THE OREGON PLAN *for Salmon and Watersheds*

Abundance Monitoring of Juvenile Salmonids In Oregon Coastal and Lower Columbia Streams, 2007

Report Number: OPSW-ODFW-2008-1

Abundance Monitoring of Juvenile Salmonids in Oregon Coastal and Lower Columbia Streams, 2007

Oregon Plan for Salmon and Watersheds

Annual Monitoring Report No. OPSW-ODFW-2008-1

April, 2008

David B. Jepsen and Kevin Leader
Western Oregon Rearing Project
Oregon Department of Fish and Wildlife
28655 Highway 34
Corvallis, OR 97333

Citation: Jepsen, D. B., and K. Leader. 2008. Abundance Monitoring of Juvenile Salmonids in Oregon Coastal and Lower Columbia Streams, 2007. Monitoring Program Report Number OPSW-ODFW-2008-1, Oregon Department of Fish and Wildlife, Salem.

CONTENTS

FIGURES

Page

TABLES

SUMMARY

This report summarizes annual monitoring results of the abundance and distribution of juvenile salmonids in streams of western Oregon in 2007 by the Western Oregon Rearing Project, in support of the Oregon Plan for Salmon and Watersheds.

Tasks for 2007

1. Use the existing rearing distribution of juvenile salmonids as sampling frames and the Environmental Monitoring and Assessment Program (EMAP) site selection process to provide a random, spatially balanced set of sites for snorkel surveys sites. Monitor juvenile salmonids in three coho salmon evolutionarily significant units (ESU's) and three steelhead distinct population segments (DPS's), partitioned across several monitoring strata, defined as:

    - Four strata for the Oregon Coast Coho ESU frame (OCC), with a target of 40 (1^{st}-3^{rd} order stream reaches) sites per stratum. These same strata survey the tributary portion of Oregon Coast Steelhead DPS.

    - Four strata for the Oregon Coast Steelhead DPS frame, with a target of 10-15 (4^{th}-6^{th} order stream reaches) sites per stratum.

    - Five strata in southern coastal Oregon with one frame and stratum for 1^{st}-3^{rd} order stream reaches in the Southern Oregon Northern California Coho ESU (SONCC; South Coast strata), and one frames and four strata for the Klamath Mountain Province Steelhead DPS (KMPS; 1^{st}-3^{rd} order streams, 4^{th}-6^{th} order streams, Non-Rogue basins, Rogue basins). Sample size target for the SONCC stratum was 25-30 sites and for the KMPS >50 sites.

    - Two strata for the Lower Columbia River Coho ESU frame (Oregon basins), for stream reaches within the known rearing distribution of coho and steelhead. One stratum was comprised of 1^{st}-3^{rd} order stream reaches, and the other of 4^{th}-6^{th} order stream reaches. These strata also encompass the Lower Columbia River Steelhead DPS. The target number of sites for the frame was 80-100 sites.

    - Assess the quality of snorkel survey fish counts by conducting re-counts in the same pools at 10-20% of sites per stratum.

2. Based on fish counts from snorkel surveys, calculate and summarize the abundance and distribution metrics for each ESU or DPS at the level of the strata.

3. Incorporate annual survey data into a long-term record of trend for OCC juvenile fish density for each stratum by plotting the current year estimates in relation to previous years.

Accomplishments and Findings in 2007

Task 1. We successfully drew from each sampling frame a spatially-balanced set of candidate sites for each stratum. However, not all sites in all strata could be snorkeled or electrofished, due mostly to landowner denials, lack of rearing habitat, or lack of time for the crew to visit within the 2-3 month survey interval. We did not meet our goal of 80-100 sites for the Lower Columbia frame, nor for a target of 40 sites per strata in the OCC frame for three tributary strata (Table 1). Mainstem reaches were sampled with higher effort than tributary reaches. Survey effort will be rebalanced in 2008 to achieve a > 2% of rearing habitat surveyed for each stratum. We met our goal of re-surveying 10-20% of tributary sites (N= 32 sites), with high agreement between initial survey counts and resurveys (coho; r^2=0.99, steelhead; r^2=0.84).

Task 2. The number of surveys within strata was sufficient to obtain abundance and distribution metrics at the strata level for each ESU or DPS. Estimates are summarized in Tables 2 and 3.

Task 3. Annual juvenile coho abundance estimates in the OCC tributary strata were plotted into time series to visually show trends in this metric (Figure 3). There has been a consistent improvement in coho abundance in the North Coast, whereas other strata show cyclic patterns in abundance over the nine years of monitoring.

Management Applications

These annual snorkel survey data continue to build on the long term record of summer juvenile salmonid abundance and distribution estimates for several western Oregon salmonid management units. They will be used with a suite of other population and habitat metrics to evaluate the large scale and long term success of Oregon Plan objectives, including the next OC Coho Assessment and OCC conservation planning under the Native Fish Conservation Policy. More information about these programs can be found at: http://www.oregon-plan.org/OPSW/cohoproject/coho_proj.shtml

Not only do these juvenile fish surveys provide baseline summer rearing information at the ESU scale, they are appropriately stratified to scales that are relevant to district management needs. Although caution must be used in interpreting the estimates for any individual year, large declines in summer parr estimates may be considered a response variable that is influenced by among other things, poor spawning success, poor fry survival, or insufficient summer rearing habitat. Individual site information is available upon request by contacting project staff, via the web site: http://nrimp.dfw.state.or.us/crl/default.aspx?pn=WORP

INTRODUCTION

As part of the Oregon Plan for Salmon and Watersheds, the Oregon Department of Fish and Wildlife (ODFW) initiated a project in 1998 to monitor the trend in abundance and distribution of juvenile coho salmon (*Oncorhynchus kisutch*) rearing in Oregon coastal streams. Monitoring is currently designed to provide annual abundance and distribution information at the stratum-scale (described in Jepsen and Leader 2007) for each of several coho evolutionarily significant units (ESU's) and steelhead distinct population segments (DPS's), and to eventually use these annual data to provide long-term trend information. Ultimately these juvenile fish data will be used to investigate relationships between freshwater habitat characteristics, adult spawner abundance, and juvenile recruitment. This progress report summarizes abundance and distribution data collected in 2007 for each ESU and DPS, and for the Oregon Coast Coho ESU includes a time series for abundance data for all years of monitoring. A fuller description of the OCC, OCS, SONCC and KMPS sampling frames, study design and survey methods, is found in Jepsen and Rodgers (2004) and for the LCRC and LCRS frames in Jepsen and Leader (2007). The strata are diagramed in Figure 1 and organized in subsequent tables.

At a subset of the OCC sites, this project also collects water temperature data and macroinvertebrate data in conjunction with Oregon Department of Environmental Quality. These data will be reported separately, and can be requested from project staff. In addition, the project re-initiated a snorkel and electrofishing verification study in the Smith River basin, which will be summarized in a separate report.

METHODS

Monitoring Strata Designation and Data Analysis

For each stratum, candidate sites were chosen randomly from the respective sampling frame to provide a spatially balanced set of EMAP sample points. Each point was assigned a 1,000 meter transect (site), and where transects overlapped, the EMAP points were aggregated into one sample site.

Data were summarized by strata for analyses (Table 1). Sites that could not be snorkeled were electrofished for frequency counts. The accuracy of snorkeled pool fish counts was assessed by re-snorkeling the same pools at 10-20% of sites per strata, and limited to those sites that contained juvenile coho. A resurvey generally occurred within 1-4 days of the original survey. For the principle distribution and abundance metrics, a site value was calculated, and then all sites per stratum were averaged. Variance estimates were derived following the procedure reported in Stevens (2002), from which 95% confidence intervals were calculated. Juvenile fish distribution was summarized as 1) % of sites per stratum where fish were present or absent, and 2) % of pools per site containing fish, averaged for each stratum. The principal abundance metric was density of fish in pools, averaged for each stratum. We also summarized the % of sites per stratum where coho densities were ≥ 0.7 fish/m^2.

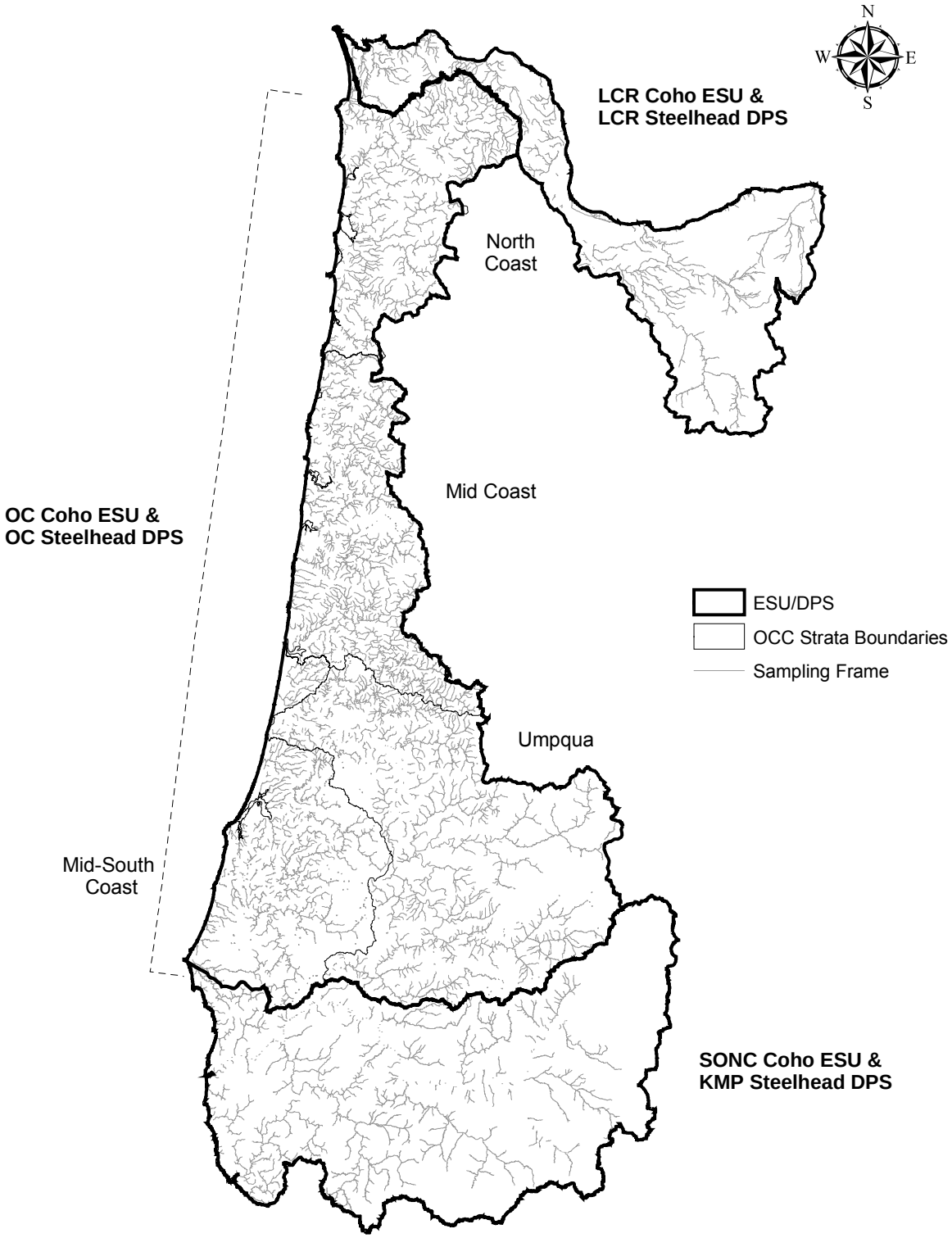

Figure 1. The spatial extent of juvenile salmonid rearing habitat within several salmonid management units (ESU, DPS) in western Oregon. The stream network of reaches with rearing habitat formed the sampling frame for selection of snorkel survey sites. Sample frames were stratified as described in Jepsen and Leader (2007).

RESULTS AND DISCUSSION

In this report we provide stratum-level summaries for each coho ESU or steelhead DPS. Counts of cutthroat trout are recorded coincident with coho and steelhead counts, but are not reported here. Data on individual sample sites, UTM coordinates, and fish counts are available upon request by the Western Oregon Rearing Project.

Survey Effort and Resurveys

In total, we snorkel surveyed 6,276 pools (5,353 in 1^{st}-3^{rd} order reaches, 923 in 4^{th}-6^{th} order reaches), spread across 354 sites. In addition, we did electrofishing surveys at 23 sites and 274 pools. In the Lower Columbia River frame, we were only able to snorkel survey 57 sites and therefore did not meet our target number of 80-100 sites (Table 1). This was the second consecutive year we have failed to meet this target. Twenty three candidate tributary sites were not visited, due mostly to the inability of the two crew that are dedicated to tributary snorkel surveys (one based in Astoria and one in Clackamas) to cover all sites in the two month survey interval (Aug-Sept). Currently there are no funds to support additional field staff. Within the OCC strata, we did not meet our objective of surveying > 40 sites in the North Coast and Mid-South Coast or Umpqua strata, but did in the Mid Coast stratum. Many sites within the North Coast and Mid-South Coast strata were not visited because crews ran out of time within the 2 month sampling interval. The process of getting landowner approval takes more effort in the Mid-South Coast, and as in previous years, landowner denials were highest in the Mid-South Coast. As in previous years we met our objective to survey > 10 sites per strata in all of the OCS 4^{th}-6^{th} order reach strata. Likewise, we met our target number of sites in the KMPS strata (N=54 tributary sites, 14 large water sites). In the SONCC stratum were only able to survey 21 sites, fewer than our target of 25-30 sites.

Survey effort varied between strata in 2007, with strata in larger streams being surveyed at a higher relative level of effort than tributary strata. For the 2008 monitoring, we will look into the feasibility of rebalancing the effort evenly across strata, so that the % of miles surveyed is more evenly distributed. A sensitively analysis on estimate variance may identify strata that need greater survey effort than others.

A total of 32 tributary sites (12% of tributary sites) that were snorkeled were revisited for fish counts by crew leaders. When resurveys of juvenile salmonid counts from coho tributaries were compared to original surveys (Figure 2), the calculated slope of the relationships were 0.972x (coho; r^2=0.99), and 0.960x (steelhead; r^2=0.84), indicating high agreement between initial survey counts and resurveys.

Table 1. Summary of surveyed and non-surveyed candidate sites in 2007 for juvenile salmonid surveys in western Oregon streams, organized by species unit (ESU or DPS) and monitoring strata. Refer to Jepsen and Leader (2007) for description of ESU or DPS acronym and extent of strata.

		Surveyed			Not Surveyed			
ESU/DPS and Strata	Rearing Miles In Stratum	Snorkel	Electro-fish	% Stratum Sampled	Could Not Be Sampled	Above Barrier	Access Not Given	Not Visited
LCR Coho and LCR Steelhead								
Lower Columbia:								
1st-3rd order	882	40	10	3.4	8	5	1	23
4th-6th order	232	7	--	1.9	0	0	0	10
OC Coho and OC Steelhead								
North Coast:								
1st-3rd order	1,456	33	3	1.5	3	0	3	12
4th-6th order	191	16	--	5.3	0	0	0	4
Mid-Coast:								
1st-3rd order	2,024	40	1	1.3	0	8	5	1
4th-6th order	192	17	--	5.7	0	0	0	2
Mid-South Coast:								
1st-3rd order	1,358	29	2	1.4	1	2	7	14
4th-6th order	158	12	--	4.7	0	0	3	5
Umpqua								
1st-3rd order	2,397	34	5	1.9	2	4	6	4
4th-6th order	468	11	--	1.5	2	0	1	6
SONC Coho								
South Coast:								
1st-3rd order	469	21	0	2.8	3	0	5	1
KMP Steelhead								
Non-Rogue Basin:								
1st-3rd order	324	27	0	5.2	0	0	0	17
4th-6th order	43	5	0	7.3	0	0	1	2
Rogue Basin:								
1st-3rd order	987	26	1	1.7	1	0	5	6
4th-6th order	243	8	1	2.4	0	0	1	7

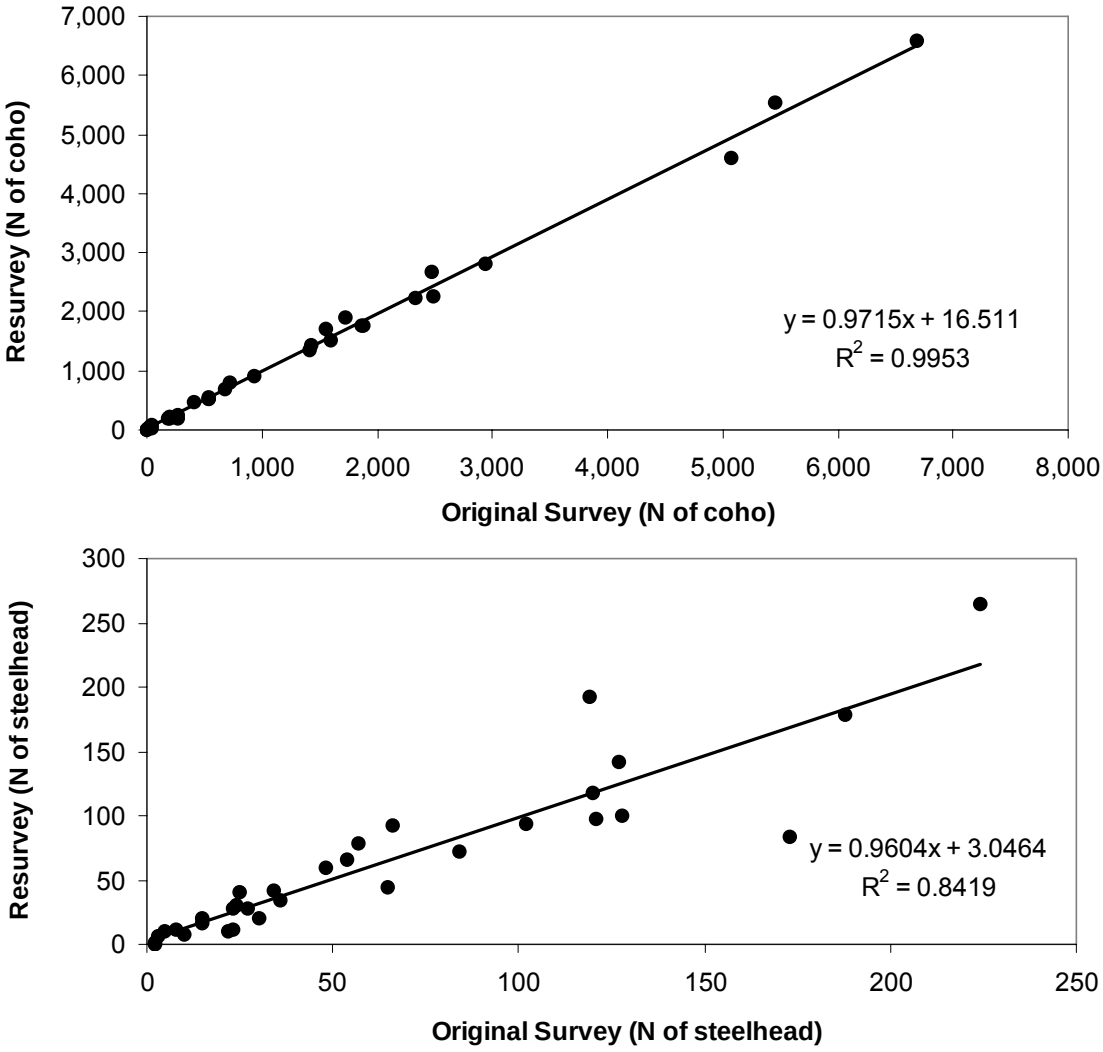

Figure 2. The linear relationship between original snorkel counts of the number of juvenile salmonids in pools and resurvey of the same pools in 2007. N = 32 sites and 1,477pools

Annual Juvenile Fish Distribution and Abundance

Lower Columbia River Coho

Coho occurred at 72% of 1st-3rd order stream reaches, and at 71% of 4th-6th order stream reaches (Table 2). Average percent pool occupancy was 42% at tributary sites and 31% of 4th-6th order stream reaches. Average coho densities in pools was 0.13 fish/m^2 and 0.02 fish/m^2 for 1st-3rd order and 4th-6th order reaches, respectively (Table 3). Only one tributary site (2.5% of sites) had coho rearing densities > 0.7 fish/m^2 (Moffett Creek, a Columbia River Gorge tributary).

Lower Columbia River Steelhead

Steelhead occurred at 58% of 1st-3rd order stream reaches, and at 83% of 4th-6th order stream reaches (Table 2). Average percent pool occupancy was 24% at tributary sites and 33% of 4th-6th order stream reaches. Average steelhead densities in pools was 0.03 fish/m^2 and 0.004 fish/m^2 for 1st-3rd order and 4th-6th order reaches, respectively (Table 3).

Oregon Coast Coho

Coho occurred in 63%-84% of the 1st-3rd order stream reaches, and as in previous years were less widespread in the Umpqua basin than in other monitoring strata (Table 2). Within the 1st-3rd order stream strata, the average percent pool occupancy ranged from 50% (Umpqua basin) to 71% (North Coast). Results of z-tests (not reported here) and overlap of 95% confidence intervals for all strata indicated little evidence of differences in pool occupancy between strata. In 4th-6th order stream strata, coho occurred in 64%-100% of reaches, and were less widespread in the Mid Coast and Umpqua basin strata. Within the 4th-6th order stream sites of a stratum, the average percent pool occupancy ranged from 33% (Umpqua) to 78% (North Coast).

Average coho densities in pools in the 1st-3rd order stream strata (Table 3) ranged from 0.26 fish/m^2 (Umpqua basin) to 0.72 fish/m^2 (North Coast). With the exception of the Umpqua monitoring area, the 1st-3rd order stream strata had > 20% of sites with juvenile coho densities $\geq$0.7 fish/m^2 (summer rearing full seeding level). As in past years, average coho densities were much lower in the 4th-6th order stream reach strata than in associated tributary strata. Seeding levels were achieved in 6% of the North Coast 4th-6th order stream reaches, but in none of the other monitoring areas.

Oregon Coast Steelhead

Juvenile steelhead occurred in 61-83% of the 1st-3rd order stream sites, and as in 2006 were less widespread in the Mid- South Coast than in other monitoring strata. As in 2005 and 2006, within the 1st-3rd order stream strata, the average percent pool occupancy by steelhead was lowest in the Umpqua basin (23%) and highest in the North Coast (47%). Steelhead occurred in 45%-100% of 4th-6th order stream reaches, and were less widespread in the Umpqua and more widespread in the Mid-South Coast. With

the exception of the Mid Coast, steelhead were observed in a greater proportion of pools of larger streams than tributary streams.

Average steelhead densities in pools in the 1st-3rd order stream strata (Table 3) ranged from 0.02 fish/m^2 (Mid-South Coast) to 0.06 fish/m^2 (North Coast). As in past years, average steelhead densities were lower in the 4th-6th order stream reach strata than in tributary strata.

Southern Oregon/Northern California Coho

Coho occurred in 81% of the sites in the SONCC, and average percent pool occupancy was 62% (Table 2). The average coho density in pools was 0.40 fish/m^2 with only one site (19% of sites) supporting > 0.7 fish/m^2.

Klamath Mountain Province Steelhead

Juvenile steelhead occurred in 100% of the 1st-3rd order stream reaches in both the Non Rogue and Rogue basin strata (Table 2), and they were observed in all of the 4th-6th order reaches in Non Rogue basin stratum, and 79% of reaches in the Rogue basin stratum. Average percent pool occupancies in 1st-3rd order reaches were slightly greater in the Non Rogue reaches (72%) than in the Rogue reaches (67%). In larger streams the percent pool occupancy was 79% and 63% in the Non Rogue and Rogue basin reaches, respectively. The average steelhead density in pools was greater in the Rogue basin between the two 1st-3rd order strata, and similar between the two 4th-6th order strata (Table 3).

Time Series Trend of OCC Juvenile Abundance

There are now ten years of abundance and distribution estimates for OC coho in the four tributary strata. Review of the time series show some trends in summer coho parr densities within the OCC ESU (Figure 3). In the North Coast stratum densities have generally increased since monitoring began, and it appears the estimates for 2006 and 2007 were higher than previous monitoring years. The Mid Coast has shown a cyclic pattern in coho abundance. Densities in the Mid-South Coast and Umpqua strata have declined since 2005. In most years juvenile coho densities in the Mid Coast and Umpqua strata have remained < 0.4 fish/m^2, suggesting some limitation in fresh water rearing potential, relative to other strata in some years.

The data in Figure 3 are averages from sites from several panels in the probability design, including ten years of annual sites, 3 years of 3-year sites, one year of 9-year sites and 10 years of once only sites. Analysis of trend in abundance for the annual sites has not yet been conducted, but may reveal stronger patterns than reported here.

Table 2. The occurrence of juvenile coho and steelhead (Sthd; > 90 mm) from direct counts in snorkeling or electrofishing surveys in 2007 within monitoring strata of western Oregon streams. See Jepsen and Leader (2007) for description of strata.

ESU/DPS and Strata	N of Sites	% Of Sites with At Least One Juvenile Fish		Mean Percent Pool Occupancy And 95% Confidence Interval			
		Coho	Sthd	Coho	95% CI	Sthd	95% CI
LCR Coho and LCR Steelhead							
1st-3rd order	50	72	58	42	8	24	7
4th-6th order	7	71	83	31	18	33	14
OC Coho and OC Steelhead							
North Coast:							
1st-3rd order	36	83	83	71	10	47	7
4th-6th order	16	100	88	78	6	62	13
Mid-Coast:							
1st-3rd order	41	78	61	69	11	23	8
4th-6th order	17	71	59	38	11	14	7
Mid-South Coast:							
1st-3rd order	31	84	81	70	10	28	6
4th-6th order	12	100	100	64	13	68	8
Umpqua							
1st-3rd order	38	63	66	50	10	23	6
4th-6th order	11	64	45	33	8	33	14
SONC Coho							
South Coast:							
1st-3rd order	21	81	--	62	12	--	--
KMP Steelhead							
Non-Rogue Basin:							
1st-3rd order	27	--	100	--	--	72	7
4th-6th order	5	--	100	--	--	79	17
Rogue Basin:							
1st-3rd order	27	--	100	--	--	67	12
4th-6th order	9	--	79	--	--	63	16

Table 3. Density (fish/m^2) of juvenile coho and steelhead (Sthd: > 90 mm) in pools from snorkeler counts in 2007 within monitoring strata of western Oregon streams. See Jepsen and Leader (2007) for description of strata.

ESU/DPS and Strata	N of Sites	% Sites with Coho >0.7 fish/m^2	Mean Density of Fish in Pools and 95% Confidence Interval			
			Coho	95% CI	Sthd	95% CI
LCR Coho and LCR Steelhead						
Lower Columbia:						
1st-3rd order	40	1	0.131	0.047	0.026	0.032
4th-6th order	7	0	0.022	0.022	0.004	0.003
OC Coho and OC Steelhead						
North Coast:						
1st-3rd order	33	39	0.717	0.192	0.058	0.061
4th-6th order	16	6	0.175	0.100	0.047	0.025
Mid-Coast:						
1st-3rd order	40	24	0.494	0.171	0.027	0.038
4th-6th order	17	0	0.010	0.010	0.002	0.003
Mid-South Coast:						
1st-3rd order	29	26	0.482	0.152	0.016	0.022
4th-6th order	12	0	0.031	0.019	0.012	0.006
Umpqua						
1st-3rd order	33	11	0.260	0.118	0.021	0.027
4th-6th order	11	0	0.068	0.064	0.019	0.022
SONC Coho						
South Coast:						
1st-3rd order	19	19	0.402	0.153	--	--
KMP Steelhead						
Non-Rogue Basin:						
1st-3rd order	26	--	--	--	0.058	0.020
4th-6th order	5	--	--	--	0.012	0.009
Rogue Basin:						
1st-3rd order	22	--	--	--	0.148	0.055
4th-6th order	8	--	--	--	0.031	0.021

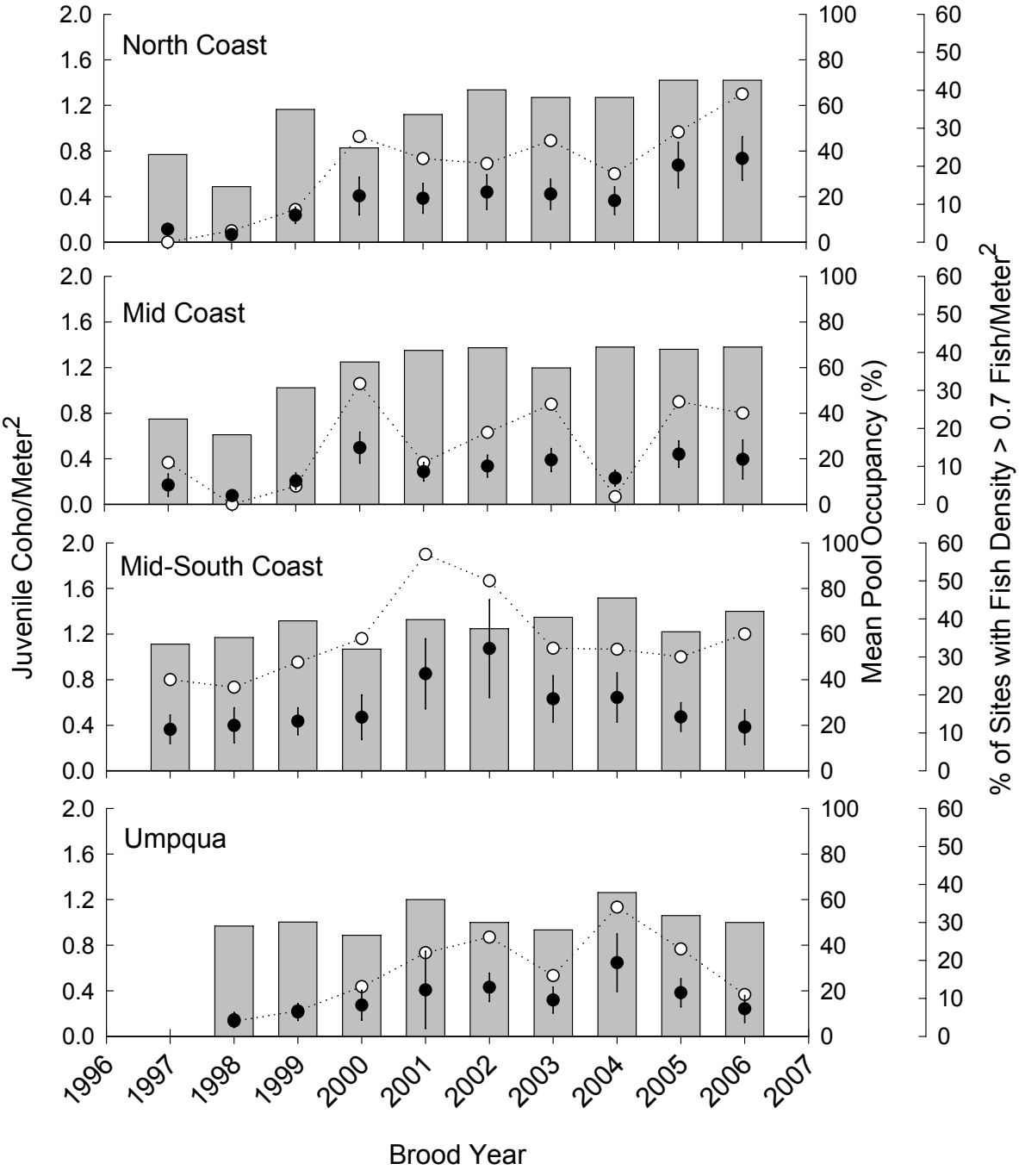

Figure 3. Annual trend in abundance and frequency metrics for juvenile coho salmon in the Oregon Coast Coho ESU, based on snorkel surveys in 1st-3rd order stream reaches. Panels are organized by monitoring strata. Black symbols with 95% CI are for mean density (coho/meter^2), gray bars are for % pool occupancy, and white symbols with dotted lines are for % of sites with fish density >0.7 fish/meter^2.

REFERENCES

Jepsen, D. B. and Leader, K. 2007. Abundance monitoring of juvenile salmonids in Oregon coastal streams, 2006. Monitoring Program Report Number OPSW-ODFW-2007-1, Oregon Department of Fish and Wildlife, Salem.

Jepsen, D. B. and Rodgers, J. D. 2004. Abundance monitoring of juvenile salmonids in Oregon coastal streams, 2002-2003. Monitoring Program Report Number OPSW-ODFW-2003-1, Oregon Department of Fish and Wildlife, Salem.

Stevens, D.L., Jr. 2002. Sampling design and statistical analysis methods for the integrated biological and physical monitoring of Oregon streams. Monitoring Program Report Number OPSW-ODFW-2002-7, Oregon Department of Fish and Wildlife, Portland.