<u>LUCKIAMUTE</u>
<u>RAPID BIO-ASSESSMENT 2011</u>

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Luckiamute Watershed Council

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INTRODUCTION

The 2011 Rapid Bio-Assessment inventory of the Luckiamute Watershed was a replicate inventory that attempted to target the most productive salmonid habitats in the basin. This was the fourth consecutive inventory in the basin designed to describe the distribution and relative abundance of coho, cutthroat trout and winter steelhead. 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 provided limited summer production potential. Survey efforts were reduced to 96.6 stream miles in 2009 and covered only the highest quality habitat reaches. Surveys were further refined in 2010 to a subset of the highest quality habitats (90.2 stream miles) and reduced again in 2011 to 84.6 stream miles. Some streams in the basin were also surveyed in 2002 and 2003 in a separate effort funded by Boise Cascade, the previous owner of the current Forest Capital holdings. 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 (RBA) survey method was designed to sub-sample 20 percent of the pool 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 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).

Most surveys were initiated by randomly selecting any one of the first five pools encountered. The protocol however was altered for small tributaries (2nd and 3rd 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 mapped distances using USGS 1:24,000 series maps. This is related to the level of sinuosity within the floodplain that is not incorporated in topographic map layers. 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 this 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 the summer pinch period.

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, however, is not the seasonal limitation for the production and survival of salmonids within the basin.

Expanded estimates for anadromous salmonids have remained very low during each of the last four inventoried years: 2008, 2009, 2010, and 2011. Tables #1-4, below, summarize these estimates for each of the 5 sub-watersheds surveyed. Table #5, under "Site Specific Observations", contains totals for each individual stream. A surprising appearance of juvenile coho occurred during the summer of 2010 throughout the basin. No coho were observed in the basin in 2009 and only a very minor presence was detected in 2008. Expanded juvenile coho estimates for just the 90.2 miles surveyed reached 45,858 in 2010 (expansion includes 20% visual bias). Coho abundance across the Luckiamute Basin returned to a very low level in 2011. Only 840 summer parr (including the application of a 20% snorkel bias calculated by ODFW) were observed throughout the 84.6 stream miles that were surveyed. This represents a 98% decline in abundance from the previous year.

In 2010 juvenile coho were observed in almost every surveyed reach and tributary downstream of RM 58 on the Luckiamute mainstem. A relatively insignificant 5 ft. bedrock falls at RM 58, between the confluences of Cougar and WF Luckiamute, appears to have terminated the upstream migration of adult coho during the winter of 2009 and therefore some of the most productive stream reaches in the Luckiamute Watershed remained un-utilized by coho (Boulder, Miller, Wolf, and WF Luckiamute). The continuous presence of juvenile 1+ steelhead throughout the upper Luckiamute Basin upstream of RM 58 indicates that adult steelhead have passed this barrier during all years surveyed (2002, 2003, 2008, 2009, 2010, and 2011). Pedee, Teal, the Luckiamute mainstem (below RM 58) and Ritner, in that order, represented the four highest production totals for coho in 2010. These four subbasins contained 88% of all juvenile coho observed that year.

In 2011, Teal, Pedee and the Little Luckiamute, in that order, were the only streams exhibiting coho production. No juvenile coho were documented in the Luckiamute mainstem in 2011. Teal Cr., (trib of the Little Luckiamute) was the only stream segment exhibiting any significant coho production in 2011, an expanded estimate of 570 summer parr (including the 20% visual bias). This represents 68% of the all coho observed in the Luckiamute basin in 2011.

Based on a back-calculation from the expanded juvenile coho estimate for 2010, a minimum adult escapement value for the streams surveyed would have been 417 adult coho for the 2009 winter brood. This same back-calculation from juvenile estimates from 2011 suggests a total adult escapement of 6-8 coho for all stream segments for the 2010 brood. These adult back-calculations are based on a 10% egg / summer parr survival rate and 1:1 male/female escapement ratio. These estimates do not represent a full basin-wide production total since several stream reaches were not surveyed, although they do account for all stream reaches with any significant anadromous production potential.

No juvenile inventories were conducted in the basin during the summer of 2007 which would have been the parents of the adults that returned in 2009 / 2010. Therefore no assessment of trends in abundance can be established for the 2006 / 2009 coho cohort, which currently appears to be the strongest cohort in the Luckiamute Basin. Only 6 coho parr were observed during the 2008 summer inventories. This suggests that the few returning adults (6-8) in 2010 were strays, unrelated to any previously established Luckiamute cohort. The 2007 / 2010 adult cohort and the 2005 / 2008 cohort both appear to be for all practical purposes, extirpated in the basin. This leaves the 2006 / 2009 adult cohort as the only potentially viable coho cohort in the Luckiamute basin. This conclusion can be verified by sub sampling the system for coho parr during the summer of 2013 when the progeny of the remaining cohort (2006 / 2009 / 2012) should be summer rearing in the basin.

Production estimates for 1+ steelhead in the Luckiamute Basin have decreased significantly during the last two survey years. A 36% decline in abundance in 2010 was followed by a 23% decline in 2011. The expanded estimate of 820 1+ steelhead observed in 2011 (for pool habitats only) was the lowest estimate to date of this four year inventory. These trends are based on estimates from previous inventory years which have been normalized to match the stream reaches surveyed in 2011. The highest expanded estimate so far of 1,660 1+ steelhead, was observed in 2009. Some portion of the 2010 decline resulted from the restricted access in key stream reaches that had been accessible in previous years. These data gaps appeared in Maxfield, Ritner, and Pedee. These data gaps were, however, consistent between the 2010 and 2011 survey years. Also, these streams were relatively low producers for 1+ steelhead during all survey years. Considerable declines in 1+ steelhead production have occurred in the primary steelhead anchor habitats for this species: the upper Luckiamute mainstem (down 17% in 2010 and 2011), Boulder (down 79% in 2010, no change in 2011), WF Luckiamute (down 83% in 2010, down 100% in 2011), and Teal (down 14% in 2010, no change in 2011).

Cutthroat abundance has exhibited comparatively less change over the four year survey period. Roughly speaking, two years of high abundance (2008 and 2010) have appeared interspersed with two years of low abundance (2009 and 2011). A minor 17.7% decline in abundance occurred between 2010 and 2011, which matches the 18.6% decline apparent between 2008 and 2011. A certain amount of variation is inherent within the methodology and overall, the basin-wide cutthroat population appears to be relatively stable. Significant gains and losses have been noted, however, within individual streams, and a large percentage of this population probably migrates in and out of the un-surveyed portions of the Luckiamute and Little Luckiamute mainstem reaches. The highest expanded estimate for cutthroat in this inventory reached 11,980 cutthroat in 2008 while the lowest was 9,745 cutthroat in 2011. Again, the fact that access was denied on more private property parcels in 2010 than in 2008 and 2009 suggests that the inter-annual comparison of trend suffers from the lack of inter-annual replicability in the case of Maxfield, Ritner, and Pedee. The directly comparable surveys between years for the upper mainstem Luckiamute observed a 90% increase in cutthroat abundance for 2010 followed by a 39% decrease in abundance for 2011.

Sampling biases have not been developed for 1+ steelhead and cutthroat but are significant because of their avoidance behavior. 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 industrial forest 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 represent critical anchor habitats for the survival of anadromous salmonids within the Luckiamute Watershed. They are characterized by significant summer flows, cool water temperatures, and low rates of sedimentation. Both steelhead and cutthroat production rates have been highest within the uppermost sub-watershed during the last three survey years. 80% of all 1+ steelhead and 51% of all cutthroat were found there in 2008, 62% and 36% in 2009, 63% and 52%, respectively, in 2010, and 65% and 48% in 2011. Coho have not been observed above the 5 ft bedrock falls between Cougar Cr. and the WF Luckiamute reducing the potential for competitive interactions with the wild winter steelhead rearing in headwater reaches. The distribution of juvenile coho throughout the Pedee, Ritner, and Teal sub-basins during the 2010 and 2011 inventories suggests that system function persists in these habitats also. The lower gradient habitats and finer gravel substrates of Pedee, Ritner, and Teal are well suited for coho production and their location lower in the basin make them natural targets for re-colonization. Heavy sediment loading and low summer flows are both factors limiting the current capacity of the habitat in both Pedee and Ritner. The lack of adult escapement (coho and steelhead) within the Little Luckiamute is currently the primary limiting factor for Teal Cr.

Inter-annual comparisons of the 0+ age class trout abundance are largely inappropriate because of the variability in survey timing and fry emergence. The observed inter annual variation in tables 1 – 4 below for the 0+ age class were likely the result of the variable timing of fry emergence. Some surveys occurred pre emergence and some post.

Overall 0+trout production appeared to decrease during the 2010 inventory by 25%, despite the fact that most surveys occurred even later in the season (between 4-6 weeks later) than in 2009. The observed declines in abundance for the Pedee and Maxfield sub-watersheds were likely the result of the data gaps that appeared in 2010 resulting from spotty access for Maxfield, Ritner, Sheythe, and Pedee.

Considering all four years of inventory data, the Middle Little Luckiamute / Teal, the Upper Luckiamute / Pedee-Ritner and the Upper Luckiamute / Boulder-West Fork sub-watersheds appear to represent the top three priority zones for restoring system function 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 (RM 61-68)	11,700				
Luckiamute River + Boulder, Wolf		0	205	760	3,990
West Fork Luckiamute River		0	315	110	2,255
Sub-total		**0**	**520**	**870**	**6,245**
Upper Luckiamute River/Vincent Creek (RM 47.3-61)	22,300				
Luckiamute River + other tributaries		0	575	140	1,510
Sub-total		**0**	**575**	**140**	**1,510**
Upper Luckiamute River/Maxfield Creek (RM 39.7-47.3)	20,000				
Maxfield Creek		0	260	70	645
Luckiamute River		0	0	0	255
Sub-total		**0**	**260**	**70**	**900**
Upper Luckiamute River/Pedee Creek (RM 38-39.7)	19,000				
Ritner, Sheythe		0	435	0	825
Pedee Creek		0	495	35	1,345
Luckiamute River		0	0	0	230
Sub-total		**0**	**930**	**35**	**2,400**
Middle Little Luckiamute River (RM 11.5-15.4)	23,500				
Teal, Grant		0	700	0	825
Little Luckiamute River		6	145	0	100
Sub-total		**6**	**845**	**0**	**925**
2008 TOTALS		**6**	**3,130**	**975**	**11,980**

- Visual bias included for coho only
- Estimates for 2008 are normalized to include only the same streams as surveyed in 2011.

(Table 2)

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

Sub-watershed	Area (acres)	coho Salmon	0+	steelhead	cutthroat
Upper Luckiamute River (RM 61-68)	11,700				
Luckiamute River + Boulder, Wolf		0	745	920	2,810
West Fork Luckiamute River		0	755	90	1,110
Sub-total		**0**	**1,500**	**1,010**	**3,920**
Upper Luckiamute River/Vincent Creek (RM 47.3-61)	22,300				
Luckiamute River + other tributaries		0	1,835	490	2,080
Sub-total		**0**	**1,835**	**490**	**2,080**
Upper Luckiamute River/Maxfield Creek (RM 39.7-47.3)	20,000				
Maxfield Creek		0	875	0	895
Luckiamute River + other tributaries		0	0	0	20
Sub-total		**0**	**875**	**0**	**915**
Upper Luckiamute River/Pedee Creek (RM 38-39.7)	19,000				
Ritner, Sheythe		0	2,260	0	1,020
Pedee Creek		0	1,720	50	1,330
Luckiamute River		0	0	0	0
Sub-total		**0**	**3,980**	**50**	**2,350**
Middle Little Luckiamute River (RM 11.5-15.4)	23,500				
Teal, Grant		0	3,440	110	1,585
Little Luckiamute River		0	25	0	5
Sub-total		**0**	**3,465**	**110**	**1,590**
2009 TOTALS		**0**	**11,655**	**1,660**	**10,855**

- Visual bias not included
- Estimates for 2009 are normalized to include only the same streams as surveyed in 2011.

(Table 3)

Sub-watersheds of the Luckiamute Basin – 2010 Expanded Estimates (Normalized)

Sub-watershed	Area (acres)	coho Salmon	0+	steelhead	cutthroat
Upper Luckiamute River (RM 61-68)	11,700				
Luckiamute River + Boulder, Wolf		0	2,630	640	5,120
West Fork Luckiamute River		0	1,045	15	975
Sub-total		**0**	**3,675**	**655**	**6,095**
Upper Luckiamute River/Vincent Creek (RM 47.3-61)	22,300				
Luckiamute River + other tributaries		8,322	2,955	300	2,380
Sub-total		**8,322**	**2,955**	**300**	**2,380**
Upper Luckiamute River/Maxfield Creek (RM 39.7-47.3)	20,000				
Maxfield Creek		564	235	0	265
Luckiamute River + other tributaries		300	0	0	30
Sub-total		**864**	**235**	**0**	**295**
Upper Luckiamute River/Pedee Creek (RM 38-39.7)	19,000				
Ritner, Sheythe		7,878	80	0	190
Pedee Creek		13,386	1,425	15	1,685
Luckiamute River		300	0	0	0
Sub-total		**21,564**	**1,505**	**15**	**1,875**
Middle Little Luckiamute River (RM 11.5-15.4)	23,500				
Teal, Grant		11,994	880	95	1,145
Little Luckiamute River		1,284	0	0	60
Sub-total		**13,278**	**880**	**95**	**1,205**
2010 TOTALS		**44,028**	**9,250**	**1,065**	**11,850**

- Visual bias included for coho only
- Estimates for 2010 are normalized to include only the same streams as surveyed in 2011. Many gaps in survey efforts, however, occurred in Maxfield, Ritner, Sheythe, and Pedee in 2010 due to landowner denials of access. These gaps were not present in 2008 and 2009 (Tables 1 and 2, above) and resulted in an under-estimate of abundance for 2010.

(Table 4)
Sub-watersheds of the Luckiamute Basin – 2011 Expanded Estimates (Normalized)

Sub-watershed	Area (acres)	coho Salmon	0+	steelhead	cutthroat
Upper Luckiamute River (RM 61-68)	11,700				
Luckiamute River + Boulder, Wolf		0	1,285	535	3,590
West Fork Luckiamute River		0	505	0	1,090
Sub-total		**0**	**1,790**	**535**	**4,680**
Upper Luckiamute River/Vincent Creek (RM 47.3-61)	22,300				
Luckiamute River + other tributaries		0	640	195	1,515
Sub-total		**0**	**640**	**195**	**1,515**
Upper Luckiamute River/Maxfield Creek (RM 39.7-47.3)	20,000				
Maxfield Creek		0	520	0	255
Luckiamute River + other tributaries		0	0	0	160
Sub-total		**0**	**520**	**0**	**415**
Upper Luckiamute River/Pedee Creek (RM 38-39.7)	19,000				
Ritner, Sheythe		6	775	0	330
Pedee Creek		150	2,200	0	1,325
Luckiamute River		0	0	0	15
Sub-total		**156**	**2,975**	**0**	**1,670**
Middle Little Luckiamute River (RM 11.5-15.4)	23,500				
Teal, Grant		570	745	90	1,240
Little Luckiamute River		114	5	0	225
Sub-total		**684**	**750**	**90**	**1,465**
2011 TOTALS		**840**	**6,675**	**820**	**9,745**

- Visual bias included for coho only
- Many gaps in survey efforts occurred in Maxfield, Ritner, Sheythe, and Pedee in 2010 and 2011 due to landowner denials of access. These gaps were not present in 2008 and 2009 (Tables 1 and 2, above) and resulted in an under-estimate of abundance for 2011.

Few, if any, stream habitats were seeded to capacity during the last four years of inventories in the Luckiamute Basin. There remains extensive summer habitat available to salmonids that is 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. The quantification of knotweed was omitted from the 2011 inventory since most sites had been well documented during the previous 3 years. Overall trends in beaver dam abundance have not been stable with both increases and declines observed in the last 3 years when similar stream segments were inventoried. Increases were observed in 2010 from the previous year followed by a year of declining abundance. A total of 92 active dams were noted in 2008 (214 stream miles), 44 active dams in 2009 (96.6 stream miles), 69 active dams in 2010 (90.2 miles), and 10 active dams in 2011 (84.6 stream miles).

Many streams in the Luckiamute Basin are 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.

This analysis effort is 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 5)

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 population 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 6)

Luckiamute River 2011 Inventory of high priority stream segments (Expanded Estimates)

Stream	**coho**	% Total	**0+**	% Total	**Sthd**	% Total	**Cut**	% Total
Mainstem	0		1,455*	21.4	770*	86.5	4,750*	47.0
Boulder	0		125	1.8	30*	3.4	280	2.8
Cougar	0		75	1.1	0		5	
Grant/Teal	0		60		0		55	
Harris	0		95	1.4	0		140	1.4
Little Luckiamute	114*	13.6	5		0		225	2.2
Maxfield	0		520*	7.7	0		255	2.5
Pedee	150*	17.9	2,200*	32.4	0		1,325*	13.1
Ritner	6		775*	11.4	0		330*	3.3
Rockpit	0		115	1.7	0		275	2.7
Sheythe/Ritner	0		35		0		25	
Slide	0		35		0		65	
Teal/Little Luck.	570*	67.9	685*	10.1	90*	10.1	1,185*	11.7
Trib. AJ/Luck.	0		30		0		0	
WF Luckiamute	0		260	3.8	0		830*	8.2
- Trib. C/WF Luck.	0		140	2.1	0		215	2.1
Wolf	0		75	1.1	0		90	
Total	**840**	100	**6,685**	98.5	**890**	100	**10,050**	99.5

- * 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 included for coho only

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 observed there during all surveys. In addition, most of the high quality spawning and rearing habitat in the basin can be observed overlapping the last five miles of anadromous distribution in the mainstem. This zone stretched roughly from the confluence of the WF Luckiamute (RM 61 - just upstream of a 3000 ft. boulder gorge and 4-5 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, 2010, and 2011 the mainstem survey began at RM 38 (Ira Hooker Bridge, just downstream from the confluence of Pedee Cr.), omitting the temperature limited lower mainstem where poor visibility also compromised survey accuracy in previous surveys. These surveys extended upstream to the uppermost bridge crossing at RM 68 in 2009 and up to the following culvert at RM 69.3 in 2010 and 2011. Limited survey efforts in 2002 and 2003 covered only the mainstem reach between RM 61-68. Survey data from all of these years has been normalized for comparison purposes in the discussion below and the chart that follows to include only the mainstem reaches between RM 38-61 (a four year comparison) and RM 61-68 (a six year comparison).

2010 represents the only inventory year so far to exhibit summer rearing coho parr in the Luckiamute mainstem. Although low numbers of coho parr were observed in 2011 in Teal, Ritner, Pedee, and the Little Luckiamute mainstem, none were found in the Luckiamute mainstem. An expanded estimate of 8,904 summer parr (including 20% visual bias) was observed in the lower Luckiamute mainstem in 2010, between RM 38-58. This was the third largest abundance of coho within the Luckiamute Basin after Pedee (13,386 summer parr) and Teal (11,994 summer parr). The Luckiamute mainstem estimate represented approximately 19% of the inventory-wide coho total that year. Upstream distribution was terminated at RM 58 by a 5 ft. bedrock falls which prevented adult coho escapement into the higher quality spawning habitats of the upper mainstem as well as the West Fork, Boulder, Wolf, and Rock Pit. This falls has been passable for adult steelhead during all years of this inventory. The presence of coho parr in the first sample pool of the 2010 survey at the Ira Hooker Bridge suggests that their distribution in the mainstem extended downstream below the survey start point and that some portion of that mainstem segment was not quantified. Average rearing density for summer parr in the mainstem in 2010 was extremely low (0.1 coho/sq.m.) and exhibited a peak in abundance at RM 54.2, just below a large log jam formed in association with a series of abandoned railroad bridge abutments (above confluence of Slide Cr.). The absence of coho summer parr in the mainstem in 2011 is most likely due to low adult escapement basin-wide and/or a very limited number of successful adult spawnings.

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) resulted in greater habitat complexity (supplemented by a helicopter-wood restoration treatment between RM 62.5 and RM 64.4). Many steep side tributaries exist 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 six years of historical inventory. Numerous ephemeral log jam barriers and boulder falls occur between RM 66 - 68. These anadromous obstacles do not appear to be permanent.

The abbreviated surveys conducted in 2002 and 2003 included only this upper segment of the Luckiamute mainstem (above the WF Luckiamute confluence) and a few selected tributaries. The first chart at the end of this discussion compares the findings between years in just this upper segment. The second chart compares findings from the lower mainstem segment for 2008, 2009, 2010, and 2011. Consistent and considerable improvements in steelhead production (up 52%, then 25%) were noted in the upper reach until 2009, when expanded estimates exhibited little change. A gradual decline in abundance has been observed since then – down 17% in 2010 then down another 17% in 2011. The final 2011 estimate remained higher than the first estimate from 2002. Cutthroat estimates for the same reach have shown strong improvements since 2002 within a wide range of variance. A discernable trend line is hard to define for cutthroat over the last 4 survey years. A notable 39% decline in abundance occurred for cutthroat in the upper mainstem in 2011. The expanded estimate of 4,770 cutthroat in 2010 marked the highest abundance observed to date for the upper Luckiamute mainstem during the last six years of inventory. The highest estimate for 0+trout in the mainstem was also recorded in 2010 although much of this increase was likely due to the later timing of the survey (Aug. 18-30 compared to the last week in June for 2008 and 2009).

1+ steelhead distribution in the mainstem has remained limited to the 12 stream miles between RM 53.6 - 65.6 during most survey years. The lower end of this distribution occurs near the Slide Cr. confluence (RM 54) and the upper end is terminated by large log and boulder jams (up to 8 ft. high). Density profiles for both juvenile steelhead and cutthroat peaked in similar patterns during 2002, 2003, and 2008 survey years near the upstream end of their distribution between RM 63 and 65. This reach is found above the LWD helicopter treatment segment (RM 61-63). During the 2002 survey, 79% of all 1+ steelhead and 46% of all cutthroat above the confluence of the WF Luckiamute (7 miles total) were observed in the upper 2 stream miles. In the 2003 survey 72% of all 1+ steelhead and 41% of all cutthroat were found there. In the 2008 survey, 71% of all 1+ steelhead and 60% of all cutthroat were found there. The remarkable similarity between these survey years supports a conclusion that this stream segment represents an important anchor habitat for salmonids in the Luckiamute mainstem.

The zone of peak density has been shifting downstream since the 2008 survey. In 2009 approximately 64% of all 1+ steelhead and 33% of all cutthroat observed in the upper mainstem were found in these 2 miles, in 2010 down to 26% and 13%, respectively, and in 2011 back up slightly to 36% and 40%, respectively. This may be the result of both steelhead and cutthroat exhibiting a habitat preference for the maturing helicopter restoration reach which is beginning to offer exceptional habitat complexity all year around. In 2010 several pools in this restoration reach exhibited levels of extreme complexity (reportedly otter-proof) resulting from the gradual accumulation of transient woody debris. The highest individual pool counts for cutthroat in the Luckiamute mainstem in 2010 occurred in this zone near RM 62. Cutthroat counts in 2011 peaked further upstream near RM 64. The highest individual pool counts for 1+ steelhead all occurred within the restoration reach in 2011, roughly between the mouth of Boulder Cr to a point 0.5 miles upstream. In 2010 these peaks occurred closer to the end of steelhead distribution near RM 65.

Estimates from the lower half of the Luckiamute mainstem (RM 38-61) have shown comparatively less change, aside from the presence of coho in 2010. 1+ steelhead and cutthroat abundances peaked in 2009 and have both dropped consistently during the last two survey years.

2011 production levels for both of these species have returned to similar levels as observed in 2008. An interesting and opposite declining trend for 1+steelhead and cutthroat can be seen between the lower (steelhead down 34%, cutthroat down 10%) and upper (steelhead down 17%, cutthroat down 39%) mainstem estimates for 2011. No 1+ steelhead were observed downstream of RM 52.8 in 2011. Cutthroat were present throughout the entire mainstem reach (although not in every sample pool). The radical spike in 0+trout numbers in 2010 was mainly the result of a later survey timing that year (Sept. for 2010 and July for 2008, 2009, and 2011). This effect, which obscured a probable decline in overall 0+trout production in 2010, can be seen in the continued decline of 1+steelhead and cutthroat estimates for 2011.

Invasive knotweed was firmly established at RM 38 (low density around Ira Hooker Bridge) and between RM 49 – 54 (high density from Hoskins Bridge to the Slide Cr. confluence at Fisherman's Camp) during the summer of 2010. Only one area of consistent beaver activity has been observed on the Luckiamute mainstem, all the way at the end of the survey near RM 68. Two strong dams with large ponds were reported here during all survey years except 2010.

Year	**coho**	**0+**	**Sthd**	**Sthd/sq.m.**	**Cut**	**Cut/sq.m.**
2002	0	135	395	0.0552	1,480	0.1515
2003	0	535	600	0.0823	2,885	0.2260
2008	0	20	750	0.0553	3,630	0.2908
2009	0	245	735	0.0635	2,505	0.1375
2010	0	2,305	610	0.0678	4,770	0.2711
2011	0	935	505	0.0351	2,910	0.2140

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

Year	**coho**	**coho/sq.m.**	**0+**	**Sthd**	**Sthd/sq.m.**	**Cut**	**Cut/sq.m.**
2008	0	-	215	150	0.0105	1,515	0.0123
2009	0	-	610	340	0.0252	1,720	0.0365
2010	8,904	0.1	1,955	295	0.0162	1,640	0.0481
2011	0	-	405	195	0.0280	1,480	0.0539

- Normalized for RM 38 – 61 of Luckiamute Mainstem (Ira Hooker Bridge near Pedee Cr. to West Fork)
- Visual bias included for coho only

Boulder

Moderate steelhead abundance was observed in Boulder Cr. in 2002, 2003, and 2009. None were found in 2008 and only a minimal presence was detected in 2010 and 2011. Cutthroat abundance displayed a gradual decline between 2002 and 2009 (the lowest level in 6 years of inventory). A slight rebound has occurred in 2010 and 2011 although, in general, very little change is evident across the six survey years. 0+trout abundances have similarly shown little change over the course of the last five survey years, almost none were present in 2002. The low production levels observed during the last six 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 survey 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. A higher level of agreement between the two reaches was observed in 2010, when 1+ steelhead estimates fell 17% in the upper mainstem (down 79% in Boulder) and cutthroat estimates increased by 90% (up 26% in Boulder), and 2011 when steelhead estimates showed very little change both in the upper mainstem and in Boulder. Cutthroat trends, however, remained in conflict with a 31.4% decrease observed in the upper mainstem and a minor 4% increase observed in Boulder.

About 1.5 miles of good spawning and rearing habitat can be observed 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. All 0+trout and 1+steelhead, and most cutthroat, have been observed downstream of RM 1.5. 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, after 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. 2 beaver dams were encountered on Trib. B in 2009, 10 were noted in 2010, none were found in 2011.

Year	**coho**	**0+**	**Sthd**	**Sthd/sq.m.**	**Cut**	**Cut/sq.m.**
2002	-	5	105	0.0656	320	0.1118
2003	-	135	150	0.1059	345	0.1956
2008	-	115	-	-	270	0.2059
2009	-	205	140	0.1088	215	0.1767
2010	-	200	30	0.0630	270	0.1499
2011	-	125	30	0.1448	280	0.2374

- Visual bias not included

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 2010 survey on Cougar Cr. encountered coho summer parr in the first sample pool (only). This was the only survey in the 6 year inventory to find summer rearing coho in Cougar Cr. This steep stream has exhibited a minor 1+ steelhead presence during all survey years except 2008 and 2011. Mainstem distribution has varied between 0.2 miles (2003) and 1.3 miles (2009).

Cutthroat abundance in Cougar appeared highest in 2008 and decreased in 2009 as survey distance increased. Trends for 2010 and 2011 are difficult to determine due to the decreases in survey distance. No knotweed noted. No beaver dams noted.

Year	coho	Coho/sq.m.	0+	Sthd	Sthd/sq.m.	Cut	Cut/sq.m.
2002-1.0 miles	-	-	50	30	0.0918	70	0.1096
2003-1.0 miles	-	-	290	30	0.0577	175	0.1607
2008-1.0 miles	-	-	300	-	-	255	0.1608
2009-2.2 miles	-	-	1,065	110	0.1312	240	0.1543
2010-0.7 miles	18	0.4	275	5	0.2153	65	0.2813
2011-0.4 miles	-	-	75	-	-	5	0.4485

- Visual bias included for coho only

Harris

Harris Cr. was included in this inventory for the first time in 2010. This medium sized tributary enters the Luckiamute mainstem around RM 53.4, downstream of Slide Cr. and upstream of Hull Cr. Barriers to juvenile passage were encountered here, including a 4 ft. bedrock slide (present at the stream mouth) as well as a 6 inch culvert perch immediately following. An additional 3 ft. bedrock falls was encountered near RM 0.4. The survey ended upstream of the falls with a steep gradient and a confined channel within a canyon. In 2010 an expanded estimate of 12 coho summer parr (including 20% visual bias) were encountered in a single, non-random plunge pool beneath a 4 ft. beaver dam. No 1+ steelhead have been found here. All the obstacles encountered appeared to represent barriers to juvenile migration although none represented a permanent barrier to adult migration. The moderate levels of cutthroat and 0+trout production that were observed in Harris in 2010 declined substantially in 2011 by 52% and 56%, respectively. No stream side knotweed was encountered. 8 beaver dams were observed in 2010, none were present in 2011.

Year	Coho	coho/sq.m.	0+	Sthd	Cut	Cut/sq.m.
2010 – 1.1 miles	12	2.7	215	-	290	0.2755
2011 – 1.3 miles	-	-	95	-	140	0.2248

- Visual bias included for coho only

Little Luckiamute

The 2009, 2010, and 2011 Little Luckiamute mainstem surveys began at the confluence of Teal Cr. and ended at the falls in Fall City. Salmonid production in the Little Luckiamute mainstem has remained consistently lower than in the Luckiamute mainstem during each year of this inventory (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 totals un-expanded. Most cutthroat and all 0+trout rearing that year occurred upstream of Falls City. Very few anadromous fish of any species were encountered in 2009.

Significantly higher numbers of cutthroat were observed in 2010 along with a small population of coho summer parr. A very low average rearing density of 0.02 coho/sq.m. was maintained all the way from the mouth of Teal Cr. to the falls in Falls City. This population represented 2.8% of the 2010 inventory total estimate for coho. Another significant increase in cutthroat abundance occurred in 2011 (275%) while coho estimates dropped 91% to a minimal presence in just 4 sample pools (lineal expanse covering 20 pools when expanded). These 4 sightings all occurred between 0.3 – 1.7 stream miles upstream of the survey's starting point (Teal Cr.). In relation to the minor abundance of coho observed basin-wide in 2011, this small group accounted for a relatively large proportion (13.6%) of the 2011 inventory total. Individual pool counts for coho increased consistently above the mouth of Teal Cr. in 2010 and 2011. The highest individual pool count for coho in the Little Luckiamute mainstem occurred in 2010 in the non-randomly selected pool at the base of the falls in Falls City (325 summer parr, including 20% visual bias).

Many warm water fish species were observed including shiners, dace, squawfish, and suckers. Several cutthroat exhibited signs of infection. Mixed substrates and large midchannel islands were noted. Knotweed presence was heavy near the mouth of Teal Creek in 2010. One beaver dam was encountered.

Year	**coho**	**coho/sq.m.**	**0+**	**Sthd**	**Sthd/sq.m.**	**Cut**	**Cut/sq.m.**
2008 - 27.4 miles	5	0.01	220	5	0.0002	960	0.0518
2009 - 3.8 miles	-	-	25	-	-	5	0.0012
2010 - 3.9 miles	1,284	0.02	-	-	-	60	0.0155
2011 - 3.9 miles	114	0.007	5	-	-	225	0.0144

- Visual bias included for coho only

Maxfield

This stream exhibits good spawning substrates for the persistence of anadromous salmonids. An equal distribution 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 also reported and overall water temperatures were noted as warm. Visibility was poor below RM 0.4. Surveyor access in 2011 was denied between RM 1.1 and RM 1.7. Coho were present only in 2010, out of the four surveyed years. Coho distribution in 2010 extended from the mouth of Maxfield upstream to RM 3.8 where a 2 ft. mud falls appeared to terminate upstream temperature dependant juvenile migrations. A peak rearing density of 0.9 coho/sq.m. was observed at RM 3.3 just upstream of Trib. A (RM 3.2), where a large segment of the mainstem was denied access for survey. This suggests that the 2010 summary of fish abundance underestimates actual abundance.

A wide meander belt and old beaver swamps (none active) were encountered in most of Maxfield before a shift in gradient and a 3 ft. bedrock falls ended the survey at RM 5. Increasing bedrock exposures and multiple cascades limit production in the upper reaches of the Maxfield Cr. mainstem. Full spanning log structures were present as a result of an instream restoration project on the Hall property near the mouth. These structures did not appear to be maintaining significant salmonid rearing densities during summer flow regimes. The cumulative impact of increasing temperature on a downstream gradient from headwaters to mouth, exacerbated by summer water withdrawals has probably resulted in the low salmonid rearing densities on the Hall property.

Maxfield was one of only 5 tributaries in the basin where 1+ steelhead were observed in 2008. No steelhead have been documented there since. Cutthroat and 0+trout abundance increased significantly in 2009 (30% and 178% each) but cutthroat densities remained very low with several gaps in distribution. Total expanded estimates for 1+ steelhead and cutthroat from 2010 cannot be directly compared since approximately 3.3 miles of stream were dropped from the 2010 survey because of a loss of access. This suggests that cutthroat abundance declined in 2011 with only 0.6 stream miles omitted from the distance surveyed in 2009.

The potential for higher coho, 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**	**coho/sq.m.**	**0+**	**Sthd**	**Sthd/sq.m.**	**Cut**	**Cut/sq.m.**
2008	-	-	315	70	0.0791	690	0.2328
2009	-	-	875	-	-	895	0.1807
2010	564	0.3	235	-	-	265	0.2012
2011	-	-	520	-	-	255	0.2082

- Visual bias included for coho only

Pedee

High abundances of coho parr were observed in Pedee and SF Pedee in 2010. This was the first year out of five that exhibited coho rearing in the Pedee sub-basin. Approximately 29.2% of all coho in the 2010 Luckiamute inventory were encountered in the Pedee mainstem and SF Pedee, which represented the largest abundance of coho within the Luckiamute Basin that year (an estimated 13,386 summer parr, expanded, including a 20% visual bias). Coho abundance declined by 98% in 2011 with only 150 summer parr observed (including visual bias). These juveniles were likely the progeny of a single spawning pair. Several portions of the lower Pedee Cr mainstem (below RM 2) were not included in the 2010 or 2011 survey because of a lack of landowner permission. This issue is problematic when comparing inter-annual trends for the sub-basin. The mainstem estimates provided in the table below for 2010 and 2011 under estimate the sub-basins production potential for all species for this reason. The upper NF Pedee survey and all of the SF Pedee survey remained consistent and both are directly comparable to previous years.

All coho observed in 2011 in the Pedee sub-basin were found in a relatively short stream reach between RM 3.6 – 4.5. This reach stretches roughly from the confluence of Trib B to the confluence of the South Fork. Average rearing densities there were extremely low (0.05 fish/sq.m.).

No coho were observed in Tribs. B, C, or D or in the SF Pedee. A 1 ft. diameter culvert perched by 6 ft. with a 3 ft. sill log trapped at the upper end of the culvert was encountered in Trib. D. The presence of several bedrock cascades, low summer flows and limited spawning gravels limits the production potential of Trib D. The 4ft. bedrock falls at the mouth of Trib. B followed by many long stretches of exposed bedrock significantly reduces anadromous production potential here as well. Trib.A exhibited the best potential for spawning and summer rearing of all the un-named tributaries in the sub-basin. There is however only minor summer flows, heavy siltation and poorly sorted gravels. A 6ft. steel pipe culvert was perched by 1 ft. at the mouth of Trib. A, representing a barrier to upstream juvenile migrations from the mainstem.

Steelhead abundance in the sub-basin has remained minimal during all surveyed years. Most observations have been in the upper NF Pedee and lower SF Pedee. None were observed in 2011 and a gradually declining trend has emerged across all six survey years. Cutthroat production has been strong in the Pedee Cr sub-basin when compared to the remainder of the Luckiamute tributaries during most surveyed years. This sub-basin has contained the highest abundance of cutthroat of all the Luckiamute tributaries inventoried during the last two survey years, 2010 and 2011 and the second largest population in both 2008 and 2009 (after West Fork Luckiamute and Teal). In both 2010 and 2011 (comparable inventory distances), this represented 13% of all cutthroat observed in the inventory.

Cutthroat estimates appear to have decreased across the sub-basin in 2011, dropping 18% in the Pedee mainstem and 84% in SF Pedee. The surveyed reaches in 2010 and 2011 remained roughly identical. The fact that cutthroat (and 0+trout) abundance increased by 74% in NF Pedee during the same year indicates a significant shift in rearing patterns, possibly related to water temperature. This is notable since surveys in 2011 (early August) occurred about one month earlier than in 2010 (early September). There had been comparatively little change in cutthroat abundance in NF Pedee in the 5 survey years prior to 2011.

A large amount of aquatic habitat is present in the Pedee sub-basin. About ten miles of stream was surveyed here in 2008, and most of it was accessible to anadromous salmonids. Habitat conditions were poor, however, throughout the lower three miles of the mainstem (deep channel entrenchment, heavy sedimentation, low summer flows). Habitat conditions began to improve upstream of the South Fork confluence. Good pool / riffle dynamics provided for gravel sorting and a boost in complexity. Anadromous potential in both of the main forks ends in steep boulders, bedrock steps, and large wood jams.

The highest quality habitats were observed in SF Pedee. 2.5 stream miles were accessible to anadromous adults. Productive conditions were noted, including cold water, high quality gravel, well scoured pools, and two passable culverts. The active stream channel was smaller than NF Pedee, but exhibited higher quality habitat conditions. The upslope harvest buffer was intact and some old growth Douglas Firs had been retained in the riparian. A small 2 ft. falls was present at RM 0.4 which represents a barrier to juvenile migrations. SF Pedee is capable of supporting fair to high levels of anadromous spawning and rearing. The first 1.4 miles of SF Pedee was surveyed in both 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 Teal Cr., 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 has been reported in Pedee.

Pedee mainstem (6.2 miles)

Year	coho	coho/sq.m.	0+	Sthd	Sthd/sq.m.	Cut	Cut/sq.m.
2008	-	-	160	30	0.0281	530	0.0566
2009	-	-	1,140	-	-	795	0.0686
2010	9,132	0.5	760	15	0.0122	1,120	0.0862
2011	150	0.05	735	-	-	920	0.0622

- Visual bias included for coho only
- 2010 and 2011 survey missing 1.7 miles (landowner denial)

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

Year	Coho	coho/sq.m.	0+	Sthd	Sthd/sq.m.	Cut	Cut/sq.m.
2002	-	-	45	20	0.0174	270	0.1315
2003	-	-	50	35	0.0949	220	0.1232
2008	-	-	60	10	0.0957	245	0.1188
2009	-	-	935	-	-	380	0.1424
2010	1,795	0.5	265	5	0.0103	245	0.1114
2011	-	-	460	-	-	425	0.0996

- Visual bias included for coho only

Normalized for RM 0 – RM 1.4 of SF Pedee

Year	Coho	coho/sq.m.	0+	Sthd	Sthd/sq.m.	Cut	Cut/sq.m.
2002	-	-	55	5	0.0276	105	0.0997
2003	-	-	115	-	-	335	0.2520
2008	-	-	90	-	-	550	0.2302
2009	-	-	470	40	0.1067	470	0.2042
2010	3,895	1.0	295	-	-	425	0.1186
2011	-	-	515	-	-	70	0.1750

- Visual bias included for coho only

Ritner

5.6 miles of the Ritner mainstem were surveyed in 2008 and 2009, beginning at the stream's mouth and ending at the 15 ft. impassable falls just downstream of Trib. A. Surveys in 2010 and 2011 began and ended at the same locations, although several landowners denied surveyor access to approximately one mile of stream (over 3 separate data gaps) downstream of RM 3. 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 six surveyed years.

Moderate coho production was observed throughout 9.4 miles of the Ritner sub-basin in 2010. A total expanded estimate of 7,878 summer parr (including 20% visual bias) were present in the sub-basin at the time of survey. In 2011, only a single summer parr (un-expanded) was observed near RM 4.2, upstream of Clayton and Sheythe (this was likely a hold over from the previous year). The Ritner sub-basin was the third most productive tributary in the 2010 inventory after Pedee and Teal (contributing 17.2% of the basin-wide coho estimate). Kinsey Cr., a main tributary of Ritner, has not been surveyed during any of these inventories.

The upper Ritner mainstem appeared to be by far the most productive reach in the sub-basin for all anadromous species for each of the 6 survey years. 63% of all coho in the Ritner mainstem were observed there in 2010, along with the two highest peaks in rearing density at RM 3.7 (1.2 coho/sq.m.) and RM 4.7 (1.3 coho/sq.m.). Almost all cutthroat and 0+trout observed in the mainstem for all years were also found in this reach.

Moderate stream gradients throughout the upper mainstem provide the best spawning and rearing habitat for anadromous species. Clear and cold stream flows have been the norm here. The falls represents a definitive barrier to migration. Stream gradients increase rapidly above the barrier falls where the mainstem canyon narrows and several smaller bedrock falls are present. Cutthroat and 0+ trout were observed above the falls also in 2002, 2003, and 2008.

Downstream of Sheythe and Clayton the mainstem channel is compromised by deep channel entrenchment, high solar exposure, and heavy deposition of sediments. Low stream flows result in slow pool turn-over rates and summer water quality obviously declines. Several coho parr were observed in 2010 with external membrane responses to either parasites or infection. Large schools of dace were observed in this reach along with occasional observations of freshwater mussels. A total of 10 active beaver dams were documented in 2010, dropping to 4 active dams in 2011.

Moderate cutthroat production has been observed during most survey years in Ritner. Both cutthroat and 0+trout estimates declined sharply in 2010 (down 84% and 98%, respectively, in upper Ritner), but rebounded in 2011 to moderate levels. Abundance levels for these two age classes appeared to be at their lowest levels for all 6 survey years in 2010. Survey timing may have contributed to these variations in the upper mainstem (6/26/08, 8/26/09, 9/9/10, 7/29/11), particularly in the case of the extreme spike in 0+trout abundance on 8/26/09. Basin-wide trends remain difficult to compare due to the many survey gaps in surrounding tributaries in 2010 and 2011. Current inventories indicate that steelhead are no longer present in the sub-basin. Low level steelhead production was observed in 2002 and 2003 only.

The main triple culvert at RM 4.4 appeared adequate for fish passage even though two of the pipes displayed an 8 inch perch. 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). There was no evidence of this effect in 2010 or in 2011. Moderate to large spikes in cutthroat density were also observed just below the main falls during some surveys. A moderate spike in coho density was observed at this location in 2010. Invasive knotweed was observed at the mouth of Ritner Cr. in 2010.

Year	**Coho**	**Coho/sq.m.**	**0+**	**Sthd**	**Cut**	**Cut/sq.m.**
2008	-	-	290	-	600	0.1182
2009	-	-	1,540	-	620	0.0607
2010	6,510	0.4	50	-	110	0.0197
2011	6	0.007	740	-	305	0.0462

- 5.6 mile Ritner mainstem only, ending at falls/Trib.A
- Estimates for 2010 and 2011 are not directly comparable due to survey gaps (landowner denials)
- Visual bias included for coho only

Year	**Coho**	**Coho/sq.m.**	**0+**	**Sthd**	**Sthd/sq.m.**	**Cut**	**Cut/sq.m.**
2002	-	-	70	10	0.0086	175	0.0996
2003	-	-	155	35	0.0300	285	0.1354
2008	-	-	280	-	-	535	0.1368
2009	-	-	1,375	-	-	430	0.0671
2010	4,110	0.6	25	-	-	70	0.0236
2011	6	0.007	710	-	-	250	0.0541

- Normalized for Upper Ritner (Sheythe confluence to falls/Trib. A confluence – 2.6 miles)
- Visual bias included for coho only

Sheythe / Trib. to Ritner

This stream is the largest and most productive tributary to Ritner. Six years of surveys here have documented generally poor spawning and rearing conditions for anadromous fish. Low numbers of cutthroat and 0+trout only were present until 2010 when moderate coho production occurred. Cutthroat and 0+trout production remained extremely low. An expanded estimate of 462 coho summer parr (including 20% visual bias) were observed in the mainstem (1 mile) with an additional 366 coho summer parr documented in Trib A (only 250 ft.). This accounted for 11% of the Ritner sub-basin coho total. No Coho were present here in 2011 and cutthroat abundance declined by 50%.

Medium visibility during all surveys reduces our confidence in the snorkel observations in Sheythe. The consistency in visibility classifications between years however, suggests that the comparison for trend between years in the chart below is valid. Spawning conditions appear poor in Sheythe due to high siltation rates. A few marginal sites with fair gravels were noted around RM 1. The confluence with Trib. A occurs near an extensive wetland stretching across the wide floodplain. Several islands exist between multiple channel braids. This appears to be the most productive and unique zone in Sheythe Cr.. A strong beaver legacy was present there also and 7 active (massive) dams were noted in 2010. No knotweed was noted. The culvert at the mouth was in good condition and passable to adults and summer juveniles.

Year	**coho**	**coho/sq.m.**	**0+**	**Sthd**	**Cut**	**Cut/sq.m.**
2002	-	-	-	-	120	0.0695
2003	-	-	50	-	90	0.1326
2008	-	-	10	-	5	0.1094
2009	-	-	175	-	95	0.1421
2010	462	0.2	20	-	50	0.0624
2011	-	-	35	-	25	0.0458

- Normalized up to RM 1 (not including Trib. A)
- Visual bias included for coho only

Rock Pit

The 2011 survey extended 2.2 miles upstream from the confluence with the mainstem Luckiamute and encountered three barriers to 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 large log jam just downstream of the second culvert exhibited a 3 ft. falls also. All three were certainly barriers to juvenile migration as well as significant obstacles to adult passage. Two passable culverts in good shape were also present downstream of the log jam. A low level 1+ steelhead presence was detected in 2009 only, indicating that the culvert at the mouth was passable for adults at that time. Large wood jams and steep stream gradients limit adult passage and spawning potential upstream of RM 2. The relatively small cutthroat and 0+trout abundances in Rock Pit have increased during each survey year. Although survey distance has also increased, almost all fish during all surveys have been observed downstream of RM 1. Overall production potential appears low. Short surveys in Tribs. A and B have exhibited low abundances of 0+trout and cutthroat only.

Year	**coho**	**0+**	**Sthd**	**Sthd/sq.m.**	**Cut**	**Cut/sq.m.**
2008-1.6 mile	-	-	-	-	145	0.1392
2009-1.6 mile	-	80	75	0.1388	180	0.2948
2010-1.8 mile	-	210	-	-	225	0.1324
2011-2.2 mile	-	115	-	-	275	0.3054

- Mainstem only
- Visual bias not included

Slide

A 6 ft. bedrock slide at the mouth of Slide Cr. and a 12 ft. vertical debris jam at RM 0.5 prohibit upstream juvenile migrations and seriously limit adult passage in this stream. High stream flows and cold water temperatures appear to be the most important contributions from this moderately large sub-basin to the Luckiamute mainstem habitat. No coho or steelhead have been found here during this inventory. No beaver dams or knotweed were reported. No surveys were done in Slide in 2009.

Year	**coho**	**0+**	**Sthd**	**Cut**	**Cut/sq.m.**
2008-0.2 mile	-	40	-	5	0.2243
2010-0.5 mile	-	135	-	60	0.2306
2011-0.5 mile	-	35	-	65	0.7145

- 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. Anadromous access to much of the best habitat in Teal Cr. is blocked by numerous impassable waterfalls. Surveys here in 2009, 2010, and 2011 ended at the first of these falls (8 ft.) near RM 7. Significant coho production was observed in Teal in 2010 (11,856 summer parr, expanded with 20% visual bias) with evidence of upstream juvenile migrations in the two main tributaries Grant (0.7 miles) and Boughey (200 ft.). This sub-basin accounted for 26% of all coho basin-wide that year which ranked as the second largest tributary contribution after Pedee Cr. (29% over 9 stream miles). Coho abundance declined sharply here by 95% during the 2011 inventory when only 570 summer parr (expanded with 20% visual bias) were estimated to be present. Most were focused near RM 4.1, where some of the best spawning habitat occurred, and RM 6.5 (just downstream from the main falls). This small population represented the largest portion (68%) of Coho summer parr in the 2011 Luckiamute inventory, which included all of the best anadromous spawning habitat in the basin. The substantial drop in coho production observed here in 2011 appears to be the result of a very low adult escapement basin-wide in the Luckiamute and a very limited number of successful adult spawners. Back-calculation from the 2010 summer parr estimate suggests a minimum adult escapement of 96–109 coho within Teal Cr. for the 2009 winter brood. Back-calculation from the 2011 summer parr estimate suggests a minimum adult escapement of 4-6 coho within Teal Cr. for the 2010 winter brood (2 or 3 successful redds).

Significantly improved cutthroat production (+295%) was observed in Teal in 2009. A slow decline began in 2010 with a minor decrease of 24% followed by an even more minor decrease of 5.3% in 2011. A similar trend has developed for 0+ trout which increased in abundance dramatically in 2009 and then have slowly declined during the last two survey years. The changes observed for 1+steelhead are insignificant. Estimates for all species remained higher in 2011 than when first surveyed in 2008. Cutthroat and 1+ steelhead densities progressively increased as the falls were approached. No cutthroat were observed downstream of RM 0.7. No 1+ steelhead were observed downstream of RM 3.5. This was likely the result of the poor visibility documented by the field crew below RM 2.0.

Teal Cr. was one of the largest fish producers during all years of the Luckiamute Inventory. This stream currently represents one of the top four anchor habitats for anadromous species in the basin, along with Pedee Cr., WF Luckiamute, and the upper Luckiamute mainstem. In 2011, the Teal Cr. sub-basin and the Little Luckiamute mainstem each contributed the second highest estimates for 1+ steelhead (10%), after the Luckiamute mainstem, and the fourth highest estimate for cutthroat (12.3%), after the Luckiamute mainstem, the Little Luckiamute mainstem, and the Pedee sub-basin. The potential for increased anadromous production appears large in Teal Cr. and is probably currently limited by low 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.

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 higher quality habitats for anadromous fish in the Teal Cr. sub-basin. Surveys in 2008 extended upstream to RM 8 and encountered numerous waterfalls and bedrock slides, including the 8 ft. falls at RM 7 (the end of anadromous passage) and a large 35 – 40 ft. falls at RM 7.5. 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. Invasive knotweed was noted in 2010 near the mouth of Teal Cr., at RM 1.9, and at RM 3.5.

Minor upstream migrations of coho summer parr were noted in Boughey (126 summer parr, expanded) and Grant (12 summer parr, expanded) during the 2010 surveys. None were present in 2011. Anadromous production potential in Boughey appears very low due to the lack of spawning gravel, low stream gradient, poor water quality, and a plugged culvert near the mouth. Production potential appears somewhat higher in Grant although a series of small falls at RM 0.4 (4 ft.) and RM 0.6 (4 ft. perched culvert) represent significant obstacles to adult migration and definite barriers to juvenile migration. A low abundance and poor sorting of spawning gravels, high siltation rates, and channel entrenchment were observed in Grant. Low numbers of cutthroat were observed in both streams.

Year	**coho**	**Coho/sq.m.**	**0+**	**Sthd**	**Sthd/sq.m.**	**Cut**	**Cut/sq.m.**
2008	-	-	425	-	-	380	0.0485
2009	-	-	3,205	110	0.0973	1,500	0.0858
2010	11,856	0.6	880	95	0.0343	1,135	0.0835
2011	570	0.07	585	90	0.0433	1,075	0.0812

- Normalized for RM 0 – 7 (up to first 8 ft. falls)
- Not including Boughey or Grant
- Visual bias included for coho only

WF Luckiamute

This 4 mile stream segment contained the most productive tributary habitat for cutthroat and steelhead during the 2008 Luckiamute Basin inventory. Declines in production for both of these species were observed in 2009 and 2010. Declines in steelhead production continued in 2011 (down to zero) while cutthroat production rebounded slightly with a 19% increase. Abundance estimates for cutthroat and 0+trout remained higher in 2011 than when first quantified in 2002. The reason(s) for the collapse of steelhead in the West Fork are unknown. Luckiamute basin-wide trends for 1+ steelhead have mirrored this decline (down 37% in 2010 and down 23% in 2011). 1+steelhead abundance in the upper Luckiamute mainstem (the primary steelhead stronghold in the basin) also declined in 2011 by 17.2% while abundance in the lower segment went down 34%. Cutthroat trends for the basin have shown less agreement (no change in 2010 and a 18% decline in 2011). Upper Luckiamute mainstem estimates for cutthroat have also contrasted with West Fork trends with a sharp 39% drop observed in 2011 following a strong 90% increase in 2010. Basin-wide trends must be normalized since fewer streams were surveyed during the 2011 inventory than in 2010, 2009, or 2008 (Luckiamute mainstem surveys have also changed over the years).

Abundance levels for 1+ steelhead in the West Fork Luckiamute are currently at their lowest level in six years of surveys. The West Fork (sub-basin) population of cutthroat represented 12% of the 2010 inventory total and a similar 11% of the 2011 inventory total. This ranked as the fifth largest cutthroat population among the stream reaches surveyed in 2011, behind the Luckiamute mainstem, the Little Luckiamute mainstem, Pedee, and Teal. No coho have been observed in the West Fork during this six year inventory. Coho distribution in the Luckiamute mainstem in 2010 ended approximately one mile downstream of the mouth of the

West Fork at a 5 ft. bedrock falls. That was the only year of this inventory when juvenile coho were observed in the Luckiamute mainstem.

Stream habitats in the WF Luckiamute appear to be functioning well and continue to represent a strong anchor habitat for salmonids within the larger Luckiamute Basin. This stream is the largest headwater tributary to the Luckiamute mainstem. The geographical position of the WF as a headwater stream 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. 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. This pattern continued for cutthroat and 0+trout in 2011. The lower three miles of mainstem habitat downstream of the confluence of Trib. C and D is the prime habitat segment for the WF mainstem. The valley and active stream channel narrow considerably upstream of these two tributaries and stream flows diminish. In 2011 most fish were observed downstream of a large log jam at RM 2.6 which exhibited a 5 ft. plunge. This included 84% of all cutthroat in the mainstem and 42% of all 0+trout in the mainstem. The very highest counts for cutthroat all occurred downstream of RM 1.6 (about 0.5 miles below the mouth of Trib. B). A new bridge has recently been put in at RM 1.6. Very few fish at all were encountered upstream of Trib. E near RM 3.3.

Strong 0+trout production was observed in the West Fork in 2010. It is difficult to compare the inter-annual changes for this age class since survey timings have been different for each survey (6/23/08, 7/14/09, 9/2/10, 7/15/11). Emergence of this age class continues throughout the extent of the summer and abundance naturally increases later in the summer. A predictable decline for 0+trout of 50% occurred in 2011, compared to 2010, as the survey timing moved from September back to July. Abundance levels for 0+trout and cutthroat both remained higher in 2011 than when first inventoried in 2002.

Beaver activity was abundant throughout this zone in 2002 and 2003, but has recently declined (0 dams in 2008, 1 dam in 2009, 3 dams in 2010, 0 dams in 2011). No culverts were noted. No knotweed was observed.

The most productive un-named tributary to the West Fork during all survey years was Trib. C. Expanded estimates for cutthroat there have totaled 545 (2008), 185 (2009), 215 (2010), and 215 (2011) over a relatively consistent one mile survey reach. No steelhead have been observed there since 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. A total of 2 active beaver dams were encountered in Trib. C in 2011. Low numbers of cutthroat and 0+trout were present in Tribs. D and E as well. No fish were present in Trib. B in 2011 due to a concrete culvert barrier at RM 0.1 which exhibited a 2.5 ft. perch with no jump pool. In addition this culvert had a steel grate over the upstream end. This culvert represents a low priority for replacement based on the relatively low production potential exhibited in Trib. B. Anadromous potential is limited in these habitats by low summer stream flows resulting in small pool surface areas.

Year	coho	0+	Sthd	Cut
2008	-	315	110	2,255
2009	-	755	90	1,110
2010	-	1,045	15	975
2011	-	505	-	1,090

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

Year	coho	0+	Sthd	Sthd/sq.m.	Cut	Cut/sq.m.
2002	-	65	90	0.1430	560	0.0467
2003	-	125	70	0.0211	495	0.0890
2008	-	150	110	0.0162	1,570	0.0842
2009	-	465	90	0.0095	850	0.0503
2010	-	645	15	0.0399	700	0.0619
2011	-	260	-	-	830	0.1462

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

Wolf

A clear legacy of beaver activity has been 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, 6 dams in 2010, and 0 dams in 2011. Stream flows were very low and visibility was classified as poor. Several pools were completely isolated by sub-surface flows. Several pockets of high quality spawning gravel were observed that would have been appropriate for anadromous spawning.

No coho have been observed here in six years of survey. Low numbers of steelhead were observed in 2009 only. Low abundances of cutthroat have been sustained here throughout the surveyed years with little change in abundance. Production estimates for 0+trout have shown a greater degree of fluctuation and a declining trend since 2009. Survey distance has remained between 1.0 - 1.5 miles each year, ending in a flat and braided stream channel. Low summer flows and extensive wetlands describe the current condition of the aquatic corridor. The culvert at the mouth of Wolf appeared to be perched by 2 ft. at the time of survey in 2011. Many of the beaver dams encountered in 2010 also exhibited heights of 2-3 ft. The frequently blocked trash rack on the inlet end of the first culvert also restricts passage.

Year	coho	0+	Sthd	Sthd/sq.m.	Cut	Cut/sq.m.
2002	-	20	-	-	105	0.1282
2003	-	35	-	-	115	0.1011
2008	-	70	-	-	90	0.1179
2009	-	295	45	0.0117	90	0.0851
2010	-	100	-	-	80	0.0939
2011	-	75	-	-	90	0.1509

- Visual bias not included

Unnamed Tributaries

Trib. AJ was the only un-named tributary to the Luckiamute mainstem included in the 2011 inventory. A short survey distance of 0.2 miles exhibited an expanded estimate of 30 0+trout only. Trib AJ was located just downstream of the mouth of Cougar Cr. and just upstream of the mouth Trib. AI. This small, steep stream exhibited habitat characteristics very similar to Tribs. AA – AI. These include steep gradients, large cobbles and boulders, poor pool formation, frequent wood jams, and cold clear flows. Production potential for anadromous adults appears to be very low in these streams due to poor spawning conditions and multiple barriers to migration. The most important function of these tributaries is their contribution of cold, clear water to the Luckiamute mainstem which aids greatly in decreasing water temperatures there. Rising water temperature is the main limiting factor to anadromous production potential in the Luckiamute mainstem. For this reason it remains important to maintain forest cover and preserve cool stream flows in the adjacent sub-basins of Tribs. AA-AJ. The production potential of these small tributaries is greatest within the extent of the floodplain of the mainstem as the trib traverses a low gradient terrace.

Watershed Recommendations

- Focus restoration efforts on the upper Luckiamute mainstem, West Fork Luckiamute and Teal Cr. While implementing on the ground projects on these three subbasins in the short term, continue to develop long term restoration strategies for Pedee, Ritner and Maxfield that can be classified as tier 2 recovery priorities.
- Decrease water temperatures in the 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 to restore riparian vegetation. This is a strategy that has the best chance of succeeding if projects are prioritized from a top down perspective.
- Elevated summer water temperatures in both the mainstem Luckiamute and the Little Luckiamute limit the potential for expanding the current range of summer rearing juvenile salmonids. For this reason it remains important to maintain functional riparian buffers to preserve and protect cool stream flows in small 2nd and 3rd order tributary corridors that cumulatively impact mainstem habitats.
- 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, 2009, 2010, and 2011. 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.