Science Bulletin

Oregon Department of Fish and Wildlife

Number 2025-05
Conservation & Recovery Program

Status of Habitat Conditions in the Clatskanie River and Scappoose Bay Population Units

This report should be cited as:

Strickland, M.J. and S.E. Crowley. 2025. Status of Habitat Conditions in the Clatskanie River and Scappoose Bay Population Units. Science Bulletin 2025-05. Oregon Department of Fish and Wildlife, Salem.

Status of Habitat Conditions in the Clatskanie River and Scappoose Bay Population Units

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March 2025

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ABSTRACT

In this report we summarize results of habitat surveys for two Columbia River coho salmon populations in the Lower Columbia Coho Salmon Evolutionary Significant Unit (ESU). Habitat data were collected during the winter of 2013 (February – April) and using a spatially balanced survey selection process (Generalized Random Tessellation Stratification; GRTS) we surveyed 65 unique sites within the range of coho salmon spawning or rearing. Surveys occurred entirely within the Clatskanie River and Scappoose Bay populations. We used a Habitat Limiting Factors Model (HLFM) to estimate habitat capacity for winter coho parr and the HabRate model to assess habitat quality for each surveyed stream reach. HLFM estimates were expanded based on the total coho distribution in each population. While there was not a significant difference in the quantity of coho rearing habitat between the two populations or across land use types or petrology, the HLFM predicted Scappoose Bay had the potential to support more juvenile coho (1,349 parr/km). HLFM results indicated the Scappoose Bay population had more individual survey sites that could support greater than 1,850 parr/km suggesting that population also has more high-quality habitat. Based on these results, high quality habitat in the Scappoose Bay population is approximately 10% greater than the Clatskanie population across the distribution of coho salmon spawning and rearing. In addition, we detected a difference in reproductive habitat quality (spawning and emergence) between both populations and dominant petrology. At the population scale, the Clatskanie River had a greater percentage of gravel substrate, while the Scappoose had an overall greater percentage of fine sediment substrate type.

This report is organized into the following summaries describing freshwater habitat conditions for the Clatskanie River and Scappoose Bay coho populations within the Lower Columbia Coho ESU:

1) Status of channel and valley attributes, stream morphology, substrate composition, and instream wood.

2) Presence of attributes that suggest active habitat forming processes such as beaver activity, instream restoration structures, debris jams, and mass wasting.

3) Summary of land use and geology across populations and association with instream habitat.

4) Describe winter habitat capacity and habitat quality for rearing juvenile coho salmon using a life stage model platform, Habitat Limiting Factors Model (HLFM) version 7.0 (version 5.0 in Nickelson et al. 1992a).

5) Describe overall habitat quality for coho salmon using HabRate (Burke et al. 2010)

6) Identify and describe potential chum salmon spawning habitat.

INTRODUCTION

The Lower Columbia River Conservation and Recovery Plan for Oregon Populations of Salmon and Steelhead (ODFW 2010) serves as both a federal recovery plan and state conservation plan for Oregon fish populations listed under the federal Endangered Species Act (ESA). The Lower Columbia Plan was designed to implement actions needed to conserve and recover salmon and steelhead in the Oregon portion of an area designated as the Lower Columbia River (LCR) sub-domain. This includes the Columbia River and its tributaries in Oregon and Washington from Hood River downstream but excludes the Willamette River and tributaries upstream of Willamette Falls. The plan addresses fish population units with geographic and evolutionary similarities called Evolutionarily Significant Units (ESUs) for federal ESA-listed salmon. These fish population groups are further subdivided into three geographically based strata: Coast, Cascade, and Gorge. To contribute towards monitoring objectives described in the Lower Columbia Plan, we conducted winter habitat surveys in two independent coho populations (Figure 1) within the Coast stratum (Clatskanie River and Scappoose Bay) to determine the status of tributary habitat as it relates to coho salmon (*Oncorhynchus kisutch*) and chum salmon (*Oncorhynchus keta*).

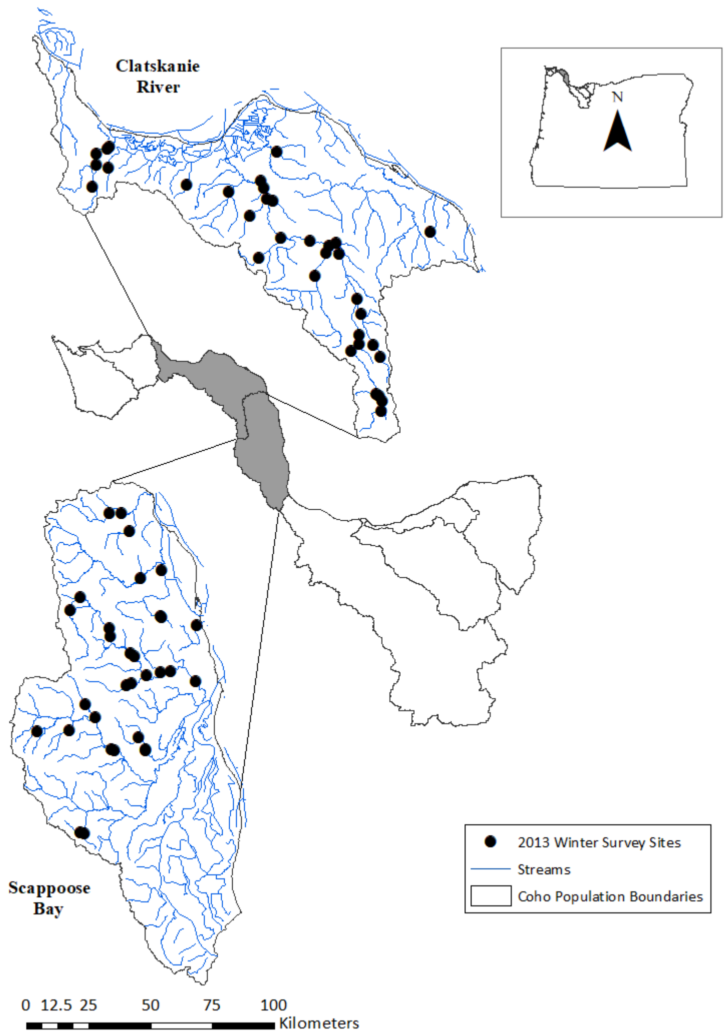

Figure 1. Location of completed 2013 winter habitat surveys within the Clatskanie River and Scappoose Bay populations in the Coast stratum of the Lower Columbia Coho ESU.

The plan indicated that within tributary streams across populations, quality habitat and a lack of stream complexity were common limiting factors. Channel complexity can be indicative of higher quality habitat and essential winter rearing habitat for juvenile coho salmon, particularly during high flow conditions (Nickelson and Lawson 1998, ODFW 2005, Ebersole et al. 2006). An analysis in the Oregon Coast Coho Conservation Plan for the State of Oregon (ODFW 2007) indicated that high quality winter habitat in Oregon coastal subbasins can produce ≥ 1,850 parr/km. This potential habitat capacity represents a large freshwater survival buffer that may help coho persist though extended periods of poor ocean survival. We used this concept and applied it to the Clatskanie River and Scappoose Bay populations. The Habitat Limiting Factors Model (HLFM) (Nickelson et al. 1992a, Nickelson et al. 1992b, Nickelson 1998) estimates the capacity of streams to support juvenile salmon based on quantitative descriptions of winter habitat. The model assigns value to the size, type, and complexity of habitat units, giving highest value to slow water pools such as alcoves and beaver ponds and pools with large wood.

Because winter habitat limits the capacity of most coastal streams to support juvenile coho (Rodgers et al. 2005), accurate estimates of winter habitat are essential to life cycle modeling and to meet objectives of the Oregon Lower Columbia Plan. Additionally, seasonal changes in the periodicity and distribution of beaver activity make it difficult to assess the status of winter habitat provided by beaver except with winter surveys (Romer et al. 2007).

Surveying at the population scale created a unique opportunity to work collaboratively with ODFW's Program to Restore Oregon's Chum Salmon (PROCS). The objective of this project is to reestablish naturally spawning populations of chum salmon in the Lower Columbia River tributaries. In 2013, PROCS prioritized their efforts by geographic strata, focusing initial efforts within the Coast stratum, specifically the Clatskanie River and Scappoose Bay population units. The 2013 winter habitat surveys were conducted in these two population units to assist in identifying the distribution and abundance of potential chum spawning sites. Following these survey efforts, Scappoose was eliminated from further consideration as a reintroduction location, and focus has since shifted to the Clatskanie River and select sites in the Big Creek basin (Youngs Bay population unit).

At the time of these winter habitat surveys, Chum salmon were considered functionally extirpated from the Oregon side of the Columbia River and only three populations were present on the Washington side; Grays River, Washougal, and Lower Gorge (Johnson et al. 1997). The recovery strategy employed by the Chum Reintroduction Project is to identify and address limiting factors, re-establish chum populations, and monitor effectiveness.

This report discusses findings from stream habitat surveys conducted between February and April of 2013. The survey sites were randomly selected and spatially balanced within the distribution of juvenile and adult coho using the Generalized Random Tessellation Stratified (GRTS) sample design (Stevens 2002). Surveys represented wadeable streams (primarily 1^{st} – 3^{rd} order) across the Clatskanie River and Scappoose Bay populations within the Lower Columbia Coho ESU. We (1) describe the status of winter habitat in each population, (2) quantify and summarize the habitat capacity for juvenile coho salmon in each population, (3) compare stream conditions and habitat capacities between populations, land use, and geology, (4) describe the status of potential chum salmon spawning habitat.

METHODS

Study Area and Site Selection

We used a GRTS design to select spatially balanced points within both the Clatskanie River and Scappoose Bay populations (Stevens 2002). Additional details of population scale site selection are described in Strickland et al. (2018). The identified populations fall within the Coast monitoring stratum of the Lower Columbia Coho ESU. The stratum is composed of coho salmon population areas based on population dynamics, genetic information, geographic distribution, species life history, and morphological traits (Lawson et al. 2004, Wainwright et al. 2006). The underlying lithology of the region is primarily marine sandstones, basaltic volcanic rock, and intrusive igneous rock (Spies et al. 2002). The regional climate is heavily influenced by marine processes, and winter temperatures generally fluctuate between 5˚ and 15˚C (Spies et al. 2002). Precipitation, primarily rain, generally ranges from 100 cm to 200 cm per year. Land ownership in the region is a mix of private and federal lands and urban, agricultural, and forest land uses.

Stream Habitat Surveys

Sites surveyed by the Aquatic Inventories Project were approximately one kilometer in length, and data collection adhered to protocols developed by Moore et al. (2007). Attributes collected and summarized at the reach level described physical habitat, channel morphology, substrate composition and instream wood (Table 1). Habitat data were collected during winter conditions (February – April) and were used to describe the status, capacity, and quality of habitat at the population scale.

Table 1. Habitat attributes used in report analyses, categorized by general stream template grouping.

Habitat Category	Habitat Attribute
Channel and Valley Form	Valley Width Index (VWI)
	Active Channel Height (m) (ACH)
	Active Channel Width (m)* (ACW)
	Channel Gradient (%)*
	Width to Depth Ratio
Stream Morphology	Primary Channel Length
	Primary Channel Area
	Secondary Channel Length
	Secondary Channel Area (%)*
	Pool Habitat (%)*
	Slack Water Pool Habitat (%)*
	Residual Pool Depth (m)*
	Riffle Depth (m)
	Units per 100 meters
	Number of Pools
Substrate Composition	% Fines (weighted by habitat unit area)*
	Sand and Organics in Riffle Habitat Units (%)
	% Gravel (weighted by habitat unit area)*
	Gravel in Riffle Habitat Units (%)
	% Bedrock (weighted by habitat unit area)*
Instream Wood	Number of Wood Pieces*
	Wood Volume (m^3)*
	Number of Large Wood Key Pieces*

*Habitat attributes with ANOVA results.

Survey Statistics

Surveys were selected and summarized for each population; non-surveyed sites were inspected for the reason we were unable to sample. We also summarized the proportion of surveys with beaver activity (chewed sticks, trails, dens, etc.) and beaver dams, debris jams, mass wasting, and habitat restoration structures (placed wood and boulder structures) in each population. We described the distribution of surveys across land ownership and principal land use within populations using a United States Geological Survey (USGS) land use coverage layer in a Geographic Information System (GIS). Land use categories were agriculture, federal forest, private forest, state forest, urban, and other (mix of parks, military, and Native American land holdings). Lithology was assessed within and compared across populations using a USGS GIS geology layer (Walker et al. 2003) to identify the following underlying rock types: intrusive, metamorphic, sedimentary, and volcanic. A 500-meter buffer was created around individual sites to identify both dominant land use and rock type.

Habitat Condition

To provide comparative context for evaluating percent substrate, pool habitat, secondary channels, and large wood metrics within the range of coho salmon spawning and rearing habitat, we used reference values derived from a multi-agency effort to standardize setting reference conditions (Miller et al. 2016). Reference sites were selected to represent areas of least human disturbance or the most natural state. Once those sites were chosen, we extracted the 25th and 75th percentile values of a given habitat metric to compare with current data. Metric data were summarized for each site as a percent composition or scaled to a standardized stream length. Sites within a population unit were weighted equally and combined to provide a population scale profile of instream physical habitat. Analysis of Variance (ANOVA) procedures tested differences among instream habitat attributes across individual populations, land use types and lithology. In instances where significant differences were observed, Kruskal-Wallis rank sum and chi-squared tests were performed to assess differences between independent variables. All statistical analyses were performed with R software (R Development Core Team 2006).

Habitat Capacity

We used the HLFM to estimate rearing capacity by assigning a density (juvenile coho salmon/m^2) value based on the size, type, and complexity of habitat units. The model assigns the highest value to beaver ponds, alcoves, and pools with large wood (Nickelson 1998). Capacity to support juvenile coho salmon during winter conditions was considered high if the HLFM value exceeded 1,850 parr/kilometer, and low if capacity estimates were below 900 parr/kilometer (Strickland et al. 2018). A detailed overview of how the HLFM is used to describe habitat capacity at the reach scale is in Anlauf and Jones (2007) and Anlauf-Dunn et al. (2012). ANOVA was used to test the null hypothesis of no difference in juvenile coho parr/kilometer across populations, land use, and geology. When a significant difference was observed, Kruskal-

Wallis rank sum and chi-squared tests were performed to assess where these differences occurred.

Habitat Quality

The HLFM was used to estimate the amount of high quality (HQ) habitat available in both stream kilometers and as a percentage of the known distribution of coho salmon spawning and rearing habitat. These estimates were based on the number of sites within each population that exceeded a capacity of 1,850 juvenile coho parr/km. We calculated a site weight based on the number of sites surveyed within the distribution of coho salmon. Then, we multiplied the site weight by the number of sites exceeding 1,850 juvenile coho parr/km to estimate the kilometers of high-quality habitat in each population. The error estimate was derived from the upper and lower 95% confidence interval based on the nearest estimate to 1,850 parr/km on the cumulative distribution function. A more comprehensive overview of the calculation of high-quality habitat at the population scale can be found in Strickland et al. (2018).

The HabRate model was designed to evaluate habitat quality for specific life-stages of salmonids and creates habitat rankings of high (3), medium (2), and low (1) for each habitat variable and each life stage (Anlauf and Jones 2007, Burke et al. 2010, and Anlauf-Dunn and Jones 2012). We used the model to evaluate coho salmon spawning and emergence habitat quality and summer and winter rearing habitat quality. We used a Kruskal-Wallis rank sum test to assess differences among HabRate life history ratings across populations and land use types. Results of the model ratings were based on data collected to evaluate general habitat condition; therefore, the spawning and emergence ratings were mostly influenced by percentages of gravel and the amount of pool habitat. Overwinter habitat ratings can be attributed to available pool habitat, large wood, and channel complexity (i.e. percent secondary channels).

Chum Spawning Habitat Distribution

A GIS was used to display and identify the 2013 winter survey sites that overlapped with potential chum salmon spawning habitat. Overlapping sites fell within the upper limits of the chum salmon spawning intrinsic potential, which is based on stream gradient. Chum salmon will spawn in areas with up to 2% gradient but will migrate through stream reaches with up to 5% gradient. The winter survey sites within the upper limits of the intrinsic potential were analyzed for potential groundwater and upwelling characteristics (percent secondary channels), habitat type, and substrate.

RESULTS

Survey Statistics

Survey targets were met in each of the population units (Table 2). Of the proposed 36 sites in the Clatskanie River population, we completed 34 surveys and dropped 2 sites due to landowner denial. We completed 31 sites in the Scappoose Bay population unit and dropped 25 sites (18 sites were denied and 7 sites were dropped due to time constraints). Twenty-three sites were selected to serve as an oversample to ensure enough sites to meet our objectives in the Scappoose Bay population unit.

Table 2. Proportion of sites surveyed in each population relative to total number of sites drawn in the random pull and primary reason for sites not surveyed.

Population	Total Sites Pulled	Percentage of Sites Surveyed	Primary Reason for Not Surveying
Clatskanie River	36	94.4	Landowner Denial
Scappoose Bay	56	55.3	Landowner Denial

This study was designed to target population scale sampling within wadeable streams and due to this strategy, populations were sampled with adequate coverage across the range of coho salmon spawning and rearing habitat. We did not intentionally stratify by land use or lithology, and we did not sample non-wadeable habitat. We surveyed 23% of the 151 km of rearing and spawning habitat accessible to coho salmon in the Clatskanie River population and 19% of the 167 km of accessible coho habitat in the Scappoose Bay population.

Most surveyed sites in the Clatskanie River population occurred largely within volcanic rock, while sedimentary rock was dominant in the Scappoose Bay population (Table 3). Metamorphic and intrusive rock were not present in any of the buffered sites surveyed across both populations.

Table 3. Lithology within populations is based on individually sampled sites. Data depicts the total number of sites surveyed and the percentage of rock type encountered within a 500-meter buffer around the GRTS point.

Population	Surveyed Sites	% Intrusive	% Sedimentary	% Volcanic
Clatskanie River	34	0	39.20	60.80
Scappoose Bay	31	0	64.41	35.59

Most sites were in private forest lands across both populations (Figure 2, Table 4), but both Clatskanie and Scappoose had a significant amount of the surveyed area within other land use types. Sixteen percent of the Clatskanie population fell within state forest and 7% within urban areas. The Scappoose population had nearly 27% within urban areas and 10% within agricultural land use.

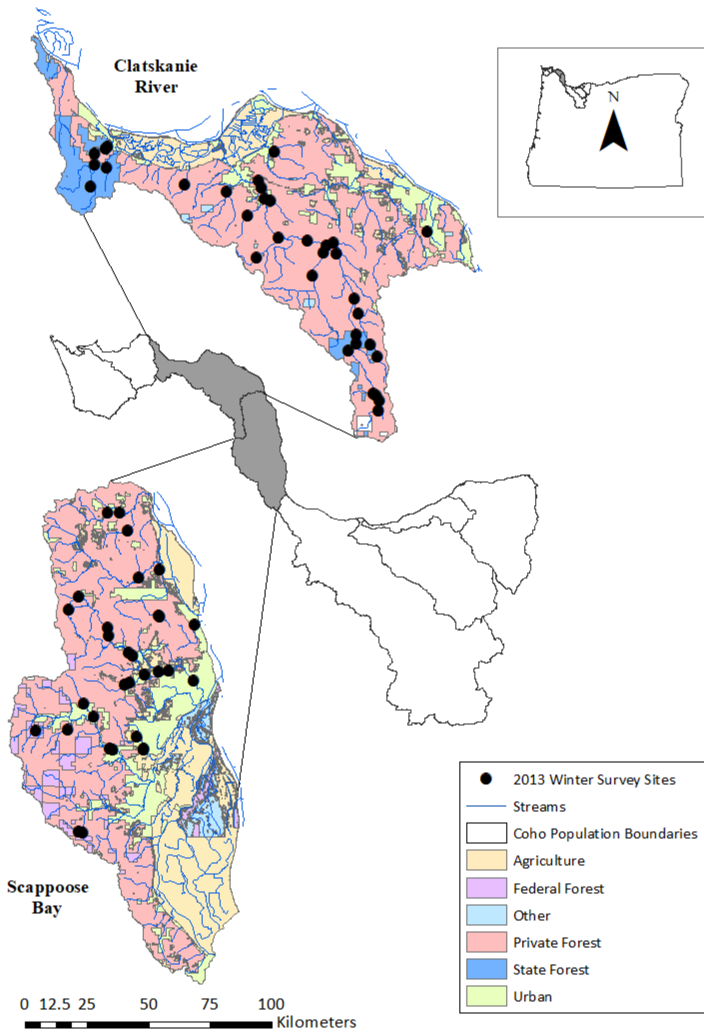

Figure 2. Land use types within the Clatskanie River and Scappoose Bay populations and location of 2013 winter survey sites.

Table 4. Percent land use within populations is based on individually sampled sites. Data depicts the total number of sites surveyed and the percentage of land use type encountered within a 500-meter buffer around the GRTS point.

Population	Surveyed Sites	% Agriculture	% Federal Forest	% Private Forest	% State Forest	% Urban	% Other*
Clatskanie River	34	1.34	0	75.16	16.48	7.01	0.01
Scappoose Bay	31	10.03	2.83	60.22	0	26.92	0

*State Park, tribal, and military lands.

While beaver activity (chewed sticks, trails, scat, etc.) and constructed dams were observed in both populations, the proportion of beaver activity was significantly greater than constructed dams (Table 5). This is likely attributed to most Oregon Coast Range beaver dams being small, ephemeral, and generally unable to withstand peak winter flow events (Leidholt-Bruner et al. 1992). Restoration structures such as artificially placed wood or boulder structures (clusters, weirs, wing dams, etc.) were a relatively rare occurrence across both populations. Naturally occurring debris jams were found in almost every site within the Clatskanie population (97%) and just under half of the sites in the Scappoose Bay population (42%). Evidence of mass wasting (avalanches, earthflows, and landslides) occurred at a greater proportion of Clatskanie River sites (53%) compared to the Scappoose Bay sites (39%).

Table 5. Summary of presence of comment codes at each site within individual populations. Values based on the ratio of the number of sites presence of observation was identified within individual populations and the total number of sites surveyed.

Population	Beaver Dams	Beaver Activity	Natural Debris Jams	Mass Wasting	Artificial Wood Structures	Artificial Boulder Structures
Clatskanie River	0.18	0.91	0.97	0.53	0.12	0.03
Scappoose Bay	0.32	0.81	0.81	0.39	0.06	0.03

Habitat Condition

Data were evaluated across the Scappoose and Clatskanie areas by population, land use, and lithology. Differences were observed within fine sediments, gradient, and percent pool habitat, and across all wood (Table 6).

Table 6. Results of ANOVA assessing differences among instream habitat attributes across individual populations. Dependent variable = habitat attribute, independent variable = population. Alpha = 0.05.

Habitat Attribute	Residual DF	DF	MSE	F value	P-value
% Fine Sediments*	63	1	11.04	16.16	<0.001
% Gravel	63	1	680.70	1.84	0.180
% Bedrock*	63	1	0.01	0.001	0.973
% Secondary Channel Area*	63	1	11.02	3.91	0.053
Gradient*	63	1	14.72	19.13	<0.001
% Pool Habitat*	63	1	6.22	10.29	0.002
% Slack Water Pool*	63	1	11.91	1.49	0.226
Residual Pool Depth	63	1	0.09	1.83	0.181
Active Channel Width*	63	1	0.90	3.30	0.074
Wood Volume*	63	1	7.22	8.14	0.006
Key Pieces of Wood*	63	1	54.30	7.50	0.008
Wood Pieces per 100m*	63	1	2.01	4.45	0.039

*Habitat attributes were log transformed.

Within land use, differences were observed across both percent secondary channel and percent slack water pool habitat (Table 7).

Table 7. Results of ANOVA assessing differences among instream habitat attributes across populations by land use. Dependent variable = habitat attribute, independent variable = land use. Alpha = 0.05.

Habitat Attribute	Residual DF	DF	MSE	F value	P-value
% Fine Sediments*	60	4	1.45	1.80	0.140
% Gravel	60	4	472.8	1.28	0.288
% Bedrock*	60	4	1.77	0.19	0.942
% Secondary Channel Area*	60	4	10.66	4.38	0.004
Gradient*	60	4	2.01	2.18	0.082
% Pool Habitat*	60	4	0.83	1.21	0.315
% Slack Water Pool*	60	4	23.17	3.29	0.017
Residual Pool Depth	60	4	0.06	0.40	0.809
Active Channel Width*	60	4	0.44	1.62	0.182
Wood Volume*	60	4	8.94	1.44	0.233
Key Pieces of Wood*	60	4	54.30	1.33	0.351
Wood Pieces per 100m*	60	4	0.61	1.29	0.283

*Habitat attributes were log transformed.

When we assessed attributes across the lithology of Clatskanie River and Scappoose Bay, only wood volume showed a significant difference (Tables 8).

Table 8. Results of ANOVA assessing differences among instream attributes across populations by lithology. Dependent variable = habitat attribute, independent variable = rock type. Alpha = 0.05.

Habitat Attribute	Residual DF	DF	MSE	F value	P-value
% Fine Sediments*	63	1	1.59	1.91	0.172
% Gravel	63	1	459.2	1.23	0.272
% Bedrock*	63	1	3.02	0.34	0.561
% Secondary Channel Area*	63	1	0.09	0.03	0.867
Gradient*	63	1	2.76	2.87	0.095
% Pool Habitat*	63	1	1.30	1.91	0.172
% Slack Water Pool*	63	1	23.73	3.05	0.086
Residual Pool Depth	63	1	0.04	0.71	0.404
Active Channel Width*	63	1	0.64	2.30	0.134
Wood Volume*	63	1	6.36	7.06	0.010
Key Pieces of Wood*	63	1	29.38	3.85	0.054
Wood Pieces per 100m*	63	1	1.78	3.91	0.052

*Habitat attributes were log transformed.

When habitat data were compared to the reference thresholds (25th and 75th percentiles), median values for wood attributes summarized in populations fell below lower thresholds, except for key pieces of wood in the Clatskanie River, which fell within thresholds (Figure 3).

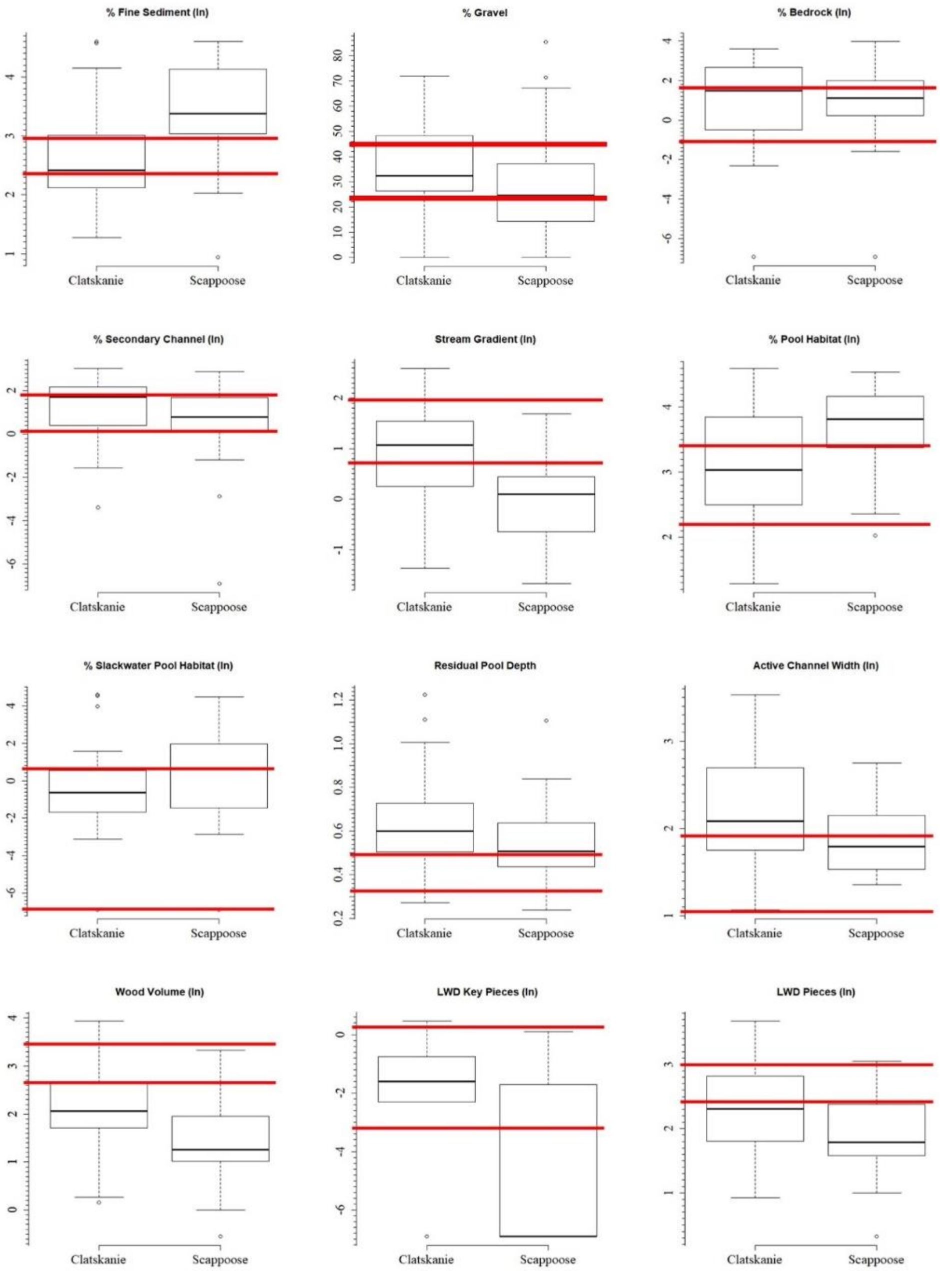

Figure 3. Boxplots of habitat attributes (y-axis) within Clatskanie River and Scappoose Bay coho populations (x-axis). Plots depict minimum values, lower quartile bounds, medians, upper quartile bounds, and maximum values. Horizontal red lines indicate upper and lower breakpoints for the respective habitat attributes (Miller et al. 2016).

It should be noted that median values for percent fine sediments and percent pool habitat exceeded upper thresholds in the Scappoose Bay population. The median value for stream gradient in the Scappoose population fell below the 25th percentile threshold, explaining some of the upper threshold exceedance. These results were similar for attributes summarized for land use types (Figure 4) and lithology (Figure 5).

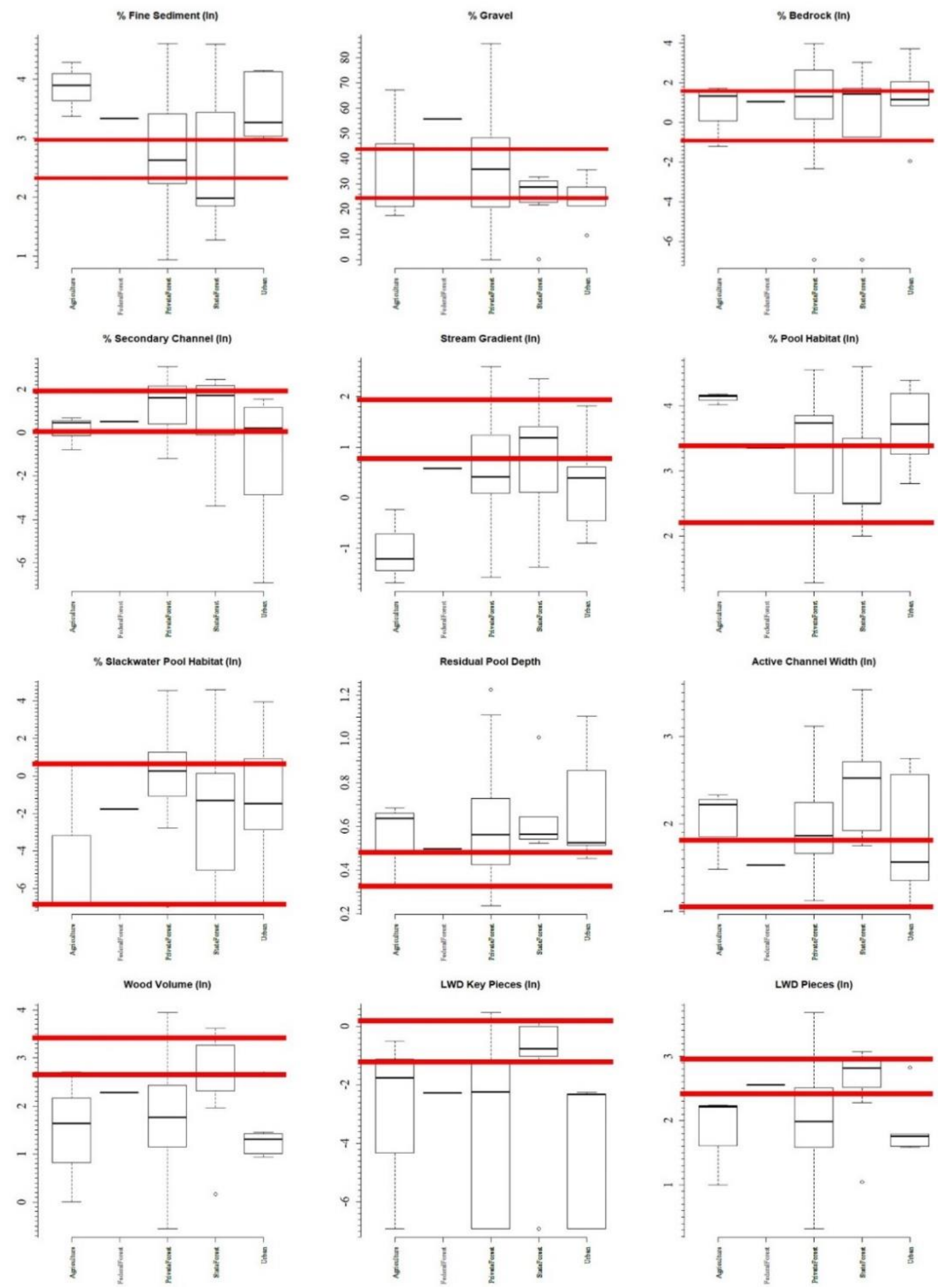

Figure 4. Boxplots of habitat attributes (y-axis) within dominant land use types (x-axis) at individual sites. Plots depict minimum values, lower quartile bounds, medians, upper quartile bounds, and maximum values. Horizontal red lines indicate upper and lower breakpoints for the respective habitat attributes (Miller et al. 2016).

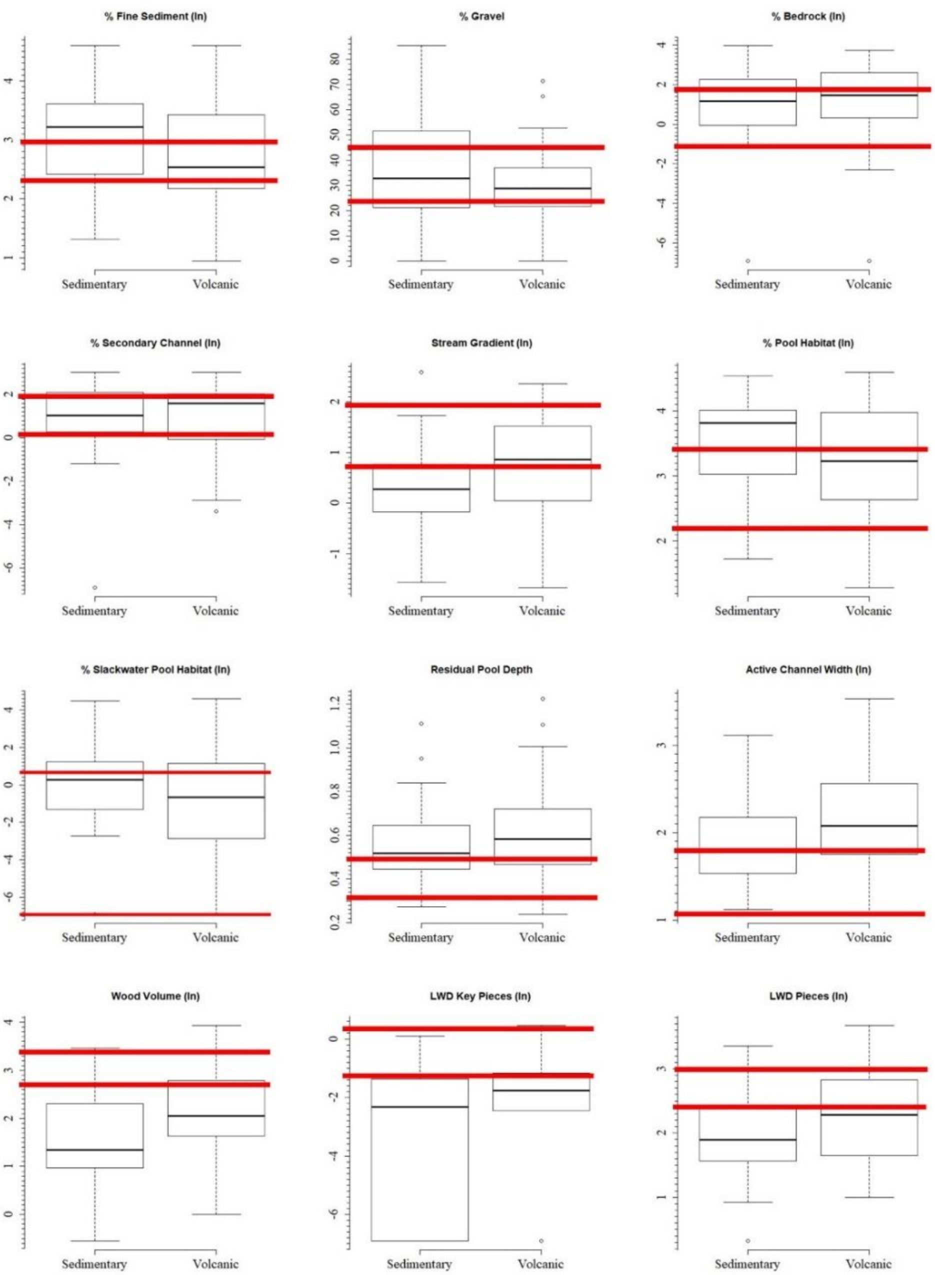

Figure 5. Boxplots of habitat attributes (y-axis) within dominant lithology (x-axis) at individual sites. Plots depict minimum values, lower quartile bounds, medians, upper quartile bounds, and maximum values. Horizontal red lines indicate upper and lower breakpoints for the respective habitat attributes (Miller et al. 2016).

Habitat Capacity

The ANOVA results did not indicate a significant difference in juvenile coho salmon capacities among populations, land use, or lithology (Table 9); therefore, we accepted our null hypothesis that winter parr/km would not differ significantly across independent variables.

Table 9. Results of ANOVA assessing winter parr/km by population, land use, and lithology. Alpha = 0.05.

Independent Variable	Residual DF	DF	MSE	F value	P-value
Population*	63	1	3.53	3.35	0.065
Land Use*	60	4	0.65	0.61	0.657
Lithology*	63	1	0.02	0.02	0.902

*Dependent variables (winter parr/km) were log transformed.

We calculated summary statistics within populations for winter habitat capacity estimates of juvenile coho salmon and found the Clatskanie River population to have the potential to support 1,083.81 parr/km and the Scappoose Bay population had the potential to support 1,348.85 parr/km (Table 10).

Table 10. Summary statistics within populations for winter parr/km for the Lower Columbia ESU.

Population	N	Mean	Standard Deviation	Lower 95%	Upper 95%
Clatskanie River	34	1083.81	1100.02	773.30	1394.31
Scappoose Bay	31	1348.85	983.69	1106.90	1590.80

Habitat Quality

When we compared median values across populations, land use, and lithology to low (<900 parr/km) and high (>1,850 parr/km) quality habitat thresholds, the majority fell between the stated values indicating predominately moderate quality juvenile coho rearing habitat (Figure 6). It should be noted that median values for the Clatskanie River population and sedimentary geology fell below 900 parr/km. Median values for the agricultural land use type exceeded 1,850 parr/km; agricultural land constituted approximately 11% of the surveyed area across both populations.

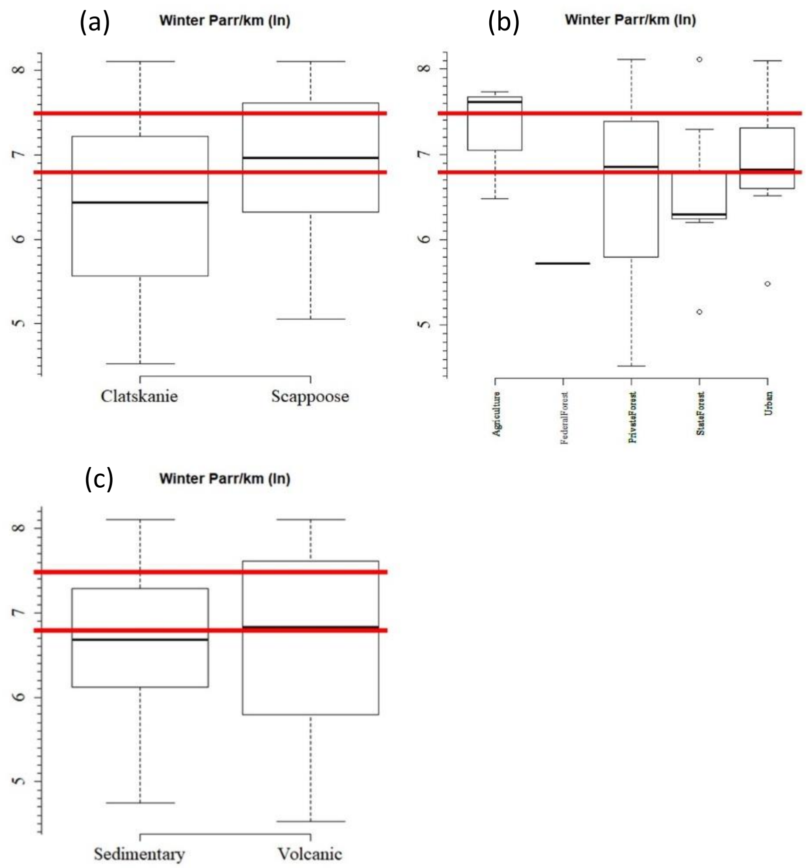

Figure 6. HLFM estimates of winter parr/km (ln) (y-axis) with (a) Clatskanie River and Scappoose Bay coho populations, (b) land use types, and (c) lithology. The horizontal red lines indicate thresholds for high-quality habitat (>1850 parr/km) and low-quality habitat (<900 parr/km).

We also found Scappoose Bay to have a higher percentage of high-quality habitat with 27.65% when compared with the Clatskanie River population which had 17.23% (Table 11).

Table 11. HLFM results within each population. High-quality (HQ) is considered >1850 winter parr/km.

Population	# Sites	Surveyed km	Coho km	# Sites w/ HQ Habitat	HQ Habitat (km)	% HQ	% Error	Error (km)
Clatskanie River	34	34.82	151.05	6	26.03	17.23	11.13	16.81
Scappoose Bay	31	32.55	167.83	9	46.41	27.65	11.46	19.23

Results of the Kruskal-Wallis chi-squared test assessing differences among HabRate ratings found significant differences in spawning and emergence habitat among populations and among rock types (Table 12). A multiple comparison test also detected a difference in spawning and emergence habitat between populations, but differences were not detected between land uses or lithology. In addition, results of the HabRate overwinter habitat ratings were not found to be significantly different between populations, land use types, or lithology.

Table 12. Results of Kruskal-Wallis chi-squared test assessing differences among HabRate life history ratings across populations, land use, and lithology. Dependent variable = life history stage, independent variables = population, land use type, and lithology.

Life History Stage	DF	Chi-Square Test	P-value
		Across Populations	
Spawning and Emergence	1	6.2294	0.0126
Overwinter Habitat	1	0.7066	0.4006
		Across Land Use Types	
Spawning and Emergence	4	6.3649	0.1735
Overwinter Habitat	4	1.2829	0.8643
		Across Lithology Types	
Spawning and Emergence	1	4.2925	0.0382
Overwinter Habitat	1	1.0059	0.3159

Chum Spawning Habitat Distribution

Across populations we identified 42 winter surveys within the upper limits of the chum salmon spawning intrinsic potential. Of these, 36 surveys had an average gradient less than 2%, and six surveys had an average gradient between 2% and 5%, a gradient too steep for spawning but suitable for migrating adult chum salmon (Alfonse et al. 2017). Within populations, 17 sites were in the Clatskanie River, and 25 in Scappoose Bay. Although there was not a significant difference between populations, the Clatskanie River had a slightly higher median value for percent secondary channel. The Clatskanie River population was identified as having a significantly lower percentage of fine sediments across surveyed reaches.

Preferred chum salmon spawning habitat includes streams with low gradient, side channels, and ample gravel substrate in riffle habitat (Geist et al. 2002 and Hillson 2007). In the Clatskanie River population, four survey sites with less than 2% gradient had riffle habitat with more than 50% gravel, more than 45% gravel in the surveyed length, and multiple side channels (Figure 7). Three sites were on the main stem of the Clatskanie River, and one was on Conyers Creek, a tributary of the Clatskanie River.

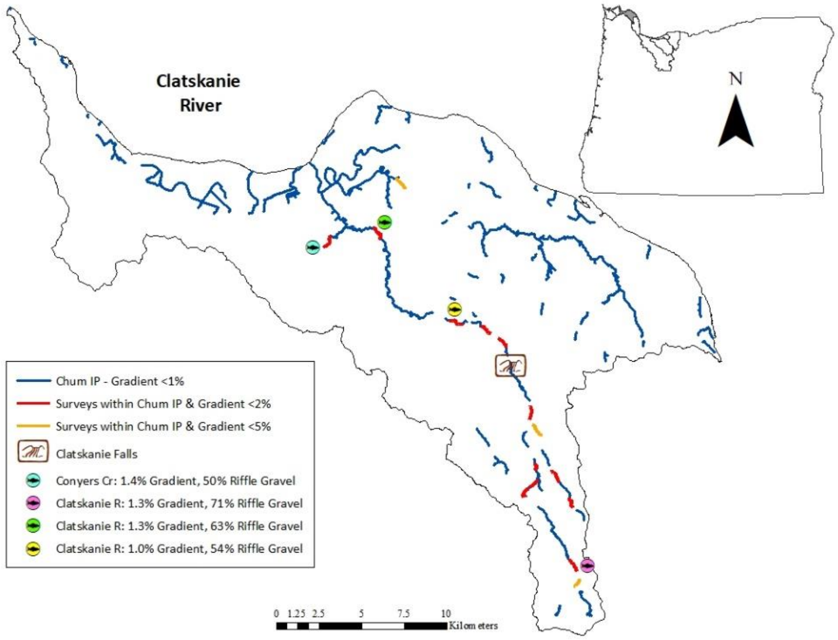

Figure 7. Survey sites within the Clatskanie River population identified as potential for high-quality chum salmon spawning habitat.

In the Scappoose Bay population, three sites with less than 2% gradient had more than 60% gravel in riffle units, more than 35% gravel in the surveyed length, and multiple secondary channels. The stream reaches were on Milton Creek, South Fork Goble Creek, and Sly Creek (Figure 8).

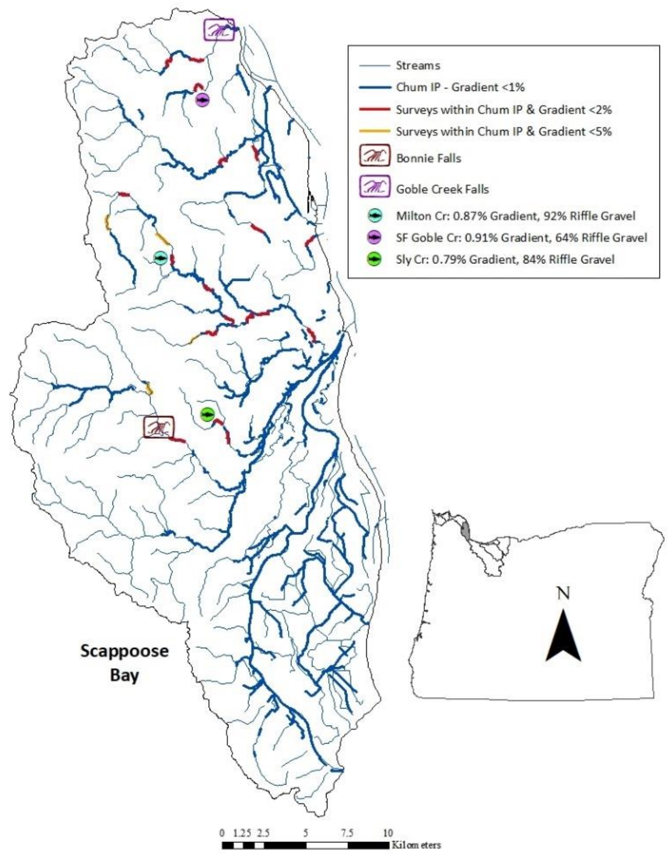

Figure 8. Survey sites within the Scappoose Bay population identified as potential for high-quality chum salmon spawning habitat.

DISCUSSION

One objective of our winter habitat surveys was to identify areas of potential chum salmon spawning habitat for further assessment by PROCS. Low gradient streams with gravel substrate and areas of upwelling are ideal for chum salmon spawning habitat (Geist et al. 2002, Hillson 2007). The winter surveys identified four stream sites in the Clatskanie River population unit and three stream sites in the Scappoose Bay population unit which met the high-quality habitat metrics (Boano et al. 2014). While the low gradient (<2%) stream reaches surveyed in the Scappoose Bay population had a greater proportion of secondary channels, the high amount of fine sediment in the substrate would make some stream reaches less ideal for chum salmon spawning.

Other obstacles for upstream movement of adult chum salmon include potential barriers, such as falls and culverts primarily in the upper end of distribution, and tide gates that are more common in lower stream reaches. Within the Scappoose Bay populations, the surveyed site on South Fork Goble Creek was less than 1% gradient with 64% gravel substrate in riffle unit types and had side channels. However, for adult chum salmon to migrate to the site, they would need to navigate a Bishop Road crossing consisting of a vertical jump to a concrete slab, along with a fish ladder at Goble Creek Falls. Currently, the fish ladder allows for passage of coho salmon, Chinook salmon, and steelhead. The road crossing is on ODFW's fish passage priority list.

Although there were no barriers to upstream adult fish migration in the main stem of the Clatskanie River, a natural 2-meter-high waterfall is located approximately 4 kilometers downstream of the confluence with Little Clatskanie River. Juvenile coho salmon, steelhead, and cutthroat trout have been observed upstream of the falls in the headwaters of Clatskanie River.

The overlap of the 2013 survey sites and the upper limits of chum salmon spawning potential created an opportunity to identify and describe available habitat, but the primary focus was evaluating coho salmon rearing capacity and quality during winter conditions. While many of the observed similarities between populations and overall habitat quality in the Clatskanie River population were expected, the overall quality of coho rearing habitat in the Scappoose Bay population was not expected. Results of the HLFM suggest moderate quality rearing habitat across the population with an overall capacity estimate of approximately 1,350 coho parr/km. Even the lower 95% confidence interval fell well within the range of moderate rearing habitat quality (1,106.90 parr/km). Results of the winter surveys suggest approximately 27% of Scappoose Bay population stream habitat is high quality coho winter rearing condition/habitat.

When the winter habitat surveys were conducted in 2013, Scappoose Bay was the only population in the Lower Columbia ESU with a Life Cycle Monitoring (LCM) site (North Scappoose Creek). Suring et al. (2015) reported less coho smolt production per/km at the North Scappoose site when compared to what has been observed at LCM sites across the Oregon Coast ESU. In addition, spawner densities averaged only 10% when compared to the other LCM sites (Suring et al. 2015). When viewed comparatively to weighted HLFM results for coho parr/km and kilometers of high-quality winter habitat across Oregon Coast ESU coho populations (Strickland et al. 2018), the Scappoose Bay population should have some of the highest population estimates due to the habitat quality available. The disparity between winter habitat quality and observed fish is most likely related to summer habitat limiting factors. Unfortunately, there is not an LCM site within the Clatskanie River population, meaning a direct comparison of winter habitat conditions and empirical fish counts cannot be made between populations for the purpose of this report. Additionally, the North Scappoose site was removed from operation in 2019.

The results of this report suggest future stream monitoring efforts within the Lower Columbia ESU should be stratified at the population scale to evaluate habitat conditions, with a focus on summer temperature monitoring, and equal effort spent conducting juvenile salmonid snorkel surveys. These efforts would give us the opportunity to compare stream habitat and temperature as limiting factors for empirical abundance estimates across populations. This scale of effort would allow us to evaluate whether results from the Scappoose Bay population are isolated.

ACKNOWLEDGMENTS

We thank the staff and field biologists who contributed to this report:

Kara Anlauf-Dunn
Jake Biron
Nick Chambers
Kim Jones
Peggy Kavanagh
Ben Maxfield
Amanda Pantovich
Miles Penk
Charlie Stein
Lora Tennant

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