THE OREGON PLAN *for Salmon and Watersheds*

Western Oregon Adult Winter Steelhead and Lamprey, 2020 Redd Survey Data Report

Report Number: OPSW-ODFW-2020-09

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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 2020. Also included is a brief summary of lamprey data collected from the same monitoring efforts. Total wild winter steelhead redd estimates in the Southwest Washington (SWW) Evolutionary Significant Unit (ESU) and in the Lower Columbia River (LCR) ESU were 179% and 63% of the prior 5-year average, respectively. Total wild winter steelhead redd estimates were 117% of the 5-year average for the Oregon Coast (OC) Distinct Population Segment (DPS). Estimate precision goals were met for steelhead redd estimates in the LCR ESU and OC DPS, the North Coast Monitoring Area (MA) and the Mid-South Coast MA, and the Nestucca Basin. Precision goals were not met in the SWW ESU, nor the remaining two OC MAs (Mid Coast and Umpqua). 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 2020 in the Lower Columbia and Oregon Coast compared to recent years.

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 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 SWW and LCR ESU's are currently monitored at the population scale, though funding limited efforts in 2020 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 scale, and in 2020 at the population scale in the Nestucca River basin. No monitoring has occurred in the KMP DPS 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. Areas above dams or fish traps where counts of winter steelhead are available are not sampled, these include: River Mill (Clackamas River) and Winchester (North Umpqua River) dams, and Big Creek Hatchery and Sandy Hatchery weirs. The Bonnie Falls Trap (Scappoose Basin) is no longer a counting station. Surveys above the former trap were not added to the survey frame in 2020. However surveys will be selected above this point in future years. Counts of steelhead passed upstream of these sites 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 to generate a total redd count for each survey. Pacific lamprey standard surveys and any steelhead survey that still have activity at the end of May are typically continued into June, or until the end of spawning activity, however in 2020 surveys were discontinued at the end of May. Specific

descriptions of project protocols can be found in the annual survey procedures manual (ODFW 2020).

Steelhead redd abundance estimates are converted to fish abundance using a standard redd-to-fish conversion factor developed in the OC ESU (ODFW 2013). Steelhead abundance estimates (including both dam counts and spawning survey results) for the 2020 spawning season are reported in Table 5.

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 included.

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 wild abundance. 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, individual strata estimates are calculated, then rolled up to final population estimates (Table 7). In the OC DPS, the ODFW Coastal Multi-Species Conservation and Management Plan 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 for 2020 are presented in Table 6 as a single estimate for the Oregon Coast DPS.

RESULTS

Survey Effort

SWW & LCR ESU's

- Survey effort in the SWW and LCR ESU's in 2020 was similar to recent years (Table 1).
- The percentage of sites which were successfully surveyed in the SWW ESU (64%) and the LCR ESU (55%) were above the 5-year averages (58% and 52%, respectively).
- 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.
- Also due to budget restraints, trapping at Bonnie Falls in the Scappoose population was not conducted in 2020, nor were areas above this site included in monitoring for that year. The area will be included in future monitoring.

- Conditions in the SWW and LCR ESU's were average or better in terms of survey success rates, and flows were mostly agreeable to survey protocols in 2020. The greater challenges in 2020 were adjustments and logistical complications due to implementation of COVID-19 response measures, however field staff were successful in completing surveys throughout the season.

Oregon Coast DPS

- Survey effort in the OC DPS in 2020 was similar to recent years (Table 1).
- The percentage of sites successfully surveyed (57%) was above the 5-year average (51%).
- Survey conditions in the OC DPS were good for most of the season with lower than average rainfall and stream discharge. Conditions were amenable to survey protocols in 2020 as a result (Figure 11). Field staff were successful in completing surveys throughout the season despite the logistical complications associated with the emergence of COVID-19 and its associated safety adjustments.

Redd Abundance

SWW & LCR ESU's

- The 2020 wild winter steelhead redd abundance estimate in the SWW ESU (890 redds) was 179% of the 5-year average (Table 2).
- The 2020 wild redd abundance for the LCR ESU (2,064 redds) was 63% of the 5-year average (Table 2).

Oregon Coast DPS

- The 2020 wild winter steelhead redd abundance in the OC DPS (58,522 redds) was 117% of the 5-year average (Table 2).
- Wild estimates were above average in three of the four Oregon Coast MA's. The Umpqua MA estimate (10,281 redds) was relatively low (94% of the 5-year average), and the North Coast MA estimate (19,769 redds) was the highest (146% of the 5-year average).

Hatchery Proportion

SWW & LCR ESU's

- In the SWW ESU, pHOS estimates were similar or lower than 5-year averages, and below 10% in all populations (Figure 5 & Table 2).
- In the LCR ESU, pHOS estimates were below, or similar to, the prior 5-year averages (Figure 5 & Table 2). Hatchery proportions for the Lower Clackamas spawning surveys were 16% in 2020 (Figure 5 & Table 2). However, when combined with the count of fish passed above the North Fork Clackamas Dam (100% wild), the basin total pHOS for the Clackamas was 7.8%.

- In 2020, all populations had a sample size below the 10 live/dead fish-observation target, except for the Sandy migration corridor and the Clatskanie Population with 20 and 24 steelhead observations with known clip status respectively. (Figure 5).
- The 2020 pHOS estimate in the Sandy River Population did not exceed 5%, therefore a Summer Steelhead hatchery percentage is not required. The pHOS estimate for spawning ground surveys in the Clackamas population was 16%, requiring a calculation of February Summer Steelhead pHOS which is 0% for 2020.

Oregon Coast DPS

- In the OC DPS, the estimate of pHOS was 2.4%, which is well below the 5-year average of 12.6% (Table 2), and the lowest estimate since monitoring began in 2003.
- Estimates of pHOS were below the prior 5-year average in three MAs, with only the Umpqua MA estimate (1.5% pHOS) above the 5-year average (0.1% pHOS).
- In 2020, all MAs had a sample size well above the 10 live/dead fish-observation target (Figure 9).

Distribution and Timing

LCR & SWW ESU's

- Site occupancy (percentage of sites with at least one steelhead redd) was above the 5-year average in both the SWW ESU and the LCR ESU (Table 3). All populations had occupancy rates in 2020 that were above or similar to the prior 5-year average.
- Winter steelhead redd timing for 2020 in the SWW ESU was normal, while LCR ESU redd timing was average in the Sandy River but slightly late in the Clackamas River (Figure 6).

Oregon Coast DPS

- The percentage of occupied sites in the OC DPS in 2020 was above the 5-year average, with some regional variability by MA (Table 3).
- Winter steelhead spawn timing in 2020 was fairly typical for each MA (Figure 10). Spawn timing in the Mid Coast MA often has a bimodal distribution, typically peaking in late-February and then to a lesser degree in early-April,. However, in 2020 the latter peak timing was greater.

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 for 2020 (Figure 12).

Oregon Coast DPS

- In the OC DPS, 2020 Pacific Lamprey redd density on steelhead surveys was just 72% of the 17-year average (Figure 14).

- Within Pacific Lamprey index surveys on the Oregon Coast, 2020 spawn timing was highest in May, which is normal, though the peak was less distinct than is typical (Figure 15). Note that due to logistical complications from COVID-19 response, lamprey surveys were ended early (not conducted in June), so the latter portion of spawn timing was not captured.
- 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. Site status in Oregon winter steelhead ESU/DPSs by monitoring area or population, 2020. 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 Non-response	Non-target
Southwest Washington	Youngs Bay	ns	ns	ns
	Big Cr	ns	ns	ns
	Clatskanie [b]	25	7	1
	Scappoose	16	14	1
	Total	**41**	**21**	**2**
Lower Columbia River	Clackamas [b]	29	26	0
	Sandy [b]	31	22	1
	Gorge	ns	ns	ns
	Total	**60**	**48**	**1**
Oregon Coast [a]	North Coast	66	18	13
	Nestucca [c]	*33*	*9*	*7*
	Mid Coast	40	24	8
	Mid South Coast	36	19	4
	Umpqua	37	36	13
	Total	**179**	**97**	**38**
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. Spawning survey results for Oregon winter steelhead redd abundance estimates and percent hatchery origin spawning (pHOS) for 2020 and previous 5-year averages. Wild proportions and pHOS estimates are derived from fin-mark observations on live and dead steelhead. ns = no surveys conducted. Total abundance estimates for the Clackamas population do not include fish passage counts above the North Fork Clackamas Dam.

ESU/DPS	Population or Monitoring Area	Survey Effort		Winter Steelhead Redd Abundance				pHOS	
				Total		Wild			
		Number of Surveys	Miles	2020	5-Yr Avg	2020	5-Yr Avg	2020	5-Yr Avg
Southwest Washington	Youngs Bay	ns	ns	ns	ns	ns	ns	ns	ns
	Big Cr	ns	ns	ns	ns	ns	ns	ns	ns
	Clatskanie [ab]	25	24.4	833	463	823	452	1.2%	3.9%
	Scappoose [b]	16	10.9	67	45	67	45	0.0%	0.0%
	Total	**41**	**35.3**	**900**	**509**	**890**	**498**	**1.1%**	**3.7%**
Lower Columbia River	Clackamas [ab]	29	32.7	617	1,032	517	882	16.2%	15.4%
	Sandy [ab]	31	39.6	1,627	2,553	1,547	2,370	4.9%	6.2%
	Gorge	ns	ns	ns	ns	ns	ns	ns	ns
	Total	**60**	**72.3**	**2,244**	**3,585**	**2,064**	**3,252**	**8.0%**	**8.7%**
Oregon Coast [c]	North Coast	66	61.3	21,077	15,439	19,769	13,568	6.2%	13.4%
	Nestucca [d]	*33*	*29.0*	*3,909*	*na*	*3,146*	*na*	*19.5%*	*na*
	Mid Coast	40	31.1	16,175	18,330	16,175	15,583	0.0%	16.5%
	Mid South Coast	36	30.0	12,297	12,378	12,297	9,757	0.0%	19.6%
	Umpqua	37	29.5	10,436	10,967	10,281	10,916	1.5%	0.1%
	Total	**179**	**151.9**	**59,985**	**57,114**	**58,522**	**49,824**	**2.4%**	**12.6%**
Klamath Mountains Province	South Coast	ns	ns	ns	ns	ns	ns	ns	ns
	Rogue River	ns	ns	ns	ns	ns	ns	ns	ns
	Total	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**	**ns**

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

b = Not adequate sample, less than 10 known-fin-clip-status (live or dead) fish were observed. Therefore, an alternative method was used to estimate wild redds, which includes data from prior seasons. Numbers in orange are, or in part include, wild redd estimates based on an alternative method.

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

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

Table 3. Oregon winter steelhead redd density and site occupancy, 2020. 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	
		2020	5-Yr Avg	2020	5-Yr Avg
Southwest Washington	Young's Bay	ns	ns	ns	ns
	Big Creek	ns	ns	ns	ns
	Clatskanie	15.0	8.2	71%	65%
	Scappoose	1.3	0.7	31%	21%
	Total	**8.5**	**4.4**	**56%**	**45%**
Lower Columbia River	Clackamas	3.7	5.9	67%	57%
	Sandy	10.5	16.8	74%	74%
	Gorge	ns	ns	ns	ns
	Total	**7.0**	**11.1**	**70%**	**67%**
Oregon Coast	North Coast	17.7	14.0	79%	67%
	Mid Coast	10.5	11.5	78%	69%
	Mid-South Coast	12.6	12.6	78%	75%
	Umpqua	6.5	6.5	70%	70%
	Total	**11.3**	**10.6**	**77%**	**70%**
Klamath Mountians Province	South Coast	ns	ns	ns	ns
	Rogue River	ns	ns	ns	ns
	Total	**ns**	**ns**	**ns**	**ns**

Table 4. Oregon winter steelhead fish abundance estimates, 2020. 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]	1,420	746	1,403	-
	Scappoose [b]	117	68	118	-
	Total	**1,534**	**748**	**1,517**	**-**
Lower Columbia River	Clackamas [ab]	1,052	396	883	-
	Sandy [ab]	2,770	1,065	2,634	-
	Gorge	ns	ns	ns	ns
	Total	**3,818**	**1,136**	3,513	**-**
Oregon Coast [c]	North Coast	35,835	9,945	33,611	9,595
	Nestucca [d]	*6,649*	*1,513*	*5,352*	*1,218*
	Mid Coast	27,501	8,435	27,501	8,435
	Mid South Coast	20,908	5,398	20,908	5,398
	Umpqua [b]	17,745	6,118	17,482	6,027
	Total	**101,977**	**15,373**	**99,491**	**15,113**
Klamath Mountains Province	South 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, an alternative method was used to estimate wild redds, which includes data from prior seasons. Numbers in orange are, or in part include, wild redd estimates based on an alternative method.

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

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

Table 5. Annual fish abundance estimates of naturally spawning wild steelhead by Monitoring Area (MA), in Oregon Coast Steelhead DPSs, run years 2003 to 2020, including estimates for areas above counting stations. n.a. = not available.

	Oregon Coast DPS				Klamath Mountains Province DPS	
Year	North Coast	Mid Coast	Mid-South	Umpqua	South Coast	Rogue River
2003	48,838	30,760	20,154	52,754	8,252	27,640
2004	48,622	23,877	17,335	33,159	15,462	n.a.
2005	32,516	13,417	38,884	24,762	17,063	16,613
2006	35,814	22,947	33,239	21,247	9,638	19,158
2007	35,010	17,230	41,334	32,011	11,763	19,292
2008	20,164	21,471	31,974	35,490	9,388	13,929
2009	17,740	20,540	15,535	23,423	24,259	24,065
2010	32,181	28,367	33,880	37,702	7,535	n.a.
2011	16,937	32,894	16,161	28,563	3,077	n.a.
2012	26,973	32,430	12,608	32,302	4,658	n.a.
2013	49,934	47,480	26,223	48,847	15,237	n.a.
2014	24,118	15,324	18,495	26,496	7,567	n.a.
2015	41,893	26,357	19,635	29,513	2,863	n.a.
2016[a]	26,338	40,485	23,887	28,893	n.a.	n.a.
2017[a]	18,228	9,443	11,749	20,790	n.a.	n.a.
2018[a]	15,481	32,377	18,503	35,495	n.a.	n.a.
2019[a]	13,410	24,182	9,179	29,704	n.a.	n.a.
2020[a]	33,611	27,640	20,909	27,501	n.a.	n.a.

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

Table 6. Oregon Winter Steelhead redd abundance estimates within Oregon Coast Hotspots in 2020. 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	2	1.4	49	**5,170**	**2,673**	**4,700**	**2,430**
	Mid Coast Hotspots	4	3.1	89				
	Mid South Coast Hotspots	1	1.9	61				
	Umpqua Hotspots	1	0.7	42				
	Total	**8**	**7.0**	**241**				

Table 7. Oregon Winter steelhead redd abundance estimates by stratified area, 2020. Due to small sample sizes in 2020, 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*	23	22.4	57.0	783	437	783	437
	Plympton Cr.Strata	2	1.1	1.1	50	-	38	-
	Clatskanie Total	25	23.5	58.1	833	437	821	-
Lower Columbia River	*Clackamas Strata*	21	20.7	139.5	559	229	475	-
	Clackamas Migration Strata	7	10.8	31.5	58	31	42	-
	Eagle Cr. Hatchery	1	1.2	9.5	-	-	-	-
	Lower Clackamas Total	29	32.7	180.5	617	666	517	-
	Sandy Strata	20	18.7	133.6	1,379	618	1,324	-
	Sandy Migration Strata	11	21.0	22.0	248	89	224	80
	Cedar Cr. Hatchery Strata	ns	ns	0.6	ns	ns	ns	-
	Sandy Total	31	39.7	156.2	1,627	624	1,548	-
	Lower Columbia ESU Total	**85**	**95.9**	**394.8**	**3,077**	**797**	**2,886**	-

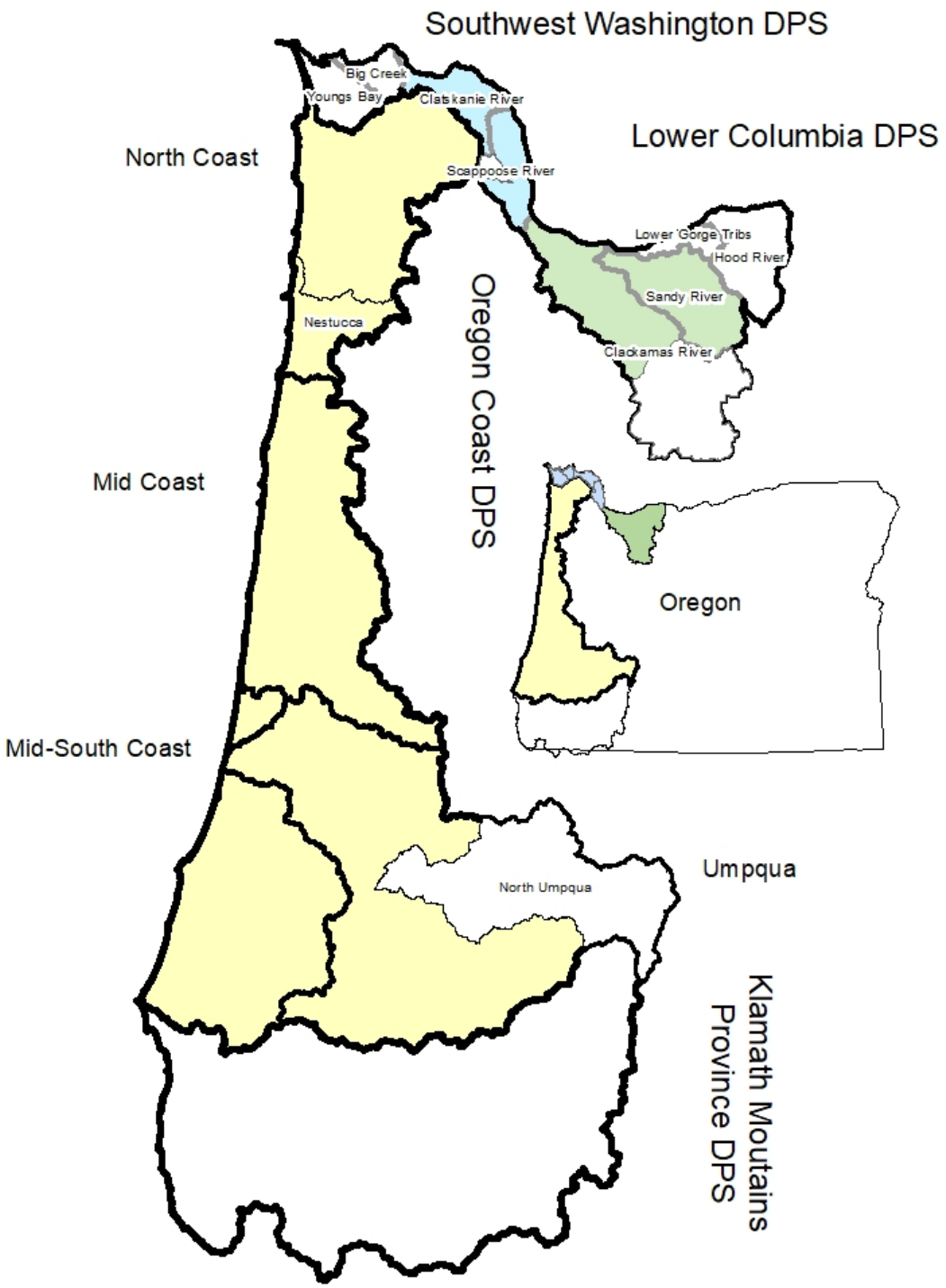

Figure 1. Geographic scope of winter steelhead monitoring, 2020. Monitoring scales include: Evolutionary Significant Unit (ESU), Dependent Population Segment (DPS), Monitoring Area (MA), and population. Areas without color were not monitored in 2020. Boundaries as defined by Busby et.al. (1996) for ESU/DPS, by Myers et al. (2006) for the LCR ESU populations, by the 2005 Oregon Native Fish Status Report (ODFW 2005) for other populations.

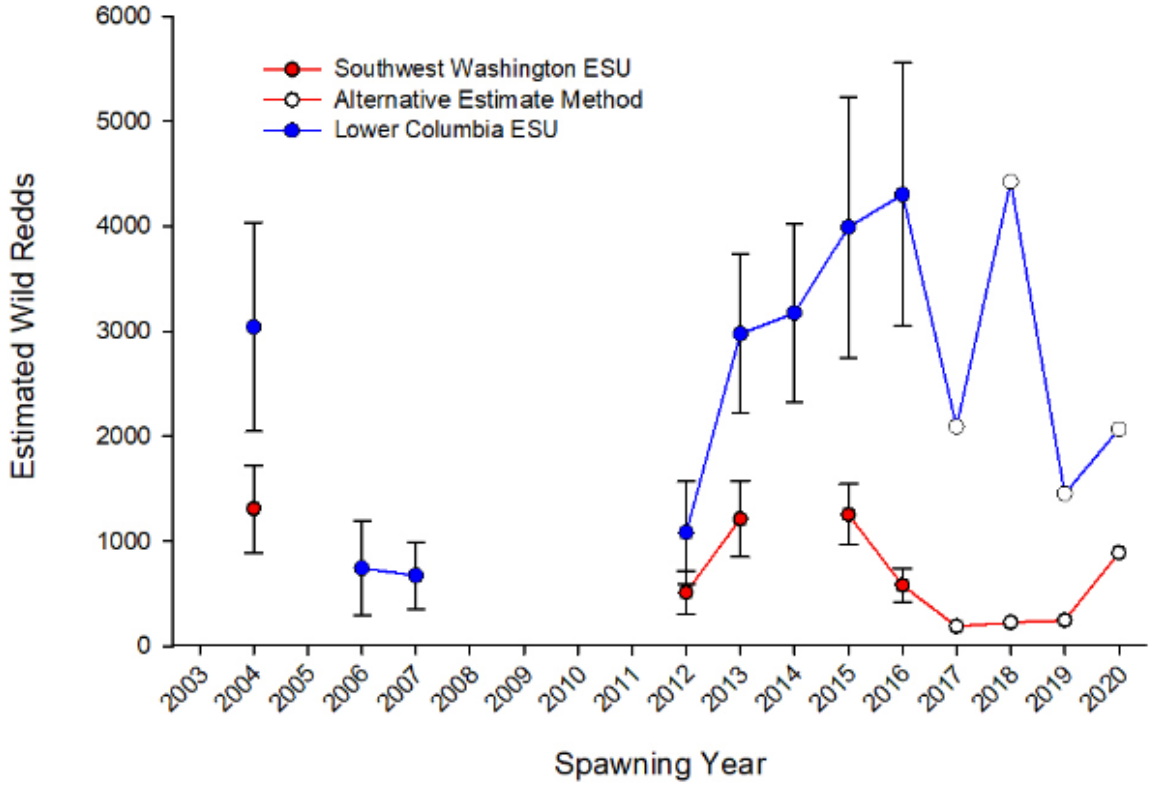

Figure 2. Wild winter steelhead redd estimates in the Oregon portions of the SWW and LCR ESUs based on random surveys, 2004 to 2020. Error bars represent 95% confidence intervals. Inclusion of survey data from specific populations and from above counting stations has varied across years. Note: 2017 to 2020 error bars were not available because estimates were calculated with alternative methods.

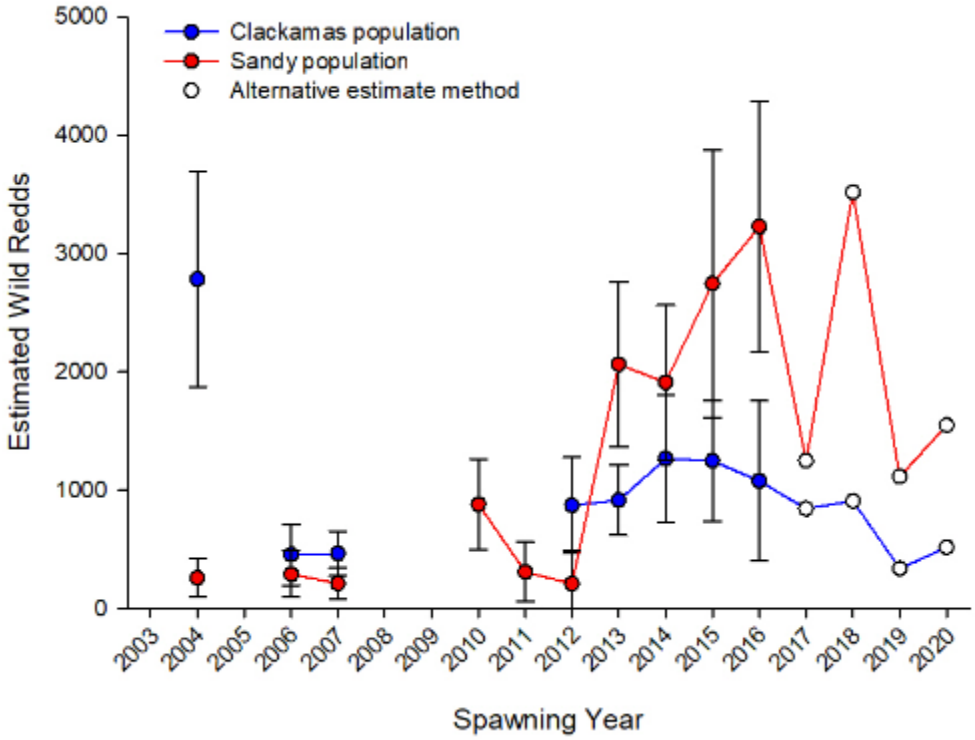

Figure 3. Wild winter steelhead redd estimates in the Clackamas and Sandy River populations based on random surveys, 2004 to 2020. Error bars represent 95% confidence intervals. Note: 2017 to 2020 error bars were not available because estimates were calculated with alternative methods.

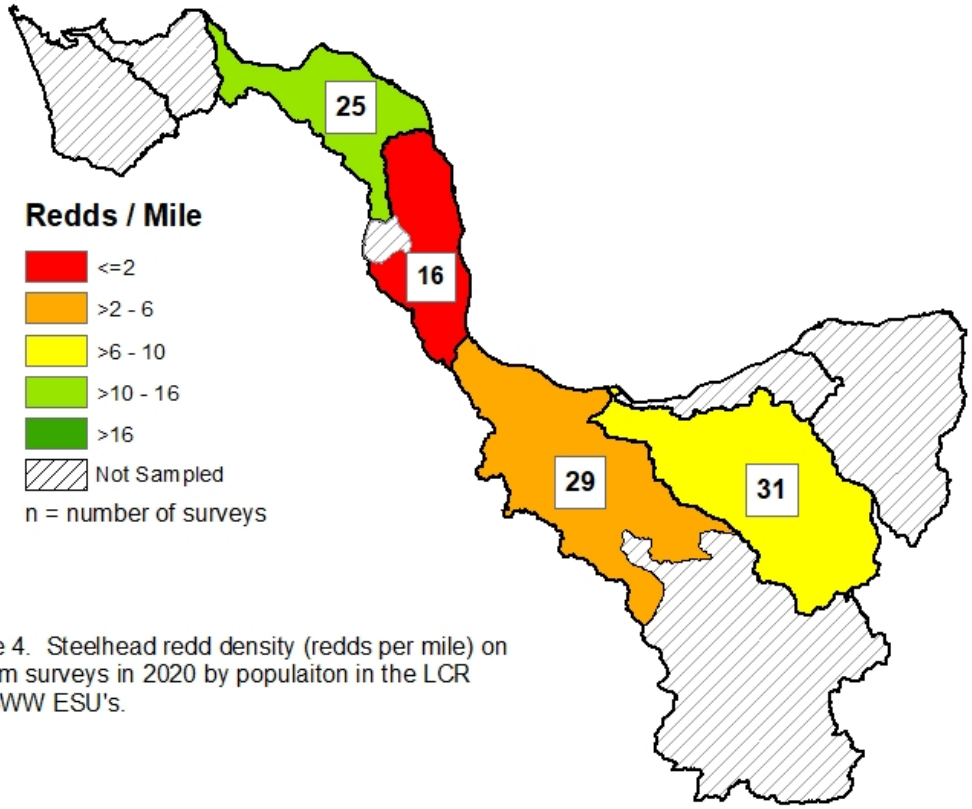

Figure 4. Steelhead redd density (redds per mile) on random surveys in 2020 by populaiton in the LCR and SWW ESU's.

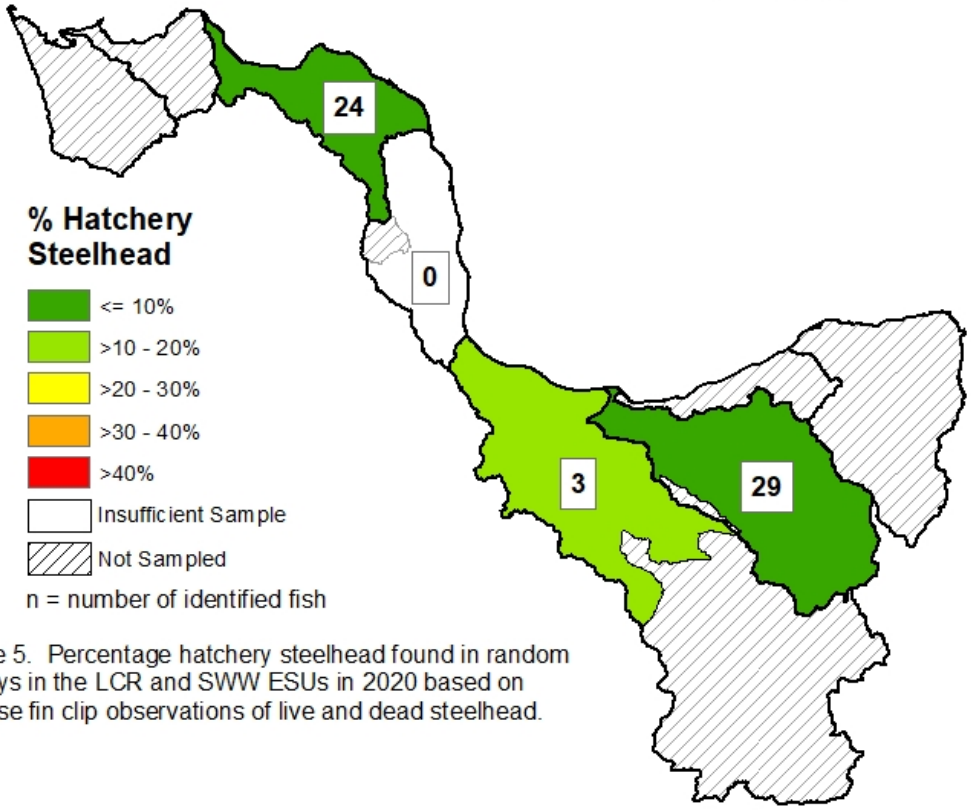

Figure 5. Percentage hatchery steelhead found in random surveys in the LCR and SWW ESUs in 2020 based on adipose fin clip observations of live and dead steelhead.

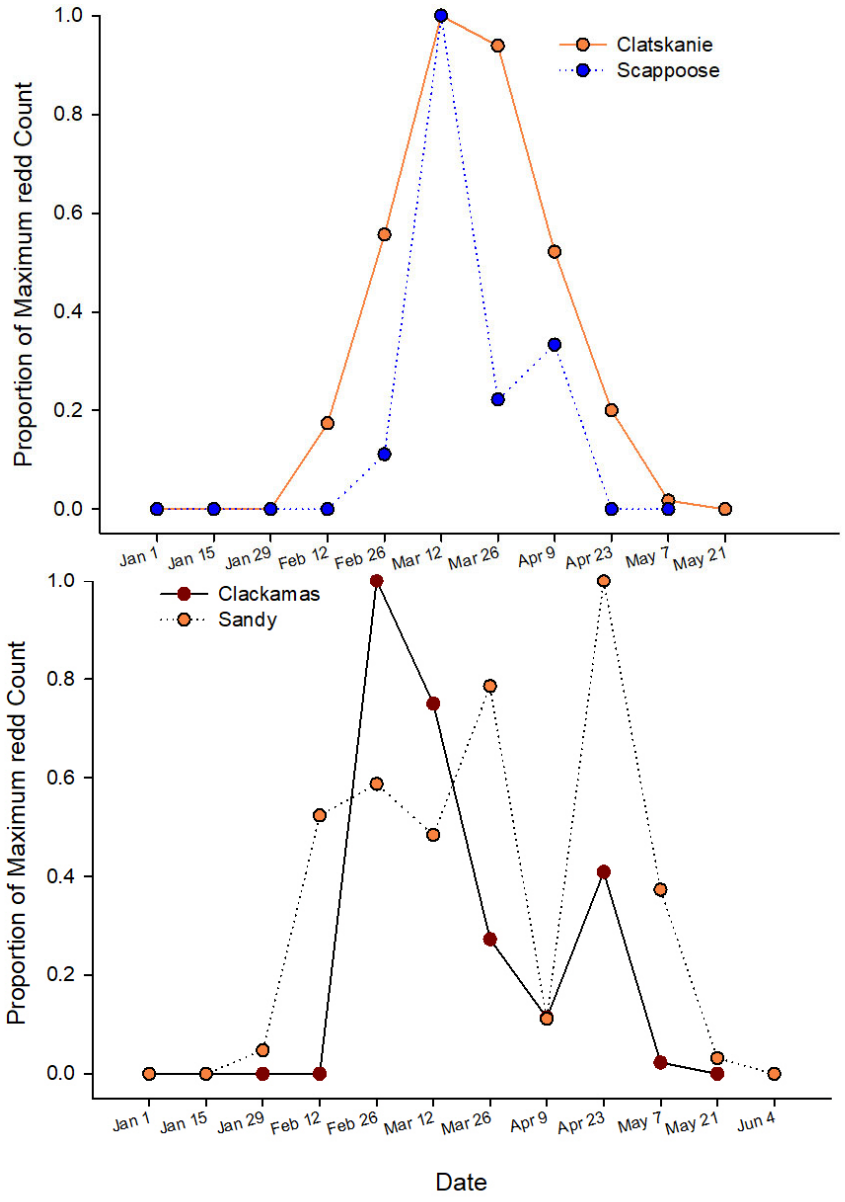

Figure 6. Winter steelhead spawn timing, represented by proportion of the maximum redd count in a) SWW ESU populations and b) LCR ESU populations, 2020.

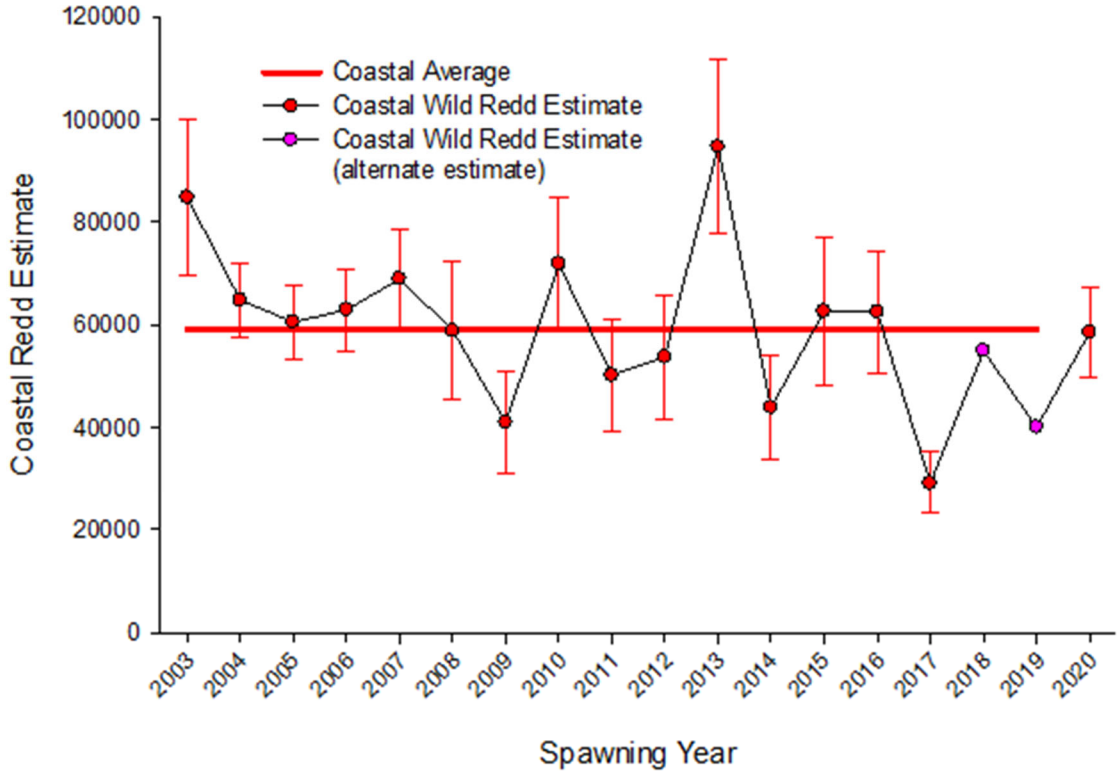

Figure 7. Estimated number of wild winter steelhead redds in the Oregon Coast DPS, 2003 to 2020. Error bars represent 95% confidence intervals. Note: 2018 and 2019 error bars were not available because estimates were calculated with alternative methods.

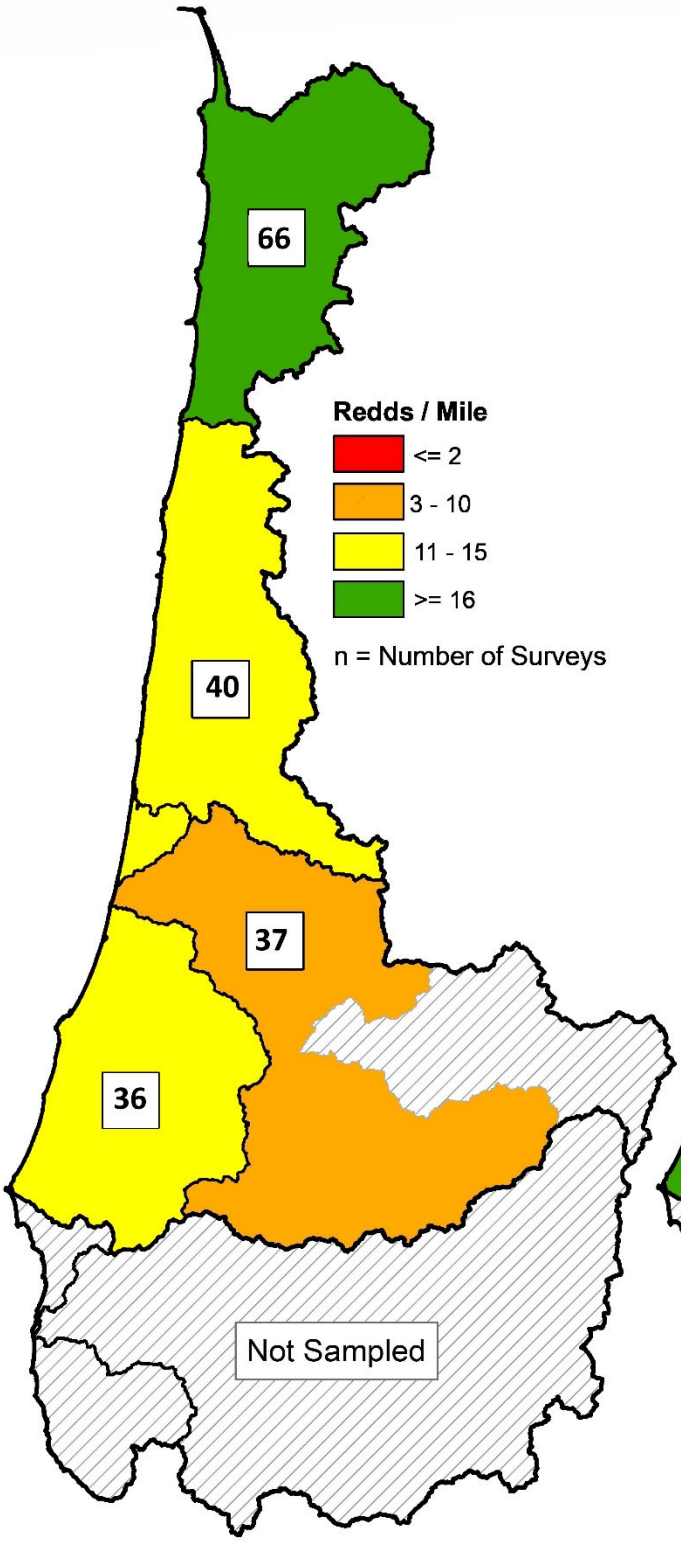

Figure 8. Steelhead redd density (redds per mile) in random surveys in 2020 by monitoring area in the Coastal and KMP DPS's.

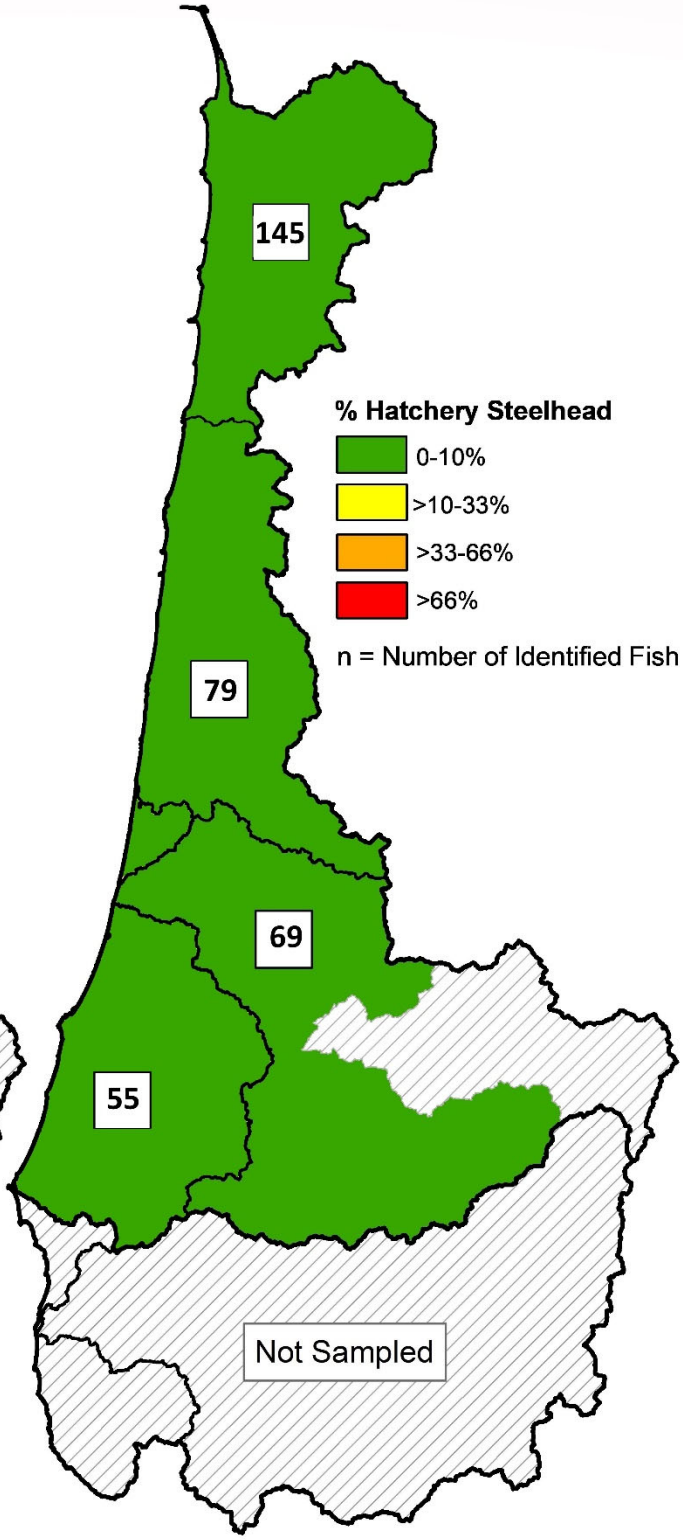

Figure 9. Percentage hatchery steelhead found in random surveys in each of the six Coastal and KMP monitoring areas in 2020 based on fin clip observations of live and dead steelhead.

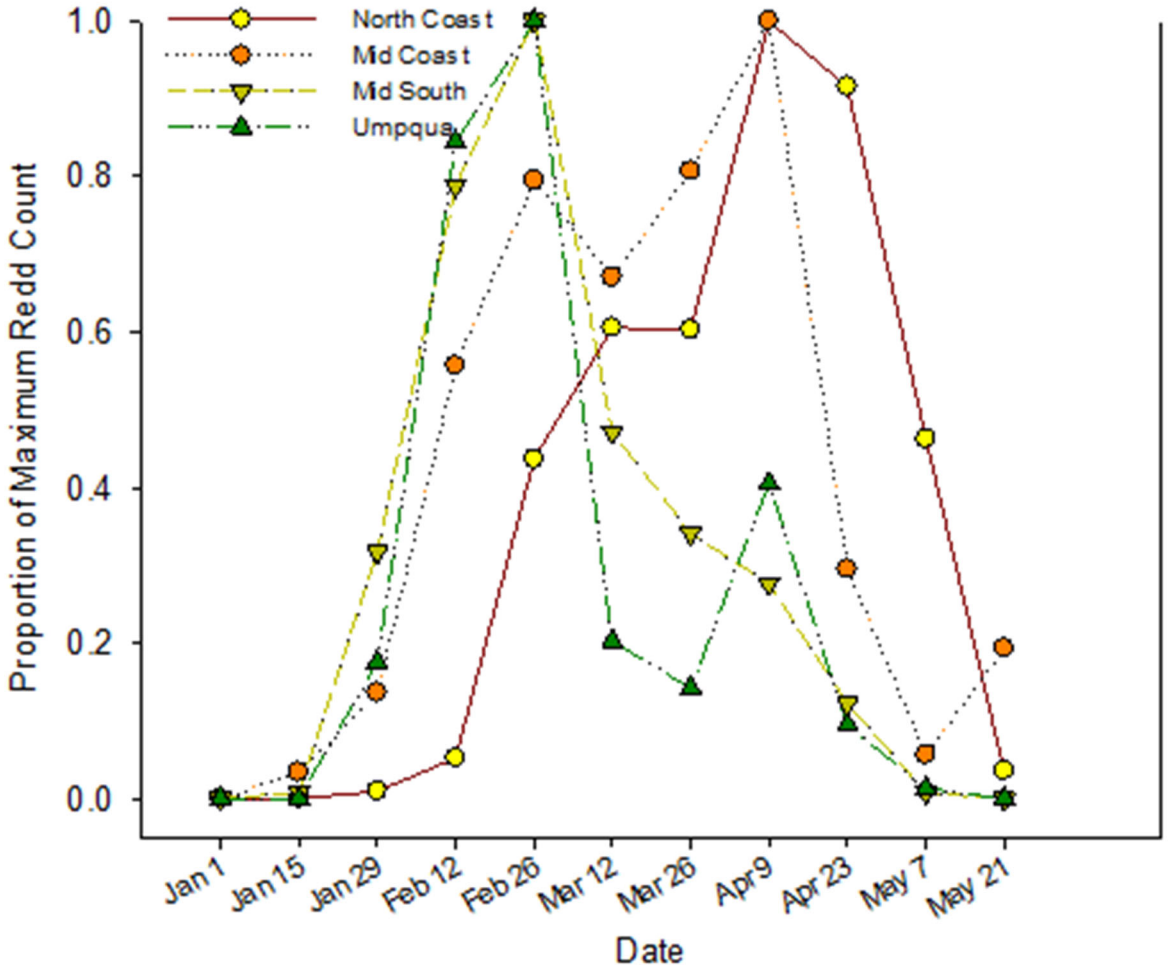

Figure 10. Winter steelhead spawn timing, represented by proportion of the maximum redd count in each of the four OC DPS monitoring areas, 2020.

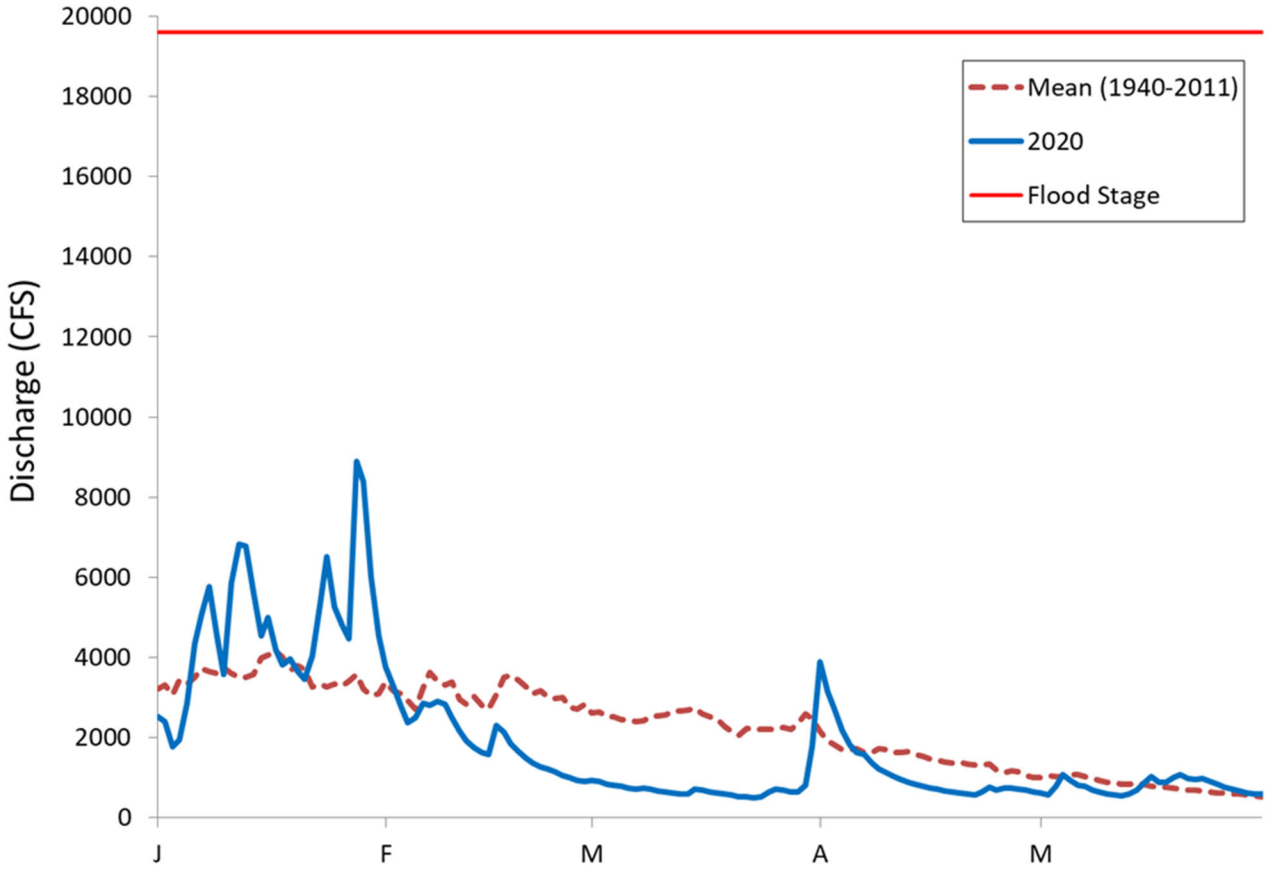

Figure 11. Stream discharge at Alsea River near Tidewater during 2020, compared to mean discharge from 1940 to 2011. (Flood stage = 19,500 CFS)

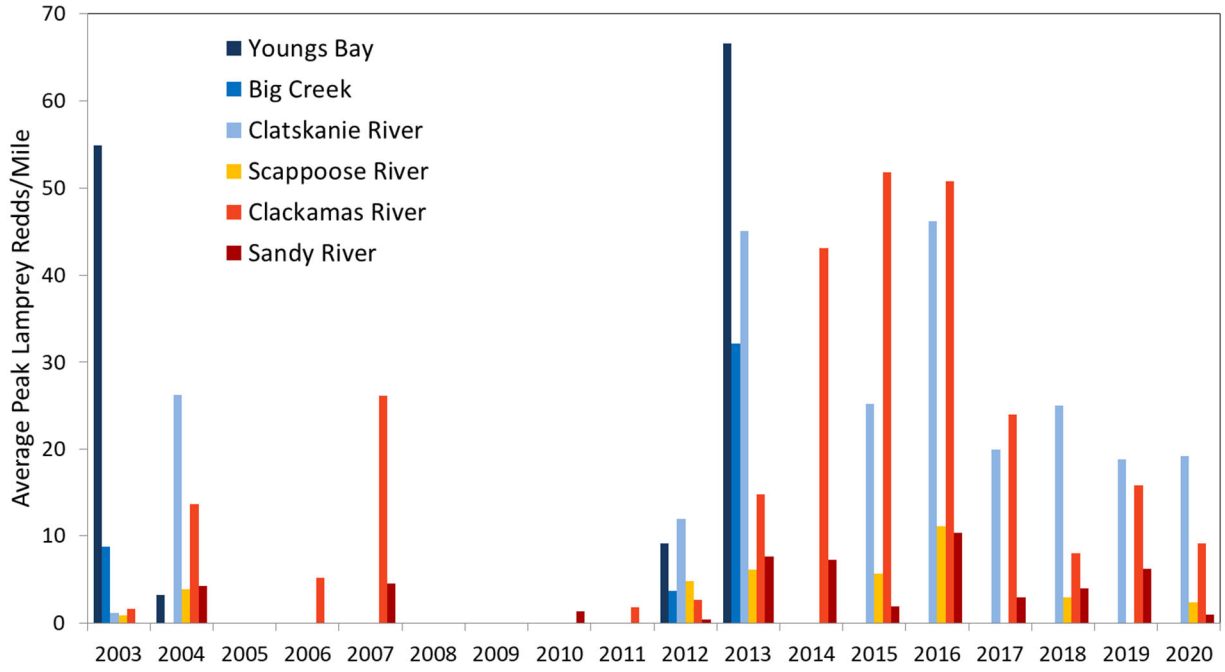

Figure 12. Lower Columbia Pacific Lamprey Peak Redd Density in Random Steelhead Spawning Surveys, 2003-2020. Note that not all populations were monitored in all years.

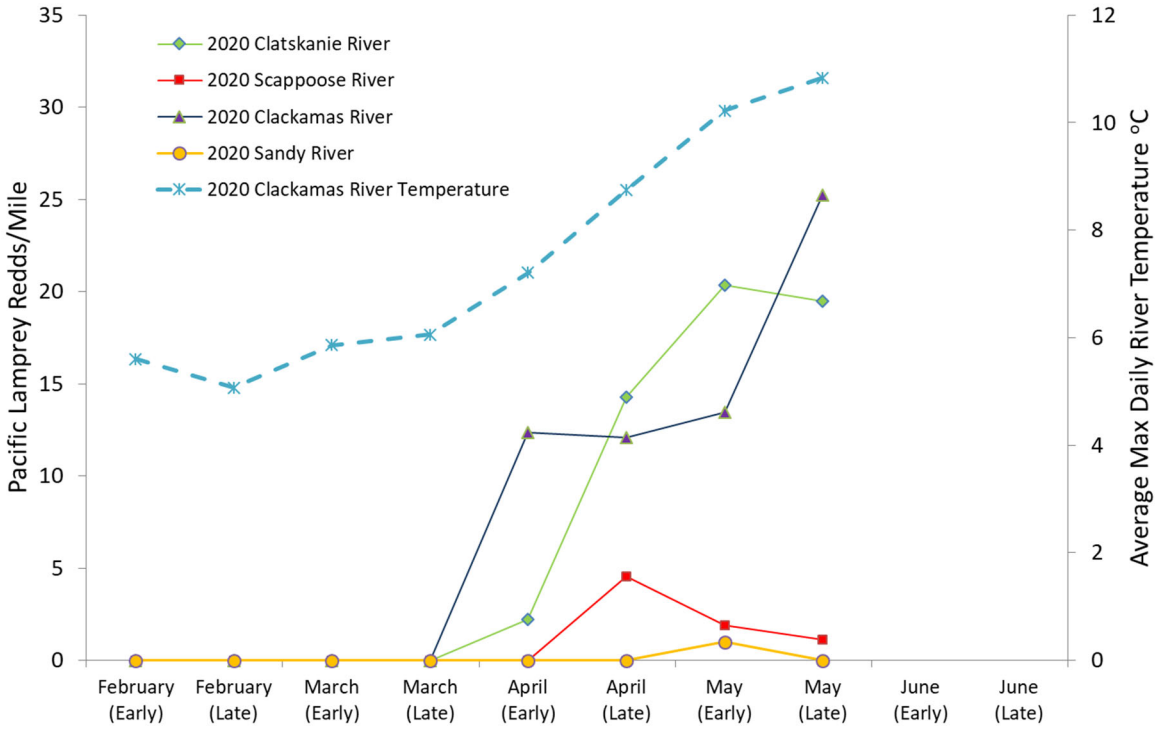

Figure 13. Lower Columbia Pacific Lamprey spawn timing in random steelhead surveys in 2020 and average daily max water temperature in the Clackamas River.

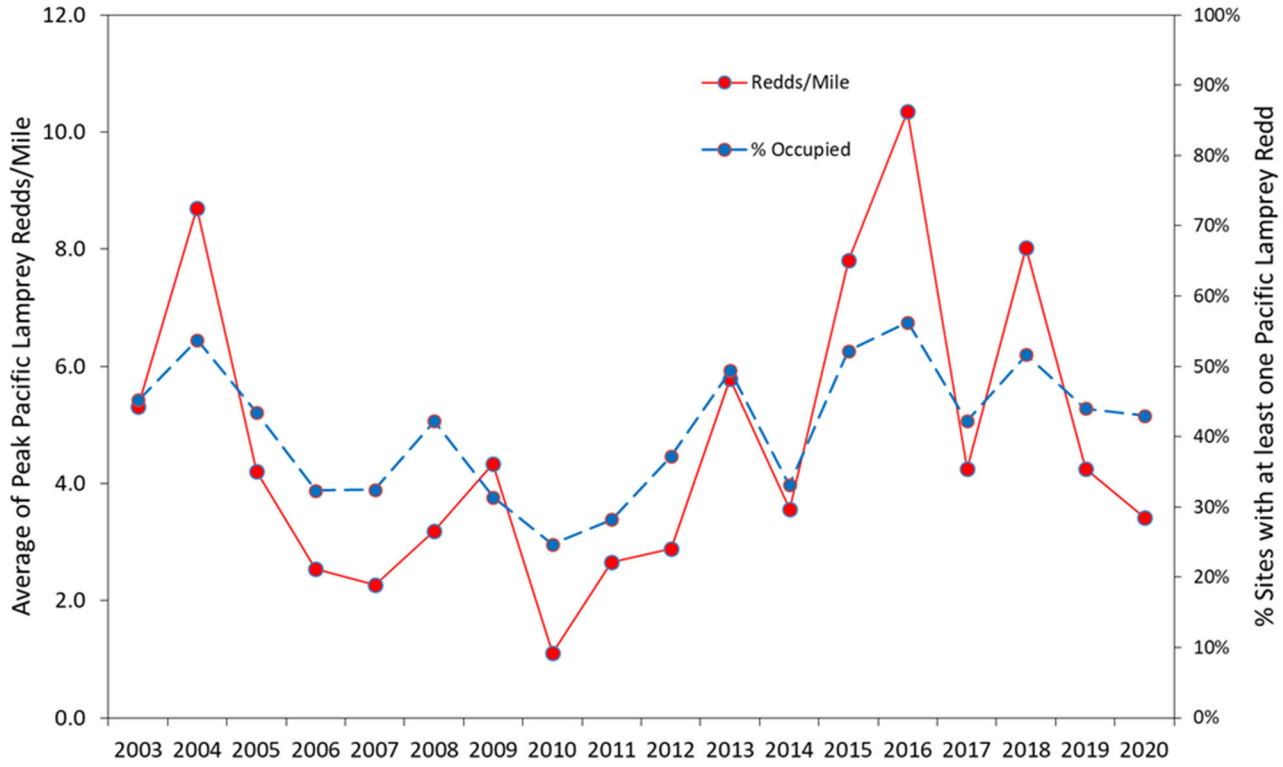

Figure 14. Oregon coast Pacific Lamprey peak redd density and percent of sites occupied in random steelhead spawning surveys, 2003 to 2020.

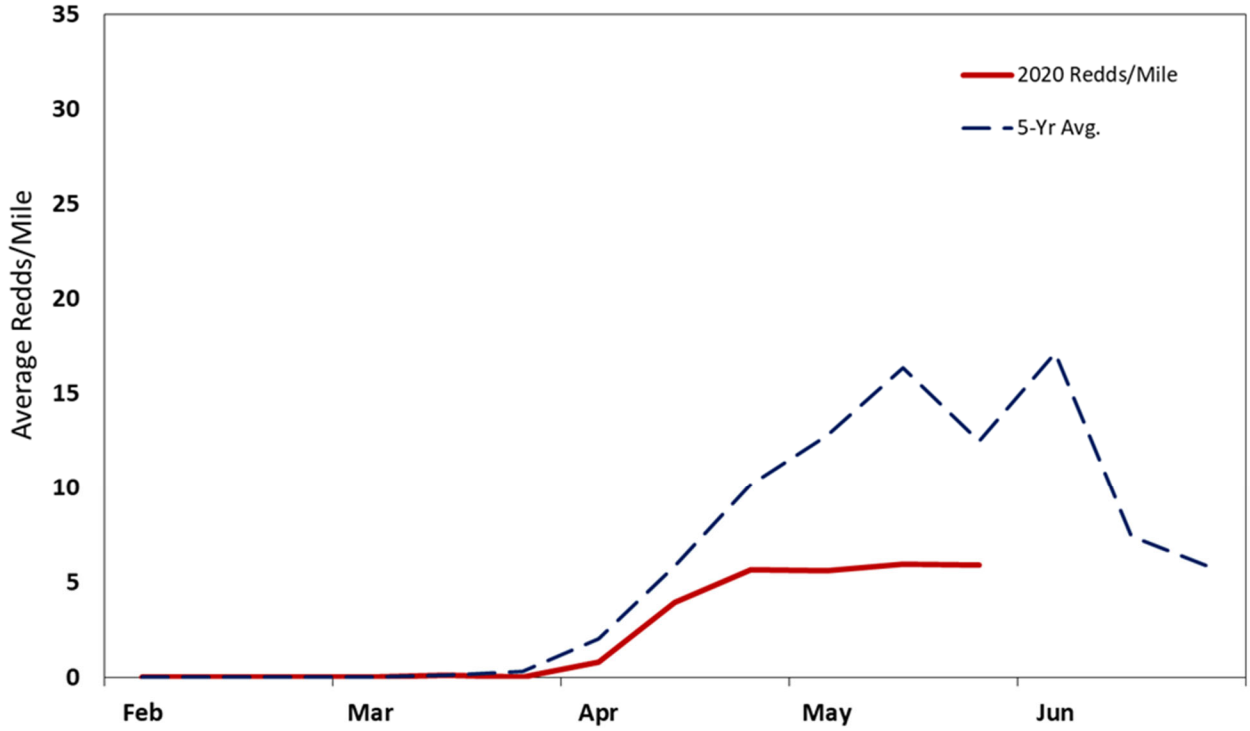

Figure 15. Oregon coast Pacific Lamprey spawn timing in index surveys, 2020.

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