Chinook and Steelhead Assessment in Squilchuck, Stemilt and Colockum Creeks, May-October 2025

Final Report to Upper Columbia Salmon Recovery Board for Chelan County Natural Resources Department

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Contents

1 Summary

1. We conducted a presence/absence study of fish populations, primarily targeting Chinook salmon (*Oncorhynchus tshawytscha*) and Steelhead trout (*O. mykiss*) in the lower reaches of Squilchuck, Stemilt, and Colockum Creeks, three minor tributaries of the Upper Columbia River.
2. Sampling was planned to represent seasonal variability in winter, spring, summer and fall of 2025. This is the final report for this study period.
3. Key methods included backpack electrofishing and PIT tagging.
4. Target salmonid species were encountered during all sampling events in most study areas.

2 Introduction

Understanding the distribution of salmonid species within minor tributaries of the Columbia River is essential for understanding how these systems benefit the basin-wide populations, and for guiding effective habitat restoration efforts. Many smaller creeks in this basin have been altered by land use and barriers to fish passage, creating variable habitat quality, yet baseline information on the presence or absence of key salmonid species is often lacking.

To address this gap, we conducted field sampling in Stemilt, Squilchuck, and Colockum Creeks to document the occurrence of Chinook salmon (*Oncorhynchus tshawytscha*), Steelhead/Rainbow trout (*O. mykiss*), and Coho salmon (*O. kisutch*). These species are of particular ecological and management importance in the Columbia River basin, where populations have experienced significant declines. Determining how these creeks currently support salmonid populations will help evaluate whether targeted restoration activities, such as improving fish passage, managing withdrawals, or restoring instream habitat, would be beneficial for threatened species, and identify which of these types of tributaries might offer the greatest potential gains from restoration efforts.

The specific objectives of this study were to:

- Assess the seasonal presence or absence of Chinook salmon, *O. mykiss* and Coho salmon in Stemilt, Squilchuck, and Colockum Creeks.
- Provide baseline information to inform priority data gaps, and help guide future restoration, monitoring and management decisions.

3 Methods

3.1 Sampling Locations

Stemilt Creek is a small tributary approximately 19.9 km long (Andonaegui, 2001) that enters the Columbia River around river kilometer (rkm) 743, just south of the city of Wenatchee (Fig 1). Squilchuck Creek is roughly 17 km long (Andonaegui, 2001) and joins the Columbia River around rkm 746. For all sampling events, we sampled 550 m of Stemilt Creek starting at its confluence with the Columbia River, and 340 m of Squilchuck Creek starting at its confluence. For the fall sample event only, we added an additional site of 180 m, approximately 1.4 km further upstream in Squilchuck Creek. The survey extent covers a broad range of anthropogenically altered habitat conditions, including private industrial and residential properties, railroad lines and rail yards, numerous culverts and bridges, and irrigation withdrawals. During summer, both creeks experienced high daytime water temperatures $> 18^{\circ}C$, limiting our sampling window to early mornings following cool nights. At the lower end of the Squilchuck Creek sampling reach, near its confluence with the Columbia River, we started sampling upstream of a drop that may act as a temporary passage barrier for certain life stages of anadromous species during periods of low flow (Figure 2a).

Colockum Creek has a length of approximately 19.3 km (Andonaegui, 2001) and flows into the Columbia River around rkm 724. Compared to Stemilt and Squilchuck Creeks, the lower portion of Colockum Creek retained cool water temperatures $< 13^{\circ}C$ throughout the summer, while the upper portion exhibited elevated daytime temperatures similar to Stemilt and Squilchuck. We sampled Colockum creek during the summer event only, from its confluence to approximately 0.24 km upstream (Lower Colockum) and a second reach between rkm 1.55 and 2.00 (Upper Colockum). The lower sampling reach is bounded at the upstream end by a steep canyon section with a series of small waterfalls that may limit passage for some life stages of anadromous species (Figures 2b, 2c). The creek flows through numerous private properties and is subject to dewatering and high summer temperatures, but otherwise remains largely in a natural state. Chelan County is currently working on a Reach Assessment and Habitat Survey in Colockum Creek.

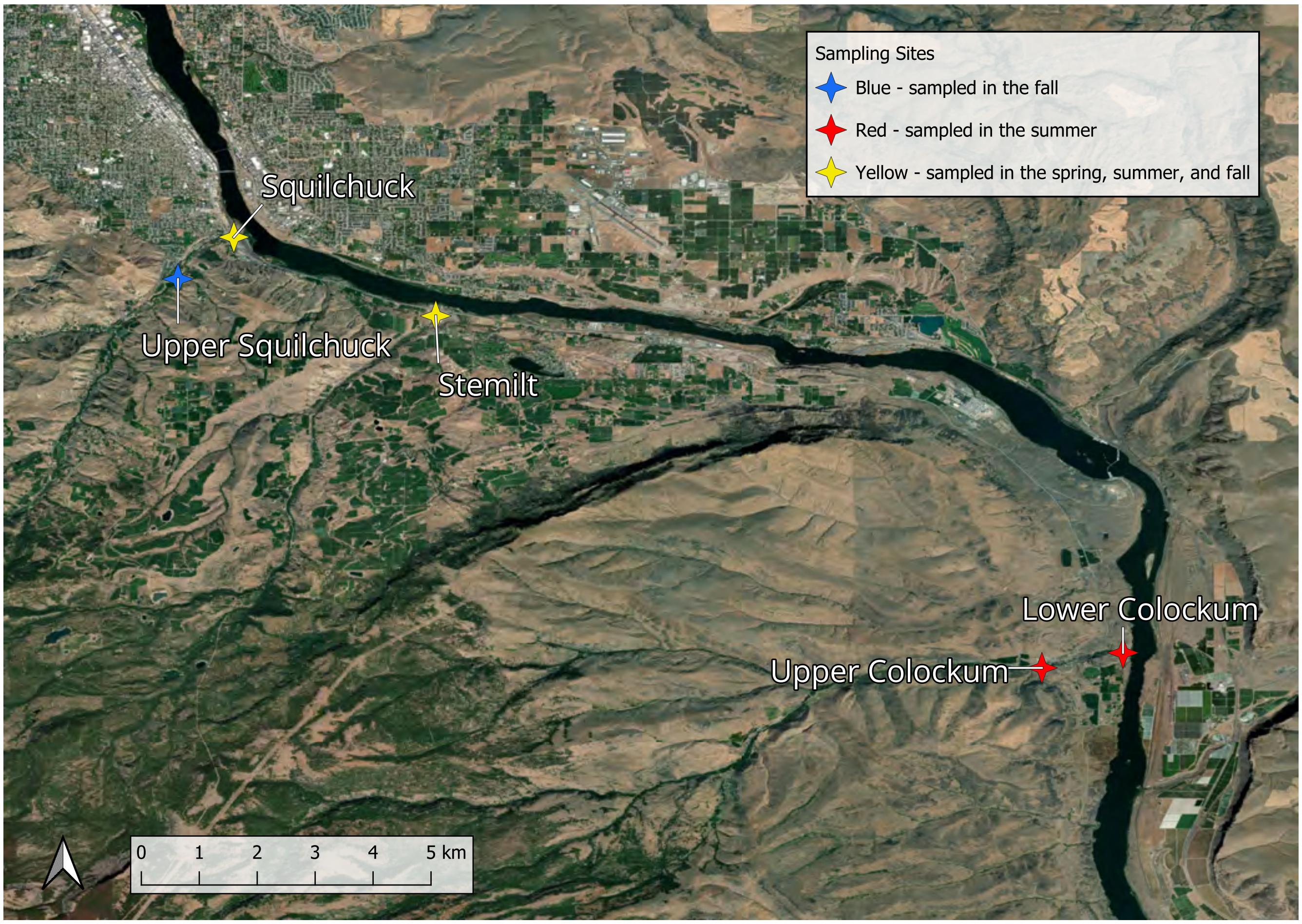


Figure 1: Sampling locations in Stemilt, Squilchuck and Colockum Creek.

3.2 Data Collection

In February 2025, eight minnow traps baited with cured salmon roe were deployed overnight in Stemilt and Squilchuck Creeks to determine fish use and potential value in further winter sampling efforts. Low fish capture numbers in two of the traps, coupled with poor environmental conditions precluded any further winter sampling. Spring, summer and fall sampling was done using a backpack electrofisher operated by one technician with two to three supporting dipnetters and/or seine netters during sampling events in Stemilt and Squilchuck Creeks in May and October, and in

(a)

(b)

(c)

Figure 2: Drop at bottom of Squilchuck Creek (a) and Colockum Creek canyon with waterfalls above upper bound of lower sampling area (b, c) that may limit passage for some life stages of anadromous species. *Images: Mike Kane*

Stemilt, Squilchuck, and Colockum Creeks in August. Colockum Creek was not included in the original study area, but added in August when additional funding was secured. Snorkel herding "snerding" with a seine net was used as a supplemental capture method in deep pools. Primary target species included Chinook salmon and Steelhead/Rainbow trout, while Coho salmon were also considered as an important native salmonid target species. Because there is no reliable way to distinguish between Steelhead and Rainbow trout, all individuals were recorded collectively as *O. mykiss* without further differentiation. Future PIT tag detections outside the tagging site may help elucidate migration patterns that could confirm anadromy, while future recaptures at the same site could help confirm residency. For each captured fish, GPS coordinates (August and October) and species identity were recorded. To minimize injury risk, fish exposed to more than 20 seconds of electrofishing or shocked three times before being netted, were georeferenced as unknown species and passed over.

All captured fish were held in insulated, aerated buckets with water temperature continuously monitored to maintain stable conditions. Fish tagging and measurements were conducted shortly after capture in order to minimize holding time and release fish close to their capture locations. For tagging, fish were anesthetized using 160-180 mg/L tricaine methanesulfonate (MS-222). Each individual was identified, measured for fork length (mm), and fitted with a PIT tag (8-12 mm depending on fish size). Fish smaller than 50 mm fork length were identified and measured but not tagged. After recovery, fish were released near their capture location. Tagging was performed on *O. mykiss*, Chinook, and Coho during capture-mark events. During recapture-mark events, Coho salmon were measured but not tagged. When sampling extended over two consecutive days, it indicates that the creek could not be fully sampled in a single day. In these cases, the remaining section was completed on the following day (see Table 1). PIT tag detection arrays were not installed or available within any of the creeks sampled. In order to evaluate tagged fish movements outside of the study sites, all tags were reported to the Columbia Basin PIT Tag Information System (www.ptagis.org). This network leverages extensive tag detection infrastructure on all mainstem Columbia River dams as well as streambed arrays in most major tributaries, numerous smolt traps and floating barge antennas, and mark-recapture studies conducted by many other agencies and organizations in the watershed. Advanced data queries were performed as recently as the day before publication of this report to determine whether any of the fish tagged during this study had been detected elsewhere at any time.

Table 1: Sampling locations, dates, and methods for each event. BMT=Baited Minnow Trap, EF=Backpack Electrofishing, SN=Snorkel Herding

Tributary	Sampling Date	Capture Method	Sampling Event
Stemilt Creek	02/27, 02/28	BMT	presence/absence
	05/20, 05/21	EF	capture-mark event
	08/05, 08/06	EF	recapture-mark event
	08/19, 08/20	EF	recapture-mark event
	10/15	EF, SN	recapture-mark event
Upper Squilchuck Creek	10/14	EF, SN	capture-mark event
Lower Squilchuck Creek	05/20	EF	capture-mark event
	08/05	EF	recapture-mark event
	10/14	EF	recapture-mark event
Upper Colockum Creek	08/07	EF	capture-mark event
	08/19	EF	recapture-mark event
Lower Colockum Creek	08/06	EF, SN	capture-mark event

3.3 Data Analysis

Given the relatively small dataset, our analyses focused primarily on exploratory approaches. Presence-absence data were used to visualize the spatial distribution of the different species across sampling reaches, fork length distributions, and individual movement patterns.

Where the number of recaptures permitted, simple abundance estimates were derived using the Lincoln-Petersen (Petersen, 1896; Lincoln, 1930) and Chapman modified estimators (Chapman, 1951). Both approaches assume a closed population, an assumption not strictly met in this study. However, estimates were calculated using only the two August sampling events, as there were only few weeks between them, minimizing violations of closure assumptions. Also, we assume that emigration and mortality rates were similar for tagged and untagged fish and that immigration between mark and recapture events was negligible based on the life history characteristics of the target species.

Finally, growth rates were calculated for recaptured individuals where repeated length measurements were available, providing additional insight into fish condition and habitat suitability across sampling areas.

4 Results

Fish from multiple species were captured during all sampling events across all creeks. Species composition and the number of individuals captured varied among tributaries and sampling periods, as described for each tributary separately in the following subsections.

4.1 Stemilt Creek

During the first sampling event in February, six Coho salmon yearlings (78 - 101 mm FL) were captured in two baited minnow traps shortly downstream of the railroad crossing. Individuals were measured and scanned for tags but not tagged. During May, August and October, all three target species were captured during every sampling event, with *O. mykiss* and Coho Salmon captured in higher numbers than Chinook Salmon (Table 2). The number of species captured or encountered differed from the number of fish marked and recaptured because some individuals were observed in the creek but could not be captured or were too small to tag. Coho were only tagged in the May and the first August sampling event because they occurred in high numbers but were not one of the target species. Brook Trout were also encountered across the entire sampling reaches during the May, August and October sampling events but their numbers were only recorded in August and October (Table 2). Recaptures of *O. mykiss* and Coho Salmon enabled simple abundance estimates for the August sampling period only (Table 2 and Figure 3).

Using the Lincoln-Petersen method, the *O. mykiss* summer population was estimated at approximately 55 individuals within the sampling area, while the Coho Salmon population was estimated at approximately 329 individuals. Chapman's modified estimator yielded similar results, with estimated abundances of 55 and 313 individuals, respectively. More advanced population estimation using Cormack-Jolly Seber or similar was not possible due to insufficient and imbalanced sample sizes (no racaptures during the first recapture event) across the seasonal sampling events. Chinook Salmon were captured in much lower numbers, with a maximum of seven individuals marked on a single day and only two recaptures recorded (Figure 3), therefore abundance estimation was not possible.

The longest residence time detected for Chinook Salmon was 56 days (Table 3). For *O. mykiss*, one individual was recaptured after 91 days and seven individuals after 70 days. The longest residence time observed for Coho Salmon was 70 days, with seven individuals recaptured at that interval.

Table 2: Number of individuals captured/encountered (C), marked (M), recaptured (R) per species during all sampling events in Stemilt Creek.

Sampling date	**Chinook**			***O. mykiss***			**Coho**			**Brook**
	C	**M**	**R**	**C**	**M**	**R**	**C**	**M**	**R**	**C**
02/27, 02/28	-	-	-	-	-	-	6	-	-	-
05/20, 05/21	6	4	-	28	22	-	41	37	-	-
08/05, 08/06	5	3	-	31	27	-	67	62	-	37
08/19, 08/20	4	2	1	25	11	14	60	-	12	49
10/15	9	7	1	18	10	8	42	-	7	23

Table 3: Number of individuals per species with specific residence times/maximum number of days between recaptures in Stemilt Creek.

Species	**Residence Time/Max. No. Days between Recaptures**			
	14	**56**	**70**	**91**
		No. of Individuals		
Chinook	1	1	-	-
O. mykiss	9	1	7	1
Coho	9	-	7	-

While *O. mykiss* were captured in August and October throughout the entire sampling reach (Figures 4a & 5a), Chinook and Coho Salmon were primarily captured in the lower sections of the creek, closer to the mouth (Figures 4b, 4c and 5b, 5c). All species occurred at higher densities at two sampling locations situated shortly upstream and downstream of the road and railroad crossings, suggesting that these areas may provide higher-quality habitat or some other ecological benefit. Eastern Brook Trout were also present across the entire sampling reach at both sampling events, with higher densities in the previously described areas and further upstream, where only *O. mykiss* was otherwise abundant (Figure 4d).

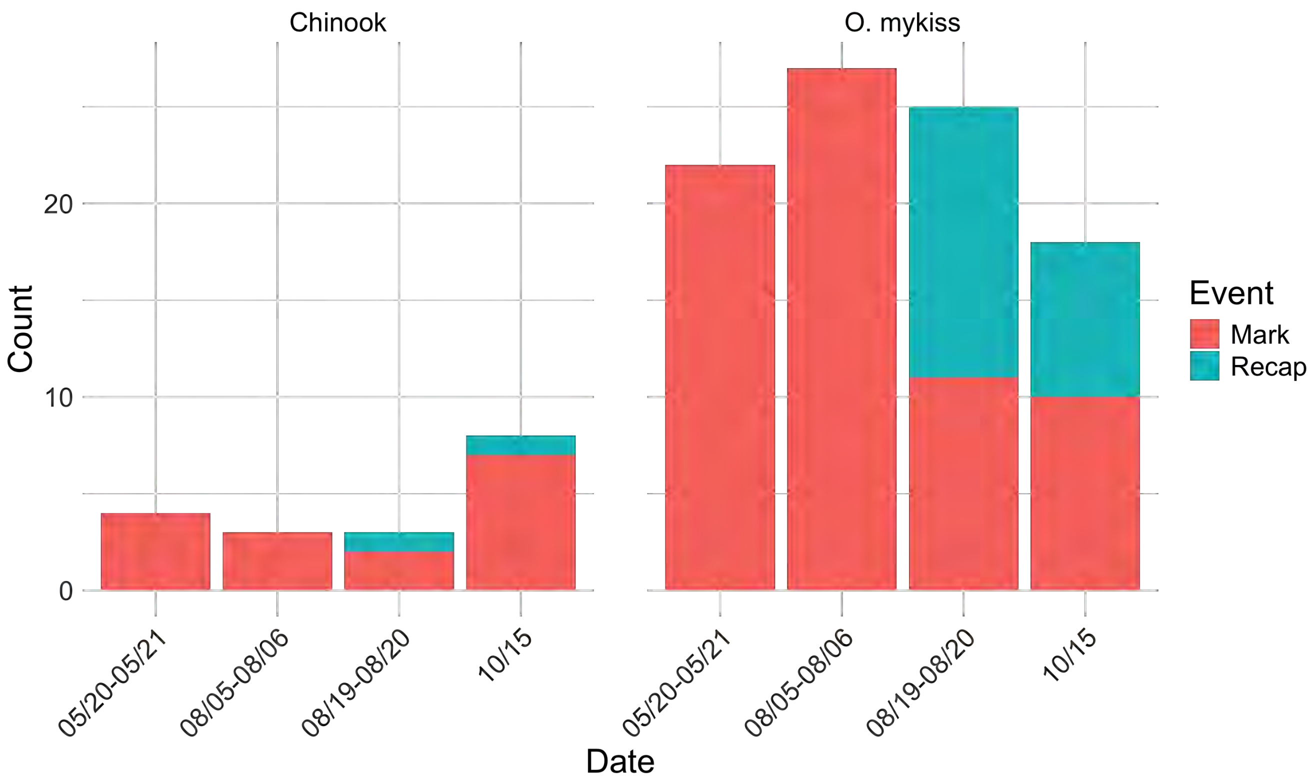
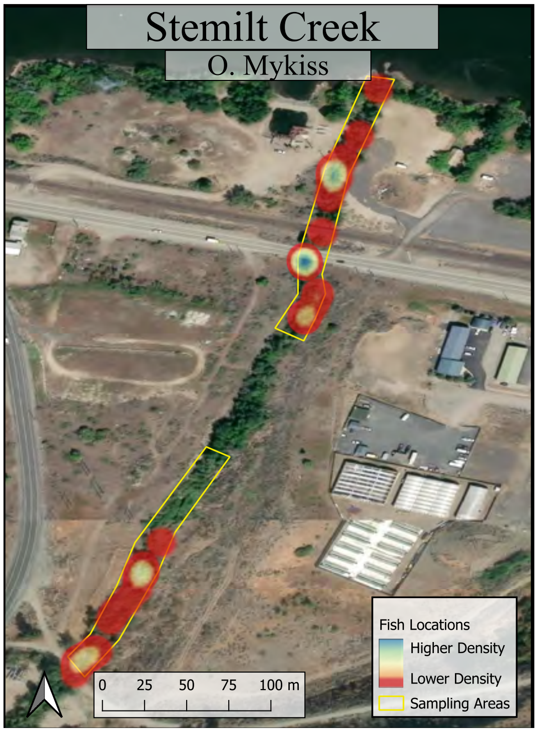


Figure 3: Mark-recapture summary for Stemilt Creek across all sampling dates for Chinook and O. mykiss.



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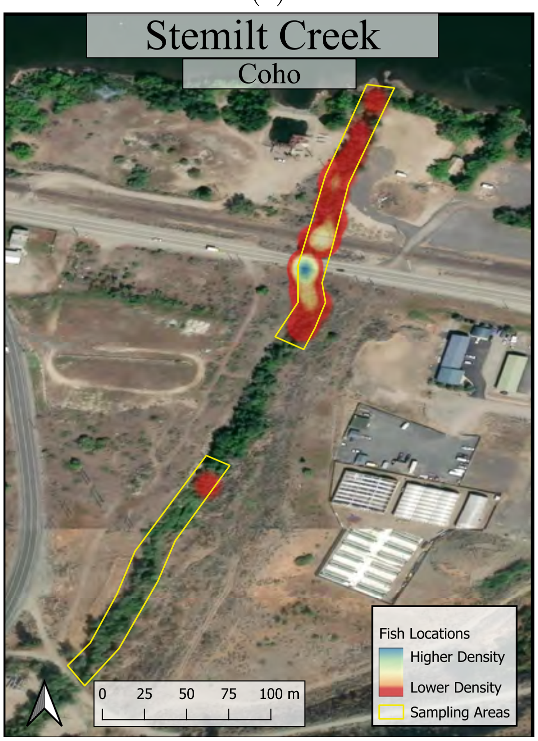

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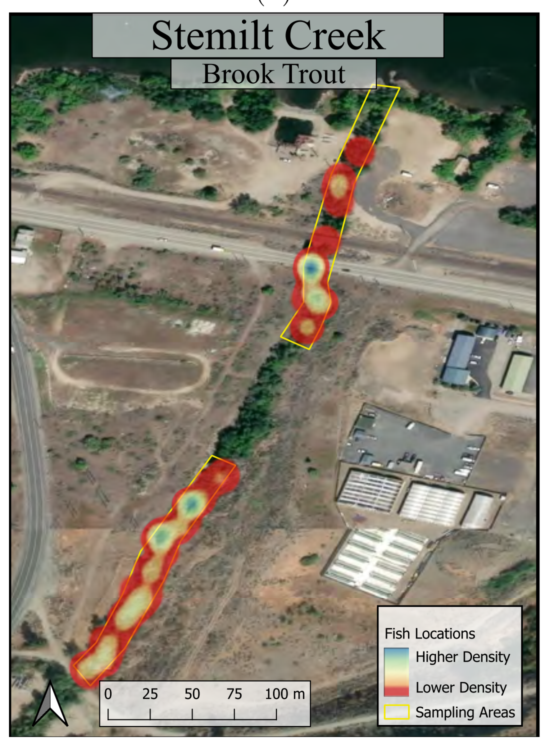

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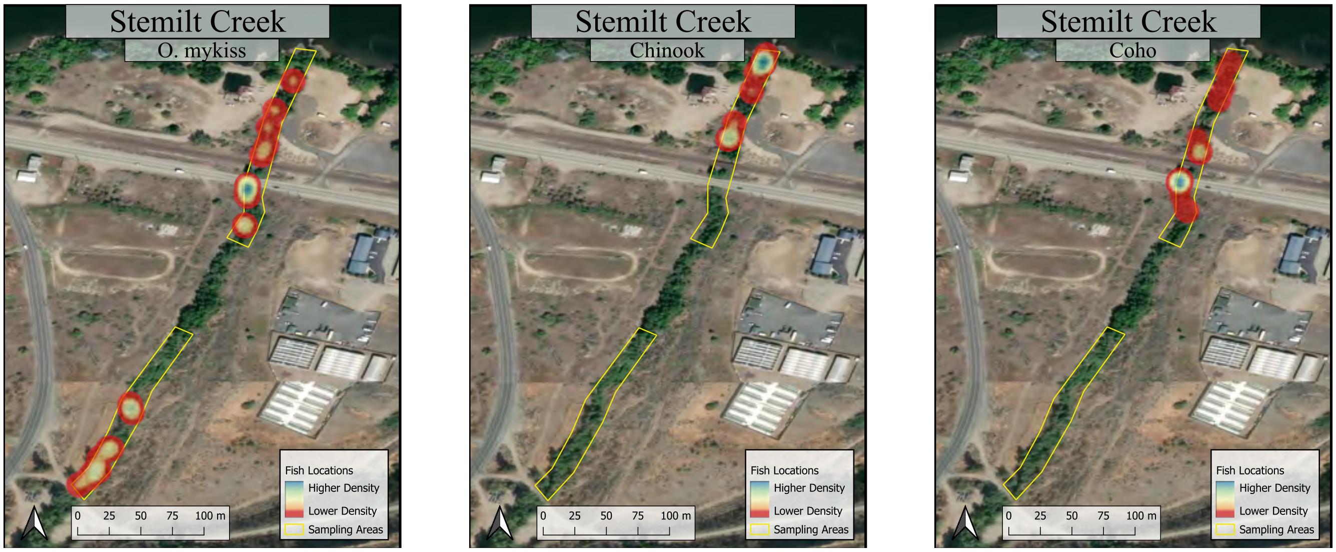
Figure 4: Heatmaps for capture locations of *O. mykiss* (a), Chinook Salmon (b) and Coho Salmon (c) in Stemilt Creek during August sampling events.

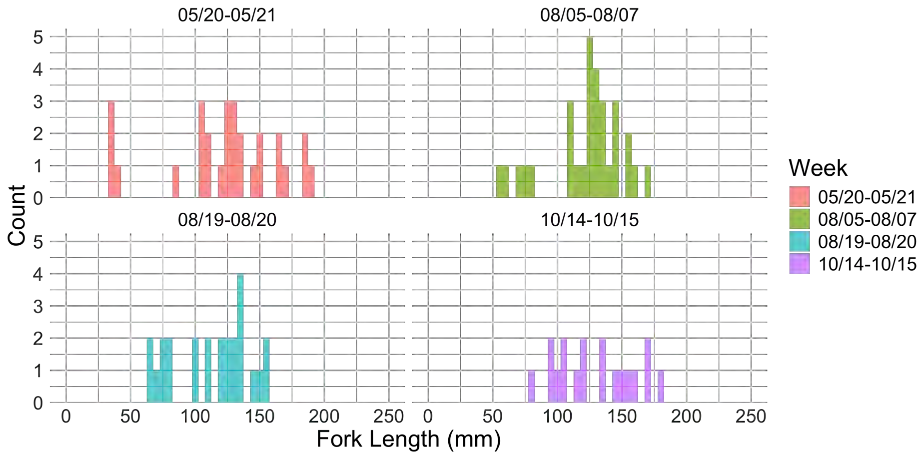


(a) (b) (c)

Figure 5: Heatmaps for capture locations of *O. mykiss* (a), Chinook Salmon (b) and Coho Salmon (c) in Stemilt Creek during October sampling events.

Fork length distributions suggested the presence of multiple juvenile cohorts for all species. Fork lengths of *O. mykiss* ranged from less than 50 mm to greater than 150 mm in May. While smaller individuals were still present in August, most fish measured between 100-150 mm and between 100-180 mm in October (Figure 6a). Chinook Salmon ranged from 40–70 mm in May and 50-90 mm in August and October. One individual captured in October had a fork length of 175 mm (Figure 6b) suggesting a late-emigrating smolt that strayed into the creek. Coho yearlings greater than 100 mm were present in May along with a few smaller individuals, but they appeared to have emigrated by August and October, when individual sizes ranged between 60-100 mm (Figure 6c). Growth rates appeared higher for Coho Salmon (1.1 $\pm$ 1.3 mm/week) compared to *O. mykiss* (1.0 $\pm$ 0.9 mm/week) during the entire sampling period, but high variability makes interpretation of growth trends difficult, given the small sample size.

Two *O. mykiss* tagged in Stemilt Creek in May were subsequently detected at Rock Island Dam in late May and early June, while a third individual was detected at Bonneville Dam during the same period (Figure 7). No other outside detections have been noted at the time of reporting.



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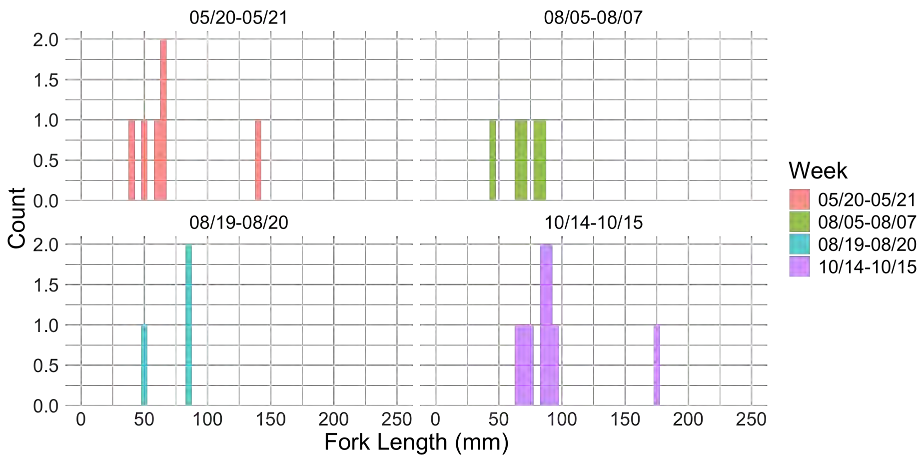

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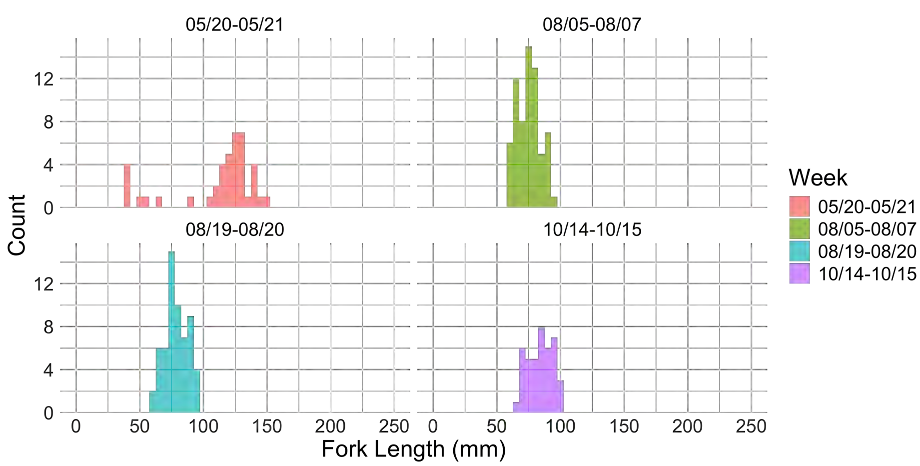


(c)

Figure 6: Fork length distributions over all sampling dates for *O. mykiss* (a), Chinook Salmon (b) and Coho Salmon (c) in Stemilt Creek during August sampling events. Consecutive sampling days were combined to visualize the distribution across the entire sampling area. Y-axes are not normalized.

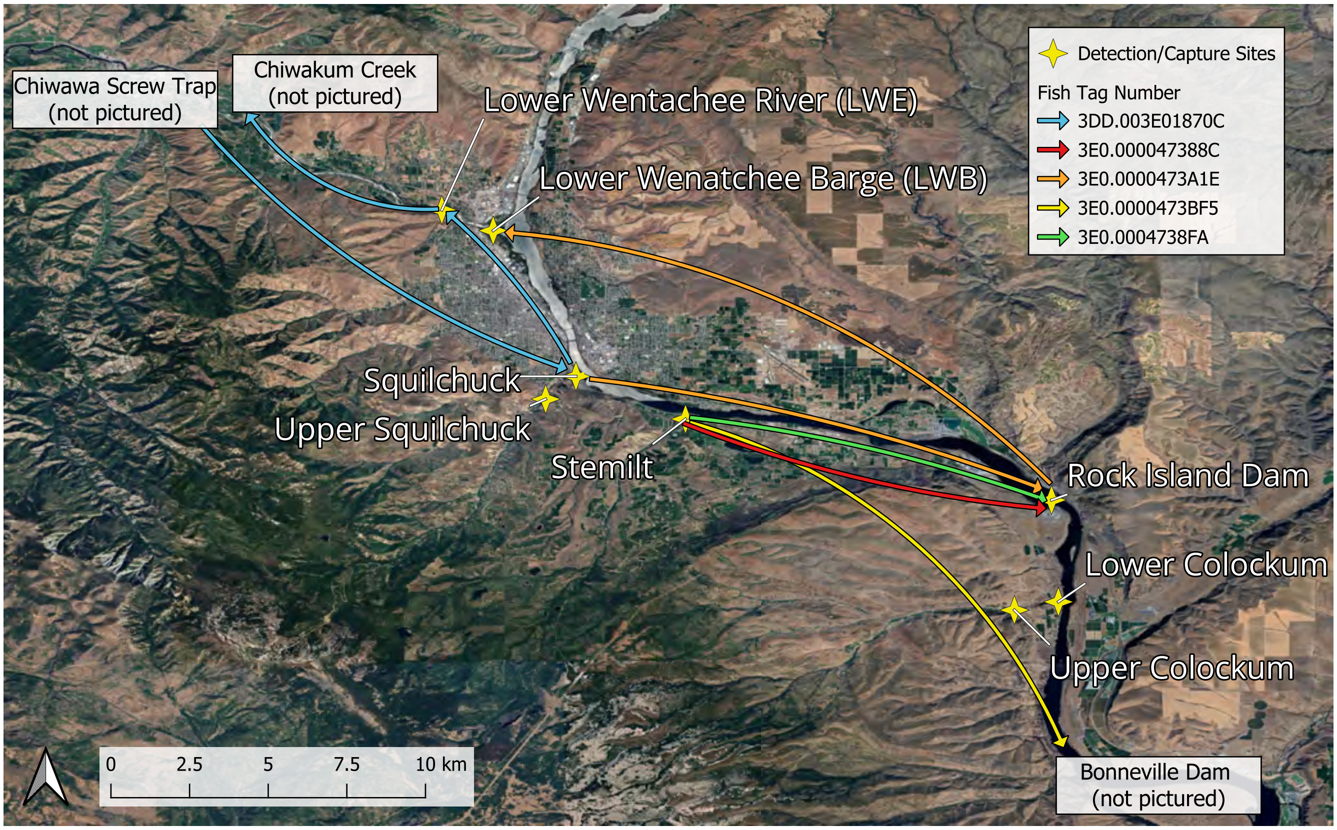


Figure 7: Migration of *O. mykiss* into and out of Stemilt, Squilchuck and Colockum Creeks.

4.2 Squilchuck Creek

Compared to Stemilt Creek, the number of fish captured in Lower Squilchuck Creek was low, with a total of only 16 individuals across three sampling events (Table 4). In May, most individuals captured were yearling *O. mykiss* (170–220 mm), along with one yearling Coho Salmon (>150 mm). In August and October, a small number of Coho and Chinook Salmon were captured. There were no recaptures on any of the sampling events. A small number of Eastern Brook Trout were also present in the sampling reach.

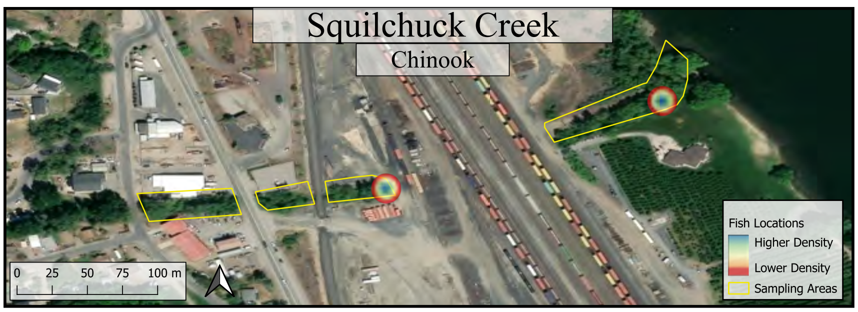
All Coho captured in August were located near the mouth of the Columbia River, whereas Chinook were also captured slightly farther upstream, above the railyard crossing (Figure 8). Both species exhibited fork lengths of less than 85 mm. In October, all capture locations for Chinook and Coho Salmon were close to the mouth of the Columbia River (Figure 9 left). Fork lengths ranged between 95 mm and 104 mm, with one smaller Chinook (79 mm).

The low number of captured individuals did not permit abundance or growth rate estimates at this location. The lower 2 km of the tributary runs through a rail yard, commercial businesses and a densely populated residential area and trailer park. Additionally a 117 m long culvert characterized as an "unknown barrier" (Schmidt, 2006) and a small outfall drop a the mouth of the Columbia could be contributing to the low number of captured individuals.

One *O. mykiss* tagged in Lower Squilchuck Creek in May was subsequently detected at Rock Island Dam in early July, and then again at the Lower Wenatchee Barge in late November. Another individual was tagged at the Chiwawa Screw Trap in April, recaptured in Squilchuck Creek in May, and later detected in the Lower Wenatchee River (LWE) in June, at Tumwater Dam in July, and finally at Chiwaukum Creek in August (Figure 7).

Table 4: Number of individuals captured/encountered (C), marked (M), recaptured (R) per species during all sampling events in Lower and Upper Squilchuck Creek.

Sampling date	**Chinook**			***O. mykiss***			**Coho**		
Lower	**C**	**M**	**R**	**C**	**M**	**R**	**C**	**M**	**R**
05/20	-	-	-	5	4	-	1	1	-
08/05	2	2	-	-	-	-	3	1	-
10/14	4	4	-	-	-	-	1	1	-
Upper	**C**	**M**	**R**	**C**	**M**	**R**	**C**	**M**	**R**
10/14	-	-	-	39	39	-	-	-	-



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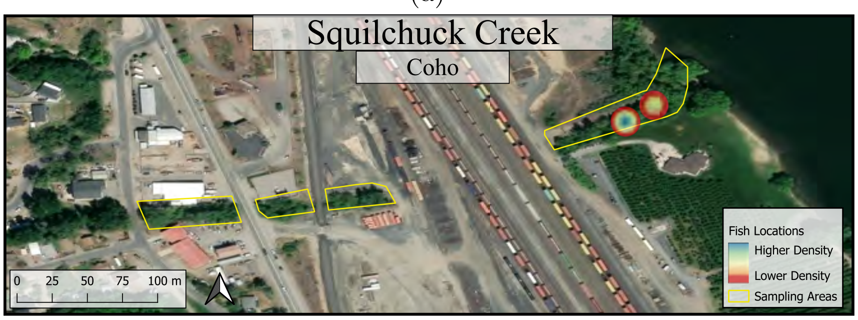


(b)

Figure 8: Heatmaps of capture locations for Chinook Salmon (a) and Coho Salmon (b) in the Lower Squilchuck Creek during August sampling events. *O. mykiss* and Brook Trout were not captured at this time.

The Upper Squilchuck Creek was only sampled once in October. 39 *O. mykiss* were captured across the entire sampling reach and marked (Figure 11 right). No other species were encountered. Most individuals had a fork length between 120 mm and 220 mm, with a couple of individuals between 50 mm and 70 mm (Figure 10).

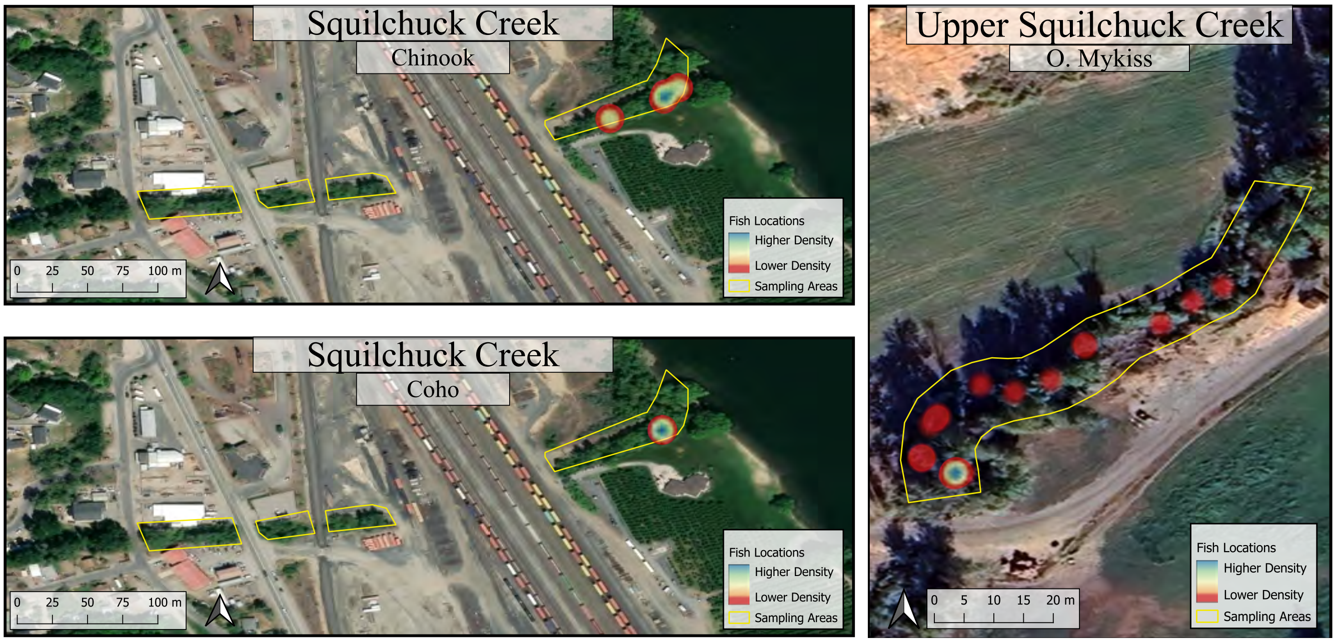


Figure 9: Heatmaps of capture locations for Chinook Salmon (top left) and Coho Salmon (bottom left) in the Lower Squilchuck Creek and *O. mykiss* in the Upper Squilchuck Creek (right) during the October sampling events. *O. mykiss* and Brook Trout were not captured at this time.

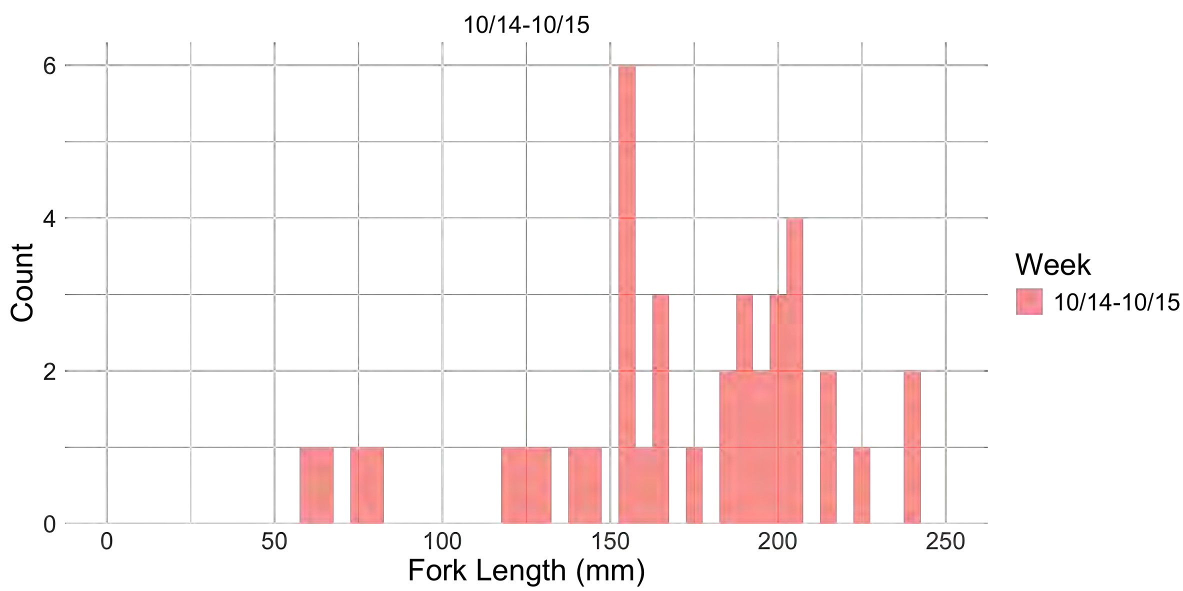


Figure 10: Fork length distribution for the October sampling event for *O. mykiss* in the Upper Squilchuck.

4.3 Colockum Creek

The upper and lower sampling reaches in Colockum Creek are separated by a steep canyon with a series of small waterfalls that likely represent a natural barrier for certain life stages of anadromous species, which could explain the differences in species distributions between the two reaches. In the lower reach, large numbers of Steelhead and Coho Salmon were captured, along with a few Chinook Salmon (Table 5). Landowner restrictions prevented a second sampling event in this reach, so no abundance estimates could be calculated.

Table 5: Number of individuals captured/encountered (C), marked (M), recaptured (R) per species during all sampling events in Lower and Upper Colockum Creek.

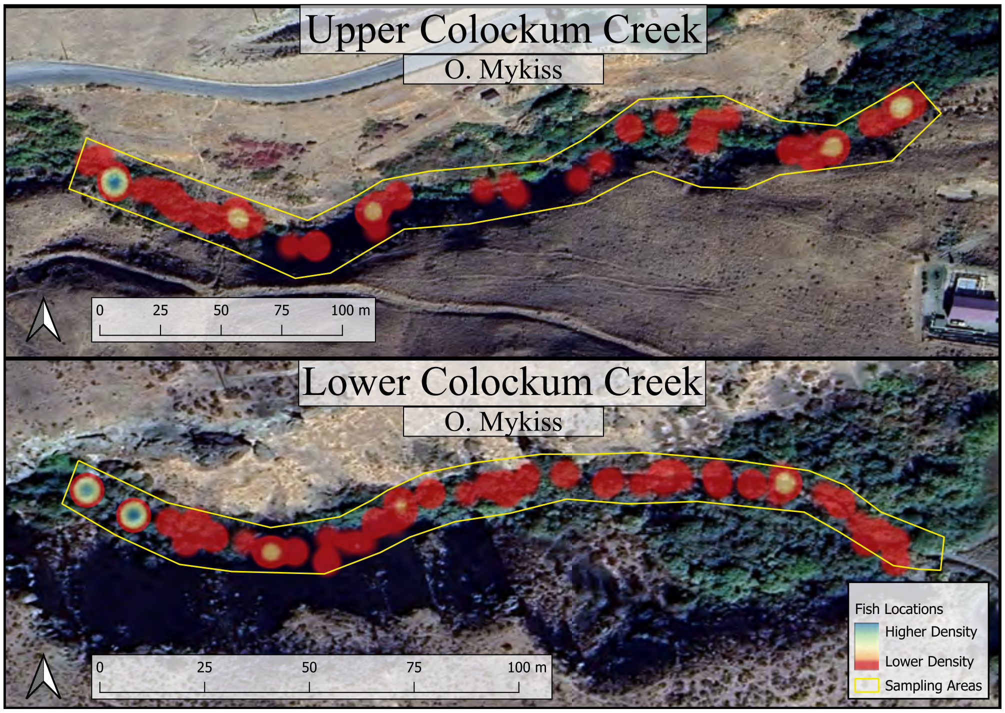
Sampling date	**Chinook**			***O. mykiss***			**Coho**		
Lower	**C**	**M**	**R**	**C**	**M**	**R**	**C**	**M**	**R**
08/06	4	3	-	121	46	-	247	230	-
Upper	**C**	**M**	**R**	**C**	**M**	**R**	**C**	**M**	**R**
08/07	-	-	-	67	57	-	-	-	-
08/19	-	-	-	56	31	18	-	-	-

In contrast, only *O. mykiss* were captured in the upper reach (Table 5). According to Lincoln-Petersen estimates, the population in this reach consisted of approximately 208 individuals, while Chapman estimates were similar at 203 individuals. The reach was sampled only twice in August, preventing growth rate estimates.

O. mykiss were captured throughout both sampling reaches, with higher densities observed near the upper ends of each reach (Figure 11a). In the lower Colockum reach, deep pools at the upstream end of the reach contained high abundances of fish. Chinook and Coho Salmon were also most abundant in the deep pools described above, with fewer individuals occurring farther downstream (Figures 11b and 11c).

Fork length distributions of *O. mykiss* indicated multiple juvenile cohorts in both the upper and lower reaches of Colockum Creek. In the lower reach, most individuals measured between 40 and 80 mm, with a few between 110 and 140 mm and one individual exceeding 160 mm. In the upper reach, most individuals measured between 110 and 160 mm, although some smaller individuals around 55 mm and some larger individuals near 200 mm were also present.

The majority of Coho Salmon measured between 50 and 100 mm (Figure 11c, whereas Chinook Salmon ranged from 65 to 85 mm.



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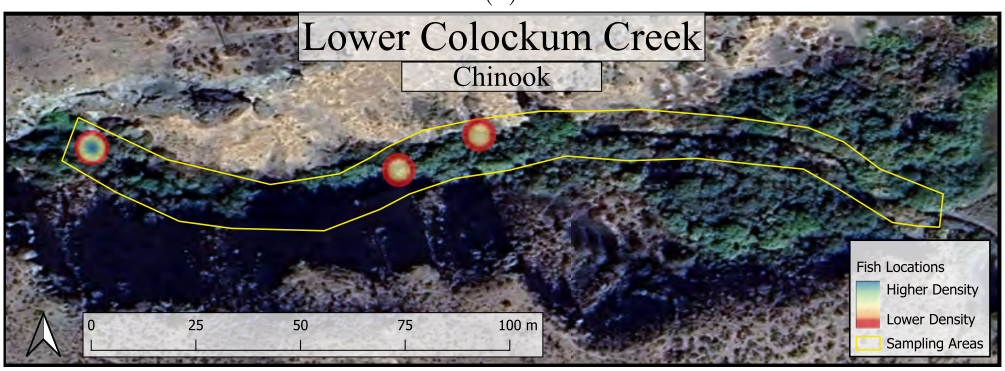

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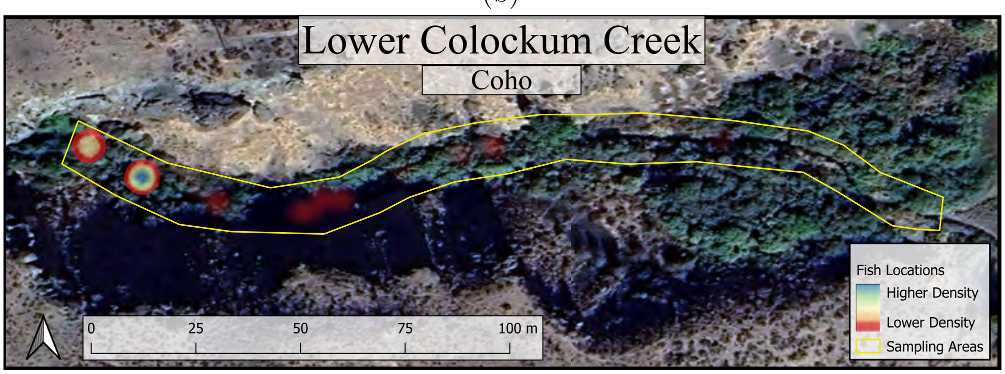
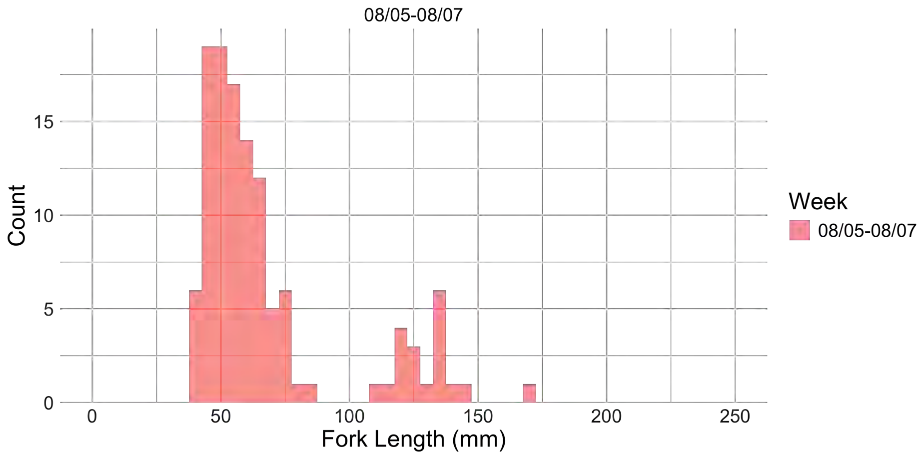


(c)

Figure 11: Heatmaps of capture locations for *O. mykiss* in the upper and lower Colockum Creek reaches (a) and for Chinook (b) and Coho (c) in the Lower Colockum during August sampling events. Brook Trout were not captured in this creek.



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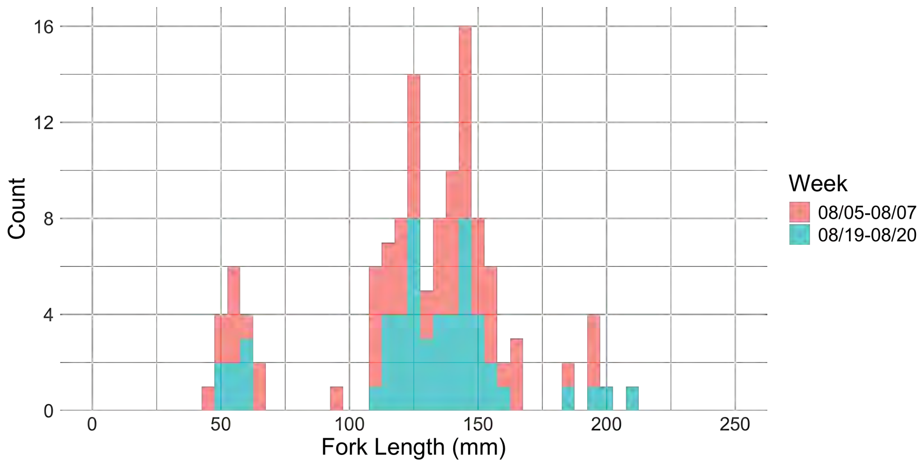

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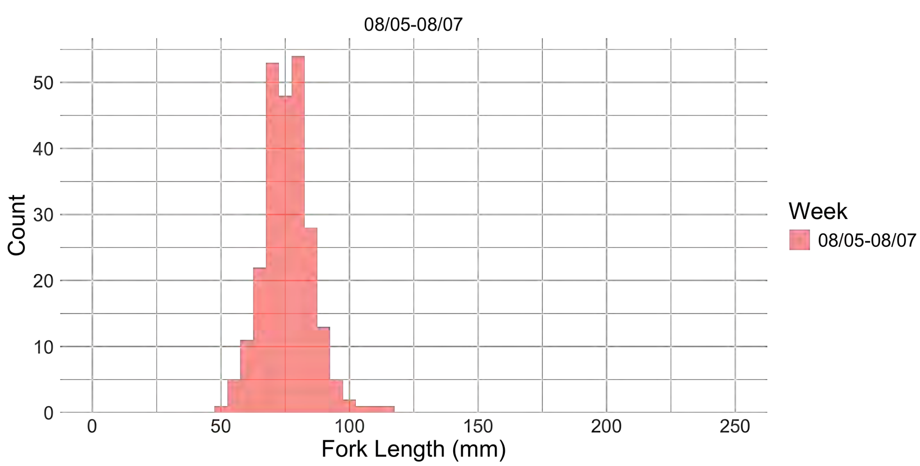

(c)

Figure 12: Fork length distributions over all sampling dates for *O. mykiss* in the Lower (a) and Upper Colockum Creek (b), and for Coho in the Lower Colockum Creek (c). Y-axis are not normalized.

5 Discussion

This study provides baseline information on the occurrence, distribution, and size structure of salmonid species across the lower reaches of three Columbia River tributaries: Stemilt, Squilchuck, and Colockum Creeks. Multiple juvenile cohorts of *O. mykiss* and Coho Salmon were captured in Stemilt Creek, whereas Chinook Salmon occurred in much lower numbers. Colockum Creek supported Coho Salmon, Chinook Salmon, and *O. mykiss* in the lower reach, while only *O. mykiss* were present in the upper reach which is likely above the anadromous range for most life stages except during certain flows. In contrast, Squilchuck Creek yielded very few individuals overall in the lower section, suggesting limited habitat quality or other constraints on salmonid presence. However, large numbers of *O. mykiss* were encountered in the upper section of Squilchuck that was assumed to be upstream of several significant anadromous passage barriers. Where recapture numbers were sufficient, Lincoln–Petersen and Chapman estimators provided similar abundance estimates, indicating small but viable populations in Stemilt Creek and the upper Colockum reach. Long residence time shown for a few recaptures within Stemilt Creek indicates that this system supports a rearing population of both Chinook and *O. mykiss* potentially across multiple seasons. By contrast, the few fish encountered in lower Squilchuck Creek may have been seeking temporary refuge during active emigration, or simply exploring new territory without finding suitable habitat for longer term residence. This is further supported by the relatively high proportion of *O. mykiss* encountered here that were subsequently detected elsewhere, including observation of a migrating juvenile Steelhead that was tagged in the upper Wenatchee subbasin at Chiwawa Creek before moving downstream into Squilchuck Creek, and then back upstream to the middle Wenatchee subbasin in Chiwaukum Creek.

Habitat conditions strongly influenced observed patterns. Colockum Creek maintained cooler water temperatures in the lower reach throughout the summer, likely supporting the higher salmonid abundance observed there. In comparison, elevated daytime temperatures in Stemilt and Squilchuck Creeks likely restricted suitable habitat during summer sampling periods. In Squilchuck Creek, the outfall drop at the confluence with the Columbia River, the 117 m long culvert under the rail yard and other factors including dense residential development likely contribute to degraded habitat conditions, which may explain the low abundance and limited distribution of salmonids in this system.

Barriers and connectivity also played a role in shaping species distributions. The steep canyon section with multiple waterfalls above the lower sample reach of Colockum Creek is likely a natural barrier to certain life stages of anadromous fish. Assessment work in Colockum Creek in 2025 has identified presence of only *O. mykiss* through eDNA samples taken at the Tarpiscan Road Bridge and five other sites upstream (M. Kane, pers.com., 2025). Current Reach Assessment work, including assessment of natural and artificial barriers, flow, habitat and eDNA will be helpful in determining the potential fish distribution. Historic PIT tag arrays upstream of the canyon (Tarpiscan Road) have indicated adult steelhead migration to upstream reaches (M. Kane, pers.com., 2025).

These initial findings should be combined with updated habitat, flow and barrier data to prioritize projects to address flow, screening, passage and habitat conditions in all three tributaries. Additional questions on water quality have been raised, specifically with regard to Squilchuck Creek and it would be worthwhile to consider this and also look at fish use upstream of the railyard and residential development.

Finally, several limitations should be noted. Small sample sizes in Squilchuck Creek and parts of Colockum Creek limited the ability to generate precise abundance or growth estimates. Mark-recapture analyses also assumed closed populations, an assumption unlikely to be fully met in these dynamic systems. Nonetheless, by combining presence-absence surveys, size distributions, and limited abundance estimates, this study provides a foundation for evaluating habitat conditions, prioritizing restoration, and guiding future monitoring efforts.

5.1 Future Monitoring Recommendations

1. Any future juvenile PIT tagging studies in these creeks would be greatly improved by the installation of temporary PIT tag detection arrays to monitor outmigration of tagged fish.
2. Temporary PIT tag arrays would offer the additional benefit of detecting migrating adults that could be spawning or seeking temporary refuge in these systems.
3. Future PIT tagging efforts should focus on Spring and Fall periods within the same sample reaches, where tag detections and additional PIT tagging may help apportion steelhead and resident rainbow *O. mykiss*, as well as further identify residence time and rearing status of all juvenile salmonids.
4. Additional spawner data would be useful, but redd surveys are likely too difficult due to water conditions during key spawning periods.
5. A comprehensive monitoring plan should be developed alongside any planned restoration activities, as these systems will each provide a unique and valuable insight into the restoration potential of small urban streams throughout the Columbia Basin.

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