Canton Creek Report 2016

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For Pacific Rivers

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Canton Creek Snorkel Surveys (2011-2016)

Executive Summary

During five of the last six summers, a snorkel survey of Canton Creek (North Umpqua basin) was completed by Phoenix School students and staff, Jeff McEnroe of the BLM, and Charley, Andrew, and Dylan Dewberry, of Pacific Rivers. Thomas McGregor, Director of work experience at the Phoenix School, coordinated the student participation and Kelly Coates from the Cow Creek Tribe helped with the snorkeling and snorkel training. The survey included all of the mainstem of Canton Creek to the fourth bridge, Pass Creek, and Mellow Moon Creeks. In addition, several smaller tributaries were surveyed to document steelhead use.

The snorkel surveys enable us to construct a snapshot of summer rearing of salmonids in Canton Creek. This snapshot of the abundance and distribution of steelhead (the dominant salmonid) in the basin and the evaluation of the stream habitat and landscape processes provide basic information to identify restoration opportunities within the basin. With each additional year of survey, the trends in the population of each salmonid and age class of steelhead become clearer. It also allows us to greater understand the factors affecting the abundance and distribution of the salmonids in the basin.

A number of trends are observed in the trajectory of steelhead within the basin. The population of age-0 steelhead in the basin averaged between 30,000 and 40,000 during the period (2011-2016) except for 2014 and 2016 when about half as many were observed. The population of age-one steelhead in the basin averaged between 2,500 and

3,000 during the period, except for 2011 when almost twice that number were observed and 2016 when one-half that number were observed. The population of age-2 steelhead in the basin averaged between 300-1000 during the period. The largest population was observed in 2011 and the lowest in 2016.

The cutthroat population estimates were between 52 and 350 fish. The largest numbers were observed in 2011 and the lowest were observed in 2016. This is the same trend observed in age-2 steelhead, suggesting that similar factors were controlling both of these populations.

The coho population estimates were between 350 and 750. No trends were evident because of the small number of fish observed in each survey.

We began a life-history analysis of the steelhead in the Canton Creek basin. The initial analysis of the first three consecutive years suggests that stream habitat, especially for age-1 steelhead, is limiting. The number of adult steelhead spawning in the basin did not differ during these four years. The number of age-0 steelhead averaged between 30,000-40,000 fish, except for 2014 when only about one-half as many were observed. The stream flow was unusual in 2014. No large storm event occurred during early January and subsequent storms were as large or larger than the storm the steelhead came in on, so many redds were removed and much fine sediment was incorporated into the redds. Both these results decreased the survival of age-0 steelhead in 2014. However, in each year approximately 2,500-2,800 age-1 steelhead were observed in the basin during the three years of survey. Even the 2014 age-0 steelhead resulted in 2,820 age-1 steelhead the next year. This was the highest number of age-1 fish found during the three years of surveys.

The results of the life-history analysis from 2016 indicate that the severe high temperature conditions during the summer of 2015 significantly reduced the survival of age-1 and age-2 steelhead within the basin. The number of age-0 steelhead observed in the basin was low, about one-half of normal. This suggests redd survival was below average in 2016. However, the major tributaries of Pass Creek had average or above average survival rates, because the number of age-0 steelhead was average or above in these reaches. Subsequent surveys and life-history analysis will greatly increase our understanding of steelhead population dynamics in Canton Creek and their response to restoration efforts.

Introduction

In 2011, a partnership was formed among Pacific Rivers, the Phoenix School in Roseburg, Oregon, the Cow Creek Tribe, and the BLM to begin collecting baseline information prior to designing a restoration project within the Canton Creek Drainage basin. The Canton Creek Drainage was of interest because it is partially within the Oregon and California Railroad Lands (O&C) as well as being strategically located within the North Umpqua basin. This project provides an opportunity to collect background information for designing an effective restoration project within the context of the North Umpqua drainage.

During five summers: 2011, 2013, 2014, 2015 and 2016, a snorkel survey for juvenile salmonids in Canton Creek (North Umpqua basin) was completed by Phoenix School students and staff, Jeff McEnroe of the BLM, and Charley, Andrew, and Dylan Dewberry, for Pacific Rivers (See appendix). Thomas McGregor, Director of work experience at the Phoenix School, coordinated the student participation and Kelly Coates from the Cow Creek Tribe and Jeff MacEnroe (BLM) helped with the snorkel training. The survey included all of the mainstem Canton Creek to the fourth bridge, Pass Creek, and Mellow Moon Creeks. In addition, several smaller tributaries were surveyed to document steelhead presence.

Study Area

Canton Creek is a major tributary of Steamboat Creek in the North Umpqua River basin (Figure 1). The drainage area is approximately 60 square miles. Canton Creek is a strategically important producer of steelhead trout, coho salmon, chinook salmon and cutthroat trout within the North Umpqua drainage. Most of the western two-thirds of the basin are BLM-private land checkerboard (O&C lands). The remaining one-third of the basin is managed by the USFS.

The basin is entirely within the western Cascades. The geology is dominated by weathered tertiary volcanic rocks. The dominant forest community is Western Hemlock-Douglas fir.

Methods

The snorkel surveys were conducted during August and September each year using the Hankin-Reeves method (Hankin and Reeves 1990). A dive crew consisting of two or more people work their way upstream through their designated stream reach. The stream channel was divided into three habitat types: riffles, pools, and glides. For each habitat unit, the length and width was estimated. The frequency of the surveyed units was: 1:10 riffles; 1:8 glides; and 1:5 pools. All salmonids were counted in each surveyed stream habitat. In the habitat units that were snorkeled, the length and width were measured.

The Phoenix students participated in a day of training prior to conducting their surveys. The topics emphasized during the training were safety, identifying the three habitat types in Canton Creek, how to identify the species and age of the salmonids found in the basin, and how to approach counting the fish in a habitat unit. During training, the students spent a total of four hours in the stream conducting actual counts in habitat units. All students could identify coho, steelhead, and cutthroat trout.

The Phoenix School students divided into three teams. One team snorkeled Mellow Moon Creek, a west-side tributary of Canton Creek. The second team snorkeled Pass Creek, the major left fork of Canton Creek, while the third team snorkeled upper Canton Creek. In addition, all three Phoenix School teams surveyed a section of the Canton Creek mainstem. Charley Dewberry alternately worked with each crew to verify their counts. In addition, he snorkeled a reach of Mellow Moon Creek, upper Canton Creek, and Pass Creek to verify the student counts.

Charley and Andrew Dewberry snorkeled the majority of the mainstem of Canton Creek. The mainstem of Canton Creek consists of the lower ten miles of Canton Creek up to the confluence of Pass and Upper Canton Creeks.

For these surveys, age-0 and 1 trout include both steelhead and cutthroat trout. While some individuals are easy to identify into their respective species, others are very difficult. As a result, we elected to combine both species into these age categories. Age-2 steelhead were differentiated from age-2 cutthroat trout. While a few adult salmonids were observed in the surveys, they are not included in this discussion.

Results and Discussion

Surveyed Reaches

During the five years, the following reaches of Canton Creek were snorkeled each year: the mainstem up to the confluence with Pass Creek, Pass Creek, Upper Canton to the first bridge, and Mellow Moon Creek. During 2011, not all of Pass Creek and Upper Canton Creek were finished by the students. In some years selected reaches of the following creeks were surveyed: No Man Creek, Francis Creek, Chilcote Creek, and an unnamed tributary in upper Canton Creek.

In all four previous years, the mainstem of Canton Creek was snorkeled by Charley and Andrew or Dylan Dewberry. During 2016, all three of the Phoenix school teams snorkeled a portion of the mainstem of Canton Creek. In all four previous years, the Phoenix School divers finished Mellow Moon Creek and at least 75% of both Pass and Upper Canton Creeks. Charley Dewberry completed the surveys of upper Canton Creek and Pass Creeks and verified the student counts. During 2016, the Phoenix school students completed the surveys on all of Mellow Moon, Pass, and Upper Canton Creeks.

Salmonid Population Estimates

The results of the five years of snorkel surveys are summarized in Tables 1-5. Coho salmon, steelhead trout, and cutthroat trout were observed and their populations estimated in the basin. In addition, a few adult steelhead and Chinook salmon were observed in the mainstem of Canton Creek.

Age-0 Steelhead

Steelhead trout were the most abundant salmonid within the basin. All three ages of steelhead were observed. As expected, age-0 fish dominated the survey. During the five years of survey, between 30,000 - 40,000 age-0 steelhead were usually observed in the major surveyed reaches. The 2011 survey estimate of 40,129 age-0 steelhead is low because only about 75% of Pass Creek was completed by the students. In 2014 and 2016, the estimate of age-0 steelhead was only about one-half of the usual number.

No explanation is immediately available at this time to explain the declines. There are a number of possibilities including: declining number of spawning adults, timing of flood events allowing adult steelhead to migrate upstream to spawning areas, and flood waters scouring out redds or reducing survival of the fry due to high amounts of sedimentation. This topic will be discussed in greater detail in a subsequent section.

The number of age-0 steelhead was examined by reach. In the mainstem (the lower approximately 10 miles) of Canton Creek, the number of age-0 steelhead has varied between about 7,500 and 33,000 fish. In 2011, the highest year with the highest number of age-0 steelhead in the basin, over 33,000 or over 80% of the age-0 fish were located in the mainstem of Canton Creek. By contrast, in 2014 the year with the lowest observed number of age-0 steelhead in the basin, only 7,500 or 46% of the age-0 steelhead were in the lower mainstem reach. In 2016 only about 11,500 age-0 steelhead were observed in the mainstem and this accounted for about 60% of the age-0 steelhead in the basin. It appears that in years with a high population of age-0 steelhead, the mainstem reach of Canton Creek is producing a greater percentage of the fish than in years with lower number of fish observed in the basin.

In Pass Creek, the population estimates of age-0 steelhead were between 3,138 and 9,500 fish during the five years of survey (Table 1). There is a different trend in the population estimates from those of the mainstem of Canton Creek. The lowest count was from 2011, the year with the highest total basin count of age-0 steelhead. The highest count of age-0 steelhead in Pass Creek was observed in 2013, a year with an average total basin count.

In Upper Canton Creek, the population estimates of age-0 steelhead were between 3,300 and 5,950 for the four years of survey (Table 1). In 2016, one-half the number of age-0 steelhead were observed in Upper Canton Creek. No immediate explanation is available as to why Upper Canton Creek numbers were lower than average while Pass Creek numbers were average.

In Mellow Moon Creek, a tributary of Pass Creek, the population estimates for age-0 steelhead were between 130 and 550 fish. The number age-0 steelhead was about average in 2016 for Mellow Moon Creek. The five-year pattern in Mellow Moon Creek was different from that of the mainstem of Canton Creek. The pattern does not track Pass Creek as close as anticipated since Mellow Moon is a tributary of Pass Creek, but the numbers are low so that determining the trends is more problematic than with higher estimates.

When the total number of age-0 steelhead in the basin was high, the main stem of Canton Creek accounted for about three-quarters of the age-0 steelhead in the basin. When the number of age-0 Steelhead was low in the basin (2014), only about 45% of the age-0 steelhead were in the mainstem of Canton Creek. This suggests that the preferred habitat for age-0 steelhead is in Pass, upper Canton, and the tributaries not the mainstem of Canton Creek. The mainstem is not the center of age-0 rearing, except in high production years.

To summarize, the total number of age-0 steelhead in the Canton Creek drainage was significantly lower than the average observed during the five years of survey. It was similar to 2014, when about 50% of average was observed in the basin. The trajectory of age-0 steelhead in the mainstem of Canton Creek mirrored that of the stream system as a whole. This was not surprising as the mainstem of Canton is by far the largest reach. However, Pass and Upper Canton Creeks did not reflect that pattern. In these two reaches, the population estimates of age-0 steelhead peaked during 2013.

Age-1 Steelhead

The population estimates of age-1 steelhead were between 1,500 and 5,000 fish (Table 2). The largest population was observed in 2011, even though the survey underestimated the number of fish in that year because only about three-quarters of Pass Creek and Upper Canton Creeks were completed. The lowest number of age-1 steelhead was observed in 2016.

The population estimates were also calculated by reach. In the mainstem of Canton Creek, the population estimates of age-1 steelhead were between 800 and 3,600 fish. In 2011, a high population year, the mainstem accounted for about 70% of the total age-1 steelhead in the basin; while 2013, in an average population year, the mainstem accounted for only 35% of the age-1 steelhead in the basin. In 2016, the lowest number of age-1 steelhead were observed in the mainstem. The percentage of age-1 steelhead found in the mainstem in average production years fluctuated greatly among the five years of sampling. No pattern or cause was immediately detected.

The population estimates for the age-1 steelhead in Pass Creek were between 200 and 950 fish. A below average number of age-1 steelhead was observed in Pass Creek in

2016, but the number was not near as low as expected given the very low basin total. Surprisingly, the right fork and left fork of Pass Creek had the highest recorded number of age-1 steelhead observed during the five year of survey. This suggests that age-1 fish either survived well in these tributaries or the fish moved there to escape the high stream temperatures in the summer of 2015. The number of fish in Pass Creek does not correlate well with the total number of fish observed in the Canton Creek basin as a whole. No cause was immediately discernable.

The population estimates of age-1 steelhead in Upper Canton Creek were between 134 and 1050 fish. In 2016, Upper Canton Creek had the lowest number of age-1 steelhead observed during the five years of survey. The correlation between the annual population estimates between Upper Canton Creek and the total annual total number of fish observed in the basin was much higher than that observed in Pass Creek. It is curious that the trajectory of age-1 steelhead is significantly different in Upper Canton Creek and Pass Creeks. These two reaches are of similar location and size within the stream network. In essence, Pass Creek is the left fork of Canton Creek, while Upper Canton is the right fork. This suggests that the factors controlling the number of fish rearing in particular reaches are probably many and complex.

The population estimates of age-1 steelhead in Mellow Moon Creek were between 12 and 200 fish. During 2016, an above average number of age-1 steelhead were observed in Mellow Moon Creek. The correlation between the population of Mellow Moon, a tributary of Pass Creek, and either Pass Creek or the total number of fish observed in the Canton Creek basin was low. No causal explanation was apparent.

In summary, the abundance of age-1 steelhead in the basin as a whole averaged between 2,500 and 2,800 fish in three of the surveys. In the first year of the survey (2011), over 5,000 fish were observed in the basin. Over 3,500 were observed in the mainstem of Canton Creek in 2011. In 2016, about one-half the average were observed in the basin. The only areas with above average counts were the left and right fork of Pass Creek and Mellow Moon Creek. These are all tributaries of Pass Creek. This suggests that the age-1 steelhead had moved into these tributaries to avoid the high stream temperature in 2015.

Age-2 Steelhead

The population estimates for age-2 steelhead were between 268 and 900 fish (Table 3). The largest number of fish was observed in 2011 while the lowest number of fish was observed in 2016. The factors affecting the number of age-2 fish will be discussed in greater detail in the life history analysis section.

The population estimates of age-2 steelhead were also calculated by stream reach. In the mainstem of Canton Creek, the population estimates tracked those of the basin as a whole because the mainstem is the largest and usually dominant section for age-2 steelhead. The population estimates for age-2 steelhead in Upper Canton Creek also largely tracked the trajectory of the basin as a whole. The trajectories of the populations in Pass and Mellow Moon Creeks were opposite the trajectories of the mainstem and Canton Creeks. Again, like age-1 fish, a higher than expected number of age-2 fish was found in the tributaries of Pass Creek. This suggests that these fish moved to these tributaries to avoid the high stream temperatures of 2015 and stayed or returned in 2016, anticipating the same high temperatures.

In summary, the trajectory of age-2 steelhead in the five surveys was highest in 2011, lowest in 2016. The survey estimates in all reaches except Pass Creek and Mellow Moon followed the same pattern. Pass Creek and Mellow moon, a tributary of Pass Creek, had a similar trajectory which was different from that of the other reaches.

Cutthroat Trout

The majority of the cutthroat trout observed in the Canton Creek basin were in the mainstem reach. The trajectory of Cutthroat trout in the Canton Creek watershed was similar to the age-2 steelhead in the basin. They were highest in the 2011 survey and lowest in the 2016 survey and moderate in the other three surveys. Surprisingly, a high number of cutthroat trout were found in the right fork of Pass Creek only during 2016. A similar pattern was observed in age-1 and age-2 steelhead.

Coho and Chinook salmon

In each survey year, less than a thousand coho salmon juveniles were observed in the lower reaches of Canton Creek. Almost all of the coho were observed in side channels connected to pools and away from the major recreational swimming areas. All coho were observed below the falls just below the first bridge crossing over Canton Creek.

Chinook salmon were observed in very low numbers in lower Canton Creek in each of the surveys. Their numbers were so low that reliable population estimates could not be made. No more than 10 juveniles were observed in any one year. All observed chinook were below the first series of falls.

Overview of the salmonids in the basin

The lower ten miles of the mainstem of Canton Creek are the most important reaches for adult cutthroat trout and juvenile coho and chinook salmon. No juvenile coho or chinook salmon juveniles were observed above the third falls, just below the first bridge. Steelhead trout of all ages are distributed throughout the Canton Creek basin.

Life-History Analysis

With three consecutive years of surveys, we can begin a life-history analysis of the steelhead population in the Canton Creek watershed. Each year class of juvenile steelhead is followed through their three years of life in freshwater. For example, steelhead that were age-0 in 2013 were age-1 in 2014, and age-2 in 2015. A life-history analysis looks at the percent survival of each age of steelhead to the next year. As additional year classes are followed through their freshwater cycle, the analysis detects differences in survival in either age-0 to age-1 or from age-1 to age-2. These survival rates can then be compared with differences in environmental factors such as annual peak flows or low-flows. Over a period of time, the life-history analysis combined with adult steelhead counts and streamflow information becomes a powerful tool for determining the trajectory of health of the stream habitat.

The first step in the life-history analysis is to examine the number of age-0 fish in each year (Table 6). During the five years of surveys, the number of age-0 fish averaged between 30,000 and 40,000 fish, except for 2014 when only about one-half of the number of fish were observed in the basin. Table 7 gives the Oregon Department of Fish and Wildlife (ODFW) estimates of the wild summer and winter steelhead adults in the North

Umpqua collected at Winchester Dam. The combined estimates indicate that the total number of adult fish migrating upstream of Winchester Dam was similar from 2011-2016. A low return is probably not the cause of the low number of age-0 steelhead observed in 2014. Next, we will examine the annual stream hydrographs for the water years between 2011 and 2016 to see if there are patterns that correspond to the abundances of steelhead age-0's in the basin.

Having watched steelhead spawn in Oregon streams for over 30 years, I have observed that steelhead spawning is most successful in years when the highest flow of the year occurs around January 1 and is large enough to move gravel sized sediment in the spawning areas, and subsequent storms are not large enough to move significant sediment. The spawning strategy of steelhead appears to be that they move upstream as far as possible during the peak storm of the year. They spawn on new gravel that has just moved and been deposited. When steelhead spawn, they are "betting" that each subsequent storm event and peak flow will be lower than the one that they spawned on. If the storm they move upstream on is not large enough to move significant gravel and clear the fines out of it, survival of the eggs is low. If subsequent storms are large and subsequent stream flows are as high, or higher, than the storm they spawned on, the gravel will be moved and the eggs scoured out with the gravel.

Appendix I presents graphs of the daily streamflow from Steamboat Creek near the confluence with Canton Creek from the water years 2011 through 2015. The water year runs from October 1 through September 30. We will assume that the annual streamflow trends are similar between Canton, the largest tributary of Steamboat Creek, and Steamboat Creek itself.

The annual hydrographs of the water years suggests that the above narrative of steelhead spawning success is correct for Canton Creek. When the stream discharge at the Steamboat Creek gaging station exceeds approximately 10,000 cfs, major movement of gravel will occur in Canton Creek. In 2011, the year with the highest age-0 population in the Canton Creek, the peak flows occurred in January 2011 and exceeded 18,000 cfs. Subsequent storms during the winter never exceeded 5,000 cfs. In 2015, the year with the second highest age-0 population of steelhead had a similar stream flow pattern. The peak flow event occurred in late December and was about 17.000 cfs. Subsequent storm events resulted in peak flows that did not exceed 5,000 cfs.

The age-0 population in Canton Creek in 2014 was about one-half of that observed in the other three years of survey. The analysis of the peak flow and subsequent flows were different than those of the high population years for age-0 fish. First, no storm approaching 10,000 cfs occurred in January. There was one storm with a peak discharge of 3,000 cfs in January and one of 4,000 cfs in early February. Then there were three storms in late February through April of 11,000cfs, and two of 8,000 cfs. There was no large storm that allowed steelhead to move far upstream into small tributary stream with freshly deposited clean gravel in early January. Second, subsequent storms in late February through April were larger than the storm the steelhead spawned on. The first storm was large enough to move gravel-sized sediment. It undoubtedly scoured out many redds. The second two storms moved some gravel but deposited considerable fine sediment in the redds, reducing survival of the fry. As a result, it is likely that the effect of these storms was to significantly reduce the survival of the eggs, either by scouring them out or by suffocating them with fine sediment. The result was that there were about half of the number of age-0 steelhead as observed in the other surveys.

In 2016, like 2014, only about one-half of the average number of age-0 steelhead were observed in the basin. Analysis of the stream flow did not fit the expected pattern. The peak flow was approximately 15,000 cfs in December. In early January, a peak of about 7,000 cfs was experienced in the basin. After that the next few peaks declined from 4,000 to 2,000 cfs. Then in mid-March 2016, there was a peak of approximately 4,000 cfs. It is possible that this higher peak resulted in the scouring of a significant number of redds in the basin.

The magnitude of the effects of these hydrologic events depends on the health of the stream habitat. In the best habitats, sediment movement and storage (fines and gravel) are very patchy. Even with poor hydrologic conditions for spawning, there are patches of clean gravel. Also, in years with very high flows, protected areas create stable clean gravel beds for spawning. Additional discussion of the health of the stream habitat occurs in the restoration section.

The survival rate of each of these populations of age-0 fish to age-1 fish gives us information on the status of the set of stream habitat features that these age-0 to age-1 fish utilize as they grow. There are now two year classes that we can compare the survival rates of age-0 to age-1 steelhead in Canton Creek(2013 and 2014). In 2013, there were 31,500 age-0 steelhead estimated in Canton Creek. The following year, there were 2,523 age-1 steelhead in the basin. This is a survival rate of about 8%. In the following year, there were only 16,281 age-0 steelhead in Canton Creek, but there were 2,820 age-1 steelhead the next year. That is a survival rate of about 17% -- double that of the previous year. In 2015, there were 35,279 age-0 steelhead and in 2016 there were 1,514 age-1 steelhead. This is a survival rate of 4%, -- much lower than the survival rate of the two earlier year classes. This is likely the result of the high stream temperatures in 2015.

This is not a new pattern for steelhead. The number of age-0 fish highly fluctuates from year to year, in this case from 16,000-40,000 fish. However, the number of Age-1 fish has been between 2,500-2,800 in three survey years (Table 6). This suggests that the habitat for age-1 fish in its current state is about 2,500-2,800 fish. In 2016, only about one-half of the normal population number of age-1 steelhead were observed because of the high stream temperatures. Additional healthy habitat would provide greater habitat for age-1 fish and increase the carrying capacity for steelhead in the basin.

We only have two years of analysis that we can examine for the survival of steelhead from age-1 to age 2. The year class 2012 (when they were age-0) had 2526 age-1 fish in 2013 and 624 age-2 fish in 2014. This is a survival rate of 25%. The year class 2013 had 2523 age-1 fish in 2014 and 486 age-2 fish in 2015. This is a survival rate of 19%. It is interesting to note that although there was not a survey in 2012, the 2011 year class was the largest age-0 population that we have observed during the survey period and it resulted in the lowest population of age-2 fish observed during the surveys. In 2016, the survival from age-1 to age steelhead was only 9.5%, about one-half of that observed in the two earlier surveys. As discussed earlier, we have the minimal data to begin to construct a life-history analysis, but with additional surveys, the analysis of survival rates combined with streamflow data should lead to a greater understanding of the dynamics of steelhead in Canton Creek.

Restoration Opportunities

This section remains the same as last year except for the first two paragraphs of comments. The results from the 2016 survey provide additional weight to the recommendations. The summer of 2015, was unusual at it resulted in lower than average survival rates for each year-class of steelhead. In 2016, the distribution of some steelhead was unusual and had not been observed in previous surveys. First, a large number of age-1 and age-2 steelhead and cutthroat trout that were in the basin during the summer of 2015 moved into upper tributaries of Pass Creek during the summer of 2016. This movement was likely a response to the high stream temperature during the previous year.

Second, the number of age-0 steelhead was highest or at least above average in these same Pass Creek tributaries during 2016, a year with about half the number of age-0 steelhead observed in the basin. This suggests that survival rates from redds were above average for the year in those reaches, while they were below average in all other reaches within the basin.

The idealized view of landscape process dynamics is as follows: The cycle begins with a forest fire. The fire reduces the root strength in the soil for about 10 years until the new vegetation growth becomes established. Large storms increase the likelihood of landslides and debris flows (landslides that move down stream channels) in this ten-year window. The result is a large pulse of rocks, sediment, and large wood into the stream systems. This pulse of rocks and large wood is the capital that will build the stream habitats for the next century. Mature Douglas fir logs take over a century to decompose and western red cedar takes over four-hundred years to decompose if they are kept wet. After the fire, the vegetation begins to grow on the hillsides. It takes at least 75 years for the trees to grow big enough to provide the capital (key pieces) for building the stream habitat. So after the fire, the stream rapidly gains the majority of the capital that will build the habitat for over a century. The capital peaks a decade or so after the fire, then it generally declines until the next major fire, unless there is a major storm event of approximately 100-year or greater recurrence interval. These very large storms can bring in substantial material to reset capital for building stream habitat. Meanwhile, the vegetation begins to regrow on the uplands. It starts slow and after 75 years, the trees are large enough to begin to provide large inputs into the stream. The large wood inputs to the stream increase until the next major fire. At that point, they spike and begin a new cycle. The wood capital in the stream is out of sync with the age of the trees on the uplands.

Additionally, in the riparian zones that are less likely to burn, large trees are undercut by the stream or through wind-throw fall into the stream. These large trees can become key pieces that collect and hold large wood, creating a jam.

When a pulse of rock and large wood enters a stream channel, it usually forms a jam where it sets up. This jam creates a temporary dam, storing sediment above it and creating a deep pool below it. Tributary streams and the headwaters of Canton Creek historically would have had a number of these temporary dams storing sediment. The jams would also control the long profile of the stream. When the stream capital is high, the grade of the stream would be controlled by the temporary dams. Most of the stream energy would be dissipated as it drops over the jams. In the mainstem of Canton Creek, only a few temporary dams would be significant enough to remain in place for any period of time. The stream power in the mainstem of Canton Creek is sufficient to move all but the largest trees and jams. These jams and temporary dams create excellent habitat for all ages of steelhead.

Management activities such as road building and timber harvest change the amount and size of the material that enters the stream. Timber harvest, like fire, reduces the root strength of the soil and increases the likelihood of initiating landslides However, there will be little large wood remaining after timber harvest. When the debris flows stop, they create temporary dams, but many of them do not have enough large wood to maintain the dam through the initial storm. When these dams fail, they create what is called "a dam-break flood." The resulting wall of water and debris scours the stream channel for miles before dissipating. These events are among the most destructive phenomena that happen in streams.

In the Canton Creek watershed, timber harvest and road building has had a significant effect on the amount and timing of the inputs of capital to build the stream system. Timber harvest has decreased the amount of large wood capital in the stream system to build the habitat. Also, timber harvest has greatly increased the likelihood of creating a dam-break flood. The road system has also increased the likelihood of catastrophic slope failure if a section of road fails during a storm. The road network can also disrupt the routing of sediment into stream channels.

In the headwater reaches of Canton Creek, there is a variable amount of large wood capital in the streams and portions of the hill-slopes have been harvested. For instance, in the West Fork of Pass Creek, there are several jams that control the gradient in the upper reaches. The frequency of these jams is within the natural variability. In the lower reaches of the west fork, there are a few large key pieces that could serve as the foundational pieces for jams but there are no jams in the lower portion of the reach where jams are controlling the stream gradient. In addition to the hill-slope and road recommendations, large wood could be placed on the key pieces to simulate jams until the vegetation inputs into the stream are large enough to serve as these key pieces.

In these headwater streams, the key management recommendation is to ensure that in areas that are likely to initiate landslides and debris flows, that large trees are established and protected to provide the capital to build the stream habitats when they slide. On federal lands, these areas include the riparian zones of ephemeral and intermittent streams. The second major management action is to ensure that the road network does not generate large magnitude slides or reroute the natural movement of debris flows in the basin. Either through upgrading the road network or decommissioning roads that are not immediately necessary to meet the management objectives will reduce the risk of road generated landslides.

Lastly, fire management should be addressed. Specific goals should be established for fire management within the basin.

In the mid-reaches, including Pass Creek and upper Canton Creeks, the existing capital of large wood in the stream system is very low. There is only one jam that is controlling the gradient in the mid-reaches. It is in upper Canton Creek (see photos).

Many riparian zones in these mid-reaches have large trees that are beginning to fall into the stream. Over time these fallen trees will increase the large wood capital in these reaches. Protection of trees that can reach the stream channels during wind-thrown events is critical, given the lower volume of large wood in the stream reaches. A limited number of large trees could be tipped into the reaches to stimulate jam creation.

In both Pass and upper Canton Creeks, there are a number of unconstrained reaches where the stream is or has been braided over time. These areas provide excellent opportunities for adding large wood to the system. These areas are also the most important areas for protecting trees within the riparian zone.

The lower mainstem of Canton Creek has no large wood gradient control and has limited amounts of large wood within the channels. This reach has high power and all but the largest conifers are immediately broken up and exported downstream. There are very limited opportunities for large wood placement. Also, the lower 4 miles experiences a high volume of recreational use during the summer months. This recreational area coincides with the distribution of coho within the basin. There are limited opportunities to place large wood in side channel and backwater areas to provide critical habitat for coho in lower Canton Creek. The major recommendation is to protect the riparian zone trees and allow them to blow down naturally.

Recommendations for future work:

1) Continue the snorkel surveys for at least 2 more years and continue the life-history analysis of the steelhead populations. This is a powerful analytical tool for understanding the dynamics of steelhead in the basin. The incorporation of the adult counts and stream flow information into the life-history analysis will greatly increase our

understanding of the steelhead populations in the basin. This information will greatly increase the ability to design effective restoration actions within the basin.

2) Complete an analysis of the salmonids in the basin based on densities within habitat units. This information enhances the life-history understanding of the population dynamics within the basin. (First year of analysis will be completed with BLM and Watershed Council funding).

2) Incorporate the fire and flood history of the basin into the understanding of the salmonid population dynamics.

Table 1. Population estimate of Steelhead Age 0 in Canton Creek (2011,2013, 2014, 2015, 2016).

Reach	2011	2013	2014	2015	2016
Mainstem	32,968	15,430	7,433	23,180	11,537
Upper Cant	3,888	5,948	3,247	4,901	1,372
Pass Creek	3,138	9,523	5,089	5,491	4,784
RF Pass Creek		200	131	462	572
LF Pass Creek		165	216	716	498
Mellow Mo	135	233	165	529	207
Total	40,129	31,499	16,281	35,279	18,970

Table2. Population estimate of Steelhead Age 1 in Canton Creek (2011,2013, 2014 and 2015, 2016).

Reach	2011	2013	2014	2015	2016
Mainstem	3,615	892	1,512	1,585	796
Upper Cant	1,059	644	444	685	134
Pass Creek	211	937	518	287	264
RF Pass Creek		6	0	4	118
LF Pass Creek		35	37	31	48
Mellow Mo	197	53	12	228	154
Total	5,082	2,567	2,523	2,820	1,514

Table3. Population estimate of Steelhead Age 2 in Canton Creek (2011,2013, 2014 and 2015, 2016).

Reach	2011	2013	2014	2015	2016
Mainstem	673	113	432	301	96
Upper Cant	173	36	102	146	28
Pass Creek	29	124	84	25	26
RF Pass Creek		0	0	4	50
LF Pass Creek		0	0	0	5
Mellow Mo	69	58	6	10	63
Total	944	331	624	486	268

Table4. Population estimate of Cutthroat in Canton Creek (2011,2013, 2014 and 2015, 2016).

Reach	2011	2013	2014	2015	2016
Mainstem	167	42	165	154	32
Upper Cant	31	35	6	0	0
Pass Creek	107	13	15	0	0
RF Pass Creek		0	0	0	20
LF Pass Creek		0	0	0	0
Mellow Moon		0	6	0	0
Total	305	90	192	154	52

Table5. Population estimate of Coho Salmon in Canton Creek (2011,2013, 2014, and 2015, 2016).

Reach	2011	2013	2014	2015	2016
Mainstem	710	376	416	372	363
Upper Cant	0	0	0	0	0
Pass Creek	0	0	0	0	0
RF Pass Creek		0	0	0	0
LF Pass Creek		0	0	0	0
Mellow Moon		0	0	0	0
Total	710	376	416	372	363

Table 7. Number of Wild Adult Steelhead Passing Winchester Dam, North Umpqua, Oregon (2010-present)

Year	Winter	Summer	Total
2011	9589	5415	15004
2012	13788	6597	20385
2013	12479	6347	18826
2014	10605	3885	14490
2015	11266	2,979*	14245
2016	12,499*		

* indicates partial count- 200 days of survey.

Table 6. Life history analysis for Steelhead Trout in Canton Creek, Oregon.

	2011	2012	2013	2014	2015	2016
Age-0	40129		31499	16281	35279	18970
Age-1		2526	2523	2820	1514	
Age-2	331	624	486	268		

Table 7. Number of Wild Adult Steelhead Passing Winchester Dam, North Umpqua, Oregon (2010-present)

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