LUCKIAMUTE
RAPID BIO-ASSESSMENT 2009

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Luckiamute Watershed Council

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INTRODUCTION

The 2009 Rapid Bio-Assessment inventory of the Luckiamute Watershed was a replicate inventory targeting the most productive salmonid habitat in the basin. This inventory was designed to describe the distribution and relative abundance of cutthroat trout and anadromous winter steelhead. 96.6 stream miles were inventoried in 2009. The entire basin (214 stream miles) was inventoried in 2008 utilizing the RBA protocol which included many miles of dysfunctional aquatic habitats that currently exhibit deep channel entrenchment, elevated summer temperature profiles and provide limited summer production potential. Some streams in the basin were also surveyed in 2002 and 2003. These included Beaver, Boulder, Clayton, Cougar, Miller, Pedee, Ritner, Sheythe, West Fork Luckiamute, Wolf, and approximately 7 miles of the upper Luckiamute mainstem. Results and comparisons to those surveys are included below in the Site Specific observations.

The intent of the RBA inventory was to gather information on the status of juvenile salmonid summer distributions and summer rearing densities. The inventory consisted of extensive snorkel surveys that began at the mouth of each stream and continued to the end of significant salmonid rearing potential (not to the end of Cutthroat distribution). These surveys will be used to develop a base line for understanding how juvenile salmonids are currently utilizing habitats within the basin during summer flow regimes. Replicates of this inventory in high priority stream reaches (streams exhibiting residual system function) will be critical for identifying trends in the distribution and abundance of juvenile Coho, Steelhead and Cutthroat in response to watershed restoration and management.

The Rapid Bio-Assessment survey method (RBA) was designed to sub-sample (20%) pool rearing habitats using a Rapid Assay technique that could cover large distances and succeed in describing the current distribution of juvenile salmonids in all of the surveyed streams and their tributaries. Beaver dam frequency and knotweed presence was also recorded.

METHODS

The basins and sub-basins surveyed were selected and prioritized by the Luckiamute Watershed Council (LWC). Survey crews were concentrated within a sub basin to complete the sampling activity within a concise window of time. This approach led to transportation efficiency and eliminated any possibility of population shifts in response to changes in flow or temperature. Land owner contacts were made for all of the private, industrial and public ownerships that existed on both sides of every stream reach surveyed. Contacts were conducted by students from Western Oregon University. Developing these contacts involved extensive research in the county tax assessor's office and then a personal contact to describe the survey and request permission for access. The land owner information was recorded (name, contact #, tax lot # and location) and is available from the LWC as a byproduct of this contract.

Most surveys were initiated by randomly selecting any one of the first five pools encountered. The protocol however was altered for small tributaries (2^{nd} and 3^{rd} order) where salmonid presence or absence was undetermined. In these tributaries, the first pool above the confluence was selected as unit number one. This alteration in protocol was adopted to identify minor upstream temperature dependant migrations that may not have extended more than a few hundred feet. The identification of this type of migratory pattern in juvenile salmonids is critical for understanding potential limiting factors within the basin (temperature, passage, etc.). Some surveys by necessity were initiated at a point above agricultural influence where visibility

conditions shifted from poor to good. In these surveys the start point of the survey will be indicated separately on the USGS quads (project deliverables).

The survey continued sampling at a 20% frequency (every fifth pool) until at least two units without Cutthroat were observed or when the surveyor determined that the end of significant production potential for cutthroat had been reached

In sub-basins with low rearing densities, there were situations where Cutthroat were not detected for more than two sampled units. These conflicting situations were left to the surveyor's discretion, whether to continue or terminate the survey.

Pools had to meet minimum criteria of being at least as long as the average stream width. They also had to exhibit a scour element (this factor eliminates most glide habitats) and a hydraulic control at the downstream end. There were no minimum criteria established for depth. Only main channel pools were sampled. Side channel pools, back waters and alcoves were not incorporated into the surveyed pool habitats. The primary reasons for not including these secondary and off channel pools is that they compromise the consistency of measuring, summarizing and reporting lineal stream distances. Given this fact, the method tends to underestimate total abundance in complex stream channels.

The lineal distances represented in the database were estimated by pacing from the beginning of one sampled unit to the beginning of the next sampled unit. The length of the sampled pool is an independent quantity, which was always measured and not estimated.

Total distances represented in the database are consistently greater than map wheeled distances using USGS 1:24,000 series maps. This is related to the level of sinuosity within the floodplain that is not incorporated in mapping. If you are attempting to overlay this database on existing stream layer information there would be a need to justify lineal distances with known tributary junctions (these can often be found in the comments column).

Pool widths were generally estimated. Because pool widths vary significantly within a single unit, a visual estimate of the average width was considered adequate. Pool widths were typically measured at intervals throughout the survey to calibrate the surveyor's ability to judge distance.

The snorkeler entered the pool from the downstream end and proceeded to the transition from pool to riffle at the head of the pool. In pools with large numbers of juveniles of different species, multiple passes were completed to enumerate by species. (Cutthroat first pass, 0+ trout second pass, etc.). This allowed the surveyor to concentrate on a single species and is important to the collection of an accurate value. In addition, older age class Steelhead and Cutthroat were often easier to enumerate on the second pass because they were concentrating on locating food items stirred up during the surveyor's first pass and appeared to exhibit less of their initial avoidance behavior.

In large order stream corridors two snorkelers surveyed parallel to each other, splitting the difference to the center from each bank.

A cover/complexity rating was attributed to each pool sampled. This rating was an attempt to qualify the habitat sampled within the reach. The 1 - 5 rating is based on the abundance of multiple cover components within a sampled unit (wood, large substrate, undercut bank, overhanging vegetation). Excessive depth (>3 ft) was not considered a significant cover component. The following criteria were utilized:

1 0 cover present
2 1-25 % of the pool surface area is associated with cover
3 26-50 % of the pool surface area is associated with cover
4 51-75 % of the pool surface area is associated with cover
5 > 75 % of the pool surface area is associated with cover

A point to consider here is that the frequency of higher complexity pools increases with a decrease in stream order. This inverse relationship is primarily a function of average channel width and the resultant ability of narrow channels to retain higher densities of migratory wood. Channel morphology begins to play a much more significant role in this relationship during winter flow regimes where increases in floodplain interaction and the abundance of low velocity habitat may become as significant as wood complexity.

A numerical rating was given to each sampled unit for the surveyor's estimate of visibility. The following criteria were utilized:

Visibility
1 excellent
2 moderate
3 poor

This variable appends a measure of confidence to the collected data. Survey segments with a visibility value of 1 can assume normal probabilities of detection (the observed is within 20 percent of the actual for Coho). Segments with a measure of 2 suggest that less confidence can be applied to the observed number (uncalibrated) and segments with a visibility rating of 3 suggest that the observation can probably be used for only an assessment of presence or absence.

Beaver dam presence was recorded during the 2008 inventory. Beaver dams were simply counted along the survey and given a sum total at the end of each stream. Only intact full spanning dams were counted. This variable may then be sorted in the database for presence, absence, total number and trend within each sub basin.

There was also commentary recorded within each of the surveyed reaches that included information on temperature, tributary junctions, culvert function, the abundance of other species and adjacent land use. This commentary is included in only the raw Access database under the "comments" field and not in the Excel workbook.

The database contains a field designed to facilitate the development of a GIS data layer. These LLID location numbers are unique for each stream segment. Latitude and longitude values were not collected for start points because these values already exist in the actual LLID number used to initiate a surveyed reach.

GENERAL OBSERVATIONS

The 201,738 acre Luckiamute Watershed is located on the west side of the Willamette Valley 62 miles south of Portland in Benton and Polk counties. The Luckiamute River and its tributaries drain coast range sub-basins dominated by low elevation headwaters that range primarily between 100 and 1,000 ft. This general morphology is very significant in predisposing the system to some of the aquatic dysfunction observed within this inventory. The combination of low gradients and simplification within the channel from the historic impacts of agriculture have resulted in deep channel entrenchment that has isolated many miles of Luckiamute Basin stream corridors from their floodplains. This has resulted in the trickle down effect of reducing summer base flows and degrading water quality (temperature). Many upper basin tributaries such as Boulder, Ritner, Pedee, and Teal begin as steep rocky streams flowing through boulder gorges and rapids and over large waterfalls. Portions of these upper basin tributaries maintain a higher level of functionality as a result of higher gradients that sustain higher water quality well into summer pinch period flow regimes.

Steep stream gradients and cool summer flows become less abundant as the wide valley floors of the Luckiamute and Little Luckiamute converge. Channel morphologies and the resultant aquatic habitats shift rapidly toward the predominant characteristics of the basin: slack water habitats, low summer flows, high solar exposure, elevated summer stream temperatures, heavy silt depositions and a transition from cold to warm water aquatic species. Water withdrawals and a sedimentary geology throughout the majority of the watershed compound the low flow / high temperature condition that in general does not facilitate summer salmonid rearing. These extensive low gradient aquatic habitats provide abundant winter habitat for resident, fluvial and anadromous salmonid juveniles. Winter habitat is however, not the seasonal limitation for the production and survival of salmonids within the basin.

Expanded estimates for anadromous salmonids were very low during both of the 2008 and 2009 inventories. Tables #1 and #2, below, summarize these estimates for each of the 5 sub-watersheds surveyed. Table #4, under" Site Specific Observations", contains totals for each individual stream. No Coho were observed in the basin in 2009. Only 1,750 1+Steelhead were estimated to be present utilizing pool habitats during the summer of 2009 in the entire Luckiamute Basin. This represented a 43% increase in abundance compared to the expanded estimate from 2008 (1,225 1+Steelhead), although individual stream rearing densities remained extremely low. Cutthroat abundance (12,910 – expanded) exhibited a minor decline of 11% compared to estimates from 2008 (14,560 – expanded). Sampling biases have not been developed for 1+Steelhead and Cutthroat but are significant since large numbers of these species rear in riffle/rapid habitats that were not sampled as part of this inventory. Steelhead, Cutthroat and 0+ numbers from this analysis can only be utilized to identify key rearing reaches and monitor inter-annual trends, not for basin or reach scale population estimates.

1+Steelhead distribution in the Luckiamute Basin most accurately highlights the habitats within the basin that exhibit residual system function. Consecutive survey years have observed this residual function in the uppermost sub-watershed of the Luckiamute mainstem, which included Boulder and the West Fork Luckiamute (including Miller and Cougar). These reaches exhibit prime stream gradients for sorting anadromous spawning gravels and high quality summer rearing habitat. Again, underlying gradient and channel morphology in this upper portion of the watershed drives the abundance of high quality habitat for salmonids. In addition,

the transition from agriculture to an industrial forest land use in these upper basin reaches has preserved the riparian canopies that are required to support higher wood complexity, greater floodplain interaction, higher water quality and the development of a complex food web for juvenile salmonid survival. Higher elevations surrounding these headwaters result in numerous cold water tributaries that mitigate for elevated summer temperature profiles. Many restoration prescriptions have been implemented in this sub-watershed which has also contributed to maintaining and enhancing salmonid production potential.

These reaches currently represent the most critical habitat for the survival of anadromous salmonids within the Luckiamute Watershed. They are characterized by significant summer flows, low water temperatures, and low rates of sedimentation. Surveys in 2008 and 2009 observed 40% and 38%, respectively, of the total observed Cutthroat (normalized for comparison) also in this sub-watershed. In addition, good spawning and rearing conditions were observed in Teal and Pedee Cr. These two sub-basins represent secondary anchor habitats within the watershed.

1+Steelhead abundance increased by 12.2% between 2008 and 2009 in the uppermost Luckiamute sub-watershed while Cutthroat abundance declined 33.5%. The most significant changes were observed in the Luckiamute Mainstem (SH +19%, CT –16%) and the West Fork Luckiamute (SH –18%, CT –46%). 1+Steelhead abundance declined linearly downstream through each sub-watershed. 28% of the total steelhead were observed in the Vincent Cr. sub-watershed of the Luckiamute mainstem, 0% in the Maxfield-Plunket-Price sub-watershed, 3% in the Pedee-Ritner-Sheythe-Clayton sub-watershed and 6% in Teal Cr. in 2009 (Middle Little Luckiamute sub-watershed). A more critical comparative analysis of existing habitat parameters in each of these sub-watersheds would be necessary to sort out the relationship between Steelhead abundance and spatial variation. Cutthroat contributions to the observed total for the four sub-watersheds mentioned above suggest similar production potentials, totaling 17%, 12%, 19%, and 14%, respectively, of the total number of cutthroat observed in the 97 mile sub sample of habitats.

Both 1+Steelhead and Cutthroat abundance increased in the Vincent Cr. sub-watershed, 250% and 26% each. In the Maxfield-Plunket-Price sub-watershed 1+Steelhead abundance declined from 70 (expanded) to zero while Cutthroat abundance declined 26%. The Pedee-Ritner sub-watershed exhibited very minor changes in 1+Steelhead abundance (from 35-expanded in 2008 to 50-expanded in 2009) and Cutthroat abundance (+2.5%). All 1+Steelhead in this sub-watershed were observed in Pedee Cr. both years. Almost no change in Cutthroat abundance was observed in Pedee Cr. between 2008 and 2009 while the estimate in Ritner increased 35%.

A large increase in 1+Steelhead and Cutthroat abundance was observed in the Middle Little Luckiamute sub-watershed in 2009, all within the Teal Cr. sub-basin. Expanded estimates for Cutthroat in Teal increased by 109% while 1+Steelhead estimates increased from zero to 110 (expanded). This suggests that adult anadromous steelhead spawned successfully in Teal Cr during the spring of 2008 but not in the spring of 2007. This population segment represented 6% of the observed total 1+Steelhead (97 mile sub sample). Teal Cr exhibits the greatest production potential for anadromous salmonids within the Little Luckiamute sub-basin. Cutthroat production across the Middle Little Luckiamute sub-watershed increased by 86% and accounted for 14% of the basin-wide total (13% in 2008).

0+ trout estimates in 2009 increased 213% from the previous year's inventory. Every sub-watershed in the 2009 inventory experienced an increase in 0+trout abundance, from 81% in Maxfield-Plunket-Price to 320% in Pedee-Ritner. The largest sub-watershed abundance of the 0+

age class was observed in Pedee-Ritner (31% of inventory total) and Teal-Little Luckiamute (26% of inventory total). These increases are likely the result of the later survey timing in 2009 which clearly occurred post fry emergence. In the case of Ritner the inventory was conducted 2 months later. In the case of Teal Cr, inventories were conducted one month later. Inter annual comparisons of 0+ age class abundance would be inappropriate because of this variation in survey timing.

The Middle Little Luckiamute, Pedee-Ritner, and Boulder-Beaver-West Fork sub-watersheds appear to represent the top three priority zones for restoring, recovering and enhancing both anadromous and resident salmonid populations. A restoration focus on these areas assumes that strengthening and improving existing functional habitats is a desired basin scale strategy for expanding the distribution of salmonids to adjacent habitats.

(Table 1)
Sub-watersheds of the Luckiamute Basin – 2008 Expanded Estimates (Normalized)

Sub-watershed	Area (acres)	Coho Salmon	0+	Steelhead	Cutthroat
Upper Luckiamute River (Pool 119-194)	11,700				
Luckiamute River* + Boulder, Beaver, Wolf		0	240	765	3,965
West Fork Luckiamute River + Miller Creek		0	385	215	3,425
Sub-total		**0**	**625**	**980**	**7,390**
Upper Luckiamute River/Vincent Creek (Pool 73-118)	22,300				
Luckiamute River + other tributaries		0	615	140	1,510
Vincent		5	60	0	245
Sub-total		**5**	**675**	**140**	**1,755**
Upper Luckiamute River/Maxfield Creek (Pool 65-72)	20,000				
Plunkett Creek		0	510	0	535
Price Creek		0	325	0	580
Maxfield Creek		0	260	70	645
Luckiamute River		0	0	0	255
Sub-total		**0**	**1,095**	**70**	**2,015**
Upper Luckiamute River/Pedee Creek (Pool 60-64)	19,000				
Ritner, Sheythe and Clayton Creeks		0	490	0	865
Pedee Creek		0	495	35	1,345
Luckiamute River		0	0	0	230
Sub-total		**0**	**985**	**35**	**2,440**
Middle Little Luckiamute River (Pool 27-55)	23,500				
Teal and Grant Creeks		0	685	0	760
Waymire Creek		40	100	0	100
Little Luckiamute River		5	145	0	100
Sub-total		**45**	**930**	**0**	**960**
2008 TOTALS		**50**	**4,310**	**1,225**	**14,560**

- Visual bias not included
- *7.5 mile reach + Tribs. AA, AC, AD

(Table 2)
Sub-watersheds of the Luckiamute Basin – 2009 Expanded Estimates (Normalized)

Sub-watershed	Area (acres)	Coho Salmon	0+	Steelhead	Cutthroat
Upper Luckiamute River (Pool 65-189)	11,700				
Luckiamute River* + Boulder, Beaver, Wolf		0	900	960	3,310
West Fork Luckiamute River + Miller Creek		0	1,125	140	1,605
Sub-total		**0**	**2,025**	**1,100**	**4,915**
Upper Luckiamute River/Vincent Creek (Pool 19-64)	22,300				
Luckiamute River + other tributaries		0	1,835	490	2,080
Vincent		0	25	0	135
Sub-total		**0**	**1,860**	**490**	**2,215**
Upper Luckiamute River/Maxfield Creek (Pool 5-18)	20,000				
Plunkett Creek		0	665	0	85
Price Creek		0	445	0	495
Maxfield Creek		0	875	0	895
Luckiamute River + other tributaries		0	0	0	20
Sub-total		**0**	**1,985**	**0**	**1,495**
Upper Luckiamute River/Pedee Creek (Pool 1-4)	19,000				
Ritner, Sheythe and Clayton Creeks		0	2,420	0	1,170
Pedee Creek		0	1,720	50	1,330
Luckiamute River		0	0	0	0
Sub-total		**0**	**4,140**	**50**	**2,500**
Middle Little Luckiamute River (Pool 1-18)	23,500				
Teal and Grant Creeks		0	3,440	110	1,585
Waymire Creek		0	35	0	195
Little Luckiamute River		0	25	0	5
Sub-total		**0**	**3,500**	**110**	**1,785**
2009 TOTALS		**0**	**13,510**	**1,750**	**12,910**

- Visual bias not included
- * 8.5 mile reach + Tribs. AA, AD, AE, AH

Most habitats were not seeded to capacity in the inventoried sub-basins and there remains extensive summer habitat available to salmonids that are currently under-utilized. The average density for a surveyed reach is an excellent measure of trend that can be monitored from year to year. However, it tends to portray only a general description of the current status within a reach. Understanding how each reach is functioning is more accurately interpreted in a review of how the rearing density changes within the reach. The pivot table graphics provided in electronic format with this summary are essential for the proper interpretation of this review.

Information on beaver dam and knotweed locations are documented in the Access database with further description recorded under the comments heading. This information is also summarized below in the Site Specific Observations. Overall, beaver activity appears to be relatively high in the Luckiamute Basin. A total of 92 active dams were encountered in 2008 over 214 stream miles and 44 active dams were encountered in 2009 over 96.6 stream miles. Many streams were completely dominated by an extensive legacy of beaver impoundments. The continued collection of this supplemental data could be very revealing as land use patterns and anadromous fish production change over time. The presence of beaver dams is a powerful ecological attribute capable of re-setting the clock on channel degradation and entrenchment.

Distribution profiles

The distribution of juveniles and their observed rearing densities for each surveyed reach provide a basis for understanding how each reach is functioning in relation to the remainder of the basin or sub-basin. These profiles can help identify spawning locations, identify potential barriers to upstream adult and juvenile migration, identify the end point of anadromous distribution and they may also indicate how juvenile salmonid populations are responding to environmental variables such as increased temperature. You will find a review of these distribution profiles within this document for each of the streams surveyed.

The average rearing density for a stream segment is utilized in this report as a metric for evaluating inter annual variation and long term trend analysis. In this work, stream averages are calculated as the sum of the individual pool averages divided by the number of pools sampled. This approach gives equal value to each pool, independent of pool size. An alternative approach would be to divide total surface area by the total number of fish observed. This approach weights the average by pool size. This approach dilutes the value of highly productive stream segments by overwhelming the calculation with large unproductive lower habitat units.

This effort is more interested in getting a sense of what the true rearing potential is for the highest quality individual pool habitats. By attributing equal value to each pool regardless of size, we have been able to identify a realistic rearing target within a stream reach for the metric of full seeding. From this type of analysis we hope to also identify key anchor habitats that exist within a stream segment that exhibit exceptional function. Identifying the localized anchor habitats that exhibit high production potential aides in understanding the unique biological and morphological characteristics that create and maintain exceptional ecosystem functionality.

Because we have chosen to calculate averages without weighting the data for pool size a direct expansion of pool surface areas multiplied by the reach average to calculate a population estimate would be inappropriate.

Adult and Juvenile Barriers

Adult migration barriers are verified by determining that no anadromous production is occurring above a given obstruction (culvert, falls, debris jam, beaver dam, etc.). There are many barriers, both natural and manmade, that impact the migration of salmonids. Some are definitive barriers that are obvious obstructions (such as bedrock falls). Many barriers however, only impede adult salmonid migrations during low flow regimes. Summer juvenile inventories allow us to definitively quantify whether passage was obtained at any point during the season of adult anadromous migration. Barrier classification becomes more subjective within stream reaches exhibiting only cutthroat populations because of the presence of resident and fluvial life history strategies populating stream reaches both above and below definitive barriers.

Juvenile salmonids typically migrate upstream for a variety of reasons (temperature, winter hydraulic refuge, food resources). Hydraulic refuge and food resources are typically fall, winter and spring migrations that would not be detectable during summer distribution inventories. Temperature however, is probably the most significant driver of upstream juvenile salmonid migrations during summer flow regimes. Juvenile barriers are subjective to the eye of the observer. The trend in juvenile density can be a method of detecting either partial or full barriers to upstream migration. Each of the surveyed reaches contains a comments section in the Access database to note the presence of culverts, jams and other physical factors that may influence the ability of salmonid populations to make full use of aquatic corridors.

Temperature Dependant Migrations

Potential temperature dependant migrations can be observed in the database by looking for densities that decrease significantly as the lineal distance increases from the mouth of the stream or tributary. This is more likely to be observed in the case of low abundance years where tributary habitats that are seeded to capacity are the exception. During years of high abundance there is a more significant potential for density dependant upstream migrations that would be indistinguishable from the distribution pattern mentioned above. The recognition of this migration pattern allows us, during years of low escapement, to identify important sources of high water quality within the basin that may be traditionally overlooked because of some other morphological condition that suggests to us that there is no significant potential for rearing salmonids (i.e. lack of spawning gravel). These stream reaches typically exhibit declining densities with increased distance from the mouth and no indication of a spawning peak (a point near the upper distribution of the population with significantly higher rearing densities). These tributaries may be functioning as important summer refugia for salmonid juveniles threatened by increasing temperatures in the mainstems.

This appears to be a critical issue in the predominantly low gradient Luckiamute Basin. Low instream flows and high solar exposure in most streams has resulted in cumulative downstream impacts that create an uninhabitable scenario for juvenile salmonids (a condition that gets progressively worse during summer months). Many miles of warm, stagnant slack-water pools were observed in the lower mainstem habitats of the Luckiamute, Little Luckiamute, and Soap Cr., to name a few. Mainstem headwaters and small tributary habitats adjacent to these reaches provide the only near term source of summer refugia.

Precautions

The average densities generated as an end product for each stream reach are the result of a 20 percent sample. Consequently, they probably vary significantly around the true average density. There are many sources of potential variation, start point, number of units sampled within the reach, surveyor variability, etc. The range of variability for at least one of these variables (start point), was documented in the final review of the 1998 Rapid Bio-Assessment conducted by Bio-Surveys for the Midcoast Watershed Council. To facilitate the proper utilization of the data included in this inventory, the 1998 results are included below. The true average density of a stream reach was retrieved by querying the database from an ODFW survey on East Fk. Lobster in the Alsea Basin where every pool was sampled. Comparisons could then be made between the true average density and a randomly selected 20 percent sub sample (every 5th pool). Only mainstem pools were utilized within the range of Coho distribution to match the protocol for the Rapid Bio-Assessment.

(Table 3)

SAMPLE FREQUENCY	AVG. COHO DENSITY	AVG. SH DENSITY	AVG. CUT DENSITY	AVG. 0+ DENSITY
100 %	1.07	.03	.04	.13
50 %	1.10	.04	.03	.14
20 % Start Pool 1	0.87	.04	.03	.13
20 % Start Pool 3	1.01	.03	.03	.13
20 % Start Pool 5	1.13	.05	.04	.12

SITE SPECIFIC OBSERVATIONS

Site specific observations within this document have been organized in an alphabetical format with the exception of the largest stream segment, the Luckiamute mainstem, which is listed first. Small unnamed tributaries to the Luckiamute mainstem are listed last.

These production estimates are based on an expansion of the 20% snorkel sample in pools only and therefore do not constitute an entire production estimate for the basin. These estimates greatly under estimate the standing crop of 0+, Steelhead and Cutthroat because a large component of their standing crop is summer rearing in riffle / rapid and glide habitats that were not inventoried. In addition, there is also production for 0+ and cutthroat that may extend upstream beyond the end point of some surveys. The information below can be utilized to establish a baseline for trend monitoring for subsequent survey years on the basin-wide scale and by tributary. It also provides a comparison of the relative production potentials between tributaries that can be utilized as a foundation for prioritizing restoration opportunities.

(Table 4)
Luckiamute River 2009 Inventory of high priority stream segments (Expanded Estimates)

Stream	**Coho**	% Total	**0+**	% Total	**Sthd**	% Total	**Cut**	% Total
Mainstem	0		855	6.3	1,075*	61.4	4,380*	33.9
Beaver	0		25		0		75	
Boulder	0		205	1.5	140*	8.0	215	1.7
Clayton/Ritner	0		160	1.2	0		150	1.2
Cougar	0		1,065*	7.9	110*	6.3	240	1.9
Grant/Teal	0		235	1.7	0		85	
Little Luckiamute	0		25		0		5	
Maxfield	0		875*	6.5	0		895*	6.9
Miller/WF Luck.	0		370	2.7	50	2.9	495	3.8
Pedee	0		1,720*	12.7	50	2.9	1,330*	10.3
Plunket	0		665	4.9	0		85	
Price	0		445	3.3	0		495	3.8
Ritner	0		1,540*	11.4	0		620	4.8
Rockpit	0		175	1.3	75	4.3	200	1.5
Sheythe/Ritner	0		720	5.3	0		400	3.1
Teal/Little Luck.	0		3,205*	23.7	110*	6.3	1,500*	11.6
Vincent	0		25		0		135	1.0
Waymire/Little Luck.	0		35		0		195	1.5
Wolf	0		295	2.2	45	2.6	90	
WF Luckiamute	0		505	3.7	90*	5.1	925*	7.2
- Trib. C/WF Luck.	0		250	1.9	0		185	1.4
Total	**0**		**13,395**	**99.1**	**1,745**	**99.7**	**12,700**	**98.4**

- * Highlighted estimates represent the top 5 producers by species and age class
- Percent contributions are indicated for only those sub-basins that contributed greater than 1% of the total.
- Visual bias not included

Mainstem Luckiamute

The Luckiamute mainstem is the largest habitat component within the Luckiamute basin. Due largely to this fact, the highest numbers of juvenile Steelhead and Cutthroat have been found there during all surveys. This was also due to the fact that most of the high quality spawning and rearing habitat in the basin can be found in the upper-most five miles of mainstem anadromous distribution. This zone stretched roughly from the confluence of the WF Luckiamute (RM 61 - just upstream of a 3000 ft. boulder gorge and 4 ft. falls) to the confluence of Trib. AD (RM 66) where another long boulder gorge was encountered with a series of 4-6 ft. plunges and sill-logs. River Mileages were computed from the stream mouth (confluence with the Willamette) where the 2008 RBA survey began and not from mileages indicated on the USGS stream layer. In 2009 the mainstem survey began at RM 38 (Ira Hooker Bridge), omitting the temperature limited lower mainstem from the 2009 inventory where poor visibility compromised survey accuracy. In addition, the 2009 survey extended upstream an additional 1.2 miles to RM 69.3 (above the last bridge crossing).

Stream flows were higher and colder in the upper mainstem than in any other reach in the basin. Gravel resources were also cleaner and more abundant, and pool / riffle formations (a direct result of underlying gradient) offered greater habitat complexity (supplemented by a helicopter-wood restoration treatment between RM 62.5 and RM 64.4). Many steep side tributaries occur throughout this reach which contribute significantly to the abundance of cold water, spawning gravel, and woody debris. Surprisingly, no Coho have been observed in this reach during any of the four years of historical inventory. RM 66 marked the end of anadromous distribution during all surveys. The anadromous barriers there do not appear to be permanent. A large 12-20 ft. high debris jam at RM 66.5 was encountered which represents a more formidable, although also ephemeral barrier. Numerous ephemeral log jam barriers and boulder falls occur between RM 66 - 68.

The abbreviated surveys conducted in 2002 and 2003 included only this upper segment of the Luckiamute mainstem and a few selected tributaries. The chart at the end of this discussion compares findings from just this upper segment between all four years. Consistent and considerable improvements in Steelhead (up 52%, then 25%) were noted in this reach until 2009 when estimates exhibited little change. Large increases in Cutthroat production (up 95%, then 26%) were also observed in this reach until 2009 when estimates fell 31% (returning roughly to the same level observed in 2003). 1+Steelhead distribution appeared more evenly distributed in 2009 between RM 56.6 - 65.6 and actually exhibited an overall increase in abundance of 19.4% in the mainstem. This followed the overall trend observed for the 2009 inventory which exhibited an increase of 43% in 1+Steelhead abundance. Cutthroat abundance declined 16% across the 2009 mainstem survey, reflecting the inventory-wide decline of 11%. 0+trout abundance in 2009, increased by 1125% between RM 61 – 68 and by 264% across the entire mainstem survey. This particular intra annual comparison is appropriate because there was only a 13 day differential in survey timing between years (June 17- June 30), indicating that the observed increase in the abundance of the 0+ age class was actually measuring real change and not increases associated with fry emergence. 0+trout abundance increased by 213% across the entire 2009 Luckiamute inventory.

Juvenile Steelhead and Cutthroat counts peaked in similar patterns during all four surveys between RM 63 and 65, just upstream of the confluence of Boulder Cr., a significant cold water tributary. During the eight mile 2002 survey 79% of all 1+Steelhead and 46% of all Cutthroat

were found in 2 stream miles. In the eight mile 2003 survey 72% of all 1+Steelhead and 41% of all Cutthroat were found there. Considering the same eight miles of the 2008 survey, 71% of all 1+Steelhead and 60% of all Cutthroat were found there. The remarkable similarity between these survey years supports the conclusion that this stream segment represents the most important anchor habitat for salmonids in the Luckiamute mainstem. This pattern was less pronounced during the 2009 survey when the percentages noted above fell to 64% of all 1+Steelhead and 33% of all Cutthroat between RM 63 and 65. This may be the result of steelhead and cutthroat expanding their range downstream from the helicopter restoration reach.

All 1+Steelhead in the mainstem in 2009 were observed between RM 56.6 - 65.6 (roughly between Slide Cr. /Fisherman's Camp and Trib. AD near the upper mainstem bridge). Three main peaks in Cutthroat abundance were observed in 2009 at RM's 58, 62.4, and 67.8. For reference, the mouth of the West Fork occurs approximately at RM 61 and the mouth of Boulder Cr. at RM 62.6. The uppermost peak in Cutthroat abundance in 2009 (RM 67.8) occurred well upstream of several log jam and boulder fall barriers to anadromous migration in a beaver dam pool maintained by a 6 ft. beaver dam. No Cutthroat or Steelhead were observed in the mainstem downstream of RM 45.5 in 2009 (start-point at RM 38). The replicate data from 2008 suggests similar extents of salmonid distribution downstream on the mainstem. In 2008, 1+Steelhead were observed downstream to RM 48 and Cutthroat downstream to RM 39 (RM 40 at Pedee Cr.).

Invasive knotweed was noted at RM 38 (low density around Ira Hooker Bridge) and between RM 49 – 54 (high density from Hoskins Bridge to Slide Cr. confluence at Fisherman's Camp). Only two beaver dams were noted on the mainstem in 2009, both upstream of RM 68.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2002	0	135	395	1,480
2003	0	535	600	2,885
2008	0	20	750	3,630
2009	0	245	735	2,505

- Normalized for RM 61 – 68 of Luckiamute Mainstem (West Fork to upper-most Mainstem bridge)
- Visual bias not included

Beaver

Poor visibility hindered snorkeling efforts in Beaver Creek. A degraded culvert was encountered at the first pool with a steep pitch and an 8 inch plunge. This represents a barrier to juvenile migration although the small stream size and overall poor quality of stream habitat contributes to a low production potential in this stream. Fine gravels were rare and poorly sorted and stream flows were low and stagnant. Five active beaver dams were noted. No knotweed was found. Similar conditions, including bad visibility, were observed during three previous surveys.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2002-0.5 miles	-	-	5	40
2003-0.6 miles	-	15	-	105
2008-0.2 miles	-	10	-	30
2009-1.3 miles	-	25	-	75

- Visual bias not included
- Lineal distance not normalized for direct comparison

Boulder

Moderate Steelhead abundance was observed in Boulder Cr. in 2009. In comparison, this was an improvement over the previous year's inventory. No 1+Steelhead were observed during the 2008 survey and Cutthroat abundance was 16% lower than in 2002. Cutthroat abundance continued to decline in 2009, reaching its lowest level in 4 years of inventory. 0+trout abundance increased in 2009 to its highest documented level within the survey period. The low production levels observed during the last four surveys of Boulder Cr. seem unusual considering the existence of high quality spawning and rearing habitat for salmonids. Water quality (temp) and visibility has been excellent for all four surveyed years.

In 2003, Steelhead and Cutthroat production increased 52% and 95% respectively from the previous year, in the upper seven miles of the Luckiamute mainstem, compared with 43% and 8%, respectively, in the Boulder sub-basin. Comparing the 2008 and 2003 mainstem Luckiamute surveys indicates that Steelhead and Cutthroat abundance each increased by 25% but declines of 100% and 22%, respectively, were noted in Boulder. In 2009 both 1+Steelhead and Cutthroat abundance declined in the upper mainstem, 2% and 31%, respectively, while an increase from 0 to 140 (expanded) 1+Steelhead was observed in Boulder Cr. along with a 20% decline in Cutthroat abundance. The reason for these conflicting trends is not clear.

About 1.5 miles of good spawning and rearing conditions can be found in Boulder Cr., including the lower 0.2 miles of Tribs. A and B. Abundant gravel reserves with good sorting are present, along with high pool complexities, including numerous man-made log structures. Good stream sinuosity and pool/riffle ratios add to the habitat complexity here. Anadromous production potential in this stream appears high and probably ranks among the top four in the basin, along with the West Fork and Teal/Little Luckiamute, behind the Luckiamute mainstem. A large log jam followed by a series of impassable bedrock falls ends anadromous potential at RM 2.2. No knotweed was noted. Two beaver dams were encountered on Trib. B.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2002	0	5	105	320
2003	0	135	150	345
2008	0	115	0	270
2009	0	205	140	215

- Visual bias not included

Clayton / Trib. to Ritner

Moderate Cutthroat production has been observed in Clayton during all four survey years. The abundance level for this species increased 30% in 2009 to reach its highest level of the survey period (comparable to 2003). 0+trout abundance increased also by 191% to reach nearly its highest level of the survey period (also comparable to 2003). Based on the difference in survey distances, however, it appears that Cutthroat densities were significantly higher in 2003 (less than half the distance of the 2009 survey) and were roughly similar in 2002 and 2009. The longest survey in 2008 yielded the lowest densities of the survey period for both Cutthroat and 0+trout. 1+Steelhead were observed in low numbers in 2002 and 2003 only. Fine gravels were

present intermittently throughout the mainstem of Clayton, although siltation rates were high. The survey ended in steeper gradients and larger cobble above a few bedrock steps. The Clayton Cr. culvert was not a barrier to migration.

Clayton Cr. and Sheythe Cr. (2.5 miles) are the two main tributaries to Ritner Cr. Expanded estimates for Cutthroat in Sheythe in 2008 were similar, 105 total, while those in the Ritner mainstem (6 miles) reached 580. In 2009 the Sheythe Cr. estimate climbed to 400 Cutthroat, while the Ritner mainstem estimate increased less proportionately, to 620 Cutthroat. Variations in visibility between years limit the accuracy of these estimates. No knotweed was noted. Three beaver dams were encountered.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2002-0.8 miles	-	25	5	75
2003-0.8 miles	-	165	15	145
2008-2.9 miles	-	55	-	115
2009-2.1 miles	-	160	-	150

- Visual bias not included
- Lineal distance not normalized for direct comparison

Cougar

Anadromous potential is limited in Cougar Cr. by several bedrock slides and falls. Numerous boulder pours and log jams were also noted. A 5 ft. bedrock falls very near the mouth appears to be the main barrier. An 8 ft. log jam at RM 1.3 followed by a 15 ft. bedrock falls at RM 1.6 represents a more permanent barrier. Water quality was reported to be very high with cold, clear flows documented. This tributary is an important source of high quality flow that mitigates for increasing mainstem temperatures observed in the mainstem Luckiamute at its confluence. Upstream of the Cougar Cr. confluence at RM 59 on the Luckiamute mainstem begins the most highly productive reach in the basin for salmonids.

The 2009 survey on Cougar Cr. extended for 1.6 miles on the mainstem and a total of 0.6 miles on Tribs. A, B, C, and D. This survey encountered the highest 1+Steelhead and 0+trout densities of the four year survey period. Cutthroat densities in 2009 appeared lower than in 2008 or 2003, based on survey distance, but somewhat higher than in 2002 (the lowest estimate in the survey period). This steep stream has exhibited a minor 1+Steelhead presence during all survey years except 2008. Mainstem distribution has varied between 0.2 miles (2003), 0.8 miles (2002), and 1.3 miles (2009). 0+trout estimates have shown consistently strong improvements since 2002. Expanded estimates for the Cougar Cr. tributaries (2009 only) totaled 90 0+trout, 5 1+Steelhead, and 30 Cutthroat, all of which are included in the table below.

No knotweed noted. No beaver dams noted.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2002-1.0 miles	-	50	30	70
2003-1.0 miles	-	290	30	175
2008-1.0 miles	-	300	-	255
2009-2.2 miles	-	1,065	110	240

- Visual bias not included

Grant / Trib. to Teal

Moderate Cutthroat production and low Steelhead potential was observed. Production appears mostly limited by a low abundance and poor sorting of spawning gravels, siltation, channel entrenchment, and a series of small falls at RM 0.4 (4 ft.) and RM 0.6 (5 ft.). The stream gradient upstream of this narrow canyon pinch increases compared to the low, flat Teal Cr. floodplain where Grant Cr. begins. There is some potential for anadromous spawning in the upper mile of the mainstem and in the first half-mile of Tribs. A and B, which branch off to the left and right about 1000 ft. apart. The two falls and their shallow bedrock jump pools may limit adult escapement during most winter flow regimes.

The water quality appeared fair, stream flow was high, and cool water was reported. Total survey length in 2008 extended 1.6 miles in Grant, 0.9 miles in Trib. A and 0.6 miles in Trib. B. Total survey length in 2009 included just 1.1 miles of the mainstem. Production potential in all three branches ended at the 2008 survey end points where a transition to steeper gradients and larger substrates was observed. Two beaver dams were encountered in 2009. No knotweed was noted.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2008-3.1 miles	-	245	-	315
2009-1.1 miles	-	235	-	85

- Visual bias not included

Little Luckiamute

2009 snorkel surveys on the Little Luckiamute mainstem were reduced from 27.4 miles in 2008 to 3.8 miles. The surveys began at the confluence of Teal Cr. and ended at the falls in Fall City. Salmonid production in the Little Luckiamute mainstem continues to be lower than in the Luckiamute mainstem (reason undetermined). The condition of low productivity in the mainstem probably also limits the salmonid rearing capacity of some of the higher quality tributaries such as Teal, Grant and Waymire. In 2008 only one juvenile Steelhead (RM 8.7) and one Coho summer parr (near the mouth of Waymire) were observed in the Little Luckiamute mainstem, both un-expanded, and Cutthroat production overall was 82% lower than in the Luckiamute mainstem, in similar visibility conditions. Most Cutthroat and all 0+trout rearing that year occurred upstream of Falls City. No 1+Steelhead or Coho were observed during the shortened 2009 survey and only a single (un-expanded) Cutthroat was observed.

Many warm water fish species were observed including shiners, dace, squawfish, and suckers. Knotweed was noted near the mouth of Teal Creek. One beaver dam was encountered.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2008 - 27.4 miles	5	220	5	960
2009 - 3.8 miles	0	25	0	5

- Visual bias not included

Maxfield

This stream exhibits good anadromous spawning conditions. A fairly even mix of gravel, cobble, and exposed bedrock riffle was observed. Good in-stream wood complexity was common. Areas of high solar exposure and thick algae were reported and overall water temperature was noted as warm. Visibility was poor below RM 3. Beaver activity was frequent throughout and five active dams were noted. Sculpin and crayfish were unusually large. Full spanning log structures were present as a result of an instream restoration project on the Hall property in lower Maxfield Cr. These structures did not appear to be maintaining significant salmonid rearing densities during summer flow regimes. Increasing bedrock exposures and multiple cascades limit production in the upper reaches of the Maxfield Cr mainstem.

Maxfield was one of only 5 tributaries in the basin where 1+Steelhead were observed in 2008. No Steelhead were observed during the 2009 survey although Cutthroat and 0+trout abundance increased significantly (30% and 178% each). Cutthroat density remained very low in 2009 with several gaps in distribution. Peak densities occurred at RM 2.3 and 4.8. A barrier to adult migration was present at RM 4.4 where a culvert plunges 3.5 ft. onto rocks. Total survey distance extended 5.2 miles in 2008 (including Tribs. A and B) and 5.1 miles in 2009 (mainstem only).

The potential for higher Steelhead and Cutthroat production clearly exists here with improved adult escapement and a focus on restoring ecological function. Water withdrawals are most likely limiting production potential during the summer and restricting the access to and quality of, the aquatic habitats. Increasing stream flow typically leads to cooler water temperatures, deeper pools, and cleaner gravels.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2008	0	315	70	690
2009	0	875	0	895

- Visual bias not included

Miller / Trib. to WF Luckiamute

One year (2008) of very high Cutthroat densities (1,170-expanded) and three years of moderate densities (485-500, expanded) have been observed in Miller. 1+Steelhead densities have remained low during all four survey years (40-50, expanded, for 2002 and 2009; 105-120, expanded, for 2003 and 2008). Most Cutthroat and all 1+Steelhead were observed rearing in the lower half, from the confluence with the WF Luckiamute to the confluence of Trib. A during all survey years. Cascades dominate the stream channel above the confluence of Trib A and the abundance of pool habitat diminishes quickly. The 2009 survey ended at an ephemeral anadromous barrier, a 5 ft. log jam falls, at RM 1.5. Trib. A offers an additional 0.5 miles of moderately productive habitat. Low abundances of 1+Steelhead and Cutthroat were observed in Trib. A in 2003 and 2008 (Cutthroat only in 2002). In 2009 this small stream exhibited only a minor population of 50 Cutthroat (expanded). Good visibility and excellent water quality was reported in all reaches.

The 1+Steelhead population here was the second largest among the Luckiamute tributaries in 2008 and accounted for 9% of the basin-wide total. Only five tributaries contained

Steelhead that year, the WF Luckiamute, Miller, Maxfield, Pedee, and the Little Luckiamute (in order of abundance). Following a 50% decline in abundance for this species in 2009, Miller Cr. represented the sixth largest population in the basin (out of eight tributaries with SH). This decline ran contrary to the overall 43% increase in 1+Steelhead that was observed across the entire inventory in 2009. Miller Cr. also exhibited the third largest tributary Cutthroat population in 2008. Following an inventory-wide decline of 11% for this species in 2009, estimates in Miller dropped 58%. Miller Cr. estimates from 2009 accounted for 3% of all 1+Steelhead and 4% of all Cutthroat in the inventory. Considering just the West Fork sub-basin (7.7 miles), the 2009 Miller Cr. populations accounted for 36% of all 1+Steelhead and 31% of all Cutthroat.

Based on the salmonid production observed from the 2008 survey and visual observations of relatively high quality habitat, it is believed that Miller Cr. represents one of the best anchor habitats for anadromous fish in the basin. Production potential here appears significantly higher than any of the four survey years has so far demonstrated. Adult escapement is the main limiting factor. Included in these anchor habitats are the WF Luckiamute, Pedee, Boulder, and the upper Luckiamute mainstem.

No knotweed was noted. No beaver dams were noted.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2002	-	145	40	485
2003	-	50	120	500
2008	-	70	105	1,170
2009	-	370	50	495

- Visual bias not included

Pedee

High abundances of Cutthroat and low level Steelhead production were observed for the second year in a row in the Pedee Cr. sub-basin. Production levels for these species showed little change between 2008 and 2009 across the sub-basin as whole. This stream contained the second largest population of Cutthroat of all the Luckiamute tributaries for 2008 (after the West Fork) and also in 2009 (after Teal). In 2009 this represented 10% of all Cutthroat in the inventory (7% in 2008). The very low abundances of 1+Steelhead observed here represented the fourth (2008) and sixth (2009) largest tributary populations (about 3% of basin-wide totals each year). Only five tributaries in the Luckiamute Basin contained Steelhead in 2008, eight in 2009.

A large amount of aquatic habitat is present in the Pedee sub-basin. About ten miles of stream was surveyed here in 2008, and almost all of it appeared accessible to anadromous adults. Surveys were reduced to 8.2 miles in 2009. Conditions appeared relatively poor, however, throughout the lower three miles of the mainstem, leading up to the main junction with the South Fork (RM 2.7). Medium visibility due to tannic water was reported through most of this reach along with low flows, heavy sedimentation, and deep channel entrenchment. Conditions began to improve upstream of the South Fork. Good pool formation and sufficient gravel sorting became more frequent. Cutthroat abundance peaked around RM 4.5 (RM 5 in 2008) and approximately

79% of all Cutthroat in the mainstem of Pedee in 2009 were observed upstream of RM 3. The mainstem survey ended in steep gradients and large boulder plunges at RM 6.2.

An expanded estimate of 795 Cutthroat was present in the mainstem at the time of survey. This represented 60% of all Cutthroat in the sub-basin (39% in 2008). All 1+Steelhead in the sub-basin in 2009 (50-expanded) were observed in the South Fork. A short 1.4 mile section of the upper North Fork was surveyed independently in 2002 and 2003. This reach stretched from approximately RM 4.6 – 6 and included much of the best habitat for the Pedee Cr mainstem. The results are summarized below for comparison. Relatively little change was noted between the first three years of survey. In 2009 this reach exhibited a 55% increase in Cutthroat abundance (while Cutthroat abundance across the sub-basin showed little change). No 1+Steelhead were observed here in 2009.

The highest quality habitats were observed in SF Pedee. Surveys here in 2008 and 2009 extended 2.0 miles upstream from the forks and encountered cold water, two passable culverts, good gravel, and well scoured pools. The stream channel was smaller than the NF Pedee, but was in overall better condition. Well sorted spawning gravels and an interactive floodplain were noted. The upslope harvest buffer was intact and a few old growth Douglas Firs were retained. A small 2 ft. falls was present at RM 0.4 which represents a barrier to juvenile migrations. This stream appears capable of supporting anadromous spawning and rearing. Cutthroat production appeared very high here in 2008 and 2009 (610 and 535, expanded, respectively). Steelhead production increased in the South Fork in 2009 to its highest level in four survey years (50-expanded). No 1+Steelhead were observed here in 2003 or 2008. At the time of survey in 2009 the South Fork contained 34% of all 0+trout, 100% of all 1+Steelhead, and 40% of all Cutthroat observed in the Pedee sub-basin. Anadromous potential ends in the South Fork around RM 2 due to increasing stream gradients, large boulders, and numerous log jams. The first 1.4 miles of SF Pedee were surveyed in 2002 and 2003. These results are summarized below for comparison.

The above observations and survey data suggest that SF Pedee and the upper 3 miles of NF Pedee exhibit the highest potentials for anadromous salmonid production in the Pedee Cr. sub-basin. These two reaches, along with the lower WF Luckiamute (including Miller Cr.), Boulder Cr., and the upper Luckiamute mainstem, represent the most important anchor habitats for salmonids in the Luckiamute Basin. No knotweed was reported in the sub-basin. Only one beaver dam was noted in the mainstem downstream of the South Fork junction.

Pedee sub-basin total (including SF Pedee)

Year	**Coho**	**0+**	**Sthd**	**Cut**
2008	-	495	35	1,345
2009	-	1,720	50	1,330

- Visual bias not included

Normalized for RM 4.6 – RM 6 of Pedee mainstem (NF Pedee)

Year	**Coho**	**0+**	**Sthd**	**Cut**
2002	-	45	20	270
2003	-	50	35	220
2008	-	60	10	245
2009	-	935	-	380

- Visual bias not included

Normalized for RM 0 – RM 1.4 of SF Pedee

Year	Coho	0+	Sthd	Cut
2002	-	55	5	105
2003	-	115	-	335
2008	-	90	-	550
2009	-	470	40	470

- Visual bias not included

Plunket

Moderate Cutthroat production was observed in Plunket in 2008. Estimates for this species decreased by 84% in 2009 driven primarily by a 1 mile decrease in survey distance. No Steelhead were present during either of the years surveyed. The dry channel conditions encountered at several points during the survey represent temporary barriers to juvenile migrations. A 2 ft. bedrock falls at RM 0.7 and a 4 ft. bedrock falls at RM 1.1 represent more permanent barriers to juvenile migration. Cutthroat abundance peaked in the first mile of the survey, probably due to these barriers to migration. The second falls probably restricts adult passage much of the time. Medium visibility and low wood complexity was reported throughout the survey. A moderate knotweed presence was noted at RM 1.4. Two active beaver dams were encountered. Production potential for anadromous adults appears low in this sub-basin.

Year	Coho	0+	Sthd	Cut
2008-3.4 miles	-	510	-	535
2009-2.4 miles	-	665	-	85

- Visual bias not included

Price

Price Cr. exhibits moderate potential for anadromous production. No 1+Steelhead have been found. Good gravels and cold water were present. Ample shade, many deep pools, and numerous channel braids were also noted. Abundant reserves of old wood were encountered throughout the survey, adding to habitat complexity. The stream passed through a diverse assortment of forest, grassland, and cattle pasture in the 4.4 miles of survey. A similarly diverse mix of sand, mud, cobble, and gravel was present along the stream bottom. Dry channel conditions near the mouth and a culvert plunge of 2 ft. at the end of the survey limit juvenile migrations.

Cutthroat abundance declined slightly (14%) in 2009 after the dissimilar survey lengths were normalized. Anadromous steelhead production appears achievable here with sufficient adult escapement. Cutthroat production could also be enhanced with attention to water quantity and quality. Water withdrawals are most likely limiting habitat quality and access from the mainstem Luckiamute for temperature dependant upstream migrations during low summer flow regimes. Increasing summer stream flows would be a high priority restoration prescription for this tributary.

Year	Coho	0+	Sthd	Cut
2008 - 4.9 miles	-	325	-	580
2009 - 4.4 miles	-	445	-	495

- Visual bias not included

Ritner

5.8 miles of the Ritner mainstem were surveyed in 2009, beginning at the stream's mouth and ending at the 15 ft. impassable falls just downstream of Trib. A. The two main tributaries in this sub-basin, Clayton and Sheythe, have been summarized separately. Approximately 3.5 miles of upper Ritner and Trib. A were also surveyed in 2002 and 2003. These results have been normalized below for the 2.6 mile stream reach between the mouth of Sheythe Cr. and the 15 ft. falls for each of the four surveyed years. In general, moderate Cutthroat production was observed during all years of survey with little change in abundance between 2008 and 2009 but a roughly 100% - 200% improvement since the surveys conducted in 2002 and 2003. These findings suggest slow improvements in Cutthroat abundance in Ritner Cr. Current inventories indicate that Steelhead are no longer present. Low level Steelhead production was observed in 2002 and 2003. Summer surveys in 2010 should strengthen this observation if a trend is occurring.

53% of all Cutthroat in the Ritner sub-basin were observed rearing in the Ritner mainstem in 2009 (13% in Clayton, 34% in Sheythe). This mainstem population accounted for 4.8% of the total for the 2009 basin-wide inventory. Almost all Cutthroat in the mainstem have been observed upstream of RM 2 (between the confluences of Clayton and Sheythe) and downstream of the falls at RM 5.8. Moderate stream gradients through this reach provide the best looking spawning and rearing habitat for Cutthroat and Steelhead. The falls represents a definitive barrier to migration. Downstream of Sheythe and Clayton the mainstem is dominated by deep channel entrenchment, high solar exposure, and heavily silted gravel. Large schools of dace were observed in this reach along with a small number of freshwater mussels. Stream gradients increase quickly upstream of the falls where the mainstem canyon narrows and several smaller bedrock falls are encountered. Cutthroat and 0+ trout were observed upstream of the falls also in 2002, 2003, and 2008.

The main triple culvert at RM 4.4 appeared adequate for fish passage even though two of the pipes displayed an 8 inch plunge. This crossing does however compromise the natural migration and delivery of forest resources to lower stream reaches (migratory LWD and gravel). Examination of fish densities revealed spikes in density at this crossing during some years but not others (suggesting that the site sometimes inhibits the upstream migration of juveniles). Moderate to large spikes in Cutthroat density were observed just below the main falls during all surveys. Six beaver dams were noted in the Ritner mainstem in 2009. No knotweed was found.

Year	Coho	0+	Sthd	Cut
2008	-	290	-	600
2009	-	1,540	-	620

- Ritner mainstem only, ending at falls/Trib.A
- Visual bias not included

Year	Coho	0+	Sthd	Cut
2002	-	70	10	175
2003	-	155	35	285
2008	-	280	-	535
2009	-	1,375	-	430

- Normalized for Upper Ritner (Sheythe confluence to falls/Trib. A confluence)
- Visual bias not included

Rock Pit

The 2009 survey extended 1.6 miles upstream and encountered two barriers to juvenile migration. The first culvert at the mouth of the stream was partially collapsed, full of wood, and perched by 3 ft., while a second culvert at RM 0.8 also exhibited a 3 ft. plunge. A low level 1+Steelhead presence was detected in 2009 and not 2008, indicating that the culvert at the mouth is still passable for large anadromous adults. A relatively small Cutthroat population was observed during both survey years. Production potential appears low. Two active beaver dams were encountered. Short surveys in Tribs. A and B in 2009 exhibited low abundances of 0+trout and Cutthroat.

Year	Coho	0+	Sthd	Cut
2008	-	-	-	145
2009	-	80	75	180

- Mainstem only
- Visual bias not included

Sheythe / Trib. to Ritner

Poor anadromous spawning and rearing potential has been documented in the Sheythe Cr sub-basin during the last four surveys. Low numbers of Cutthroat and 0+trout only were present all years. Aside from a steep drop in abundance in 2008, Cutthroat abundance has increased gradually during each survey. In 2009 Sheythe Cr. contained 34% of all Cutthroat in the Ritner sub-basin (13% in Clayton, 53% in the Ritner mainstem). Medium visibility during all surveys may have compromised fish observations in the lower mile of Sheythe, though improved water clarity beyond that point was noted each year. The consistency of visibility conditions during each survey suggests that the comparison between years in the chart below is valid.

Spawning conditions appear poor in Sheythe due to high siltation rates. A few marginal sites suitable for Steelhead and Cutthroat spawning were noted around the midpoint of the survey. A strong beaver legacy was present also in this reach although no active dams were encountered in 2009. No knotweed was noted. The culvert at the mouth was in good shape.

Year	Coho	0+	Sthd	Cut
2002	-	30	-	300
2003	-	150	-	310
2008	-	10	-	75
2009	-	720	-	400

- Normalized up to RM 2
- Visual bias not included

Teal / Trib. to Little Luckiamute

The steep canyons at the headwaters of this sub-basin provide one of the best sources of cold summer flows to the Little Luckiamute. The main drinking water reservoir for Falls City is located on a high bench above the upper stream channel. Unfortunately, anadromous access to much of the best habitat in Teal Cr. is blocked by numerous impassable waterfalls. The 2009 survey extended 6 miles up the mainstem to the first of these falls (8 ft.). Significantly improved Cutthroat production (+295%) was observed here in 2009 despite the inventory-wide 11% decline. Densities progressively increased as the falls were approached. A low level 1+Steelhead presence was observed in Teal in 2009 between RM 4 – 5.3 only. This small cluster of Steelhead was especially relevant because none were observed in Teal Cr in 2008.

Teal Cr. appeared to be one of the largest fish producers in the 2009 Luckiamute Inventory, contributing the highest estimate for 0+trout of any stream (24%), including the Luckiamute mainstem, the second highest tributary estimate for 1+Steelhead (6% - after Boulder and equal to Cougar), and the #1 tributary producer for Cutthroat (12%). The production improvements observed in Teal in 2009 represented probably the most significant inter annual differences observed when comparing two years of inventory-wide observations. The potential for increased Steelhead production appears large in Teal Cr. and is probably currently limited by adult escapement.

The lower 3 miles of Teal Cr. was dominated by very low stream gradients and a sinuous entrenched channel. This morphology is directly related to the entrenchment in the Little Luckiamute mainstem that provides hydraulic control to its tributaries. Most pools were long and flat and exhibited extensive exposure to solar impacts. Substrates were dominated by sand with a mix of fine and coarse gravels in the tail-outs of some pools. Red side shiners and dace dominated these warm-water habitats. Numerous log jams were also present, along with two beaver dams. Invasive knotweed was noted near the stream's mouth and at RM 1.9.

The stream channel changes quickly near RM 4 where Teal Cr. enters a narrow canyon and stream gradients begin to climb. The next two stream miles appear to exhibit the most suitable stream gradients and overall habitat conditions for anadromous fish in the Teal Cr. sub-basin. All 1+Steelhead, 49% of all Cutthroat, and 57% of all 0+trout in the Teal Cr. mainstem were observed in the two miles below the first falls (RM 6). The highest individual pool counts for each species were also observed there. Surveys in 2008 extended upstream to RM 7.5 and encountered numerous waterfalls and bedrock slides, including the 8 ft. falls at RM 6 (the end of anadromous passage) and a large 35 – 40 ft. falls at RM 6.3. Cutthroat and 0+trout were observed in good numbers upstream of these falls. The NF Teal exhibited similar characteristics, including a larger 50 ft. falls. The lower mainstem tributaries Boughey and Grant were also surveyed in 2008. These tributaries both exhibited very low potential for anadromous salmonid production.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2008	-	425	-	380
2009	-	3,205	110	1,500

- Normalized for RM 0 – 6 (up to first 8 ft. falls)
- Visual bias not included

Vincent

Vincent Cr. is warm and heavily burdened with silt at the start. Very little flow was noticeable and most pools were dominated by stagnant water and large schools of dace. Visibilities were moderate to poor below the forks with Burgett Cr. at RM 2 and then improved for the rest of the 3.5 mile survey. Water temperatures also decreased upstream of the mouth of Burgett. Burgett and Alexander Cr. were both surveyed in 2008 and exhibited overall poor conditions for anadromous salmonids (lack of spawning gravels, barriers to adult migration, and elevated water temperatures). Upstream of RM 3 spawning conditions degrade due to increasing rock size, bedrock exposure, and steeper gradients.

Cutthroat production is currently low in Vincent and no Steelhead have been documented. A single Coho summer parr was observed here in 2008 (probably a residual 1+ Coho from the 2006 winter brood that did not smolt). In general, this sub-basin exhibits low anadromous potential and does not exhibit typical anchor habitat characteristics for large anadromous salmonids.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2008	5	60	-	245
2009	-	25	-	135

- Visual bias not included

Waymire / Trib. to Little Luckiamute

A small 3 ft. bedrock falls at the mouth of Waymire represents a barrier for juveniles but not adults. In 2008 a relatively low rearing density of 0.6 Coho/sq.m. was observed in the plunge pool below this falls. The fact that there were no more Coho seen upstream in Waymire suggests that these juveniles were seeking temperature refugia in a tributary of the mainstem Little Luckiamute. The only other Coho observed in the Little Luckiamute sub-basin (5 – expanded) in 2008 were observed in the Little Luckiamute mainstem just upstream of the mouth of Waymire and just downstream of the 30 ft. falls in Falls City. This combination of Coho sightings suggests that a single adult spawning event occurred somewhere between the falls at Fall City and the confluence of Waymire. No Coho were observed here in 2009. No Steelhead were observed during either survey. Low level Cutthroat production was present both years and increased by 95% in 2009. Cutthroat densities throughout the mainstem remained very low.

Moderate production potential was present throughout most of the 2.1 mile survey. Good gravels and a mixed canopy of alder, maple, ash, and blackberry were present. Beaver activity appeared to be high although no active dams were encountered (compared to 9 active dams in 2008). Stream gradients and flows were relatively low during the early summer survey and most pools appeared to be long and flat with little wood complexity. Two additional barriers to juvenile migration were noted at RM 1.1 and 1.3, both resulting from a 2 ft. plunge off a cement culvert step. A large body of knotweed was noted at the first culvert. Gradually larger boulders, hard bedrock, and steep rapids began to dominate near the end of the survey. Good visibility was reported.

Year	Coho	0+	Sthd	Cut
2008	40	100	-	100
2009	-	35	-	195

- Visual bias not included

Wolf

A clear legacy of beaver activity was observed in this stream. It is suspected that a dam break flood event has recently scoured large amounts of sediment from the channel (possible collapse of historical beaver dams). Bedrock exposures were common and channel diversity was low. Numerous active dams were noted during the 2002 and 2003 surveys, one dam only in 2008 and 2009. Stream flows were very low and several pools were completely isolated by sub-surface flows. Several patches of rich spawning gravel were observed, suggesting the potential for anadromous spawning.

No Coho have been observed here in four years of survey. Low numbers of Steelhead were observed in 2009 only. Low abundances of Cutthroat have exhibited little change. Survey distance has remained between 1.0 - 1.5 miles each year ending in a flat and braided stream channel. Poor water quality, low flows, and extensive wetlands describe the current condition of the aquatic corridor. The frequently blocked trash rack on the upper end of the first culvert also restricts passage.

Year	Coho	0+	Sthd	Cut
2002	-	20	-	105
2003	-	35	-	115
2008	-	70	-	90
2009	-	295	45	90

- Visual bias not included

WF Luckiamute

This 4.1 mile stream segment contained the most productive tributary habitat for Cutthroat and Steelhead in the whole 2008 Luckiamute Basin inventory. Declines in production for both these species were observed in 2009. Abundance levels for 1+Steelhead declined 18% while those for Cutthroat fell 46%. This decrease in production made up a significant portion of the overall 11% decline in Cutthroat observed across the basin in 2009. Overall, 1+Steelhead production increased by 43% across the basin in 2009. The West Fork Cutthroat population in 2009 declined in its relative contribution to the basin (7.2%) and the 1+Steelhead contribution also declined to 5.1%. It is not clear which factors in particular influenced these significant shifts in rearing and production. No Coho have been observed here in two years of inventory.

Stream habitats in the WF Luckiamute appear to be functioning well and continue to represent a strong anchor habitat for salmonids in the Luckiamute Basin. This stream is the largest headwater tributary to the Luckiamute mainstem. The issue of its headwater location reinforces the critical nature of the WF Luckiamutes importance for the survival and maintenance of resident, fluvial and anadromous salmonid populations in the basin as a whole. The WF and Miller (7.7 miles combined), accounted for 18% of all Cutthroat and 17% of all

1+Steelhead in the basin in 2008. These percentages declined to 12% and 8%, respectively, in 2009. Full production potential remains considerably higher.

Distribution profiles for 1+Steelhead and Cutthroat most years have displayed peaking densities near the mouth of the stream with abundance levels decreasing upstream. Steelhead distribution ended at the mouth of Trib. C while Cutthroat distribution continued to the end of the survey. The lower three miles of mainstem habitat leading up to the mouths of Trib. C and D appears to be the prime zone within the WF mainstem. The valley and active stream channel narrow considerably upstream of these two tributaries and stream flows diminish. Beaver activity was abundant throughout this zone in 2002 and 2003, but has declined to almost nothing (0 dams in 2008, 1 dam in 2009). No culverts were noted. No knotweed.

Surveys in the West Fork mainstem in 2009 totaled 4.1 miles and accounted for 64% of all 1+Steelhead and 53% of all Cutthroat in the sub-basin. Surveys in Miller Cr. in 2009 totaled 2 miles and accounted for 36% of all 1+Steelhead and 31% of all Cutthroat in the West Fork sub-basin. Surveys in the un-named tributaries to the West Fork in 2009 totaled 1.6 miles and accounted for 16% of all sub-basin Cutthroat (no Steelhead).

The second most important tributary to the WF (after Miller), appears to be Trib. C. Cutthroat production here in 2008 was strong and appeared much higher than in 2002 or 2003, although survey distances were much shorter for those years. An expanded estimate of 545 Cutthroat were present in 2008 through 1.1 miles of survey. Only 185 (expanded) were observed in 2009 (1.0 miles), which was a higher abundance than observed in any of the other un-named tributaries. No Steelhead were observed here in 2008 or 2009, but low numbers were present in 2002 and 2003. A large log jam on top of a bedrock cascade near RM 0.8 appears to be the end of anadromous passage in Trib. C. Low numbers of Cutthroat and 0+trout were present in Tribs. B, D, and E as well. Anadromous potential is limited in these habitats by low summer stream flows resulting in small pool surface areas. No culvert problems were identified. A 3 ft. falls was noted in Trib. B at RM 0.4.

Year	**Coho**	**0+**	**Sthd**	**Cut**
2008	-	315	110	2,255
2009	-	755	90	1,110

- Includes Tribs. B, C, D, and E
- Visual bias not included

Year	**Coho**	**0+**	**Sthd**	**Cut**
2002	-	65	90	560
2003	-	125	70	495
2008	-	150	110	1,570
2009	-	465	90	850

- No tributaries included, mainstem WF only
- Visual bias not included

Unnamed Tributaries

Short surveys were also conducted on 4 unnamed tributaries to the Luckiamute mainstem. All exhibited little to no potential for anadromous production and very limited potential for resident cutthroat due to low summer flows, steep gradients, poor pool formation, and lack of suitable spawning gravel. These streams are referred to in the database and on the maps as Trib. AA, Trib. AD, Trib. AE, and Trib. AH. Tribs. A through Z were labeled on the final maps but not surveyed due to small stream size or lack of stream flow.

A low abundance of Cutthroat spawning gravel was observed in Trib. AA along with expanded estimates of 55 0+ trout, 5 1+Steelhead, and 10 Cutthroat. Trib. AD exhibited a strong beaver legacy and expanded estimates of 60 0+ trout and 200 Cutthroat. No fish were observed in Tribs. AE or AH.

Watershed Recommendations

- Continue restoration efforts on the upper Luckiamute mainstem, Boulder, West Fork, and Miller. Develop restoration strategies for Ritner, Pedee, Price, Maxfield, and Teal as high priority next steps.
- Decrease water temperatures in the lower Luckiamute, Little Luckiamute, and Soap Cr. mainstem habitats. This is a long term goal that will be accomplished through minimizing water withdrawals, initiating riparian canopy development and excluding cattle from stream channels and riparian vegetation.
- Restore the loss of floodplain linkage caused by deep channel entrenchment, build sinuosity and recover drained riparian wetlands. Promote beaver re-colonization. These strategies will expand aquatic rearing habitat during both summer and winter flow regimes and help to raise the summer water table. The notable drop in stream levels and water tables throughout the Willamette Valley during the last century appears to be one of the largest factors affecting floodplain habitats and their potential for anadromous fish production.

Distribution and Rearing Density Graphics

An Excel Workbook has been developed from the raw Access data that allows the user to preview distribution, density and abundance graphics by year, stream and species. This pivot table work book allows managers and users to access information for all of the streams surveyed in 2008 and 2009. Please contact the Luckiamute Watershed Council for an updated version of this tool.

In addition, it is important to note that an extensive amount of supplemental raw data (primarily in the form of surveyor notes and comments) is available in the Access database which can also be obtained through the Luckiamute Watershed Council.