Yakima/Klickitat Fisheries Project

Klickitat Only Monitoring and Evaluation

Annual Report
2003 - 2004

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YAKIMA/KLICKITAT FISHERIES PROJECT
KLICKITAT ONLY

Monitoring and Evaluation
Annual Report 2003
April 1, 2003—April 30, 2004

Project No. 199506335

The Confederated Tribes and Bands of
The Yakama Nation

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YAKIMA/KLICKITAT FISHERIES PROJECT
KLICKITAT ONLY

Monitoring and Evaluation 2003 Annual Report

Preface

The monitoring and evaluation activities described in this report were determined by consensus of the scientists from the Yakama Nation (YN). Klickitat Subbasin Monitoring and Evaluation (M&E) activities have been subjected to scientific and technical review by members of YKFP's Science/Technical Advisory Committee (STAC) as part of the YKFP's overall M&E proposal. Yakama Nation YKFP project biologists have transformed the conceptual design into the tasks described.

This report summarizes progress and results for the following major categories of YN-managed tasks under this contract:

1. **Monitoring and Evaluation**: Develop methods of detecting indices of assesing existing natural production, as well as methods of detecting a realized increase in natural production, with specified statistical power.
2. **EDT Modeling**: Identify preferred enhancement options with respect to habitat and artificial propagation using the EDT model with applicable TFW protocols and/or other scientific methods where appropriate.
3. **Ecological Interactions**: In order to determine if supplementation increases the incidence of pathogens, we will establish a baseline data set describing existing levels of pathogens in wild resident trout and naturally produced steelhead, chinook and coho.

1. Monitoring & Evaluation

Overall Objective: Develop methods to assess existing natural production, as well as methods to statistically detect an increase in natural production.

Task 1.a Klickitat juvenile salmonid population surveys

Objective: To determine the spatial distribution/relative abundance of salmonids throughout the Klickitat Basin.

Rationale: Winter habitat utilization is of particular interest in the Klickitat watershed due to the relatively cold temperatures and potential of anchor ice occurring within higher elevation segments of the mainstem and tributaries.

Planned Methods:

Conduct summer and winter snorkel and electro-fishing surveys in three mainstem reaches:

- McCormick Meadows to Castile Falls
- Castile Falls to the WDFW Klickitat Salmon Hatchery (summer only)
- WDFW Klickitat Salmon Hatchery to Lyle Falls.

Snorkel surveys will be direct fish counts; electro-fishing surveys will use catch per unit effort to estimate relative abundance.

Conduct summer and winter electro-fishing surveys in selected reaches of the key tributaries to the Klickitat River. Use depletion estimates to determine absolute abundance.

We will begin by identifying river segments containing potential over-winter habitat, then evaluate our ability to enumerate by species in those segments. In the event all aspects progress as hoped, systematic and comprehensive surveys of the chosen segments will commence. Clear water will be essential for success.

Results:

Mainstem

A lower river (RM 12.5) snorkel survey was conducted on 6/24/03. The survey was preliminary in nature and carried out to take advantage of unusually clear water conditions. A number of problems were encountered; limited visibility being the most significant. Though water clarity appeared excellent from above the water surface we found visibility limited to approximately 4 feet while snorkeling, primarily due to suspended fine sediments. This limitation made identification of juvenile salmonids to species highly uncertain at distances greater than 3 feet.

Snorkel surveys in the lower mainstem Klickitat are problematic. Swift current makes upstream movement nearly impossible, except along shallow shorelines. The current also makes snorkeling downstream difficult. Excessive speed does not provide adequate time for complete coverage of assigned snorkeling lanes.

Tributaries

Electro-fishing surveys were completed in Bear, Summit, Tepee, Trout and White Creeks. We employed a depletion methodology utilizing two or three passes on multiple 100-meter

segments within each of the streams. Population densities are presented on a fish/linear meter basis in Appendix A.

The Tepee and White Creek sites were done in conjunction with the TFW (Timber, Fish, & Wildlife) Habitat surveys (see task 1.i below) and the Bear, Summit and Trout Creek surveys were done in conjunction with a separate study. *O. mykiss* (steelhead/rainbow trout) were the only species found in all tributaries with the exception of Summit Cr. where *S. fontinalis* (brook trout) were also found.

Less comprehensive "spot" electro-fishing surveys were undertaken in the mainstem above Castile Falls, the Diamond Fork (also above Castile Falls) and Outlet Creek. These were preliminary surveys designed to provide information with respect to planning future abundance and distribution surveys. Surveys in the mainstem Klickitat above Castile Falls identified *O. mykiss*, *O. tshawytscha* (chinook), and *S. fontinalis* (brook trout).

Task 1.b Klickitat mobile juvenile monitoring sites

Objective: To determine the feasibility of using rotary traps to monitor long-term juvenile salmonid out-migrants in the upper and lower Klickitat River.

Planned Methods:

- Fish rotary traps located at the WDFW Klickitat Hatchery and near RM 2.5 in the mainstem river on a year-round basis. A rotary trap located above Castile Falls will be fished seasonally between May and November.
- Conduct calibration studies at each trap to determine the feasibility of establishing a fish-entrainment-to-river-discharge relationship, as well as the feasibility to operate the traps on a year-round basis. Calibration efforts will use linear regression to describe discharge/entrainment relationships.

Protocols require obtaining environmental and trap data along with bio-data on 10 to 30 of each salmonid species represented. The excess and non-salmonid fish are tallied by species. Bio-data consists of fork lengths, weights and smoltification stage. Record environmental and trap data including weather conditions, water temperature and clarity, trap revolution speed, and debris load.

Results: Three rotary screw-traps were fished during the 2003 fiscal year. The five-foot trap fished above Castile Falls was relocated closer to the falls where river morphology is more conducive to flow/entrainment evaluation. The five-foot trap located at the Klickitat Hatchery (RM 42) was fished throughout most of the year as was the eight-foot Lyle Falls trap fished at RM 2.5.

Developing flow/entrainment relationships for the three traps is our goal. The ideal screw trap location maximizes the volume of water sampled. This normally requires a constricted or narrowed channel with a well-defined thalweg and increased water velocities. Suitable morphology is prerequisite to establishing a consistent flow/entrainment relationship. Preliminary results at the new Lyle Falls and Castile Falls sites are encouraging and testing will continue. Identifying and testing a more suitable site for the hatchery trap is planned in the near future. The catch of each trap is summarized on a monthly basis and presented in

Appendix B.

Traps are discussed individually in the following narrative.

Upper Trap

Our search for a more suitable site for the upper trap caused a significant delay in deployment. The new site was identified and the trap deployed on August 4, 2003. The site is immediately upstream of the fish ladder exit at Castile Falls. We believe channel characteristics at this site are suitable for establishing a flow/entrainment relationship. Initial trap efficiency testing was done on 12 August, 13 August and 5 September, 2003. Fish utilized for the testing were hatchery origin spring chinook released above Castile Falls.

The upper trap was operated through Oct. 9, 2003 and initial calibration tests were accomplished with promising results. The trap caught predominantly rainbow/steelhead (*O. mykiss*) and spring chinook (*O. tshawytscha*) fry/parr along with a single brook trout (*S. fontinalis*). The chinook fry/parr observed resulted from a hatchery "thinning" release done in May 2003, or were progeny of hatchery adults that were transported and released above Castile Falls.

Hatchery Trap

The hatchery trap responsibilities were transferred to hatchery personnel (fish culturist) on July 28, 2003. Unusually high suspended fine sediment loads in the Klickitat River in October resulted in the loss of approximately 6 weeks of fishing time. Unusually cold weather in January accounted for another 4 weeks of lost fishing time.

This trap catches predominantly rainbow/steelhead (*O. mykiss*), spring chinook (*O. tshawytscha*) and coho (*O. kisutch*). Non-target species frequently caught in the trap include dace (*Rhinichthys spp.*), suckers (*Catostomus spp.*), ammocoetes (larvae of lamprey, *Lampetra spp.*), whitefish (*Prosopium spp.*) and sculpin (*Cottus spp.*).

Since very few fall chinook spawn above the hatchery, we generally consider chinook captured by the trap to be spring chinook. Distinguishing between spring and fall chinook juveniles is problematic. Timing of emergence, and therefore size, is an indicator but alone is not sufficient for positive identification. Therefore we do not attempt to distinguish between the two, except when known hatchery releases have occurred and the fish are marked accordingly. We are able to estimate a probability based on the number of spring chinook redds upstream of the hatchery compared to those of fall chinook. As an example, our spring chinook redd counts above the hatchery for 2001 and 2002 were 121 and 389 respectively; the fall chinook redd counts were zero and 3, respectively. Barring any upstream movement of progeny, we would not expect any fall chinook in the trap from the 2001 brood year, while up to 1% of the catch from the 2002 brood year could be fall chinook. Since this is entirely theoretical, we have not attempted to make any such estimate within Appendix B.

Lyle Falls Trap

The Lyle Falls trap is the only eight-foot trap used on the Klickitat. Because of its location, this trap samples all anadromous species that use the Klickitat watershed. Non-target species frequently caught in the trap include ammocoetes (larvae of lamprey, *Lampetra spp.*), dace

(*Rhinichthys spp.*), redside shiners (*R. balteatus*) sculpin (*Cottus spp.*), suckers (*Catostomus spp.*), and whitefish (*Prosopium spp.*)

The trap has the potential to provide valuable information regarding outmigration timing and abundance. Since deployment at the new site (RM 2.5) on August 7, 2002, we have accomplished numerous mark-recapture entrainment evaluations with excellent results. The new site offers a narrowed channel and increased flow velocities.

Many adjustments have been necessary and problems encountered. Recurring problems with the debris wheel mechanism reduced trap fishing time. When either the live-box or cone are filled with debris or the cone mesh is plugged with algae the water flow-through is reduced, this causes the rear of the trap to sink forcing the live-box lid open and potentially releasing any fish trapped in the live-box. The trap spent 5 weeks awaiting repairs in October and the early November. Heavy snowfall in late December and unusually cold temperatures throughout January and into February made it impossible to fish the trap. Additionally, in late March the trap was severely damaged by floating debris and due to its overall "well worn" condition we replaced it. The replacement trap was obtained at no cost. Significant modifications to the trap were implemented to increase the structural integrity and reduce the safety risks to crew members. These modifications included replacing the original "A" frame cone support with a large and overhead "H" frame support system, replacing the aluminum cross-members with steel units, installing a chain hoist for cone raising/lowering, modifying 3 pairs of pontoons so they can be used as a set and installing safety rails on the sides. These modifications should extend the useful life of the trap and increase crew safety.

Initial flow/entrainment calibration studies have been conducted with very encouraging results. Studies were initiated in April, 2003 and have continued through the end of the current FY2003 reporting period. We have completed 14 individual mark-recapture studies as of the close of this reporting period. Hatchery origin coho, spring chinook and steelhead were used for these studies. Statistical analysis utilizing linear regression was used to evaluate recapture rates at various river discharges. Results indicate chinook and coho entrainment rates are very similar while recapture rates of steelhead are significantly lower. We believe the difference is based on size and swimming ability at outmigration. Hatchery steelhead (Skamania stock) are significantly larger than hatchery salmon at release. For example, the 2004 Skamania steelhead were released at 5.2/pound while the hatchery spring chinook and coho were 13/pound and 14.9/pound, respectively. Sampling results are presented in Appendix B. Though results as of this writing are encouraging, our testing has been limited to a narrow range of flows corresponding to hatchery release timing. Additional testing at higher (> 2400 cfs) and lower (< 1400 and > 700 cfs) flows is needed. Flow/entrainment studies will be an ongoing activity of the monitoring and evaluation project.

Task 1.c Spawning ground surveys (redd counts)

Objectives:

- To enumerate the temporal and spatial distribution of redd deposition in the Klickitat basin for spring chinook, fall chinook, coho and steelhead.

- To collect biological information from carcasses.

Planned Methods:

- Conduct regular foot and/or boat surveys within the established geographic range for each species.
- Individually mark redds during each survey.
- Sample carcasses to determine egg retention, sex, and body length; to collect scale samples; and to check for possible experimental marks.

Results: Spawner surveys results are briefly discussed by species below. We began utilizing hand-held GPS (Global Positioning System) units during this reporting period to document individual redd locations. This will provide a basis for detailed monitoring and evaluation in the future while also providing the capacity for GIS analysis and the production of detailed presentationquality mapping products. The GPS data will also be stored within our database making it available for long-term trend analysis which we view as a critical component of our monitoring and evaluation obligation.

A summary of spawning ground survey results by species is presented in Appendix C.

Spring Chinook

Spring chinook surveys were conducted between August 19 and October 6, 2003. Klickitat spring chinook are mainstem spawners. The large majority of redds were found between Castile Falls and the WDFW hatchery. This 22-mile segment contained 148 (88.6%) of the 167 redds identified below Castile Falls. The remaining 11.4% were located between the hatchery and the Summit Creek confluence.

Excess adults returning to the hatchery were transported above Castile Falls to spawn naturally and seed the habitat and rebuild a naturally spawning population above the falls. The fish transported included 440 females, 122 adult males and 98 jacks, for a total of 660 fish. These fish accounted for 165 redds, or 49.7%, of the combined spring chinook redd count for 2003.

Fall Chinook

Unusually high and prolonged suspended fine sediments in the Klickitat River starting in late October greatly limited fall chinook spawner surveys. The sediment flows were most likely a result of warm temperatures and rain events on glaciated eastern slopes of Mt. Adams; glacial runoff mobilized deposits of previous debris flows into Big Muddy Cr. and the Klickitat River. Observers at the Klickitat Hatchery described the river as “flowing quicksand” on 10/20/03. The sand settled out within a week but fine sediment remained mobilized for approximately four weeks. We were unable to carry out our normal fall chinook and coho spawner surveys during this time. Visibility on 10/20/03 was <1” but slowly improved to approximately 18” by 11/5/03. Multiple reports of dead and dying fish in the vicinity of Leidl Campground were received and investigated. We were able to verify significant mortality but, due to the depth of sediment and poor visibility, were unable to quantify the loss. Many fish were completely buried in fine sediment and could not be seen. The fine sediment impacted water clarity well into January, 2004.

We normally begin fall chinook spawner surveys in mid October but, due to the unusually

high turbidity, were unable to begin surveys until November and turbidity did remain a problem. Fall chinook spawner surveys were conducted between November 5 and December 17, 2003. A total of 474 redds were identified. It seems likely that a significant proportion of the eggs deposited below the Big Muddy confluence prior to the 10/20/03 event were lost due to the high sediment levels. Fall chinook are mainstem spawners and generally utilize the lower river. The highest redd densities were found in the 2.9 miles from Liedl Bridge downstream to Stinson Flats. This segment contained 190 or 40% of the total, a redd density of 65.5 per mile. Fall chinook were found spawning from the Klickitat Hatchery down nearly to Lyle Falls, a total of 40.1 river miles; the average redd density was 11.8 per mile.

Coho

Coho spawner surveys are generally conducted in conjunction with late fall chinook spawner surveys and were therefore also impacted by the sediment introduction noted above. Coho spawner surveys were conducted from November 5 through February 24, 2003. Coho spawning occurs in the lower reaches of most lower river tributaries as well as the mainstem below Parrot's Crossing (RM 49.4). Most spawning occurs between the WDFW hatchery and Beeks Canyon. This 18-mile segment contained 100 (89%) of the total redd count of 112.

Coho seem to have more of a problem passing Lyle Falls than chinook or steelhead. In recent years we have observed extremely high densities of fish at the mouth of Silva and Canyon Creeks which are both less than a mile below Lyle Falls. Even though neither of these tributaries are suitable for spawning, the fish congregate by the hundreds at their confluences.

Steelhead

Steelhead spawner surveys commenced on February 10, 2003 (FY2002) and were completed on June 2, 2003 (FY2003). Surveys for FY2004 also began during this annual reporting period but will be presented in the FY2004 annual report.

The total steelhead redd count for the entire Klickitat watershed to date is 290 which represents the highest count ever recorded for the watershed. Since significant additional effort and many more miles have been surveyed in the past two years these results are not comparable to years prior to FY2002 without some adjustments for survey coverage. The previous high of 261 was documented in FY 2002 (spring of 2003).

Of the 290 redds observed, 94 (32%) were found in the mainstem; the remaining 196 (68%) were in tributaries. The White Creek drainage (RM 39.6), including Brush and Teepee creeks, accounted for 113 (39%) of the Klickitat total and 57.7% of the tributary total. Additionly, Swale Creek added another 22 or 7.6% of the Klickitat total and 11.2% of the tributary total. These two tributaries alone account for over 47% of the entire redd count for the Klickitat system. See Appendix B for spawner survey results.

Our coverage was not entirely complete. Private landownership and trespass issues limited our coverage in the Little Klickitat drainage. The Little Klickitat is the largest tributary and is thought to be significant in terms of steelhead spawning. Permission to survey the Little Klickitat from the falls at RM 6.1 to the mouth was sought but denied. We were able to survey the 1.2 miles from the Bowman Cr. confluence to the mouth and observed eight redds in three passes.

High spring flows, turbidity, and vastness limit the effectiveness of the mainstem surveys. We believe there is an unavoidable bias toward undercounting in the mainstem.

Task 1.d Scale analysis

Objective: To determine age and stock composition of juvenile and adult salmonid stocks in the Klickitat basin.

Planned Methods:

- Use scale analysis to estimate the proportion of hatchery and wild smolts in the estimated smolt outmigration for unmarked fall chinook.
- Estimates of the proportion of hatchery and wild adult carcasses collected will be applied to estimate adult returns by age.

Results: Scale samples were obtained from adult chinook (*O. tshawytscha*) and coho (*O. kisutch*) carcasses. Because of the previously noted sediment inputs in late October our scale sampling was reduced dramatically. Many carcasses were buried under inches of fine sediment making them difficult for the survey crews to identify. The samples that were obtained have been processed and ages determined. Appendix D presents the age breakdown with accompanying fork length ranges and elementary statistics for each species sampled.

Chinook

Scale samples were obtained from adult chinook carcasses during spawner surveys. We differentiate spring and fall chinook by age at outmigration. The spring chinook samples consisted of 61% female and 39% male of which 81.5% were unmarked (possibly wild) and 18.5% were of hatchery origin. Only four and five year olds were represented in our sampling, the female breakdown was 64% four and 36% five year olds. The males consisted of 44% four and 56% five year olds.

The fall chinook samples consisted of 52% female and 48% male of which 60% were unmarked (possibly wild) and 40% were of hatchery origin. Some variation between sexes was found: males ranged from 2-year-old jacks to 5-year-olds, and females from 3- to 5-year-olds. Eighty percent of the females were 4-year-olds, another 17 percent were 5 years old, and 3% were 3-year-olds. Males were predominantly 5 years old (43%), but 3- and 4-year-olds were well represented, at 14% and 41% respectively, one 2-year old jack was also included in the sample.

Coho

Scale samples were obtained from adult coho carcasses during spawner surveys. The coho spawning was very limited as were the available carcasses. The samples included 11 scale sets that were readable but only 9 were sexed. The breakdown was 3 females and 6 males, 33% and 67% respectively. Seven were unmarked (possibly wild) and 4 were of hatchery origin. All fish were 3-year-olds. The median fork length was 59 cm. for the males and 73 cm. for the females, a notable difference. The small sample size does not justify drawing any conclusions with respect to fork length of the fish that spawned in the Klickitat.

Task 1.e Klickitat Hatchery Rotary Screw Trap Operation by Fish Culturists.

Rationale: Monitor juvenile salmonid outmigrants and from both natural and artificial production sources. Information generated from the Hatchery rotary screw trap (RM 42.2) will be used to generate natural production estimates, and provide information of future artificial production strategies.

Planned Methods: The experienced Fish Culturists duty stationed at the Klickitat Hatchery (82% of their total funding is non-BPA contract) will provide support to operate, maintain, and collect biodata from fish collected in the hatchery rotary screw trap. Information collected will be incorporation into the M&E database. The use of culturist is needed to facilitate an efficient use of M&E staff time, as this individual is on station, and can perform the required duties more efficiently. Note: The bulk of the salary comes from a non-BPA funding source.

The hatchery screw trap is located on the property of the WDFW Klickitat Hatchery near Glenwood, WA. This trap is operated throughout the year and requires daily checking during outmigration and high water periods. Outside these periods the trap is checked on a 48 hour basis. With efforts to maximize data gathering, re-deployment of the trap in the immediate area will be necessary. A more suitable site with proper river morphology (critical to trap calibration) has been identified ~200 meters downriver from its current location. Ideal river morphology includes a confined/narrowed channel with a well defined thalweg and relatively high water velocities. High velocities have the probability for increased debris, resulting in trap damage. Increased vigilance at the site will be provided by the on-site personnel.

Results: Please see Task 1.b above (Klickitat Mobile Juvenile Monitoring Sites) for discussion of results. Data is summarized and presented below in Appendix B.

Task 1.f Sediment impacts on habitat

Objective: To monitor stream sediment loads associated with anthropogenic factors (e.g., logging, agriculture and road building.

Rationale: Excessive stream sediment loads can play a critical role in egg-to-fry survival, and can depress survival and productivity of many other life stages of salmonids. Sediment surveys provide quantitative information to incorporate into various watershed and land-use planning processes in the subbasin.

Planned Methods: Representative gravel samples will be collected from throughout the basin, using TFW Salmonid Spawning Gravel Composition Survey methodology. Each sample will be analyzed to estimate the percentage of fines or small particles present (particles <1.00 mm and particles <0.85 mm). These impacts would be incorporated in analyses of impacts of "extrinsic" factors on natural production.

Results: A total of 11 sites in Diamond Fork Creek and the Klickitat River were sampled during 2003. Data from sediment monitoring (along with river mile for each sampling site) is presented in Appendix E. To develop long-term trend data, continued annual sampling should be conducted at these sites as well as other sites previously sampled.

Some general observations can be made from the existing data. Many of the sites, including Diamond Fork Top of Meadows, Diamond Fork Confluence, Klickitat R. Elkhorn, Klickitat R. Cow Camp, and Klickitat R. Leidl, have shown fairly steady decreases in fine sediment levels since 1999 or 2000. This may be due to somewhat improved timber harvest and road management in parts of the watershed (relative to past practices). A 4- to 5-year flood event in January of 2002 may have also mobilized fine sediments out of some sampling reaches, and the effects of this may still be exhibited in some 2003 samples.

One site, Diamond Fork Bottom of Meadows, has shown a fairly steady increase in fine sediments since sampling began in 2001. Although more sampling years (both before 2001 and after 2003) would be necessary to increase certainty, there appears to be localized bank erosion and fine sediment deposition in the meadows. Effects on streambanks, channel morphology, and meadow condition from past grazing and road use practices that may be associated with this are being addressed in a restoration project administered under the Klickitat Watershed Enhancement Project.

Several other sites, including Klickitat R. Parrots Crossing reach, Klickitat R. downstream of White Cr., Klickitat R. downstream of Little Klickitat R., and Klickitat R. downstream of Swale Cr., have exhibited year-to-year variation in fine sediment levels with no strong trends readily apparent.

Task 1.g Klickitat fish passage obstruction inventory assessment

Objectives:

- To locate and describe existing salmonid fish migration barriers in the Klickitat basin.
- To better describe both existing and future anadromous distribution for EDT modeling purposes.

Rationale: Fish passage barriers occur in numerous forms from man-made structures such as dams and road culverts to natural barriers including waterfalls, bedrock chutes, cascades, debris jams, or even beaver dams. The most significant barriers within the Klickitat watershed are culverts, dams, waterfalls, bedrock chutes, and cascades. Fish passage barrier assessment work is critical to delineating the extent of anadromy within the Klickitat watershed and therefore necessary as a monitoring and evaluation function within the YKFP.

Planned Method:

- Gather existing data that has been collected in past years by YN Fisheries staff and other agencies (e.g., Dept. of Transportation, WDFW).
- Conduct field surveys using WDFW's *Fish Passage Barrier Assessment and Prioritization Protocol* to locate and assess both natural and artificial passage problems not identified through existing reports, etc. Barrier survey included this year will look at both natural and artificial barriers with an eye toward defining boundaries to anadromy.
- Classify all barriers as "passable" or "impassable" along with any conditions under

which the classifications apply.

The WDFW *Fish Passage Barrier Assessment and Prioritization Manual* identifies two levels of evaluation. Level A determines if the culvert is a barrier or non-barrier. If a Level A evaluation is inconclusive, a Level B analysis is required. Level B analysis requires collecting physical data sufficient for hydraulic modeling.

Results: FY2003 efforts concentrated on identifying and documenting additional artificial barriers and adding them to our database. Most of the work in 2003 concentrated on locating and classifying culverts.

To date we have inventoried a total of 82 culverts at 68 locations within the watershed. During 2003, 21 culverts at 20 locations were surveyed. Level A evaluation has been attempted on all sites, although errors and quality control issues indicate that some of these sites will need to be revisited. Seven of the culverts (at 7 different locations) surveyed in 2003 are barriers to fish passage; one is known not to be a barrier. The others require Level B analysis and barrier status is not known at this time. Most of the culverts surveyed in 2003 were in the White Creek watershed, and most culverts were on small intermittent tributary streams. One culvert surveyed on the upper mainstem of White Creek was determined to be a barrier due to slope; this is likely the only culvert surveyed in 2003 that has major significance to anadromous fish populations (primarily steelhead). Other culverts on smaller streams may only affect resident trout populations; however, juvenile steelhead may utilize rearing habitat in some small tributary streams and further evaluation is necessary to determine significance of some barrier culverts.

Task 1.h Klickitat water quality inventory

Objective: Record water quality measurements on selected tributaries and within selected habitat survey reaches on a seasonal basis.

Rationale: The relationship of water temperature to dissolved oxygen (DO) is a critical factor within the Klickitat watershed. Many of the significant steelhead spawning and rearing tributaries are subject to excessive warming or even dewatering during the summer. There is an inverse relationship between water temperature and DO; as water temperature increases DO decreases. According to research published by the U.S. Army Corps of Engineers (USACE), the upper lethal temperature boundary for steelhead/rainbow is 75^{o}F (23.9^{o}C). Additionally, due to increased metabolic rates, growth ceases in all cold water species at temperatures exceeding 68^{o}F (20 ^{o}C) (Bell, 1990).

Methodology: Thermographs were deployed to measure and record water temperatures. Mean daily water temperatures will be monitored on an annual basis for several key tributaries and mainstem sites using Hobo and Onset thermographs.

Results: Water temperature monitoring was conducted at 36 locations on 20 tributaries and the Klickitat mainstem during FY2003. The tributaries sampled included Bear, Bowman, Butte Meadows, Clearwater, Diamond Fork, Dillacorte, Fish Lake Stream, Little Klickitat, Logging Camp, McCreedy, Outlet, Piscoe, Snyder, Summit, Surveyors, Swale, Trappers, Trout, West Fork and White creeks. Thermographs were also placed at five locations on the mainstem between RM 6 and RM 80. Air temperature was also monitored at five key

locations within the watershed

The water temperature problem is more prevalent in the lower basin, from White Creek downstream. Warm temperatures and associated reductions in dissolved oxygen, along with dewatering, are responsible for significant losses of juvenile steelhead. We have observed stranding and subsequent desiccation in a number of tributaries. Considerable losses occur annually in White, Tepee, Brush, Dead Canyon, Swale, and Dillacort creeks as a result of dewatering and/or warming of refugia pools.

The temperature data are summarized in Appendix F.

Reference:

Bell, M. 1990. Fisheries Handbook of Engineering Requirements and Biological Criteria. Fish Passage Development and Evaluation Program, U.S. Army Corps of Engineers, North Pacific Division, Portland, Oregon.

Task 1.i Klickitat habitat inventories

Objective: The near-term objective is to collect baseline data on existing habitat conditions, fish populations, and passage conditions throughout the basin.

Rationale: This information will be used to refine the Ecosystem Diagnosis and Treatment (EDT) model, which will guide decisions about future habitat restoration and hatchery supplementation projects as well as mainstem and tributary passage improvements. Habitat inventories also provide quantitative information to incorporate into various watershed and land-use planning processes in the subbasin.

Planned Methods: The habitat inventories will be conducted using the TFW methodology (modules: Stream Segment Identification, Reference Point Survey, Habitat Unit Survey, Wadable Stream Discharge, and Large Woody Debris Survey). Data gathered will be included in the relational database currently under development and will be used for comparative purposes and trend analysis. Comparisons can be made between sites; in the future as sites previously surveyed are revisited temporal changes can be analyzed at a given site.

Results: During the 2003 field season, habitat inventories were conducted at 6 stream sites: Diamond Fork Creek, White Creek (2 sites), Tepee Creek (2 sites), and East Fork Tepee Creek. This was the first visit to these sites; these sites were chosen because of importance to steelhead spawning and rearing and to document conditions prior to potential upcoming restoration work (White, Tepee, and East Fork Tepee), and to provide monitoring information useful to an ongoing meadow restoration project (Diamond Fork). Some data from these inventories has been entered into the relational database; due to slightly different TFW methodology that was utilized for the 2003 surveys, Large Woody Debris survey data has not been entered yet and will require additional database development. Considerable assistance with database development, data management, and site selection has been received from Klickitat Watershed Enhancement Project personnel and YKFP Database Management personnel. Past developments in the database proved extremely useful in 2003 – quantitative data on large woody debris in Klickitat basin streams was incorporated into Yakama Reservation Forest Management Plan stream protection guidelines.

2. EDT Modeling

Overall Objective: Identify preferred enhancement options with respect to habitat and artificial propagation using the EDT model, applicable TFW protocols, and/or other scientific methods where appropriate.

Task 2.a Klickitat habitat and production assessment

Objective: To estimate potential benefits from habitat restoration and artificial production scenarios using the EDT model.

Rationale: The EDT model is being developed to be the primary focus for the Klickitat Subbasin Plan, and a component of the habitat section of the Klickitat Subbasin Master Plan.

Planned Methods:

- Apply the EDT model on habitat improvement strategies and artificial propagation/supplementation options for chinook, coho and steelhead.
- Incorporate existing data into relational database (ACCESS) and identify additional data needs to refine and bolster output.
- Generate alternatives designed to maximize potential fishery benefits regarding habitat, passage and artificial production options.

Results:

The EDT modeler completed the population of the EDT model and developed restoration and preservation model runs for inclusion into the Klickitat Subbasin Plan, Klickitat Subbasin Anadromous Fishery Master Plan, and to prioritize habitat restoration actions for the Klickitat Watershed Enhancement Project, as well as develop project proposals for the Washington State Salmon Recovery Funding Board effort. A chronology of accomplishments for 2003/2004 is presented in bullet form below, with the Klickitat River steelhead and spring chinook EDT restoration potential results presented in Appendix G.

- Compilation of existing scientific data in Klickitat basin for level 2 data inputs
- Finalized appropriate reach segments and reach breaks for model based on physical geomorphic characteristics
- Analyzed existing USGS stream gauging information for subbasins and created annual flow patterns for several level 2 attributes
- Populated channel morphometry dimensions for several subbasins in model
- Conducted several field surveys for data acquisition and basin-wide familiarization
- Completion of data acquisition and populating of patient attributes
- Completion of data inputs for template conditions and design
- Completion of consumer output reports depicting restoration and preservation

potential reach by reach, and construction of scenario generator that will analyze the following in the coming year:

1. Possible benefits of habitat restoration modeled through scenario generator
2. Benefits of supplementation spatially modeled through out the basin

3. Ecological Interactions

Task 3.a Pathogen sampling

Rationale: This work will help determine if supplementation increases the incidence of pathogens.

Objective: Establish a baseline data set describing existing levels of pathogens in wild resident trout and naturally produced chinook and coho.

Planned Method: Yakama Nation field crews will collect approximately 50 resident rainbow trout, 50 brook trout, 50 chinook and 50 coho smolts and pre-smolts throughout the Klickitat Basin. They will examine the fish for pathogens, using standard protocols at the USFWS Fish Health Laboratory, to identify fish pathogens present in the Klickitat Basin. USFWS will conduct analysis at no cost, per federal Wild Fish Study procedures and guidelines.

Results: Pathogen sampling was conducted in October of 2002 and November of 2003 Because we were unable to acquire sufficient samples during FY2002 additional sampling was necessary for FY2003. The 2003 sampling was done in the mainstem Klickitat above Castile Falls at mile marker 27. Tributary sampling was done in Diamond Fork and Outlet Creeks. Mr. Kenneth Lujan, a microbiologist with the USFWS Lower Columbia River Fish Health Center, accompanied us during all sampling and was responsible for the lab work and analysis. A table with all positive results is presented in Appendix F along with an explanatory statement written by Mr. Lujan.

RS (*Renibacterium salmoninarum*), the disease agent for Bacterial Kidney Disease (BKD), was found in most samples; most other tests were negative. We extend our gratitude to Mr. Lujan and the Lower Columbia River Fish Health Center for their assistance and expertise.

4. Appendices

Appendix A. Juvenile Salmonid Population Surveys.

Tributary Electro-Fishing Salmonid Population Estimates – 2003

Stream	Date	Site ID	Sample Length	# Passes	Pop. Est.	95% Conf. Range	Density (Fish/linear m.)
Bear	14-Oct	low 1	100 m.	3	28	27 - 41	0.28
Bear	15-Oct	low 2	100 m.	3	33	23 - 114	0.33
Bear	14-Oct	low 3	100 m.	3	31	29 - 47	0.31
Bear	27-Oct	high 1	100 m.	3	39	37 - 53	0.39
Bear	20-Oct	high 2	100 m.	2	40	30 - 106	0.40
Bear	20-Oct	high 3	100 m.	2	34	32 - 48	0.34
Summit	9-Oct	low 1	100 m.	3	70	63 - 97	0.70
Summit	8-Oct	low 2	100 m.	3	114	107 - 135	1.14
Summit	8-Oct	low 3	100 m.	3	190	153 - 284	1.90
Summit	13-Oct	high 1	100 m.	3	122	116 - 141	1.22
Summit	10-Oct	high 2	100 m.	3	113	108 - 129	1.13
Summit	9-Oct	high 3	100 m.	2	127	107 - 192	1.27
Tepee	24-Jun	TFW #1	100 m.	3	28	28 - 28	0.28
Tepee	26-Jun	TFW #2	101 m.	3	106	78 - 215	1.06
Trout	25-Sep	low 1	100 m.	3	155	150 - 169	1.55
Trout	29-Sep	low 2	100 m.	2	99	95 - 117	0.99
Trout	30-Sep	low 3	100 m.	2	138	134 - 151	1.38
Trout	10-Oct	high 1	100 m.	3	77	68 - 108	0.77
Trout	2-Oct	high 2	100 m.	3	74	71 - 87	0.74
Trout	7-Oct	high 3	100 m.	3	88	84 - 102	0.88
White	19-Jul	TFW #5	100 m.	3	85	85 - 92	0.85

Note: O. mykiss predominant in all streams, S. fontinalis present in Summit Cr. only

Appendix B. Mobile Juvenile Monitoring Sites (Screw Traps)

Upper Trap - FY2003				
Catch by Month				
Month	Rainbow/ Steelhead	Spring Chinook	Brook Trout	Monthly Totals
January	n/a	n/a	n/a	n/a
February	n/a	n/a	n/a	n/a
March	n/a	n/a	n/a	n/a
April	n/a	n/a	n/a	n/a
May	n/a	n/a	n/a	n/a
June	n/a	n/a	n/a	n/a
July	n/a	n/a	n/a	n/a
August	14	1661	0	1675
September	16	472	1	489
October	0	48	0	48
November	n/a	n/a	n/a	n/a
December	n/a	n/a	n/a	n/a
Totals	30	2181	1	2212

Note: Trap fished at new site in FY2003. Deployed Aug. 4 and removed on Oct. 9, 2003

Hatchery Trap - FY2003						
Catch by Month						
Month	Chinook	Chinook Fry	Coho	Coho Fry	O. Mykiss	Monthly totals
April	22	188	25	22	27	284
May	1794	130	136	129	43	2232
June	345	12	210	184	17	768
July	262	29	11	93	4	399
August	72	12	53	25	4	166
September	64	0	35	0	13	112
October	65	0	88	0	5	158
November	116	0	160	0	57	333
December	35	0	58	0	5	98
January	17	4	33	0	1	55
February	0	0	54	8	6	68
March	14	68	7	87	7	183
April	15	317	2	1	0	335
Totals	2821	760	872	549	189	5191

***Note:** Large amounts of sand and finer sediment entered the river via the Big Muddy on October 19, 2003. This event greatly reduced fishing time during late Oct. and Nov.

** **Note:** Trap was frozen over for extended periods during January and February, 2004.

Lyle Falls Screw trap - FY2003					
Catch by Month					
Month	Chinook	Coho	Hatchery O. Mykiss	Wild O. Mykiss	Monthly totals
April	11	38428	1	277	38717
May	486	7094	3944	824	12348
June	4016	322	27	15	4380
July	5883	0	0	0	5883
August	5015	5	1	13	5034
September	3207	9	1	80	3297
October*	20	1	0	3	24
November*	117	6	2	24	149
December*	98	18	1	36	153
January*	0	0	0	0	0
February*	17	0	0	5	22
March*	11625	44	6	66	11741
April	128	7489	3	805	8425
Totals	30612	14988	3985	1871	51456

***Note:** Fishing time was limited in these months due to mechanical failures and weather extremes.

Appendix C. Spawning ground surveys (redd counts)

KLICKITAT WATERSHED - SPRING CHINOOK SPAWNING SURVEY RESULTS, 2003							
RIVER	REACH	MILES*	# OF PASSES	REACH TOTALS	REDDS /MILE*	LIVE OBS.	MORTS OBS.
Klickitat							
MAIN STEM	**Above Castile Falls**						
	Hucklebarry Cr. - McCormick Mdws.	3.4	2	19	5.7	20	1
	McCormick Mdws - Cow Camp	8.0	2	82	10.3	48	12
	Cow Camp - McCreedy Cr.	7.1	2	64	9.0	28	4
	McCreedy Cr. - Castile Falls	6.0	2	0	0.0	0	0
	Subtotal	24.4		165	6.8	96	17
	Below Castile Falls						
	Castile Falls #11 - Castile Falls #1	0.6	1	4	6.7	0	0
	Castile Falls #1 - Signal Peak Br.	3.3	3	41	12.4	31	10
	Signal Peak Br. - old USGS gage	10.5	2	71	6.8	57	13
	Old USGS gage - WDFW Hatchery	8.2	2	34	4.1	19	1
	WDF Hatchery - Summit Cr.	5.5	1	17	3.1	10	7
	Summit Cr. - Leidl Br.	5.6	1	0	0.0	0	2
	Subtotal	33.7		167	5.0	117	33
	MAINSTEM TOTALS	**58.1**		**332**	**5.7**	**213**	**50**
	Above Castile Falls contribution			**49.7%**		**45%**	**34%**
	Below Castile Falls contribution			**50.3%**		**55%**	**66%**

n/s = not surveyed

*mileage derived from GIS arc lengths (feet/5280)

Note: Excess hatchery returns were transported above Castile Falls and released to spawn naturally. Included in the transport were 440 females, 122 adult males and 98 jacks, totaling 660 fish. Their contribution to the overall redd count was ~50%.

KLICKITAT WATERSHED - FALL CHINOOK SPAWNING SURVEY RESULTS, 2003							
RIVER	REACH	MILES*	# OF PASSES	REACH TOTALS	REDDS /MILE*	LIVE OBS.	MORTS OBS.
Klickitat							
MAIN STEM	Castile Falls #11 - Castile Falls #1	0.6	0	n/s			
	Castile Falls #1 - Signal Peak Br.	3.3	0	n/s			
	Signal Peak Br. - Big Muddy Cr.	6.9	0	n/s			
	Big Muddy Cr. - old USGS gage	3.3	0	n/s			
	Old USGS gage - WDFW Hatchery	8.2	0	n/s			
	WDF Hatchery - Summit Cr.	5.4	2	18	3.3	282	67
	Summit Cr. - Leidl Br.	5.2	2	159	30.6	234	78
	Leidl Br. - Stinson Flats	2.9	2	190	65.5	217	198
	Stinson Flat - Soda Springs	4.5	2	26	5.8	348	268
	Soda Springs - Little Klickitat	4.8	2	31	6.5	289	355
	Little Klick - Twin Bridges	1.2	2	12	10.0	11	23
	Twin Bridges - Klick Field Office	1.2	1	1	0.8	3	14
	Klick Field Office - Town of Klickitat	3.6	1	19	5.3	21	94
	Klickitat Town - Pitt Bridge	3.4	1	14	4.1	6	71
	Pitt Bridge - Turkey Farm CG	5.4	1	0	0.0	6	18
	Turkey Farm CG - Lyle Falls trap	2.5	1	4	1.6	6	72
	Below Lyle Falls	0.5	0	n/s			
	MAINSTEM TOTALS	**40.6**		**474**	**11.7**	**1423**	**1258**

n/s = not surveyed

*mileage derived from GIS arc lengths (feet/5280)

KLICKITAT WATERSHED - COHO SPAWNING SURVEY RESULTS, 2003							
RIVER	REACH	MILES*	# OF PASSES	REACH TOTALS	REDDS /MILE*	LIVE OBS.	DEAD OBS.
Klickitat							
MAIN STEM	Castile Falls #10 - Castile Falls #1	0.6	0	n/s			
	Castile Falls - Signal Peak Br.	3.3	0	n/s			
	Signal Peak Br. - Big Muddy Cr.	6.9	0	n/s			
	Big Muddy Cr. - old USGS gage	3.3	0	n/s			
	Old USGS gage - WDFW Hatchery	8.2	0	n/s			
	WDF Hatchery - Summit Cr.	5.4	4	45	8.3	209	4
	Summit Cr. - Leidl Br.	5.2	3	17	3.3	30	7
	Leidl Br. - Stinson Flat	2.9	4	12	4.1	2	3
	Stinson Flat - Beeks Canyon	4.5	4	26	5.8	24	5
	Beeks Canyon - Little Klickitat	4.8	3	1	0.2	55	1
	Little Klickitat - Twin Bridges	1.5	4	2	1.3	19	2
	Twin Br. - Field Office	1.2	4	0	0.0	0	0
	Field office - Klickitat Town	3.6	2	0	0.0	3	2
	Klickitat Town - Pitt Bridge	3.4	3	0	0.0	20	0
	Pitt Bridge - Bus turn around	2	2	0	0.0	0	1
	Bus turn around - Turkey Farm	3.3	2	0	0.0	2	1
	Turkey Farm - Lyle Falls	2.5	1	0	0.0	1	0
	MAINSTEM TOTAL	40.3		103	2.6	365	26
TRIBUTARIES							
Trib of trib							
WHITE CREEK	Bottom 1.5 miles	1.5	2	0	0.0	0	0
SUMMIT CREEK	Falls - Rt. bank spring inflow	1.3	2	0	0.0	1	0
DEAD CANYON CR	Bottom mile	1.3	2	2	1.5	12	2
BEEKS CANYON	Bottom .25 mile	0.5	2	0	0.0	7	0
LITTLE KLICKITAT	Bowman Cr. - confluence	1.2	2	0	0.0	3	0
Bowman Cr.	Falls - confluence	1.0	1	0	0.0	0	0
Canyon Cr.	Bottom mile	1.0	0	0	0.0	0	0
SWALE CREEK	above railroad trestle	1.1	1	0	0.0	0	0
	Trestle - confluence	1.1	1	0	0.0	0	0
SNYDER CREEK	lowermost bridge to mouth	0.8	2	2	2.5	7	0
LOGGING CAMP CR	bottom mile	1.0	2	0	0.0	0	0
WHEELER CREEK	bottom mile	1.0	2	0	0.0	0	0
DILLACORTE CR	bottom mile	1.5	2	0	0.0	0	0
SILVA CREEK	Bottom	0.1	2	0	0.0	25	3
CANYON CREEK	Bottom 1/4 mile	0.1	2	5	50.0	369	144
	Tributary Totals	13.5		9	1.1	424	149
	COMBINED TOTAL	**53.8**		**112**		**789**	**175**
	Tributary Contribution			**15%**		**18%**	**14%**
	Mainstem Contribution			**85%**		**82%**	**86%**

n/s = not surveyed

*mileage derived from GIS arc lengths (feet/5280)

KLICKITAT WATERSHED - STEELHEAD SPAWNING SURVEY RESULTS, 2003							
RIVER	REACH	MILES*	# OF PASSES	REACH TOTALS	REDDS /MILE*	LIVE OBS.	DEAD OBS.
Klickitat							
MAIN STEM	Hucklebarry Cr. - McCormick Mdws.	2	0	0	0.0	0	0
	McCormick Mdws - Cattle guard	5.1	1	0	0.0	0	0
	Cattle guard - Castile Falls	12.9	1	0	0.0	0	0
	Castile Falls #10 - Castile Falls #1	0.8	0	n/s			
	Castile Falls - Signal Peak Br.	3.3	1	1	0.3	0	0
	Signal Peak Br. - Big Muddy Cr.	6.9	1	1	0.1	0	0
	Big Muddy Cr. - old USGS gage	3.3	1	0	0.0	0	0
	Old USGS gage - WDFW Hatchery	8.2	2	1	0.1	1	0
	WDF Hatchery - Summit Cr.	5.5	2	2	0.4	3	0
	Summit Cr. - Leidl Br.	5.6	2	16	2.9	7	0
	Leidl Br. - Stinson Flat	2.5	2	13	5.2	10	0
	Stinson Flat - Beeks Canyon	4.6	2	29	6.3	9	3
	Beeks Canyon - Little Klickitat	4.7	2	11	2.3	6	1
	Little Klickiat - Twin Bridges	1.5	2	0	0.0	0	0
	Twin Br. - Field Office	1.2	2	6	5.0	4	0
	Field office - Ice House	1.3	2	1	0.8	5	1
	Ice house - town of Klickitat	2.7	2	2	0.7	6	2
	Town of Klick - Pitt	2.5	2	5	2.0	7	0
	Pitt - Turkey Farm	5	2	6	1.2	3	1
	Turkey Farm - Lyle Falls	2	2	0	0.0	0	0
	MAINSTEM TOTAL	54.4		94	1.7	61	8
TRIBUTARIES							
Trib of trib							
DIAMOND FORK	Bottom 5 miles	5.0	0	n/s			
McCREEDY CR.	Bottom 3/4 mile	0.8	0	n/s			
CHAPARRAL CR.	Klick road to confluence	0.8	0	n/s			
PISCOE CR.	Bottom 3 miles	3.0	1	1	0.3	0	0
SURVEYORS CR.	2nd xing to 1st xing	2.2	0	n/s			
	1st xing to mouth	1.7	2	0	0.0	0	0
BIG MUDDY	End of Rd. to falls	1.4	0	n/s			
OUTLET CREEK		0.3	1	0	0.0	0	0
WHITE CREEK	Upper Rd. Xing - IXL Rd.	2.8	2	9	3.2	2	0
	IXL Rd. - 191 Rd. Xing	3.1	2	4	1.3	2	0
	191 Rd. Xing - Cedar Valley Rd.	2.4	2	11	4.6	3	0
	Cedar Valley Rd. - Brush Cr.	4.6	3	11	2.4	0	0
	Brush Cr. - Washed out xing	1.8	2	5	2.8	0	0
	Washed out Xing. - Schafer Cr.	1.2	1	3	2.5	0	1
	Schafer Cr. - mouth	1.9	1	2	1.1	0	1
West Fork Cr.	Lower LB trib. - mouth	1.9	0	n/s			
Teepee Cr.	RB Trib - IXL Rd.	2.2	2	20	9.1	2	0
	IXL Rd.- Teepee Cr. Rd.	2.5	2	23	9.2	4	0
	Teepee Cr. Rd. - mouth	3.4	3	17	5.0	0	0
Brush Creek	Xing 3.8 mi above Coyote Springs Rd.	3.8	1	0	0.0	0	0
	Coyote Springs Rd. - Cedar Valley Rd.	2.0	2	0	0.0	0	0
	Cedar Valley Rd. - Blue Creek	2.6	2	8	3.1	9	0
	Blue Creek - mouth	2.2	2	0	0.0	5	0
SUMMIT CREEK	Falls - Confluence	1.3	2	4	3.1	2	0
DEAD CANYON CR	lower 3.5 miles	3.5	3	13	3.7	2	0

BEEKS CANYON	Falls to mouth	0.5	2	2	4.0	0	0
LITTLE KLICKITAT	Bowman Cr. - mouth	1.2	1	2	1.7	0	0
Bowman Cr.	Falls - mouth	1.0	1	3	3.0	0	0
Canyon Cr.	Bottom 3 miles	3.0	1	8	2.7	0	0
SWALE CREEK	upper trestle to mouth	2.2	3	22	10.0	8	0
SNYDER CREEK	Upper falls - upper new bridge	1.7	1	0	0.0	0	0
	Upper new bridge - mouth	0.9	3	1	1.1	2	0
LOGGING CAMP CR	Bottom mile	1.0	4	6	6.0	0	1
WHEELER CREEK	Bottom 2 miles	2.0	2	12	6.0	11	1
DILLACORTE CR	Falls - mouth	1.5	3	8	5.3	11	4
SILVA CREEK	Bottom	0.1	n/s				
CANYON CREEK	Bottom 1/4 mile	0.3	1	1	4.0	0	0
	Tributary Totals	65.7		196	3.0	63	8
	COMBINED TOTAL	**120.1**		**290**	**2.4**	**124**	**16**
	Tributary Contribution			**68%**		**31%**	**82%**
	Mainstem Contribution			**32%**		**69%**	**18%**

n/s = not surveyed

*mileage derived from GIS arc lengths (feet/5280)

Appendix D. Scale analysis

2003 Spring Chinook scale based Age data

Age	Sex	Num. Sampled	Avg. Fk Lgth.	Med. Fk Lgth.	Max. Fk Lgth.	Min. Fk Lgth.	% of sex	% of total
2	Female	0					0.0%	0.0%
3	Female	0					0.0%	0.0%
4	Female	9	77	78	82	72	64.3%	39.1%
5	Female	5	91	91	95	84	35.7%	21.7%
Females		14					100.0%	60.9%
2	Male	0					0.0%	0.0%
3	Male	0					0.0%	0.0%
4	Male	4	85	82	98	77	44.4%	17.4%
5	Male	5	90	90	94	87	55.6%	21.7%
Males		9					100%	39.1%
Totals		23						100.0%

Note: Fork lengths measured in centimeters, 3 samples indicated regenerated scales (1 female, 2 males).

2003 Fall Chinook scale based Age data

Age	Sex	Num. Sampled	Avg. Fk Lgth.	Med. Fk Lgth.	Max. Fk Lgth.	Min. Fk Lgth.	% of sex	% of total
2	Female	0					0.0%	0.0%
3	Female	2	79	79	81	77	3.3%	1.7%
4	Female	48	87	87	98	79	80.0%	41.4%
5	Female	10	93	92	99.5	87.5	16.7%	8.6%
Females		60					100.0%	51.7%
2	Male	1	39	39	39	39	1.8%	0.9%
3	Male	8	79	78.5	89	75	14.3%	6.9%
4	Male	23	86.5	87	98	78	41.1%	19.8%
5	Male	24	102	102	114	92	42.9%	20.7%
Males		56					100%	48.3%
Totals		116						100.0%

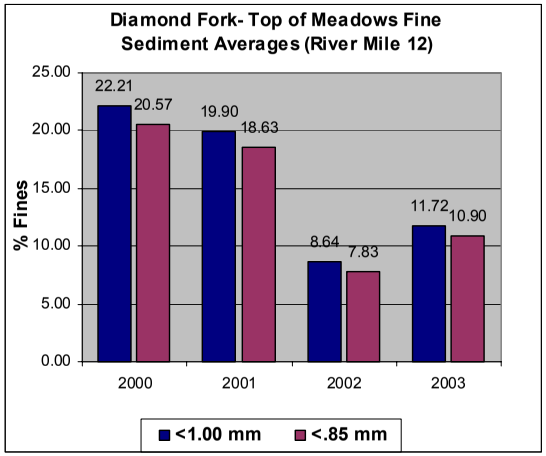
Note: Fork lengths measured in centimeters, 3 samples indicated regenerated scales (3 female, 4 males).

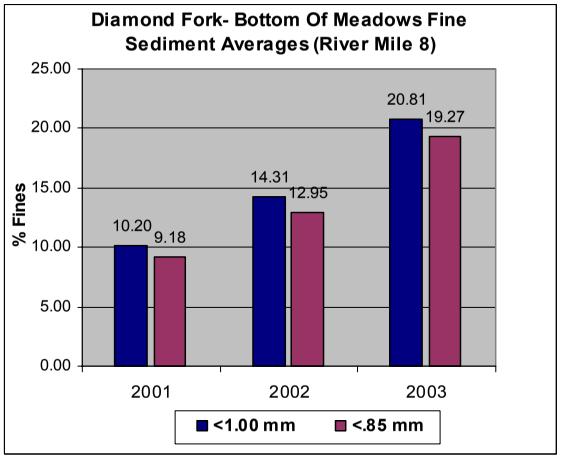
2003 Coho scale based Age data

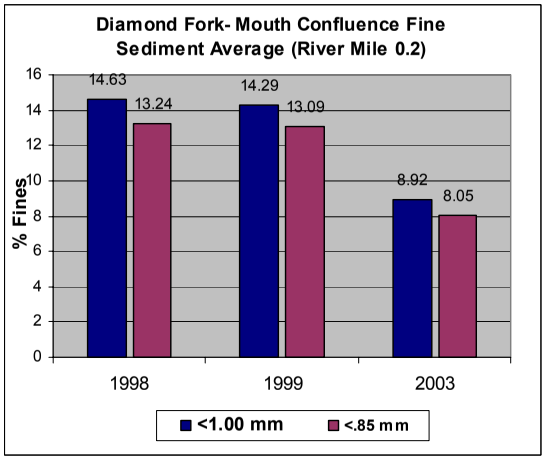
Age	Sex	Num. Sampled	Avg. Fk Lgth.	Med. Fk Lgth.	Max. Fk Lgth.	Min. Fk Lgth.	% of sex
3	Female	3	75	73	81	71	33%
3	Male	6	62	59	77	54	67%
Total		9					100.0%

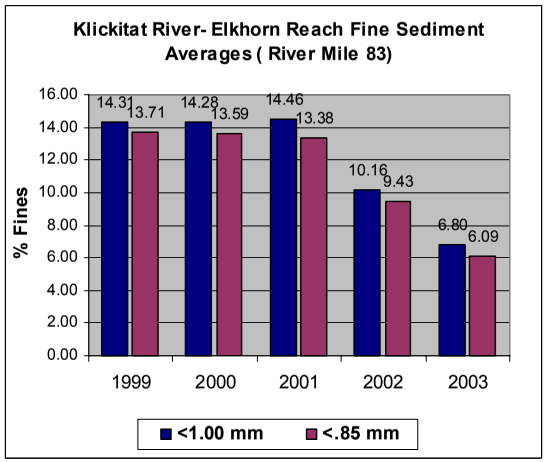
Note: Fork lengths measured in centimeters

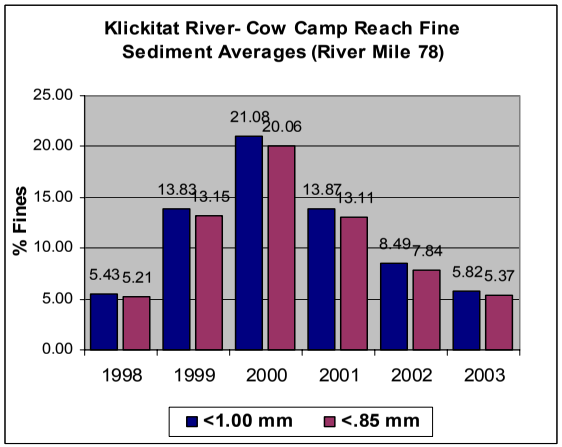
Appendix E. Sediment data

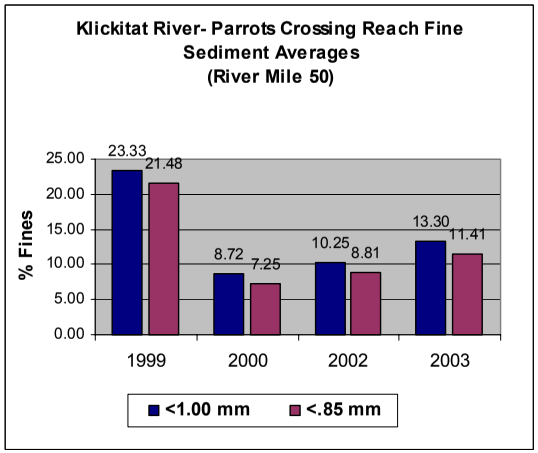


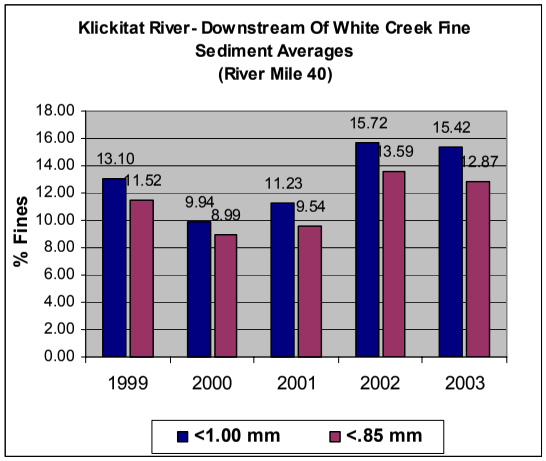


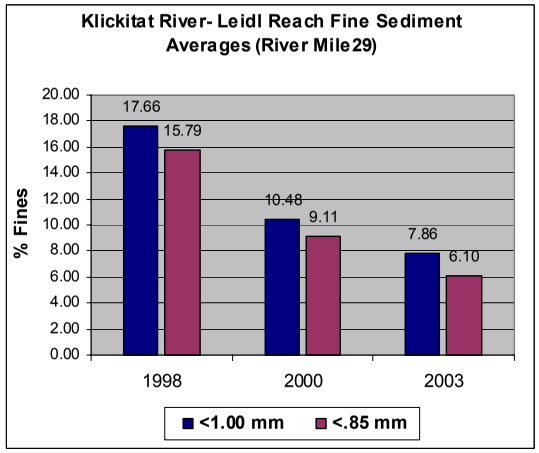


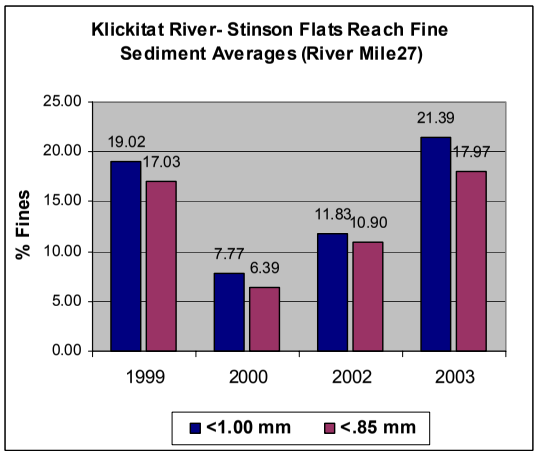


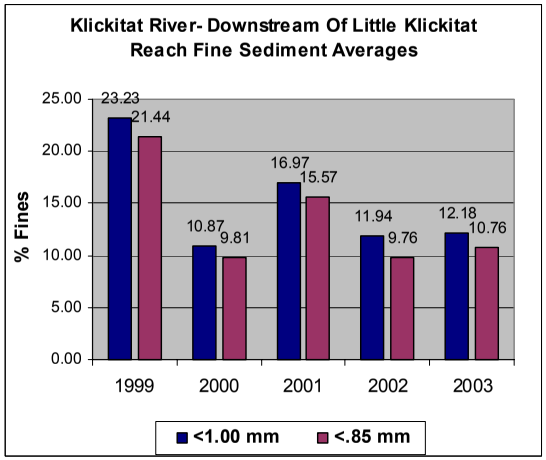


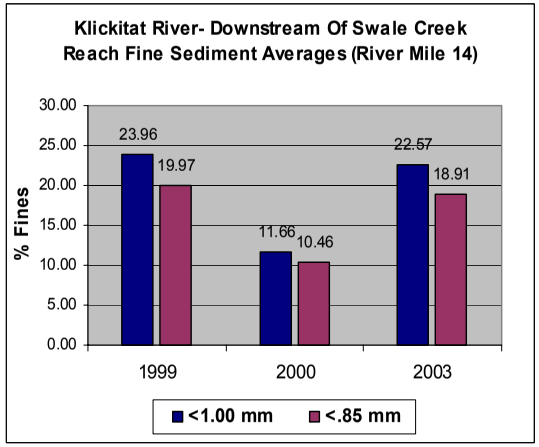



Klickitat River- Downstream Of White Creek Fine Sediment Averages (River Mile 40)
% Fines
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
13.10
11.52
9.94
8.99
11.23
9.54
15.72
13.59
15.42
12.87
1999
2000
2001
2002
2003
<1.00 mm
<.85 mm


Klickitat River- Leidl Reach Fine Sediment Averages (River Mile29)
% Fines
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
17.66
15.79
10.48
9.11
7.86
6.10
1998
2000
2003
<1.00 mm
<.85 mm


Klickitat River- Stinson Flats Reach Fine Sediment Averages (River Mile27)
% Fines
25.00
20.00
15.00
10.00
5.00
0.00
19.02
17.03
7.77
6.39
11.83
10.90
21.39
17.97
1999
2000
2002
2003
<1.00 mm
<.85 mm


Klickitat River- Downstream Of Little Klickitat Reach Fine Sediment Averages
% Fines
25.00
20.00
15.00
10.00
5.00
0.00
23.23
21.44
10.87
9.81
16.97
15.57
11.94
9.76
12.18
10.76
1999
2000
2001
2002
2003
<1.00 mm
<.85 mm


Klickitat River- Downstream Of Swale Creek Reach Fine Sediment Averages (River Mile 14)
% Fines
30.00
25.00
20.00
15.00
10.00
5.00
0.00
23.96
19.97
11.66
10.46
22.57
18.91
1999
2000
2003
<1.00 mm
<.85 mm

Appendix F. Klickitat Water Quality Inventory

Klickitat Watershed Temperatures - 2003														
				# 1 Day Min.		# 1 Day Avg.		# 1 Day Max.		# 7 Day Avg. Daily Max.				
Location/ID	Stream	# Days Recorded	Temp. Type	< 0.5	< 4.4	< 0.5	< 4.4	< 23	< 24	> 12	> 16	> 17.5	> 18	> 22
BearMouthX	Bear	168	Water	3	33	0	30	0	0	58	0	0	0	0
BowmnMouth	Bowman	131	Water	1	73	0	59	0	0	15	15	5	0	0
ButteMedWS	Butte Mead.	258	Water	108	177	77	155	0	0	60	0	0	0	0
Clearwater	Clearwater	224	Water	1	135	0	123	0	0	0	0	0	0	0
CowcampAir	Klickitat	243	Air	160	196	93	142	74	68	125	88	82	80	75
DiaLowMedW	Diamond Fork	258	Water	105	172	74	150	0	0	80	61	25	17	0
DiaMouthRX	Diamond Fork	224	Water	59	136	43	132	0	0	74	11	0	0	0
DaiUppMedW	Diamond Fork	258	Water	96	175	61	155	0	0	72	17	0	0	0
DillacortX	Dillacorte	127	Water	0	15	0	13	0	0	17	10	7	7	0
FishLakRdX	Fish Lake Str.	220	Water	21	134	2	130	0	0	0	0	0	0	0
HatcAirTem	Klickitat	138	Air	38	58	20	45	73	69	90	90	86	86	78
KLCastleBr	Klickitat	190	Water	19	94	8	66	0	0	79	36	1	0	0
KlckYKFPHQ	Klickitat	205	Water	0	30	0	22	0	0	110	75	49	38	0
KLCowcampX	Klickitat	224	Water	35	135	18	123	0	0	75	29	2	0	0
KLHatchTrp	Klickitat	206	Water	8	109	2	107	0	0	80	11	0	0	0
KLMedwsAir	Diamond Fork	258	Air	161	234	100	143	35	23	116	90	80	76	29
KYKFPHQAir	Klickitat	208	Air	43	82	14	54	106	99	135	131	126	126	113
LKlikLodge	Little Klickitat	120	Water	0	31	0	29	0	0	84	76	74	63	0
LKlikMouth	Little Klickitat	232	Water	3	72	2	61	9	2	118	86	81	78	18
LklikOlsen	Little Klickitat	244	Water	16	94	10	79	64	48	127	109	96	91	73
LogCampCr	Logging Camp	204	Water	0	16	0	10	55	47	88	82	77	76	60
McCreedRdX	McCreedy	147	Water	0	56	0	53	0	0	0	0	0	0	0
NewLyleTrp	Klickitat	157	Water	0	45	0	40	0	0	91	77	66	51	0
NLyleTrpAir	Klickitat	159	Air	41	62	10	54	80	78	96	93	92	92	85
OutletRdXg	Outlet	200	Water	23	100	13	93	36	27	84	72	70	69	44
PiscoMouth	Piscoe	224	Water	33	133	19	127	0	0	73	0	0	0	0
SnyderMill	Snyder	200	Water	2	85	0	69	0	0	84	72	55	52	0
SnydrMouth	Snyder	134	Water	0	24	0	22	34	29	94	81	63	62	37
SumitMouth	Summit	174	Water	9	82	8	77	0	0	79	48	18	12	0
SurveyorsX	Surveyors	224	Water	3	113	0	94	0	0	81	39	17	10	0
SwaleHarms	Swale	206	Water	0	68	0	58	59	32	90	90	89	88	76
SwaleMouth	Swale	134	Water	1	51	0	24	31	25	59	55	55	52	41
TrapperRdX	Trappers	224	Water	0	135	0	121	0	0	0	0	0	0	0
TroutRvrtRdX	Trout	102	Water	6	12	3	12	2	0	90	80	73	62	8
WestForkRX	West Fork	157	Water	0	131	0	119	0	0	0	0	0	0	0
WhiteMouth	White	102	Water	0	12	0	12	6	0	90	87	79	76	13

Appendix G. EDT Steelhead and spring chinook restoration potential

1.2 Lower Klickitat EDT reaches analysis for restoration potential referencing the overall steelhead population below Castile Falls.

Sections 1.2 – 1.5 of the document discusses the top ten restoration reaches with the following objectives:

1.) Discussion of potential increases of population performance parameters and primary parameter associated with the overall restoration potential rank
2.) Identification of primary level 3 survival correlates and/or level 2 attributes with greatest impacts to survival and related life stages with highest mortality
3.) Miscellaneous caveats potentially affecting the overall restoration ranking a reach has received

1.21 Reach rankings in order of restoration potential: The overall rankings are based on a summation of individual population performance parameters which results in several reaches displaying the same overall ranking. Reaches that have the same restoration ranking are grouped together but are not displayed in any order of importance.

1.) Swale 2

Description: Swale Cr- SE tributary to NW tributary (begins 3.967 miles upstream from mouth of Swale Cr)

Length: 3.808 mi

Swale 2 exhibits minor potential increases in Abundance, Productivity and life history diversity but is one of the few reaches that exhibits restoration potential for all three performance parameters. Among all reaches, swale 2 possesses the ability to contribute substantially to the life history diversity index for the lower Klickitat steelhead population, ranking 3rd overall in this category. The EDT model shows a 30% decrease in the life history diversity index for the entire Steelhead population below Castile Falls. Of this 30%, the model states that restoration in this reach alone could restore up to 4% of this decline. It also shows a potential increase in abundance and productivity of 2% each.

Because of the physical degradation this reach has undergone due to the railroad prism and in channel work, a combination of level 3 attributes have severely impacted several life stages in the following order: Egg incubation displays an 88.4% decline in productivity from high temperatures, increases in sediment and loss of key habitat. Active rearing life stages show a decrease in productivity by 69.3% from an overwhelming combination of level 3 attributes with major hits from loss of key habitat, high temperatures, potential pathogens, loss of flow and habitat diversity. Fry colonization productivity has decreased by 41.9% primarily from loss of key habitat, temperatures, and habitat diversity. There are no underlining caveats for the ranking of this reach due to severity of degradation it has undergone and the potential it possesses for steelhead.

2.) Klick 12

Description: Klickitat R- Dead Canyon to Summit Cr

Length: 6.271 mi

Klick 12 restoration potential incorporates substantial potential for increases in productivity (9%) and abundance (4%). The productivity potential ranks 1st among all the reaches and 2nd overall with respect to abundance for the individual categories. The combined affect from the two of this account for the overall ranking since the model shows no potential increase for the life history diversity index. A 9% increase in productivity would be a modest improvement in productivity considering the difference in this parameter from historic to current (13.5 to 4.2). This contributes to rationalization of restoration importance of this reach with respect to the overall population performance. Level 3 correlates contributing to the degradation of this reach is broad with none displaying a dominating affect on productivity. The model illustrates a decrease of survival during the egg incubation life stage due to elevated concentrations of fine sediment. Physical degradations appear on the upper and lower ends of the reach affecting the habitat diversity in the forms of riparian vegetation, hydro confinement and loss of wood. Changes in the Biologic community also contribute to the restoration potential this reach displays. Biological affects include an increase in competition and predation from hatchery outplants and species introduction in the rearing life stages. The model also shows a probable increase in mortality from pathogens due to these outplants and the proximity of Klickitat hatchery. Two caveats exist with the restoration ranking this reach receives: First, this is a rather long reach which correlates to a large capacity (length x channel width). This increase of area will have a slight impact on the magnitude of relative potential increases in the population performance parameters. Second, a high proportion of factors affecting the restoration potential actually lye outside of this reach such as increased levels of turbidity and fine sediment during the late winter, early spring months and biologic community impacts from the hatchery upstream.

2.) Swale 1

Description: Swale Cr- Mouth to SE tributary 3.967 miles upstream

Length: 3.967 mi

Swale 1 also received an overall restoration ranking of 2 with potential increases

in abundance by 3%, increases in productivity by 1% and increases in the life history diversity index by 4%. The potential increase in productivity itself ranks fairly low among all reaches associated with the steelhead population compared to the overall rankings for increases in abundance and diversity index. This would lead one to the conclusion that the potential increases in abundance and the diversity index are the primary parameters associated with the overall restoration ranking this reach receives. Another aspect to consider with the potential abundance is it's relation to productivity and capacity. Abundance is a function of both productivity and capacity and because the productivity potential is fairly low, one could relate the potential abundance to a decrease in the overall capacity that is associated with the biological response to the amount of available key habitat. The model shows loss of key habitat for nearly every life stage which results in this decrease of capacity encompassing the entire life cycle spent within Swale Creek.

Like Swale 2, this reach exhibits a substantial potential for increasing the life history diversity index by 4%. An interpretation of this hypothesizes that the low survival for the egg incubation and 0 age active rearing life stages have a substantial number of unsuccessful life history trajectories associated with them. These decreases in productivity for the egg incubation life stage are heavily impacted from increased levels of fine sediment over background levels and elevated temperatures. 0 age rearing life stages have major hits from loss of key habitat, elevated temperature, potential

pathogens, habitat diversity and low flow. Other life stages have decreases in productivity as well with similar biological affects from habitat diversity, elevated temperatures, loss of late summer flow and decreases in key habitat. The last component to consider with this reach's restoration ranking is its geographic proximity for steelhead utilizing the Swale Cr watershed. All life trajectories in the Swale Cr. watershed are eventually routed through Swale1. Any decreases in survival for a portion of life stages will affect a greater amount of trajectories than reaches above swale 1 in the watershed.

3.) Klick 11

Description: Klickitat **R- Beeks Canyon to Dead Canyon**

Length: 5.518 mi

The overall restoration ranking of 3 for klick 11 from the EDT model has the following potential increases: 4% abundance, 6% productivity and no potential for the life history diversity index. Even without any potential increases in the diversity index this reach ranks fairly high due to the high individual rankings for abundance and productivity. Degradations to the quality and quantity of habitat occur in isolated locations on the right bank of the Klickitat river in this reach. These degradations are strongly linked to the hydro confining affect the Champion haul road has on the river along with the vegetation loss in the form of canopy cover and accelerated bank erosion. These physical factors relate the degradations of quantity and quality of habitat directly to productivity and abundance which is reflected in the loss of key habitat quantity for nearly every single life stage. Biological community affects also contribute to the restoration potential this reach displays. Competition from hatchery outplants have decreased the productivity for the rearing life stages of wild juvenile steelhead along with potential increases in predation. This increase in predation is reflected in the active, inactive, migrant and colonization life stages that are also impacted from species introduction and community richness. Another level 3 biologic attribute contributing to the restoration potential is the presence of pathogens. This value is derived from a synergistic affect from several level 2 attributes. A single level 2 attribute affecting this biological response in the form of species introductions is present so the overall impact is minimal from this level 3 attribute.

4.) Klick 10

Description: Klickitat R- Little Klickitat to Beeks Canyon

Length: 5.510 mi

The overall restoration ranking of 4 this reach received from the EDT model has a potential increase in abundance of 3%, increase of productivity by 5% and a 0% increase in the life history diversity index. This reach receives very similar potentials for productivity and abundance as those in Klick 11. This is not a surprise due to similar degradations these 2 reaches have undergone. Interpretations of physical and biologic level 3 attributes affecting productivity and life stages from Klick 11 could be applied to the restoration potential this reach displays in conjunction with one other level 3 component. The model displays a larger impact to the habitat diversity for several life stages for Klick 10 over Klick 11. Greater decreases in the presence of large woody debris and a higher percent of linear distance confined from the champion haul road result in this additional impact to the marginal habitat diversity. Because of this, one might expect this reach to rank higher than Klick 11 for the overall restoration potential. Klick 11 receives a higher ranking because of its higher capacity

that lends itself to greater channel widths, higher percentage of off channel habitat and the unconfined nature of the reach.

4.) Klick 8

Description: Klickitat R- Snyder Cr to Swale Cr

Length: 3.258 mi

The overall restoration ranking of 4 Klick 8 receives displays a potential increase in abundance by 2%, increase of productivity by 3% and an increase in the life history diversity index of 1%. This reach does not possess the ability to contribute to increases for abundance and productivity to those seen in other reaches with the same restoration ranking but unlike other reaches with the same restoration ranking, the model shows an existing potential to increase the life history diversity by 1% for the overall Klickitat steelhead population. The potential increases in the productivity have a strong case as the primary component driving the overall restoration ranking. Decreases in productivity are related to the quality of available habitat for all life stages occurring within a given reach. The level 3 attribute expression of this is habitat diversity that is a compilation of several physical level 2 attributes. This level 3 parameter has the most significant impact on nearly all existing life stages occurring in this reach. Degradations of the habitat diversity include hydro confinement from the main road paralleling the river along with the old railroad prism in some areas, degraded riparian function in the form of canopy cover and loss of wood which acts as pockets of refugia and channel roughness.

The model also has several biological components contributing to the restoration potential that include the following: competition form hatchery outplants, increased levels of predation and the presence of pathogens. These biological level 3 attributes are present in several but not all life stages and appear to be secondary components with respect to any of the population performance parameters. The model also shows a decrease in the level 3 attribute of food. Of the level 2 attributes that are compiled into this level 3 (biological response), decreases in salmon carcasses appears to be most heavily weighted for a decrease in the food supply. This decrease in the food supply is also related to the sustainable capacity of this reach for all life stages and is reflected in the restoration potential for abundance.

4.) Swale 3

Description: Swale Cr- NW tributary (tributary that overlays the Warwick fault) to a south tributary

Length: 3.438 mi

The overall restoration ranking for this reach has the potential increases for abundance of 2%, increases of productivity equivalent to 1% and potential increases in the diversity index of 3%. This potential increase in the diversity index is the primary population parameter associated with the overall restoration ranking. The individual potential increases for abundance and productivity affect a smaller proportion of life history trajectories for any given life stage than the number in the reaches below which results in a decreased impact to the overall productivity and abundance of the entire population. This is not to say that these are the sole reasons as to why this reach has a lower potential for increases in productivity and abundance (with respect to swale 1 & Swale 2) because other factors are contributing as well. For instance, swale 2 may have loss a greater amount of marginal habitat

than swale 3 which contributes to decreases in capacity and abundance. A major limiting factor identified in the EDT reach analysis points to increased temperatures that have substantial impacts to the productivity for the egg incubation, spawning, fry colonization and 0 age active rearing life stage. The other level 3 with the greatest impact on productivities of specific life stages is loss of key habitat for spawning, egg incubation and fry colonization due to the physical changes and historic channel work that has occurred. Other biologic level 3 attributes contribute less but some to the overall restoration potential along with loss of late summer flow. The synergistic affect of elevated temperatures, loss of key habitat quantity and other level 3 attributes has resulted with in reach mortalities for a portion of the trajectories routed through this particular reach. This is reflected in the potential increases of the life history diversity index.

4.) Klick 13

Description: Klickitat R- Summit Cr to White Cr

Length: 2.541 mi

Restoration potential for Klick 13 consists of the following: 2% increase for abundance, 4% increase in productivity and a 1% increase in the life history diversity index. Of the 3 population parameters associated with the overall population performance and restoration ranking, the potential increase displayed in the productivity is substantially larger than the potential for increases in abundance and diversity index. Assessment of the level 3 components having negative impacts on the productivity of a given life stage suggests that the quality of habitat diversity has been degraded in conjunction with increases of fine sediment over background levels. The level 3 analysis also suggests that increases in predation due to hatchery outplants and competition from hatchery outplants has contributed to decreases in productivity for several life stages. Of all the reach rankings, this reach displays the least amount of confidence with its overall ranking. This hypothesis lends itself to the uncertainty associated with the impact of hydro confinement affecting the habitat diversity and channel stability. This is identified because of the confined nature the canyon walls existing along this entire reach. Needless to say, this is not stating that there hasn't been alteration in the canopy and habitat diversity due to the existing road but simply stating that the impact may not be as significant as the model suggests.

5.) White 4

Description: White Cr- Brush Cr To 1st meadow

Length: 4.737 mi

Restoration potential for individual population performance parameters are as follows for White 4: potential increase in abundance of 2%, potential increases in productivity of 1% and potential increases in the life history diversity index of 5%. With respect to the entire lower Klickitat steelhead population below Castile Falls, the potential increases for the life history diversity index is the primary component for the overall restoration ranking. This individual population performance parameter for White 4 ranks first among all other reach potentials.

Level 3 attributes affecting the restoration rankings are primarily physical degradations that the reach has undergone. Degradations in the habitat diversity have negative affects on productivity for almost all life stages. Level 2 attributes with degradations affecting the level 3 attribute of habitat

diversity include riparian function, amounts of large woody debris and hydro confinement (or entrenchment). These physical attributes have also resulted in altered habitat types that in turn have decreased the capacity for given habitat type associated with specific life stages. Decreases of late summer flow and elevated temperatures also contribute to the demise of this reach. The overall affect of these level 3 attributes results with reach specific mortalities affecting the trajectories associated with them. Nearly 2/3 of all life history trajectories in the White cr watershed spend some portion of their life cycle in this reach. Because of the relative importance the White cr watershed inherently displays to the overall steelhead population, there is no surprise or caveats associated with this reach's ranking as it should remain top priority for any physical restoration actions.

6.) Klick 5

Description: Klickitat R- Dillacort Canyon to Logging Camp Canyon

Length: 4.001 mi

The overall restoration potential ranking for this reach has the following potential increases: abundance increase of 2%, productivity increase of 3% and an increase of diversity index by 1%. Of the three population performance parameters, none seem to display an overwhelming affect on the overall restoration ranking associated with this reach. Restoration potential for this reach is primarily associated with physical degradations with slight contributions from biological factors and water quality parameters. Habitat diversity has impacted the most life stages over any other level 3 attribute. Level 2 attributes associated with this include Riparian function in the form of canopy cover and vegetation, loss of wood and hydro confinement from proximity of the main road. Level 3 biological attributes having negative impacts on productivity are represented in the form of hatchery outplants resulting in an increased competition for food and space. This biological attribute along with diminished food sources due to declined amounts of salmon carcasses are components contributing to the potential increases of abundance in the form of decreased food resources. The last element to consider with this reaches high ranking is related to the high percentage of the populations life history trajectories (97%) routed through the reach through space and time. This reach displays a high sensitivity and increased magnitude of negative affects on a given life stages productivity due to the proximity of the reach.

7.) Klick7

Description: Klickitat R- Wheeler Canyon to Snyder Cr

Length: 3.337 mi

The overall restoration potential ranking for this reach has the following potential increases: abundance increase of 2%, productivity increase of 3% and an increase of diversity index by 0%. The restoration rankings for this particular reach has nearly the same level 3 attributes affecting productivity of life stage as those seen in Klick 5 above. The only discrepancy between the two is the proximity of Klick 7 to or near a human population center of which would be the town of Klickitat. Reach 7 receives a slightly increased affect on the harassment attribute due to this. The reach is ranked just below Klick 5 due to a decreased amount of life history trajectories routed through this reach.

1.2 Upper Klickitat EDT reaches analysis for restoration potential referencing the overall steelhead population above Castile Falls.

1.) Klick 30

Description: Klickitat R- Klickitat R meadows (RM 78.2) to Huckleberry Cr

Length: 8.545 mi

Klick 30 restoration potential ranks 1st among the upper Klickitat reaches for steelhead that incorporates substantial potential for increases in productivity (9%), abundance (9%) and Life history diversity index (7%). All three of these population performance parameters are contributing to the overall restoration ranking Klick 30 has been diagnosed with by the EDT model. The high potential increases for productivity are a function of the quality habitat that has been degraded in isolated areas of this reach. One of the level 3 attributes displaying decreases in productivity related to this is the habitat diversity. In this case, decreases of productivity occur in the colonization, rearing and inactive life stages. The degradation of habitat diversity is a function of deteriorated riparian conditions in isolated locations in the form of decreased canopy and stream bank vegetation, loss of wood and local entrenchment. Local entrenchment has also accelerated bank erosion in some areas and may be the primary contributor to the slight increases of fine sediment over background levels. This is expressed in the level 3 attribute of sediment load of which also has decreased productivity in the egg incubation life stage. Other secondary level 3 attributes contributing to decreased productivity in the egg incubation life stage are slight increases of temperature and decreased channel stability due to local entrenchment.

The high potential increases of abundance for steelhead in this reach are a function of both the potential productivity and capacity. Potential increases and factors affecting productivity are listed in the above paragraph. Potential increases in abundance from decreased capacity are associated with the loss of food resources from decreases of salmon carcasses that primarily impact the fry colonization and early stages of active rearing. The potential displayed for the life history diversity parameter is a result of unsuccessful life history trajectories that result in mortality for fish in this reach. All of the listed degradations above impact this parameter in one form or another. Another factor that may be contributing to the mortality of over wintering life stages could be related to the cold temperatures. This hypothesis speculates the possible decreases of ground water sources offering pockets of refugia for overwintering life stages that will require further research. One caveat exists with this reaches ranking that is related to the stream reaches length. This reach is abnormally longer in length of which results in an increased capacity of area offered for all life stages. This will have increased the individual increases for restoration potential but because all three parameters rank very high individually, this reach would still rank among the top three if had a linear length equivalent to other reaches in the upper Klickitat.

2.) Klick 27

Description: Klickitat R- McCreedy Cr to Piscoe Cr

Length: 3.877 mi

Klick 27 restoration potential ranks 2nd among the upper Klickitat reaches for steelhead that incorporates potential for increases in productivity of 9%, substantial increases in abundance (13%) and increases for Life history diversity index of 4%. The high restoration ranking this reach has

received is correlated to the potential increases of abundance primarily, the model also displays a substantial increase in productivity and should be viewed as an important component as well.

Of all the reaches in the upper Klickitat mainstem, this reach has the greatest linear length of hydro confinement due to the main road next to it. The stream bank has been rip rapped to protect the road in areas of which contributes to the simplification of habitat in isolated areas of this reach. From this, the model shows decreases of key habitat for several life stages that ultimately results in decreased capacity. The EDT model also shows a decrease of food resources due to declined number of salmon carcasses. This decrease in food source contributes to the declined capacity for several life stages that is expressed in decreased productivity and overall restoration potential for increases of abundance. Sediment load has been identified as a major limiting factor for several life stages. Egg incubation has the greatest decline in productivity due to fine sediment. Other life stages affected by fine sediment or turbidity include spawning, colonization and migrant life stages.

3.) Klick 25

Description: Klickitat R- Upper end of Castile Falls to Chaparrel Cr

Length: 3.038 mi

Restoration potential for Klick 25 consists of the following: 8% increase for abundance, 6% increase in productivity and a 1% increase in the life history diversity. Both abundance and productivity are key components for this reaches overall restoration potential. Increases in the life history diversity index from restoration are minimal as compared to the other parameters. This low potential displays the high success rate of life history trajectory paths offered to a given fish. This is also related to the fact that this reach offers a tremendous amount of habitat diversity and has very minimal physical alterations from anthropogenic impacts. Within reach level 3 parameters affecting overall productivity and abundance are food and sediment load. Declined food resources are the result of decreased salmon carcasses affecting colonization and early rearing life stages. The model also identifies sediment load as a major level 3 component affecting productivity for egg incubation, spawning and migrant life stages due to increases of fine sediment and turbidity. Sources of increased sediment load occur upstream of this reach in tributaries exhibiting road densities from forest management activities.

3.) Piscoe 3

Description: Piscoe Cr- piscoe2 to Piscoe road crossing (reach begins 3.65 mi from the mouth)

Length: 2.993 mi

Restoration potential for Piscoe 3 consists of the following: 3% increase for abundance, 2% increase in productivity and a 5% increase in the life history diversity. The overall restoration ranking for piscoe 3 is driven by the potential for increasing the life history diversity relative to the upper Klickitat steelhead population. Several level 3 attributes contribute to the potential this reach displays with sediment load as the key limiting factor expressed in the egg incubation life stage. The model identifies other parameters that consist of habitat diversity, key habitat quantity, channel stability, food resources and elevated temperatures. Of all the top ten reach rankings for the upper Klickitat, this reach exhibits the least confidence and highest uncertainty associated with its overall ranking for 2 reasons. First, available data sources were scarce that addressed piscoe cr and ground truthing was

limited due to time constraints. Second, the upper Klickitat has not been thoroughly seeded with steelhead due to passage issues at Castile Falls up until this point. As a result, distribution and future seeding of natural populations of tributaries is not known. Professional biological opinions also have identified other tributaries with higher priorities due to experience and knowledge of that particular area.

4.) Klick 26

Description: Klickitat R- Chaparrel Cr to McCreedy Cr

Length: 2.70 mi

Restoration potential for Klick 26 consists of the following: 8% increase for abundance, 5% increase in productivity and a 1% increase in the life history diversity. The primary population parameter influencing the overall restoration potential is the potential this reach displays for increasing the populations abundance. Degradations undergone in this reach are very similar to the degradations in Klick 27 that is located upstream. In fact, the analysis of klick 27 could be applied to this reach with one exception. This reach has a decreased linear length of stream bank influenced by hydro confinement than the amount in Klick 27. This is expressed in the habitat diversity level 3 attribute. If one was to look at the individual population parameter potentials, you'll notice that Klick 27 has a greater potential for the productivity parameter. This is directly related to the quality of habitat linked to the level 3 correlate habitat diversity. With this one exception, all other level 3 correlates affect similar life stages as those identified in Klick 27.

5.) Klick 28

Description: Klickitat R- Piscoe Cr to Diamond Fork

Length: 1.627 mi

Restoration potential for Klick 28 consists of the following: 4% increase for abundance, 3% increase in productivity and a 1% increase in the life history diversity. The ability of this reach to contribute to the overall steelhead productivity and abundance are the key components driving this overall restoration ranking. A current high success rate of life history trajectories is reflected in the slight potential that exists for the increases in the diversity index. Level 3 components identified by the model that are negatively impacting productivity include sediment load in the form of fines and turbidity, channel stability, and increased predation associated with the presence of hatchery fish. Although the presence of hatchery fish exists due to outplanting of adult spawners and parr, effects are minimal compared to sediment load and decreased food sources. Decreases in food sources identified from the model are a consequence of declined salmon carcasses. This decrease in food resource coupled with a slight decrease of key habitat for several life stages has reduced the overall capacity this reach once exhibited and is identified in the potential increases for abundance.

6.) Diamond 1

Description: Diamond Fork - Mouth pt upstream ~1.58 miles

Length: 1.586 mi

Restoration potential for Diamond 1 consists of the following: 2% increase for abundance,

1% increase in productivity and a 3% increase in the life history diversity. The overall restoration ranking associated with this reach is a product of all three population performance parameters. This reaches limiting factors include declines in productivity for the egg incubation life stage due to fine sediment and elevated temperatures. The overwintering life stage has the largest decline in productivity as a result of decreased habitat diversity and low winter temperatures. The model identifies a loss of key habitat for nearly every life stage which translates to a decrease in the overall capacity and abundance. Other biological level 3 factors have had slight affects are the existence of hatchery fish from a scarce amount of outplantings. Also, 100% of steelhead life history trajectories in the Diamond Fork are routed through this reach at some point so degradations in this reach will affect the sub population of the Diamond Fork.

7.) Diamond 5

Description: Diamond Cr- Butte Meadows Cr to top of last meadow

Length: 2.183 mi

Restoration potential for Diamond 5 consists of the following: 2% increase for abundance, 1% increase in productivity and a 3% increase in the life history diversity. The overall restoration ranking associated with this reach is a product of all three population performance parameters. The model identifies the same limiting level 3 correlates for this reach as Diamond 1. High levels of fine sediment combined with elevated temperatures have substantially decreased productivity for the egg incubation life stage. The model displays major decreases in productivity for the inactive life stages due to decreases of food resources, habitat diversity, and low winter temperatures. Decreases of key habitat for nearly every life stage have negatively influenced the capacity which is reflected in the potential increases for abundance.

8.) Klick 18

Description: Klickitat R- Trout Cr to Big Muddy Cr

Length: 10.865 mi

Restoration potential for Klick 18 consists of the following: 2% increase for abundance, 1% increase in productivity and a 1% increase in the life history diversity. All 3 of the population parameters contribute to this reaches overall ranking. This reach is located in a relatively isolated area that has not undergone any physical degradation. Restoration potential associated with this reach is reflected and driven by the decrease of food resources. Historically, this reach is thought to have had a higher number of salmon carcasses. The model also displays a slight predation increase do to the presence of hatchery outplants and decreases in productivity for the migrant life stage from elevated concentrations of turbidity during spring runoff months.

9.) Klick 29

Description: Klickitat R- Diamond Fork to bottom Klickitat R meadows

Length: 1.518 mi

Restoration potential for Klick 29 consists of the following: 3% increase for abundance, 3% increase in productivity and a 0% increase in the life history diversity. The potential increases for abundance and productivity both are driving parameters with the overall restoration potential rank this reach displays. This reach has 1 major limiting factor that has negatively impacted the productivity and appears to be fine sediment. With fine sediment, elevated temperatures work synergistically to decrease to productivity of the egg incubation life stage. Other life stages have minor decreases in productivity due to decreased food resources, decreased habitat diversity and competition with the few hatchery fish that exist in this reach.

Spring Chinook

1.4 Lower Klickitat EDT reaches analysis for restoration potential referencing the overall Spring Chinook population below Castile Falls.

1.) Klick 18

Description: Klickitat R- Trout Cr to Big Muddy Cr

Length: 10.865 mi

Klick 18 ranks 1st for the overall restoration potential associated with the three population performance parameters. This reach displays a potential increase of abundance equal to 7% and a potential increase in productivity equal to 6% and no potential increase for the life history diversity index. The combined affect from the two of this account for the overall ranking since the model shows no potential increase for the life history diversity index. The restoration potential exhibited by this reach is weighted upon the level 3 attribute of food. A decrease in salmon carcasses negatively affects the productivity of the fry colonization, 0, 1 age rearing and the inactive wintering life stages of Spring Chinook. This decrease in food source not only results in decreased productivity but diminishes the capacity of the reach as well. Due to the location of this isolated reach, no physical alterations from anthropogenic impacts influence the restoration potential, it is considered to remain in a pristine state. The other level 3 correlate the model has identified impacting survival of several life stages is the sediment load. This sediment load is linked to the increases of concentrations of suspended sediment (turbidity) during the late winter and spring months of the year. Potential sources are located upstream from the reach itself from incoming tributaries displaying resource management implications with road densities. The overall ranking of this reach was a bit unexpected as there are two other factors influencing the reaches ranking of 1. First, this reach is the lowest reach in the system designated as a spawning reach for the Spring Chinook population below Castile Falls. This translates to nearly 100% of the populations life history trajectories either rear or migrate through this reach resulting in exposure to the environmental conditions. Second, this reach is one of the longest reaches in the Klickitat EDT model. This extended length contributes to an increased capacity which magnifies the restoration potential related to this and abundance.

2.) Klick 12

Description: Klickitat R- Dead Canyon to Summit Cr

Length: 6.271 mi

Klick 12 ranks 2nd for the overall restoration potential associated with the three population performance parameters. This reach displays a potential increase of abundance equal to 6% and a potential increase in productivity equal to 4% and no potential increase for the life history diversity index. The combined affect from the two of this account for the overall ranking since the model shows no potential increase for the life history diversity index. Physical degradations appear on the upper and lower ends of the reach affecting the habitat diversity in the forms of riparian vegetation, hydro confinement and loss of wood. Changes in the Biologic community also contribute to the restoration potential this reach displays. Biological affects include an increase in predation from hatchery outplants and species introduction in the migrant and rearing life stages. The model also indicates a decrease in key habitat quantity affecting the productivity for the rearing life stages that occur in this reach.

3.) Klick 10

Description: Klickitat R- Little Klickitat to Beeks Canyon

Length: 5.510 mi

Klick 10 ranks 3rd for the overall restoration potential associated with the three population performance parameters. This reach displays a potential increase of abundance equal to 3% and a potential increase in productivity equal to 2% and no potential increase for the life history diversity index. The model displays a decrease of survival from the habitat diversity level 3 attribute for several life stages. Level 2 attributes affecting the habitat diversity included hydro confinement from the champion haul road, diminished amounts of large woody debris and loss of Canopy cover expressed in the Riparian function attribute. The habitat diversity has affected the quality of habitat and is linked to the restoration parameter of productivity. Decreases of key habitat and food have been identified for several life stages and are articulated in the restoration parameter for abundance. Very little biological influences affect the restoration potential of this reach in the form of hatchery outplants.

3.) Klick 11

Description: Klickitat **R- Beeks Canyon to Dead Canyon**

Length: 5.518 mi

The overall restoration ranking of 3 for klick 11 from the EDT model has the following potential increases: 3% abundance, 2% productivity and no potential for the life history diversity index. Even without any potential increases in the diversity index this reach ranks fairly high due to the high individual rankings for abundance and productivity. Degradations to the quality and quantity of habitat occur in isolated locations on the right bank of the Klickitat River in this reach. These degradations are strongly linked to the hydro confining affect the Champion haul road has on the river along with the vegetation loss in the form of canopy cover and accelerated bank erosion. These physical factors relate the degradations of quantity and quality of habitat directly to productivity and

abundance which is reflected in the loss of key habitat quantity for several life stages. Biological community affects contribute little to the decreases of productivity for rearing and migrant life stages in the form of predation. Hatchery outplants act as the modifying component influencing this level 3 correlate.

3.) Klick 13

Description: Klickitat R- Summit Cr to White Cr

Length: 2.541 mi

Restoration potential for Klick 13 consists of the following: 3% increase for abundance, 2% increase in productivity and a 0% increase in the life history diversity index. Of the 3 population parameters associated with the overall population performance and restoration ranking, the potential increase displayed in the productivity and abundance are obviously the key components to the ranking since the diversity index potential is 0. Assessment of the level 3 components having negative impacts on the productivity of a given life stage suggests that the quality of habitat diversity has been degraded in conjunction with increases of fine sediment over background levels. The level 3 analysis also suggests that increases in predation due to hatchery outplants and competition from hatchery outplants has contributed to decreases in productivity for several life stages. Of all the reach rankings, this reach displays the least amount of confidence with its overall ranking. This hypothesis lends itself to the uncertainty associated with the impact of hydro confinement affecting the habitat diversity and channel stability. This is identified because of the confined nature the canyon walls existing along this entire reach. Needless to say, this is not stating that there hasn't been alteration in the canopy and habitat diversity due to the existing road but simply stating that the impact may not be as significant as the model suggests.

Upper Klickitat EDT reaches analysis for restoration potential referencing the overall Spring Chinook population above Castile Falls.

1.) Klick 30

Description: Klickitat R- Klickitat R meadows (RM 78.2) to Huckleberry Cr

Length: 8.545 mi

Klick 30 restoration potential ranks 1st among the upper Klickitat reaches for steelhead that incorporates substantial potential for increases in productivity (30%), abundance (21%) and no potential increases for the Life history diversity index (0%). The high potential increases for productivity are a function of the quality habitat that has been degraded in isolated areas of this reach. One of the level 3 attributes displaying decreases in productivity related to this is the habitat diversity. In this case, decreases of productivity occur in the colonization, migrant and inactive life stages. The degradation of habitat diversity is a function of deteriorated riparian conditions in isolated locations in the form of decreased canopy and stream bank vegetation, loss of wood and local entrenchment. Local entrenchment has also accelerated bank erosion in some areas and may be the primary contributor to the slight increases of fine sediment over background levels. This is expressed in the level 3 attribute of sediment load of which also has decreased productivity in the egg incubation life stage. Other secondary level 3 attributes contributing to decreased productivity in the egg incubation

life stage are slight increases of temperature and decreased channel stability due to local entrenchment.

The high potential increases of abundance for spring Chinook in this reach are a function of both the potential productivity and capacity. Potential increases and factors affecting productivity are listed in the above paragraph. Potential increases in abundance from decreased capacity are associated with the loss of food resources from decreases of salmon carcasses that primarily impact the fry colonization and early stages of active rearing. Another factor that may be contributing to the mortality of over wintering life stages could be related to the cold temperatures. This hypothesis speculates the possible decreases of ground water sources offering pockets of refugia for overwintering life stages that will require further analysis and research. One caveat exists with this reaches ranking that is related to the stream reaches length. This reach is abnormally longer in length of which results in an increased capacity of area offered for all life stages. This will magnify the affects of the individual increases for restoration potential but because two of the three parameters rank very high individually, this reach would still rank among the top three if had a linear length equivalent to other reaches in the upper Klickitat.

2.) Klick 27

Description: Klickitat R- McCreedy Cr to Piscoe Cr

Length: 3.877 mi

Klick 27 restoration potential ranks 2nd among the upper Klickitat reaches for spring Chinook that incorporates potential for increases in productivity of 15%, increases in abundance of 11% and no increases for Life history diversity index. The high restoration ranking this reach has received is correlated to the potential increases of productivity primarily, the model also displays a substantial increase in abundance and should be viewed as an important component as well.

Of all the reaches in the upper Klickitat mainstem, this reach has the greatest linear length of hydro confinement due to the main road next to it. The stream bank has been rip rapped to protect the road in areas of which contributes to the simplification of habitat in isolated areas of this reach. From this, the model shows decreases of key habitat for several life stages that ultimately results in decreased capacity. The EDT model also shows a decrease of food resources due to declined number of salmon carcasses. This decrease in food source contributes to the declined capacity for several life stages that is expressed in decreased productivity and overall restoration potential for increases of abundance. Sediment load has been identified as a major limiting factor for several life stages. Egg incubation has the greatest decline in productivity due to fine sediment. Other life stages affected by fine sediment or turbidity include colonization, migrant and prespawning holding life stages.

3.) Klick 26

Description: Klickitat R- Chaparrel Cr to McCreedy Cr

Length: 2.70 mi

Restoration potential for Klick 26 consists of the following: 8% increase for abundance, 11% increase in productivity and a 0% increase in the life history diversity. The primary population parameter influencing the overall restoration potential is the potential this reach displays for increasing the populations productivity. Degradations undergone in this reach are very similar to the degradations

in Klick 27 that is located upstream. In fact, the analysis of klick 27 could be applied to this reach with one exception. This reach has a decreased linear length of stream bank influenced by hydro confinement than the amount in Klick 27. This is expressed in the habitat diversity level 3 attribute. If one was to look at the individual population parameter potentials, you'll notice that Klick 27 has a greater potential for the productivity parameter. This is directly related to the quality of habitat linked to the level 3 correlate habitat diversity. With this one exception, all other level 3 correlates affect similar life stages as those identified in Klick 27.

4.) Klick 25

Description: Klickitat R- Upper end of Castile Falls to Chaparrel Cr

Length: 3.038 mi

Restoration potential for Klick 25 consists of the following: 5% increase for abundance, 7% increase in productivity and a 0% increase in the life history diversity. Both abundance and productivity are key components for this reaches overall restoration potential. Within reach level 3 parameters affecting overall productivity and abundance are food and sediment load. Declined food resources are the result of decreased salmon carcasses affecting colonization and early rearing life stages. The model also identifies sediment load as a major level 3 component affecting productivity for egg incubation, spawning and migrant life stages due to increases of fine sediment and turbidity. Sources of increased sediment load occur upstream of this reach in tributaries exhibiting road densities from forest management activities. This reach offers a tremendous amount of habitat diversity with a healthy riparian corridor and wood recruitment that exhibits minimal physical alterations from anthropogenic impacts.

5.) Klick 28

Description: Klickitat R- Piscoe Cr to Diamond Fork

Length: 1.627 mi

Restoration potential for Klick 28 consists of the following: 4% increase for abundance, 5% increase in productivity and a 0% increase in the life history diversity. The ability of this reach to contribute to the overall steelhead productivity and abundance are both key components associated with the overall restoration ranking. Level 3 components identified by the model that are negatively impacting productivity include sediment load in the form of fines and turbidity, channel stability, and increased predation associated with the presence of hatchery fish. Although the presence of hatchery fish exists due to outplanting of adult spawners and parr, effects are minimal compared to sediment load and decreased food sources. Decreases in food sources identified from the model are a consequence of declined salmon carcasses. This decrease in food resource coupled with a slight decrease of key habitat for several life stages has reduced the overall capacity this reach once exhibited and is identified in the potential increases for abundance.

Appendix H. Pathogen Sampling

Summary of test results

LOCATION	DATE	SPECIES	SAMPLE SIZE	TESTED POSITIVE FOR	COMMENT
Bear Creek	10/10/02	*O. mykiss*	19	RS	+6/9 pools detected by ELISA, confirmed by PCR +3/3
					Gyrodactylus on the skin (low)
Brush Creek	10/9/02	*O. mykiss*	19	RS	+2/2 pools detected by ELISA, confirmed by PCR +2/2
Fish Lake Stream	10/10/02	*S. fontinalis*	8	RS	+2/5 pools detected by ELISA, confirmed by PCR +2/2
Fish Lake Stream	10/10/02	*O. mykiss*	1		All test results were negative
Klick. Hatchery Trap	10/10/02	*O. kisutch*	1		All test results were negative
Klick. Hatchery Trap	10/10/02	*O. tshawytscha*	7	RS	+1/3 pools detected by ELISA, confirmed by PCR +1/1
Klick. Hatchery Trap	10/16/02	*O. tshawytscha*	2	RS (suspect)	detected by ELISA, not confirmed by PCR
Little Klickitat River	10/9/02	*O. kisutch*	33	RS (suspect)	+2/18 pools detected by ELISA, not confirmed by PCR 0/2
Little Klickitat River	10/9/02	*O. mykiss*	2	RS (suspect)	+1/1 pool detected by ELISA, not confirmed by PCR 0/1
McCreedy Creek	10/16/02	*S. fontinalis*	6	RS (suspect)	+4/4 detected by ELISA, not confirmed by PCR 0/3
McCreedy Creek	10/16/02	*O. mykiss*	11	RS	+9/10 pools detected by ELISA, confirmed by PCR +2/3
					Epistylis on the skin (low), Spores found in heads, not *M. cerebralis*
Piscoe Creek	10/16/02	*S. fontinalis*	7	RS (suspect)	+4/4 detected by ELISA, not confirmed by PCR 0/3
Piscoe Creek	10/16/02	*O. mykiss*	20	RS (suspect)	+7/9 detected by ELISA, not confirmed by PCR 0/3
Summit Creek	10/9/02	*O. kisutch*	23	RS	+3/5 pools detected by ELISA, confirmed by PCR +2/3
Summit Creek	10/9/02	*O. mykiss*	11	RS (suspect)	+1/4 detected by ELISA, not confirmed by PCR 0/1
Surveyors Creek	10/10/02	*S. fontinalis*	4	RS	+1/1 pools detected by ELISA, confirmed by PCR +1/1
Swale Creek	10/9/02	*O. kisutch*	25	RS	+6/8 pools detected by ELISA, confirmed by PCR +3/3
					ELISA and virus pooled
					Neascus (Black spot) on the skin (moderate levels)
Swale Creek	10/9/02	*O. mykiss*	6	RS	+2/2 pools detected by ELISA, confirmed by PCR +1/2
					ELISA and virus pooled in 3 fish pools.
					Hookworms in the hind-gut (moderate levels)
Tepee Creek	10/9/02	*O. mykiss*	20	RS (suspect)	+2/2 pools detected by ELISA, not confirmed by PCR 0/2
Trout Creek	10/10/02	*O. mykiss*	20	RS	+8/8 pools detected by ELISA, confirmed by PCR +1/3
					Epistylis on the skin (moderate)
Upper Klick. Trap	10/10/02	*O. mykiss*	1	RS	+1/1 pools detected by ELISA, confirmed by PCR +1/1
					Dorsal fungus, possible injury
Upper Klick. Trap	10/16/02	*O. tshawytscha*	1	RS	detected by ELISA, confirmed by PCR, **Gross Kidney lesion**
White Creek	10/9/02	*O. mykiss*	22	RS	+5/5 pools detected by ELISA, confirmed by PCR +1/3
					Epistylis on gill (low)
Klick, above Castile	11/3/03	*O. tshawytscha*	19	RS	+2/5 detected by ELISA, confirmed by PCR +2/2
					Ich (heavy) on 2 fish, 2 fish adipose fin clipped
Klick, above Castile	11/3/03	*O. mykiss*	12		ELISA not detected, all tests negative
					Epistylis on the skin (low)
Klick, above Castile	11/3/03	*S. fontinalis*	1		ELISA not detected, all tests negative
Diamond Fork	11/3/03	*O. mykiss*	10	RS	5/7 detected by ELISA, confirmed by PCR +2/3
					Epistylis on the skin (low)
Diamond Fork	11/3/03	*O. tshawytscha*	5	RS	+4/5 detected by ELISA, confirmed by PCR +3/3
					all fish adipose fin clipped
Outlet Creek	11/3/03	*O. mykiss*	5		ELISA not detected, all tests negative.
					All fish assumed to be of hatchery origin

Explanatory statement is from Mr. Kenneth Lujan, the Microbiologist who performed the laboratory analysis.

Klickitat River sampling 2002

In October 2002 [and November 2003], the Lower Columbia River Fish Health Center, with the cooperation of the Fisheries Resource Management of the Confederated Tribes and Bands of the Yakama Nation, examined 442 fish from 20 sites. The fish examined included brook trout, rainbow trout, coho salmon, steelhead, and spring chinook salmon. They were examined using the protocols

from the Laboratory Procedures Manual for the National Wild Fish Health Survey. Overall, the fish appeared to be in good health. Only one fish showed signs of an active bacterial infection. A spring chinook salmon smolt from the upper Klickitat River trap had a swollen, grossly infected kidney. It was positive for *Renibacterium salmoninarum*, bacterial kidney disease (BKD. *Renibacterium salmoninarum* (Rs) is a gram positive, fastidious, slow growing bacillus. It is nonmotile, nonacid-fast and does not produce spores. BKD has been detected in both free ranging and cultured salmonids. All species of salmonids are susceptible to BKD in varying degrees. Pacific salmon are the least resistant, whereas rainbow trout are the most resistant (Lesee 1995). The disease can be transmitted both horizontally, possibly by ingestion of feces from infected fish, and vertically, through infected gametes. Some investigators propose that all fish are carriers of Rs and the disease occurs only when the conditions are favorable to the bacterium. Therefore, like most diseases of fish, stress plays a key role in the severity of the disease (Lesee 1995).

The enzyme-linked immunosorbent assay (ELISA) is a highly sensitive and complex protocol that requires careful preparation of assay reagents and strict adherence to protocol. It was selected as the most sensitive screening method for Rs antigen in both salmonid and non-salmonid fish species tested for the survey. As a confirmation method, subsets of samples containing the highest optical densities values (ODs) from each ELISA assay were tested for the presence of Rs DNA by the Polymerase Chain Reaction procedure (PCR). Eleven of 17 sites had optical densities of Rs antigen detected by ELISA and tested positive for Rs DNA by PCR. In addition, Rs was found in all six species. Six of 17 sites had optical densities of Rs antigen detected by ELISA but tested negative for Rs DNA by the PCR technique.

There were a couple of parasites detected during the examination. Coho salmon from Swale Creek and the Little Klickitat River had moderate levels of *Neascus* (Black Spot Disease) on the skin. *Neascus* may cause mortality, especially when infections are heavy and water temperatures decline. Black spot disease exhibit numerous black raised nodules (1-2 mm in diameter) in the skin, fins, and gills (Lesee 1995).

Steelhead from White Creek had moderate levels of *Epistylis* on the gills. *Epistylis* is a very common parasite in fishes and can sometimes contribute to mortality due to partial smothering of the gills.

References:

Lasee, Becky. 1995. Introduction to Fish Health Management.

True, Kimberly. 2000. National Wild Fish Health Survey. Laboratory Procedures Manual.