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Nestucca River Native Broodstock Monitoring – Juveniles

NESTUCCA RIVER NATIVE WINTER STEELHEAD BROODSTOCK MONITORING – JUVENILES

2006 Annual Progress Report

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Abstract

As part of a broodstock removal evaluation program for Nestucca River winter steelhead, a spatially balanced stratified random probability design was used to select sites for summer snorkel surveys of juvenile salmonids. Fish counts from pools during the summer of 2006 provided estimates of rearing abundance and distribution for juvenile steelhead and juvenile coho rearing in pools in 2005. A total of 32 sites were snorkeled and used in analyses. Juvenile steelhead and cutthroat trout > 90 mm were observed at all sites, and juvenile coho were found at 88% of sites. Averaged across sites, coho were observed in 78% of pools, and cutthroat and steelhead were present in 61% and 62% of pools, respectively The average number of fish/meter of stream sampled was 1.05, 0.06, and 0.04 for coho, steelhead, and cutthroat, respectively. In comparisons between six years of snorkel survey data (2001-2006), there were no detectable annual differences in average percent pool occupancy for steelhead, but some inter-annual differences for coho and cutthroat. Juvenile coho densities have been similar over the 6 years of surveying. Steelhead densities were lower in 2002, 2004, 2005, and 2006 than in 2001. Relative to other probabilistic snorkel survey counts on the northern Oregon coast, steelhead densities in Nestucca tributaries have been higher in five out of six years. Adult redd estimates have not shown a consistent decline over the course of the surveying, and there is no statistical evidence that juvenile steelhead abundance and distribution have declined due to the removal of some wild adult steelhead.

Introduction

In the spring of 2001, the Oregon Department of Fish and Wildlife (ODFW) adopted a proposal to collect approximately 76 wild winter steelhead females from the Nestucca River Basin for hatchery broodstock. A description of the broodstock collection program and the rationale relative to adult fish is described in Sucac (2005*a*). As part of an effort to monitor the impact of this broodstock collection on the wild winter steelhead population in the Nestucca, ODFW's Western Oregon Rearing Project was given the task of monitoring trends in the relative abundance and distribution of juvenile steelhead in the basin, and to corroborate trends in adult data. This report presents the results of the sampling conducted during the summer of 2006.

Methods

Study Design

We established surveys of juvenile steelhead rearing habitat in 30-35, one-kilometer stream reaches in the Nestucca River basin. Sites were randomly selected using a stream reach database maintained by ODFW's Oregon

Anadromous Salmonid Inventory and Sampling (OASIS) project. A description of the theory and general approach to the survey design is described in Stevens (2002). On the Little Nestucca River, candidate stream reaches included all areas accessible to steelhead above tidewater. On the main Nestucca River, candidate stream reaches included all areas accessible to steelhead above the confluence of the Nestucca River and Beaver Creek. In total, 373 km of stream channel fell within the snorkeling sample universe.

Once completed, the site selection process provided the geographic coordinates (i.e. latitude and longitude) of each of the candidate sites. We then produced topographic maps showing the location of each sample point. Field crews used a handheld geographic positioning system (GPS) to find the start and end of each survey reach. For an abundance metric we used mean fish density in pools (described below), and for a distribution metric used the mean percent of pools per site that contained fish (pool occupancy).

Survey Methodology

Surveys were conducted between early August and late September, 2006. A description of the survey methodology is in Jepsen (2004) and more information on snorkel methodology and general survey design can be found in Jepsen and Rodgers (2004). Briefly, snorkel methodology involved a single upstream pass through each pool that met acceptable dimensions, but at some larger mainstem sites, counts were made while swimming downstream. To conduct the surveys, a two-to-four person snorkel crew counted the number of 1+ juvenile steelhead, 1+ cutthroat trout, and all coho salmon in each of the sample reaches. 0+ juvenile cutthroat and steelhead (< 90 mm fork length) were not counted.

To provide some quality control of the snorkel data, and to provide information on temporal changes in abundance during the course of the sampling season, supervisory staff had a goal of resurveying a random sample of 10 to 20 percent of the sites surveyed.

Data Analysis

The percentage of snorkel sites with at least on fish, and mean percent pool occupancy were calculated for juvenile coho, $\geq$ 90 mm steelhead, and $\geq$ 90 mm cutthroat. For each pool within a site, the number of fish/m^2 was calculated, and then a site average was calculated for each of the three species/size classes. A basin-wide density estimate was obtained for each of the three species/size classes by averaging the individual site densities. The 95% confidence interval around each species/size class density and pool occupancy estimate was determined using the statistical analysis outlined by Stevens (2002). This analysis also provided sample variances from which Z-values (Snedecor and Cochran 1980) were obtained to compare means. Because some sites were outliers in terms of fish presence and abundance, a Kruskal-Wallis test (Snedecor and Cochran 1980) compared medians across years.

Results and Discussion

We surveyed a total of 33 sites during the summer of 2006 (Figure 1). One survey overlapped with another site, so was included as part of that surveys. As a result, we analyzed snorkel data from a total of 32 different reaches in the Nestucca River Basin in 2006.

Table 1 shows the summary statistics for the percentage of sites that contained at least one fish, the mean percentage of pools per site that contained at least one fish (pool occupancy), and the density of fish in pools observed in the Nestucca River Basin in 2006. Juvenile steelhead $\geq$ 90 mm and cutthroat $\geq$ 90 mm were observed at all sites, with coho salmon observed at 88% of sites. On average, coho were observed in 78% of pools, and cutthroat and steelhead were present in 61% and 62% of pools, respectively. The spatial distribution of juvenile fish occurrence is summarized in Figures 2-4. Coho had higher average pool densities (fish/ m^2) than steelhead and cutthroat (Table 1). A total of 33,612 coho, 2,044 steelhead, and 1,237 cutthroat were observed in 583 snorkeled pools (Appendix A). The average number of fish/meter of stream sampled was 1.05, 0.06, and 0.04 for coho, steelhead, and cutthroat, respectively. Multiplying these numbers by the total length of stream in our sampling universe resulted in estimates of 381,060 juvenile coho, 23,173 steelhead $\geq$ 90 mm, and 14,024 cutthroat $\geq$ 90 mm.

Table 1. Summary statistics for juvenile salmonid snorkel surveys conducted in the Nestucca River Basin in 2006.

Metric	Coho	$\geq$ 90 mm Steelhead	$\geq$ 90 mm Cutthroat
Sample size	32	32	32
Mean Fish/m^2 (95% confidence interval)	0.36(0.095)	0.04(0.014)	0.02(0.008)
Median density	0.32	0.03	0.01
Number of sites with at least one fish	28	32	32
Percentage of sites with at least one fish	88	100	100
Mean % pool occupancy (95% confidence interval)	78(10)	61(6)	62(7)
Median % pool occupancy	98	61	63

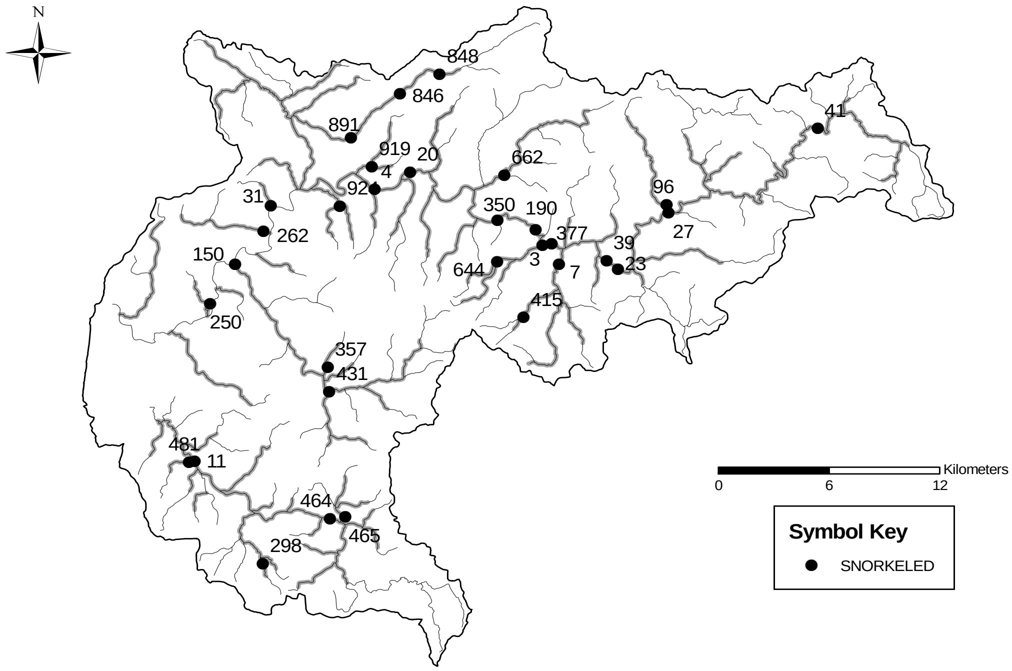


Figure 1. Location of sample stream reaches snorkeled for juvenile steelhead abundance in the Nestucca River Basin, 2006. Numbers next to site numbers are for reference to Appendix A. Gray highlighted stream areas depict candidate stream segments.

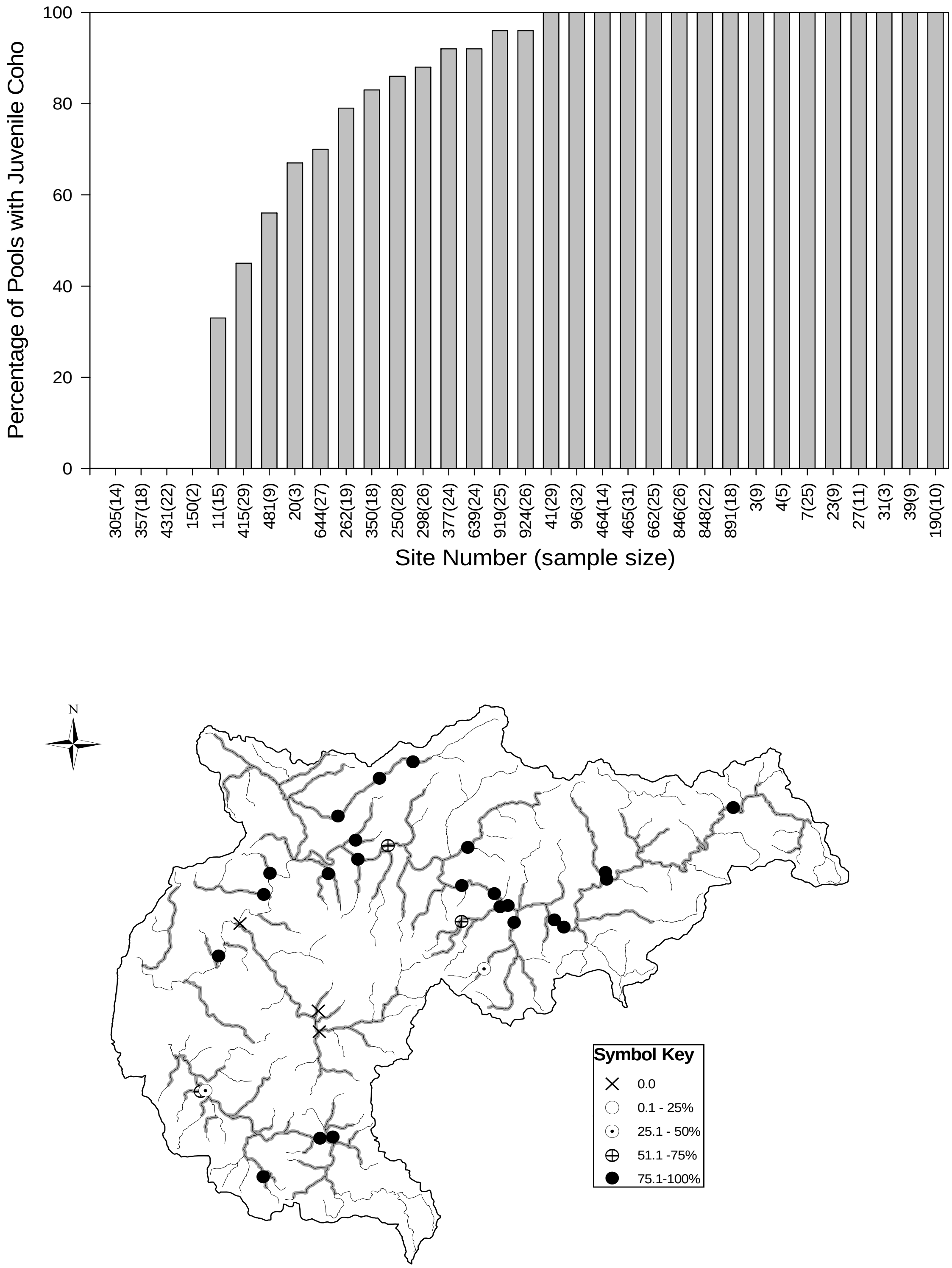
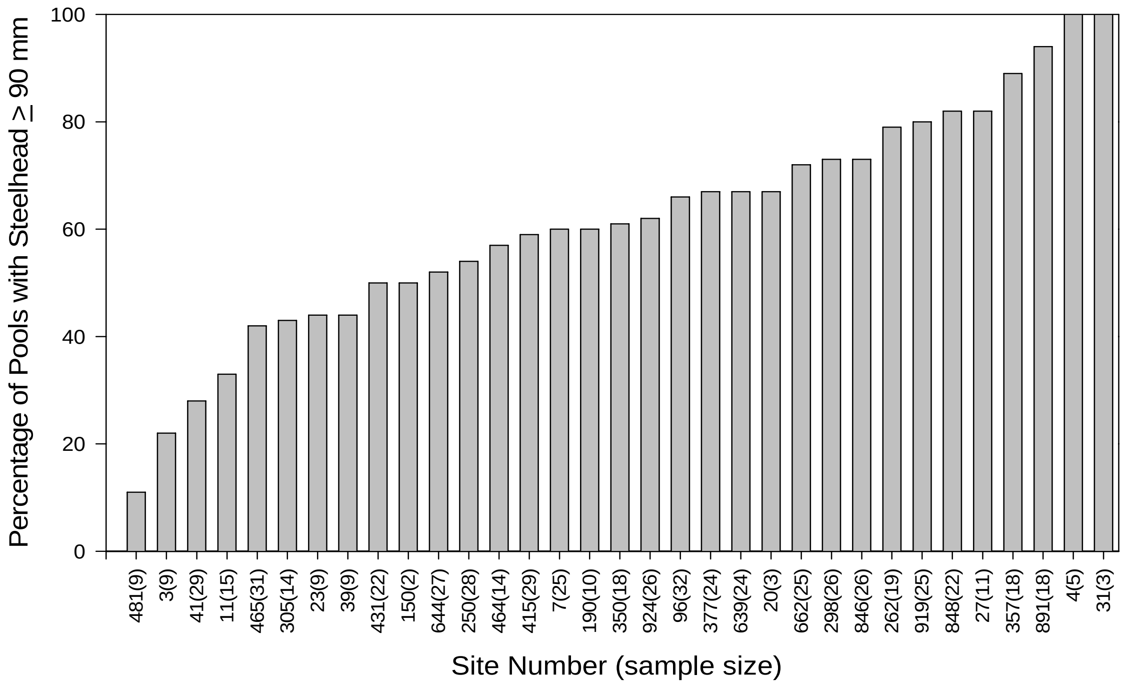


Figure 2. Percent pool occupancy of juvenile coho at each site snorkeled in the Nestucca River in 2006.



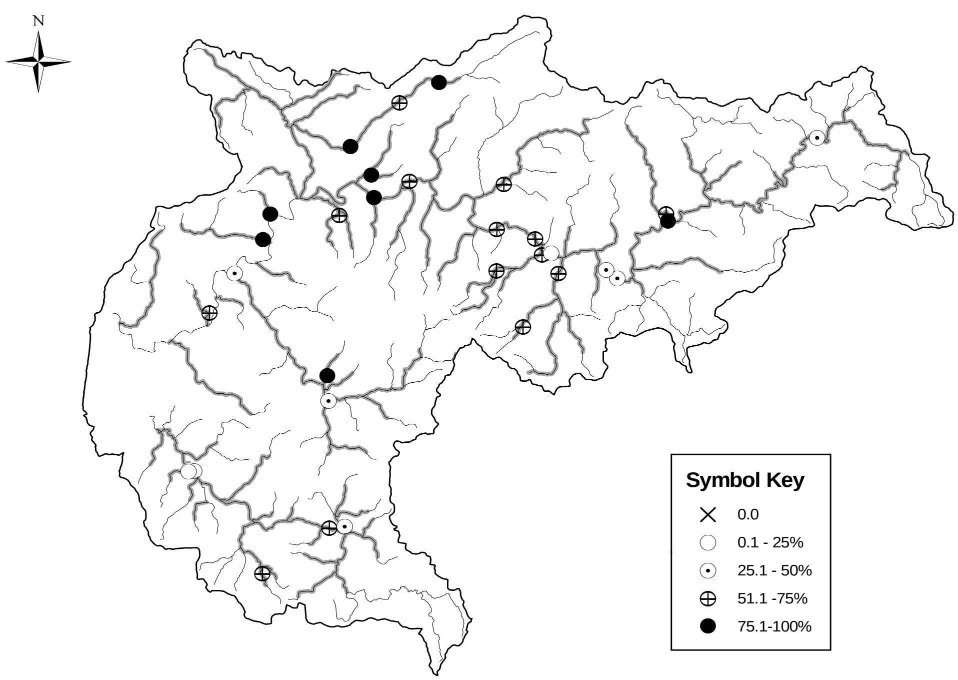
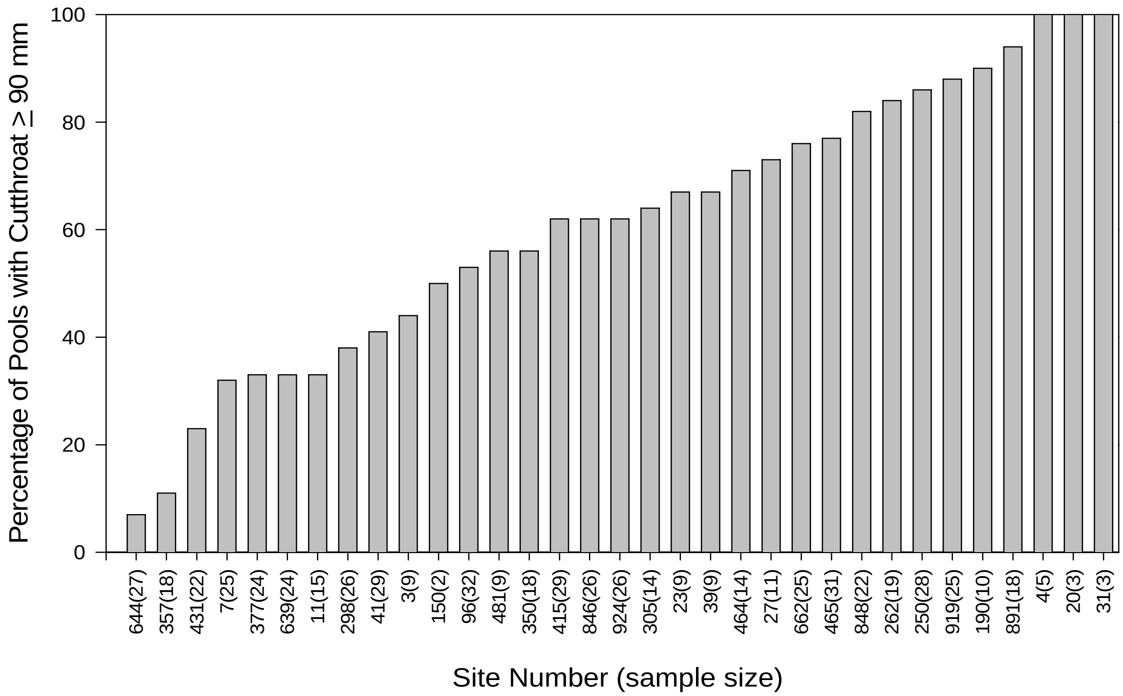


Figure 3. Percent pool occupancy of > 90 mm juvenile steelhead at each site snorkeled in the Nestucca River in 2006.



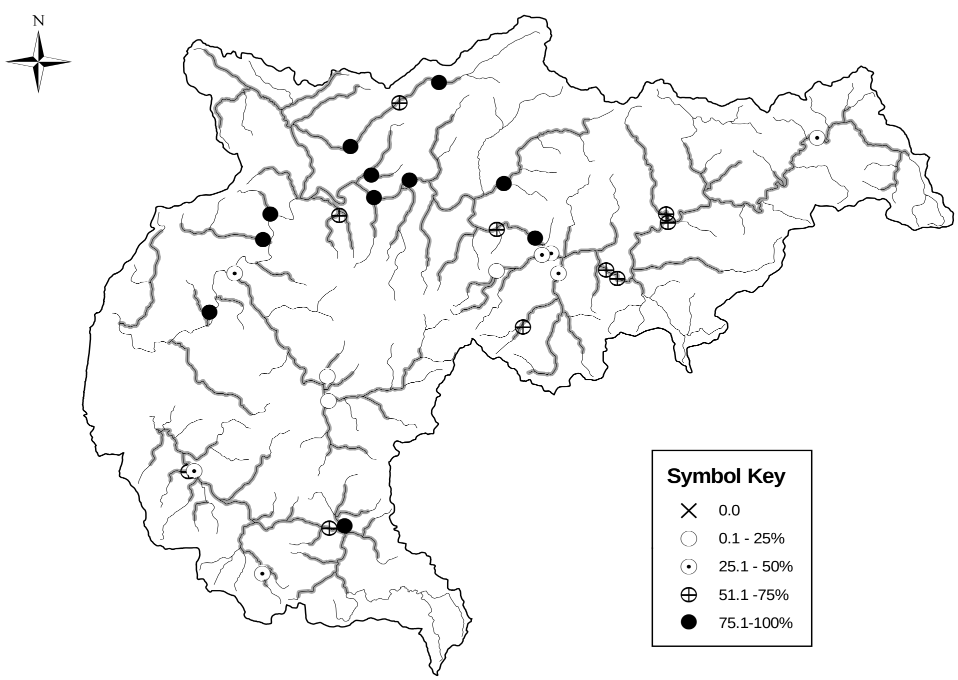


Figure 4. Percent pool occupancy of > 90 mm juvenile cutthroat at each site snorkeled in the Nestucca River in 2006.

Annual Trends

In comparisons across six years of snorkel survey data (2001-2006) the percentage of sites that contained at least one fish were similar within species for all three species (Figure 5). The exception was lower frequency of coho in 2001 where < 70% of sites contained at least one fish. There were no detectable annual differences in average percent pool occupancy (Figure 6) for steelhead, but some inter-annual differences for coho and cutthroat (Table 2). Cutthroat were found in less than 45% of pools in 2004, but in other years were found in >55% of pools. Median pool occupancy between years for both coho and steelhead were similar (Kruskal-Wallis median test: p = 0.282 and 0.561 for coho and steelhead, respectively), but median cutthroat percent pool occupancy was different among years (Kruskal-Wallis p = 0.020).

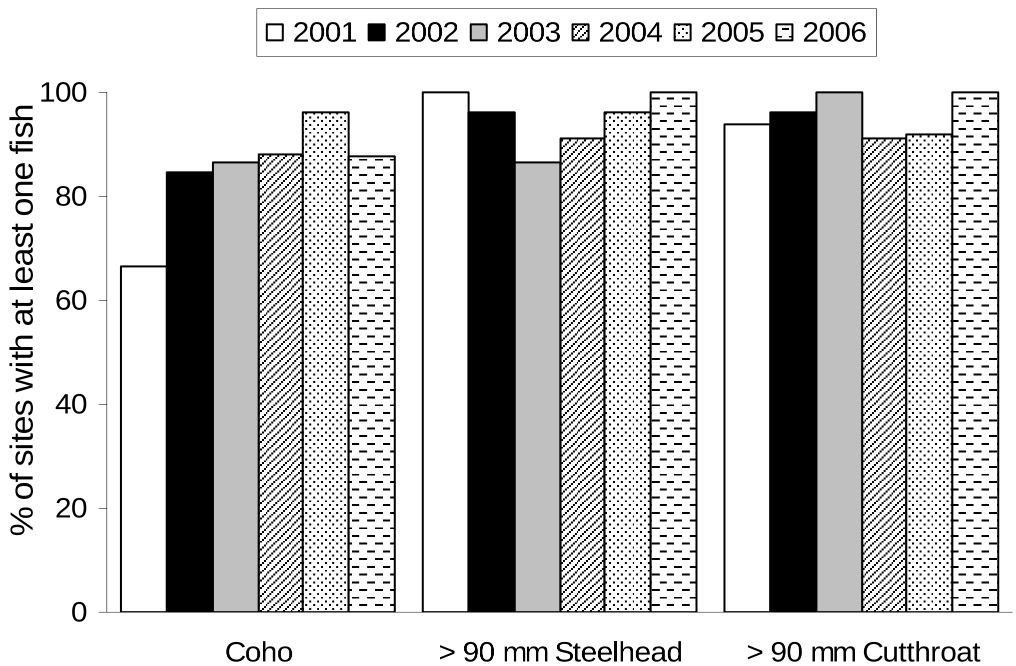


Figure 5. Percentage of Nestucca River Basin sites that contained at least one juvenile coho, steelhead, or cutthroat in the summers of 2001-2006.

The mean density of juvenile coho was not significantly different between the six years of surveys (Table 2, Figure 7). Steelhead densities were lower in 2002, 2004, 2005, and 2006 than in 2001, and cutthroat densities in 2006 were lower than in 2003, and greater than in 2004. Median densities were not significantly different between years for coho (Kruskal-Wallis p = 0.684) but were for steelhead (p=0.037) and cutthroat (p<0.001). In comparisons among coho broods, (juvenile coho data collected in 2003 and 2006; same 3 year brood cycle), coho density estimates in 2005 were similar to those in 2002 ($p = 0.803$, and Figure 7). Steelhead have a more variable life history in the Nestucca, therefore comparisons between brood lines is difficult. Susac (2005*b*) reported that 65.9% of scale samples taken from adult steelhead in the Nestucca emigrated from freshwater at age 2, with the majority of the remainder (31.7%) emigrating at age 3.

Relative to other probabilistic snorkel survey counts on the northern Oregon coast, steelhead densities in tributaries have been higher in Nestucca tributaries in most years, except in 2005 when North Coast steelhead densities appeared higher than in the Nestucca (Figure 8). This variability is unaccounted for.

One objective of the juvenile steelhead abundance and distribution metrics is to corroborate trends with trends in adult spawners. Adult spawner redd counts started in the winter of 2001, and progeny the following summer would be mostly age 0+ trout < 90 mm (and thereby indistinguishable from age 0+ cutthroat trout). Therefore summer snorkel counts in 2002 would be the first year that progeny from 2001 could be counted. However, our snorkel survey methodology does not discern size and age classes for fish > 90 mm FL, therefore it is difficult to associate a given yearly adult abundance estimate with a particular snorkel survey year. Assuming a conservative estimate that ~66% of the juvenile steelhead observed any given summer are age 1+ fish that were spawned two preceding winters ago (from scale analysis cited above), we can roughly construct the relationship between the number of adult redds and subsequent juvenile production. There is a modest relationship between adult spawner estimates and age 1+ juvenile snorkel counts ($r^2=0.329$, Figure 9), but removing the visible outlier for spawn year 2004 (snorkel year 2005) improves the linear relationship ($r^2=0.86$). It is not clear why the steelhead density estimate in pools in 2005 did not track adult redd counts to the extent that it did other years. Assuming the relationship is predictive; one expectation is that a trend in adult numbers would result in a similar trend in juveniles. Adult redd estimates have not shown a consistent decline over the course of the surveying (Lewis in prep, and Figure 9), and there no statistical evidence that juvenile steelhead densities have declined due to the removal of some wild adult steelhead.

Table 2. *P*-values for tests of significance (Z statistic) for comparisons of the mean percentage of pools per site that contained juvenile salmonids, and mean fish densities for the Nestucca River Basin, 2001-2006. Significant differences are bolded.

	P-values for Mean % Pool Occupancy					*P*-values for Mean Density				
Year	2001	2002	2003	2004	2005	2001	2002	2003	2004	2005
Coho										
2002	0.332					0.751				
2003	0.131	0.565				0.086	0.158			
2004	**< 0.05**	0.106	0.438			0.537	0.804	0.194		
2005	**< 0.05**	0.075	0.331	0.736		0.959	0.803	0.107	0.604	
2006	**< 0.05**	0.4021	0.4445	0.9558	0.8046	0.5233	0.7788	0.2144	0.9642	0.5867
Steelhead										
2002	0.783					**< 0.05**				
2003	0.368	0.298				0.284	0.082			
2004	0.756	0.597	0.544			**< 0.05**	0.911	0.137		
2005	0.439	0.350	0.818	0.665		**< 0.05**	0.159	**< 0.05**	0.176	
2006	0.1579	0.9484	0.9484	0.3569	0.6937	**< 0.05**	0.6650	**< 0.05**	0.6194	0.3589
Cutthroat										
2002	0.171					0.239				
2003	0.643	0.383				0.856	0.182			
2004	**< 0.05**	**< 0.05**	**< 0.05**			**< 0.05**	**< 0.05**	**< 0.05**		
2005	0.277	0.854	0.526	**< 0.05**		**< 0.05**	**< 0.05**	**< 0.05**	**< 0.05**	
2006	0.2902	0.6576	0.5968	**< 0.05**	0.8509	0.0564	0.1215	**< 0.05**	**< 0.05**	0.4927

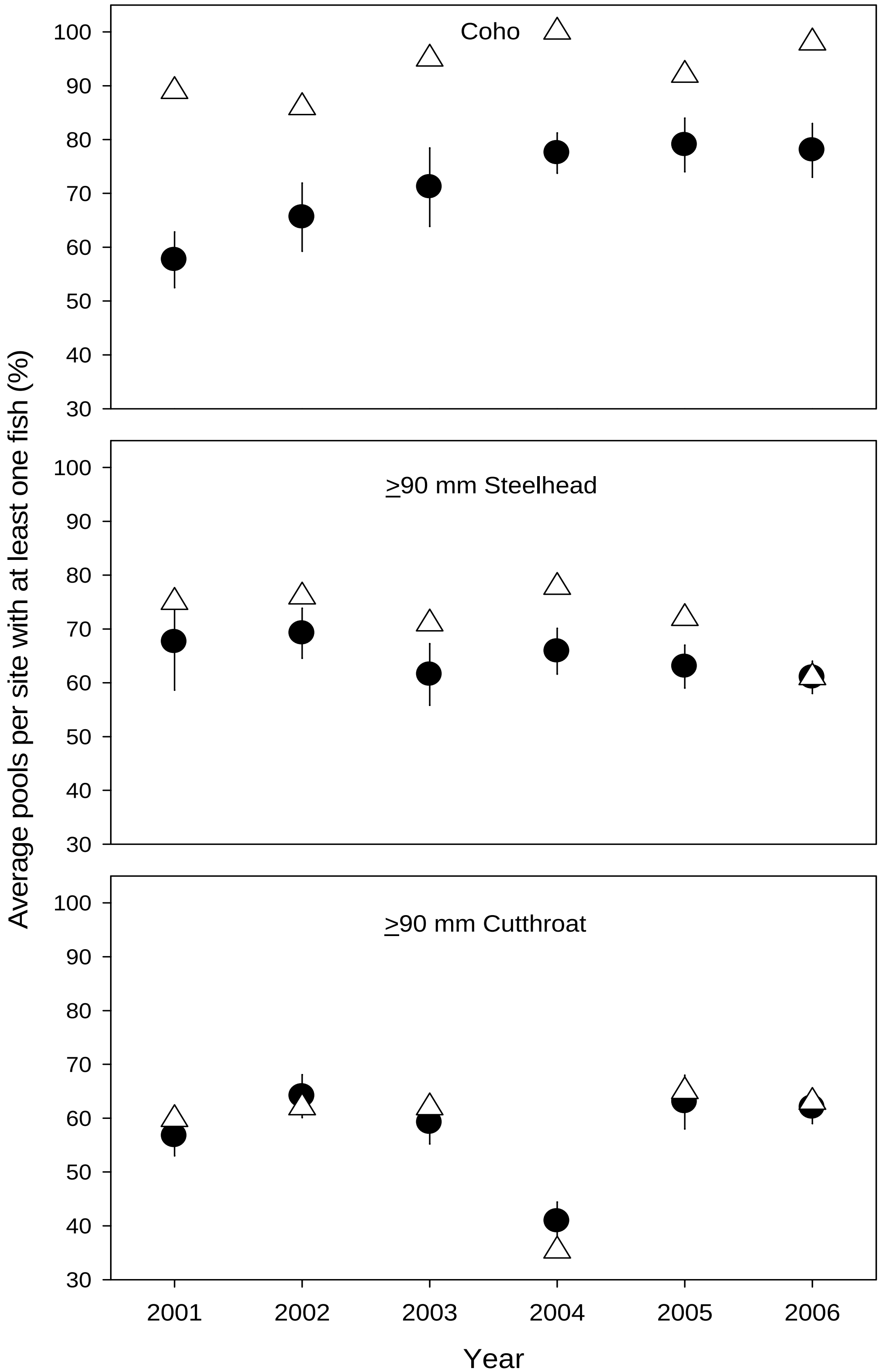


Figure 6. Mean (and standard errors) and median (triangles) pool occupancy of juvenile coho, steelhead, and cutthroat trout surveyed in the Nestucca River Basin in 2001-2006.

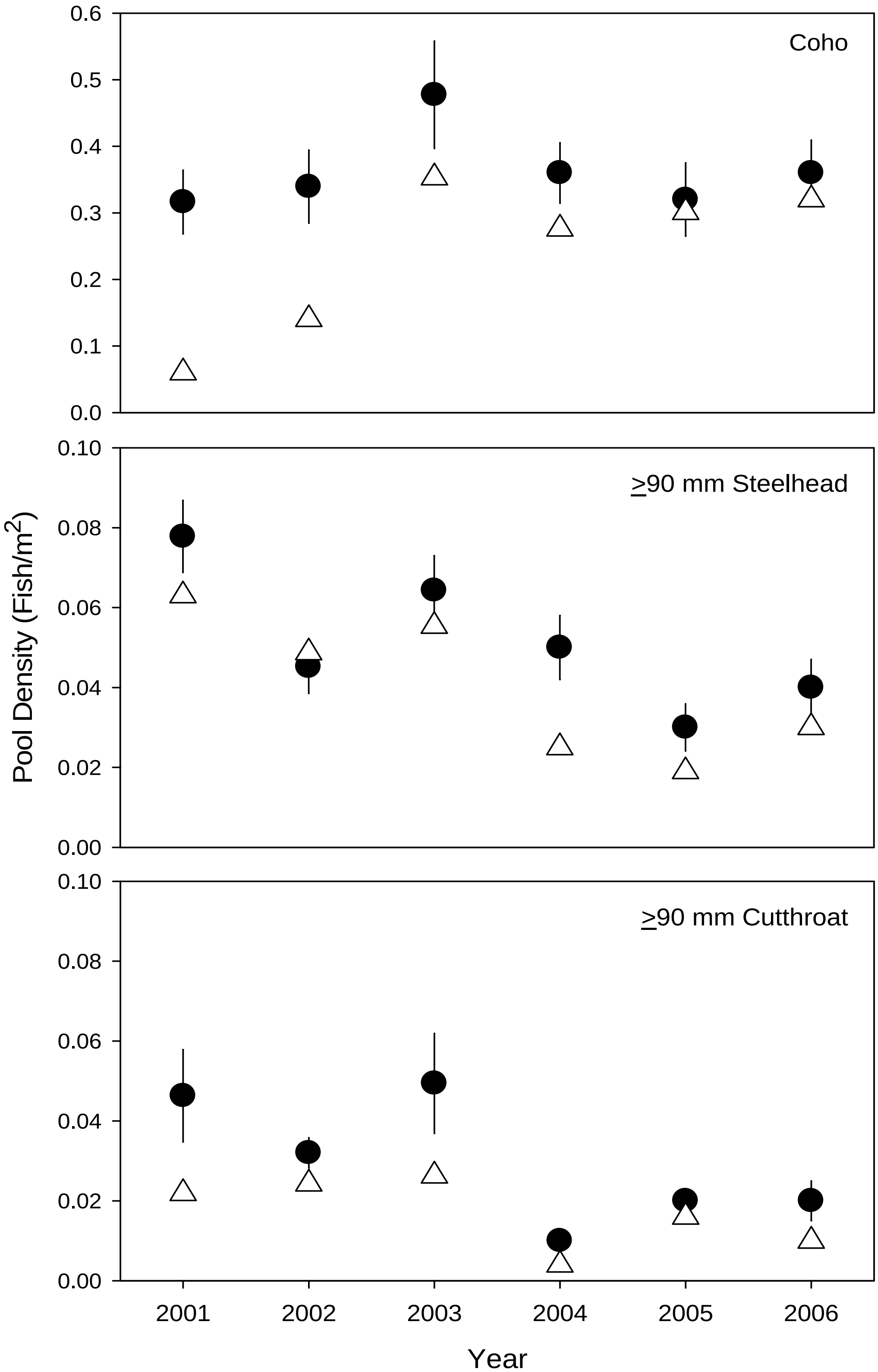


Figure 7. Mean (and standard errors) and median (triangles) pool densities in pools of juvenile coho, steelhead, and cutthroat trout surveyed in the Nestucca River Basin in 2001-2006.

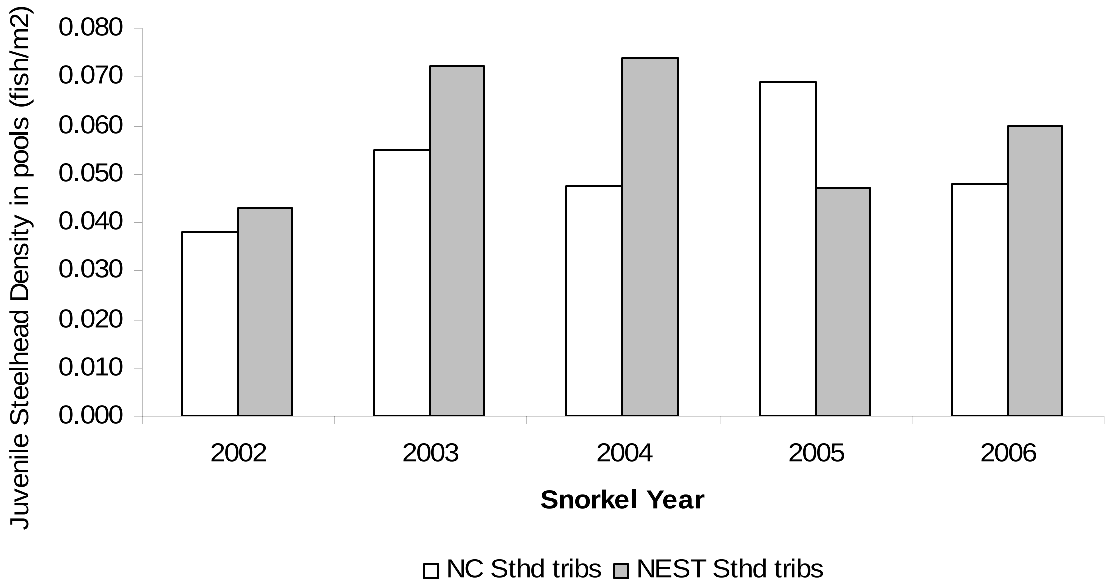


Figure 8. Mean density of juvenile steelhead in tributary pools from the North Coast Monitoring Area (Oregon Plan monitoring, white bars) and the Nestucca Basin broodstock study (gray bars).

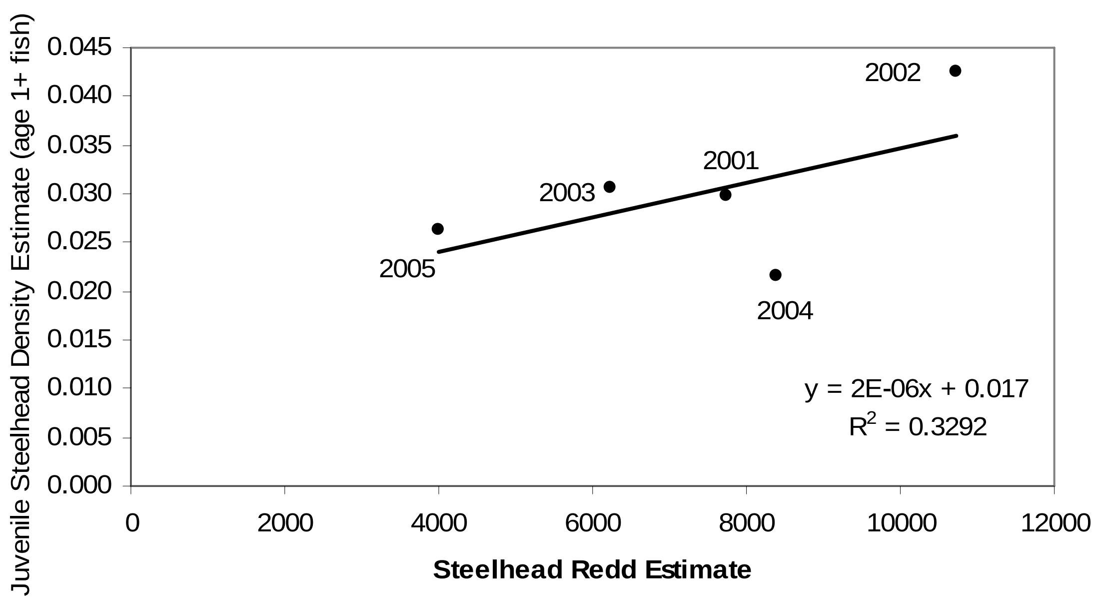


Figure 9. Relationship between estimated number of wild winter steelhead redds and subsequent juvenile steelhead densities in the Nestucca River Basin. Relationship assumes that juvenile estimates are ~66% of the total juvenile density, and therefore are the progeny of adults that spawned ~1.5 years prior. Numbers next to symbols indicate spawning year.

Conclusions

To date, there is no consistent trend among the juvenile population metrics that the adult broodstock removal program has resulted in a reduction in the abundance and distribution of juvenile steelhead in the Nestucca River basin. Annual juvenile steelhead density estimates in pools have not differed over the course of the monitoring.

References

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Susac, G. 2005*b*. Nestucca River Native Winter Steelhead Broodstock Monitoring – Adults. Alternate title: Assessment of the status of Nestucca River Adult Winter Steelhead. 2004 Annual Progress Report, Oregon Department of Fish and Wildlife, Salem

Appendix

Appendix A. Summary data for sites snorkeled in the Nestucca River Basin during August and September 2006. Site numbers in bold are 4th-5th order streams.

Site Number	Survey Length (m)	Number of Pools	Pool Surface Area (m^2)	Number of Fish Observed in Pools		
				Coho	Steelhead	Cutthroat
41	1016	29	3,548	2372	13	18
96	1002	32	12,808	4699	148	59
250	1001	28	429	158	28	44
262	1000	19	3,031	689	107	86
298	1002	26	1,371	754	80	18
305	1000	14	143	0	7	12
357	1001	18	324	0	62	2
377	938	24	3,088	2061	73	30
415	1001	29	1,038	248	133	32
431	1103	22	2,487	0	21	8
464	1028	14	9,305	932	19	28
465	1007	31	6,169	3344	52	108
481	347	9	185	29	1	11
644	1055	27	1,660	781	68	3
662	1021	25	4,399	1652	114	68
846	1015	26	2,335	1501	135	38
848	1000	22	1,858	1318	124	57
891	1004	18	2,474	1253	185	64
919	1005	25	1,023	309	71	95
924	1010	26	632	199	37	19
3	1040	9	12,148	688	4	7
4	1000	5	24,826	199	59	42
7	1000	25	3,125	1741	62	17
11	998	15	10,668	19	7	5
20	1000	3	27,851	256	58	12
23	1029	9	10,977	1381	28	14
27	1000	11	4,925	1733	104	54
31	1096	3	40,167	49	11	43
39	1029	9	10,977	1381	28	14
150	1073	2	44,006	0	2	14
190	1035	10	14,608	1105	21	135
350	1150	18	18,024	700	109	50

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