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Oregon North Coast Spring Chinook Stock Assessment – 2007-08

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CONTENTS

INTRODUCTION

Chinook salmon populations on the Oregon coast exhibit two general life history types, classified as either spring-run or fall-run depending on population demographic traits. Fall Chinook salmon are present in most Oregon coastal basins, and the Oregon Department of Fish and Wildlife (ODFW) has identified 28 fall Chinook salmon populations (ODFW 2005). Spring Chinook salmon are found in larger river basins on the Oregon coast and the upper portions of the Umpqua and Rogue rivers. In the 2005 ODFW Native Fish Status Report, spring Chinook salmon were identified as distinct from and having a more limited distribution than coastal fall Chinook salmon with only 10 identified populations. Since 2005, there has been debate whether spring Chinook salmon in many Oregon coastal basins are distinct populations or rather an alternate life history of the fall Chinook populations. ODFW is currently drafting a multi-species conservation plan in which both Chinook salmon life-history types, early (spring) and late (fall), will be viewed as of a single population in most coastal basins. Oregon coastal fall Chinook salmon have been monitored through a set of 56 standard spawning ground surveys, many conducted since the 1950's. There has not been a similar, consistent, coast-wide monitoring program for Oregon coastal spring Chinook salmon spawners. Abundance of these populations has been monitored through a variety of methods including: freshwater harvest estimates, counts at dams and weirs, summer resting-hole counts, and occasional spawning ground surveys.

In 1998, the National Marine Fisheries Service (NMFS) reviewed west coast Chinook salmon populations with regards to status under the Federal Endangered Species Act (ESA). NMFS identified a total of 15 Chinook salmon Evolutionarily Significant Units (ESUs) (Myers et al. 1998). Subsequent review resulted in refinement of ESU boundaries and identification of an additional two Chinook salmon ESUs (Federal Register Notice 1999). Oregon coastal Chinook salmon are predominantly in the Oregon Coast ESU (Necanicum River to Elk River). This ESU includes both spring and fall Chinook salmon, and was determined to not warrant listing (Federal Register Notice 1998). In 2005, ODFW conducted a review of Oregon native fish status, with regards to the State's Native Fish Conservation Policy (NFCP). This review grouped populations by Species Management Unit (SMU), and examined coastal spring and fall Chinook salmon populations separately. The review determined the near-term sustainability of the Coastal Fall Chinook SMU was not at risk, but the Coastal Spring Chinook SMU was at risk (ODFW 2005). The Tillamook and Nestucca spring Chinook salmon populations were of particular concern because they failed to pass the interim criteria for abundance, productivity, and reproductive independence. In 2012, ODFW began developing a management plan under the NFCP that includes coastal Chinook salmon. This will include an updated status review, and unlike the 2005 status review, will treat Chinook salmon in most basins, including the Tillamook and Nestucca, as a single population with an early (spring-run) and a late (fall-run) component.

Hatchery supplementation of spring Chinook salmon has occurred in the Tillamook and Nestucca basins since the early 1900's. Currently, hatchery spring Chinook salmon are released in the fall as sub-yearling smolts, and predominately return to spawn as 3 to 5-year-old adults. During the period of this study, hatchery spring Chinook salmon from the 2000 through 2006 brood years (year parents were spawned) were returning to the Tillamook and Nestucca basins. In total, Trask Hatchery, Cedar Creek Hatchery (Nestucca), and the Salmon and Trout Enhancement Program at Whiskey Creek averaged approximately 430,000 spring Chinook

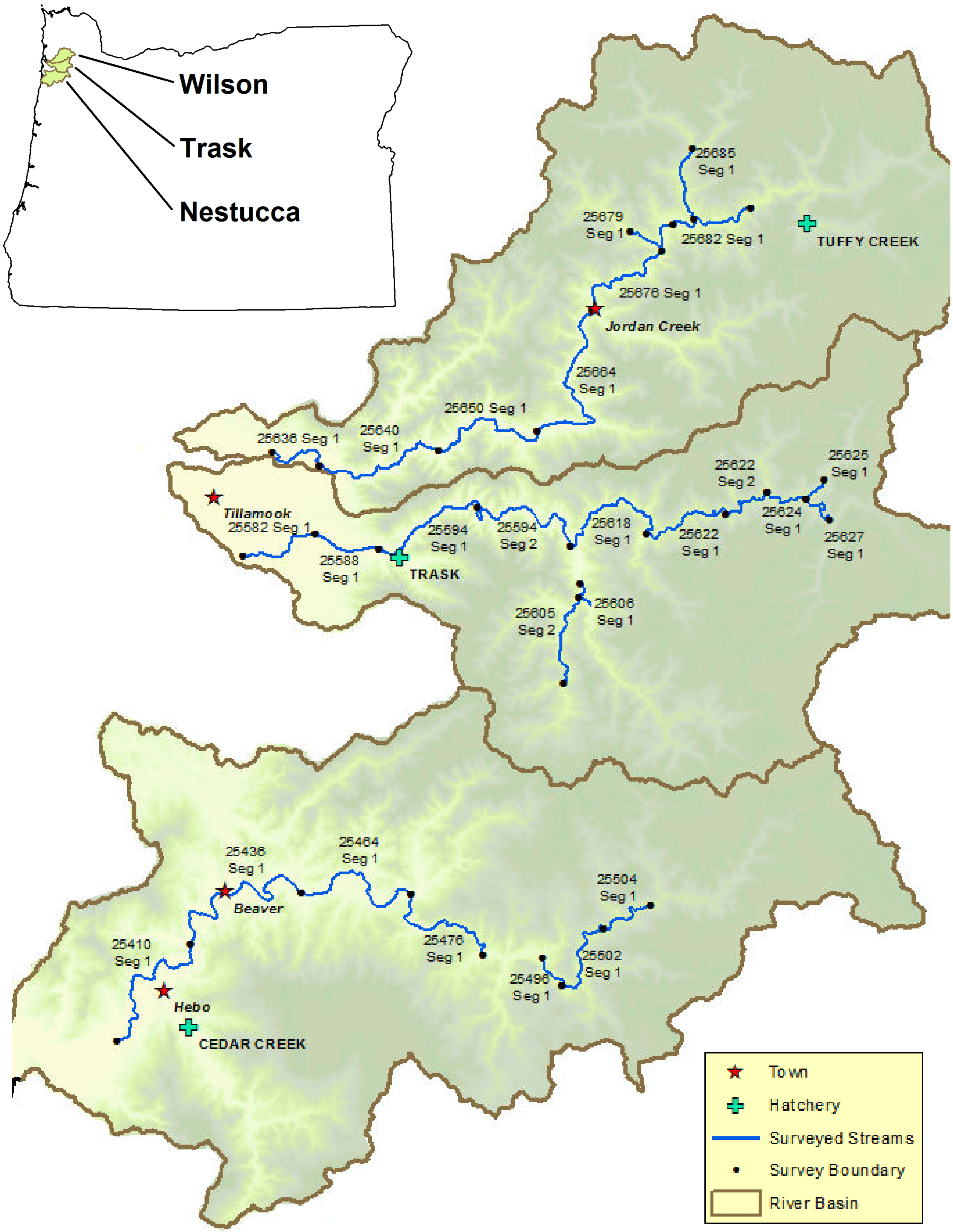

Figure 1. Spring Chinook salmon study area in 2007 and 2008.

salmon smolts and 70,000 fry released annually during the 2000 to 2006 brood years. Hatchery spring Chinook salmon smolts and fry have been mass marked with an adipose fin-clip since the 1998 brood year. Therefore, during the period of this study hatchery origin adult spring Chinook salmon released as smolts or fry could be positively identified by the lack of an adipose fin. Declining trends in wild coastal spring Chinook salmon populations have resulted in management actions to target harvest on adipose fin-clipped hatchery fish, and to restrict harvest of wild origin fish.

Results of status reviews and changes in management practices have highlighted the need for a more thorough evaluation of stock status for the Tillamook and Nestucca spring Chinook salmon populations (ODFW 2005). In response to this need, ODFW developed a monitoring plan for spring Chinook salmon in these basins. The monitoring plan identified four project objectives: 1) Determine adult spring Chinook salmon abundance in the Trask, Wilson, and Nestucca Rivers; 2) Determine the proportion of hatchery origin spring Chinook salmon on the spawning grounds in these three basins; 3) Determine age structure and sex ratios for spring Chinook salmon spawners; and 4) Determine distribution and abundance for spring Chinook salmon recycled from local ODFW hatcheries. This project began in 2004 with an exploratory season to determine distribution, survey methodology, and feasibility of the proposed protocol. From 2005 through 2008 a more intensive sampling effort was implemented, designed to cover the entire distribution of spring Chinook salmon spawning in the Nestucca, Trask, and Wilson rivers.

This report documents results for project Objectives 1 to 3 during the 2007 and 2008 seasons, and summarizes results for all four years of the study. Objective 4 requires tagging of recycled fish which was only done in 2006. Detailed results for all four objectives during the 2005 and 2006 seasons are reported in Stewart and Suring (2008).

METHODS

Study Area

Exploratory surveys conducted in 2004 in the Wilson, Trask and Nestucca River basins were used to determine the distribution of spring Chinook salmon and to set up surveys for monitoring these basins. Distribution was further refined as crews conducted spring Chinook salmon spawning ground surveys in 2005 and 2006 (Stewart and Suring 2008). The sampling frame consists of 27 survey reaches in the Wilson, Trask, and Nestucca Rivers (Figure 1 and Table 1). These reaches total 93.6 stream miles and, based on the exploratory surveys, are believed to encompass the entire distribution of spring Chinook salmon spawning in these basins. Two reaches were excluded from survey efforts because habitat was deemed non-suitable for Chinook salmon spawning (no spawning gravel), though Chinook salmon spawning exists upstream and downstream of these reaches (Table 1).

Survey Methods

Two 2-person crews surveyed from mid-August through mid-October. This period is thought to encompass the entire spawning season, with peak spawning typically during the 2nd or 3rd week of September. Surveyors floated downstream in pontoon boats on all non-wadeable streams and walked upstream on all wadeable streams, covering the established spring Chinook salmon distribution in the study area. Surveyors attempted to conduct each survey at least once every 10 days.

Field protocols, data collection, and analysis were similar to those used in coastal fall Chinook salmon, chum salmon, and coho salmon surveys (Jacobs et al. 2002). Crews recorded counts of redds and live fish, with fish counts being tallied by fin-clip status. For each carcass recovered, scale samples were obtained, and length, sex, and fin-clip status were recorded. Snouts were taken from all adipose fin-clipped fish for coded-wire-tag (CWT) recovery. In 2008, crews also collected tissue samples from 62 carcasses in all three basins combined for genetic analysis in a cooperative effort with other ODFW staff and external groups. However, the genetic data and results are not presented in this report.

Table 1. Survey effort for the 2007 and 2008 spring Chinook salmon spawner survey seasons.

Basin	Reach	Survey Description	Length (mi)	Survey Days	
				2007	**2008**
Nestucca:	25410 Seg 1	Nestucca R: Cloverdal -> Farmer Cr	5.8	2	1
	25436 Seg 1	Nestucca R: Farmer Cr -> Tony Cr	7.1	5	5
	25464 Seg 1	Nestucca R: Tony Cr -> Moon Cr	5.1	4	6
	25476 Seg 1	Nestucca R: Moon Cr -> Powder Cr	4.5	5	4
	*25484 Seg 1**	*Nestucca R: Powder Cr -> Nestucca Bridge*	*2.3**	*0*	*0*
	25496 Seg 1	Nestucca R: Nestucca Bridge -> Rocky Bend	1.3	4	4
	25502 Seg 1	Nestucca R: Rocky Bend -> Alder Glen	3.4	4	4
	25504 Seg 1	Nestucca R: Alder Glen -> Hogg Pass	2.3	4	4
			29.5	**28**	**28**
Trask:	25582 Seg 1	Trask R: Hwy 101 -> Long Prairie Bridge	2.9	2	2
	25588 Seg 1	Trask R: Long Prairie Bridge -> Loren's Drift	2.2	2	2
	25594 Seg 1	Trask R: Loren's Drift -> Peninsula Park	4.1	5	5
	25594 Seg 2	Trask R: Peninsula Park -> Trask Park	5.1	5	5
	*25605 Seg 1**	*SF Trask R: Trask Park to Bridge*	*1.5**	*0*	*0*
	25605 Seg 2	SF Trask R: Bridge -> Bill Cr	3.8	4	5
	25606 Seg 1	EF of SF Trask R: Mouth -> End of habitat	0.5	3	3
	25618 Seg 1	NF Trask R: Mouth -> Bark Shanty	4.6	4	5
	25622 Seg 1	NF Trask R: Bark Shanty -> Bridge Timbers	3.6	4	5
	25622 Seg 2	NF Trask R: Bridge Timbers -> Clear Cr	2.1	4	4
	25624 Seg 1	NF Trask R: Clear Cr -> NF of NF	1.6	4	4
	25625 Seg 1	NF of NF Trask R: Mouth -> Schetky Rd	1.0	1	1
	25627 Seg 1	MF of NF Trask R: Mouth -> End of habitat	1.9	2	2
			33.4	**40**	**43**
Wilson:	25636 Seg 1	Wilson R: Sollie Smith -> Hughey Cr	2.7	2	1
	25640 Seg 1	Wilson R: Hughey Cr -> Siskeyville	4.4	4	4
	25650 Seg 1	Wilson R: Siskeyville -> Sprague Wayside	4.6	4	4
	25664 Seg 1	Wilson R: Sprague Wayside -> Jordan Cr	6.6	4	4
	25676 Seg 1	Wilson R: Jordan Cr -> Jones Cr	5.1	4	4
	25679 Seg 1	Cedar Cr: Mouth -> End of habitat	1.3	2	1
	25682 Seg 1	Wilson R: Jones Cr -> King Mt	3.4	4	4
	25685 Seg 1	NF Wilson R: Mouth -> WF Wilson	2.6	2	1
			30.7	**26**	**23**
Total:			**93.6**	**94**	**94**

** reach excluded from survey efforts due to lack of Chinook spawning habitat (no spawning gravel), reach length not included in totals*

Data Analysis

The Area-Under-the-Curve (AUC) method was used to calculate an estimate of spring Chinook salmon spawner abundance in each of the three monitored river basins (Jacobs et al. 2002). An AUC estimate was calculated for each reach, and because monitoring covered all known spawning distribution, these AUC estimates were then summed to produce a population estimate. For surveys that had a peak live count higher than the AUC estimate, the peak live count was used in the population estimates. Chinook salmon were assumed to have an average survey life of 12.1 days (Perrin and Irvine 1990). Both adult and jack AUC estimates used the same survey life average. Detection probability on spawning ground surveys was assumed to be 76.1% for adult Chinook salmon and 63.6% for jack Chinook salmon (Solazzi 1984). The AUC estimates were rounded to the nearest whole number.

RESULTS AND DISCUSSION

Assessment of Survey Conditions

Survey conditions during spring Chinook salmon spawning season are generally very mild and are characterized by stream flows at or near annual lows. Figure 2 shows the mean daily stream discharge for the Wilson River during the 2007-2008 spring Chinook salmon spawning seasons in comparison to the 20th and 80th percentiles of mean daily flows for 93 years (1916 through 2008). The 2007 Wilson River flows were typical of average stream flows. During the spawning season, surveyors were not usually constrained by poor visibility or long periods where they were unable to conduct surveys due to high and/or turbid flows. The 2008 season brought an uncommon rise in flows during the third week in August. Therefore, crews altered their survey schedules to avoid periods of poor survey visibility. In 2007 and 2008, flows came up higher than average in early October just as the spawning season was nearing its end. Though the goal was to successfully survey each survey reach every 10 days, logistics did not always allow for this frequent of visits. The average number of days between surveys was 12.8 days in 2007 and 11.9 days in 2008.

Favorable flows and survey conditions during spring Chinook salmon spawning season allow for reasonable monitoring while the majority of the fish are present on the spawning grounds. The majority of live Chinook salmon observations on spawning grounds occurred in September with smaller portions in both late-August and early-October. Of the total live Chinook salmon observations over all four years of monitoring, 15% occurred in August, 79% in September, and 6% in October.

Adult Spawner Abundance

Spring Chinook salmon adult spawner abundance estimates were very similar in 2007 and 2008 for the Nestucca and Wilson basins, while there was a 32% increase in the Trask basin abundance from 2007 to 2008 (Table 2). During the 2005 and 2006 survey seasons, surveys were not conducted as frequently as in 2007 and 2008, so we did not calculate AUC estimates for these years as estimates may have been less reliable. A map of AUC density per survey can be found in Appendix Figure A.

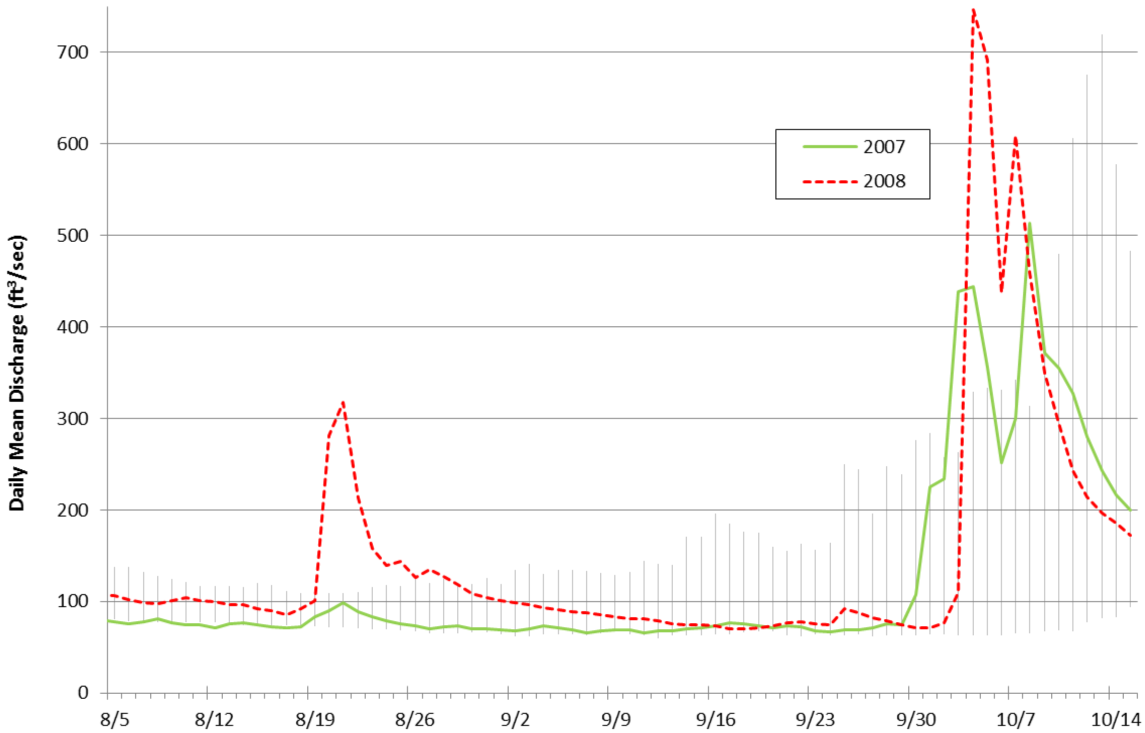

Figure 2. Daily mean river discharge in cubic feet per second during the 2007 and 2008 spawning seasons in the Wilson River near Tillamook. Vertical grey bars represent limits of the 20th and 80th percentiles of mean daily flows for the period 1916 through 2008.

In all three basins, a large portion of the estimate is based on a single survey located low in the basin, with the exception of the Wilson in 2008. These surveys low in the Nestucca and Trask are located close to the hatcheries of origin as well as the smolt release locations. Over the 2007 and 2008 spawning seasons AUC abundance estimates averaged 290 adults in the Nestucca, 715 adults in the Trask, and 86 adults in the Wilson (Table 2). Jacks were not very abundant in live counts, thus AUC estimates for the entire study area were quite small with 19 jacks estimated in 2007 and 35 jacks estimated in 2008.

In 2005 and 2006, abundance was reported in terms of peak density, with peak counts including both live and dead Chinook salmon (Stewart and Suring, 2008). Table 3 shows peak densities survey-by-survey, with averages of each survey and basin across all four years of this study. Peak density was highest in 2005, declined for 2 years, and then slightly increased again in 2008 (Figure 3). A map of average peak density per survey reach can be found in Appendix Figure B.

Abundance estimates (AUC) are available only for 2007 and 2008, and are presented in Table 4, along with the season totals for adult spring Chinook salmon live fish observed and carcasses recovered from all four years. The AUC estimates are greater than the total live fish observed on surveys by 23.6% and 18.6% in 2007 and 2008, respectively. Since we assume that we only observe 76.1% of the total fish in each survey, it is not surprising that our AUC estimate

Table 2. Spring Chinook salmon AUC estimates and densities (fish/mile) for the 2007 and 2008 spawning seasons.

Basin	Reach	AUC Estimate		AUC Density		AUC Jack Estimate	
		2007	2008	2007	2008	2007	2008
Nestucca:	25410 Seg 1	30	12	5.2	2.1	0	3
	25436 Seg 1	179	120	25.2	16.9	6	6
	25464 Seg 1	60	54	11.8	10.6	0	5
	25476 Seg 1	9	25	2.0	5.6	0	0
	25496 Seg 1	0	3	0.0	2.3	0	0
	25502 Seg 1	12	33	3.5	9.7	0	0
	25504 Seg 1	1	41	0.4	17.8	0	0
		291	**288**	**9.9**	**9.8**	**6**	**14**
Trask:	25582 Seg 1	0	8	0.0	2.8	0	0
	25588 Seg 1	30	26	13.6	11.8	0	3
	25594 Seg 1	393	415	95.9	101.2	6	6
	25594 Seg 2	64	116	12.5	22.7	2	0
	25605 Seg 2	50	75	13.2	19.7	0	2
	25606 Seg 1	3	3	6.0	6.0	0	0
	25618 Seg 1	28	70	6.1	15.2	0	3
	25622 Seg 1	32	55	8.9	15.3	0	3
	25622 Seg 2	0	38	0.0	18.1	0	2
	25624 Seg 1	16	5	10.0	3.1	0	0
	25625 Seg 1	0	0	0.0	0.0	0	0
	25627 Seg 1	1	1	0.5	0.5	0	0
		617	**812**	**18.5**	**24.3**	**8**	**19**
Wilson:	25636 Seg 1	12	0	4.4	0.0	0	0
	25640 Seg 1	42	18	9.5	4.1	2	2
	25650 Seg 1	4	17	0.9	3.7	0	0
	25664 Seg 1	8	8	1.2	1.2	0	0
	25676 Seg 1	16	17	3.1	3.3	0	0
	25679 Seg 1	0	0	0.0	0.0	0	0
	25682 Seg 1	4	25	1.2	7.4	0	0
	25685 Seg 1	0	0	0.0	0.0	3	0
		86	**85**	**2.8**	**2.8**	**5**	**2**
Total:		**994**	**1185**	**10.6**	**12.7**	**19**	**35**

would be higher than the total live fish observations. The number of carcass recoveries in 2007 and 2008 was small compared to the prior two years, when crews recovered a total of 673 and 440 carcasses in 2005 and 2006, respectively.

With the rise in flows in late August 2008, Chinook salmon may have had a tendency to spawn higher in the river basins. Figure 4 suggests this occurrence in the Nestucca and Wilson basins, and to a lesser degree in the Trask basin. Spawner density tends to be the greatest lower in the distribution which coincides with hatcheries and smolt release points, particularly on the Trask River survey which extends past the Trask hatchery (25594 Seg 1; Figure 4). However, in 2008 survey reaches with the greatest spawner densities in the Nestucca and Wilson basins were found much further upstream in the spawning habitat distribution than in 2007. The percent of sites with at least one spring Chinook salmon spawner observed increased slightly from 78% of sites occupied in 2007 to 85% of sites occupied in 2008 (Table 5). Three sites (11% of total) did

Table 3. Spring Chinook salmon peak density (fish / mile) for the 2005 to 2008 seasons.

Basin	Reach	Peak Density				
		2005	2006	2007	2008	4-yr Avg.
Nestucca:	25410 Seg 1	4.1	3.8	5.3	2.6	4.0
	25436 Seg 1	14.7	13.6	15.5	11.3	13.8
	25464 Seg 1	13.1	8.2	7.8	6.1	8.8
	25476 Seg 1	3.5	5.5	0.9	2.0	3.0
	25496 Seg 1	1.5	5.3	0.0	1.5	2.1
	25502 Seg 1	8.8	2.0	2.6	7.4	5.2
	25504 Seg 1	0.9	0.4	0.4	10.9	3.2
		8.3	**6.8**	**6.6**	**6.3**	**7.0**
Trask:	25582 Seg 1	na	2.1	0.0	2.4	1.5
	25588 Seg 1	na	25.4	10.9	11.4	15.9
	25594 Seg 1	41.8	24.8	30.0	37.3	33.5
	25594 Seg 2	33.0	7.8	5.5	11.4	14.4
	25605 Seg 2	31.5	6.2	6.8	8.2	13.2
	25606 Seg 1	0.0	0.0	4.0	4.0	2.0
	25618 Seg 1	14.8	3.3	4.1	10.9	8.3
	25622 Seg 1	12.4	5.5	3.9	6.4	7.0
	25622 Seg 2	3.3	8.6	0.0	6.7	4.6
	25624 Seg 1	5.1	15.8	7.5	1.9	7.6
	25625 Seg 1	0.0	0.0	0.0	0.0	0.0
	25627 Seg 1	2.1	0.5	0.5	0.5	0.9
		17.7	**9.2**	**7.5**	**11.0**	**11.3**
Wilson:	25636 Seg 1	na	9.5	3.3	0.0	4.3
	25640 Seg 1	11.5	7.9	7.0	3.4	7.5
	25650 Seg 1	5.5	3.5	0.7	2.2	3.0
	25664 Seg 1	1.4	2.6	1.1	1.2	1.6
	25676 Seg 1	6.0	12.5	2.0	1.8	5.6
	25679 Seg 1	0.0	0.0	0.0	0.0	0.0
	25682 Seg 1	1.8	0.9	0.9	5.6	2.3
	25685 Seg 1	1.5	0.0	0.0	0.0	0.4
		4.1	**5.2**	**2.1**	**2.0**	**3.3**
Total:		**10.3**	**7.1**	**5.4**	**6.6**	**7.3**

not have any spawners either season, although one of these sites did have spawners in 2005 (Table 3). It appears that the spawning frame that was established over the course of the project is a fairly good representation of the current spawning distribution. It is unknown at this point how the current spawning distribution compares to the historic spawning distributions.

Occurrence of Hatchery Fish in Spawner Surveys

All three of the monitoring basins have had hatchery spring Chinook salmon influences since the early 1900's, with fairly consistent hatchery smolt release numbers for the brood years that produced adult returns during this study period (Table 6). Cedar Creek hatchery on the Nestucca had releases of 110,000 annually, Trask Hatchery 245,000 annually, and Whiskey Creek Hatchery approximately 100,000 annually. All live and dead fish recorded during these spawning seasons were checked for the presence of an adipose fin showing a natural production origin. Generally, higher densities of hatchery fish were found in surveys furthest downstream, which coincide with smolt release locations (Appendix Figure C).

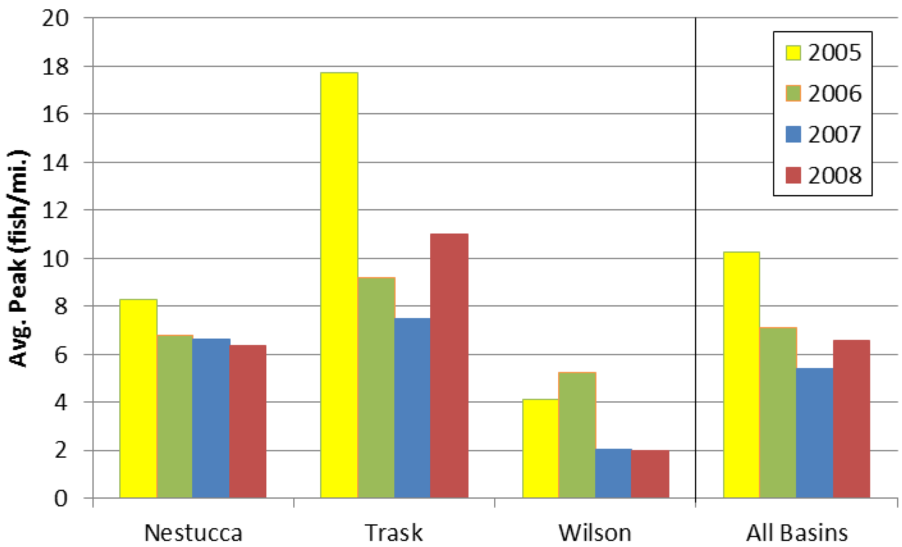

Figure 3. Average peak densities in the Nestucca, Trask, and Wilson rivers during the 2005 to 2008 survey seasons.

Table 4. Adult spring Chinook salmon abundance estimates, live observations and carcass recoveries on spawning surveys during the 2005 to 2008 seasons.

Basin	AUC Estimate		Total Live Fish				Carcasses Recovered			
	2007	2008	2005	2006	2007	2008	2005	2006	2007	2008
Nestucca:	291	288	244	297	238	260	140	171	65	60
Trask:	617	812	928	454	487	663	451	221	55	123
Wilson:	86	85	143	220	79	76	82	48	3	8
Total:	**994**	**1185**	**1315**	**971**	**804**	**999**	**673**	**440**	**123**	**191**

Annual percentage of wild origin spawners ranged from 7% to 51% in the Nestucca basin, from 20% to 42% in the Trask basin, and from 13% to 46% in the Wilson basin (Table 7). Percent wild origin spawners is calculated as the percentage of unmarked Chinook salmon (adipose fin intact) of the total recovered carcasses, by basin and year. In cases where the carcass recovery sample size is smaller than 10 for a given basin in a given year, the percent unmarked Chinook salmon is based on carcasses and live fish observations. In total, the proportion of wild produced fish decreased every year over the four years of this study, from 41% in 2005 to 17% in 2008 (Table 7).

Snouts were recovered from all adipose fin-clipped carcasses, and these snouts were sent to the ODFW lab in Clackamas to check for the presence of CWTs. According to the Pacific State Marine Fisheries Commission RMIS (Regional Mark Information System) database, hatchery spring Chinook salmon released in these three basins were marked at very high rates. All fry releases are reported as 100%, and smolt releases averaged 99.0% (± 1.4% SD) adipose

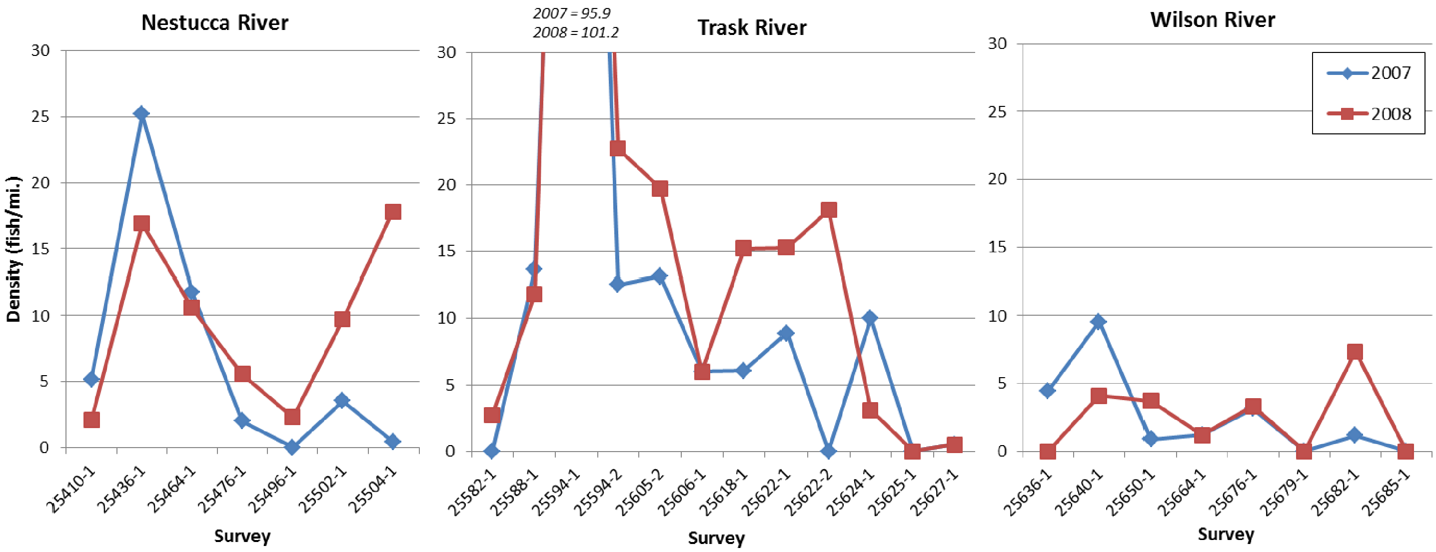

Figure 4. Summary of AUC densities (fish/mile) in all survey reaches during the 2007 and 2008 spawning seasons. Lower numbered reach ID-segments designate surveys lower in the basin. Reach 25594-1 (Trask R) had very high densities both years, and values are noted above graph.

fin-clipped prior to release, with rates varying slightly by basin and year (Table 8). The portion of all hatchery spring Chinook salmon that received a CWT prior to release also varied by basin and year, ranging from 0% to 28.2% (Table 8). A total of nine fish possessing CWTs were recovered from the Nestucca and Trask Rivers in 2007, and 22 in 2008. Of the 15 CWT fish recovered in the Nestucca, one fish was released in the Trask River (Trask stock), and the rest were Nestucca stock and releases (Table 9). Of the 16 Trask River recoveries, one fish was released in the Nestucca River (Nestucca stock) and the rest were Trask stock released in the Tillamook Bay system. Seven of the 15 Trask stock fish recovered in the Trask basin were released as smolts in the Wilson River (Table 9). The lack of CWT recoveries in the Wilson River is likely the result of the very low number of carcasses recovered there (Table 4).

Table 5. Number of sites surveyed in 2007 and 2008 and the percent of these sites occupied (AUC > 0).

Year	Basin	# of surveys	% sites with fish
2007	Nestucca	7	86%
	Trask	12	75%
	Wilson	8	75%
	Total	**27**	**78%**
2008	Nestucca	7	100%
	Trask	12	92%
	Wilson	8	63%
	Total	**27**	**85%**

Table 6. Number of spring Chinook salmon smolts and fry released per basin and in total for brood years that may have returned during the 2005-2008 spawning seasons.

	Number of Smolts Released				Number of Fry Released			
Brood Year	**Wilson**	**Trask**	**Nestucca**	**Total**	**Wilson**	**Trask**	**Nestucca**	**Total**
2000	130,575	215,192	119,664	**465,431**	14,696	0	0	**14,696**
2001	118,151	220,253	103,969	**442,373**	0	1,296	16,335	**17,631**
2002	116,388	220,608	110,467	**447,463**	12,928	16,270	61,975	**91,173**
2003	102,368	178,794	113,395	**394,557**	0	3,100	48,436	**51,536**
2004	121,611	216,568	112,560	**450,739**	15,052	30,057	37,300	**82,409**
2005	118,428	187,809	113,803	**420,040**	13,652	58,804	112,392	**184,848**
2006	102,287	209,874	119,230	**431,391**	0	19,360	19,360	**38,720**

Table 7. Summary of wild spring Chinook salmon found on spawning surveys in 2005 to 2008. Percentages are based on carcasses except where noted.

	Percent Wild Produced (Unmarked)							
Basin	**2005**	*n*	**2006**	*n*	**2007**	*n*	**2008**	*n*
Nestucca	**51%**	*108*	**30%**	*171*	**26%**	*65*	**7%**	*60*
Trask	**37%**	*345*	**32%**	*205*	**42%**	*55*	**20%**	*123*
Wilson	**46%**	*55*	**37%**	*49*	**13%**[A]	*38*[A]	**31%**[A]	*26*[A]
Total	**41%**	*508*	**32%**	*425*	**29%**	*155*	**17%**	*200*

[A] Percentage based on combined carcass and live fish observations where carcass sample size was <10

Movement of hatchery spring Chinook salmon between the Tillamook Bay and Nestucca basins was limited. Just 2 of the 31 CWT recoveries were in the adjacent basin (Table 9). There were no CWT recoveries in the study area from fish originating outside of the Tillamook and Nestucca basins. About half of the CWT fish recovered in the Trask River were released in the Wilson River. This may be because the hatchery spring Chinook salmon smolts released in the Wilson River were from Trask River stock collected at Trask hatchery, smolts from both rivers migrate through Tillamook Bay, and the two rivers enter the bay in close proximity. Because the 2005 Oregon Native Fish Status Report (ODFW 2005) considers all Tillamook Basin wild spring Chinook salmon to be a single population, this scale of fish movement was not considered to be between basin straying. Although samples sizes are small, the CWT data does provide an avenue to looking at age structure of known hatchery fish. Of the 2007 CWT recoveries, 2 were age-4 (22%) and 7 were age-5 (78%). Of the 2008 recoveries, 21 were age-4 (95%) and only 1 was age-5 (5%), (Table 9).

Population Demographics

Age of spring Chinook salmon spawners was determined by interpretation of growth patterns in the scale samples. A summary of the age structure, based on scale samples, for the 2005 through 2008 seasons is presented in Table 10. Age structure was similar across basins within each year, but varied between years in all three basins. It appears that in this period of monitoring, brood years 2000, 2002, and 2004 were stronger cohorts than brood years 2001 and 2003. This observation is most evident when looking at the fluctuation of the proportion of age-

Table 8. Percentage of released hatchery spring Chinook salmon smolts that were adipose fin-clipped and the percentage that received a CWT.

	Percent Smolts Ad Clipped			Percent Smolts CWT		
Brood Year	**Wilson**	**Trask**	**Nestucca**	**Wilson**	**Trask**	**Nestucca**
2000	98.6%	95.9%	97.8%	20.2%	12.5%	21.8%
2001	99.3%	97.7%	100.0%	0.0%	11.8%	26.0%
2002	98.4%	99.7%	98.5%	23.2%	12.1%	23.9%
2003	99.7%	99.8%	99.4%	24.6%	15.4%	21.4%
2004	99.9%	99.8%	99.7%	18.5%	28.2%	21.1%
2005	100.0%	94.8%	99.0%	0.0%	22.3%	23.0%
2006	100.0%	100.0%	100.0%	22.8%	12.8%	13.2%

Table 9. Spring Chinook salmon carcasses, recovered during the 2007 and 2008 spawning survey season, which possessed a CWT. No CWT fish were recovered in the Wilson basin.

Recovery		Age		Basin of Release		
Basin	**Year**	**Age-4**	**Age-5**	**Nestucca**	**Trask**	**Wilson**
Nestucca:	2007	0	5	5	0	0
	2008	9	1	9	1	0
Trask:	2007	2	2	1	1	2
	2008	12	0	0	7	5

4 and age-5 fish between years. For example, in 2006 and 2008 the majority of fish were age-4, while there was a majority of age-5 fish in 2005, and also in 2007 except for the Trask. Age-4 and age-5 fish combined were the majority of the age composition in all years. Age-2 fish (100% male) were recovered every year but 2005, though percent of total recoveries were quite small (mean = 5%, max = 9%) (Tables 9 and 10). Age-3 fish (83% male) were slightly more abundant than age-2, but they also made up a small percentage of total (mean =12%, max = 16%). Age-6 fish made up the smallest proportion, and they were present all years except 2008 (mean = 1%, max = 6%). Age structure of spring Chinook salmon spawners was generally similar between results based on interpretation of scales and on known age CWT fish.

Table 11 shows the average Mid-Eye to Posterior Scale (MEPS) length in millimeters, percent male, and sex ratios for each age class in all basins surveyed during the 2007 and 2008 seasons. Generally, length by age-class was similar between 2007 and 2008. The percent male decreased with increasing age in both 2007 and 2008, except for age-6 fish which may be an artifact of the small sample size (n=4) for this age class (Table 11).

Spring Chinook salmon spawn timing is shown in Figure 5 for all basins combined during the 2005 through 2008 seasons. Live fish and carcass densities peaked during the 3rd week of September while redd density peaked during the 4th week of September. Of the total live Chinook salmon observations on spawning surveys, 15% occurred in August, 79% in September, and 6% in October. Although the peak observations for live and dead fish occurred

Table 10. Age structure of spring Chinook salmon spawning populations, based on scale samples from the 2005 to 2008 spawning seasons.

			Age Structure (Percent of Total)				
Basin	**Year**	***n***	**2-year**	**3-year**	**4-year**	**5-year**	**6-year**
Nestucca	2005	*106*	0%	10%	37%	53%	1%
	2006	*178*	4%	1%	65%	25%	6%
	2007	*58*	9%	16%	26%	48%	2%
	2008	*57*	5%	14%	77%	4%	0%
Trask	2005	*339*	0%	2%	38%	60%	0%
	2006	*203*	2%	2%	73%	22%	1%
	2007	*48*	0%	10%	50%	33%	6%
	2008	*122*	7%	11%	77%	6%	0%
Wilson	2005	*55*	0%	3%	29%	67%	0%
	2006	*46*	7%	2%	74%	17%	0%
	2007	*3*	0%	0%	33%	67%	0%
	2008	*8*	0%	0%	100%	0%	0%

Table 11. Average MEPS length (mm) and standard deviation, percent males, ratio of females to 100 males, and sample size of spring Chinook salmon carcasses sampled in the Nestucca, Trask, and Wilson Rivers for 2007 and 2008.

		Age				
Year		**2-Year**	**3-Year**	**4-Year**	**5-Year**	**6-Year**
2007	Avg. Length (± SD)	399 (± 22)	636 (± 80)	720 (± 47)	766 (± 49)	830 (± 38)
	% Male	100%	86%	40%	37%	100%
	F:100M	0	17	150	171	0
	n	*5*	*14*	*40*	*46*	*4*
2008	Avg. Length (± SD)	421 (± 41)	629 (± 45)	725 (± 43)	746 (± 38)	na
	% Male	100%	81%	30%	25%	na
	F:100M	0	24	230	300	na
	n	*10*	*21*	*142*	*8*	*0*

in the same week, total carcasses recovered by month are later than total live observations. Of total carcass recoveries, 2% occurred in August, 77% in September, and 21% in October. Redd counts by month are similar to carcasses: 1% occurred in August, 81% in September, and 18% in October.

Live fish density in mid-August starts off relatively high when compared to the following 2-week time period, however the majority of the fish that make up the live observations in this time period were holding in two surveys on the lower Trask River, immediately downstream of the Trask hatchery (25588 Seg 1 on 8/16/2006 and 25594 Seg 1 on 8/16/2007). In both of these cases, crews did not get back to the surveys until September. Removing these 2 surveys from the summary gives a live fish density of 1.15 fish/mi; in contrast to the 3.03 fish/mi when included. Both of these densities are plotted in Figure 5 for comparison.

Project Summary

Objective 1) *Determine adult spring Chinook salmon abundance in the Trask, Wilson, and Nestucca Rivers:*

We successfully generated spring Chinook salmon spawner abundance estimates for 2007 and 2008 as reported in Table 2. Escapement estimates of anadromous fish species vary substantially from year to year due to many factors. One of the primary factors is likely the dynamic environmental conditions that limit abundance and survival across each life stage of a salmon. Another factor is the accuracy of the assumptions we make in our yearly abundance estimate calculations. Some of these assumptions include observer efficiency, survey life, and amount of available spawning habitat.

Observer efficiency and survey life values that were used in our calculations are static numbers taken from previous studies (Perrin and Irvine 1990; Sollazzi 1984). We acknowledge that these studies occurred in other areas and the accuracy of these values for spring Chinook salmon on the north coast of Oregon is unknown. A large portion of live fish recorded on our surveys occurred in non-wadeable (mainstem) reaches, and Solazzi expected that foot surveyors would observe a smaller percent of Chinook in mainstem spawning reaches than in tributary reaches. However, there are two reasons we believe observer efficiency may not be significantly reduced: 1) Our mainstem reaches were surveyed via boat, thus we would expect a higher observer efficiency than if we were wading these reaches; and, 2) Solazzi surveyed from October-January during relatively high flow conditions, so we would expect that our observer efficiency during low flow conditions in August-October would potentially be greater. Both the survey life and observer efficiency values are the best we have available, however, further studies could potentially provide more precise values specific to our study area and the spring Chinook salmon spawning season.

It is believed that the stream miles we identified as spring Chinook salmon habitat are relatively accurate. However, it is possible that some spawning activity could have taken place outside of our established surveys, and though we believe it would be minimal, those fish may not be represented in our estimates. It is unknown at this point how the current distribution compares to a historical distribution because we are not aware of any available data showing the full historical distribution of spring Chinook salmon in the study area.

Although we did generate spawner abundance estimates for 2007 and 2008, the data for the 2005 and 2006 seasons was not sufficiently robust to support AUC-based abundance estimates. However, there appears to be a good correspondence between the annual abundance estimate (Table 2) and peak count density (Table 3) for each of the three basins. The highest peak count densities for each basin were observed in 2005 and 2006, and the average peak count density in 2005 was nearly double the peak count density in 2007. This may infer something about the size of the returns in 2005 and 2006 when we did not produce abundance estimates. This observation also illustrates how dynamic these salmon returns can be between years in a relatively short time period. Over the course of this study, we did capture an understanding of the abundance of spring Chinook salmon in the Nestucca, Tillamook, and Trask basins. While this is valuable information, since these are dynamic populations, continued monitoring efforts are necessary.

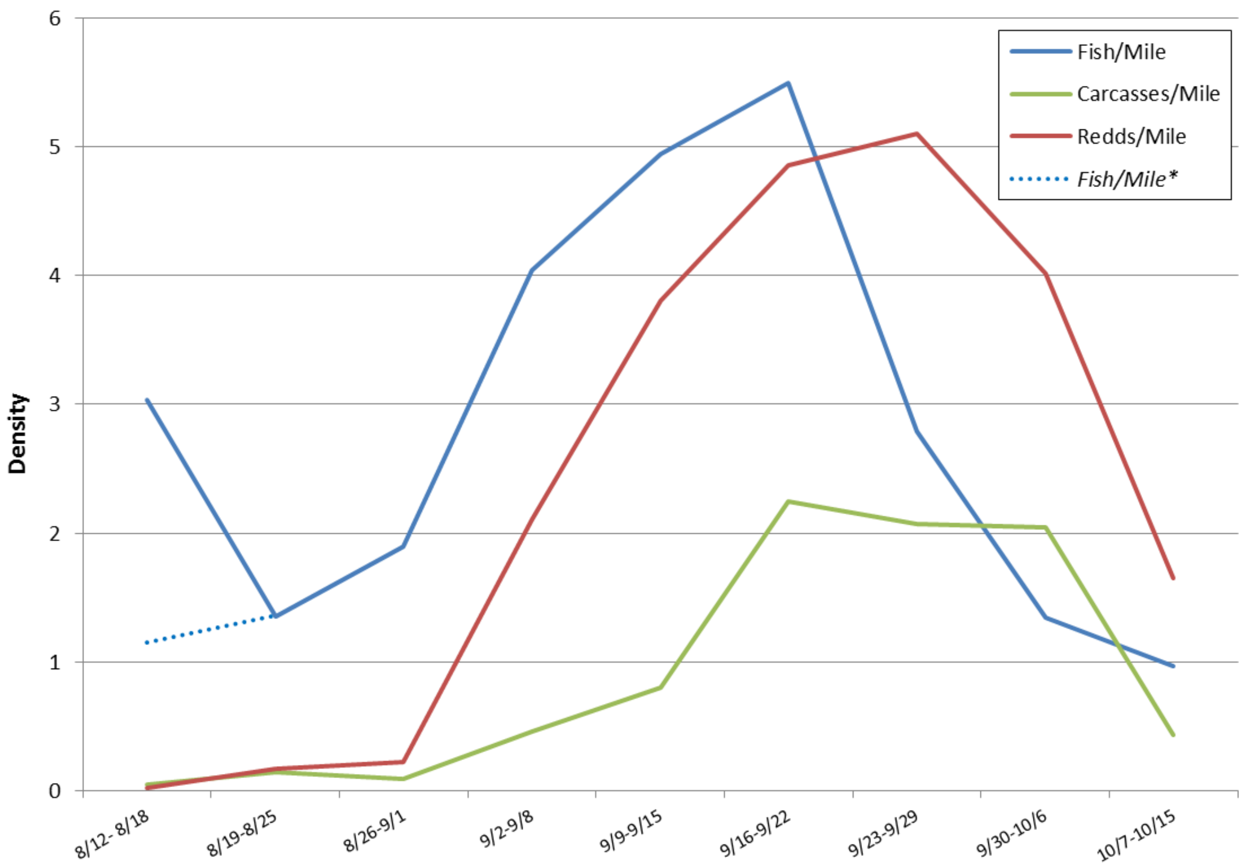

Figure 5. Temporal distribution of spring Chinook salmon live fish, carcasses and redds in the Wilson, Trask, and Nestucca River surveys during the 2005-2008 spawning seasons. **Dotted blue line shows fish/mile when discarding two survey visits in mid-August on the lower Trask River near the Trask hatchery. These two surveys had large numbers of holding fish that were not present on subsequent visits.*

Objective 2) *Determine the proportion hatchery origin spring Chinook salmon on the spawning grounds in these three basins.*

Hatchery:wild ratios were calculated in each of the four years of this study and are reported in Table 7. These ratios (reported as "percent wild" in Table 7 and inversely as "percent hatchery origin spawners" in Appendix Figure C) were determined by examining adipose fin-clip status on recovered carcasses. Over the four years of monitoring, wild produced spring Chinook salmon decreased in proportion to hatchery spring Chinook salmon every year, and in any basin and year the percent wild produced spring Chinook salmon was far less than the generic goal of 90% or more wild produced fish. Carcass numbers decreased in 2007 and 2008 as compared to 2005 and 2006, especially in the Wilson basin where sample sizes were less than 10 in 2007 and

2008. In these cases of sample size being less than 10, hatchery:wild ratios were calculated from the combination of carcasses and live fish observations, which may not be as reliable as carcass observations. While determining fin-clip status on live fish can be difficult, effort to do so should be stressed in future monitoring efforts so that the sample size of fin-clip status on live fish is large enough to use in cases where the number of carcass recoveries is small.

Objective 3) *Determine age structure and sex ratios for spring Chinook salmon spawners.*

Age structure for spring Chinook salmon was successfully determined by obtaining a large number of scale samples from carcasses and subsequently aging a vast majority of those samples through scale reading. Age structure was consistent between basins by year, but did vary between years (Table 10). When comparing cohorts represented in our study, brood years 2000, 2002, and 2004 appeared to be stronger cohorts than brood years 2001 and 2003. Age of CWT fish verified the age of a portion of those scales analyzed and aged by scale reading.

Sex ratios and average length by age were determined from spring Chinook salmon carcass data and were consistent between 2007 and 2008 (Table 11). The sex ratio of females to males increased with age, and the average length of males and females also increased with age.

Objective 4) *Determine distribution and abundance for spring Chinook salmon recycled from local ODFW hatcheries.*

Completing this objective requires tagging of recycled fish, which was only done in 2006. Results for this objective from 2006 can be found in Stewart and Suring (2008).

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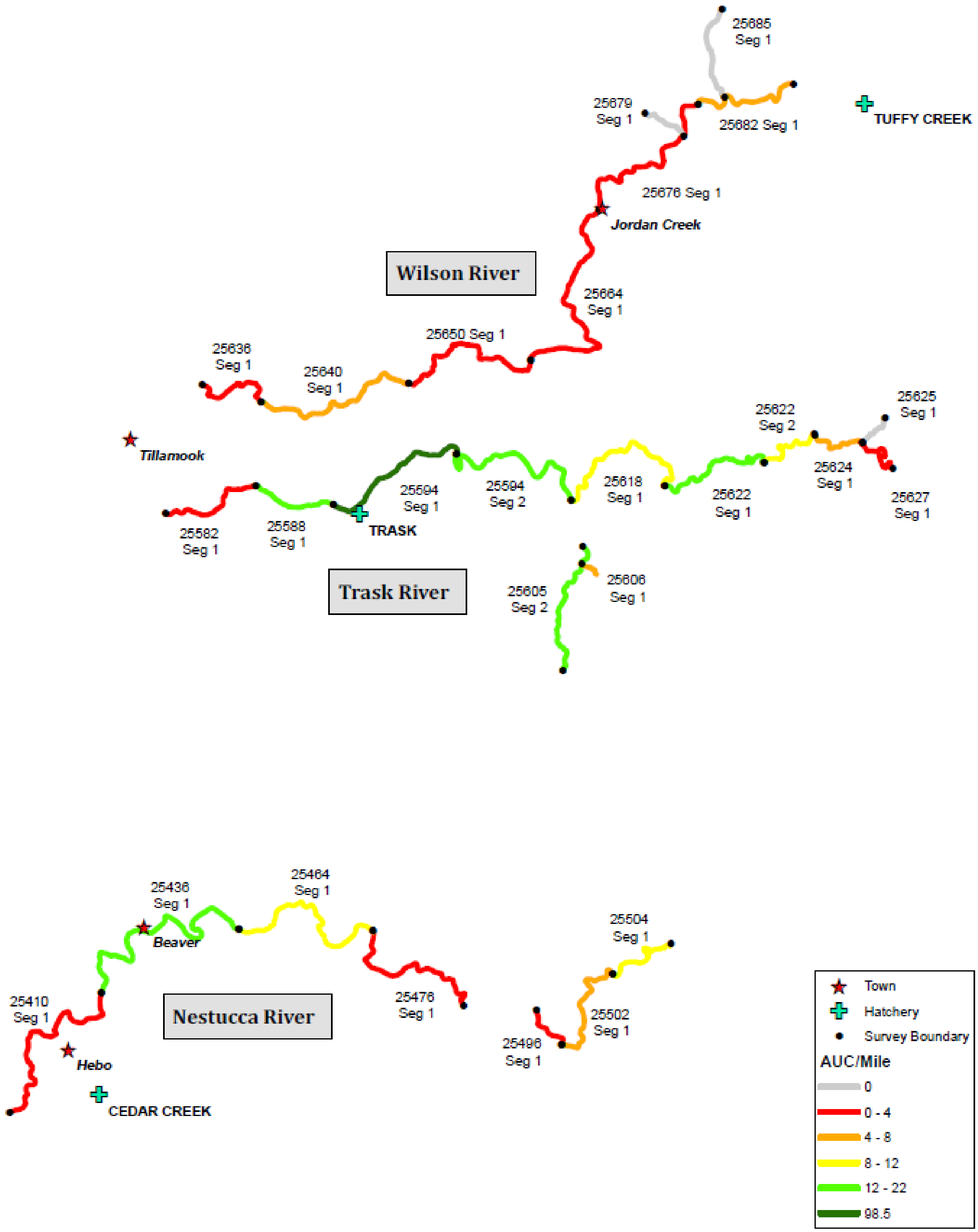
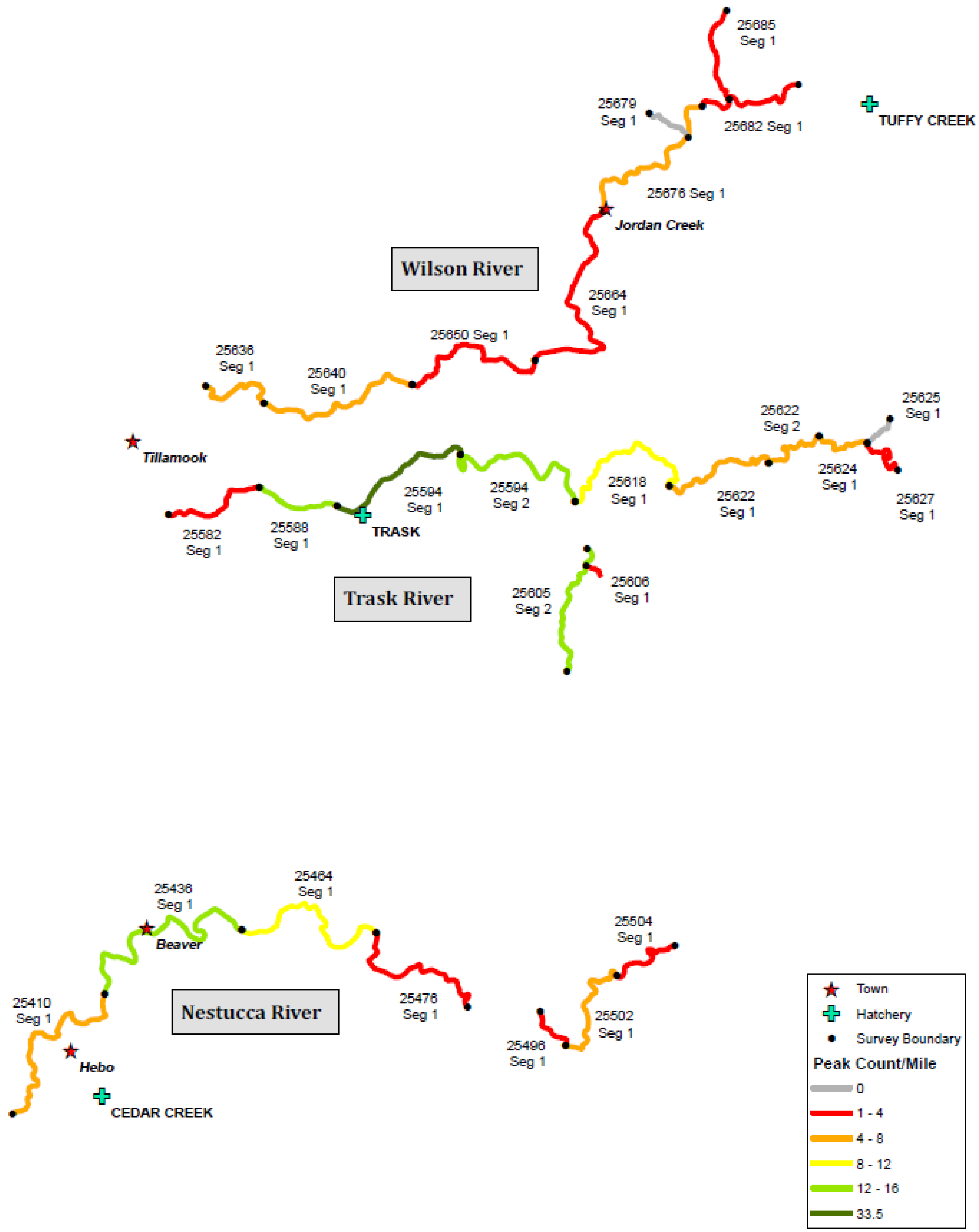
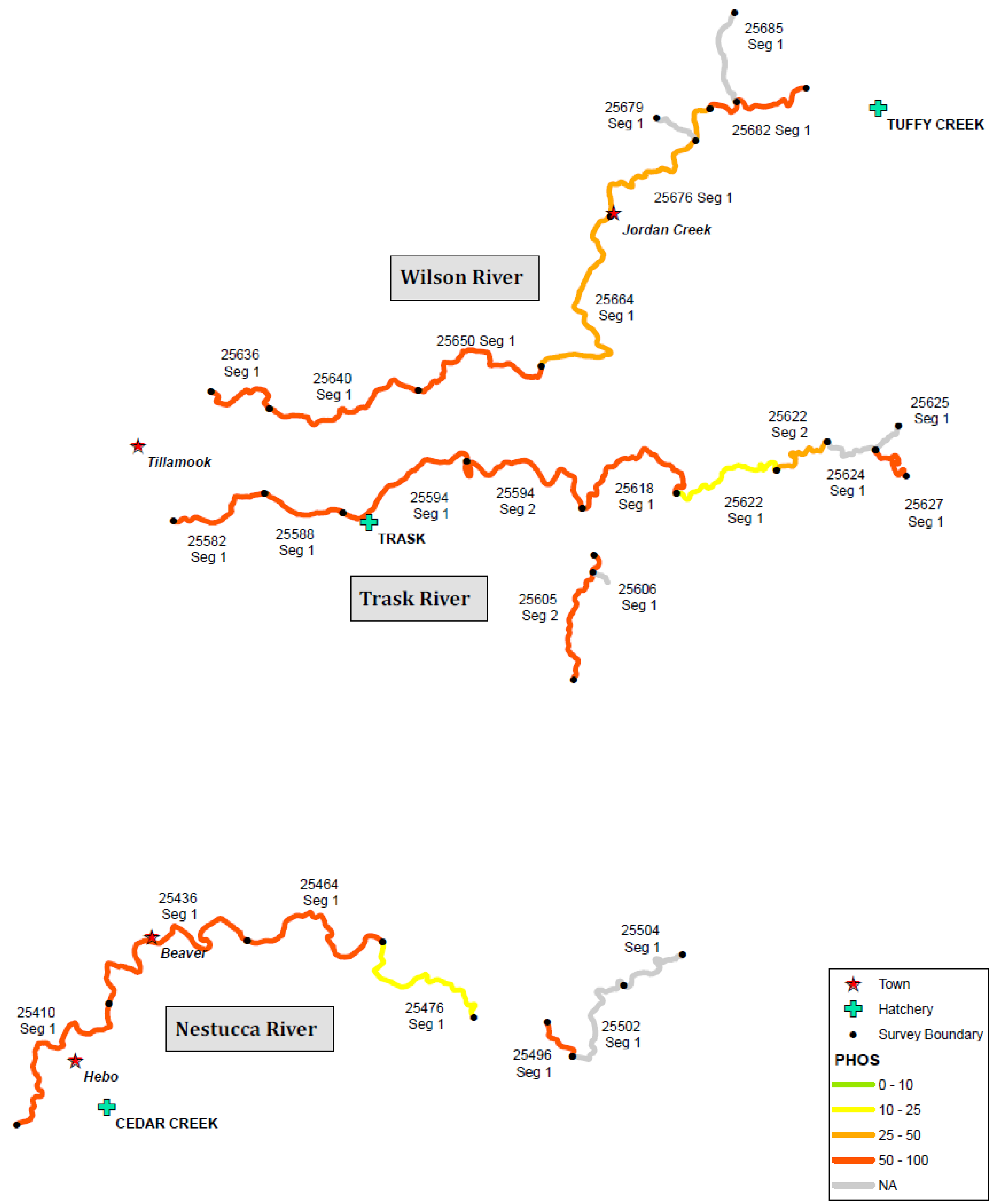
APPENDIX (DISTRIBUTION MAPS)



Appendix Figure A. Spring Chinook salmon average AUC abundance estimate densities for each survey reach from the 2007 and 2008 spawning seasons.



Appendix Figure B. Average of spring Chinook salmon peak count densities for each survey reach from the 2005 through 2008 spawning seasons.



Appendix Figure C. Average percent hatchery origin spawners for spring Chinook salmon in each survey reach from the 2007 and 2008 spawning seasons.

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