77%	77%
	Mid Coast	14.7	11.2	58%	80%
	Mid-South Coast	14.2	17.5	83%	87%
	Umpqua	10.3	8.5	73%	72%
	Total	**12.8**	**12.9**	**73%**	**79%**
Klamath Mountians Province	South Coast	ns	ns	ns	ns
	Rogue River	ns	ns	ns	ns
	Total	**ns**	**ns**	**ns**	**ns**

a = Average for period of monitoring: Oregon Coast is 2003-2017; SWW and LCR is 2012-2017.

Table 5. Oregon winter steelhead fish abundance estimates, 2018. Estimates do not include steelhead above counting stations and are thus not complete population estimates in all areas, see Appendix Tables 6 and 7. ns = no surveys conducted.

ESU/DPS	Population or Monitoring Area	Winter Steelhead Abundance			
		Total		Wild	
		Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Southwest Washington	Youngs Bay	ns	ns	ns	ns
	Big Cr	ns	ns	ns	ns
	Clatskanie [ab]	393	291	**371**	-
	Scappoose [b]	18	22	**17**	-
	Total	**406**	**292**	**385**	-
Lower Columbia River	Clackamas [ab]	1,944	658	**1,547**	-
	Sandy [a]	6,538	2,086	**5,981**	-
	Gorge	ns	ns	ns	ns
	Total	**8,478**	**2,184**	**7,525**	**-**
Oregon Coast [c]	North Coast	22,216	8,058	15,481	5,758
	Nestucca [d]	*4,798*	*1,398*	*2,991*	*872*
	Mid Coast	38,748	12,312	32,290	10,262
	Mid South Coast [b]	22,377	10,044	**18,503**	-
	Umpqua	27,136	10,292	27,136	10,292
	Total	**110,466**	**20,572**	**93,398**	**-**
Klamath Mountains Province	North Coast	ns	ns	ns	ns
	Rogue River	ns	ns	ns	ns
	Total	**ns**	**ns**	**ns**	**ns**

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

b = Not Adequate Sample. Less than 10 known-fin-clip-status (live or dead) fish were observed, therefore a special case wild estimate was calculated.

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.

* = Due to small sample sizes in 2018, wild estimates in orange are derived from an alternate estimate method using a cumulative pHOS calculation from from all years sampled.

* = Due to small sample sizes in 2018, wild estimates in green are derived from an alternate estimate method. A 5-year average was used in the Mid South MA, and the OC DPS total is the sum of the MA estimates.

Table 6. Annual redd abundance estimates of naturally spawning wild steelhead by Monitoring Area (MA), in Oregon Coast Steelhead DPSs, run years 2003 to 2018. 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.
2018[a]	9,104	18,992	10,882	15,960	n.a.	n.a.

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

Table 7. Oregon Winter Steelhead redd abundance estimates within Oregon Coast Hotspots. Estimates are calculated at the DPS scale, due to insufficient sample size at the MA scale.

DPS	Monitoring Area	Survey Effort		Spawning Miles within Hotspots	Winter Steelhead Redd Abundance			
					Total		Wild	
		Number of Surveys	Miles		Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Oregon Coast	North Coast Hotspots	3	2	49	-	-	-	-
	Mid Coast Hotspots	4	4	89	-	-	-	-
	Mid South Coast Hotspots	1	1	61	-	-	-	-
	Umpqua Hotspots	0	0	42	-	-	-	-
	Total	**8**	**6**	**241**	**6,402**	**7,575**	**474**	**561**

Table 8. Oregon Winter steelhead redd abundance estimates within stratified samples, 2018. Due to small sample sizes in 2018, wild estimates in orange are derived from an alternate estimate method using a cumulative pHOS calculation from all years sampled.

ESU	Population	Survey Effort		Aproximate Spawning Miles	Winter Steelhead Redd Abundance			
					Total		Wild	
		Number of Surveys	Miles		Estimate	95% Confidence Interval	Estimate	95% Confidence Interval
Southwest Washington	*Clatskanie Strata*	14	11	53	203	170	**195**	-
	Plympton Cr.Strata	2	2	1	26	0	**21**	-
	Clatskanie Total	16	14	54	229	169	**216**	-
Lower Columbia River	*Clackamas Strata*	18	15	140	964	347	**819**	-
	Clackamas Migration Strata	7	11	32	27	14	**21**	-
	Eagle Cr. Hatchery	5	5	10	151	165	**68**	-
	Lower Clackamas Total	30	31	181	1,142	385	**908**	-
	Sandy Strata	19	22	124	3,599	1,222	3,393	1,152
	Sandy Migration Strata	8	12	22	98	55	**76**	-
	Cedar Cr. Hatchery Strata	2	1	1	147	0	47	-
	Sandy Total	29	35	147	3,843	1,225	**3,516**	1,154
	Lower Columbia ESU Total	**92**	**91**	**446**	**5,222**	**1,294**	**4,424**	**1,152**

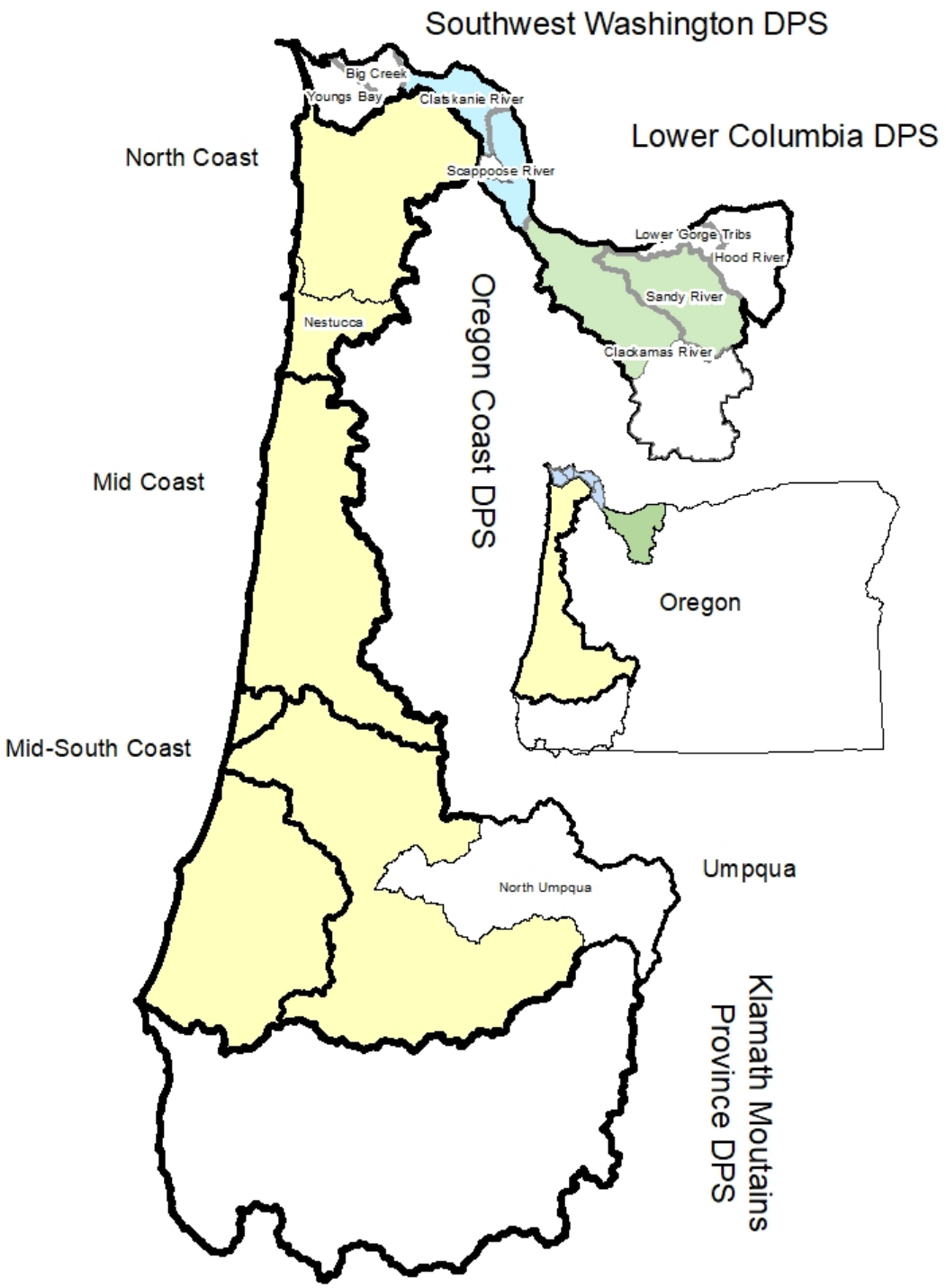

Figure 1. Geographic scope of winter steelhead monitoring, 2018. Monitoring scales include: Evolutionary Significant Unit (ESU), Dependent Population Segment (DPS), Monitoring Area (MA), and population. Areas without color were not monitored in 2018. Boundaries as defined by Busby et.al. (1996) for ESU/DPS, by Myers et al. (2006) for the LCR ESU populations, by the 2005 Oregon Native Fish Status Report (ODFW 2005) for other populations.

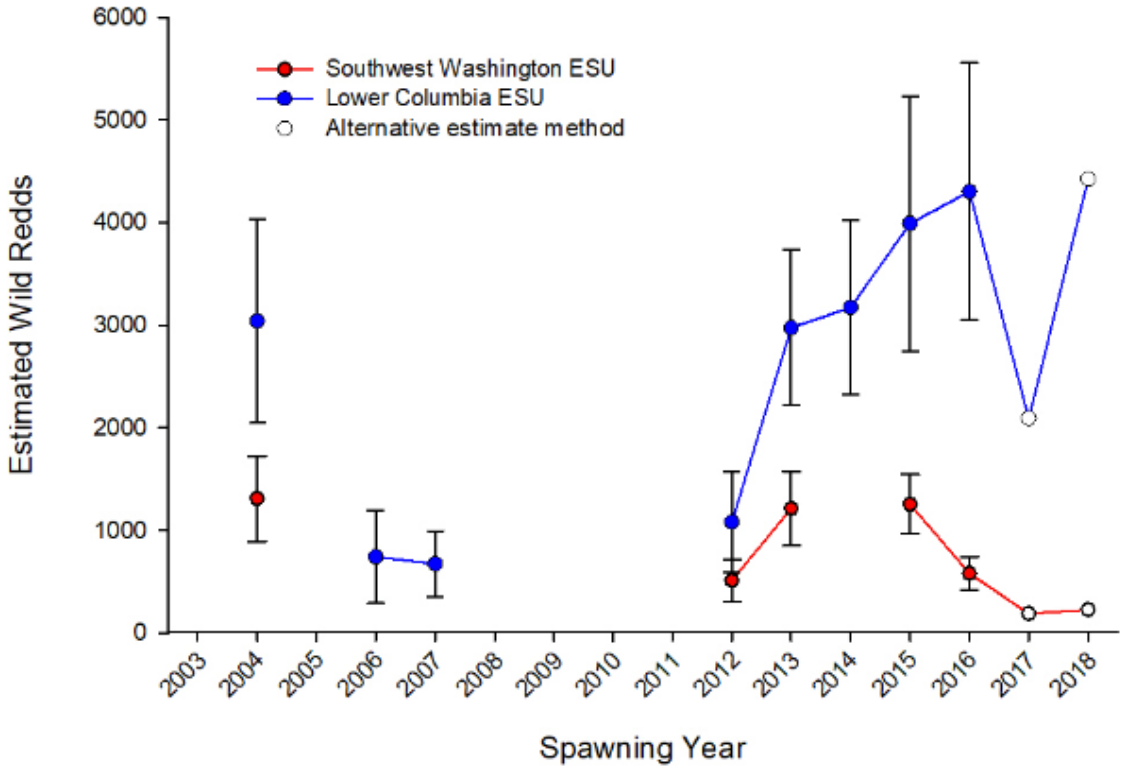

Figure 2. Wild winter steelhead redd estimates in the Oregon portions of the SWW and LCR ESUs based on random surveys, 2004 to 2018. Error bars represent 95% confidence intervals. Inclusion of survey data from specific populations and from above counting stations has varied across years. Note: 2017 and 2018 error bars were not available because estimates were calculated with alternative methods.

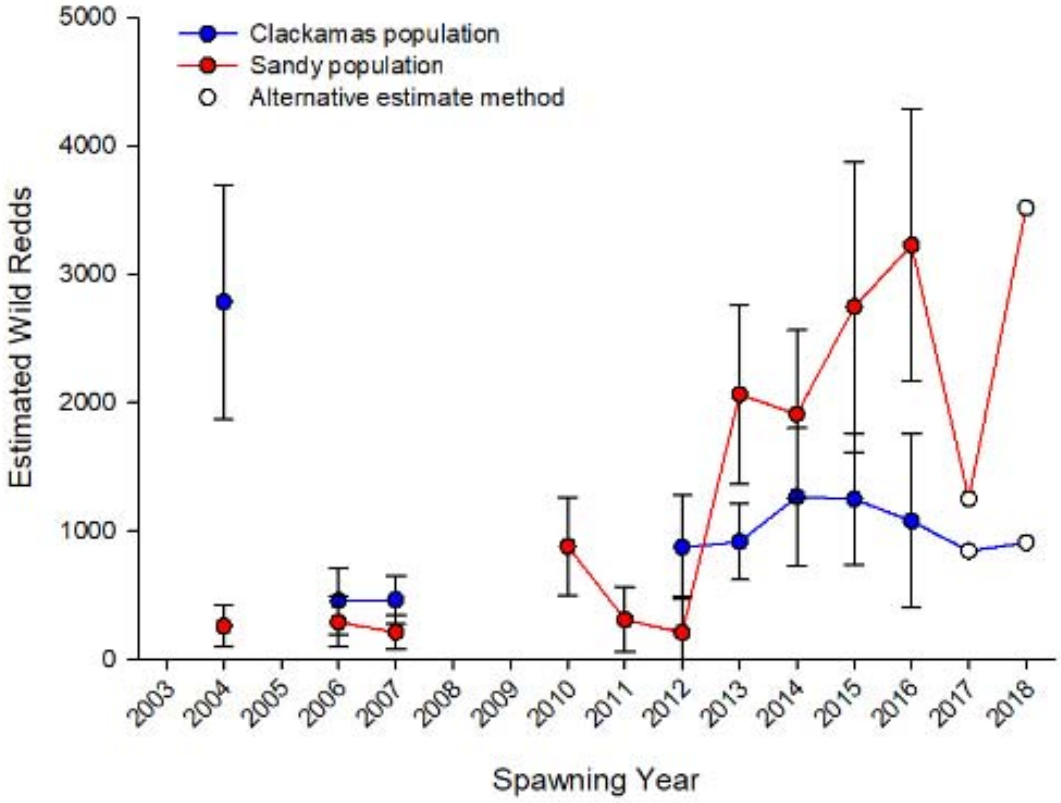

Figure 3. Wild winter steelhead redd estimates in the Clackamas and Sandy River populations based on random surveys, 2004 to 2018. Error bars represent 95% confidence intervals. Note: 2017 and 2018 error bars were not available because estimates were calculated with alternative methods.

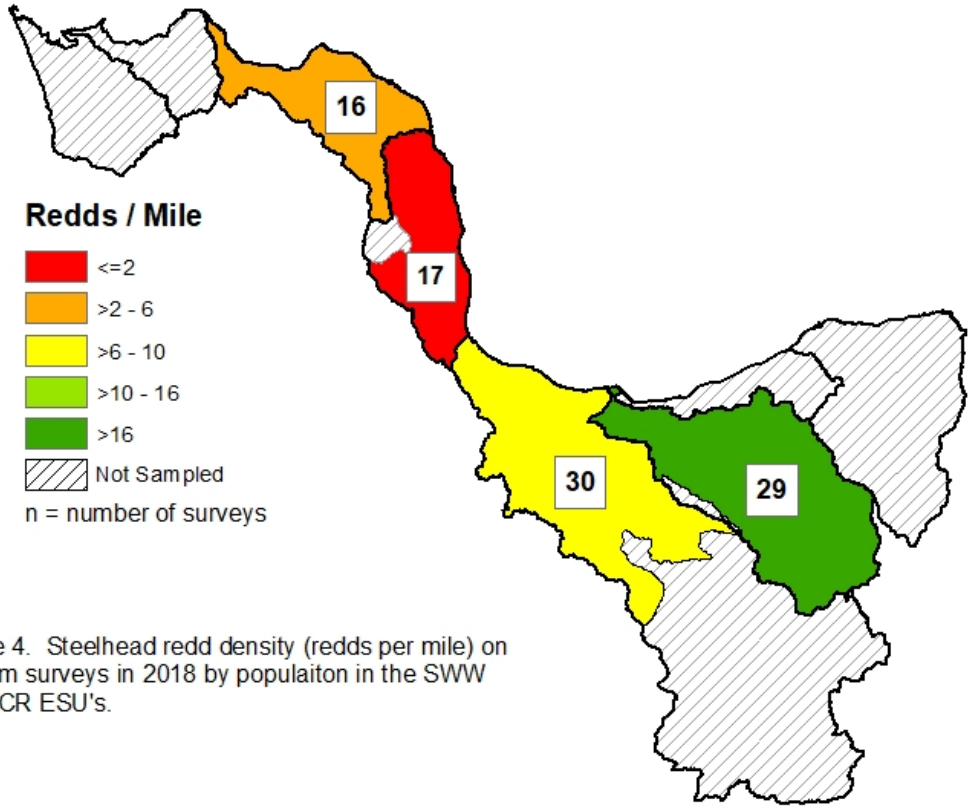

Figure 4. Steelhead redd density (redds per mile) on random surveys in 2018 by populaiton in the SWW and LCR ESU's.

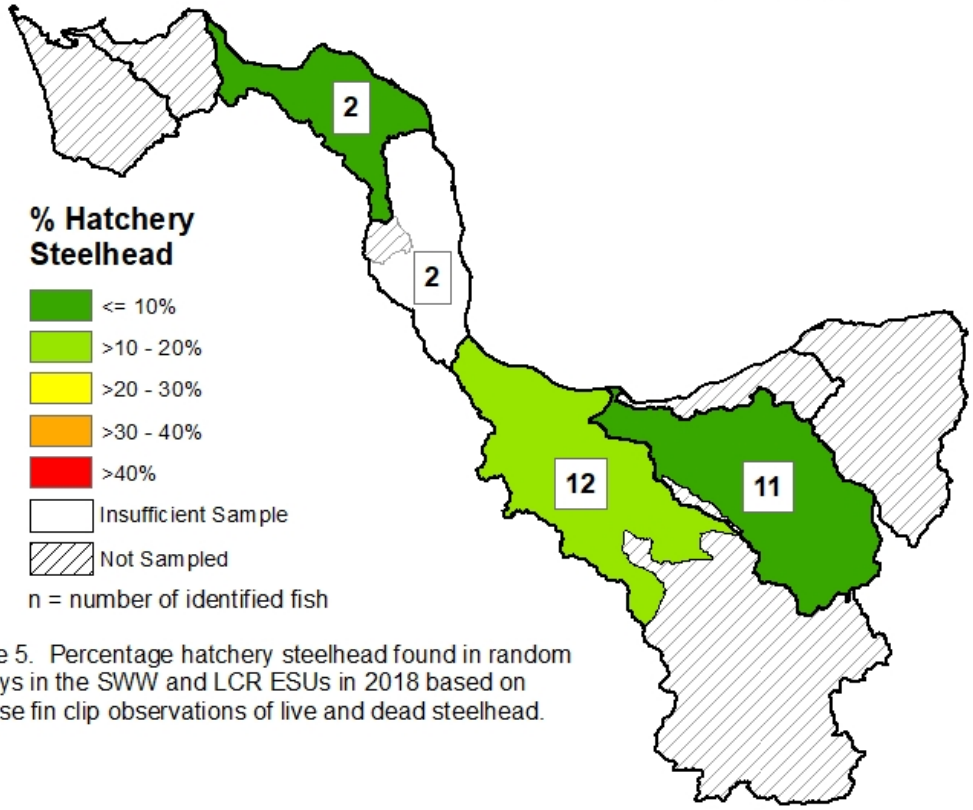

Figure 5. Percentage hatchery steelhead found in random surveys in the SWW and LCR ESUs in 2018 based on adipose fin clip observations of live and dead steelhead.

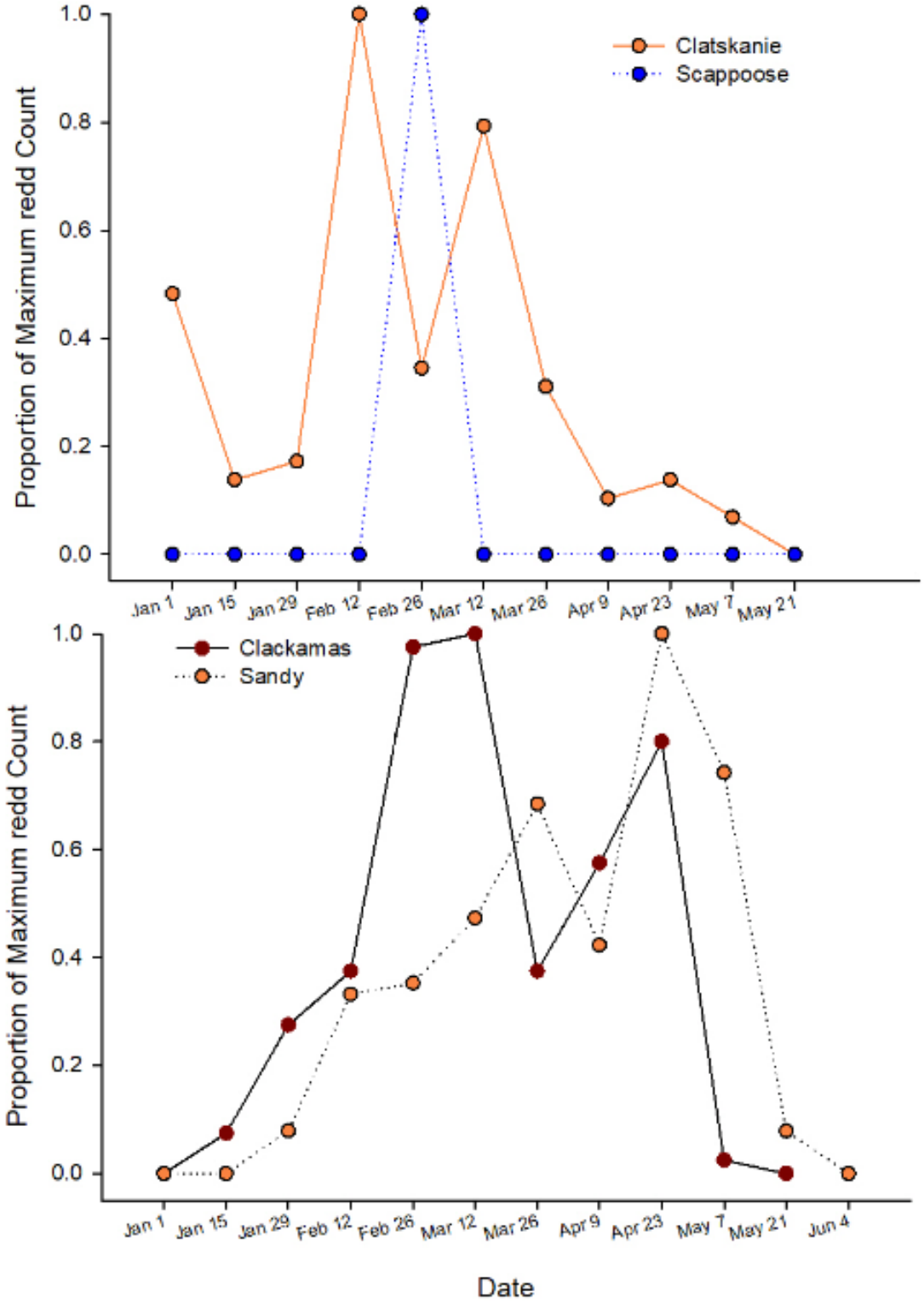

Figure 6. Winter steelhead spawn timing, represented by proportion of the maximum redd count in a) SWW ESU populations and b) LCR ESU populations, 2018.

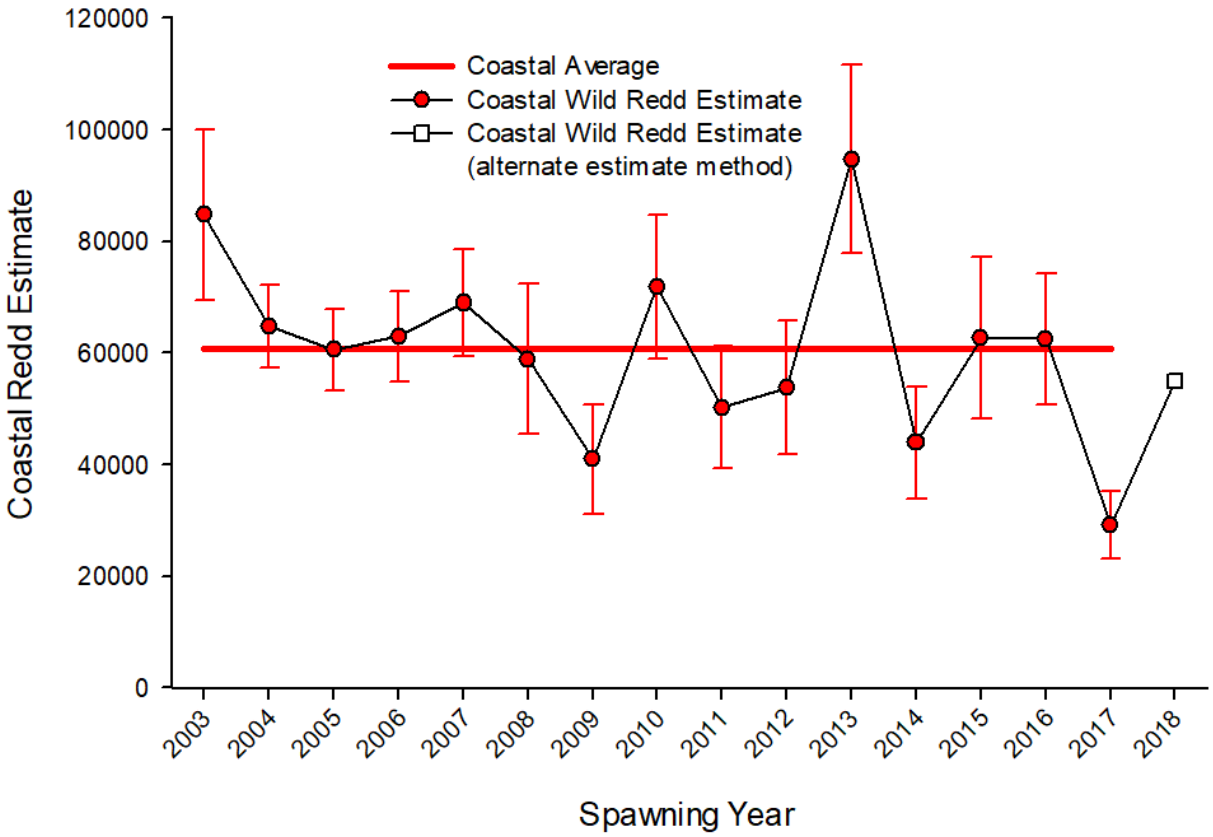

Figure 7. Estimated number of wild winter steelhead redds in the Oregon Coast DPS, 2003 to 2018. Error bars represent 95% confidence intervals. Note: 2018 error bar was not available because estimates were calculated with alternative methods.

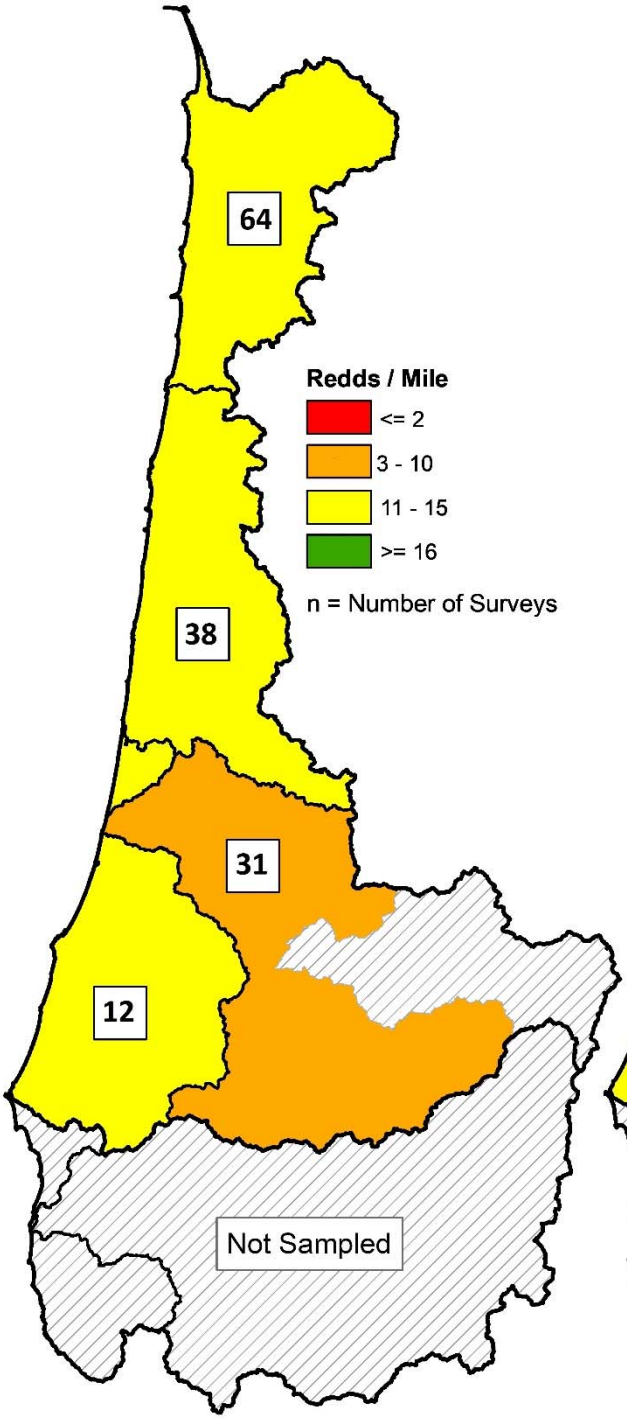

Figure 8. Steelhead redd density (redds per mile) in random surveys in 2018 by monitoring area in the Coastal and KMP DPS's.

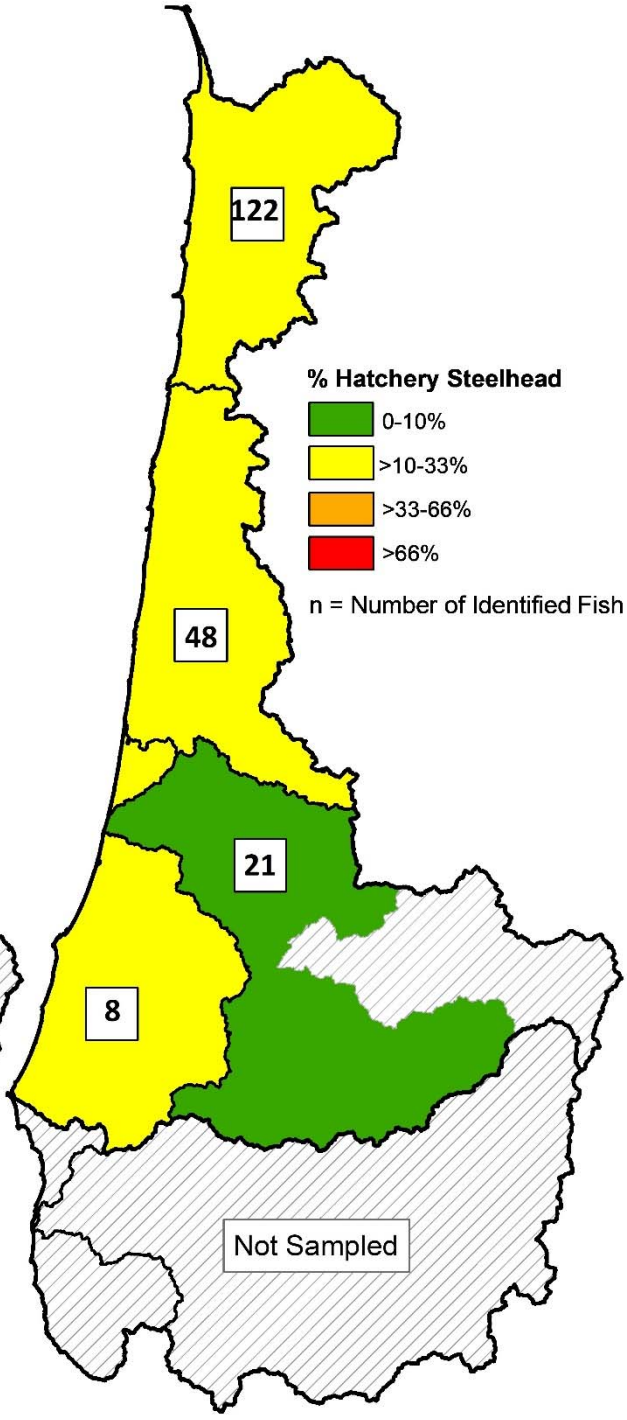

Figure 9. Percentage hatchery steelhead found in random surveys in each of the six Coastal and KMP monitoring areas in 2018 based on fin clip observations of live and dead steelhead.

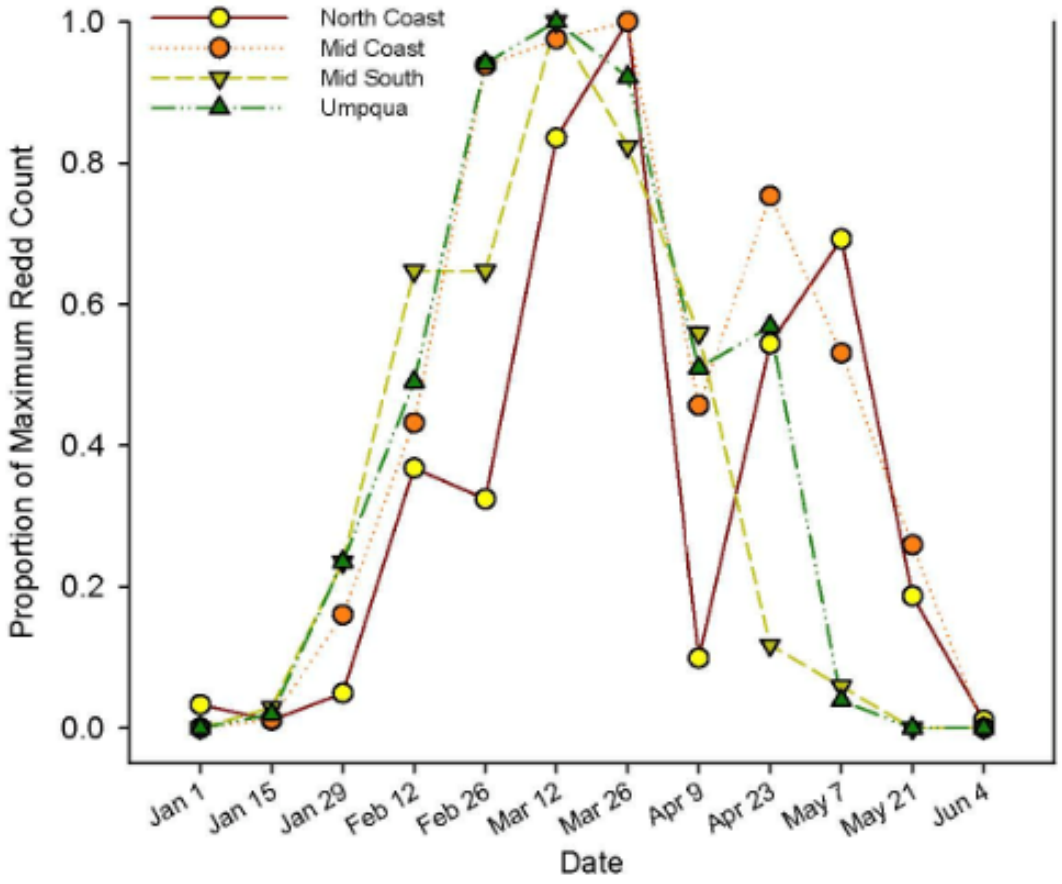

Figure 10. Winter steelhead spawn timing, represented by proportion of the maximum redd count in each of the four OC DPS monitoring areas, 2018.

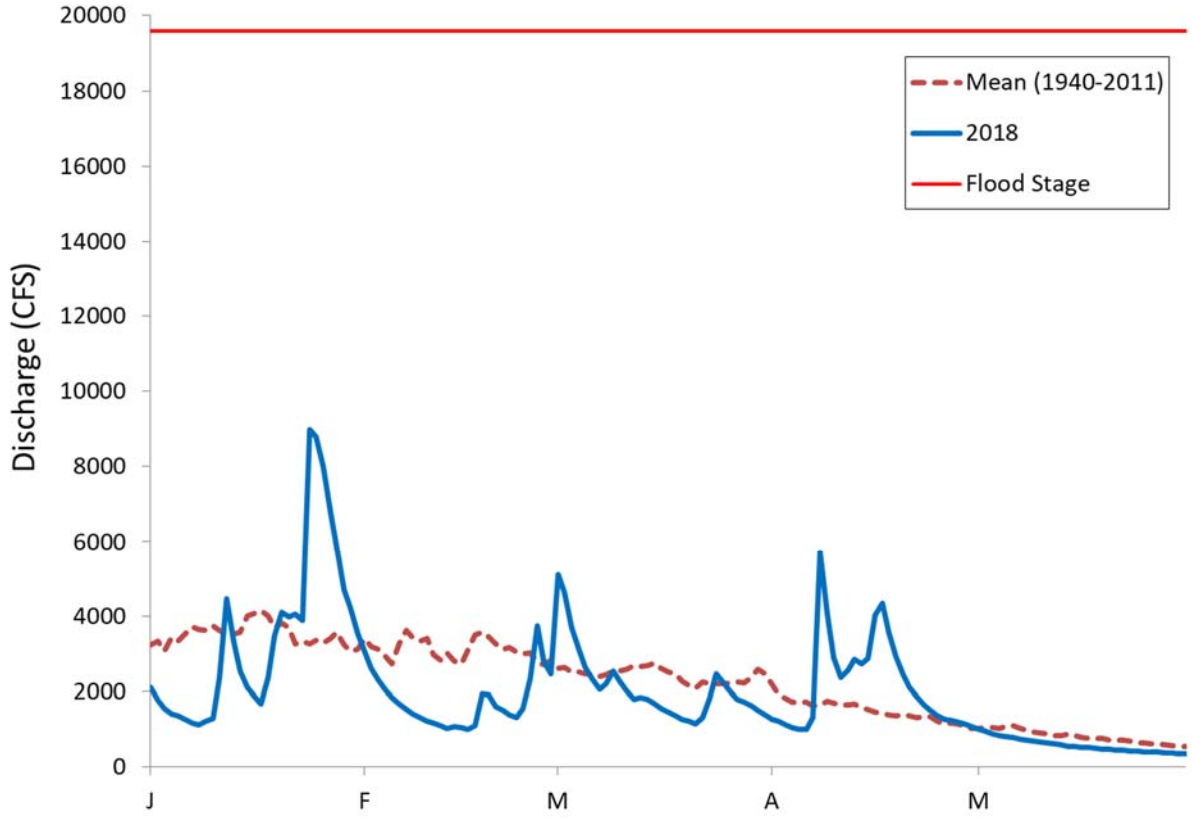

Figure 11. Stream discharge at Alsea River near Tidewater during 2018, compared to mean discharge from 1940 to 2011. (Flood stage = 19,500 CFS)

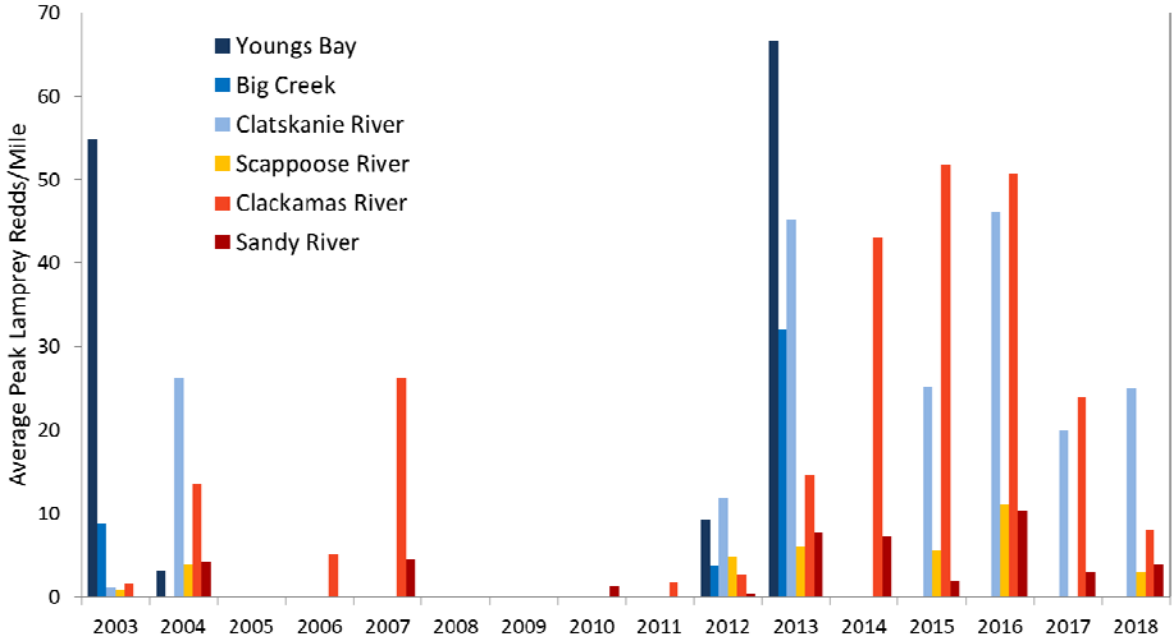

Figure 12. Lower Columbia Pacific Lamprey Peak Redd Density in Random Steelhead Spawning Surveys, 2003-2018. Note that not all populations were monitored in all years.

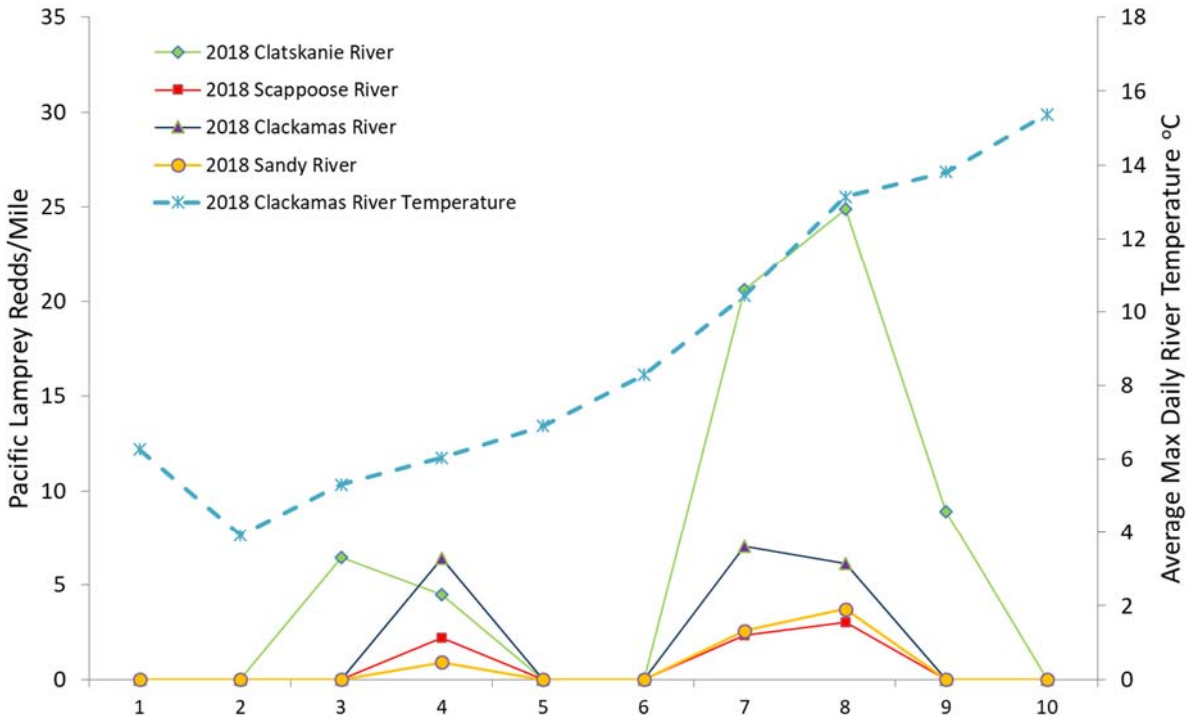

Figure 13. Lower Columbia Pacific Lamprey spawn timing in random steelhead surveys in 2018 and average daily max water temperature in the Clackamas River.

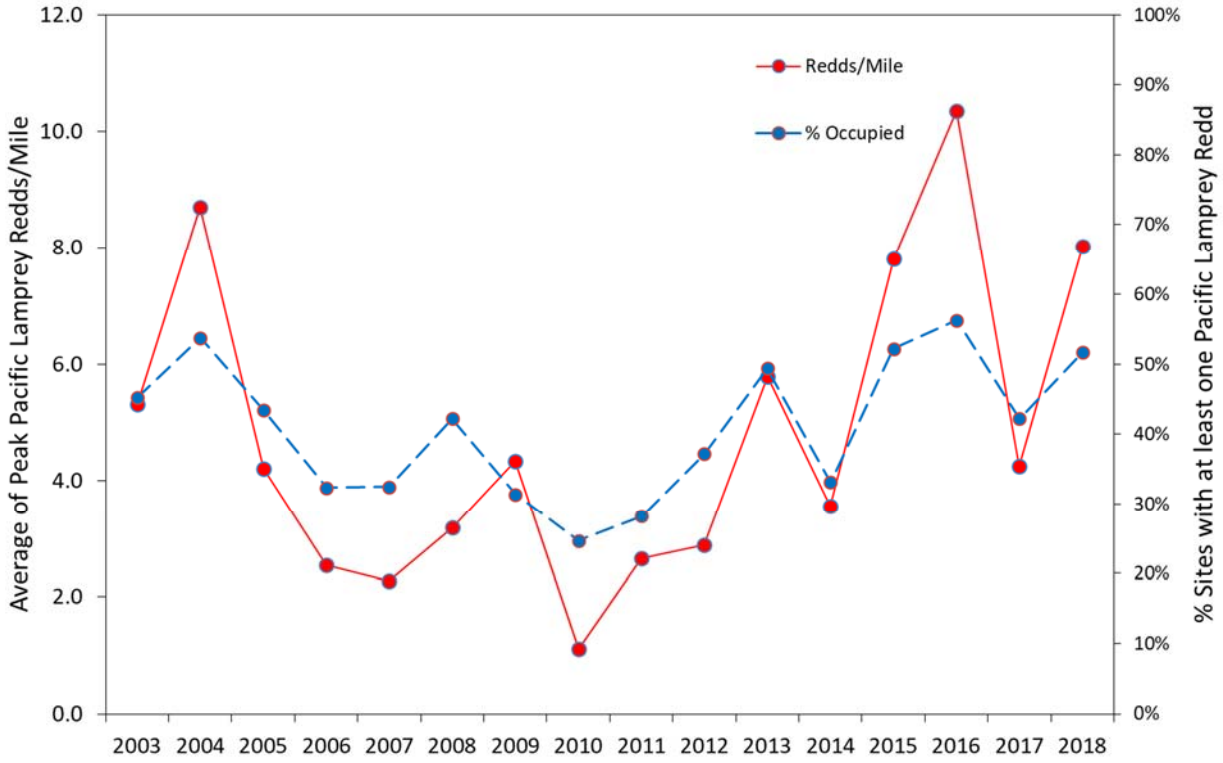

Figure 14. Oregon coast Pacific Lamprey peak redd density and percent of sites occupied in random steelhead spawning surveys, 2003 to 2018.

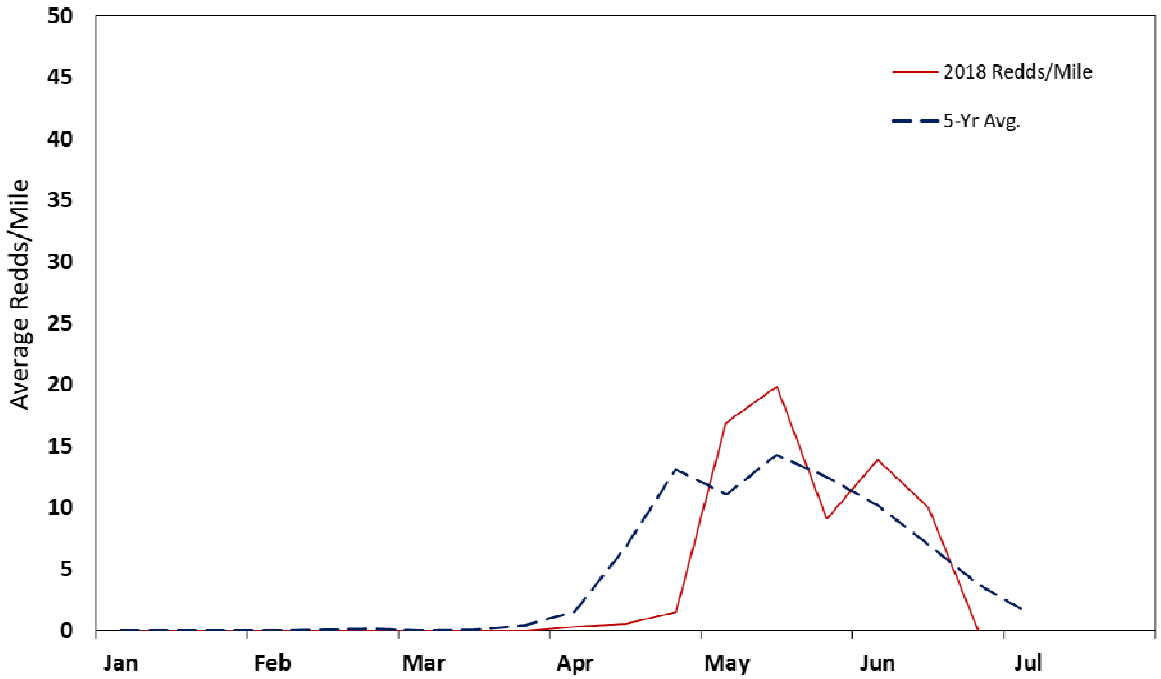

Figure 15. Oregon coast Pacific Lamprey spawn timing in index surveys, 2018.

4034 Fairview Industrial Drive SE
Salem, OR 97302