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Inventory of Fall Chinook Spawning Habitat in Mainstem Reaches of Oregon's Coastal Rivers

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TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

List of Figures

List of Tables

INTRODUCTION

The Oregon Department of Fish and Wildlife (ODFW) has completed three years of study to inventory fall Chinook (*Oncorhynchus tshawytscha)* spawning habitat in Oregon's coastal rivers. This study is part of a larger effort to develop similar high-quality escapement estimates for fall Chinook in Oregon coastal basins in order to meet Oregon's Pacific Salmon Treaty (PST) spawning escapement monitoring responsibilities. Funding for this project was provided by the U.S. Southern Boundary Committee of the Pacific Salmon Commission (PSC) pursuant to the 1999 Letter of Agreement (LOA). The PSC is comprised of fishery scientists that are responsible for the abundance-based management of north migrating fall Chinook salmon stocks covered by the Pacific Salmon Treaty.

Two stock aggregates of importance to PST fisheries have been identified to originate from Oregon coastal basins. These aggregates are thought to represent distinct genetic and behavioral characteristics and are managed separately. The North Oregon Coast (NOC) and Mid Oregon Coast (MOC) are the two stock aggregates that are north migrating, and are subject to the Chinook Technical Committee's (CTC) abundance-based management program (PSC 1997). The Umpqua River is one component of the MOC aggregate.

Current monitoring programs for Oregon coastal fall Chinook do not supply the CTC with adequate information required for the management and rebuilding of Oregon's coastal Chinook stocks. The ODFW has conducted standard spawner surveys for more than 50 years to monitor the status of Chinook stocks along coastal Oregon (Jacobs and Cooney 1997). A total of 56 standard index spawner surveys (45.8 miles) are monitored throughout 1,500 stream miles on an annual basis to estimate peak escapement levels and track trends of north-migrating stocks. Although counts in these standard surveys may be sufficient to index long-term trends of spawner abundance, they are considered inadequate for deriving dependable annual estimates of spawner escapement for two primary reasons: 1) these surveys were not selected randomly and cannot be considered representative of coast-wide spawning habitat, and 2) fall Chinook are known to spawn extensively in mainstem reaches and large tributaries, and conditions are not conducive to the foot surveys.

A 1995 habitat inventory conducted by Hodgson and Jacobs (1997) successfully verified the existence of fall Chinook spawning habitat for mainstem and large tributaries in a majority of five north coast basins. Additional habitat inventories were conducted in 1999 and 2000; and an estimated 60% of the coastal inventory had been completed at the conclusion of those studies. Documenting the extent and location of suitable fall Chinook spawning habitat in mainstem reaches may narrow the sampling universe and improve the efficiency of the fall Chinook survey procedures that are currently being evaluated (Riggers et al. 1998). This will ultimately result in improved, more efficient monitoring methods and reliable escapement estimates. This inventory was conducted in conjunction with several other CTC funded studies designed to assess fall Chinook abundance and distribution.

BACKGROUND

Mainstem reaches of the Yaquina, Smith, Coos, and Coquille Rivers have been completely inventoried, and the majority of the remaining mainstem reaches from the partial 1995 inventory (Hodgson and Jacobs 1997) of the Alsea and Siuslaw Rivers were completed in 1999. The Smith River basin, Nehalem River basin and the upper mainstem reaches of the South Umpqua River were inventoried in 2000 (Figure 1). For the Alsea River, this included the Five Rivers and Drift Creek subbasins and the lower part of the mainstem below Fall Creek. In the Siuslaw River, this included Deadwood Creek in the Lake Creek subbasin. Four reaches of the 1995 inventory in the North Fork Nehalem River were resurveyed in 1999 and 2000 for comparison of results. A total of 205 reaches comprising 649 kilometers of coastal mainstem habitat were inventoried in 1999, and 109 reaches and 235 Kilometers in 2000. A review of the Habitat Inventory database revealed that approximately 630 kilometers of mainstem reaches within MOC and NOC river basins have not been inventoried for spawning habitat prior to the start of the 2007 proposed study.

The ODFW is continuing its efforts to conduct and complete comprehensive inventories of Oregon's coastal basins for physical habitat elements associated with fall Chinook spawning sites to improve methods for estimating escapement. These inventories began during the summer low-flow period to reduce disruption caused by freshets that occur frequently during the spawning season. Identification of fall Chinook spawning habitat was based on adapted published descriptions of physical habitat associated with Chinook spawning sites to summer flow conditions. Upon final completion of the coast-wide inventory, we will then be able to refine our current database based on observations of habitat that met selected criteria. Re-surveys of about 10% of previously inventoried stream reaches will be conducted to assess annual variations of gravel distribution, habitat type and substrate composition. If significant differences are detected a correction factor will be developed and applied to past inventories to best assure that the protocol and criteria are consistent between all survey personnel.

Due to the proposed status of the Umpqua River basin as an escapement indicator basin for the MOC aggregate, ODFW harvest managers and investigators recommend that a priority be placed on completing habitat inventories in the Umpqua River basin. In 2007 surveys were completed on the South Umpqua mainstem from the mouth to Stouts Creek, the South Umpqua Cow Creek drainage from the mouth to Windy Creek, and on the North Umpqua from the mouth to Winchester Dam (located approximately 2.0 river miles upstream of Sutherlin Creek). A total of 78 reaches and 206.5 Kilometers were inventoried. Re-surveys were conducted on the upper mainstem South Umpqua for comparison to data collected for those reaches in 2000. Approximately 188.5 Kilometers remain to be surveyed in the Umpqua River basin, primarily in the lower mainstem, to complete inventories for this system.

OBJECTIVE

Document the size and distribution of spawning habitat areas within mainstem and large tributary reaches of the Umpqua River in the MOC aggregate and additional reaches throughout Oregon's NOC and MOC river aggregates as time and funding allow.

Figure 1. Map depicting the three management areas with inventoried basins in the NOC and MOC highlighted. Surveys in 2007 inventoried reaches on the North Umpqua, South Umpqua mainstem and Cow Creek drainage.

METHODS

Recent analyses indicate that coastal fall Chinook within the NOC and MOC stock aggregates use about 1,500 miles of Oregon coastal basins for spawning. Within this mileage, approximately 800 miles (53%) exist within the mainstems and large tributaries of coastal basins, which are not surveyed in conjunction with work done to estimate coho (*O. kisutch)* spawner abundance. Our approach was to conduct a modified version of the Hodgson and Jacobs (1997) study to continue our inventory of fall Chinook spawning habitat for mainstem and large tributaries of Oregon coastal rivers and streams. Our inventory and survey design has been modified to include identification and collection of data on qualitative habitat elements. These inventories began during the summer low-flow period to reduce disruption of substrate caused by freshets that occur frequently during the spawning season. Identification of fall Chinook spawning habitat was based on published descriptions of physical habitat associated with Chinook spawning sites adapted to summer flow conditions.

Survey Target Selection

Selection of the targeted area within the basin (mainstem and large tributaries) was determined using ODFW's existing database of fall Chinook spawning distribution. The partially unconfirmed database was compiled from the confirmed judgment of ODFW's coastal district biologists, coupled with stratified random coho spawner surveys conducted during 1990-1997, where at least four spawning Chinook were observed. Surveys were conducted on a reach-by-reach basis. A ***Reach*** is defined as a segment of stream extending from its mouth to headwaters, or one stream junction to an adjacent stream junction.

Criteria for Identifying Spawning Habitat

Four primary physical characteristics delineating spawning habitat are substrate composition, water depth, water velocity, and slope of the streambed (characterized in this report as ***habitat type***, i.e., pool, glide, riffle, etc.). Suitability is based upon criteria derived from the literature. Fall Chinook have been observed spawning in a wide range of conditions for each of these parameters. Values for these habitat components cited in the literature were determined during fall and early winter spawning flows. Interpreting and applying these values to conditions in low summer flows is somewhat subjective. How each of these criteria was adapted to summer conditions is discussed below.

Substrate Composition

A key component in identifying potential fall Chinook spawning habitat is the composition of substrate. Due to the large size of Chinook, they are capable of spawning in larger substrate and higher water flows than most other salmonids. Snake River fall Chinook have been observed spawning in gravel ranging from 2.5-15.2 cm (Groves 1993).

The substrate composition within each unit was broken into seven categories:

1. Fines (silt, cohesive fines, little grain structure, suspends in water column);
2. Small gravel (size range from non-cohesive sand grains to golfball);
3. Large gravel (size range from golfball to baseball);
4. Small cobble (size range from baseball to grapefruit);
5. Large cobble (size range from grapefruit to basketball);
6. Boulder (larger than a basketball); or
7. Bedrock (large, continuous, non-transported underlying rock).

The relative percentages of each of these categories was visually estimated for each unit and agreed upon by both surveyors. A unit of stream qualifying under minimum surface area criteria first had to contain suitable substrate composition of at least 50% large gravel to small cobble to qualify as a spawning habitat unit. The boundaries of each spawning habitat unit were defined by the uniformity of substrate within each unit. When composition of substrate shifted, and other qualifying criteria were met, a new spawning habitat unit would be identified and its physical data recorded.

Water Depth

Water depths in which Chinook were observed to spawn include 30-460 cm (Chapman 1943), 28-41 cm (Briggs 1953) and 10-120 cm (Bovee 1978). Surveys conducted throughout Oregon by Smith (1973) and Thompson (1972) suggested a minimum spawning depth of 24 cm. Based upon these studies, a depth of 24-100 cm under spawning flows (with 30-60 cm considered optimal) was established for this inventory. These depth criteria were not calibrated to summer flows due to the existence of dry channels where spawning would be likely under winter flows.

Depth ratings were recorded based on the following scale:

(4) – 10 to 60 cm (top of boot - top of knee) (highest rating).
(2) – 60 to 90 cm (top of knee - thigh deep).
(1) – 0 to 9 cm (surface wet - top of boot).
(0) – $\geq$90 cm (over thigh deep).

Water Velocity

Water velocities conducive to fall Chinook spawning in Oregon are reported to be 0.33-0.76 m/s (Smith, 1973). Studies outside of Oregon have produced values both similar, 0.30-0.76 m/s (Briggs 1953) and highly variable 0.37-1.89 m/s (Chapman et al. 1986). For this project, a range of 0.3-0.8 m/s has been selected as representative of water velocities utilized by spawning Oregon coastal fall Chinook. Calibrating these flows to summer conditions will be difficult. Summer flow criteria included observations of velocities ranging from a minimum of no water flow (dry channel) to a maximum of apparent surface turbulence, but not dominated by whitewater. Velocity ratings were determined according to the following scale:

(5) - moderate and gradually increasing as it flows over unit (>50% must be in tailout).
(3) - velocity is moderate and constant (i.e. glide).
(1) - velocity is minimal (i.e. pool) or too fast for ideal conditions (i.e. riffle - rapid).

If the unit encompassed portions which fell into more than one category, an average score of 2 or 4 was appointed.

Habitat Type

A habitat type was assigned to each qualifying spawning habitat unit to describe the slope of the streambed. Habitat types included riffles, glides, tailouts, and pools, and were defined by overall water depth and velocity.

In addition to these primary physical characteristics, criteria relating to the minimum substrate surface area in relation to redd size and bankfull channel width, were applied in the qualification process for classifying habitat as a *spawning habitat unit*. Tailout and pool habitats were also identified to provide a broader measure of overall habitat quality for spawning Chinook. These additional characteristics are discussed below.

Redd Size and Minimum Substrate Surface Area

Available estimates of the surface area of substrate used by fall Chinook for redd construction are wide ranging. Chapman (1943) and Burner (1951) estimated redd area for fall Chinook in tributaries of the Columbia River at 2.4-4.0 m^2 and 3.9-6.5 m^2, respectively. Conversely, Neilson and Banford (1983) found redd areas ranging from 0.5-27.5 m^2 in the Nechako River, B.C. Redd areas reported for the Hanford reach of the Columbia River were 2.1-44.8 m^2 (Chapman et al. 1986). The primary reason for this wide range of variability may be due to the differences in stream widths. The objective of this habitat inventory was to identify locations that receive a high degree of use by spawning fall Chinook in mainstem and large tributary reaches; therefore, separate criteria were used to denote minimum area of suitable habitat required for these reaches.

Mainstem and large tributaries are defined in biological terms as reaches where size and flow are not conducive to spawning activity of coho salmon (O. *kisutch*). Bankfull channel width is generally ≥ 20 m. Within these streams a minimum substrate surface area of 10 m^2 was used in conjunction with the four primary habitat criteria to qualify a section as a spawning habitat unit. For streams characterized by bankfull channel widths ≤20 m, a minimum substrate surface area of 4 m^2 was used in conjunction with primary physical criteria to qualify a section as a spawning habitat unit. A summary of physical criteria used for the inventory and how they were applied as field measurements is shown in Table 1.

Table 1. Physical criteria used to represent fall Chinook spawning habitat in Oregon coastal streams.

Criteria	Water Depth	Water Velocity	Substrate Size	Minimum Substrate Surface Area
Measured during spawning	24-100 cm	0.3-0.8 (m/s)	2-15 cm	4 m^2-(streams < 20 m wide) 10 m^2-(streams ≥ 20 m wide)
Visual Representation during summer flow	wet surface-top of thigh	Minimum: visible flow, Maximum: whitewater	≥ 50% golfball-softball sized within minimum area	same as above

Tailouts

Many authors have emphasized the importance of hyporheic flow in the choice of redd sites by Chinook. The hyporheic zone is an active ecotone between the surface stream and groundwater. Exchanges of water, nutrients, and organic matter occur in response to variations in discharge and bed topography and porosity. Upwelling subsurface water supplies stream organisms with nutrients while downwelling stream water provides dissolved oxygen and organic matter to microbes and invertebrates in the hyporheic zone. This condition is often maximized at the interface between pools and riffles (Figure 2). The preference by salmonids to spawn in such "tailout" sites has been well documented (Briggs 1953; Chapman 1943). Groot and Margolis (1991) state that "provided the condition of good sub gravel flow is met, Chinook will spawn in water that is shallow or deep, slow or fast, and where the gravel is coarse or fine." The physical criteria used in this inventory (Table 1) are designed to accommodate these features.

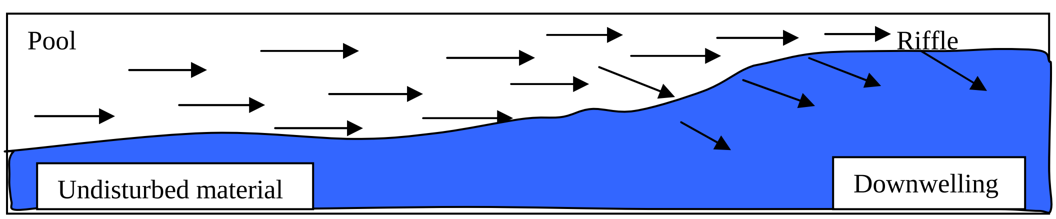

Figure 2. The pool-riffle interface creates the optimal downwelling conditions preferred by Chinook salmon for spawning (taken from Groot and Margolis 1991).

Pools

Recent studies imply a correlation of spawner abundance to channel types with high pool densities (Montgomery et al. 1999.) This relationship could be associated with cover and resting area provided from pools, or just a function of low gradients associated with pools. We documented pool habitat in conjunction with spawning habitat during this inventory. Pool units were distinguished from spawning units by recording depth on the data form. Pools are defined as a portion of a stream with reduced current velocity, often with deeper water than the surrounding area. Each qualifying pool unit had a width of at least 50% of the wetted channel width, and a length of at least one wetted channel width.

Other Features

Left and Right Bank Riparian

By consensus of surveyors, one primary and one secondary riparian type was selected for each bank from the following categories that best described the riparian zones of the left and right banks throughout the length of the Habitat Unit:

Ag - Agricultural
Cc - Clear-cut
Rp - Reproduction timber
Cf - Conifer dominated
Al - Alder dominated
Mx - Mixed hardwoods and/or conifers
Sh - Shrubs
Rs – Residential

Depositional Features

The coordinates of all depositional features that may promote carcass recoveries were recorded for each qualifying unit. This included such features as point bars, islands and backwaters.

The habitat inventories in the Umpqua Basin were conducted during three months between the first of June and end of August 2007. This time period was selected to take advantage of summer flow conditions and good visibility. Mainstem reaches and large tributaries were floated in kayaks, pontoon boats, or walked depending on flow and navigability hazards. Each contiguous patch of substrate that met our criteria was designated as a *habitat unit*, and every pool was designated as a *pool unit*. Each targeted reach was surveyed to identify the presence of habitat units and pool units. Upon designation of the unit, the location was recorded as universal transmercator (UTM) coordinates using a Garmin Map76 Global Positioning Satellite (GPS) receiver (using WGS84).

One two-person crew conducted the surveys to gathering accurate measurements of each unit using a pair of laser range finders; a 50-meter tape measure was used to measure units smaller than the rangefinder's minimum distance, to verify laser readings, and as backup method for measurements. Each qualifying habitat or pool unit was measured for length and width to the nearest 0.1 meter. Maximum depth was also measured for pool units using a graduated staff. At each unit, the bankfull channel width was measured; for longer units, average bankfull width was recorded. For each habitat unit it was also determined, by consensus of surveyors, substrate composition, water velocity and depth ratings, the percent of the unit that was within a tailout, and riparian type for left and right banks.

Waterproof field notebooks were used to record all required habitat criteria while unit data is being collected. This allowed surveyors time to review, discuss and reach consensus about ratings for habitat criteria. Once all data for a spawning habitat unit had been gathered and agreed upon, one surveyor read the notes back from the field book for recording by the second surveyor into electronic media on a handheld Personal Data Assistant (PDA). Data from PDA files were uploaded to a laptop computer at the end of each survey week.

ANALYSIS

Length, width, and depth measurements were used to determine the linear and area density of potential spawning habitat and pools within each reach. Linear habitat density was computed as the total area (m^2) of habitat units per meter of reach inventoried, and expressed as a percentage. Area habitat density factors in the variability in channel widths among reaches and was calculated as follows:

$$D_j = \frac{\sum_{i=1}^{j} h_{ij}}{l_j \bullet w_j}$$

where

D_j = percent density of potential habitat per area of channel for reach j,
h_{ij} = m^2 of estimated habitat in unit i in reach j,
l_j = length of reach j, and
w_j = mean width of channel for reach j.

Linear pool density was calculated as the total pool volume (m^3) per meter of reach inventoried. Area pool density was calculated in the same manner as the area habitat density with a component for depth of the pool unit included.

Substrate Composition

The substrate composition within each unit was divided into seven categories: fines (silt, cohesive fines), small gravel, large gravel, small cobble, large cobble, and boulder or bedrock. The relative percentage of each of these categories was visually estimated for each unit.

Overall Depth and Velocity Rating

For each unit a rating of the overall depth and velocity of the water was made. These ratings will be used at a future date to provide a general judgment of the suitability of these features for fall Chinook spawning. Higher rankings indicated higher suitability.

Depth ratings were recorded based on the following scale:

(4) – 10 to 60 cm (top of boot - top of knee) (highest rating).
(2) – 60 to 90 cm (top of knee - thigh deep).
(1) – 0 to 9 cm (surface wet - top of boot).
(0) – $\geq$90 cm (over thigh deep).

The velocity ratings were determined according to the following scale:

5 - moderate and gradually increasing as it flows over unit (>50% must be in tailout).
3 - moderate and constant (i.e. glide).
1 - minimal (i.e. pool) or too fast for ideal conditions (i.e. riffle - rapid).

If the unit encompassed portions which fell into more than one category, an average score of 2 or 4 was appointed.

Hyporheic Flow (tailouts):

The last variable of concern is the estimate of the percentage of the unit containing downwelling conditions associated with tailouts at the pool-riffle interface. Given the importance of these areas in site utilization by spawning Chinook, the larger this value the greater the suitability of the habitat within the particular unit. We rated the occurrence of this condition in each unit by estimating the proportion of the unit that was located in a tailout.

A final analysis of all units will be conducted once all coast-wide basins have had inventories completed for selected target reaches. This will ensure consistency of rating methods between study years and basins. Based upon the values obtained for each of the habitat components discussed above, a cumulative score of spawning habitat quality will be calculated for each unit. This will be determined according to the following:

$$Q_i = \frac{\left[(2V_i) + \left(\frac{S_i}{10}\right) + \left(\frac{T_i}{10}\right)\right]}{3}$$

where

Qi = habitat quality score for unit i,

Vi = velocity rating for unit i,

Si = percent gravel in substrate for unit i, and

Ti = percent of unit i in tailout.

The rating of depth was omitted from this equation due to the difficulties with interpreting ideal spawning depths during low summer flows.

To rate the quality of spawning habitat for an entire reach, unit scores will be averaged as follows:

$$Q_j = \frac{\sum_{i=1}^{j} Q_i}{n_j}$$

where

Qj = average habitat quality for reach j, and

nj = number of units in reach j.

The overall suitability of a given reach for spawning or reach score (Rj) will be calculated as:

$$R_j = Q_j \bullet D_j \ .$$

RESULTS

Surveys began in mid June 2007 and concluded on August 31, 2007. Focus was placed on completing as much of the targeted surveys remaining to be inventoried in the Umpqua River basin. A total of 78 reaches and 206.5 Kilometers were surveyed including the South Umpqua mainstem from the mouth to Stouts Creek, the South Umpqua Cow Creek drainage from the mouth to Windy Creek, and on the North Umpqua from the mouth to Winchester Dam (approximately 2.0 river miles upstream of Sutherlin Creek). Approximately 188.5 Kilometers remain in the Umpqua River basin, primarily in the lower mainstem, to complete inventories for this system.

The total length surveyed, reach area surveyed, habitat area and pool volume were summarized by subbasin for all units inventoried in 2007 (Table 2). The data was also summarized on a reach-by-reach basis for habitat area, pool volume, linear habitat density, area habitat density, linear pool volume, and area pool density (Appendix A).

Table 2. Total area surveyed by subbasin in 2007 with the total habitat area and pool volume calculated for each.

Basin	Subbasin	Length Surveyed (km)	Area Surveyed (km^2)	Habitat Area (m^2)	Pool Volume (m^3)
Umpqua River	North Umpqua	11.26	1,566.94	59,225	808,464
	South Umpqua mainstem	110.55	12,030.90	596,380	5,096,771
	South Umpqua, Cow Creek	84.64	3,403.20	138,026	202,772

Linear habitat density, area habitat density, linear pool density and area pool density were summarized by subbasin (Table 3). The North Umpqua subbasin was identified as having the greatest proportion of suitable Chinook spawner habitat within its respective river channel, with about 3% of the river channel identified as containing spawning habitat. The inventoried mainstem reaches of the South Umpqua subbasin had a recorded spawner habitat density of 1.45%, and the Cow Cr drainage of the South Umpqua had a slightly higher rating for spawner habitat density of 1.54%.

The highest area pool density was also recorded in the North Umpqua River at 13.97%, with the mainstem South Umpqua rated at 11.11%. The marked difference in area pool densities between the smaller Cow Cr drainage (2.8%) may be a factor of the much smaller overall bankfull channel width as compared to the larger mainstem reaches. Another influence may have been the very low water levels observed throughout the basin beginning in mid June 2007. With very low summer flows, water velocity ratings combined with other criteria associated with various habitat classifications may have resulted in some units being recorded as pools which are more likely to be associated with long, deep glides during winter flow regimes. For example, one unit in the North Umpqua River had a length of 1850 m, a bankfull channel width of 130 m, and a maximum depth of 7.5 m. At low water velocities, this unit appeared to be a very large, continuous pool. A similar correlation was noted in the South Umpqua River mainstem reaches with two pool units exceeding 1000 m in length with associated bankfull channel widths in excess of 130 m. Units of this size could add significantly larger than true dimensions to the overall density of pool habitat for these subbasins. Conversely, the longest unit in the Cow Creek drainage was recorded at 398 m in length and a bankfull channel width of 51 m.

Table 3. Linear and area density results by subbasin for reaches surveyed during Chinook habitat inventories conducted in 2007.

Subbasin	**Linear Habitat Density**	**Area Habitat Density**	**Linear Pool Density**	**Area Pool Density**
North Umpqua R, mouth to Winchester Dam	220.89	3.00	1204.08	13.97
South Umpqua R, mouth to Stouts Cr	136.59	1.45	1061.63	11.11
South Umpqua, Cow Cr Drainage	84.30	1.54	142.45	2.86

RECOMMENDATIONS

1. Perform cluster analysis of inventoried reaches and spawner distribution based on habitat quality parameters that may influence fall Chinook spawning behavior and location (e.g. substrate composition, slope and orientation, proximity to resting pools and tail outs, channel width).

2. Analyze spawner abundance based on distance above tidewater in conjunction with habitat parameters.

3. Document stream features that may contribute to carcass distribution and aggregation.

4. Complete the habitat inventory in the remaining basins and portions thereof (Appendix B) including: lower Umpqua basin, Elk River, Sixes River, Yachats River, Upper Alsea (North and South Fork) River, Salmon River, Nestucca River, Trask River, Kilchis River, Necanicum River and Miami River basins. Priority should be placed on the remaining Umpqua River basin consisting of approximately 188 kilometers of reaches within mainstem habitat.

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Kennedy and Dan Hoesly for their dedicated fieldwork, and sense of adventure while sharing the riverbanks with local cattle populations. And finally, we wish to thank the U.S. section, Southern Boundary Committee for providing funding to continue our Chinook habitat inventories.

LITERATURE CITED

Bovee, K.D. 1978. Probability-of-use criteria for the family Salmonidae. U.S. Fish Wild. Serv. FWS/obs-78/07; Instream Flow Inf. Paper 4:80 p.

Briggs, J.C. 1953. The behavior and reproduction of salmonid fishes in a small coastal stream. Calif. Dep. Fish Game Fish. Bull. 94:62 p.

Burner, C.J. 1951. Characteristics of spawning nests of Columbia River salmon. Fish. Bull. Fish Wildl. Serv. 61:97-110.

Chapman, W.M. 1943. The spawning of chinook salmon in the main Columbia River. Copeia 1943:168-170.

Chapman, D.W., D.E. Weitcamp, T.L. Welsh, M.B. Dell, and T.H. Schadt. 1986. Effects of river flow on the distribution of chinook salmon redds. Trans. Am. Fish. Soc. 115:537-547.

Groot, C. and L. Margolis. 1991. Pacific salmon life histories. University of British Columbia Press, Vancouver, BC. pp. 312-393.

Groves, P.A. 1993. Habitat available for, and used by, fall chinook salmon within Hells Canyon Reach of the Snake River. Annual Report 1992. Environmental Affairs Department, Idaho Power Company, Boise, ID.

Hodgson, B.L. and S.E. Jacobs. 1997. Inventory of Spawning Habitat Used by Oregon Coastal all Chinook Salmon. Oregon Department of Fish and Wildlife, Corvallis Research Department Project Report.

Jacobs, S.E. and Cooney, C.X. 1997. Oregon coastal salmon surveys, 1994-1995. Oregon Department of Fish and Wildlife, Ocean Salmon Management Information Report, Portland.

Montgomery, D. R., E. M. Beamer, G. R. Pess, and T. P. Quinn, 1999. Channel Type and Salmonid Spawning Distribution and Abundance. Can. J. Fish Aquat. Sci. 56: 377-387.

Neilson, J.D. and C.E. Banford. 1983. Chinook salmon (*Onchorynchus tshawytscha*) spawner characteristics in relation to redd physical features. Can J. Zool. 61:1524-1531.

Riggers, B. R., S. E. Jacobs, and J. White. 1998. Calibration of Methods to Survey for Fall Chinook Salmon in North Fork Nehalem and South Fork Coos Rivers. Oregon Department of Fish and Wildlife, Annual Report, September 1998, 27 p.

Smith, A.K. 1973. Development and application of spawning velocity and depth criteria for Oregon salmonids. Trans. Am. Fish. Soc. 102:312-316.

Thompson, K. 1972. Determining stream flows for fish life. In Proceedings, Instream Flow Requirement Workshop. Pac. N.W. River Basin Comm., Vancouver, Wash. pp. 31-50.

APPENDIX A

Results from 2007 inventory surveys.

APPENDIX A-1. Results of fall Chinook habitat inventory for the reaches completed on the North Umpqua, 2007.

Reach ID	Reach	Start	End	Reach Length (miles)	Reach Length (m)	Reach Avg Chan Width (m)	Reach Area (m^2)	Habitat Units	Pool Units	Total Units	Habitat Area (m^2)	Total Pool Volume (m^3)	Linear Habitat Density (%)	Area Habitat Density	Linear Pool Density	Area Pool Density	Average Percent Tailout
23617.00	N Umpqua	Mouth	Sutherlin Cr	5.00	8,046.00	140.79	1,132,829.47	28	6	34	36,597.60	756,358.00	4.55	0.03	94.00	0.67	1.76
23627.00	N Umpqua	Sutherlin Cr	Winchester Dam	2.00	3,218.40	134.88	434,112.65	23	3	26	22,627.50	52,106.00	7.03	0.05	16.19	0.12	2.69
TOTALS: 2				**7.00**	**11,264.40**		**1,566,942.12**	**51**	**9**	**60**	**59225.10**	**808464.00**	**11.58**	**0.08**	**110.19**	**0.79**	**4.46**

APPENDIX A-2. Results of fall Chinook habitat inventory for the reaches completed on the South Umpqua, 2007.

Reach ID	Reach	Start	End	Reach Length (miles)	Reach Length (m)	Reach Avg Chan Width (m)	Reach Area (m^2)	Habitat Units	Pool Units	Total Units	Habitat Area (m^2)	Total Pool Volume (m^3)	Linear Habitat Density (%)	Area Habitat Density	Linear Pool Density	Area Pool Density	Average Percent Tailout
22974.00	S Umpqua	Mouth	Champagne Cr	0.50	804.60	165.00	132759.00	0	2	2	0.00	149028.00	0.00	0.00	185.22	1.12	0
22984.00	S Umpqua	Champagne Cr	Stockel Cr	1.60	2574.72	147.80	380543.62	15	0	15	9426.00	0.00	3.66	0.02	0.00	0.00	6.86
22986.00	S Umpqua	Stockel Cr	Newton Cr	6.20	9977.04	150.76	1504157.55	35	7	42	33127.00	460296.70	3.32	0.02	46.14	0.31	0
22988.00	S Umpqua	Newton Cr	Deer Cr	2.30	3701.16	148.87	550990.08	15	8	23	6217.30	896117.40	1.68	0.01	242.12	1.63	2.67
23000.00	S Umpqua	Deer Cr	Roberts Cr	5.10	8206.92	136.93	1123747.53	33	8	41	60146.58	683081.80	7.33	0.05	83.23	0.61	0.61
23002.00	S Umpqua	Roberts Cr	Marsters Cr	1.30	2091.96	169.47	354532.17	16	3	19	12072.40	120984.00	5.77	0.03	57.83	0.34	0.00

APPENDIX A-2 (cont). Results of fall Chinook habitat inventory for the reaches completed on the South Umpqua, 2007.

Reach ID	Reach	Start	End	Reach Length (miles)	Reach Length (m)	Reach Avg Chan Width (m)	Reach Area (m^2)	Habitat Units	Pool Units	Total Units	Habitat Area (m^2)	Total Pool Volume (m^3)	Linear Habitat Density (%)	Area Habitat Density	Linear Pool Density	Area Pool Density	Average Percent Tailout
23004.00	S Umpqua	Marsters Cr	Lookingglass Cr	7.60	12229.92	135.27	1654387.87	68	16	84	93687.65	945949.90	7.66	0.06	77.35	0.57	3.09
23044.00	S Umpqua	Lookingglass Cr	Brockway Cr	0.50	804.60	126.00	101379.60	1	1	2	196.00	45511.20	0.24	0.00	56.56	0.45	0.00
23046.00	S Umpqua	Brockway Cr	Kent Cr	1.00	1609.20	129.00	207586.80	4	1	5	4711.50	16321.20	2.93	0.02	10.14	0.08	0.00
23056.00	S Umpqua	Kent Cr	Rice Cr	2.00	3218.40	117.50	378162.00	19	1	20	13097.26	12006.00	4.07	0.03	3.73	0.03	9.47
23064.00	S Umpqua	Rice Cr	Willis Cr	0.80	1287.36	117.00	150621.12	7	3	10	9261.00	8035.80	7.19	0.06	6.24	0.05	17.14
23068.00	S Umpqua	Willis Cr	S Umpqua, Clark Br	3.20	5149.44	114.44	589324.80	20	7	27	31613.00	215302.10	6.14	0.05	41.81	0.37	2.00
23072.00	S Umpqua	S Umpqua, Clark Br	Van Dine Cr	4.30	6919.56	108.09	747914.18	33	13	46	74541.50	428196.00	10.77	0.10	61.88	0.57	1.52
23074.00	S Umpqua	Van Dine Cr	Myrtle Cr	2.30	3701.16	98.07	362960.42	19	11	30	17193.11	266926.25	4.65	0.05	72.12	0.74	5.26
23132.00	S Umpqua	Myrtle Cr	Judd Cr	5.20	8367.84	95.47	798875.15	54	12	66	81598.85	211997.30	9.75	0.10	25.33	0.27	3.89
23134.00	S Umpqua	Judd Cr	Cow Cr	2.60	4183.92	103.34	432358.91	26	8	34	44382.00	124731.10	10.61	0.10	29.81	0.29	3.08
23384.00	S Umpqua	Cow Cr	Jordan Cr	3.40	5471.28	114.53	626622.48	39	12	51	36874.50	147622.05	6.74	0.06	26.98	0.24	6.79
23388.00	S Umpqua	Jordan Cr	Canyon Cr	0.50	804.60	79.00	63563.40	1	0	1	936.00	0.00	1.16	0.01	0.00	0.00	0.00
23404.00	S Umpqua	Canyon Cr	O'Shea	0.50	804.60	88.75	71408.25	4	0	4	3468.50	0.00	4.31	0.05	0.00	0.00	0.00
23406.00	S Umpqua	O'Shea	Small Cr	0.70	1126.44	72.00	81103.68	3	0	3	1915.50	0.00	1.70	0.02	0.00	0.00	0.00

APPENDIX A-2 (cont). Results of fall Chinook habitat inventory for the reaches completed on the South Umpqua, 2007.

Reach ID	Reach	Start	End	Reach Length (miles)	Reach Length (m)	Reach Avg Chan Width (m)	Reach Area (m^2)	Habitat Units	Pool Units	Total Units	Habitat Area (m^2)	Total Pool Volume (m^3)	Linear Habitat Density (%)	Area Habitat Density	Linear Pool Density	Area Pool Density	Average Percent Tailout
23408.00	S Umpqua	Small Cr	Morgan Cr	1.30	2091.96	68.50	143299.26	2	0	2	3803.00	0.00	1.82	0.03	0.00	0.00	0.00
23410.00	S Umpqua	Morgan Cr	Weaver Cr	0.30	482.76	73.67	35563.32	2	1	3	542.00	2359.80	1.12	0.02	4.89	0.07	20.00
23412.00	S Umpqua	Weaver Cr	Clough Gulch Cr	1.40	2252.88	83.20	187439.62	4	1	5	7980.00	28014.00	3.54	0.04	12.43	0.15	22.50
23414.00	S Umpqua	Clough Gulch Cr	Packard Gulch Cr	0.40	643.68	64.00	41195.52	0	1	1	0.00	9009.00	0.00	0.00	14.00	0.22	0.00
23416.00	S Umpqua	Packard Gulch Cr	Beckworth Cr	1.10	1770.12	59.00	104437.08	2	1	3	1313.50	10192.00	0.74	0.01	5.76	0.10	0.00
23418.00	S Umpqua	Beckworth Cr	Stinger Gulch Cr	0.40	643.68	57.00	36689.76	2	0	2	1620.00	0.00	2.52	0.04	0.00	0.00	0.00
23420.00	S Umpqua	Stinger Gulch Cr	Days Cr	1.20	1931.04	68.11	131525.28	5	4	9	4821.00	21483.60	2.50	0.04	11.13	0.16	0.00
23442.00	S Umpqua	Days Cr	Dietch Cr	1.00	1609.20	60.25	96954.30	5	3	8	3115.00	56696.40	1.94	0.03	35.23	0.58	0.00
23442.90	S Umpqua	Dietch Cr	Beals Cr	1.40	2252.88	60.29	135816.48	5	2	7	2649.00	24395.00	1.18	0.02	10.83	0.18	2.00
23448.00	S Umpqua	Beals Cr	Slimwater Cr	0.60	965.52	53.33	51494.40	2	1	3	3538.00	1472.50	3.66	0.07	1.53	0.03	0.00
23450.00	S Umpqua	Slimwater Cr	Hammon Cr	1.40	2252.88	70.86	159632.64	5	2	7	5631.00	44883.30	2.50	0.04	19.92	0.28	0.00
23452.00	S Umpqua	Hammon Cr	Bland Br	0.40	643.68	0.00	0.00	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23454.00	S Umpqua	Bland Br	Shively Cr	1.10	1770.12	64.44	114074.40										

APPENDIX A-2 (cont). Results of fall Chinook habitat inventory for the reaches completed on the South Umpqua, 2007.

Reach ID	Reach	Start	End	Reach Length (miles)	Reach Length (m)	Reach Avg Chan Width (m)	Reach Area (m^2)	Habitat Units	Pool Units	Total Units	Habitat Area (m^2)	Total Pool Volume (m^3)	Linear Habitat Density (%)	Area Habitat Density	Linear Pool Density	Area Pool Density	Average Percent Tailout
23408.00	S Umpqua	Small Cr	Morgan Cr	1.30	2091.96	68.50	143299.26	2	0	2	3803.00	0.00	1.82	0.03	0.00	0.00	0.00
23410.00	S Umpqua	Morgan Cr	Weaver Cr	0.30	482.76	73.67	35563.32	2	1	3	542.00	2359.80	1.12	0.02	4.89	0.07	20.00
23412.00	S Umpqua	Weaver Cr	Clough Gulch Cr	1.40	2252.88	83.20	187439.62	4	1	5	7980.00	28014.00	3.54	0.04	12.43	0.15	22.50
23414.00	S Umpqua	Clough Gulch Cr	Packard Gulch Cr	0.40	643.68	64.00	41195.52	0	1	1	0.00	9009.00	0.00	0.00	14.00	0.22	0.00
23416.00	S Umpqua	Packard Gulch Cr	Beckworth Cr	1.10	1770.12	59.00	104437.08	2	1	3	1313.50	10192.00	0.74	0.01	5.76	0.10	0.00
23418.00	S Umpqua	Beckworth Cr	Stinger Gulch Cr	0.40	643.68	57.00	36689.76	2	0	2	1620.00	0.00	2.52	0.04	0.00	0.00	0.00
23420.00	S Umpqua	Stinger Gulch Cr	Days Cr	1.20	1931.04	68.11	131525.28	5	4	9	4821.00	21483.60	2.50	0.04	11.13	0.16	0.00
23442.00	S Umpqua	Days Cr	Dietch Cr	1.00	1609.20	60.25	96954.30	5	3	8	3115.00	56696.40	1.94	0.03	35.23	0.58	0.00
23442.90	S Umpqua	Dietch Cr	Beals Cr	1.40	2252.88	60.29	135816.48	5	2	7	2649.00	24395.00	1.18	0.02	10.83	0.18	2.00
23448.00	S Umpqua	Beals Cr	Slimwater Cr	0.60	965.52	53.33	51494.40	2	1	3	3538.00	1472.50	3.66	0.07	1.53	0.03	0.00
23450.00	S Umpqua	Slimwater Cr	Hammon Cr	1.40	2252.88	70.86	159632.64	5	2	7	5631.00	44883.30	2.50	0.04	19.92	0.28	0.00
23452.00	S Umpqua	Hammon Cr	Bland Br	0.40	643.68	0.00	0.00	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23454.00	S Umpqua	Bland Br	Shively Cr	1.10	1770.12	64.44	114074.40										

APPENDIX A-3. Results of fall Chinook habitat inventory for the reaches completed on the South Umpqua, Cow Creek drainage, 2007.

Reach ID	Reach	Start	End	Reach Length (miles)	Reach Length (m)	Reach Avg Chan Width (m)	Reach Area (m^2)	Habitat Units	Pool Units	Total Units	Habitat Area (m^2)	Total Pool Volume (m^3)	Linear Habitat Density (%)	Area Habitat Density	Linear Pool Density	Area Pool Density	Average Percent Tailout
23135.00	Cow Cr	Mouth	Mitchell Cr	0.7	1126.44	60.80	68487.55	3	2	5	4608.5	5686.8	4.09	0.07	5.05	0.08	0
23141.00	Cow Cr	Ash Cr	Jerry Cr	2.3	3701.16	51.42	190317.54	13	6	19	8603	12509.7	2.32	0.05	3.38	0.07	0
23143.00	Cow Cr	Jerry Cr	Russell Cr	2	3218.40	60.75	195517.80	4	0	4	2677	0	0.83	0.01	0.00	0.00	0
23145.00	Cow Cr	Russell Cr	Catching Cr	1.4	2252.88	35.33	79601.76	2	1	3	574	1224	0.25	0.01	0.54	0.02	0
23147.00	Cow Cr	Catching Cr	Council Cr	2	3218.40	54.00	173793.60	1	0	1	900	0	0.28	0.01	0.00	0.00	0
23151.00	Cow Cr	Council Cr	Crawford Br	0.6	965.52	0.00	0.00	0	0	0	0	0	0.00	0.00	0.00	0.00	0
23153.00	Cow Cr	Crawford Br	Beatty Cr	1.5	2413.80	56.00	135172.80	3	2	5	2996.2	6292.4	1.24	0.02	2.61	0.05	0
23155.00	Cow Cr	Beatty Cr	Alder Cr	0.5	804.60	70.14	56436.94	5	2	7	2523	6667.2	3.14	0.04	8.29	0.12	0
23157.00	Cow Cr	Alder Cr	Island Cr	0.5	804.60	42.80	34436.88	2	3	5	1310	6452.4	1.63	0.04	8.02	0.19	0
23159.00	Cow Cr	Island Cr	Salt Cr	0.6	965.52	49.70	47986.34	6	4	10	8738	37029.4	9.05	0.18	38.35	0.77	0
23161.00	Cow Cr	Salt Cr	Doe Cr	1	1609.20	51.60	83034.72	2	3	5	1155	4024	0.72	0.01	2.50	0.05	0
23167.00	Cow Cr	Doe Cr	Buck Cr	0.5	804.60	86.00	69195.60	1	0	1	1417	0	1.76	0.02	0.00	0.00	0
23169.00	Cow Cr	Buck Cr	Smith Cr	0.5	804.60	64.07	51548.04	11	4	15	21032.5	8843.7	26.14	0.41	10.99	0.17	0
23171.00	Cow Cr	Smith Cr	Iron Mtn Cr	0.5	804.60	35.33	28429.20	3	0	3	3556	0	4.42	0.13	0.00	0.00	0

APPENDIX A-3 (cont). Results of fall Chinook habitat inventory for the reaches completed on the South Umpqua, Cow Creek drainage, 2007.

Reach ID	Reach	Start	End	Reach Length (miles)	Reach Length (m)	Reach Avg Chan Width (m)	Reach Area (m^2)	Habitat Units	Pool Units	Total Units	Habitat Area (m^2)	Total Pool Volume (m^3)	Linear Habitat Density (%)	Area Habitat Density	Linear Pool Density	Area Pool Density	Average Percent Tailout
23173.00	Cow Cr	Iron Mtn Cr	Table Cr	3.6	5793.12	54.24	314213.79	35	11	46	42938.5	22488.4	7.41	0.14	3.88	0.07	0
23175.00	Cow Cr	Table Cr	Little Dads Cr	0.4	643.68	64.00	41195.52	3	0	3	2741	0	4.26	0.07	0.00	0.00	0
23177.00	Cow Cr	Little Dads Cr	Cattle Cr	0.6	965.52	66.00	63724.32	4	1	5	2480.5	11059.2	2.57	0.04	11.45	0.17	0
23179.00	Cow Cr	Cattle Cr	Boulder Cr (Calf Cr)	0.8	1287.36	59.23	76251.32	12	1	13	5183.5	2898	4.03	0.07	2.25	0.04	0
23181.00	Cow Cr	Boulder Cr	Union Cr	0.4	643.68	41.00	26390.88	1	1	2	260	2295	0.40	0.01	3.57	0.09	0
23183.00	Cow Cr	Union Cr	Short Cr	1.2	1931.04	54.00	104276.16	2	1	3	306	8316	0.16	0.00	4.31	0.08	0
23185.00	Cow Cr	Short Cr	Darby Cr	1.4	2252.88	50.20	113094.58	4	1	5	1392	403.2	0.62	0.01	0.18	0.00	0
23187.00	Cow Cr	Darby Cr	Cow Cr, W Fk	3.2	5149.44	47.56	244907.37	18	7	25	9696	8738	1.88	0.04	1.70	0.04	0
23188.00	Cow Cr, W Fk	Mouth	Jacob Cr	1.4	2252.88	41.88	94339.35	8	0	8	2191.34	0	0.97	0.02	0.00	0.00	0
23243.00	Cow Cr	Cow Cr, W Fk	Middle Cr	0.4	643.68	34.67	22314.24	3	0	3	2004	0	3.11	0.09	0.00	0.00	0
23266.00	Cow Cr	Middle Cr	Susan Cr	0.8	1287.36	44.50	57287.52	0	4	4	0	4864.5	0.00	0.00	3.78	0.08	0
23268.00	Cow Cr	Susan Cr	Riffle Cr	1.7	2735.64	46.50	127207.26	4	6	10	2129	6445.05	0.78	0.02	2.36	0.05	0
23272.00	Cow Cr	Riffle Cr	Skull Cr	1	1609.20	50.63	81465.75	4	4	8	1131.5	2760.5	0.70	0.01	1.72	0.03	22.5

APPENDIX A-3 (cont). Results of fall Chinook habitat inventory for the reaches completed on the South Umpqua, Cow Creek drainage, 2007.

Reach ID	Reach	Start	End	Reach Length (miles)	Reach Length (m)	Reach Avg Chan Width (m)	Reach Area (m^2)	Habitat Units	Pool Units	Total Units	Habitat Area (m^2)	Total Pool Volume (m^3)	Linear Habitat Density (%)	Area Habitat Density	Linear Pool Density	Area Pool Density	Average Percent Tailout
23274.00	Cow Cr	Skull Cr	Dads Cr	0.5	804.60	42.33	34061.40	0	3	3	0	11333.8	0.00	0.00	14.09	0.33	0
23280.00	Cow Cr	Dads Cr	Tuller Cr	1.1	1770.12	39.40	69742.73	2	0	2	309	0	0.17	0.00	0.00	0.00	0
23282.00	Cow Cr	Tuller Cr	Panther Cr	2.5	4023.00	37.10	149253.30	1	9	10	273	21674.4	0.07	0.00	5.39	0.15	0
23284.00	Cow Cr	Panther Cr	Perkins Cr	0.4	643.68	0.00	0.00	0	0	0	0	0	0.00	0.00	0.00	0.00	0
23286.00	Cow Cr	Perkins Cr	Rattlesnake Cr	0.4	643.68	36.00	23172.48	0	1	1	0	3662.4	0.00	0.00	5.69	0.16	0
23290.00	Cow Cr	Rattlesnake Cr	Totten Cr	2.5	4023.00	41.29	166092.43	1	6	7	175	5307.5	0.04	0.00	1.32	0.03	0
23292.00	Cow Cr	Totten Cr	McCullough Cr	1	1609.20	0.00	0.00	0	0	0	0	0	0.00	0.00	0.00	0.00	0
23297.00	Cow Cr	McCullough Cr	Section Cr	2.2	3540.24	31.00	109747.44	0	2	2	0	567.5	0.00	0.00	0.16	0.01	0
23297.70	Cow Cr	Section Cr	Windy Cr	0.7	1126.44	49.40	55646.14	2	3	5	105	916	0.09	0.00	0.81	0.02	0
23305.00	Cow Cr	Windy Cr	Swamp Cr	5.9	9494.28	0.00	0.00	0	NS	NS	NS	NS	NS	NS	NS	NS	NS
23305.70	Cow Cr	Swamp Cr	Woodford Cr	0.9	1448.28	0.00	0.00	0	NS	NS	NS	NS	NS	NS	NS	NS	NS
23307.00	Cow Cr	Woodford Cr	Cow Cr, , Fortune Br	0.5	804.60	0.00	0.00	0	NS	NS	NS	NS	NS	NS	NS	NS	NS
23309.00	Cow Cr	Cow Cr, , Fortune Br	Quines Cr	2.5	4023.00	53.40	214828.20	14	1	15	4620.25	312.8	1.15	0.02	0.08	0.00	0

Appendix B. Remaining Basins to be inventoried for fall Chinook spawner habitat.

REACH ID	BA	SU	REACH	START	END	LENGTH
21491.00	55	1	ELK R	MOUTH	CEDAR CR	0.6
21491.30	55	1	ELK R	CEDAR CR	KNAPP CR	0.6
21491.50	55	1	ELK R	KNAPP CR	CAMP CR	1.9
21491.70	55	1	ELK R	CAMP CR	INDIAN CR	2.8
21493.00	55	1	ELK R	INDIAN CR	BAGLEY CR	1.3
21494.10	55	1	ELK R	BAGLEY CR	KRIEGER CR	2.9
21495.00	55	1	ELK R	KRIEGER CR	ROCK CR	1.1
21497.00	55	1	ELK R	ROCK CR	CHAPMAN CR	1.1
21501.00	55	1	ELK R	ANVIL CR	BALD MTN CR	2.2
21537.00	54	1	SIXES R	CRYSTAL CR	BEAVER CR	2.3
21539.00	54	1	SIXES R	BEAVER CR	EDSON CR	2.2
21541.00	54	1	SIXES R	EDSON CR	DRY CR	1
21545.00	54	1	SIXES R	DRY CR	ELEPHANT ROCK	5.4
21547.00	54	1	SIXES R	ELEPHANT	SIXES R, S FK	1
21549.00	54	1	SIXES R	SIXES R, S FK	OTTER CR	1.7
21551.00	54	1	SIXES R	OTTER CR	SIXES R, M FK	3.5
21553.00	54	1	SIXES R	SIXES R, M FK	SUGAR CR	2.4
22648.00	43	1	MILL CR	FOOTLOG CR	PUCKET CR	1.6
22650.00	43	1	MILL CR	PUCKET CR	DOUBLE BARREL	1
22652.00	43	1	MILL CR	DOUBLE	CAMP CR	1
22679.00	43	1	UMPQUA R	WELLS CR	GOLDEN CR	0.7
22681.00	43	1	UMPQUA R	GOLDEN CR	BURCHARD CR	2
22685.00	43	1	UMPQUA R	BURCHARD CR	WEATHERLY CR	1.6
22687.00	43	1	UMPQUA R	WEATHERLY	LUTSINGER CR	1.2
22689.00	43	1	UMPQUA R	LUTSINGER CR	BUTLER CR	0.9
22691.00	43	1	UMPQUA R	BUTLER CR	SCOTT CR	1.8
22693.00	43	1	UMPQUA R	SCOTT CR	PARADISE CR	2.3
22701.00	43	1	UMPQUA R	PARADISE CR	SAWYER CR	3.5
22703.00	43	1	UMPQUA R	SAWYER CR	ELK CR	5.8
22704.00	43	3	ELK CR	MOUTH	LITTLE TOM	2.3
22706.00	43	3	ELK CR	LITTLE TOM	HANCOCK CR	2.1
22708.00	43	3	ELK CR	HANCOCK CR	BIG TOM FOLLEY	4.2
22714.00	43	3	ELK CR	BIG TOM	BRUSH CR	3.3
22819.00	43	3	UMPQUA R	ELK CR	HEDDIN CR	4
22821.00	43	1	UMPQUA R	HEDDIN CR	FITZPATRICK CR	1.5
22823.00	43	1	UMPQUA R	FITZPATRICK	MEHL CR	1.2
22825.00	43	1	UMPQUA R	MEHL CR	WILLIAMS CR	3.5
22827.00	43	1	UMPQUA R	WILLIAMS CR	BRADS CR	1.8
22829.00	43	1	UMPQUA R	BRADS CR	MARTIN CR	4.5
22831.00	43	1	UMPQUA R	MARTIN CR	WAGGONER CR	5.5
22833.00	43	1	UMPQUA R	WAGGONER	MCGEE CR	1.6
22835.00	43	1	UMPQUA R	MCGEE CR	YELLOW CR	6.6
22843.00	43	1	UMPQUA R	YELLOW CR	LITTLE CANYON	0.4
22847.00	43	1	UMPQUA R	LITTLE	LOST CR	3.5
22849.00	43	1	UMPQUA R	LOST CR	BASIN CR	1.5

REACH ID	BA	SU	REACH	START	END	LENGTH
22851.00	43	1	UMPQUA R	BASIN CR	LEONARD CR	2.5
22853.00	43	1	UMPQUA R	LEONARD CR	PORTER CR	0.7
22855.00	43	1	UMPQUA R	PORTER CR	WOLF CR	2.7
22865.00	43	1	UMPQUA R	WOLF CR	COUGAR CR	3.3
22867.00	43	1	UMPQUA R	COUGAR CR	BOTTLE CR	4
22869.00	43	1	UMPQUA R	BOTTLE CR	HUBBARD CR	1.9
22881.00	43	1	UMPQUA R	HUBBARD CR	MILL CR	1.9
22885.00	43	1	UMPQUA R	MILL CR	CALAPOOYA CR	1.4
22890.00	43	6	CALAPOOYA CR	COON CR	DODGE CANYON	1.3
22892.00	43	6	CALAPOOYA CR	DODGE	WILLIAMS CR	2.1
22896.00	43	6	CALAPOOYA CR	WILLIAMS CR	CABIN CR	4.3
22973.00	43	1	UMPQUA R	CALAPOOYA	TURKEY CR	4
22973.70	43	1	UMPQUA R	TURKEY CR	N UMPQUA R	5.2
23005.00	43	5	LOOKINGGLASS	MOUTH	OLALLA CR	7
23075.00	43	5	MYRTLE CR	MOUTH	N MYRTLE CR	1
23305.00	43	5	COW CR	WINDY CR	SWAMP CR	4.5
23305.70	43	5	COW CR	SWAMP CR	WOODFORD CR	0.9
23627.00	43	4	N UMPQUA R	SUTHERLIN CR	DIXON CR	5.3
23629.00	43	4	N UMPQUA R	DIXON CR	CLOVER CR	0.9
23631.00	43	4	N UMPQUA R	CLOVER CR	OAK CR	2
23633.00	43	4	N UMPQUA R	OAK CR	BULL CR	1.5
23635.00	43	4	N UMPQUA R	BULL CR	COOPER CR	2
23637.00	43	4	N UMPQUA R	COOPER CR	HUNTLEY CR	2.5
23639.00	43	4	N UMPQUA R	HUNTLEY CR	FORDICE CR	0.9
23641.00	43	4	N UMPQUA R	FORDICE CR	LITTLE R	3
23719.00	43	4	N UMPQUA R	LITTLE R	BRADLEY CR	1.2
23721.00	43	4	N UMPQUA R	BRADLEY CR	FRENCH CR	0.8
23723.00	43	4	N UMPQUA R	FRENCH CR	BRITT CR	1.6
23727.00	43	4	N UMPQUA R	BRITT CR	ROCK CR	3
24558.00	30	1	YACHATS R	CEDAR CR	REEDY CR	0.5
24560.00	30	1	YACHATS R	REEDY CR	MARKS CR	0.5
24562.00	30	1	YACHATS R	MARKS CR	BEAMER CR	0.5
24564.00	30	1	YACHATS R	BEAMER CR	CARSON CR	0.5
24566.00	30	1	YACHATS R	CARSON CR	BEND CR	0.5
24568.00	30	1	YACHATS R	BEND CR	WINTERS CR	0.5
24570.00	30	1	YACHATS R	WINTERS CR	HELMS CR	0.5
24572.00	30	1	YACHATS R	HELMS CR	AXTELL CR	0.5
24574.00	30	1	YACHATS R	AXTELL CR	YACHATS R, N FK	0.5
24843.00	28	4	ALSEA R, N FK	RYDER CR	HAYDEN CR	0.8
24845.00	28	4	ALSEA R, N FK	HAYDEN CR	SEELEY CR	0.3
24845.70	28	4	ALSEA R, N FK	SEELEY CR	CROOKED CR	1
24876.00	28	5	ALSEA R, S FK	MOUTH	BUMMER CR	0.5
24884.00	28	5	ALSEA R, S FK	BUMMER CR	HEADRICK CR	0.5
24886.00	28	5	ALSEA R, S FK	HEADRICK CR	TOBE CR	0.5
24973.00	25	2	ELK CR	GRANT CR	FEAGLES CR	0.8
24975.00	25	2	ELK CR	FEAGLES CR	SPOUT CR	0.17

REACH ID	BA	SU	REACH	START	END	LENGTH
25271.00	16	1	SALMON R	MINK CR	SALMON CR	0.4
25277.00	16	1	SALMON R	SALMON CR	FRAZER CR	0.4
25279.00	16	1	SALMON R	FRAZER CR	BAXTER CR	0.6
25281.00	16	1	SALMON R	BAXTER CR	DEER CR	0.6
25287.00	16	1	SALMON R	DEER CR	WILLIS CR	1.4
25289.00	16	1	SALMON R	WILLIS CR	CURL CR	0.5
25291.00	16	1	SALMON R	CURL CR	PANTHER CR	0.5
25295.00	16	1	SALMON R	PANTHER CR	BEAR CR	1
25297.00	16	1	SALMON R	BEAR CR	SLICK ROCK CR	1.6
25301.00	16	1	SALMON R	SLICK ROCK	WIDOW CR	1.4
25305.00	16	1	SALMON R	WIDOW CR	ALDER BROOK	0.5
25307.00	16	1	SALMON R	ALDER BROOK	TREAT R	0.3
25357.00	13	4	LITTLE	FALL CR	KELLOW CR	0.5
25359.00	13	4	LITTLE	KELLOW CR	SQUAW CR	0.5
25361.00	13	4	LITTLE	SQUAW CR	AUSTIN CR	0.1
25365.00	13	4	LITTLE	AUSTIN CR	BEAR CR	1
25367.00	13	4	LITTLE	BEAR CR	MCKNIGHT CR	1.8
25369.00	13	4	LITTLE	MCKNIGHT CR	LITTLE NESTUCCA	0.1
25410.00	13	1	NESTUCCA R	SANDERS CR	HARTNEY CR	1
25412.00	13	1	NESTUCCA R	HARTNEY CR	THREE RIVERS	1
25413.00	13	2	THREE RIVERS	MOUTH	CEDAR CR	4.5
25418.00	13	2	THREE RIVERS	CEDAR CR	POLLARD CR	2.5
25420.00	13	2	THREE RIVERS	POLLARD CR	LAWRENCE CR	0.5
25422.00	13	2	THREE RIVERS	LAWRENCE CR	ALDER CR	0.2
25432.00	13	1	NESTUCCA R	THREE RIVERS	GEORGE CR	1
25434.00	13	1	NESTUCCA R	GEORGE CR	FARMER CR	1
25436.00	13	1	NESTUCCA R	FARMER CR	SALING CR	1
25438.00	13	1	NESTUCCA R	SALING CR	WEST CR	1
25440.00	13	1	NESTUCCA R	WEST CR	BEAVER CR	1
25452.00	13	1	NESTUCCA R	BEAVER CR	FOLAND CR	1.2
25458.00	13	1	NESTUCCA R	FOLAND CR	WOLFE CR	1.2
25462.00	13	1	NESTUCCA R	WOLFE CR	TONY CR	1.2
25464.00	13	1	NESTUCCA R	TONY CR	BOULDER CR	1.3
25468.00	13	1	NESTUCCA R	BOULDER CR	BAYS CR	1.2
25470.00	13	1	NESTUCCA R	BAYS CR	ALDER CR	1.2
25472.00	13	1	NESTUCCA R	ALDER CR	MOON CR	1.2
25476.00	13	1	NESTUCCA R	MOON CR	LIMESTONE CR	1.2
25478.00	13	1	NESTUCCA R	LIMESTONE	MORRIS CR	1.5
25480.00	13	1	NESTUCCA R	MORRIS CR	POWDER CR	1.2
25484.00	13	1	NESTUCCA R	POWDER CR	NIAGARA CR	1.2
25490.00	13	1	NESTUCCA R	NIAGARA CR	CLARENCE CR	1.2
25492.00	13	1	NESTUCCA R	CLARENCE CR	SLICK ROCK CR	1.2
25494.00	13	1	NESTUCCA R	SLICK ROCK	MINA CR	1.4
25496.00	13	1	NESTUCCA R	MINA CR	BIBLE CR	1.2
25500.00	13	1	NESTUCCA R	BIBLE CR	TESTAMENT CR	1.2
25502.00	13	1	NESTUCCA R	TESTAMENT	BEAR CR	2

REACH ID	BA	SU	REACH	START	END	LENGTH
25504.00	13	1	NESTUCCA R	BEAR CR	ELK CR	1.2
25510.00	13	1	NESTUCCA R	ELK CR	FAN CR	1.5
25586.00	9	1	TRASK R	MILL CR	GREEN CR	1
25588.00	9	1	TRASK R	GREEN CR	HANENKRAT CR	1.6
25590.00	9	1	TRASK R	HANENKRAT	GOLD CR	1.1
25594.00	9	1	TRASK R	GOLD CR	CEDAR CR	1
25596.00	9	1	TRASK R	CEDAR CR	HATCHERY CR	2
25598.00	9	1	TRASK R	HATCHERY CR	BLUE RIDGE CR	1.1
25600.00	9	1	TRASK R	BLUE RIDGE	BILL CR	1.4
25600.70	9	1	TRASK R	BILL CR	SAMSON CR	1
25602.00	9	1	TRASK R	SAMSON CR	RAWE CR	1.1
25604.00	9	1	TRASK R	RAWE CR	TRASK R, N FK	1.1
25605.00	9	3	TRASK R, S FK	MOUTH	TRASK R, S FK, E	4.6
25606.20	9	3	E FK OF S FK	SCOTCH CR	PIGEON CR	1.4
25606.40	9	3	E FK OF S FK	PIGEON CR	BALES CR	0.2
25611.00	9	3	TRASK R, S FK	TRASK R, S FK,	EDWARDS CR	0.5
25618.00	9	2	TRASK R, N FK	MOUTH	CLEAR CR, #1	2
25620.00	9	2	TRASK R, N FK	CLEAR CR, #1	BARK SHANTY CR	1
25622.00	9	2	TRASK R, N FK	BARK SHANTY	MICHAEL CR	5.5
25622.90	9	2	TRASK R, N FK	MICHAEL CR	CLEAR CR #2	1.2
25720.00	7	1	KILCHIS R	COAL CR	MURPHY CR	0.7
25722.00	7	1	KILCHIS R	MURPHY CR	MAPES CR	0.7
25724.00	7	1	KILCHIS R	MAPES CR	MYRTLE CR	0.7
25726.00	7	1	KILCHIS R	MYRTLE CR	THOMAS CR	1
25728.00	7	1	KILCHIS R	THOMAS CR	CLEAR CR	0.7
25730.00	7	1	KILCHIS R	CLEAR CR	WATERTANK CR	0.7
25732.00	7	1	KILCHIS R	WATERTANK	KILCHIS R, LITTLE	0.7
25744.00	7	1	KILCHIS R	KILCHIS R,	SCHOOL CR	1
25746.00	7	1	KILCHIS R	SCHOOL CR	WASHOUT CR	0.7
25748.00	7	1	KILCHIS R	WASHOUT CR	SHARP CR	0.7
25750.00	7	1	KILCHIS R	SHARP CR	SLIDE CR	1.5
25752.00	7	1	KILCHIS R	SLIDE CR	TILTON CR	0.7
25754.00	7	1	KILCHIS R	TILTON CR	BLUE STAR CR	0.7
25756.00	7	1	KILCHIS R	BLUE STAR CR	ZIGZAG CANYON	0.7
25758.00	7	1	KILCHIS R	ZIGZAG	KILCHIS R, S FK	0.7
25794.00	6	1	MIAMI R	PETERSON CR	MARGARY CR	0.3
25794.70	6	1	MIAMI R	MARGARY CR	STUART CR	0.8
25796.00	6	1	MIAMI R	STUART CR	PROUTY CR	0.2
26205.00	1	1	NECANICUM R	CIRCLE CR	DIEHL CR	2
26205.70	1	1	NECANICUM R	DIEHL CR	MEYER CR	1
26207.00	1	1	NECANICUM R	MEYER CR	HAWLEY CR	1.7
26209.00	1	1	NECANICUM R	HAWLEY CR	VOLMER CR	0.2
26211.00	1	1	NECANICUM R	VOLMER CR	KLOOTCHIE CR	1
26215.00	1	1	NECANICUM R	KLOOTCHIE	JOHNSON CR	0.4
26217.00	1	1	NECANICUM R	JOHNSON CR	MAIL CR	0.6
26219.00	1	1	NECANICUM R	MAIL CR	NECANICUM R, S	1.5