THE OREGON PLAN for Salmon and Watersheds

Status of Oregon Stocks of Coho Salmon, 2010

Report Number: OPSW-ODFW-2011-3

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SUMMARY

This report summarizes the results of status and trend monitoring for Oregon's naturally spawning coho salmon *Oncorhynchus kisutch* populations through the 2010 run year (October 2010 through January 2011). Monitoring results include:

1. Abundance of naturally spawning coho salmon
2. Density (fish/mile) of naturally spawning coho salmon
3. Coho salmon spawn timing and distribution
4. Proportion of hatchery (marked) coho salmon in naturally spawning populations

Results in this report are based on data from randomly selected spawning surveys and other methods used in areas without adequate random surveys. Results for coho salmon standard spawning surveys and spawning surveys for other species are covered in data summaries and reports posted on an Oregon Department of Fish and Wildlife (ODFW) web page (see: http://oregonstate.edu/dept/ODFW/spawn/index.htm).

Monitoring occurs at three hierarchical spatial scales, as defined by the National Marine Fisheries Service (NMFS): Evolutionarily Significant Unit (ESU); Stratum; and coho salmon Population. There are three coho salmon ESUs located entirely or partially within the State of Oregon: the Lower Columbia River (LCR) Coho ESU; the Oregon Coast (OC) Coho ESU; and the Southern Oregon/Northern California Coasts (SONCC) Coho ESU. This report summarizes results for coho salmon populations in the portion of each ESU within the State of Oregon.

In the Oregon portion of the LCR Coho ESU sufficient surveys were conducted to meet precision goals for the ESU. Yearly precision goals were not met at the stratum or population scale. In 2010 wild coho salmon spawner abundance was the second highest observed in nine years of monitoring. The abundance of hatchery coho salmon on natural spawning grounds in 2010 was slightly below the average for years 2002 through 2009. Proportion of hatchery coho salmon in the natural spawning populations was slightly below the 2002 through 2009 average for the ESU, but more variable at the stratum and population scales. Regional patterns in fish distribution, spawn timing, and hatchery proportion are apparent at both the stratum and population scales. Coho salmon spawner run timing in 2010 was similar to long-term averages with peak spawning occurring in early November, but showed a second peak in early December.

In the OC Coho ESU sufficient surveys were conducted to meet the precision goal for the ESU and all five strata, but only 6 of 24 populations met the precision goal. Wild spawner abundance increased slightly in 2010, setting a record high for the 21 years of monitoring in the Oregon Coast Coho ESU. The proportion of hatchery fish was generally low across the ESU, with all naturally spawning coho salmon populations containing greater than 90% wild fish. Distribution and density of wild coho salmon spawners was good, with over 84% of surveyed sites in the ESU occupied, and most of the 24 populations averaging over 25 wild coho salmon per mile. However, regional patterns in fish distribution and spawner density are apparent. Coho salmon spawner run timing in 2010 was similar to long-term averages with peak spawning occurring in mid December.

Inadequate funding and the need to update the Generalized Random Tessellation Stratified (GRTS) sampling frame continue to hamper the monitoring of the Oregon portion of the SONCC Coho ESU. In 2010 no GRTS surveys were conducted in the Oregon portion of the ESU. Monitoring of wild coho salmon spawners was based on the Huntley Park seining estimate. Wild coho salmon spawner abundance increased slightly in 2010 compared to 2009, but was still well below the 1994 through 2009 average. The proportion of hatchery coho salmon spawning naturally in 2010 was very close to the record low observed in this ESU over the last 16 years. Without GRTS surveys, fish distribution and spawn timing were not analyzed in 2010.

INTRODUCTION

Conservation and management of coho salmon *Oncorhynchus kisutch* in Oregon requires monitoring statuses and trends for a variety of population criteria. This is true if the populations are thriving or depressed. Collecting data during both conditions is valuable in the assessment and interpretation of current and historic population status. There are three coho salmon ESUs located entirely or partially within Oregon: the LCR Coho ESU (populations in Washington and Oregon); the OC Coho ESU (all populations in Oregon); and the SONCC Coho ESU (populations in Oregon and California). All three ESUs are currently listed as "Threatened" under the Federal Endangered Species Act (ESA). In addition, the LCR Coho ESU is listed as "Endangered" under the State of Oregon ESA.

From 1950 through 2004 spawning surveys for coho salmon were conducted in standard index areas along the Oregon coast to assess escapement trends on natural spawning grounds (Jacobs et.al. 2002). Beidler and Nickelson (1980) and Ganio et.al. (1986) reviewed the adequacy of this method to provide the level of monitoring data needed for management of Oregon's coho salmon populations. Both reviews identified areas of concern and made recommendations to improve the monitoring of naturally spawning coho salmon in Oregon. In 1990 a stratified random sampling program was initiated to address these recommendations and provide annual estimates of the abundance of naturally spawning Oregon Coastal Natural (OCN) coho salmon. The OCN area covers Oregon coastal rivers from the mouth of the Columbia River south to Cape Blanco. Methods and results for this methodology are described in Jacobs and Nickelson (1998). This methodology was used for the 1990 through 1997 spawning seasons.

In 1998 ODFW established an integrated monitoring program for Oregon coastal salmonids as part of the implementation of the Oregon Plan for Salmon and Watersheds (OPSW) (Firman and Jacobs 2001). The program consists of three geographically extensive monitoring projects based on spatially balanced random site selection, and one project that intensively monitors specific sub-basins. The three geographically extensive projects are based on the U.S. Environmental Protection Agency's Environmental Monitoring and Assessment Program. These projects incorporate a GRTS sampling design to establish a shared set of random, spatially balanced sample points (Firman and Jacobs 2001, and Stevens 2002). Beginning in 1998 the GRTS design replaced the stratified random sampling method for the selection of spawning ground surveys in the OC Coho ESU. The GRTS design was also implemented in the SONCC Coho ESU in 1998 and expanded to include the LCR Coho ESU in 2002. With some modifications, this methodology has been in use since those dates.

METHODS

Boundaries and population structures of the Oregon coho salmon ESUs, as defined by the NMFS Technical Recovery Teams (TRT), are presented in Figure 1. Although, the OPSW adult coho salmon monitoring design for the OC and SONCC Coho ESUs was established in 1998 as a 27-year study, changes in technology and salmon management, as well as the need for data at finer geographic scales, resulted in alterations to the initial design (Table 1). Significant changes in methods are discussed in Lewis et.al. (2009). The following two sub-sections give a brief description of field sampling protocols and data analysis methods.

Field Sampling

The assessment and establishment of new spawning surveys is completed during an initial set-up visit between February and September. Once landowner permissions are obtained a surveyor visits the site to determine if it contains coho salmon spawning habitat, and if there are any barriers to adult coho salmon migration. If the site has habitat and is accessible, a new spawning ground survey is established that encompasses the GRTS point. Spawning surveys are generally one mile in length, but actual boundaries are determined by the site's specific characteristics. Surveys are bound by significant landscape features including: beginning or ending of coho salmon spawning habitat; confluences with other streams; and other long-term features such as, bridges, roads, passable waterfalls, etc. Specific methods used in spawning survey set-ups can be found in the annual site verification procedures manual on the Oregon Adult Salmonid Inventory and Sampling (OASIS) project web page.

Table 1. Design criteria used to select GRTS sampling points for coho salmon spawning surveys. Sample points = scale for precision targets; Estimate = finest scale for population estimates; MA = monitoring area (~Stratum); Popn = TRT population; Group = basin or group of basins; H, M, L = High, Medium, and Low quality habitat; Frame scale = scale of stream coverage used to select GRTS points; XX Frame = last two digits of the year the frame was developed; H:W = data source for rearing origin determinations.

Run year	Geographic scale		Habitat type (HT)	Frame scale	Points by HT from			H:W
	Sample points	Estimate			98 Frame	05 Frame	07 Frame	
1998	MA	Group	M&H	1:100K	M&H			Scales
1999	MA	Group	M&H	1:100K	M&H			Fin Marks
2000	MA	Group	M&H	1:100K	M&H			Fin Marks
2001	MA	Group	M&H	1:100K	M&H			Fin Marks
2002	MA	Group	M&H	1:100K	M&H			Fin Marks
2003	MA	Group	M&H	1:100K	M&H			Fin Marks
2004	MA	Popn	M&H	1:100K	M&H			Fin Marks
2005	MA	Popn	M&H*	1:100K	M&H	L (Ump.)		Fin Marks
2006	Popn	Popn	All	1:100K	M&H	L (All)		Fin Marks
2007	Popn	Popn	All	1:24K			All	Fin Marks
2008	Popn	Popn	All	1:24K			All	Fin Marks
2009	Popn	Popn	All	1:24K			All	Fin Marks
2010	Popn	Popn	All	1:24K			All	Fin Marks

** = Sampled only Medium and High quality habitat, except in the Umpqua where all habitat was sampled.*

Figure 1. Coho salmon monitoring study area showing the populations, strata, and evoluntionarily significant units.

Coho salmon spawning ground surveys are conducted weekly from October through January of each year. The goal is to obtain at least one valid survey (in which flow and visibility allow for counts of live fish, dead fish, and redds) before coho salmon start spawning and two consecutive valid surveys with no live coho salmon observed to end each site for the season. Although the goal is to conduct a weekly survey, current protocols allow for up to 11 days between valid survey visits. Surveys that go more than 11 days between valid visits are considered to be out of rotation. When conditions permit, crews continue survey sites that have gone out of rotation and try to maintain their rotation throughout the remainder of the season.

Crews conduct the surveys by walking up-stream and recording the number of live fish, dead fish and redds observed, and categorical information on weather, visibility, and stream flow. Surveyors record the species of live fish observed, and for coho salmon, try to determine if the adipose fin has been clipped (Ad Clip). All hatchery coho salmon smolts released in Oregon coastal and lower Columbia River streams are marked with an adipose fin clip, and a subset of these are marked with a coded wire tag, prior to release. For carcasses, surveyors record species, gender, Mid Eye to Posterior Scale (MEPS) length, and any fin clips, marks, or tags. A scale sample is collected from every forth coho salmon carcass, and both a scale sample and snout are collected from every Ad Clip carcass to recovery the coded wire tag, if present. Finally, the tail is cut off of every sampled carcass to preclude repeat sampling on subsequent survey visits. Further details on the spawning survey methods can be found in the annual spawning survey procedures manual on the OASIS project web page.

Data Analysis

The Area-Under-the-Curve (AUC) technique is used to estimate the number of coho salmon adults spawning in a given stream segment throughout the spawning season (Jacobs et al. 2002). Adult coho salmon are defined as fish measuring over 430 mm MEPS. Spawning coho salmon are assumed to have an average spawning life of 11.3 days across the ESU and season (Beidler and Nickelson 1980, Perrin and Irvine 1990). Peak counts and the contribution of hatchery spawners are estimated as in Jacobs et al. (2002). Spawner density is calculated by population by year, as the total adult coho salmon AUC / total length (miles) for all surveys. Abundance and timing calculations are only done with GRTS surveys which meet criteria for a qualified survey. Post season, all GRTS surveys are evaluated to determine if they meet the criteria for inclusion in population estimates (are a qualified survey). The criteria to determine if a site is a qualified survey are based on minimizing the possibility for an inaccurate AUC calculation. This could occur if the chance of a coho salmon migrating to the site, spawning and dying in the period between survey visits is considered too high. The standard method for determining whether a site was successfully surveyed for the year involves three steps. First, the critical period is determined for each stratum, which is defined as the time period in which 90% of the live coho salmon were seen in that stratum for that year. Second, the number of days between valid surveys is calculated for each site for the year. Finally, the “gaps” between survey dates are evaluated to determine if they meet the criteria for minimizing the chance of missing coho salmon in the live counts. The standard criteria used are: no gap of 16 or more days, and no more than one gap between 12 and 15 days during the critical period.

Coho salmon spawning escapement is estimated using the Horvitz-Thompson estimator (Diaz-Ramos et al. 1996). Variance estimates are calculated using the local mean variance estimator. Escapements are calculated for the ESU as a whole, each stratum, and each independent population or group of dependent populations (Jacobs et al. 2002). Temporal distribution of spawners is based on monthly 10-day periods (1st to 10th, 11th to 20th, and 21st to end of month). The number of adult coho salmon observed is summed by geographic scale, year, and 10-day period, and then normalized for effort by dividing the sum of live adults by the corresponding sum of miles surveyed. Occupancy is defined as a peak count of at least four adult coho salmon per mile. Occupancy of coho salmon spawning habitat is calculated as the percentage of qualified GRTS spawning surveys that are occupied each year. This calculation is done at three scales: ESU, stratum and population. Three additional metrics are used to evaluate the distribution of fish with each population. The metrics are calculated for total coho salmon in populations with at least 10 qualified GRTS spawning surveys for the year. Presence is calculated as the percentage of qualified GRTS spawning surveys with at least one coho salmon observed. Area-Over-the-Curve (AOC) and minimum proportion of sites comprising 80% of the population abundance ($P_{80\%}$) are calculated from cumulative abundance curves of sites ranked from highest to lowest abundance (Walters and Cahoon 1985, Peacock and Holt 2012).

The proportion of hatchery origin spawners (pHOS) is normally calculated at the population scale to maximize the likelihood of reaching our minimum sample size goal of 10 fish with known Ad Clip status. Ad Clip status is most reliable determined from carcasses, but is recorded for live fish when possible. If Ad Clip status is available for at least 10 carcasses then pHOS is calculated from the carcass data, if not the live fish data is included. A single pHOS value for all sites in a population precludes evaluation of the spatial distribution of coho salmon by rearing origin. Therefore, pHOS values were calculated for each GRTS site at the finest of four geographic scales which met the minimum sample size goal of 10 fish with know Ad Clip status. The four spatial scales are; GRTS site, 6^{th} field hydrologic unit code (HUC), 5^{th} field HUC, and TRT population. Distribution metrics (AOC, $P_{80\%}$, and presence) were calculated separately for hatchery and wild coho salmon in populations with at least 50% GRTS site and at least 90% finer than population scale pHOS values.

In some areas, GRTS surveys for coho salmon spawners are not conducted, the number of qualified surveys is not adequate, or there is not long-term data from GRTS surveys. In these areas, other sources of monitoring data are used to document the number of adult coho salmon spawners. These include dam counts, mark-recapture estimates, and regressions of standard survey data to abundance estimates. There are five such locations in the LCR Coho ESU including: two dams (River Mill and Powerdale dams), two hatchery weirs (Big Creek and Klaskanine hatcheries), and one OPSW life-cycle monitoring site (Bonnie Falls). In these five locations, counts of adult coho salmon passed up-stream are obtained and added to the estimated abundance of coho salmon spawners for areas where GRTS surveys are conducted. In the OC Coho ESU, GRTS spawning ground surveys are conducted in all areas. However, access limitations typically result in an insufficient number of surveys in the three lake populations to make estimates. Coho salmon spawner abundances for the lake populations are calculated using regressions of long-term standard surveys to historic mark-recapture studies and habitat measurements for those locations (Jacobs et.al. 2002). Random (GRTS) coho salmon spawning surveys above Winchester Dam began in the 2005 run year. Most of the coho salmon spawning

habitat for the North Umpqua coho salmon population is located above Winchester Dam, and the count of coho salmon past the dam is used to monitor abundance for this population. The Winchester Dam count is adjusted for coho salmon collected and retained at Rock Creek Hatchery, and for angler harvest of coho salmon in the North Umpqua River above Winchester Dam. The GRTS surveys in the North Umpqua are used to provide information on the timing and distribution of coho salmon on the spawning grounds. Comparison of the GRTS estimates of coho salmon spawners to other estimates for the same area and year will be used to evaluate the accuracy and potential calibration of GRTS based survey estimates.

Implementation of a GRTS based sample for spawning coho salmon in the SONCC Coho ESU has been hampered by funding and a need to review the sample frame. The issues and limitations of the current GRTS frame for the SONCC Coho ESU are reviewed in Lewis et.al. (2009). No GRTS coho salmon spawning surveys were conducted in the SONCC Coho ESU in 2010. This is the third year since 1998 that budget constraints have precluded probabilistic sampling of coho salmon spawners in this ESU. In addition, during the 2006 through 2008 seasons budget constraints resulted in GRTS sampling at half the rate of previous years. Long-term monitoring of coho salmon spawners in the SONCC Coho ESU currently relies on a mark-recapture calculation based on adipose fin clipped coho salmon. Details of this method are described in Jacobs et.al. (2002). This method provides an estimate of adult coho salmon escapement to the Rogue basin above Huntley Park (river mile 8). These estimates are adjusted for coho salmon collected and retained at Cole Rivers Hatchery, as well as angler harvest in the Rogue basin above Huntley Park.

RESULTS

Results of monitoring coho salmon spawning escapements in Oregon basins are summarized by the three coho salmon ESUs. Results include data from GRTS spawning ground surveys and data from other sources where GRTS surveys are not conducted. Results are reported in four categories: Effort, Abundance, Distribution and Timing, and Proportion Hatchery Fish. Spatially, results are reported by ESU, stratum, and constituent coho salmon populations. The individual components that comprise the results can be found in Appendices A, B, and C (by coho salmon ESU). Ancillary data is presented in Appendix D.

There were some fairly consistent weather and stream flow patterns across our study area for the 2010 season. Temperatures were generally near normal as were snow fall amounts, except for December which had well below average snow fall. There was above average precipitation early in the season, particularly in October, followed by average to above average precipitation through December 2010. Precipitation in January 2011 continued at average to above average for the LC Coho ESU and the North and Mid Coast strata of the OC Coho ESU. Further south January precipitation transitioned to below average in the Umpqua and Lakes strata to well below average in the Mid-South Coast stratum. This resulted in generally average to above average stream flows, particularly early in the season (October and November). Stream flows tended to peak about every two weeks (mid-December, late December and mid-January) dropping to slightly below average flows between peaks. This pattern was generally conducive to

conducting salmon spawning ground surveys, and resulted in typical success rates for keeping surveys in rotation. The good October flows may have contributed to slightly earlier spawning.

Lower Columbia River Evolutionarily Significant Unit

In 1999, naturally produced coho salmon in the lower Columbia River basin were listed as "endangered" by the State of Oregon, and in 2005 were listed as "threatened" under the federal ESA (NMFS 2005). The LCR Coho ESU includes populations in both Oregon and Washington. This report summarizes monitoring of spawning escapement in the Oregon populations for the 2010 spawning season. The Oregon portion of the LCR Coho ESU is comprised of eight coho salmon populations (Meyers et al. 2006). They include all naturally spawning populations in Columbia River tributaries (excluding areas above Willamette Falls) downstream of and including the Hood River (Figure 1). Spawning habitat above dams, ladders, or hatcheries (where counts of fish are available) are not surveyed, or expanded for in GRTS abundance estimates. Areas not sampled include: above Klaskanine Hatchery for the Youngs Bay population, above Big Creek Hatchery for the Big Creek population, above Bonnie Falls for the Scappoose population, above River Mill Dam for the Clackamas population, and above the Powerdale Dam site for the Hood population (Figure 3). Marmot Dam on the Sandy River was removed in 2006 and Powerdale Dam on the Hood River in 2010. Through 2006, estimates for the Sandy population were a combination of GRTS estimates for the area below Marmot Dam and the dam count, plus any wild fish released above Marmot Dam by Sandy Hatchery staff. Coho salmon spawning estimates for the Sandy population since 2007 have been based on GRTS surveys. Logistic and budget issues currently preclude conducting GRTS surveys in the Hood River above the Powerdale Dam site. Starting with the 2010 season wild coho salmon estimates for the Hood River population will not include an estimate of coho salmon spawning in the Hood River above the Powerdale Dam site. Between 2002 and 2009 these fish accounted for about half of the Hood River population wild coho salmon spawner abundance.

Effort

Spawning surveys were generally conducted from the beginning of October 2010 to the end of January 2011. The number of spawning surveys successfully conducted during the 2010 season only reached 79% of the goal for the ESU and ranged from 57% to 300% of goal by population (Table 2). This is the fifth year targeting population scale estimates, and the number of successful surveys in 2010 was the second lowest of the five years. The 99 sites successfully surveyed in 2010 comprised approximately 53% of the sites originally drawn, similar to 2007 but lower that the previous two years. Some sites were not surveyed in 2010 due to access denials and site inaccessibility. In addition some sites were surveyed, but due to long gaps (>15 days) or multiple gaps of more than 12 days between survey dates, did not meet the estimation criteria. On average, 9% of the sites drawn each year in the LCR Coho ESU are outside of coho salmon spawning habitat (non-target). In 2010, only 7% of the sites drawn were non-target (Table D-1). Although the number of sites successfully surveyed was below goal, the 95% confidence interval for the ESU estimate met the precision target of no more than ± 30% (Table 2). None of the three strata or eight populations met the precision target in 2010 (Table 2).

Table 2. Lower Columbia River Coho ESU, GRTS spawning survey goals and results for number of surveys and 95% C.I, 2010 run year. Target response sites are reaches within coho salmon spawning habitat which were successfully surveyed.

Stratum	Population	Goal	Target response				95% CI as percent of point estimate (goal is +/- 30%)			
				2007 to 2009				2007 to 2009		
			2010	Avg.	Min.	Max.	2010	Avg.	Min.	Max.
Coast	Youngs Bay	16	18	16	13	20	114%	84%	58%	125%
	Big Creek	8	5	5	4	5	60%	71%	62%	86%
	Clatskanie	18	13	15	13	17	36%	50%	37%	71%
	Scappoose	20	15	17	16	19	57%	59%	38%	83%
	Total	**62**	**51**	**53**	**52**	**54**	**32%**	--	--	--
Cascade	Clackamas	30	17	20	17	25	40%	46%	31%	55%
	Sandy	30	23	27	26	28	77%	40%	27%	51%
	Total	**60**	**40**	**47**	**44**	**51**	**35%**	--	--	--
Gorge	Lower Gorge	2	2	3	2	4	128%	82%	57%	107%
	Hood	2	6	2	2	3	66%	76%	14%	138%
	Total	**4**	**8**	**5**	**4**	**6**	**64%**	--	--	--
ESU Total		**126**	**99**	**105**	**101**	**111**	**24%**	**18%**	**12%**	**23%**

NAS .= Not adequately surveyed (either no surveys were selected in the population or < 2 surveys stayed in rotation).

Abundance

Wild coho salmon spawner abundance in 2010 was down substantially from the record high in 2009, but was still the second highest observed in the nine years of conducting GRTS surveys in the LCR Coho ESU (Figure 2 and Table 3). Results at the population scale were more variable with the Clackamas population down 78% from 2009 to 2010, and five populations up substantially (Appendix Table A-3). One stratum (Coast) and three populations (Clatskanie, Scappoose and Lower Gorge) set record high wild adult coho salmon spawner abundances in 2010 (Table 3). Every year from 2002 through 2009, the Clackamas population had the largest wild coho salmon abundance of the eight Oregon populations in the LCR Coho ESU, with only one year less than 1,500 fish (Appendix Table A-3). In 2010 the Clackamas population had the second highest wild coho salmon spawner abundance and three populations in the LCR Coho ESU had over 1,500 wild coho salmon spawners (Table 3). Wild coho salmon spawners were more equitable distributed between strata in 2010 than in the previous eight years, Coast strata 51% vs. 28%, Cascade strata 34% vs. 62%, Gorge strata 15% vs. 10 % (Table 3). Abundance of hatchery coho salmon in 2010 on natural spawning grounds in the LCR Coho ESU was generally near to below average compared to the previous eight years. One population (Lower Gorge) set a record low and one population (Hood River) set a record high number of hatchery coho salmon spawners in 2010 (Table 3).

Table 3. Lower Columbia River Coho ESU estimated abundance of adult coho salmon spawning naturally by ESU, stratum, and population in the 2010 run year compared to the previous eight years.

Geographic scale ESU/Stratum/Population		Spawning year			
			2002 to 2009		
		2010	Avg.	Min.	Max.
Lower Columbia River ESU (Oregon Only)	**Wild**	**7,717**	**6,202**	**3,963**	**12,678**
	Hatchery	**4,167**	**4,259**	**1,336**	**12,230**
	% Hat.	**35.1%**	**36.6%**	**20.0%**	**65.6%**
Coast Stratum	**Wild**	**3,916**	**1,518**	**1,115**	**2,666**
	Hatchery	**393**	**1,112**	**89**	**3,497**
	% Hat.	**9.1%**	**36.6%**	**4.9%**	**75.8%**
Youngs Bay	Wild	68	119	21	411
	Hatchery	106	635	14	2,506
	% Hat.	60.9%	71.4%	21.9%	92.1%
Big Creek	Wild	279	307	98	792
	Hatchery	122	395	66	936
	% Hat.	30.4%	50.9%	15.5%	89.8%
Clatskanie	Wild	1,609	579	104	1,070
	Hatchery	165	113	0	543
	% Hat.	9.3%	16.1%	0.0%	54.6%
Scappoose	Wild	1,960	513	292	778
	Hatchery	0	18	0	67
	% Hat.	0.0%	2.9%	0.0%	9.9%
Cascade Stratum	**Wild**	**2,658**	**4,199**	**2,157**	**9,475**
	Hatchery	**2,411**	**2,580**	**294**	**10,871**
	% Hat.	**47.6%**	**29.8%**	**7.1%**	**71.2%**
Clackamas	Wild	1,757	3,176	1,301	7,982
	Hatchery	2,283	2,470	294	10,871
	% Hat.	56.5%	34.1%	10.5%	75.8%
Sandy	Wild	901	1,022	382	1,493
	Hatchery	128	126	0	515
	% Hat.	12.4%	12.3%	0.0%	57.4%
Gorge Stratum	**Wild**	**1,143**	**486**	**31**	**1,523**
	Hatchery	**1,363**	**756**	**192**	**2,555**
	% Hat.	**54.4%**	**47.7%**	**26.3%**	**62.7%**
Lower Gorge Tribs.	Wild	920	274	126	468
	Hatchery	65	460	67	1,512
	% Hat.	6.6%	52.5%	16.5%	85.2%
Hood River	Wild	223	280	31	1,260
	Hatchery	1,298	296	0	1,043
	% Hat.	85.3%	38.1%	0.0%	60.3%

The LCR Coho ESU and most of the Oregon populations have displayed year to year variability but no strong indication of any trend over the nine years of GRTS sampling (Figure 2; Appendix Table A-3). With the Youngs Bay, Big Creek, Lower Gorge, and Hood River populations averaging below 500, Sandy about 1,000 and Clackamas about 3,000 wild adults a year. However, there is some indication of an increasing trend, particularly over the last three years in the Clatskanie and Scappoose populations. Averaging 400-500 wild coho salmon spawners from 2002 to 2007, and over 1,000 from 2008 to 2010 (Appendix Table A-3).

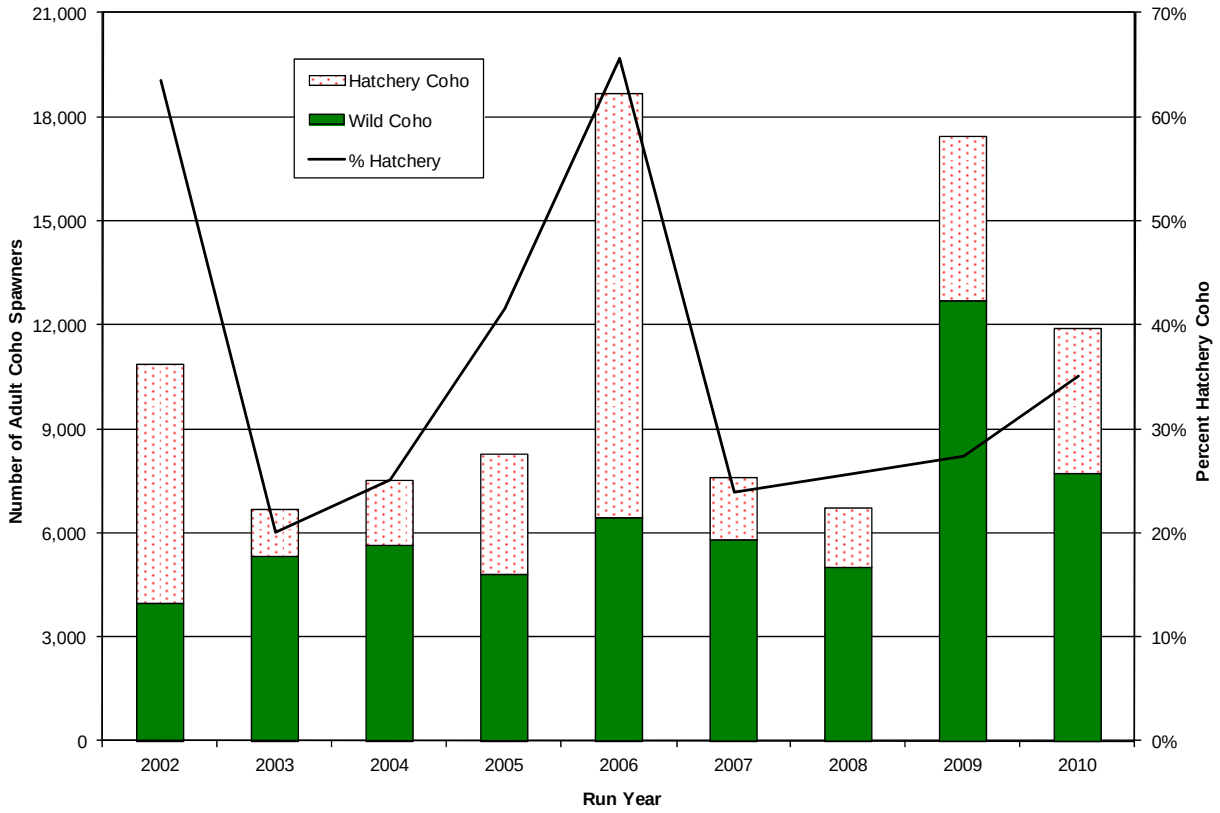

Figure 2. Lower Columbia River Coho ESU estimated abundance of adult coho salmon spawning naturally by rearing origin for the 2002 through 2010 run years.

Distribution and Timing

An average of 90 sites were surveyed annually in the LCR Coho ESU over the previous five years, and 49% of these sites were occupied by wild adult coho salmon (Table 4). Comparing results for 2010 to the average for the previous 5 years, the number of valid surveys increased slightly (99 vs. 90) but wild coho salmon occupancy decreased slightly, 47% vs. 49% (Table 4). Occupancy rates by population were more variable, with the Youngs Bay and Big Creek populations down substantially, and the Clatskanie and Scappoose populations up substantially (Table 4). Coho salmon densities (AUC/mile) are normally highest in the two gorge stratum populations (Lewis et.al 2009). Density was again very high in 2010 for the Lower Gorge and Hood River populations (Figure 3A). Compared to the previous 5 year average, coho salmon spawner density in 2010 was down substantially in the Youngs Bay, Big Creek, Clackamas and Sandy populations and up substantially in the Clatskanie, Scappoose, Lower Gorge and Hood River populations (Appendix Table D-4). Due to sample size issues, coho salmon distribution within a population was only evaluated for 5 of the 8 populations (Table 5). Coho salmon were most evenly distributed in the Clatskanie population and the Youngs Bay population had the most patchy spatial distribution (Table 5). Distribution by rearing origin could only be calculated for the Clatskanie population where wild fish distribution was similar to the overall coho distribution, but hatchery fish had a patchy spatial distribution (Table 5 & Figure 4).

Table 4. Lower Columbia River Coho ESU adult coho salmon occupancy (total & wild) by population, stratum, and ESU for the 2010 run year and previous 5 year average (2005–09). Occupancy is defined as a peak of at least 4 adult coho salmon per mile of survey. Occupied sites with at least one documented wild coho salmon are considered wild occupied.

ESU, Stratum, and TRT Population	2010 No. sites surveyed	5 yr avg. No. sites surveyed	Total coho salmon		Wild coho salmon	
			2010 % Occupied	5 yr avg. % Occupied	2010 % Occupied	5 yr avg. % Occupied
Lower Columbia River ESU	**99**	**90**	**51.5%**	**53.0%**	**46.5%**	**49.4%**
Coast Stratum	**51**	**47**	**47.1%**	**51.1%**	**39.2%**	**45.5%**
Youngs Bay	18	12	16.7%	31.4%	5.6%	21.0%
Big Creek	5	4	60.0%	63.8%	20.0%	63.8%
Clatskanie River	13	15	69.2%	63.6%	69.2%	56.9%
Scappoose Creek	15	16	60.0%	52.9%	60.0%	51.7%
Cascade Stratum	**40**	**38**	**52.5%**	**48.9%**	**50.0%**	**47.8%**
Clackamas River	17	16	70.6%	63.7%	64.7%	62.5%
Sandy River	23	22	39.1%	42.0%	39.1%	41.3%
Gorge Stratum	**8**	**5**	**75.0%**	**83.3%**	**75.0%**	**80.0%**
Lower Gorge tribs.	2	3	100.0%	95.0%	100.0%	88.3%
Hood River	6	3	66.7%	73.3%	66.7%	73.3%

Table 5. Distribution metrics for Lower Columbia River Coho ESU populations during the 2010 run year. Total fish metrics were calculated for populations with at least 10 sites, hatchery and wild metrics were calculated for populations with adequate site specific pHOS data. Populations with uniform distribution would have AOC = 0.5, $P_{80\%}$ = 0.8, and % sites with fish = 100%.

Lower Columbia populations	# of Sites	Total coho salmon			Wild coho salmon			Hatchery coho salmon		
		AOC	$P_{80\%}$	% sites with fish	AOC	$P_{80\%}$	% sites with fish	AOC	$P_{80\%}$	% sites with fish
Youngs Bay	18	0.06	0.10	17%	--	--	--	--	--	--
Big Creek	5	--	--	--	--	--	--	--	--	--
Clatskanie River	13	0.27	0.45	100%	0.25	0.41	100%	0.08	0.13	69%
Scappoose Creek	15	0.18	0.29	87%	--	--	--	--	--	--
Clackamas River	15	0.23	0.37	80%	--	--	--	--	--	--
Sandy River	23	0.11	0.22	48%	--	--	--	--	--	--
Lower Gorge tribs.	2	--	--	--	--	--	--	--	--	--
Hood River	6	--	--	--	--	--	--	--	--	--

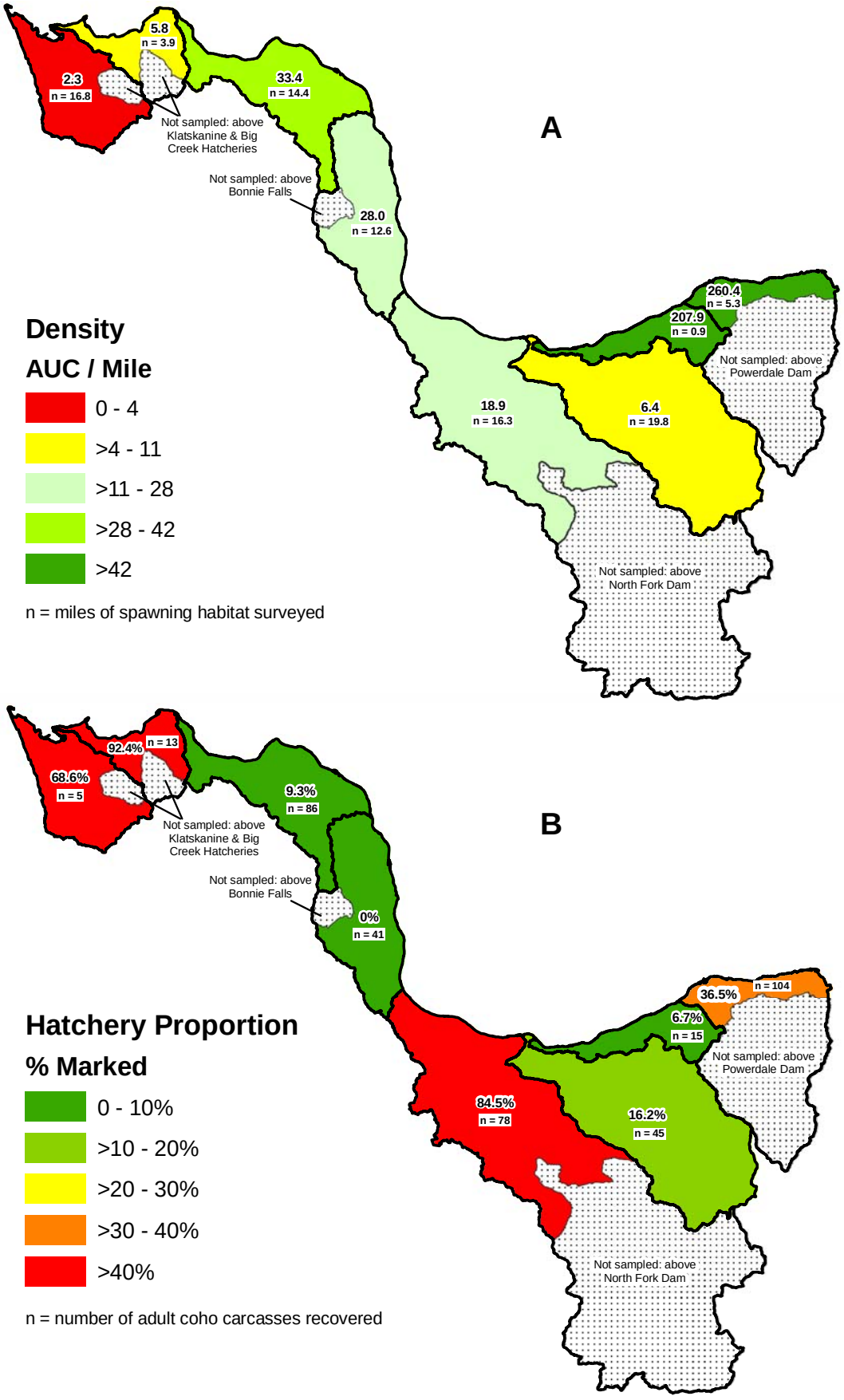

Figure 3. A) Coho salmon density in GRTS surveys by lower Columbia River TRT population, 2010. B) Percentage of marked adult coho salmon in GRTS surveys by lower Columbia River TRT population, 2010.

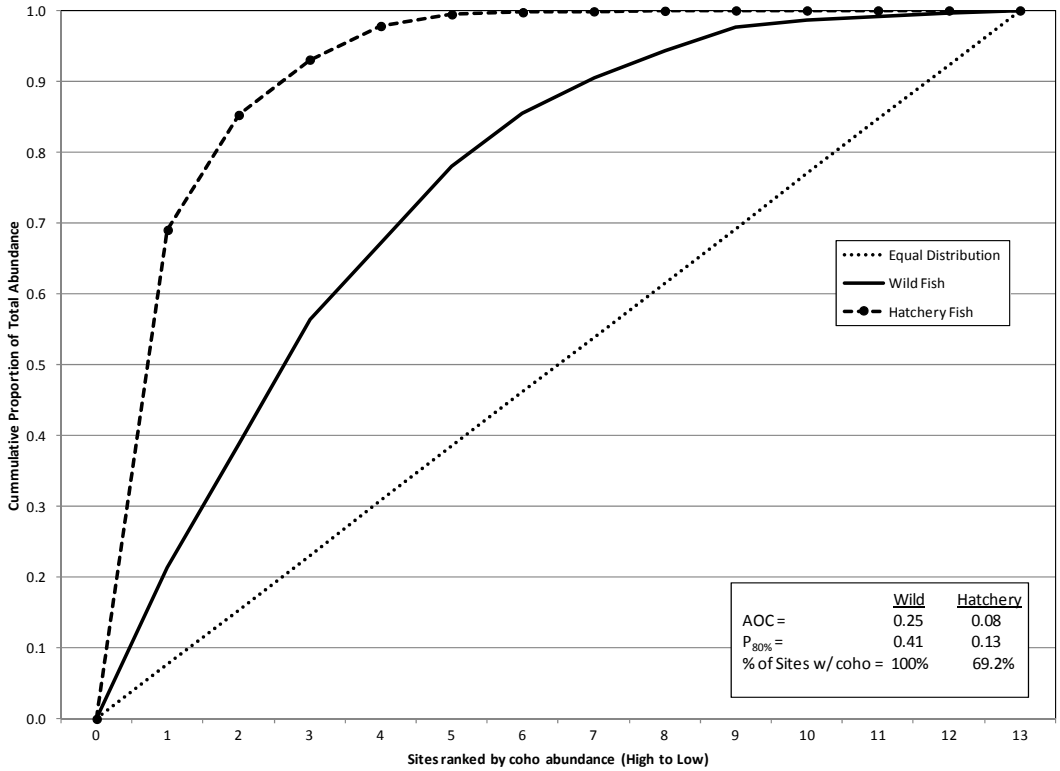

Figure 4. Cumulative frequency distribution of coho salmon in Clatskanie population, run year 2010 GRTS surveys.

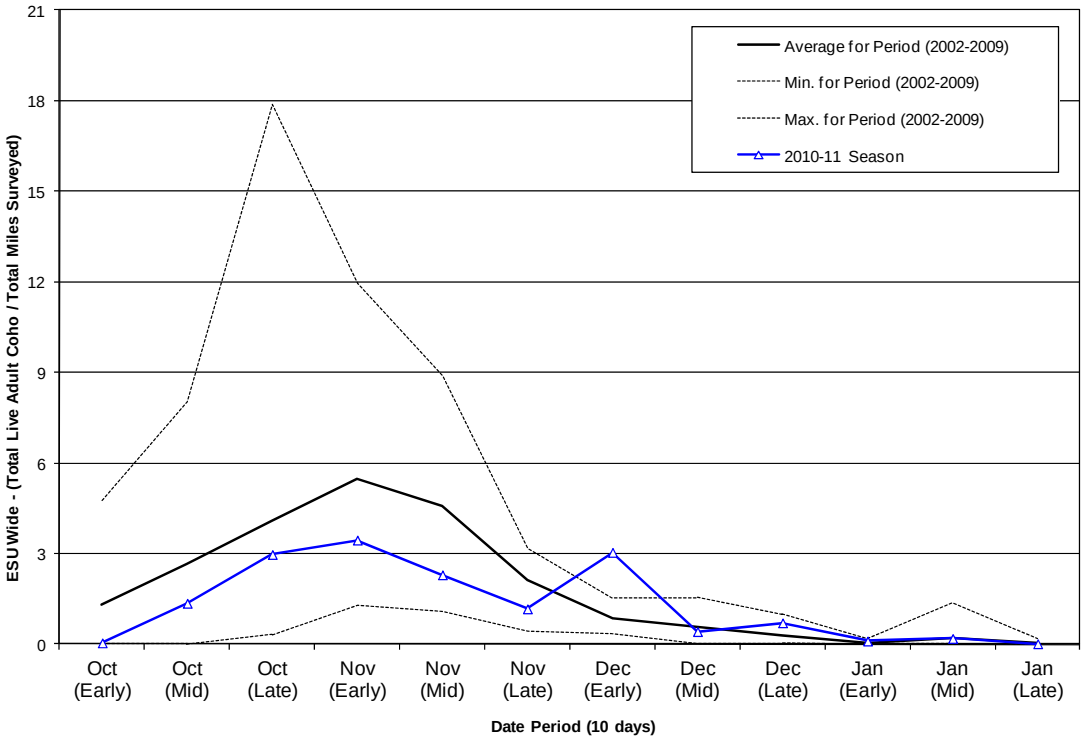

Figure 5. Run timing of live adult coho salmon in 2010 on GRTS spawning ground surveys in the Lower Columbia River Coho ESU.

For the 2002 through 2009 spawning years, peak counts of live coho salmon in the LCR Coho ESU typically occurred during the first 10 days of November with an average of 5.5 adult coho salmon per mile surveyed, and very few live coho salmon seen after early December (Figure 5). Run timing in 2010 was fairly similar to the average timing for the ESU with a peak in early November at 3.4 adult coho salmon per mile surveyed. However, there was a second peak at 3.0 adult coho salmon per mile surveyed in early December 2010 (Figure 5). The early December peak was higher than had been seen in the previous eight years of GRTS surveys in the LCR Coho ESU. Timing in the LCR Coho ESU is much earlier than in the OC Coho ESU, which typically peaks in mid to late December (Figures 5 and 10).

Proportion Hatchery Fish

The pHOS on 2010 natural spawning grounds in the LCR Coho ESU increased to 35.1% in 2010 from the 27.3% observed in 2009. However, this was still slightly less than the average of 36.6% during the previous eight years (Table 3). The rate in 2010 remains high compared to the other Oregon coho salmon ESUs, where pHOS was 1.6% for the OC Coho ESU (Table 7) and 0.3% for the SONCC Coho ESU (Table 11). The Youngs Bay, Big Creek, lower portion of the Clackamas, and Hood River populations all had high percentages of hatchery adult coho salmon in the naturally spawning populations (Figure 3B). However, the GRTS sampling does not include spawning areas above the River Mill Dam on the Clackamas River and only unmarked coho salmon are passed above the dam. The Sandy population pHOS is over 10%, but the GRTS sampling does not include any surveys above the Sandy Hatchery weir where only wild coho salmon are passed. The Clatskanie, Scappoose and Lower Gorge populations had the lowest pHOS rates in the ESU, all below 10% (Table 3 and Figure 3B). The Clatskanie population has a slightly higher pHOS that the other two, but almost all of the hatchery coho salmon were observed in Plympton Creek.

Oregon Coast Evolutionarily Significant Unit

In 2008, the Oregon Coast Coho ESU was listed as “threatened” under the federal ESA (NMFS 2008). The OC Coho ESU is comprised of five strata: North Coast, Mid-Coast, Lakes, Umpqua, and Mid-South Coast. Each stratum is composed of populations characterized as independent or dependent based on their historical structure, potential for persistence, and degree of isolation from neighboring populations (Lawson et al. 2007, Wainwright et al. 2008). There are anywhere from three to six independent populations within each stratum (Figure 1), and spawning escapement estimates are made for each independent population. Dependent populations are grouped together by stratum, and spawning escapement estimates are made for each stratum aggregate of dependent populations. Four of the five strata are monitored using a spatially balanced random sample design (Stevens 2002). These four strata are the North Coast, Mid-Coast, Umpqua, and Mid-South Coast. Abundance estimates for the Lakes stratum are made by expanding counts in standard index reaches (Jacobs et.al. 2002). Finally, GRTS sampling in the OC Coho ESU began in 1998 in all areas except the North Umpqua population, which began in 2005. Previous monitoring of coho salmon spawners in this population was based on Winchester Dam counts. For long-term consistency, the Winchester Dam count is used as the North Umpqua population spawner abundance estimate.

Effort

The 2010 spawning season is the fourth year using the updated sample frame (Table 1), which includes sampling all potential coho salmon spawning habitat based on a 1:24,000-scale digital line graph of streams. A total of 412 sites were successfully surveyed in 2010, more than the average of the previous three years (Table 6). Better weather conditions and slightly more sites selected are responsible for this improved success for the 2010 season. The only exceptions were the North Umpqua, Middle Umpqua and particularly Sixes populations which had a substantial number of sites not meet criteria for inclusion in the population estimate.

Spawning surveys were generally conducted from mid-October 2010 to the end of January 2011. This is the fifth year targeting population scale estimates (Table 1), and the number of successful surveys in 2010 was the second highest of the five years. The 412 sites successfully surveyed in 2010 are approximately 45% of the sites originally drawn, slightly better than average for the previous four years. Some sites were not surveyed in 2010 due to access denials and site inaccessibility. In addition some sites were surveyed, but due to long gaps (>15 days) or multiple gaps of more than 12 days between survey dates, did not meet the estimation criteria. Since we switched to the 1:24 k frame in 2007, on average 17.4% of the sites drawn each year in the OC Coho ESU are outside of coho salmon spawning habitat (non-target). In 2010, 17.6% of the sites drawn were non-target (Appendix Table D-3). Periodically crews identify areas that contain spawning habitat and are accessible to coho salmon, but are not within the sampling frame. These target sites that are outside the frame are noted for future exploration and addition to the frame when it is updated. Frame updates occur about every 5 to 10 years, and until that time no adjustment is made to the coho salmon abundance estimate for the target areas outside the sampling frame. Adjusting for non-target sites inside the frame, but not for target sites outside the frame will result in a negative bias in the coho salmon abundance estimate.

Despite an above average number of successful surveys in 2010, only 4 of 30 spatial sampling scales (24 populations, 5 strata, 1 ESU) met the goal for number of surveys (Table 6). Results for meeting the precision goal of a 95% CI no more than +/- 30% of the point estimate were better than results for number of surveys. In 2010 the precision goal was achieved for the ESU, all 5 of 5 strata, and 6 of 24 populations (Table 6). This is better than in previous years when the precision goal was rarely met, except for the ESU and one or two strata.

Abundance

Wild coho salmon spawner abundance in the OC Coho ESU increased in 2010 to the highest level recorded during the 21 years of GRTS sampling (Table 7). This marks the second consecutive record high wild adult coho salmon spawner abundance since the very low returns in 2007 (Figure 6). All five strata had above average abundances in 2010, with the three southern strata setting record high abundances, the North Coast stratum near a record, but the Mid-Coast stratum only slightly above half of the record high wild coho salmon abundance for the 21 year period (Table 7). Results for individual populations were similar with 6 of 24 populations setting new record highs, all in the southern three strata. The current peak in OC Coho ESU wild coho salmon spawner abundance is both higher in number of fish and better distributed across

Table 6. Oregon Coast Coho ESU, GRTS spawning survey goals and results for number of surveys and 95% CI, 2010 run year. Target response sites are reaches within coho salmon spawning habitat which were successfully surveyed.

Stratum	Population	Goal	Target response				95% CI as percent of point estimate (goal is +/- 30%)			
				2007 to 2009				2007 to 2009		
			2010	Avg.	Min.	Max.	2010	Avg.	Min.	Max.
North Coast	Necanicum	19	15	17	12	21	30%	36%	28%	49%
	Nehalem	30	34	11	6	15	26%	53%	36%	69%
	Tillamook	30	21	11	6	19	70%	48%	38%	55%
	Nestucca	30	12	11	10	13	52%	59%	34%	80%
	NC Depend.	21	15	14	11	15	57%	56%	40%	69%
	Total	**130**	**97**	**64**	**54**	**81**	**24%**	**38%**	**22%**	**47%**
Mid-Coast	Salmon	15	12	9	6	12	42%	57%	55%	60%
	Siletz	30	25	20	13	24	24%	36%	29%	44%
	Yaquina	30	21	22	15	28	35%	40%	28%	52%
	Beaver	7	5	4	2	7	100%	46%	14%	71%
	Alsea	30	27	22	17	26	22%	39%	26%	58%
	Siuslaw	30	25	22	9	36	31%	42%	31%	60%
	MC Depend.	30	20	15	11	20	93%	88%	38%	125%
	Total	**172**	**135**	**114**	**83**	**144**	**17%**	**19%**	**15%**	**22%**
Lakes	Siltcoos	18	20	12	9	16	40%	48%	33%	64%
	Tahkenitch	6	5	6	5	6	62%	78%	47%	122%
	Tenmile	13	14	7	5	10	35%	55%	29%	90%
	Total	**37**	**39**	**24**	**20**	**28**	**25%**	**39%**	**30%**	**49%**
Umpqua	L. Umpqua	30	27	30	12	51	28%	29%	25%	33%
	M. Umpqua	30	14	24	17	28	64%	63%	61%	65%
	N. Umpqua	30	14	26	19	31	81%	64%	30%	85%
	S. Umpqua	30	28	22	11	29	40%	58%	45%	69%
	Total	**120**	**83**	**105**	**59**	**133**	**26%**	**31%**	**24%**	**37%**
Mid-South Coast	Coos	30	28	23	7	32	23%	41%	25%	70%
	Coquille	30	16	14	6	26	34%	54%	25%	77%
	Floras	13	8	7	5	10	60%	40%	31%	52%
	Sixes	12	1	6	1	9	NAS	61%	60%	62%
	MS Depend.	8	5	2	0	4	86%	105%	105%	105%
	Total	**93**	**58**	**53**	**39**	**77**	**19%**	**45%**	**17%**	**69%**
ESU Total		**552**	**412**	**359**	**267**	**443**	**11%**	**17%**	**10%**	**23%**

NAS = Not adequately surveyed (either no surveys were selected in the population or < 2 surveys stayed in rotation).

Table 7. Oregon Coast Coho ESU estimated abundance of adult coho salmon spawning naturally by ESU, stratum, and population for the 2010 run year compared to the previous 20 years.

Geographic scale ESU/Stratum/Population	Coho salmon origin	Spawning year			
			1990 to 2009		
		2010	Avg.	Min.	Max.
Oregon Coast Coho ESU	**Wild**	**283,413**	**107,605**	**21,139**	**262,735**
	Hatchery	**4,618**	**11,616**	**3,271**	**26,128**
	% Hat.	**1.6%**	**13.8%**	**1.8%**	**31.4%**
North Coast Stratum	**Wild**	**54,970**	**18,054**	**1,524**	**58,096**
	Hatchery	**1,060**	**2,622**	**43**	**15,563**
	% Hat.	**1.9%**	**24.8%**	**0.3%**	**79.0%**
Necanicum River	Wild	4,445	1,125	97	4,832
	Hatchery	0	154	19	501
	% Hat.	0.0%	21.2%	1.1%	40.1%
Nehalem River	Wild	32,215	10,166	527	32,517
	Hatchery	837	2,022	0	14,014
	% Hat.	2.5%	27.5%	0.0%	87.7%
Tillamook Bay	Wild	14,890	3,717	80	16,251
	Hatchery	110	377	0	1,498
	% Hat.	0.7%	22.2%	0.0%	68.9%
Nestucca River	Wild	1,947	2,639	160	16,698
	Hatchery	93	64	0	274
	% Hat.	4.6%	7.4%	0.0%	15.3%
North Coast Dependents	Wild	1,473	406	0	2,116
	Hatchery	20	17	0	75
	% Hat.	1.3%	1.3%	0.0%	6.3%
Mid-Coast Stratum	**Wild**	**56,545**	**28,561**	**2,444**	**99,515**
	Hatchery	**111**	**2,656**	**262**	**9,633**
	% Hat.	**0.2%**	**17.9%**	**1.5%**	**50.1%**
Salmon River	Wild	1,382	256	5	1,642
	Hatchery	56	824	0	2,621
	% Hat.	3.9%	78.5%	0.0%	97.6%
Siletz River	Wild	6,283	4,819	207	24,070
	Hatchery	0	350	0	962
	% Hat.	0.0%	21.8%	0.0%	58.4%
Yaquina River	Wild	8,589	4,972	317	23,800
	Hatchery	0	234	0	1,526
	% Hat.	0.0%	9.5%	0.0%	25.0%
Beaver Creek	Wild	2,072	1,620	90	5,552
	Hatchery	0	66	0	405
	% Hat.	0.0%	4.9%	0.0%	23.8%
Alsea River	Wild	9,688	4,515	108	14,638
	Hatchery	0	432	0	2,214
	% Hat.	0.0%	21.2%	0.0%	93.8%
Siuslaw River	Wild	25,983	10,951	501	55,445
	Hatchery	0	741	0	4,136
	% Hat.	0.0%	13.7%	0.0%	37.6%
Mid Coast Dependents	Wild	2,548	1,426	51	8,179
	Hatchery	55	33	0	97
	% Hat.	2.1%	2.0%	0.0%	5.4%

Table 7. Continued.

Geographic scale ESU/Stratum/Population	Coho salmon origin	Spawning year			
			1990 to 2009		
		2010	Avg.	Min.	Max.
Lakes Stratum	**Wild**	**38,744**	**13,189**	**1,973**	**24,127**
	Hatchery	**5**	**64**	**0**	**251**
	% Hat.	**0.0%**	**0.6%**	**0.0%**	**2.2%**
Siltcoos Lake	Wild	7,678	3,794	385	7,998
	Hatchery	0	31	0	124
	% Hat.	0.0%	1.2%	0.0%	8.7%
Tahkenitch Lake	Wild	10,681	2,255	317	3,664
	Hatchery	5	16	0	107
	% Hat.	0.0%	0.6%	0.0%	3.1%
Tenmile Lake	Wild	20,385	7,139	1,271	17,131
	Hatchery	0	16	0	123
	% Hat.	0.0%	0.3%	0.0%	3.4%
Umpqua Stratum	**Wild**	**70,019**	**21,897**	**3,334**	**57,984**
	Hatchery	**3,212**	**5,698**	**434**	**17,758**
	% Hat.	**4.4%**	**23.2%**	**1.1%**	**36.0%**
Lower Umpqua River	Wild	17,516	8,269	1,257	19,245
	Hatchery	82	345	0	1,484
	% Hat.	0.5%	4.3%	0.0%	15.7%
Middle Umpqua River	Wild	18,123	5,167	563	15,075
	Hatchery	0	289	0	1,259
	% Hat.	0.0%	5.9%	0.0%	20.6%
North Umpqua River	Wild	9,397	2,079	355	7,720
	Hatchery	638	4,191	125	14,094
	% Hat.	6.4%	63.6%	3.5%	84.3%
South Umpqua River	Wild	24,983	6,381	435	20,935
	Hatchery	2,492	873	0	7,040
	% Hat.	9.1%	15.1%	0.0%	57.2%
Mid-South Coast Stratum	**Wild**	**63,135**	**25,905**	**4,890**	**53,324**
	Hatchery	**230**	**577**	**12**	**2,766**
	% Hat.	**0.4%**	**2.9%**	**0.1%**	**23.8%**
Coos River	Wild	27,658	13,709	1,112	33,595
	Hatchery	230	265	0	1,387
	% Hat.	0.8%	3.0%	0.0%	36.4%
Coquille River	Wild	23,564	10,410	2,033	28,577
	Hatchery	0	211	0	1,832
	% Hat.	0.0%	2.5%	0.0%	15.4%
Floras Creek	Wild	11,329	2,019	340	7,446
	Hatchery	0	96	0	400
	% Hat.	0.0%	5.7%	0.0%	22.8%
Sixes River	Wild	100	162	35	558
	Hatchery	0	23	0	182
	% Hat.	0.0%	11.1%	0.0%	65.7%
Mid-South Coast Dependents	Wild	484	94	0	188
	Hatchery	0	5	0	9
	% Hat.	0.0%	2.3%	0.0%	4.6%

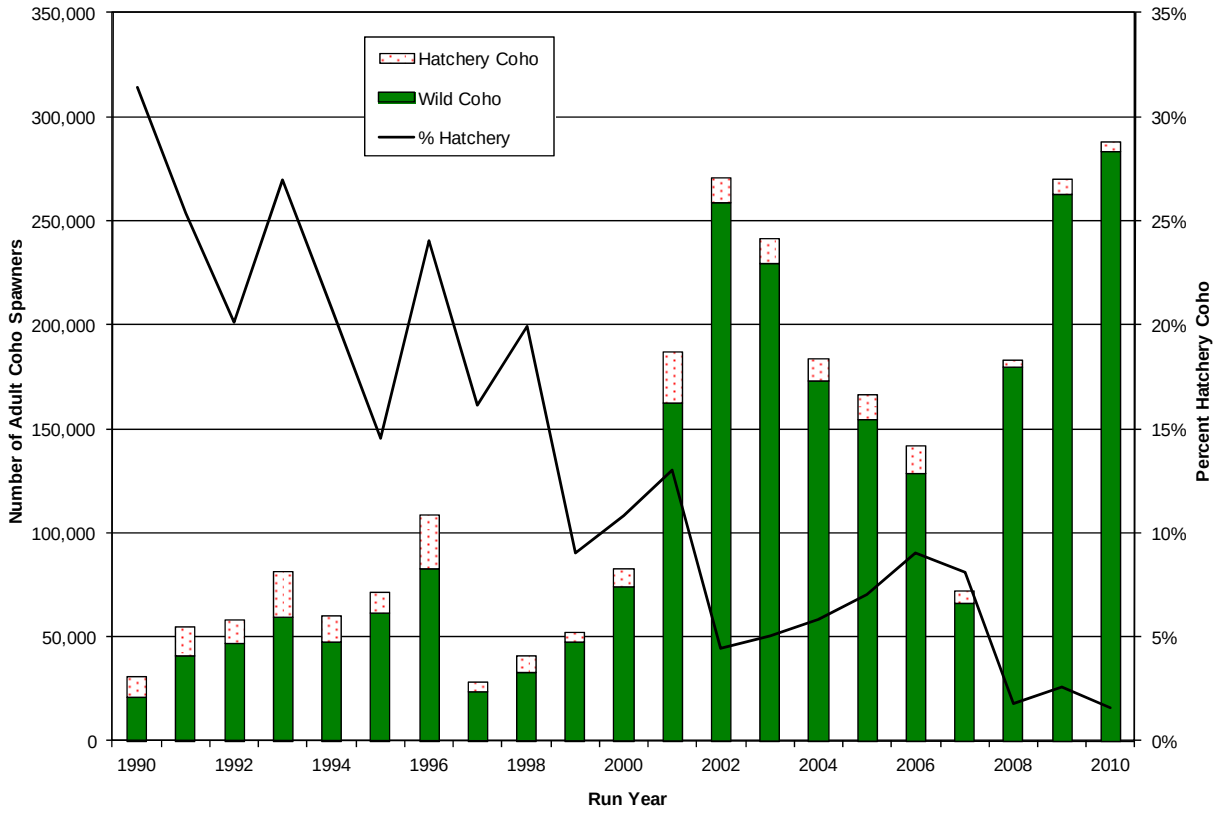

Figure 6. Oregon Coast Coho ESU estimated abundance of adult coho salmon spawning naturally by rearing origin for the 1990 through 2010 run years.

populations than the previous peak in 2002. In 2002 the Siuslaw population alone accounted for over 21% of the ESU total abundance; and four populations in the mid-south of the ESU (Yaquina, Siuslaw, Lower Umpqua and Coos Bay) accounted for over half the ESU total abundance. In 2010 the Nehalem had the highest number of wild coho salmon spawners, but was only 11% of the ESU total abundance, and it took the top six populations (at least one in each stratum) to account for over half of the ESU wide abundance. Another way to track the improvement in the distribution of wild coho salmon spawners across the OC Coho ESU is in the number of populations with over 20,000 wild adult coho salmon spawners. The lowest OC Coho ESU total wild coho salmon spawning abundance observed during the 21 years of this monitoring was 21,139 in 1990. In 2002, the previous peak abundance year, 3 of 24 populations had over 20,000 wild adult coho salmon spawners. In 2010 there were 6 of 24 populations with over 20,000 wild adult coho salmon spawners.

The Oregon Coast Coho Conservation Plan (OCCCP) established six measureable criteria for the assessment of conservation status of the 21 independent populations in the OC Coho ESU (ODFW 2007). Metrics for two of the criteria are based on the annual number of wild adult coho salmon spawners. Although the OCCCP assesses the criteria over multiple year time scales, the annual abundance estimates can be compared to the threshold value for each metric. Criterion 1 (Adult Abundance) establishes escapement goals for each population based on the annual marine

survival category (ODFW 2007, Appendix 2 Table 2). The marine survival category for 2010 was "Low" and 6 of 21 independent populations met or exceeded the OCCCP Criterion 1 escapement goal. Criterion 5 (Diversity) is based on maintaining at least 97.5% of a population's heterozygosity over a 100 year period. The threshold value for the metric is a harmonic mean of at least 1,200 wild adult coho spawners over a modeled 100 year population abundance projection. Although the 2010 estimated abundances are not a direct evaluation of the OCCCP Criterion 5 metric, 20 of the 21 independent populations met or exceeded the threshold value.

Abundance of hatchery coho salmon on natural spawning grounds in the OC Coho ESU in 2010, was well below average and near the record low for the 21 year period (Table 7). Abundance of hatchery fish in 2010 was less than the long-term average in all five strata and in 20 of 24 populations (Table 7). During the 2010 spawning season no hatchery coho salmon carcasses were detected in 13 populations. Small sample sizes can complicate detection of hatchery fish, especially if the number of hatchery fish is low. In the 13 populations where no hatchery coho salmon carcasses were recovered the number of coho salmon carcasses sampled, by population, ranged from 29 to 2,102 and averaged 518 (Appendix Table D-4). The South Umpqua was the only population with an estimated abundance of greater than 1,000 hatchery coho salmon on natural spawning grounds (Table 7). This is one of the three OC Coho ESU populations that had 2007 brood year hatchery coho salmon smolt releases, adult coho salmon returning in 2010. During 2010, only 3 of the 24 OC Coho ESU populations had an estimated abundance of greater than 250 hatchery coho salmon on natural spawning grounds.

Historically the North and Mid-Coast strata had substantially lower wild coho salmon spawning abundances than the rest of the ESU (Jacobs et.al. 2002). Both strata have shown dramatic improvement in coho salmon spawner abundance in absolute terms and in relation to other strata (Table 7). The North Coast stratum averaged less than 10% of the OC Coho ESU wild coho salmon spawner abundance for the 1990's and over 19% for the 2000's (Appendix Table B-4). The Mid-South Coast stratum showed a similar increase from the 1990's (17%) to the 2000's (27%), but was had only 20.0% of the OC Coho ESU wild coho salmon spawner abundance in 2010 (Table 7 Appendix Table B-4). Overall, the 2010 OC Coho ESU wild coho salmon spawner abundance was distributed fairly evenly across the five strata, North Coast 19.4%, Mid-Coast 20.0%, Umpqua 24.7%, Lakes 13.7% and Mid-South Coast 22.3% (Table 7). The Lakes stratum has high coho salmon spawner densities (Appendix Table D-4), but limited stream miles, so it produces a relatively small portion of the ESU total coho salmon spawner abundance (Table 7).

Distribution and Timing

In 2010, almost 85% of the 412 sites surveyed in the OC Coho ESU were occupied by wild adult coho salmon (Table 8). Occupancy in 2010 was greater than the 5 year average rate (2005 to 2009) in the OC Coho ESU, all five strata, and 21 of 24 populations. The proportion of surveys in 2010 that were occupied and contained wild fish ranged from 0% for the Sixes River population to 100% in four populations (Table 8). Occupancy rates are typically lower in the North Coast, Mid-Coast and Umpqua strata than in the Lakes and Mid-South Coast strata (Table 8). While 2010 occupancy rates are above average in all strata, the largest increase was in the North Coast stratum, with the Mid-South, Umpqua and Mid-Coast strata also having large

Table 8. Oregon Coast Coho ESU adult coho salmon occupancy (total & wild) by population, stratum, and ESU for the 2010 run year and previous 5 year average (2005–09). Occupancy is defined as a peak of at least 4 adult coho salmon per mile of survey. Occupied sites with at least one documented wild coho salmon are considered wild occupied.

ESU, Stratum, and TRT Population	2010 No. sites surveyed	5 yr avg. No. sites surveyed	Total coho salmon		Wild coho salmon	
			2010 % Occupied	5 yr avg. % Occupied	2010 % Occupied	5 yr avg. % Occupied
Oregon Coast ESU	**412**	**319**	**85.2%**	**72.3%**	**84.7%**	**70.1%**
North Coast Stratum	**97**	**67**	**87.6%**	**74.1%**	**87.6%**	**71.3%**
Necanicum River	15	16	100.0%	78.5%	100.0%	75.6%
Nehalem River	34	17	94.1%	84.4%	94.1%	84.4%
Tillamook Bay	21	12	85.7%	79.6%	85.7%	67.4%
Nestucca River	12	12	75.0%	60.0%	75.0%	57.1%
NC Dependents	15	11	73.3%	61.8%	73.3%	61.8%
Mid-Coast Stratum	**135**	**104**	**85.9%**	**75.7%**	**85.2%**	**73.1%**
Salmon River	12	7	83.3%	88.7%	83.3%	79.7%
Siletz River	25	17	96.0%	74.6%	96.0%	73.8%
Yaquina River	21	20	95.2%	81.7%	95.2%	80.3%
Beaver Creek	5	5	100.0%	87.1%	100.0%	87.1%
Alsea River	27	17	92.6%	80.6%	92.6%	80.6%
Siuslaw River	25	26	92.0%	75.0%	88.0%	73.4%
MC Dependents	20	12	45.0%	36.9%	45.0%	35.1%
Lakes Stratum	**39**	**16**	**89.7%**	**85.3%**	**89.7%**	**85.3%**
Siltcoos Lake	20	8	85.0%	94.0%	85.0%	94.0%
Tahkenitch Lake	5	4	100.0%	76.7%	100.0%	76.7%
Tenmile Lake	14	4	92.9%	95.0%	92.9%	95.0%
Umpqua Stratum	**83**	**91**	**75.9%**	**62.8%**	**74.7%**	**60.1%**
Lower Umpqua River	27	32	96.3%	82.6%	96.3%	79.1%
Mid. Umpqua River	14	21	85.7%	57.1%	85.7%	55.7%
North Umpqua River	14	18	50.0%	51.5%	42.9%	42.4%
South Umpqua River	28	19	64.3%	49.0%	64.3%	49.0%
Mid-South Stratum	**58**	**41**	**89.7%**	**75.5%**	**89.7%**	**75.0%**
Coos River	28	20	96.4%	76.6%	96.4%	76.0%
Coquille River	16	11	87.5%	84.3%	87.5%	84.3%
Floras Creek	8	5	100.0%	85.8%	100.0%	85.8%
Sixes River	1	4	0.0%	22.7%	0.0%	22.7%
MSC Dependents	5	1	60.0%	50.0%	60.0%	50.0%

increases. The Lakes stratum has the highest 5 year average wild coho salmon occupancy rate and had the smallest increase in 2010 (Table 8). Total adult coho salmon densities were generally

high across the ESU (Figure 7). Coho salmon density was calculated as the AUC estimate divided by the miles surveyed. The highest average coho salmon densities were observed in Floras Creek and the three lake populations, all four with over 290 adult coho salmon per mile in 2010 (Figure 7; Appendix Table D-4). The lowest adult coho salmon densities were in the Nestucca River and Mid- Coast dependent populations with less than 15 adult coho salmon per mile (Figure 7; Appendix Table D-4). The Lakes and Mid-South strata generally had higher coho salmon spawner densities in 2010 than North Coast, Mid-Coast and Umpqua strata (Figure 7).

Due to sample size issues, coho salmon distribution within a population was evaluated for only 19 of the 24 populations (Table 9). In 2010 the Siletz population had the most even and the Mid-Coast Dependent populations had the most patchy spatial distribution (Table 9). The percent of GRTS sites in a population with live coho observed (AUC > 0) averaged 88%, and ranged from 58% in the North Umpqua to 100% in the Salmon River and Middle Umpqua (Table 9).

Table 9. Distribution metrics for Oregon Coast Coho ESU populations during the 2010 run year. Total fish metrics were calculated for populations with at least 10 sites, hatchery and wild metrics were calculated for populations with adequate site specific pHOS data. Populations with uniform distribution would have AOC = 0.5, $P_{80\%}$ = 0.8, and % sites with fish = 100%.

Oregon Coast populations	# of Sites	Total coho salmon			Wild coho salmon			Hatchery coho salmon		
		AOC	$P_{80\%}$	% sites with fish	AOC	$P_{80\%}$	% sites with fish	AOC	$P_{80\%}$	% sites with fish
Necanicum River	15	0.31	0.53	93%	0.31	0.53	93%	*Est. no hatchery fish*		
Nehalem River	33	0.25	0.42	94%	0.25	0.42	94%	0.06	0.10	27%
Tillamook Bay	21	0.14	0.25	90%	--	--	--	--	--	--
Nestucca River	12	0.24	0.38	83%	--	--	--	--	--	--
NC Dependent	15	0.18	0.29	80%	--	--	--	--	--	--
Salmon River	12	0.26	0.44	100%	0.26	0.44	100%	0.10	0.16	42%
Siletz River	25	0.32	0.56	96%	0.32	0.56	96%	*Est. no hatchery fish*		
Yaquina River	21	0.25	0.43	95%	0.25	0.43	95%	*Est. no hatchery fish*		
Beaver Creek	5	--	--	--	--	--	--	--	--	--
Alsea River	27	0.28	0.47	96%	0.28	0.47	96%	*Est. no hatchery fish*		
Siuslaw River	25	0.24	0.39	96%	0.24	0.39	96%	0.02	0.04	8%
MC Dependent	20	0.08	0.10	65%	--	--	--	--	--	--
Siltcoos Lake	20	0.23	0.41	85%	0.23	0.41	85%	*Est. no hatchery fish*		
Tahkenitch Lake	5	--	--	--	--	--	--	--	--	--
Tenmile Lake	14	0.28	0.48	93%	0.28	0.48	93%	*Est. no hatchery fish*		
Lower Umpqua R.	27	0.26	0.45	93%	0.26	0.46	93%	0.02	0.03	11%
Middle Umpqua R.	12	0.20	0.32	100%	0.20	0.33	100%	0.04	0.07	8%
North Umpqua R.	12	0.15	0.26	58%	--	--	--	--	--	--
South Umpqua R.	27	0.19	0.35	70%	--	--	--	--	--	--
Coos River	28	0.27	0.46	96%	0.27	0.46	96%	0.04	0.06	14%
Coquille River	16	0.28	0.49	88%	0.28	0.49	88%	0.06	0.10	13%
Floras Creek	8	--	--	--	--	--	--	--	--	--
Sixes River	1	--	--	--	--	--	--	--	--	--
MSC Dependent	5	--	--	--	--	--	--	--	--	--

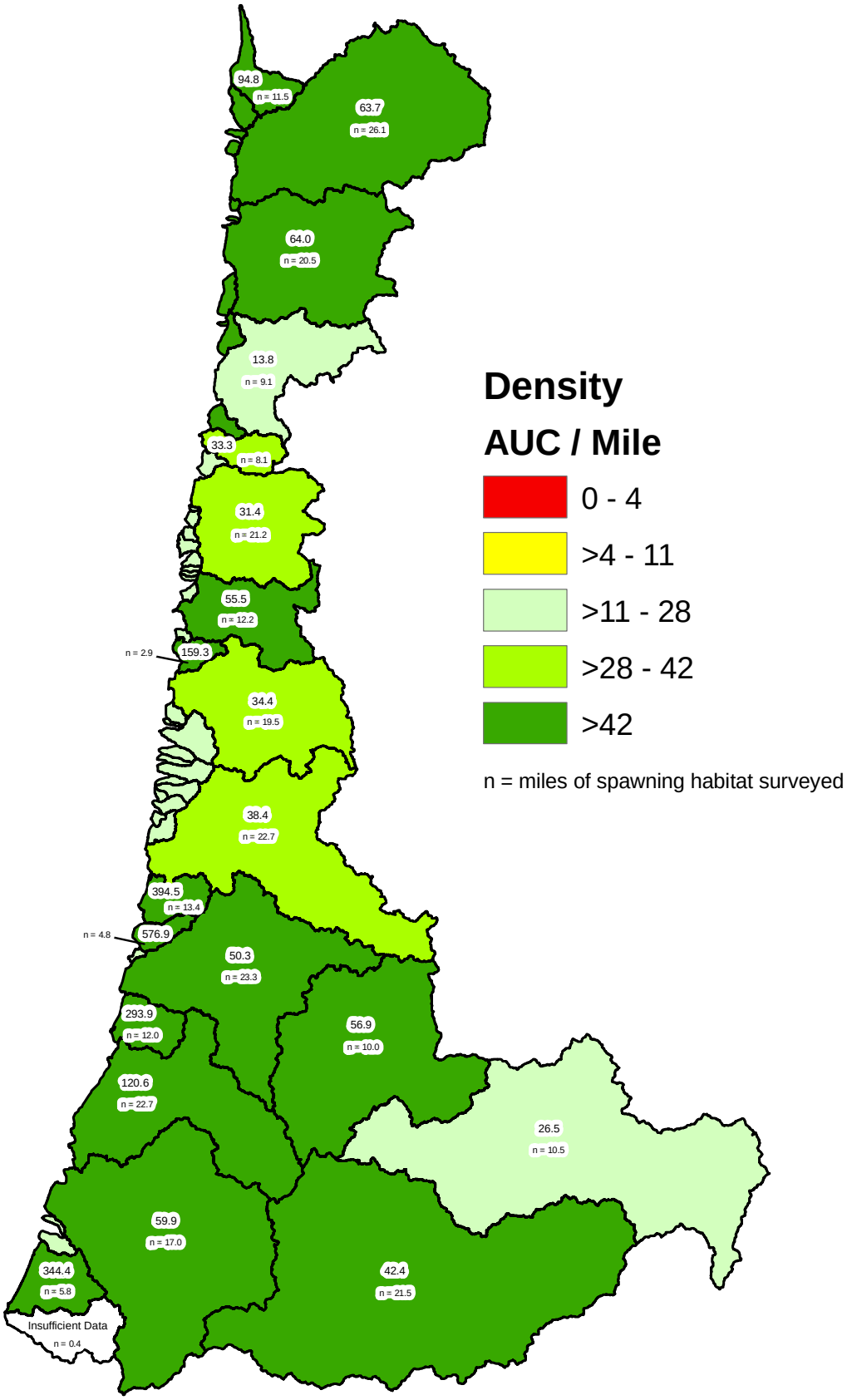

Figure 7. Coho salmon density (AUC/mile) in GRTS surveys by Oregon Coast TRT population, 2010. Functionally independent and potentially independent populations are labeled. For further detail see Appendix Table D-4.

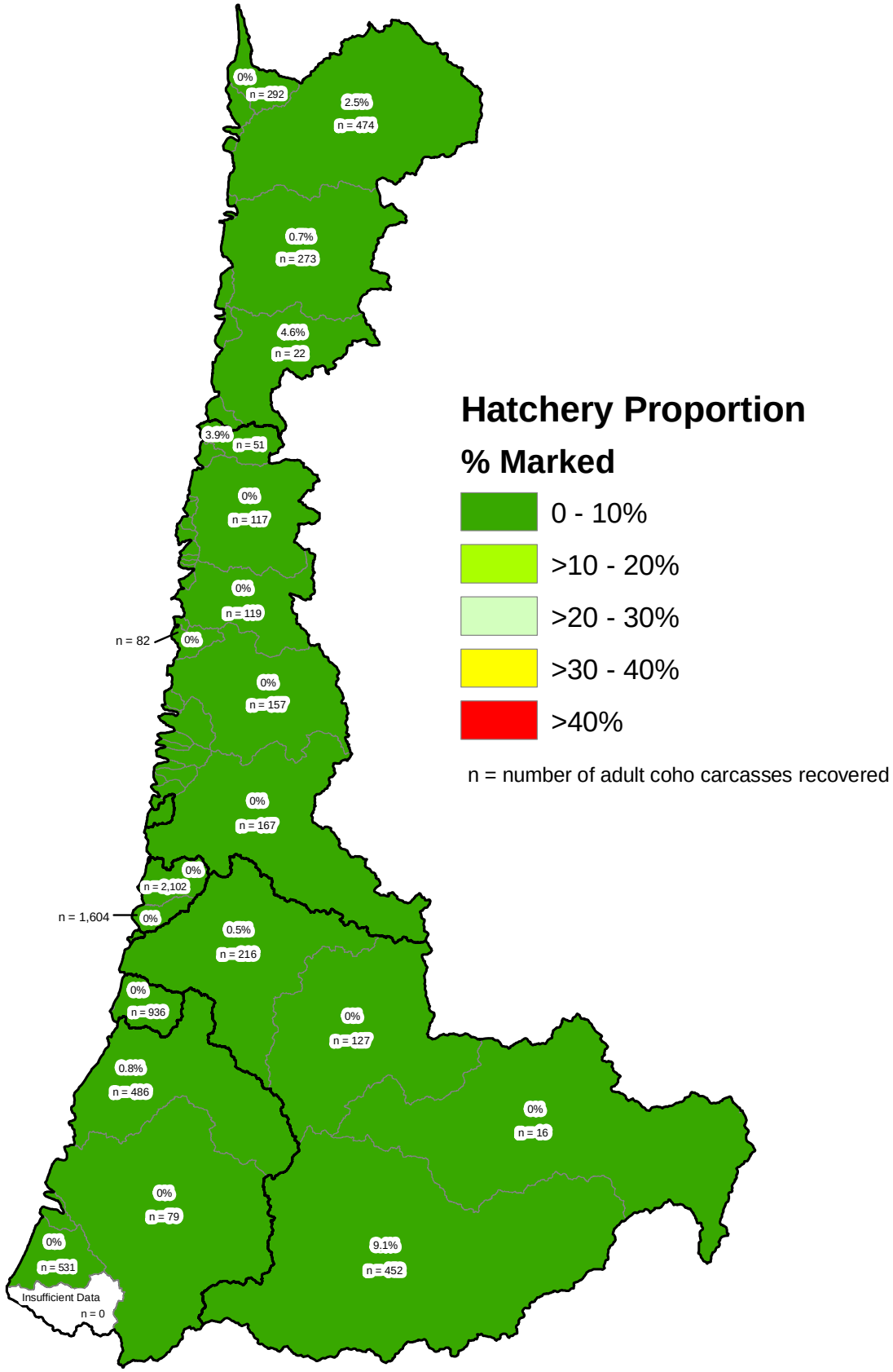

Figure 8. Percentage of marked adult coho salmon in GRTS surveys by Oregon Coast TRT population, 2010. Functionally independent and potentially independent populations are labeled. For further detail see Appendix Table D-4.

Inadequate samples for determining pHOS at spatial scales smaller that the TRT population limited the analysis of distribution by rearing origin. Only 13 populations met the criteria for calculating distribution by rearing origin (at least 50% GRTS site and at least 90% finer than population scale pHOS values). Hatchery coho salmon were not detected in 6 of the 13 populations during the 2010 season. In the remaining seven populations, the distribution of hatchery fish was much patchier (low AOC and $P_{80\%}$) and fewer sites contained hatchery fish than the distribution of wild coho salmon (Table 9 and Figure 9). The Siletz had the most even distribution and the Middle Umpqua the most patchy distribution of wild coho salmon in the 13 populations examined (Table 9). Distribution of hatchery fish within a population was only available for seven populations, with the most even distribution in the Salmon River and most patchy distribution in the Lower Umpqua (Table 9). As noted earlier, hatchery coho salmon were not observed in 2010 in the other six populations examined for distribution by origin.

Peak run timing of coho salmon spawners typically occurs in mid to late December in the OC Coho ESU. Run timing in 2010 was fairly typical with a peak in mid-December (Figure 10). However, the above average precipitation early in the season may have contributed to a slightly earlier than normal run timing, with more fish in early December than in Late December (Figure 10). On average, about 90% of the live coho salmon seen on OC Coho ESU spawning surveys are seen between mid-November and late January (Figure 10). This is both a longer period and later in the season than for the LCR Coho ESU, where 90% were seen from early October to late November (Figure 5).

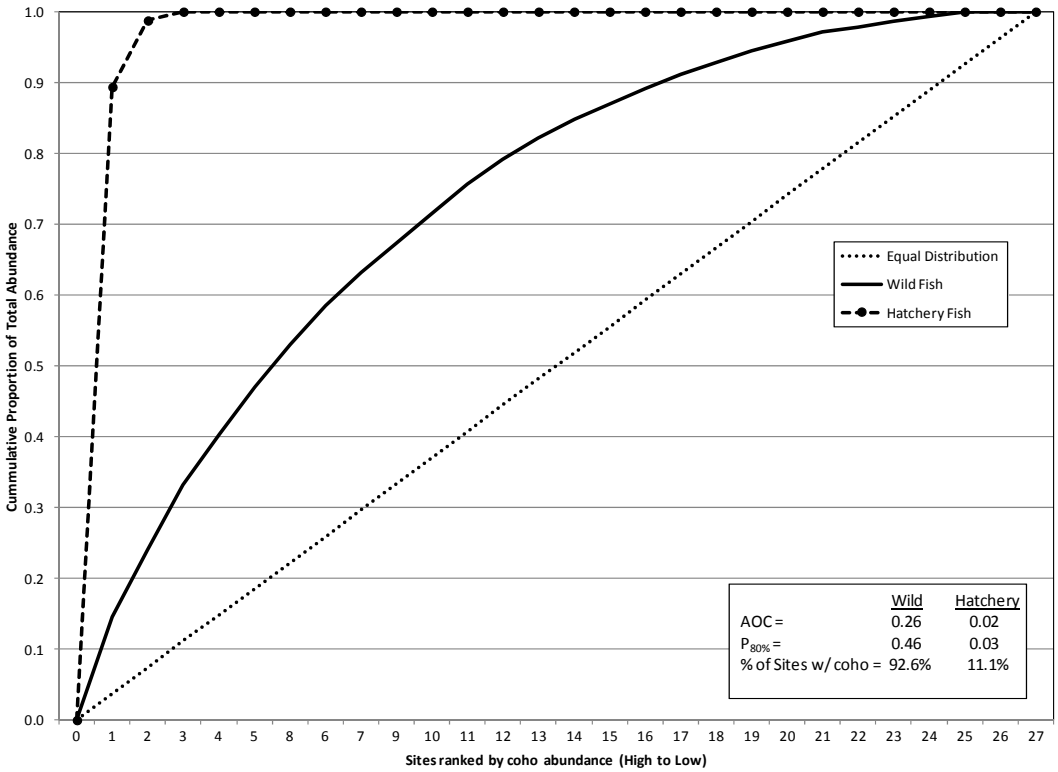

Figure 9. Cumulative frequency distribution of coho salmon in Lower Umpqua population, run year 2010 GRTS surveys.

Proportion Hatchery Fish

The OC Coho ESU naturally spawning coho salmon abundance averaged 13.8% hatchery coho salmon and ranged from 1.8% to 31.4% for the 1990 through 2009 run years (Table 7). In 2010 the proportion of hatchery fish on OC Coho ESU natural spawning grounds was 1.6%, and all five strata and all 24 populations met the Native Fish Conservation Policy (OAR 635-007-0502) interim criteria of at least 90% naturally produced spawners (Table 7 and Figure 8). A total of 240,522 hatchery coho salmon smolts were released in the OC Coho ESU in 2009 (adult returns in 2010). The releases occurred in only 3 of the 24 populations (Nehalem, Tillamook and South Umpqua) and represent less than five percent of the 5 million hatchery coho salmon smolts released annually in the OC Coho ESU in the early 1990's (Lewis 2000). Only 2 of 24 populations had greater than 5% pHOS in 2010, North Umpqua (6.4% pHOS) and South Umpqua (9.1% pHOS). Rock Creek hatchery is within the North Umpqua coho salmon population and is the rearing location for the South Umpqua coho salmon hatchery smolt release. The two other Oregon Coast Coho ESU populations with coho smolt releases in 2009 had very low pHOS rates in 2010, Nehalem 2.5% pHOS and Tillamook 0.7% pHOS (Table 7). The continuing reduction in Oregon coastal hatchery coho salmon releases has reduced the number of hatchery coho salmon adults spawning naturally within the ESU. The last year with returning hatchery adult coho salmon from smolts released in the Salmon River population was 2008. Salmon River coho salmon pHOS was 75.5% in 2008, 0.0% in 2009 and 3.9% in 2010.

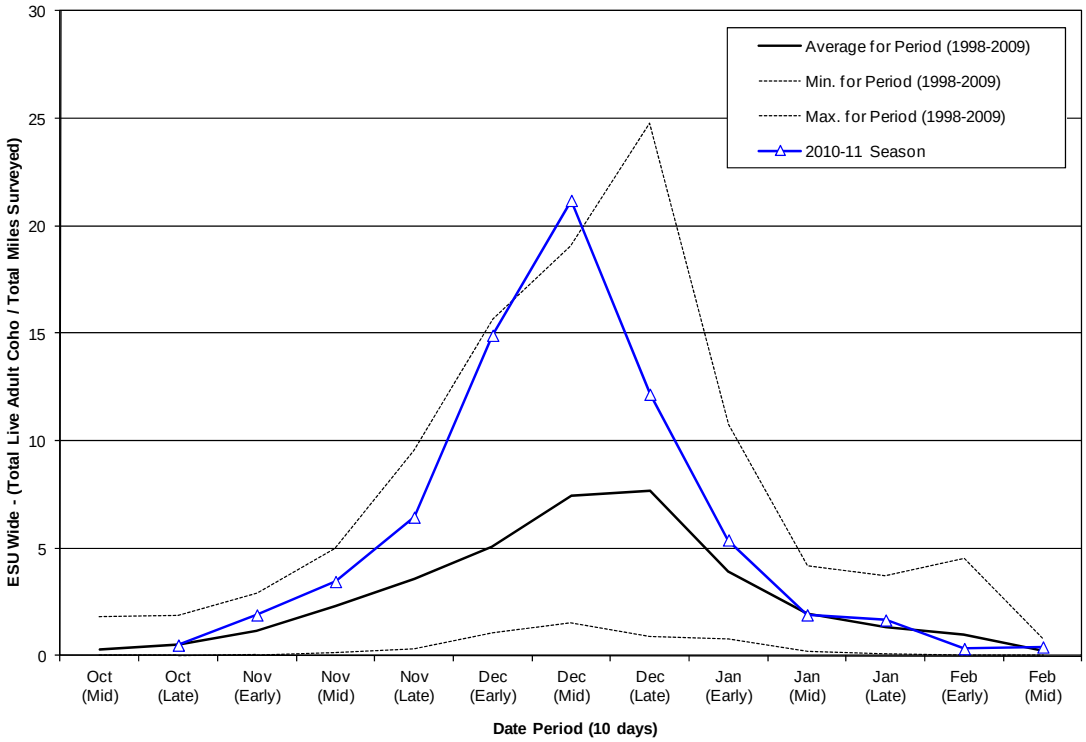

Figure 10. Run timing of live adult coho salmon in 2010 on GRTS spawning ground surveys in the Oregon Coast Coho ESU.

Southern Oregon/Northern California Coasts Evolutionarily Significant Unit

The Southern Oregon/Northern California Coasts Coho ESU includes coho salmon populations in Oregon and California. Naturally produced coho salmon in the SONCC Coho ESU were listed as "threatened" in 1997 under the federal ESA (NMFS 1997). This report covers spawning escapement monitoring of the Oregon populations in the SONCC Coho ESU, for the 2010 spawning season. The TRT for the SONCC Coho ESU reviewed the historical coho salmon population structure of this ESU and identified seven functionally or potentially independent and nine dependent or ephemeral Oregon coho salmon populations (Williams et al. 2006). Geographically, these Oregon populations occupy the northern third of the ESU and, based on an assessment of stream habitat intrinsic potential, represent a similar proportion of the historic coho salmon habitat potential for the ESU (Williams et.al. 2006).

Effort

Table 10. Southern Oregon/Northern California Coasts Coho ESU, GRTS spawning survey goals and results for number of surveys and 95% CI, 2010 run year. Target response sites are reaches within coho salmon spawning habitat which were successfully surveyed.

			Target response				95% CI as percent of point estimate (goal is +/- 30%)			
				2006 to 2008 [a]				2006 to 2008 [a]		
Stratum	Population	Goal	2010[a]	Avg.	Min.	Max.	2010[a]	Avg.	Min.	Max.
Coastal	Elk	18	--	1	0	1	--	n.a.	n.a.	n.a.
	L. Rogue	15	--	2	0	4	--	189%	189%	189%
	Chetco [b]	26	--	--	--	--	--	--	--	--
	Winchuck [b]	11	--	--	--	--	--	--	--	--
	SC Depend. [b]	15	--	--	--	--	--	--	--	--
	Total	**85**		**3**	**0**	**5**	**--**	**n.a.**	**n.a.**	**n.a.**
Interior	Illinois	30	--	3	3	4	--	113%	61%	172%
	M. Rogue & Applegate	30	--	12	8	16	--	72%	25%	127%
	U. Rogue	30	--	9	5	14	--	127%	56%	163%
	Total	**90**	**--**	**24**	**22**	**25**	**--**	**n.a.**	**n.a.**	**n.a.**
ESU Total		**175**	--	**27**	**24**	**30**	**--**	**71%**	**31%**	**116%**

n.a. = Not available.
a = No random (GRTS) surveys were conducted in the SONCC Coho ESU for run years 2009 through 2010.
b = The 98 and 07 GRTS sampling frames did not include any coho salmon spawning habitat in these populations.

Three methods have been used to monitor the abundance of adult coho salmon returning to fresh water in the Oregon portion of the SONCC Coho ESU. First, Gold Ray Dam was located at about river mile 126 on the Rogue River and was a complete barrier to adult salmonid migration, except through the fish ladder counting station. Gold Ray Dam was removed in 2010

and is no longer a source of monitoring data for salmon runs. Counts of adult and jack coho salmon migrating past Gold Ray Dam are not included in this report, but are available on a web page (http://www.dfw.state.or.us/fish/local_fisheries/rogue_river/goldray/index.asp). Gold Ray Dam counts include coho salmon migrating to natural spawning grounds and coho salmon returning to Cole Rivers Hatchery. Cole Rivers hatchery is located near the base of Lost Creek Dam (~ river mile 157 on the Rogue River) and releases approximately 200,000 coho salmon smolts annually into the Rogue River adjacent to the hatchery.

Second, GRTS based coho salmon spawning ground surveys were conducted in the SONCC Coho ESU from 1998 to 2008. This effort used the 98 Frame (Table 1) which only samples coho salmon spawning habitat in the high and moderate spawner density categories. This accounts for only 29% of the coho salmon spawning habitat in Oregon populations of the SONCC Coho ESU and does not include any coho salmon spawning habitat in the Chetco River, Winchuck River, and dependent populations of the ESU (Figure 11). The 98 Frame also only accounts for a small portion of the coho salmon spawning habitat in the Elk River (20%) and in the four Rogue River coho salmon populations (32%). Finally, there are large portions of the Illinois River and the Middle Rogue and Applegate River coho salmon populations that are within the Rogue River Gorge or the Kalmiopsis Wilderness. These areas are too remote to logistically be able to conduct spawning ground surveys on a weekly basis. Therefore, they are excluded from the spawning survey sampling frame. Due to budget constraints no GRTS surveys were conducted in the SONCC Coho ESU in 2005 and 2009 through 2010 (Table 10).

Table 11. Southern Oregon/Northern California Coasts Coho ESU estimated abundance of adult coho salmon spawning naturally in the 2010 run year compared to the previous 16 years. Rogue River Populations only.

	Coho salmon	Spawning year			
			1994 to 2009		
Data component	origin	2010	Avg.	Min.	Max.
SONCC Coho ESU (Rogue Only)	**Wild**	**3,073**	**6,729**	**394**	**24,208**
	Hatchery	**9**	**549**	**0**	**1,230**
	% Hat.	**0.3%**	**8.0%**	**0.0%**	**19.2%**
Huntley Park Est. [1]	Total	3,826	13,586	572	33,578
	Wild	3,073	6,880	414	24,486
	Hatchery	753	6,706	158	14,017
Freshwater Catch [2]	Total	168	383	79	862
Excluding Rogue Bay	Wild	0	0	0	0
	Hatchery	168	383	79	862
Cole Rivers Hatchery [3]	Total	576	5,930	147	12,298
	Wild	0	151	0	370
	Hatchery	576	5,778	127	11,937

1 = Huntley Park mark-recapture estimate of coho salmon freshwater escapement to the Rogue Basin above Huntley Park (~ River Mile 8). This includes returns to Cole Rivers Hatchery, natural spawning grounds, freshwater harvest and mortality between Huntley and upriver areas.

2 = Estimated freshwater harvest of coho salmon in the Rouge basin (excluding the Rogue River Bay), based on Angler Harvest Cards (see: http://www.dfw.state.or.us/resources/fishing/sportcatch.asp). Selective harvest of only marked coho salmon since 2004.

3 = Number of adult coho salmon collected and retained at Cole Rivers Hatchery. These numbers do not include coho salmon collected and released alive back into the wild.

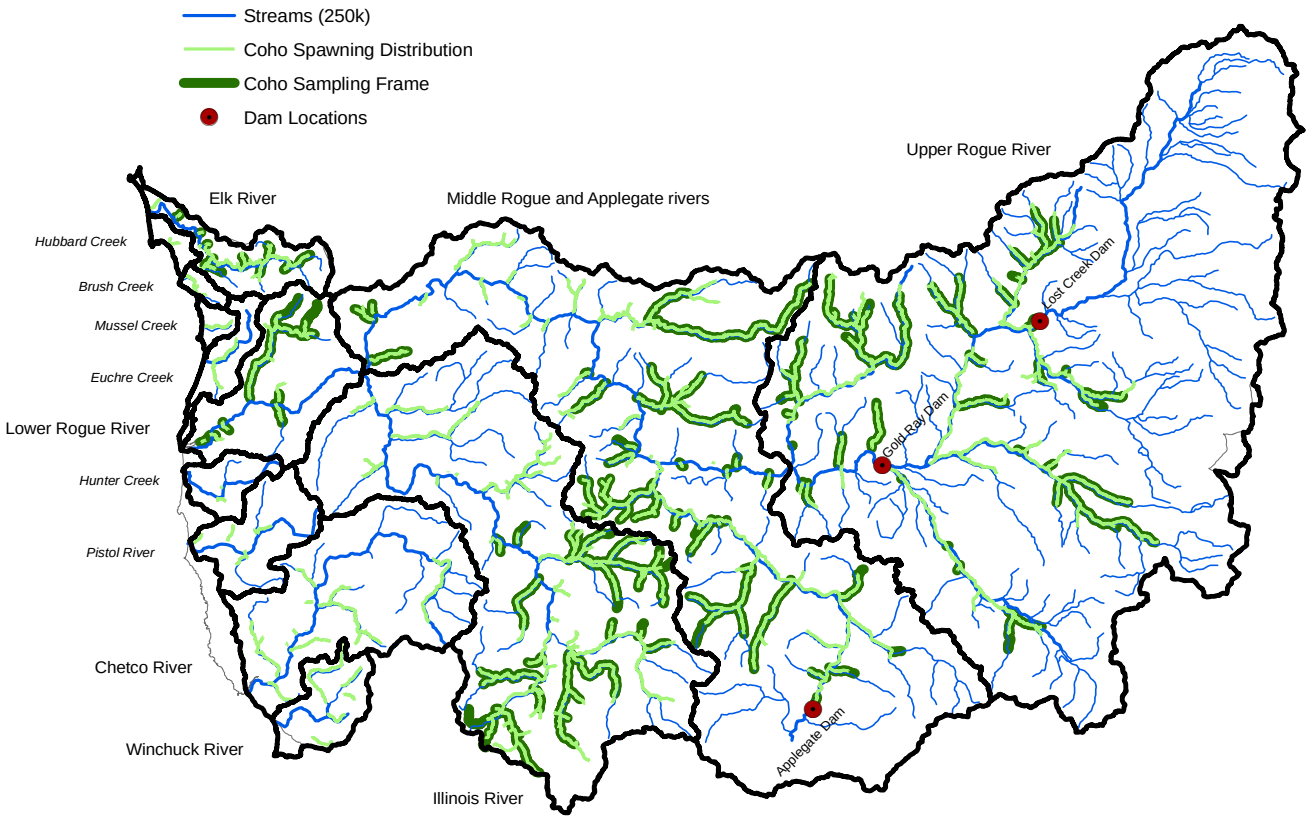

Figure 11. Distribution of coho salmon spawning habitat and the portion included in the current GRTS sampling frame for Oregon populations in the Southern Oregon/Northern California Coasts Coho ESU.

The final escapement monitoring method for the SONCC Coho ESU is a mark-recapture estimate of coho salmon entering the Rogue River. Returning adult coho salmon are sampled by seining at Huntley Park (river mile 8). The seining represents the re-capture, and provides the total coho salmon sampled (*C*) and number of Ad Clip coho salmon re-captured (*R*) for the mark-recapture equation. Adult coho salmon returning to Cole Rivers Hatchery are enumerated and also sampled for Ad Clip fish. The number of Ad Clip coho salmon collected at Cole Rivers Hatchery is expanded by a constant (1.1) to account for catch and straying of coho salmon between Huntley Park (river mile 8) and the hatchery (river mile 157). Fin-mark rates and the proportion of hatchery coho salmon at Cole Rivers Hatchery that were fin-marked are used to estimate the hatchery and wild components of the coho salmon run (Jacobs et.al. 2002). These estimates of the number of coho salmon returning to the Rogue River above Huntley Park are then converted to estimates of the number of coho salmon spawning naturally in the Rogue. The number of hatchery and wild coho salmon retained at Cole Rivers Hatchery, and the number

harvested in Rogue Basin fisheries (excluding catch in the bay) are subtracted from the Huntley Park estimate to produce an estimate of the abundance of coho salmon on natural spawning grounds in the Rogue Basin (Table 11). Cole Rivers Hatchery data is obtained from the ODFW Hatchery Management Information System. Estimates of freshwater harvest are based on return of angler harvest cards. These are generally not available until a year after the calendar year.

Abundance

Long-term monitoring of coho salmon spawner abundance in Oregon populations of the SONCC Coho ESU is based on the Huntley Park estimates of coho salmon in the Rogue Basin (Figure 12 and Table 11). Adult wild coho salmon abundance in the SONCC Coho ESU generally increased from 1994 to a peak in 2004 and then declined to a very low escapement in 2008 (Figure 12). This is similar to the pattern for the OC Coho ESU, which generally increased from 1994 to a peak in 2002 and then declined to the 2007 run year (Figure 6). Wild adult coho salmon spawner abundance in the SONCC Coho ESU has increased since the very low abundance in 2008. However, the large increase in wild adult coho salmon spawners since 2007 in the OC Coho ESU has not been seen in the SONCC Coho ESU (Figures 6 and 12).

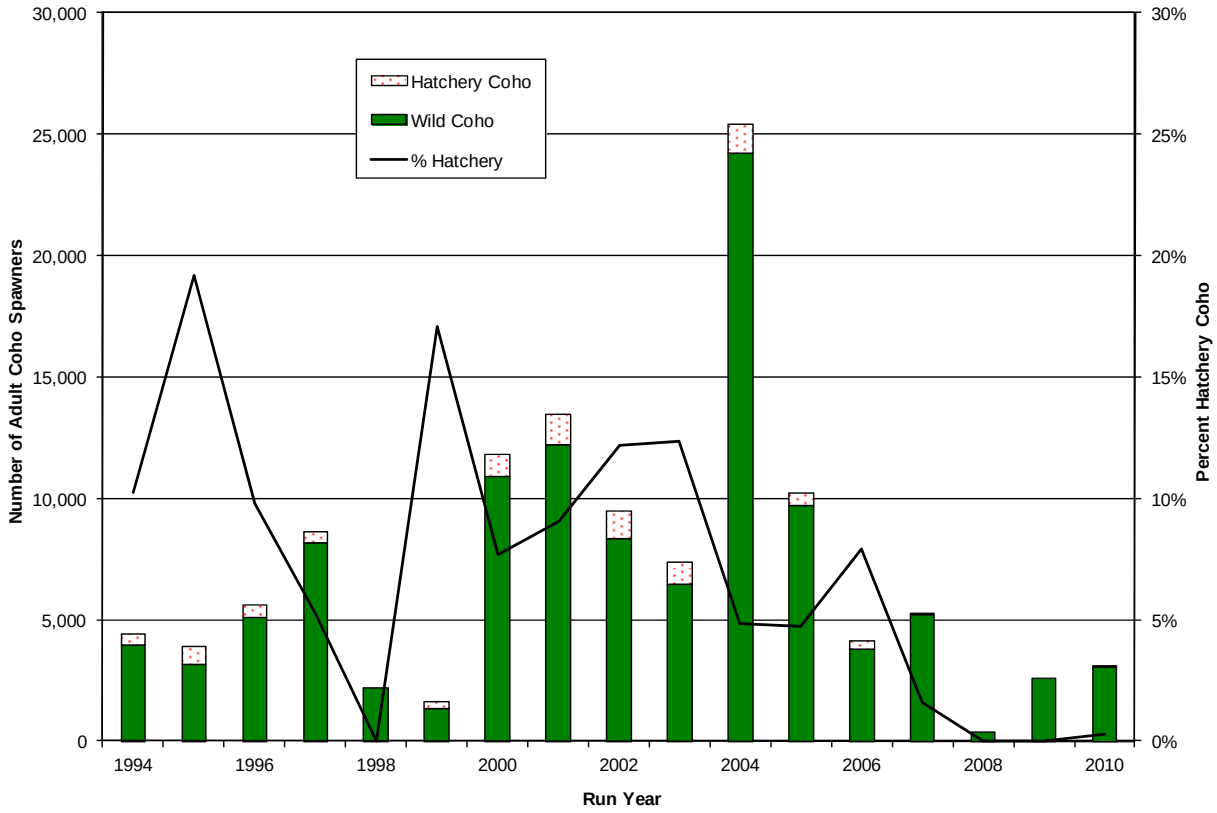

Figure 12. Southern Oregon/Northern California Coasts Coho ESU estimated abundance of adult coho salmon spawning naturally by rearing origin for the 1994 through 2010 run years. Abundance based on Huntley seining mark-recapture method.

Distribution and Timing

Huntley Park seining in the Rogue Basin provides long-term abundance data, but not spatial and temporal distribution information for coho salmon spawners. The GRTS spawning survey project can provide this information. However, no GRTS spawning grounds surveys for coho salmon were conducted in the SONCC Coho ESU in 2010. Results for previous years GRTS coho salmon spawning ground surveys in the SONCC Coho ESU are reported in Lewis et.al. (2009).

Proportion Hatchery Fish

Hatchery fish averaged less than 1.0% of the naturally spawning coho salmon in the Rogue Basin in 2010 (Table 11). This is well below the long-term average of 8% pHOS for the Rogue River naturally spawning coho salmon population. Hatchery coho salmon spawning naturally is calculated by starting with the estimated number of hatchery coho salmon passing Huntley Park (river mile 8), and then subtracting hatchery coho salmon collected upriver of Huntley Park (harvest from angler harvest card data, and returns to Cole Rivers Hatchery). Since no GRTS spawning ground surveys were conducted in 2010 there is no direct measurement of naturally spawning hatchery coho salmon to compare to this estimate. In years with both estimates of pHOS in the Rogue naturally spawning coho salmon population, the two methods produced comparable results (Lewis et.al. 2009).

ACKNOWLEDGEMENTS

We would like to thank the many field biologists and project staff who prepare for the season and conduct the surveys each year. Without their tireless efforts, hard work, and diligence this report would not be possible. We would also like to thank the ODFW staff who conduct the Huntley Park seining and who count and sample fish at hatcheries, dams, and fish traps for their hard work and dedication that provides such valuable data for this work. We are very grateful to staff at the Oregon State University statistics department and the Corvallis U.S. Environmental Protection Agency for their help with sampling design and statistical analysis.

REFERENCES

Beidler, W.M., and T.E. Nickelson. 1980. An evaluation of the Oregon Department of Fish and Wildlife standard spawning survey system for coho salmon. Oregon Department of Fish and Wildlife, Information Reports (Fish) 80-9, Salem.

Diaz-Ramos, S., D. L. Stevens, and A. R. Olsen. 1996. EMAP Statistical Methods Manual. Environmental Monitoring and Assessment Program, Corvallis, Oregon.

Firman, J.C., and S.E. Jacobs. 2001. A survey design for integrated monitoring of salmonids. In Nishida T. and C.E. Hollingworth. Proceedings of First International Symposium on GIS in Fishery Science, Saitama, Japan.

Ganio, L.M., L.D. Calvin, and C.B. Pereira. 1986. Estimating coho salmon escapement in Oregon streams. Final Report of Oregon State University, Department of Statistics, to the Oregon Department of Fish and Wildlife, Salem.

Jacobs, S., J. Firman, G. Susac, D. Stewart, and J. Weybright. 2002. Status of Oregon coastal stocks of anadromous salmonids, 2000-2001 and 2001-2002; Monitoring Program Report Number OPSW-ODFW-2002-3, Oregon Department of Fish and Wildlife, Salem.

Jacobs, S.E., and T.E. Nickelson. 1998. Use of stratified random sampling to estimate the abundance of Oregon coastal coho salmon. Oregon Department of Fish and Wildlife, Final Reports (Fish) Project # F-145-R-09, Salem.

Lawson, P.W., E.P. Bjorkstedt, M.W. Chilcote, C.W. Huntington, J.S. Mills, K.M.S. Moore, T.E. Nickelson, G.H. Reeves, H.A. Stout, T.C. Wainwright, and L.A. Weitkamp. 2007. Identification of historical populations of Coho salmon (Oncorhynchus kisutch) in the Oregon coast evolutionarily significant unit. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-79.

Lewis, M.A. 2000. Stock assessment of anadromous salmonids, 1999. Monitoring Program Report Number OPSW-ODFW-2000-4, Oregon Department of Fish and Wildlife, Salem.

Lewis, M., E. Brown, B. Sounhein, M. Weeber, E. Suring, and H. Truemper. 2009. Status of Oregon stocks of coho salmon, 2004 through 2008. Monitoring Program Report Number OPSW-ODFW-2009-3, Oregon Department of Fish and Wildlife, Salem.

Meyers, J.M., C. Busack, D. Rawding, A.R. Marshall, D.J. Teel, D.M. Van Doornik, and M.T. Maher. 2006. Historical population structure of Pacific salmonids in the Willamette River and lower Columbia River basins. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-73.

NMFS (National Marine Fisheries Service). 1997. Endangered and Threatened Species; Threatened Status for Southern Oregon/Northern California Coast Evolutionarily Significant Unit (ESU) of Coho Salmon. Federal Register 62(87):24588.

NMFS (National Marine Fisheries Service). 2005. Endangered and Threatened Species: Final Listing Determinations for 16 ESUs of West Coast Salmon, and Final 4(d) Protective Regulations for Threatened Salmonid ESUs. Federal Register 70(123):37160.

NMFS (National Marine Fisheries Service). 2008. Endangered and Threatened Species: Final Threatened Listing Determination, Final Protective Regulations, and Final Designation of Critical Habitat for the Oregon Coast Evolutionarily Significant Unit of Coho Salmon Federal Register 73(28):7816.

ODFW. 2007. Oregon Coast Coho Conservation Plan for the State of Oregon. Oregon Department of Fish and Wildlife, Salem.

Peacock, S.J. and C.A. Holt. 2012. Metrics and sampling designs for detecting trends in the distribution of spawning Pacific salmon (*Oncorhynchus* spp.). Canadian Journal of Fisheries and Aquatic Sciences 69: 681-694.

Perrin, C. J., and J. R. Irvine. 1990. A Review of Survey Life Estimates as They Apply to the Area-Under-the-Curve Method for Estimating the Spawning Escapement of Pacific Salmon. Canadian Technical Report of Fisheries and Aquatic Sciences (1733).

Stevens, D.L. 2002. Sampling design and statistical analysis methods for integrated biological and physical monitoring of Oregon streams. OPSW-ODFW-2002-07, Oregon Department of Fish and Wildlife, Salem.

Wainwright T. C., M. W. Chilcote, P. W. Lawson, T. E. Nickelson, C. W. Huntington, J. S. Mills, K. M. S. Moore, G. H. Reeves, H. Stout, and L. Weitkamp. 2008. Biological Recovery Criteria for the Oregon Coast Coho Salmon Evolutionarily Significant Unit. U.S. Dept. Commerce, NOAA Tech. Memo. NWFS-NWFSC-91.

Walters, C. J., and P. Cahoon. 1985. Evidence of decreasing spatial diversity in British Columbia salmon stocks. Canadian Journal of Fisheries and Aquatic Sciences 42: 1033-1037.

Williams, T.H., E.P. Bjorkstedt, W.G. Duffy, D. Hillemeier, G. Kautsky, T.E. Lisle, M. McCain, M. Rode, R.G. Szerlong, R.S. Schick, M.N. Goslin, and A. Agrawal. 2006. Historical population structure of coho salmon in the Southern Oregon/Northern California Coasts Evolutionarily Significant Unit. U.S. Department of Commerce, NOAA Technical Memorandum NMFS. NOAA-TM-NMFS-SWFSC-390.

APPENDIX A (LCR COHO ESU)

Table A-1. Results of randomly selected spawning ground surveys for coho salmon in the Oregon portion of the LCR Coho ESU, run year 2010. Estimates derived using GRTS protocol. Estimates of wild spawners derived through application of fin-mark observations. Missing values for populations indicate inadequate samples for determining total and/or wild abundance.

ESU, Stratum, and TRT Population	Survey effort number of		Adult coho salmon spawner abundance			
			Total		Wild	
	Surveys	Miles	Estimate	95% CI	Estimate	95% CI
Lower Columbia River ESU	**99**	**92.3**	**9,887**	**2,368**	**5,719**	**1,649**
Coast Stratum	**51**	**47.6**	**3,883**	**1,229**	**3,491**	**1,185**
Youngs Bay	18	16.7	154	175	48	55
Big Creek	5	3.9	132	79	10	6
Clatskanie River	13	14.4	1,774	637	1,609	578
Scappoose River	15	12.6	1,824	1,033	1,824	1,033
Cascade Stratum	**40**	**38.4**	**3,498**	**1,233**	**1,085**	**538**
Clackamas River	17	18.6	2,702	1,072	419	166
Sandy River	23	19.9	795	610	667	511
Gorge Stratum	**8**	**6.2**	**2,506**	**1,606**	**1,143**	**809**
Lower Gorge	2	0.9	985	1,257	920	1,173
Hood River	6	5.3	1,521	1,000	223	93

Table A-2. Number of unmarked adult coho salmon passed upstream of counting stations into areas without GRTS spawning surveys. Oregon portion of the LCR Coho ESU, run year 2010.

ESU, Stratum, and TRT Population	Counting station	Spawning year			
			2002 to 2009		
		2010	Avg.	Min.	Max.
Lower Columbia River ESU					
Coast Stratum					
Youngs Bay	Klaskanine Hatchery	**20**	**27**	**2**	**68**
Big Creek	Big Creek Hatchery	**269**	**226**	**46**	**487**
Scappoose River	Bonnie Falls Trap	**136**	**34**	**2**	**105**
Cascade Stratum					
Clackamas River	N Fk Clackamas Dam	**1,338**	**2,288**	**835**	**5,461**
Sandy River	Sandy Hatchery [a]	**234**	**131**	**57**	**184**
	Marmot Dam	**n.a.**	**809**	**310**	**1,713**
Gorge Stratum					
Hood River	Powerdale Dam	**n.a.**	**51**	**25**	**129**

a = Sandy Hatchery count through 2009 is number released above Marmot Dam, which was removed in 2006. Beginning in 2010, Sandy Hatchery releases the fish above the hatchery weir on Cedar Creek.

n.a. = Not Applicable. Marmot dam was removed in 2006 and Powerdale Dam was removed in 2009, so there are no longer any dam counts.

Table A-3. Annual abundance estimates of naturally spawning wild adult coho salmon in the Oregon portion of the LCR Coho ESU, run years 2002 through 2010. n.a. = not available.

Return Year	Youngs Bay	Big Creek	Clatskanie	Scappoose	Clackamas	Sandy	Lower Gorge	Hood River
2002	411	98	104	502	1,981	382	338	147
2003	113	435	563	336	2,507	1,348	n.a.	31
2004	149	112	398	755	2,874	1,213	n.a.	129
2005	79	219	494	348	1,301	856	263	1,260
2006	74	225	421	719	3,464	923	226	370
2007	21	212	583	375	3,608	687	126	173
2008	82	360	995	292	1,694	1,277	223	64
2009	26	792	1,070	778	7,982	1,493	468	69
2010	68	279	1,609	1,960	1,757	901	920	223

APPENDIX B (OC COHO ESU)

Table B-1. Results of randomly selected spawning ground surveys for coho salmon in the OC Coho ESU, run year 2010. Estimates derived using GRTS protocol. Estimates of wild spawners derived through application of fin-mark observations. Missing values for populations indicate inadequate samples for determining total and/or wild abundance.

ESU, Stratum, and TRT Population	Survey effort number of		Adult coho salmon spawner abundance			
			Total		Wild	
	Surveys	Miles	Estimate	95% CI	Estimate	95% CI
Oregon Coast ESU	**373**	**305.9**	**241,129**	**26,658**	**237,155**	**26,146**
North Coast Stratum	**97**	**78.6**	**56,030**	**13,726**	**54,970**	**13,526**
Necanicum River	15	11.5	4,445	1,351	4,445	1,351
Nehalem River	34	27.7	33,052	8,645	32,215	8,426
Tillamook Bay	21	20.5	15,000	10,488	14,890	10,412
Nestucca River	12	9.1	2,040	1,065	1,947	1,016
NC Dependents	15	9.9	1,493	848	1,473	837
Mid-Coast Stratum	**135**	**105.6**	**56,656**	**9,668**	**56,545**	**9,654**
Salmon River	12	8.1	1,438	604	1,382	580
Siletz River	25	21.2	6,283	1,515	6,283	1,515
Yaquina River	21	12.2	8,589	3,042	8,589	3,042
Beaver Creek	5	2.9	2,072	2,062	2,072	2,062
Alsea River	27	19.5	9,688	2,133	9,688	2,133
Siuslaw River	25	22.7	25,983	8,180	25,983	8,180
MC Dependents	20	19.0	2,603	2,420	2,548	2,368
Umpqua Stratum	**83**	**70.4**	**65,178**	**16,662**	**62,605**	**16,030**
Lower Umpqua River	27	23.1	17,598	4,895	17,516	4,872
Middle Umpqua River	14	11.3	18,123	11,542	18,123	11,542
North Umpqua River	14	12.8	1,982	1,606	1,982	1,606
South Umpqua River	28	23.0	27,475	10,856	24,983	9,871
Mid-South Coast Stratum	**58**	**51.4**	**63,264**	**12,294**	**63,035**	**12,267**
Coos River	28	22.7	27,888	6,405	27,658	6,352
Coquille River	16	17.0	23,564	7,941	23,564	7,941
Floras Creek	8	6.1	11,329	6,848	11,329	6,848
Sixes River						
MSC Dependents	5	5.0	484	417	484	417

Table B-2. Comparison of 2010 run year wild adult coho salmon spawners in the Oregon Coastal Lakes populations based on GRTS surveys and calibrated standard surveys.

ESU, Stratum, & TRT Population	Survey goal	Survey effort number of		Adult coho salmon spawner abundance			
				Total		Wild	
		Surveys	Miles	Estimate	95% CI	Estimate	95% CI
GRTS Surveys							
Lakes Strata	**37**	**39**	**30.2**	**31,391**	**7,752**	**31,391**	**7,752**
Siltcoos	18	20	13.4	13,481	5,335	13,481	5,335
Tahkenitch	6	5	4.8	6,400	3,984	6,400	3,984
Tenmile	13	14	12.0	11,510	3,971	11,510	3,971
Standard Surveys							
Lakes Strata	**14**	8	6.6	38,749		38,744	
Siltcoos	5	2	2.5	7,678		7,678	
Tahkenitch	2	2	1.6	10,686		10,681	
Tenmile	7	4	2.5	20,385		20,385	

Table B-3. Estimates of adult coho salmon run size in the North Umpqua River derived through adjustment of Winchester Dam count. Dam count adjusted for adult coho salmon retained by hatchery operations and harvest above Winchester Dam, 2010 compared to the previous 5 years.

Data component	Coho salmon origin	Spawning year			
			2005 to 2009		
		2010	Avg.	Min.	Max.
North Umpqua Coho salmon	**Wild**	9,397	3,507	1,410	7,720
	Hatchery	638	3,641	125	8,346
	% Hat.	6.4%	44.8%	3.5%	80.9%
Winchester Dam [1]	Total	10,127	7,446	3,591	10,985
	Wild	9,462	3,566	1,410	7,806
	Hatchery	665	3,880	153	8,872
Freshwater Catch [2] Above Winchester Dam	Total	24	227	28	474
	Wild	0	0	0	0
	Hatchery	24	227	28	474
Rock Creek Hatchery [3]	Total	68	71	0	196
	Wild	65	58	0	144
	Hatchery	3	12	0	52

1 = Counts of adult coho salmon by mark type (marked =hatchery, unmarked = wild) at Winchester Dam on the North Umpqua River.

2 = Estimated freshwater harvest of coho salmon in the North Umpqua basin above Winchester Dam based on Angler Harvest Cards (see: http://www.dfw.state.or.us/resources/fishing/sportcatch.asp). Selective harvest of mark coho salmon began in 2004.

3 = Number of adult coho salmon collected (at Rock Creek and at Winchester Dam) and retained at Rock Creek Hatchery. These numbers do not include coho salmon collected and released alive back into the wild.

Table B-4. Annual abundance estimates of naturally spawning wild adult coho salmon in the Oregon Coast Coho ESU, run years 1990 through 2010. n.a. = not available. *Numbers in italics are partial estimates of spawners in dependent populations*.

Stratum and Population	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
North Coast											
Necanicum River	126	752	133	512	269	181	416	97	575	351	359
Nehalem River	1,158	6,837	1,392	3,049	2,844	1,700	527	1,187	1,206	3,555	14,462
Tillamook Bay	80	1,577	176	571	1,105	341	733	437	358	1,831	2,178
Nestucca River	160	618	604	340	266	1,537	440	230	202	2,357	1,219
NC Dependents	*0*	*444*	*24*	*41*	*77*	*108*	*275*	*61*	*0*	*47*	*0*
Mid-Coast											
Salmon River	19	5	11	13	91	105	82	16	86	14	179
Siletz River	228	410	2,386	207	621	314	395	298	316	1,209	3,387
Yaquina River	318	317	528	458	2,040	4,723	4,578	419	510	2,563	637
Beaver Creek	90	484	618	275	675	308	1,296	497	401	1,511	1,464
Alsea River	775	1,011	6,273	694	828	441	1,060	601	108	1,341	3,363
Siuslaw River	2,269	2,808	3,554	4,600	3,159	6,161	7,234	501	1,020	2,980	6,532
MC Dependents	*487*	*51*	*1,037*	*467*	*317*	*348*	*1364*	*112*	*173*	*150*	*91*
Umpqua											
Lower Umpqua River	1,678	3,123	1,797	7,877	2,762	10,854	7,985	1,257	4,552	2,623	5,781
Middle Umpqua River	1,222	4,546	5,275	2,947	2,162	3,250	5,086	563	1,257	1,748	4,555
North Umpqua River	355	1,301	1,579	906	899	1,293	1,069	577	765	1,194	1,677
South Umpqua River	2,934	2,233	435	3,723	1,081	4,715	7,040	937	3,177	3,011	2,581
Lakes											
Siltcoos	1,578	2,868	385	3,569	1,302	4,415	4,707	2,653	3,122	2,756	3,835
Tahkenitch	1,085	1,215	317	954	1,056	1,577	1,627	1,842	2,817	3,664	634
Tenmile	1,687	3,033	1,271	5,544	3,354	5,092	7,092	4,092	5,169	6,123	8,278
Mid-South Coast											
Coos River	2,243	2,426	16,722	14,932	14,500	10,302	12,128	1,112	2,985	4,818	4,704
Coquille River	2,589	4,782	2,033	7,291	5,119	2,034	15,814	5,720	2,412	2,667	6,253
Floras Creek	0	0	0	0	2,653	1,351	1,519	482	879	670	1,477
Sixes River	58	35	92	253	238	77	194	143	558	56	136
MSC Dependents	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Table B-4. Concluded.

Stratum and Population	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
North Coast										
Necanicum River	4,832	2,047	2,377	2,198	1,218	750	431	1,055	3,827	4,445
Nehalem River	21,928	17,164	32,517	18,736	10,451	11,614	14,033	17,205	21,753	32,215
Tillamook Bay	1,944	13,334	13,008	2,532	1,995	8,774	2,295	4,828	16,251	14,890
Nestucca River	4,164	16,698	10,194	4,695	686	1,876	394	1,844	4,252	1,947
NC Dependents	*71*	*16*	*0*	661	2,116	1,121	376	639	2,052	1,473
Mid-Coast										
Salmon River	225	543	42	1,642	79	513	59	652	753	1,382
Siletz River	1,595	2,129	8,038	8,179	14,567	5,205	2,197	20,634	24,070	6,283
Yaquina River	3,589	23,800	16,484	5,539	3,441	4,247	3,158	10,913	11,182	8,589
Beaver Creek	1,832	3,217	5,552	4,569	2,264	1,950	611	1,218	3,575	2,072
Alsea River	3,228	9,073	10,281	5,233	13,907	1,972	2,146	13,320	14,638	9,688
Siuslaw River	10,606	55,445	29,003	8,729	16,907	5,869	3,552	17,491	30,607	25,983
MC Dependents	*816*	*5,308*	*1,852*	8,179	242	1,468	547	3,910	1,610	2,548
Umpqua										
Lower Umpqua River	11,639	18,881	16,494	8,989	18,591	7,994	4,237	9,023	19,245	17,516
Middle Umpqua River	8,940	10,738	11,090	6,375	7,608	4,852	1,587	4,472	15,075	18,123
North Umpqua River	2,634	3,368	2,862	3,559	1,969	3,000	1,410	3,438	7,720	9,397
South Umpqua River	11,871	10,517	4,337	10,997	14,364	2,246	4,549	20,935	15,944	24,983
Lakes										
Siltcoos	5,104	4,636	6,628	7,998	4,364	5,452	1,447	3,873	5,197	7,678
Tahkenitch	3,510	3,480	3,188	3,496	1,897	3,611	3,551	2,604	2,977	10,681
Tenmile	10,990	13,861	6,260	7,148	8,464	15,064	3,957	17,131	9,175	20,385
Mid-South Coast										
Coos River	33,595	33,120	25,761	23,337	17,048	11,266	1,329	14,881	26,979	27,658
Coquille River	13,833	7,676	22,403	22,138	11,806	28,577	13,968	8,791	22,286	23,564
Floras Creek	5,664	3,272	952	7,446	506	1,104	340	786	3,203	11,329
Sixes River	95	95	86	403	105	294	97	43	176	100
MSC Dependents	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0	188	484

APPENDIX C (SONCC COHO ESU)

Table C-1. Results of randomly selected spawning ground surveys for coho salmon in the Oregon portion of the SONCC Coho ESU, run year 2010. Estimates derived using GRTS protocol and are adjusted for visual observation bias. Estimates of wild spawners derived through application of carcass fin-mark observations. Missing values for populations indicate inadequate samples for determining total and/or wild abundance.

Monitoring area	Survey effort number of		Adult coho salmon spawner abundance			
			Total		Wild	
TRT Population	Surveys	Miles	Estimate	95% CI	Estimate	95% CI
South Coast *Note: Not sampled due to budget constraints.*						

Table C-2. Estimates of adult coho salmon run size in the Rogue River derived from Huntley Park seining and returns to Cole Rivers Hatchery, 1990 through 2010.

	Huntley Park seine		Cole Rivers Hatchery		Adult coho salmon run size			
	Fin-marks	Total	Adult	Adult fin-	Total		Wild	
Year	(*R*)	(*C*)	returns	marks (*M*)	Estimate	95% CI	Estimate	95% CI
1990	3	56	452	103	1,625	1,536	1,243	1,343
1991	11	106	2,209	277	2,729	1,455	471	604
1992	4	86	1,338	168	3,236	2,754	2,037	2,185
1993	2	34	756	104	1,342	1,452	768	1,099
1994	92	174	6,590	5,564	11,518	1,602	4,305	980
1995	139	211	8,714	7,757	12,923	1,248	3,359	636
1996	205	375	7,921	6,940	13,936	1,280	5,241	785
1997	245	501	8,001	7,571	16,997	1,517	8,213	1,054
1998	79	165	2,921	2,387	5,451	860	2,257	553
1999	108	163	4,381	3,742	6,194	673	1,389	319
2000	194	505	9,224	7,389	21,094	2,321	10,978	1,675
2001	423	1,041	12,759	9,837	26,596	1,950	12,579	1,341
2002	345	752	11,599	8,831	21,143	1,638	8,403	1,033
2003	170	450	6,656	4,842	14,050	1,659	6,754	1,150
2004	260	1,264	8,289	6,297	33,578	3,629	24,486	3,099
2005	146	519	4,876	3,930	15,296	2,094	9,957	1,690
2006	174	457	3,188	2,581	7,433	866	3,937	630
2007	86	343	2,085	1,727	7,517	1,365	5,242	1,140
2008	19	107	148	95	572	226	414	192
2009	12	80	503	449	3,084	1,536	2,566	1,401
2010	13	143	730	337	3,826	1,904	3,073	1,706

APPENDIX D

Table D-1. Site status of 2010 GRTS samples in the Lower Columbia River Coho ESU by TRT population. Target sites fell within coho salmon spawning habitat; response sites were successfully surveyed and non-response sites were not surveyed because of issues such as lack of landowner permission, site inaccessibility, or gaps in survey effort usually from stream turbidity. Non-target sites are outside of coho salmon spawning habitat. Average is for 2007 to 2009.

		Target response				Target non-response				Non-target			
Stratum	Population	2010	Avg.	Min	Max	2010	Avg.	Min	Max	2010	Avg.	Min	Max
Coast	Youngs Bay	18	16	13	20	3	4	3	5	6	5	3	7
	Big Creek	5	5	4	5	9	5	5	6	2	1	0	2
	Clatskanie	13	15	13	17	10	8	5	11	1	1	0	2
	Scappoose	15	17	16	19	13	10	7	13	1	2	1	3
	Total	**51**	**53**	**52**	**54**	**35**	**27**	**25**	**29**	**10**	**9**	**6**	**10**
Cascade	Clackamas	17	20	17	25	20	20	17	23	0	0	0	1
	Sandy	23	27	26	28	16	10	6	18	3	3	1	5
	Total	**40**	**47**	**44**	**51**	**36**	**30**	**23**	**41**	**3**	**3**	**1**	**5**
Gorge	Lower Gorge	2	3	2	4	4	2	0	3	0	0	0	0
	Hood	6	2	2	3	0	2	0	5	0	0	0	0
	Total	**8**	**5**	**4**	**6**	**4**	**4**	**0**	**8**	**0**	**0**	**0**	**0**
ESU Total		**99**	**105**	**101**	**111**	**75**	**61**	**51**	**78**	**13**	**12**	**9**	**15**

Table D-2. Site status of 2010 GRTS samples in the Southern Oregon/Northern California Coasts Coho ESU by TRT population. Target and Response categories as defined in Table D-1. Average is for 2006 to 2008.

		Target response				Target non-response				Non-target			
Stratum	Population	2010	Avg.	Min	Max	2010	Avg.	Min	Max	2010	Avg.	Min	Max
Coastal Sub-basins	Elk River	0	1	0	1	0	0	0	0	0	0	0	0
	L. Rogue R.	0	2	0	4	0	6	4	9	0	1	1	1
	Chetco River	0	0	0	0	0	0	0	0	0	0	0	0
	Winchuck R.	0	0	0	0	0	0	0	0	0	0	0	0
	SC Depend.	0	0	0	0	0	0	0	0	0	0	0	0
	Total	**0**	**3**	**0**	**5**	**0**	**6**	**4**	**9**	**0**	**1**	**1**	**1**
Interior Sub-basins	Illinois River	0	3	3	4	0	13	9	16	0	3	1	4
	M. Rogue & Applegate R.	0	12	8	16	0	18	7	27	0	0	0	1
	U. Rogue R.	0	9	5	14	0	14	3	20	0	0	0	1
	Total	**0**	**24**	**22**	**25**	**0**	**45**	**19**	**60**	**0**	**3**	**2**	**5**
ESU Total		**0**	**27**	**24**	**30**	**0**	**51**	**28**	**64**	**0**	**4**	**3**	**6**

Table D-3. Site status of 2010 GRTS samples in the Oregon Coast Coho ESU by TRT population. Target sites fell within coho salmon spawning habitat; response sites were successfully surveyed and non-response sites were not surveyed because of issues such as lack of landowner permission, site inaccessibility, or gaps in survey effort usually from stream turbidity. Non-target sites are outside of coho salmon spawning habitat. Average is for 2007 to 2009.

		Target response				Target non-response				Non-target			
Stratum	Population	2010	Avg.	Min	Max	2010	Avg.	Min	Max	2010	Avg.	Min	Max
North Coast	Necanicum	15	17	12	21	8	8	5	9	5	3	3	4
	Nehalem	34	11	6	15	5	24	19	29	3	5	5	6
	Tillamook	21	11	6	19	15	23	20	26	14	10	8	14
	Nestucca	12	11	10	13	30	21	20	22	9	9	6	12
	NC Depend.	15	14	11	15	8	6	4	8	17	11	9	15
	Total	**97**	**64**	**54**	**81**	**66**	**82**	**72**	**92**	**48**	**39**	**32**	**43**
Mid-Coast	Salmon	12	9	6	12	8	9	4	11	6	4	4	5
	Siletz	25	20	13	24	14	16	13	20	10	7	7	8
	Yaquina	21	22	15	28	17	12	6	20	13	9	7	13
	Beaver	5	4	2	7	5	4	0	6	4	6	5	7
	Alsea	27	22	17	26	13	14	12	17	9	10	7	14
	Siuslaw	25	22	9	36	14	16	7	26	3	2	0	4
	MC Depend.	20	15	11	20	14	15	12	16	17	16	13	18
	Total	**135**	**114**	**83**	**144**	**85**	**85**	**69**	**110**	**62**	**55**	**49**	**64**
Lakes	Siltcoos	20	12	9	16	9	11	9	14	14	9	5	11
	Tahkenitch	5	6	5	6	1	1	0	2	5	3	1	5
	Tenmile	14	7	5	10	10	12	5	20	2	4	2	7
	Total	**39**	**24**	**20**	**28**	**20**	**24**	**20**	**30**	**21**	**16**	**10**	**20**
Umpqua	L. Umpqua	27	30	12	51	14	14	6	23	1	3	2	4
	M. Umpqua	14	24	17	28	25	12	8	18	2	3	2	4
	N. Umpqua	14	26	19	31	27	11	5	17	1	2	1	4
	S. Umpqua	28	22	11	29	12	15	8	25	8	10	7	11
	Total	**83**	**103**	**59**	**133**	**78**	**51**	**33**	**83**	**12**	**17**	**13**	**21**
Mid-South Coast	Coos	28	23	7	32	10	13	5	28	5	4	2	5
	Coquille	16	14	6	26	33	28	17	35	2	3	1	4
	Floras	8	7	5	10	18	12	11	14	3	5	5	5
	Sixes	1	6	1	9	18	11	7	17	0	1	0	1
	MS Depend.	5	2	0	4	15	12	8	18	8	5	3	7
	Total	**58**	**53**	**39**	**77**	**94**	**77**	**55**	**103**	**18**	**17**	**13**	**21**
ESU Total		**412**	**359**	**267**	**443**	**343**	**319**	**250**	**418**	**161**	**144**	**131**	**167**

Table D-4. Adult coho salmon density (AUC/mile) and marked proportion information by population in the Lower Columbia River and Oregon Coast Coho ESUs during the 2010 spawning year.

ESU	Stratum	Population	Total surveys	Total surveyed length	Total live adults	2010 Density	2005-09 Avg. density	Total carcasses	2010 % Marked	2005-09 Avg. % marked
Lower Columbia River	Coastal	Youngs Bay	18	16.8	39	2.3	7.1	5	68.6%	66.3%
		Big Creek	5	3.9	20	5.8	19.7	13	92.4%	71.3%
		Clatskanie River	13	14.4	597	33.4	14.8	86	9.3%	14.9%
		Scappoose Creek	15	12.6	299	28.0	8.0	41	0.0%	1.1%
	Cascade	Clackamas River	15	16.3	369	18.9	28.6	78	84.5%	73.1%
		Sandy River	23	19.8	150	6.4	12.7	45	16.2%	4.4%
	Gorge	Lower Gorge	2	0.9	241	207.9	137.3	15	6.7%	59.5%
		Hood River	6	5.3	1,696	260.4	181.9	104	36.5%	50.7%
Oregon Coast	North Coast	Necanicum River	15	11.5	1,199	94.8	28.9	292	0.0%	6.6%
		Nehalem River	33	26.1	1,894	63.7	33.6	474	2.5%	3.9%
		Tillamook Bay	21	20.5	1,375	64.0	29.9	273	0.7%	8.5%
		Nestucca River	12	9.1	127	13.8	13.5	22	4.5%	3.1%
		NC Dependents	15	9.9	442	44.1	36.0	76	1.3%	1.5%
	Mid-Coast	Salmon River	12	8.1	267	33.3	33.8	51	3.9%	63.1%
		Siletz River	25	21.2	780	31.4	74.6	117	0.0%	4.0%
		Yaquina River	21	12.2	744	55.5	55.8	119	0.0%	3.3%
		Beaver Creek	5	2.9	538	159.3	120.7	82	0.0%	1.6%
		Alsea River	27	19.5	762	34.4	38.6	157	0.0%	0.4%
		Siuslaw River	25	22.7	897	38.4	25.6	167	0.0%	2.4%
		MC Dependents	20	19.0	324	14.7	9.9	47	2.1%	1.6%
	Lakes	Siltcoos Lake	20	13.4	5,715	394.5	106.4	2,102	0.0%	0.0%
		Tahkenitch Lake	5	4.8	3,306	576.9	152.2	1,604	0.0%	0.0%
		Tenmile Lake	14	12.0	3,852	293.9	163.5	936	0.0%	0.0%
	Mid-South Coast	Coos Bay	28	22.7	2,723	120.6	63.7	486	0.8%	0.7%
		Coquille River	16	17.0	1,009	59.9	51.5	79	0.0%	0.2%
		Floras Creek	8	5.8	2,331	344.4	48.7	531	0.0%	2.8%
		Sixes River	1	0.4	0	-...	2.2	0	-...	12.8%
		MS Dependents	5	5.1	134	26.0	5.3	29	0.0%	4.3%
	Umpqua	Lower Umpqua	27	23.3	1,279	50.3	32.8	216	0.5%	6.8%
		Middle Umpqua	12	10.0	589	56.9	19.8	127	0.0%	7.6%
		North Umpqua	12	10.5	295	26.5	27.9	16	0.0%	32.6%
		South Umpqua	27	21.5	1,010	42.4	22.5	452	9.1%	5.4%