YUKON RIVER NORTH MAINSTEM STEWARDSHIP

2013

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Prepared for:

Yukon River Panel

Canada

ACKNOWLEDGEMENTS

We would like to thank Hans Algotsson, our field supervisor, and our two student employees, Emily Hume and Emma Morin for all their hard work in the field during the summer. Andria Oppen made the Public Day successful, and Al von Finster provided technical assistance and advice to the staff. Sean Collins and Jody MacKenzie-Grieve's assistance with DNA component of the project is appreciated. We are grateful to the Yukon River Panel for recognizing the importance of our project and providing funding for it.

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ABSTRACT

The primary goal of this project was to build community capacity to maintain and protect salmon and their habitats in the Dawson region through involvement and education of local youth. Two local high school students were hired as Student Stewards and supervised by an experienced field technician. Hands-on training was provided to the youth as they carried out meaningful activities. These included restoring Chinook salmon to productive rearing habitats, salvaging juvenile Chinook from isolated pools, mapping habitats using quantitative methods, conducting juvenile Chinook salmon growth monitoring, investigating the timing and extent of juvenile Chinook salmon presence and abundance, ground-truthing GIS-based mapping, collecting DNA samples, and learning about bio-engineering techniques. Project planning was conducted in consultation with DFO and informed by our record of past activities. The crew started field work on July 8 and ended on August 9, 2012. Weather and river conditions were excellent during the field component of the project. Most planned activities were completed but were affected by alarmingly low numbers of juvenile Chinook in the Klondike watershed. The Public Day, an open invitation to local residents, was held near the Klondike river isolated pool fish salvage project area on July 19. The Student Stewards demonstrated the skills they had acquired and shared their knowledge with the 44 participants. Assessment sampling in the Fortymile River drainage was not possible due to heavy precipitation in early September. Despite the low numbers of juvenile Chinook in the Klondike, the project was a success. We believe, will contribute significantly toward meeting our long term goal for the future of salmon in the Dawson area.

INTRODUCTION

In the early 2000s Tr'ondëk Hwëch'in elders and other Dawson locals raised concerns that salmon rearing and spawning habitat had been diminishing within the Tr'ondëk Hwëch'in traditional territory. Technical investigations by the YFWMB Dawson Area Community Steward and the Department of Fisheries and Oceans Salmon Enhancement Program (SEP) staff on non-spawning streams in the Dawson area confirmed that beaver dams and other non-permanent barriers had obstructed the upstream movement of salmon fry into known rearing and overwintering habitat. (Jones 2005, von Finster 2005b & 2005c) Additionally, significant numbers of fry were found after the spring freshet in isolated pools in the Klondike River valley (von Finster 2004b & 2005a).

This provided an opportunity for the DDRRC to hire local youth for a project where they would be engaged in salmon habitat restoration, conservation and management activities. The model chosen by the DDRRC was to hire two local high school students and an older, experienced local field supervisor. A pilot project took place in 2006, and provided important information for the planning of the 2007 project. The project has been conducted every year since. Pre-season planning and in-season implementation has built on the results of past seasons. These results have been recorded in the "Record of Activities" which was updated at the conclusion of each field season. The Record is provided in Appendix D.

PROJECT GOAL AND IMPLEMENTATION STRATEGY

The goal of the 2013 project was to continue to develop and maintain community capacity in the Dawson City region to protect, maintain and restore salmon stocks and habitats. We concentrated on Chinook salmon due to the presence of the juvenile life stage throughout the summer, the priority that Dawson residents afford this species, and opportunities for the Stewards to carry out meaningful activities in non-hazardous waters. Our strategy was to hire two local high school students from early July to early/mid-August. Both Student Stewards were new to the project. As Student Stewards, they worked under the Field Supervision of an experienced elder and the guidance of a Technical Advisor. The Student Stewards were provided with a wide range of hands-on training through participation in a variety of salmon and salmon habitat management and research activities. The planned project activities reflected the expected juvenile salmon supply and environmental conditions, and the implementation reflected the actual field conditions. The context of all activities undertaken was explained to the students: they learned both *how* and *why* the activity was undertaken. The youth demonstrated their acquired skills and knowledge to children and community members during the Public Involvement Day. The existing "Record of Activities" was updated. Two monitoring and assessment sampling events took place: the first, in early June 2013, was to determine whether juvenile Chinook salmon had successfully overwintered in the areas to which they had been restored to in 2012. The second, in mid-September, was to determine rates of growth in populations of juvenile Chinook salmon that had been restored to Clinton Creek and the Viceroy Channel and those utilizing the Klondike Rive at the Boat Launch Monitoring Station. Both sampling events were conducted as in kind contributions to the project In 2013 both sampling investigations were negatively affected by high water.

RELEVANCE AND SIGNIFICANCE

This annual project is both relevant and significant to the maintenance of the constituency for salmon and salmon habitat in the Dawson area. In the Dawson community, "maintain" is a critical concept: although the cultural value of salmon is widely recognized, the community realizes little economic benefit from the salmon fishery. Significant economic benefit is realized from mining and related activities. Salmon are seen by many in the mining industry as an impediment to development and an added expense as they work hard to support their families. Children in Dawson are raised in this social environment. Many or most will enter the mining or associated industries either as a career or as seasonal workers to fund their education. Our annual projects

continue the work of ourselves and others in raising public awareness as a critical, local component in building and maintaining a constituency for salmon. We are extending a process that started in the early 1990s and has continued through community projects funded by a wide range of programs, agencies and entities. They have included the Yukon River Panel under the both the Interim and Final agreements; projects sponsored or supported by DFO under the Yukon-Canada Economic Development Agreement and other funding programs and those funded by DFO under the Habitat Conservation and Stewardship Program (HCSP), the Habitat Restoration and Salmon Enhancement Program (HRSEP) and various funding sources within the Salmon Enhancement Program (SEP). Notably, the high school students we now hire had not been born when the Dawson community first sought funding to invest in the future of our salmon.

In our 2006 Pilot Project we selected the local community of Dawson City as our target group. We chose local high school students as the most effective means of reaching the larger community. As Student Stewards, they inform their peers and parents of their activities during the course of the project and the following winter. They also explain their activities, and the value of the Klondike River to salmon, at the Public Involvement Day. This is of particular importance to the younger children who attend the event. Children tend to look up teenagers and accept them as role models. Having youth as the educators at the Public Involvement Day is a powerful means of transferring information to, and wakening interest in, the younger children. Our goal is not only the present community of Dawson, but also the future community.

The Student Stewards' exposure to salmon and salmon habitat and related research activities may influence the educational and career paths they will follow. We recognize that most youth will leave Dawson and travel to Whitehorse or much further for their education or to experience the larger world. This is expected of young people. However, we anticipate that many or most will eventually return to Dawson. They will then contribute and perhaps provide leadership to our community in the management of our lands, waters, and the salmon that depend upon them. They will become the constituency of the future for salmon.

PLANNING

Most project planning took place during the Detailed Proposal phase of the application process. The "Yukon River North Mainstem: 2012 Record of Activities" was reviewed, and the recommendations considered in the planning process. The details of the project were discussed with Fisheries and Oceans Canada Resource Restoration Biologist Sean Collins, and a common understanding was achieved.

A primary consideration was being in compliance with the Yukon Government's Code of Practice for Young and New Workers. The Code recognizes the vulnerability of young workers to injury and reinforces the principles of employer responsibility to both protect and to develop the young workers. It also compels us to carefully consider potential activities for the Stewards to ensure that societal values regarding risk are not exceeded. Unfortunately, it severely constrains our ability to conduct any boat-supported work or work in or near deep and/or swift water. We therefore concentrate on juvenile-related activities, or observations of adults from shore or overhead (i.e. Dempster Bridge) structures.

A number of Field activities were planned for the Student Stewards in 2013. These included:

- Juvenile Chinook salmon salvage from isolated pools;
- Introduction to Riparian Restoration live staking;
- Rearing habitat characterization and mapping: Germaine Creek Ground Water Channel;
- Overwintering habitat access: Viceroy Ground Water Channel;
- Yukon Placer Fish Habitat Suitability Map ground truthing;
- Juvenile Chinook salmon habitat utilization and assessment;
- Application of fish and fish habitat information in infrastructure renewal planning;
- Restoration of Chinook salmon to productive habitats upstream of non-permanent obstructions;

- Acquisition of samples from juvenile Chinook salmon for genetic analysis;
- Delivery of the Public Involvement Day.

Outcomes for most of the planned activities were identified in our Detailed Proposal and are included in the "Summary" section of each activity.

IMPLEMENTATION

Funding was confirmed on April 9, 2013 and the contract with the PSC was signed on May 17th.

The Key Personnel identified in our Conceptual and Detailed Proposals were available. Hans Algotsson returned as the Field Supervisor, Al von Finster as the Technical Advisor and Andrea Oppen as the Public Involvement Day Co-ordinator. Project coordination and communication was provided by the author in her role of Dawson District Renewable Resource Council Executive Secretariat.

A 4 x 4 SUV was provided by Hans Algotsson to transport the crew.

Equipment was taken out of storage, checked and serviced.

On April 4 an application was made to DFO for a Scientific Collection License to authorize fish sampling. License XR 91 2013 was issued on May 2. A summary report was submitted to DFO Licensing on October 29, 2013.

On June 2 and 3, 2013 the annual spring assessment sampling to investigate success of overwintering was conducted. Sampling was delayed due to the late spring thaw. When the weather warmed it did so very quickly, resulting in near catastrophic stream flows in area streams and rivers including Clinton Creek, Mickie Creek, the Klondike River and the North Klondike River. Valley bottom inundation occurred on the Klondike and North Klondike Rivers. Flows had subsided in Clinton Creek by the time sampling took place. The North Klondike River was in flood and the Klondike River was high. No overwintering Chinook were captured, and very few non-salmonids.

On May 7th the hiring process began.

The Field Work component for the project commenced on July 9, 2012. The Student Stewards were briefed in accordance with the Orientation requirements of the Yukon Government's Code of Practice for Employers of Young and New Workers. This included identification of the Field Supervisor, location of First Aid facilities, procedures for the reporting of illnesses and injuries, emergency procedures and the rights and responsibilities of both workers and employers to maintain a safe workplace. The Training requirements of the Code took place throughout the project. It included instruction and demonstration of tasks and work processes, and observation of the Student Stewards performance. Hazards were identified to the Stewards, and personal protective equipment was provided.

The Schedule was generally followed, although some modification was required due to scheduling conflicts and the very low numbers of juvenile Chinook salmon captured in the Klondike River in 2013.

The spring snow melt throughout the Yukon was late in 2013. When it did occur it resulted in very high freshet flows in all Yukon River North Mainstem streams. The freshet was followed by dry and warm weather that extended through the field work component of the project. Stream flows diminished. By the end of the project

flows in the Klondike River were lower than they had been in years. Overall, the environmental conditions for sampling were good to excellent during the field work period. A period of precipitation immediately preceding the September assessment sampling resulted in flows rising to the point where the sampling was negatively affected.

Each of our proposed activities is reported on in the following section. The title is followed by the metrics we proposed to report our "outcomes". The Summary section provides the data or a summary statement. Where the activity was scientific or technical in nature a short report follows the Summary section. The Public Involvement Day report is provided as Appendix A.

Student Stewards – outcomes reported as days worked.

The Student Stewards worked 25 days each, for a total of 50 days.

Neither Student had worked for us in past years. Emma Morin had completed Grade 10 and Emily Hume had completed Grade 11. Both have returned to school this autumn.
Prior to the project commencing they received Bear Awareness training and Standard First Aid. After orientation they received a combination of hands-on training and stream-bank seminars in aspects of salmon sampling and salmon habitat management, mapping, and research. Each of the following activities contributed to their education.

Public Involvement Day – outcomes reported as numbers of participants.

A total of 44 persons plus staff participated in the Public Involvement Day. Please see Appendix A for a report on this activity.

Salvage of salmon from isolated pools – outcomes reported as the total number of fish, by species.

Summary: A total of 3 juvenile Chinook salmon and 57 Slimy Sculpin were salvaged.

Introduction: Salvage occurred in the Germaine Creek avulsion. This is a section of Klondike River channel that carries surface flow during the spring freshet or summer high water events. Surface flows generally cease in late May or early June. Shallow pools remain and are isolated from surface flows. Large numbers of 0+ juvenile Chinook may be trapped in the pools: in 2007, for example, 1297 were salvaged (Smart, 2007). The pools heat up during the long days of early summer, with temperatures regularly above 25 degrees in mid-day. During the high temperatures the salmon congregate around cooler ground water seeps in the upstream end of the pools. The salvage component of the project is generally our first activity as it provides a good opportunity to train the Students in the capture of juvenile Chinook salmon and in the respectful handling of captured fish. It also provides an early indication of the general abundance of juvenile Chinook salmon in the Klondike River.

Methods: The salvage commenced on July 9 and extended to July 12. Minnow traps were used and were baited as per the Fisheries and Oceans Canada "Protocol for the baiting of Gee-type minnow traps for the capture of juvenile Chinook Salmon in the Yukon River Drainage Basin" (the DFO protocol). A total of 22 trap nights was expended. All fish captured were enumerated and placed in buckets. The buckets were carried by hand to the Klondike River or into waters that will have surface flow into the Klondike River throughout the summer. We had planned to weigh and measure 30 of the salmon to be salvaged.

Results: A total of 3 juvenile Chinook salmon were salvaged, including 1 on July 10 and 2 on July 11. Sculpin captures were 41 on July 10, 13 on July 11 and 3 on July 12. Weights and lengths were not determined due to the very low numbers of salmon captured.

Discussion: The 3 juvenile Chinook salmon salvaged in 2013 was the lowest number captured since salvage started in 2007. It was 387 less than the 2006 – 2011 average of 390 Chinook salvaged. This is despite the same methods in the same location being used at effectively at the same dates. The lack of juvenile salmon captured was attributed primarily to a lack of juvenile salmon in the Klondike River at the time the pools were isolated. The size of the pools depends on the annual scour during the spring freshet. It appeared that the pools were smaller than usual in 2013.

Conclusion: The very low numbers of Chinook captured were compared to the much greater captures in certain past years to demonstrate the variability possible in natural systems to the Stewards.

Riparian bio-engineering introduction – outcomes reported as result of the activity.

Summary: The Student Stewards were shown the Germaine Creek Avulsion bio-engineering project. The objectives and methods used were described and the challenges encountered were discussed.

Introduction: The Klondike River at Germaine Creek Restoration Demonstration Project was conducted in 2004 (Miles & Polster, 2004) and monitored in 2005 (Miles & Polster, 2005) and 2006(Miles & Polster, 2006). Two bio-engineering techniques were used: palisades, where large diameter (>8 cm) stem segments were buried in closely spaced rows along the river bank; and gravel bar staking, where smaller (<6 cm diameter) stem segments were buried in loosely spaced rows on top of one gravel bar on the left side (looking downstream) and one on the right side of the channel. All stakes were greater than 1 meter in length. A tracked excavator was used to apply the stakes.
The palisades were largely composed of cottonwood cuttings. After apparent initial success, the cottonwood stems were afflicted in mid-summer 2005 by an unidentified fungus. By 2006 only the willows remained alive. The area is now densely covered with young alder.
The right limit gravel bar staking has been subjected to annual ice scour. This results from the avulsion channel acting as a high water overflow channel during breakup. It is not possible to determine which of the willows that sparsely cover this section resulted from gravel bar staking and which did not. The left limit gravel bar is not scoured by ice, and success of the live plantings is high.
The final assessment of the live staking project took place in 2012 (Taylor 2012).

Methods: The Student Stewards were shown the various components of the site. The original objectives of the project were provided and the planning process described. The methods of live staking were described including identification and harvesting donor stock and placing of the stakes. The methods and results of the performance assessments were described. The challenges of applying standard methods developed in temperate regions to northern areas were discussed.

Results: The Student Stewards showed interest and absorbed the information provided.

Discussion: Live staking is a low tech activity and is uniquely suited to reclamation of lands disrupted by placer mining. It is likely that the Student Stewards will describe the principles that they have learned to friends and family that own or operate mines. Additionally, the Germaine Creek Avulsion Bio-engineering project is one of the few physical projects funded by the YR R&E Fund that followed the Assess-Intervene-Evaluate model. This allowed us to introduce the Student Stewards to the method.

Conclusions: The Student Stewards were provided with information regarding the art and science of bio-engineering and insight to the process of project planning, implementation and evaluation.

Overwintering habitat characterization and mapping - outcomes reported as the number of sites mapped and the total area of each site

Summary: The Germaine Creek Avulsion Channel (GCAC) was mapped. The channel has an effective estimated wetted area of 32339 square meters, of which 8370 square meters has a boulder substrate.

Introduction: The GCAC is about 2 kilometers long. It carries significant flows and ice loads during breakup and is scoured annually. It may carry some of the surface flows of the Klondike River during the summer following precipitation events. When surface water does not enter the upstream end of the channel from the Klondike River the flows and wetted perimeter of the GCAC are very stable. Much of the flow results from discharging ground water. Germaine Creek enters the channel from the south. This creek has a complex flow path. It has a deep valley and surface flows until it enters the Klondike River valley. It then appears to flow overland or to go underground, as it does not have a defined channel that extends to the Klondike River (Department of Fisheries and Oceans, 1992). Discharging ground water is gathered upstream of the Dawson Road and conducted under the highway through a culvert. The flow at the culvert is called "Germaine Creek". Juvenile Chinook salmon utilization, including overwintering, has been extensively investigated in the GCAC and adjacent waters such as the isolated pools located just upstream (Netro, 2008; Smart, 2006 & 2007; Taylor, 2010, 2011 & 2012; von Finster, 2004a&b and 2005 a-d).

Methods: Assessment and mapping of the channel took place on July 22 and 23. The 2012 data entry form was modified and printed on waterproof paper. The value of rearing and overwintering habitat was discussed with the Student Stewards. The Field Supervisor provided on-site training in data collection and recording. Channel assessment methodology described by Newbury and Gaboury (1993) was modified to determine the wetted area. A 0+000 station was established at the downstream limit of the stable channel and was geo-located with an etrex GPS. . The channel was measured at right angles to the direction of flow from the left water's edge to the right water's edge with a cloth engineers tape to determine *wetted width*. The wetted width was multiplied by 5 to determine the distance to the next station upstream, which became 0 + the measured distance. The process was repeated to the upstream end of continuous surface flow. The *wetted area* was calculated from the mean value of measured widths of up- and downstream stations multiplied by half the distance to adjacent up- and downstream stations. Maximum water depths were not determined as a thalweg was not apparent. Substrate composition was estimated using the Wentworth classification as modified by Bain and Stephenson (1999). In this classification, particle size of sand is < 2 mm; pebble is 2 – 64 mm; cobble is 64-265 mm, and boulder is >265 mm. Stream gradient was not determined as it is too low to be accurately measurable by hand-held clinometers.

Results: The measured length of the channel was 1663 meters. The wetted width of the channel was measured at 37 stations. The estimated total wetted area was calculated to be 32339 square meters. Boulder substrate underlay 8370 square meters, or 26% of the total area. The boulders are part of the Klondike River valley train and are similar in shape and form to those on top of the dredge piles in the lower Klondike Valley.

Discussion. The GCAC is ground water fed and has stable flows for most of the year. Once the surface inflow ceases during the falling limb of the spring freshet the wetted area is stable. The majority of the wetted area is available as rearing habitat for juvenile Chinook salmon throughout the open water period. A portion of the channel has winter flows and supports overwintering. The amount of overwintering habitat is likely related to the composition of the stream bottom. The boulders are not embedded, allowing small fish such as juvenile Chinook to enter the substrate. This provides cover from predators such as mink and otter and from larger fish such as Burbot. .

Conclusion: The Student Stewards were introduced to one of the quantitative measurement methods of mapping fish habitat.

Klondike River juvenile Chinook implied abundance and growth monitoring - outcomes reported as numbers of salmon captured, numbers sampled, basic statistical analysis and provision of raw data to interested agencies

Summary: Very few juvenile Chinook salmon were captured at the Boat Launch Monitoring Station (BLMS) in 2013. On July 19, 5 Chinook were captured and September 12, 1 Chinook was captured. These numbers were insufficient for growth monitoring.

Introduction: The BLMS is located downstream of, and across the river from, the mouth of the North Klondike. It is immediately downstream of one of the primary Chinook spawning sites on the Klondike River. The BLMS provides safe parking and easy access to the river. The river channel is laterally unstable, with bank erosion and bar creation. Large organic debris is deposited on the bars and forms log jams. High flows scour the channel beneath and behind the jams. This contributes to a high level of channel complexity for small fish such as juvenile Chinook salmon. Sampling in this area usually results in high levels of success. Little ground water discharges at the BLMS during the open water period. Thermal regimes are representative of surface water. Sampling takes place in July and September with a desired sampling size of 30 or more salmon per sampling period. The objective of the sampling is to determine implied abundance through numbers captured and an index of growth. Growth is determined by calculating the mean daily increase in fork length between the sampling periods.

Methods: Minnow traps baited and set as per the DFO protocol were used. All fish captured were enumerated by species. At each station all 0+ juvenile Chinook salmon captured were sampled. Fork lengths of each Chinook were measured to the nearest 1 mm, and weights were determined to 0.1 gram with a Ohaus HH120D digital scale.

Results: Captures of juvenile Chinook salmon were very low despite favorable sampling conditions in the July sampling period. The mean fork length of the 5 Chinook captured in July 2013 was 57 mm. The single Chinook captured in September 2013 had a fork length of 84 mm.

Discussion Very few Chinook salmon were captured at the BLMS in 2013. The implied abundance was correspondingly low. The numbers of juvenile Chinook captured and sampled fell well below the desired sample size of 30 per sampling period. They were insufficient to allow statistical analysis.

Conclusion: The results of this component of the project were supported by all other sampling conducted in the Klondike River in 2013, and emphasized the variability of natural systems.

Yukon Placer Fish Habitat Suitability (YPFHS) Map - Klondike River ground truthing - outcomes reported as locations and numbers of sites investigated and the results reported to DFO.

Summary: In 2012 nine water courses were identified from the YPFHS map as having potentially questionable Classifications. Eight of the 9 water courses were identified where they crossed the Dawson Road, and one could not be found. Seven of the 8 identified in 2012 were sampled in 2013. Fish were only captured in 2 of the 8 streams, and juvenile Chinook Salmon were only captured at one. In both 2012 and in 2013 sampling was negatively affected.

Introduction: The YPFHS classifications were computer-generated and based on existing 1:50,000 maps (Yukon Placer Secretariat, 2007). Many or most of the 1:50,000 base maps were drawn from aerial photographs taken in the 1940s and 1950s. The YPFHS classification model uses stream gradient and distance from a Chinook salmon spawning or migration route as primary determinants of habitat suitability. The classifications were not ground-truthed in the lower Klondike valley. Many are believed to be inaccurate. As an example, the first series of maps showed the North Klondike River as flowing down the Klondike ditch instead of in its real location.

The inaccurate classifications are most apparent in small streams with limited watershed area. Contour lines and drainage courses on all original 1:50,000 maps were hand drawn decades ago by technicians using the aerial photographs as a guide. Channels were drawn where none existed or currently exist. The computer-generated placer classification maps show many small tributaries as being valuable Chinook rearing streams. These are considered as: "Moderate-high suitability habitats…defined as watercourses…highly suitable for rearing juvenile Chinook salmon". However, many streams with this classification have ephemeral or intermittent flows. Others drain to ground or to flow overland (ie no defined stream channels) through wetlands before entering the Klondike River. Neither type is likely to have been used in the past or to be used in the future by juvenile Chinook salmon. The high fishery values attributed in error to dry or non-existent streams erode confidence in agency capabilities. Restrictive conditions may be needlessly placed on placer miners. The miners may be faced with added expense and delay in preparation of applications etc. They may be denied access to gold to which they have the right to mine. Although the Fish Habitat Suitability maps were only to be applied to the Placer industry, they are used much more widely. They may affect the activities of other users, such as Highways, Forestry, etc. or contribute to Land Use Planning processes.

Methods: Streams were identified in 2012, which became Year 1 of the invstigation. Between July 17 – 19, 2013 we set 2 minnow traps at each crossing of the Dawson Road. The traps were baited and set as per the DFO protocol, which is effective for the capture of juvenile Chinook salmon and Slimy Sculpin. These are two of the three most likely fish species to be present in smaller streams. Minnow trapping is ineffective for the capture of arctic grayling, which is the third species. The traps were set for two nights, with a total of 4 trap nights per stream crossing.

Results: In 2012 we were unable to provide accurate co-ordinates for the crossings due to problems with our GPS. In 2013 we were able to determine the co-ordinates, which are listed below.

Alki Cr.	64 03.67/138 59.43
Germaine Cr.	64 03.062/138 54.819
Goring Cr.	64 02.549/138 53.066
Leroy Cr.	64 01.975/138 47.601
Un-named Cr.at Dempster turnoff)	64 00.087/138 45.405
Leotta Cr.	63 58.477/138 44..398
Too Much Gold Cr.	63 57.477/138 42.664

In 2013 two juvenile Chinook Salmon and 8 sculpins were captured at Germaine Creek and one Sculpin was captured at Un-named Creek. No fish were captured at any of the other creeks.

Discussion: No fish of any kind were captured in 2012. Fish were only captured in Un-named Creek and Germaine Creek in 2013. In 2012 sampling was negatively affected by an intense rainfall immediately preceding the investigation. In 2013 the number of Chinook salmon were so low that captures of salmon in these small streams would have been very unlikely even had they been accessible to the salmon. Accessibility is mentioned due to the general absence of fish and particularly juvenile Chinook Salmon captured in past sampling at certain creeks. This included an investigation of Germaine

Creek by DFO in 1991. No fish of any kind were captured or observed in the mid reaches of the creek, and no defined channel could be observed across the alluvial fan between the Germaine Creek valley and the Dawson Road (Department of Fisheries and Oceans 1991a). Goring Creek was also investigated by DFO in 1991. No fish were captured or observed at the Dawson Road Crossing. We sampled Too Much Gold Creek in 2008 and Sculpin and captured Sculpin (Netro, 2008). More recently the creek was sampled in conjunction with highway reconstruction planning. Grayling and Sculpin were captured in downstream beaver ponds (de Graff, 2011) but not at the culvert.

Conclusion: The Student Stewards were introduced to the challenges of applying computer generated models based on mapped products to the actual, physical world. It also provides insight into the risks that limited numbers of samples will not

On-site with Yukon Government engineers to raise awareness of the application of fish and fish habitat information in infrastructure renewal planning - outcomes reported as whether it occurred

This did not occur. Contact was made with senior Highways Transportation Engineering staff, but schedules could not be co-ordinated with working level staff. This is understandable, given the extent of infrastructure damage due to the late and extended 2013 freshet.

Restoration of Chinook salmon to productive habitats upstream of non-permanent obstructions – outcomes reported as numbers of Chinook Salmon restored to productive habitat, numbers sampled, basic statistical analysis and provision of raw data to interested agencies.

Summary: A total of 681 juvenile Chinook Salmon were restored to productive habitat upstream of beaver dams on Clinton Creek. The perched culvert at the Mickie Creek stream crossing was monitored. As a result of wildfire related landslides in the upper creek valley and high flows resulting from major precipitation and rapid snowmelts between 2010 and spring of 2013, the creek is carrying a heavy bed load. This has raised the stream bottom. The culvert outlet was not perched and was not an obstruction to upstream migration by juvenile Chinook Salmon in 2013.

Introduction:

The Clinton Creek watershed contains the site of the abandoned Clinton Creek Asbestos Mine. The creek is unique in that it drains un-glaciated terrain while supporting a number of beaver colonies. On August 10, 2006, for example, 17 beaver dams were observed between the mouth of Clinton Creek and the mine site during an over flight (von Finster, 2006). Beaver are usually not able to maintain colonies on creeks in the "V" shaped valleys typical of the non-glaciated portion of the Yukon. This is due to the violent spring freshets and rapid responses to summer rainfall events characteristic of these streams. Beaver are able to dam Clinton Creek due to buffered stream flows resulting from an artificial lake in the upper watershed. This feature, Hudgeon Lake, formed when approximately 60 million tonnes of waste rock that had been dumped onto the ridge top failed and slid across the valley. Hudgeon Lake is 2100 metres long, has a surface area of 64 hectares and a volume of approximately 10 million cubic metres of water (AECOM, 2011). It provides temporary storage for water flowing from the upper valley and reduces the intensity of flows downstream. The lake provides a thermal subsidy to the creek downstream of the outlet during the open water period. Water temperatures may be very high, with a maximum hourly temperature at the lake outlet of 26.75 recorded in July 2007. The high temperatures may be sustained: in 2007, for example, temperatures over 20 degrees were measured on every day between July 11 and 30, and on 11 days in August (von Finster, 2007). Aquifers have formed in the waste rock deposits and in redistributed granular material transported downstream. This material is forming an alluvial cone that is currently about 700 meters long. Ground water discharges from the aquifers at a cooler temperature than surface waters. It both mediates high stream temperatures and provides a wide range of thermal habitats that small fish such as juvenile Chinook salmon can use for various activities such as feeding, resting, refuge, etc. The result has been a highly productive habitat

complex extending from the lake outlet downstream for about 1.5 km. Young-of year juvenile Chinook salmon were first restored to the creek in this area in 2006 (Smart, 2006). The activity has been conducted annually since. Mid-September sampling is conducted to monitor and evaluate the growth of juvenile salmon at the mine site. In some years the growth of juvenile Chinook salmon has been remarkable. The summer of 2007 had near perfect conditions: the creek had, and maintained, low/moderate flows. It was warm, increasing invertebrate productivity. The large numbers of ground water discharges appear to have provided adequate thermal refuge for fish. A total of 2070 juvenile Chinook salmon were restored to these habitats at the mine site in July and early August (Smart, 2007). Some juveniles migrated upstream from the release site: in mid-September 2007, 13 were captured at Station 1, which is the upstream limit of migration below the lake outlet. The mean fork length of this group was 99.77 mm, and the maximum length was 111 mm (von Finster, 2007). This shattered the old record for a 0+ Chinook of 100 mm fork length. The past record fish had been captured in the Fortymile River in late August, 1987 (Jaromovic & von Finster, 1988).
The lake and several smaller water bodies formed by tailings and other waste rock failures in tributary valleys now provide reservoirs for surface waters and are recharge areas for ground water. Some groundwater discharges continue throughout the winter. Yearling Chinook have been captured at the mine site in May (Mackenzie-Grieve, 2011) confirming successful overwintering.
Mickey Creek is crossed by a culvert on the Clinton Creek road. The culvert was poorly placed and the outlet is generally perched above the downstream plunge pool. The creek is unregulated. In 2004 approximately 85% of the watershed area was burned by wildfire. A significant number of slope failures soon followed (Lipovsky et al, 2005). The upper watershed further destabilized during the catastrophic precipitation events of early August, 2010. One or more sediment wedges is moving down the creek. In 2012 a wedge was passing through the culvert and the outlet was backwatered. Juvenile Chinook had unobstructed upstream passage, and restoration undertakings were not warranted. In years where upstream migration is blocked, significant numbers of juvenile Chinook may be denied access to the upper creek: in 2007, for example, 1273 Chinook were captured below the culvert and released above it. Since 2006 the average annual number of fish captured and moved to upstream habitats in Mickey and Clinton Creeks has been 1056. Clinton Creek is an example of a non natal rearing stream and is a significant distance from major spawning areas.
DNA samples have been collected during this activity in 2009, 2012 and 2013.

Methods: Restoration activities commenced on July 30 and were completed on August 7. Minnow traps were set on Clinton Creek between the Town site Ford and the mouth. Both areas are within Station 4. The minnow traps were baited and set as per the DFO protocol. All fish captured were enumerated by species. All 0+ juvenile Chinook salmon captured were placed in a container and moved to the restoration site at Station 2A, at the mouth of Wolverine Creek. An air pump was used to maintain oxygen levels during transit. A total of 29 and 30 juvenile Chinook was randomly selected on July 31 and August 1 respectively and were weighed and measured. On August 6 and 7, 100 and 59 juveniles were weighed and measured in conjunction with the collection of tissue samples. Fork lengths were measured to the nearest millimetre using a smolts board. Fish were then blotted to remove excess water and weighed to the nearest 0.1 gram using an Ohaus HH120D digital balance that had been calibrated and placed on a level surface. The site was attended on September 11 for monitoring and evaluation. However, the creek flows were high and rising. Sampling could not be safely or effectively conducted.

Results: A total of 685 juvenile Chinook salmon were captured and restored to productive habitat. Daily counts were: 59 on July 30; 50 on July 31; 24 on August 1 (a bear opened most of the traps); 198 on August 5; 291 on August 6; and 59 on August 7.
Of the total of 685 juvenile Chinook Salmon captured, a sub-set of 278 were sampled over an eight day period. The daily numbers (n), fork lengths (fl) and weights (w) of the sampled Chinook follows: on July

31, n=29, mean fl 63.48 mm, range 55 – 70 mm, mean w 2.5 g, range 1.9 – 3.7 g; August 1, n=30, mean fl 65.44 mm, range 55 – 75 mm, mean w 2.7 g, range 1.8 – 3.8 g; August 6, n=100, mean fl 64.597 mm, range 52 – 81 mm, mean w 2.8 g, range 1.4 – 5.0 g; August 7, n=59, mean fl 68.08 mm, range 66-74 mm, mean w 3.4 g, range 2.0 – 5.5 g.

Discussion: The initial low daily numbers of juvenile Chinook captured followed by a series of greater daily numbers imply that the immigration of juvenile Chinook salmon to Clinton Creek occurred slightly before we started this activity. If so, it was 2 - 3 weeks later than usual. Data from past years is limited, but in 2006substantial immigration commenced between July 7 and 12 (Smart 2006); 2007, prior to July 18 (Smart 2007) and in 2010 prior to July 16 (Taylor 2010). The Chinook may have originated from any of the 100 or more salmon spawning stocks located upstream of the Fortymile River.

The 685 juveniles restored to productive habitats in Clinton Creek during 2013 fell below the mean annual (2006 – 2012) number of 730. Collection of juveniles at Station 4 was hampered due to disturbance by three separate black bears. Placing the traps in deeper water did not deter the bears. It had the unintended and unfortunate result of the bears destroying the traps while attempting to pull them out of the water. By the third day of collection the bears were disturbing almost all traps left overnight. We mitigated this by setting traps in the morning, leaving them for 2 hours and then removing the salmon which had been collected. This was repeated in the afternoon, after which the crew returned to Dawson and the Technical Advisor continued into the evening. This negatively affected our success. In the absence of disturbance by the bears it is likely that we could have doubled the number of juvenile Chinook restored.

Heavy rains in early September resulted in high flows and substantial sediment mobilization in Clinton Creek. Sampling was to take place on September 11 – 12. However, flows in the creek were rising when the creek was attended on September 11. The creek was too high to safely work in. Additionally, minnow traps are least effective during the rising limb of hydrological events and are likely to be lost or buried in sediment.

Conclusion: The Student Stewards were able to participate in a hands on activity to directly benefit juvenile Chinook salmon. They were exposed to the complex life histories of Yukon River salmon. This included the use of non-natal streams by juveniles from distant spawning areas for rearing and overwintering. The potential advantages and disadvantages to the Chinook of using small streams was described and the value of surface and ground water in sustaining winter flows and overwintering habitats was discussed. The healthy numbers of juveniles in the creek provided an appreciation of the value of the small streams to the upstream stocks of salmon. The number of juveniles captured in Clinton Creek was compared to their virtual absence in the Klondike to introduce the Stewards to the complexity of Yukon River Chinook spawning habitats, and particularly the possible difference between effects of high water on lake outlet spawning vs. systems without lake storage. The activity provided an opportunity to introduce the Student Stewards to the risks involved in mine development; the potential consequences of following what turned out to be invalid plans; and the scope and cost of restoration/reclamation of sites such as the Clinton Creek Mine when the plans fail. It also demonstrated that there were both aesthetic and functional considerations in the evaluation of the effects of industrial undertakings, and that they were not always accordant.

Acquisition of genetic samples from juvenile Chinook salmon - outcomes reported as the number of samples collected, and any other information requested from the agency interested and within our capacity to provide.

Summary: A total of 159 samples were collected from Clinton Creek, with 100 collected on August 6 and 59 on August 7. A total of 50 samples were collected from the lower Klondike River on August 9. All supporting data was submitted to DFO.

Introduction: The use of genetic analyses for a wide range of salmon- and salmon habitat management and research purposes is expected to continue to expand. We first proposed this component of our project to introduce the Student Stewards to the method and certain of the uses of the data. Our introduction to the technique was in 2009 in partnership with DFO and ADF&G. We found that the Student Stewards were very interested: so much so that one of them brought a friend along as it was considered to be "so cool". The samples were submitted to DFO for analysis and the data reported in Mackenzie-Grieve (2010). We repeated the activity in 2012, and the data was reported in MacKenzie-Grieve (2013). She has allowed us to include her memorandum report in this document and it may be found in Appendix C. In 2013 we expanded the collection to the lower Klondike River, with the objective of determining if juvenile Chinook salmon of non-Klondike River origin were present. Although one would intuitively expect juveniles to migrate upstream into spawning rivers or streams, it has not been documented to date.

Methods: DFO Resource Restoration Biologist Sean Collins provided collection vials and preservative. All Chinook samples from Clinton Creek were collected between the mouth and the town-site ford located 1 km upstream. All Chinook samples from the Klondike River were from three sites located between approximately 9.5 and 12 km upstream from the mouth. We used the same numbering system as in 2009 and 2012, where YR- identified the site as in the Yukon River drainage, CN- for Chinook Salmon, 13- for the year and then ascending integers for each individual sample. The first sample we collected was YR-CN-12-1 and the last was YR-CN-12-209. Prior to clipping each fish, fork length was measured to the nearest millimeter on a smolt board. Each fish was then blotted to remove surface water and weighed to 0.1 gram on an Ohaus HH120 digital scale which had been placed on a level surface. We used the same method as we successfully used in 2009 and 2012. This is a modification the method described in Daum and Flannery (2011) for tissue collection: only a portion of the anal fin was removed rather than the entire fin. The fins were clipped with stainless steel scissors. Each sample was placed in an individual vial that had been pre-filled with preservative. Each vial was pre-labelled with the sample number written in indelible ink. Length and weight data was recorded on specially prepared data sheets. The sample vials and supporting data were submitted to DFO Federal Contaminated Sites Biologist Jody Mackenzie-Grieve.

Results: We collected 159 samples from Clinton Creek on August 6 and 7 in conjunction with the restoration component of the project. This was less than our target of 200 samples for Clinton Creek. The remaining samples were to be collected in September, but conditions were unfavorable for minnow trapping and collection did not occur. Lengths and weights are reported in the preceding section.
Despite relatively low rates of capture we met our target of 50 juvenile Chinook samples from the Klondike River. The 50 Klondike Chinook had a mean fork length of 72.84 mm and mean weight of 4 grams. The range of fork lengths was 61 – 82 mm, and the range for weight was 2.9 – 5.6 g.

Discussion: DNA samples from juvenile Chinook salmon were collected in lower Clinton Creek in 2009, 2012 and 2013. The analysis of the tissues collected to date has used current the Canadian genetic baseline. The samples may be analysed using improved genetic baselines in the future.
We lack the capacity to analyse the samples or the resulting data, so our discussion will focus on the collection process.
We had planned to collect most of the samples from Clinton Creek in the summer and a smaller number in the autumn. This would spread out the period of collection and address potential concerns that we were sampling a single cohort that had somehow been able to maintain contact and coherence as they migrated to Clinton Creek from potentially distant source areas. Stream flows generally decline in the autumn. September assessment sampling has been conducted annually since 2006. 2013 was the first year that it could not be conducted.

As we expected numbers of Chinook in the Klondike to be low, we spread our effort between 3 sites and set 6 traps at each site on August 8. A total of 59 juvenile Salmon were captured. This is a very low rate of catch for this sampling technique in this area. It allowed us to meet our sample size of 50 Chinook, The Chinook captured in the Lower Klondike were large and robust for the date they were sampled.

Conclusion: This activity was identified as a science project, and the need for meticulous attention to detail was stressed. The Student Stewards responded well to the discipline required in sample collection and record keeping. Students learned of the role of some of the developing methodologies are allowing further assessment and understanding of salmon behaviour.

Juvenile Chinook Salmon habitat utilization and assessment of different types of habitat - no outcomes were proposed.

Introduction: Our strategy was to introduce the students to the field of habitat assessment and Chinook salmon utilization by sampling in three types of habitats: unobstructed ground water fed channels; still water back channels ("back" channels do not have water flowing through them except during flood conditions) with little or no ground water input, and off-channel beaver ponds that drain to the Klondike River. We expected that captures of juvenile Chinook salmon would be high in the unobstructed ground water fed channels and very low or absent in the latter two types. We considered that learning where salmon are not present is as important as learning where they are present.

Methods: The very low captures in the salvage component of the project implied a virtual absence of juvenile Chinook Salmon in the easily accessible (by samplers) areas of the Klondike River watershed. We therefore reconfigured this component of the project to survey the Klondike and North Klondike Rivers to see if there were areas of local abundance. Sampling took place at the following locations and dates:

Klondike River downstream of Hunker Creek – July 15-17

- Pond near TNTA heli-base 64 03.021/139 25.808 – 4 trap/nights
- Bay below Klondike River Bridge 64 02.493/139 24.811– 4 trap/nights
- Side channel above Dredge Pond Subdivision 64 02.733/139 19.633 – 4 trap/nights
- Side channel below Bear Creek 64 02.223/139 15.633 – 4 trap/nights

Klondike R. between Hunker Cr. and Dempster Br. - July 15- 17

- Abandoned pump pond 64 02.144/139 09.597 – 4 trap/nights
- Gravel pit ponds between Germaine and Goring Cr 64 02.942/138 54.238 - 4 trap/nights

Klondike R. between Hunker Cr. and Dempster Br. - July 18-19

- Germaine Creek Ground Water Channel – 6 trap/nights

Klondike R. between Hunker Cr. and Dempster Br. - July 25-26 – Public Involvement Day

- Germaine Creek Ground Water Channel – 12 trap/nights

Klondike River above Dempster Bridge – July 9 – 11

- Side channel above bridge 63 59.164/138 44.431 – 8 trap/nights
- Logjam side channel 1 km above bridge 63 59/138 45.003 – 4 trap/nights
- Boat Landing side channel – 63 58.257/138 44.044 - 6 trap/nights
- Boat Landing isolated pool – 63 58.218/138 43.49 – 2 trap/nights
- Tourist Pull-out – 63 57.120/138 40.215 – 4 trap/nights

Klondike River above Dempster Bridge – July 18-19

- Boat Landing side channel – 63 58.257/138 44.044 - 5 trap/nights

North Klondike Watershed – July 24 – 26

- Viceroy Channel 64 00.189 138/138 35.8 – 4 trap/nights
- Side channel above North Fork Bridge 64 00.12/138 35.585 – 4 trap/nights

- Downstream of Klondike Ditch Intake 64 01.158/138 34.991 – 6 trap/nights
- Upstream of Klondike Ditch Intake 64 01.335/138 35.015 – 6 trap/nights

Results: Very few salmon were captured, although fresh water fish were captured at most stations. Captures were:

Klondike River downstream of Hunker Creek – July 15-17
- Pond near TNTA heli-base: 2 Slimy Sculpin (SS) & 1 Burbot (BB)
- Bay below Klondike River Bridge: 4-SS; 1-BB
- Side channel above Dredge Pond Subdivision: No captures
- Side channel below Bear Creek: 11-SS; 2-BB

Klondike R. between Hunker Cr. and Dempster Br. - July 15- 17
- Abandoned pump pond: 2-SS; 1-BB; one Arctic Grayling (AG)
- Gravel pit ponds between Germaine and Goring Cr: 3-BB

Klondike R. between Hunker Cr. and Dempster Br. - July 18-19
- Germaine Creek Ground Water Channel: 13-CN; 8-SS; 1-BB

Klondike R. between Hunker Cr. and Dempster Br. - July 25-26 – Public Involvement Day
- Germaine Creek Ground Water Channel: 52-CN; 11-SS; 2-BB

Klondike River above Dempster Bridge – July 9 – 11
- Side channel above bridge: 7-SS
- Logjam side channel 1 km above bridge: 3-SS
- Boat Launch side channel: 3-SS
- Boat Launch isolated pool: 1 Chinook Salmon (CN); 1-SS
- Tourist Pull-out: 1-CN; 2-SS

Klondike River above Dempster Bridge – July 18-19
- Boat Landing side channel – 63 58.257/138 44.044: 5-CN; 8-SS; 2-BB.

North Klondike Watershed – July 24-26
- Viceroy Channel: 1-SS
- Side channel above North Fork Bridge: 2-CN; 3-SS; 1-BB
- Downstream of Klondike Ditch Intake: 5-SS; 2-BB
- Upstream of Klondike Ditch Intake: 2-CN; 7-SS

North Klondike Watershed – August 8 - 9
- Viceroy Channel: 2-CN; 1-SS

Discussion: As noted in Methods, this component of the overall project was modified due to what appeared to be very low numbers of juvenile Chinook Salmon in the Klondike River in early July. We considered that it would serve no purpose to have the Student Stewards sample in areas where salmon were not likely to be present if the salmon were absent from all areas. We therefore decided to sample as widely as we could within the parameters of time, accessibility and employee safety. Areas where large numbers of Chinook had been captured in the past were targeted. Salmon were absent from most sampling area and in very low numbers in the remainder. A weak upstream migration into the GCAC was identified. It is possible that the Burbot captured in many locations had eaten some of the captured Chinook. Even so, the numbers of Chinook captured were much lower than in other years.

The low number of salmon captured in the Viceroy Channel was consistent with general levels of abundance and demonstrated that the channel was not obstructed.

This was reflected in the September assessment sampling. Only 1 juvenile Chinook salmon was captured in the Viceroy Ground Water Channel, and only 1 at the Boat Launch Monitoring Station

Numbers of freshwater fish captured were also much lower than in other years. Some species that were regularly captured in the past such as juvenile Round Whitefish and Longnosed Sucker were absent.

Conclusion: This was an opportunity for the Student Stewards to experience the range of aquatic habitat types in the road accessible portions of the Klondike River drainage basin. Capture of the non-salmon species provided insight to the environment in which the salmon live. The persistent very low numbers of salmon captured reinforced their developing understanding of the variability of natural systems and the vulnerability of salmon to environmental conditions

CONCLUSIONS AND RECOMMENDATIONS:

The 2013 North Mainstem Stewardship Program was successful. The project planning and implementation and administration went smoothly. We were able to conduct most of the planned activities that we had control over, and to modify those that we did not. The Student Stewards were able conduct useful work and to gain knowledge, understanding and a positive introduction to fisheries related work. High standards of safety were maintained and there were no injuries. Each of the Student Stewards wrote a report. They may be found in Appendix E.

We hope to be able to conduct another project in 2014. If so, we will:

- Continue our strategy of hiring local high school level Student Stewards, supervised by an experienced Field Supervisor and Technical Advisor;
- Continue with the core activities described in this report:
- Continue to investigate additional opportunities to monitor salmon, restore access to habitats or perform salvage activities;
- Seek to connect the project with other types of salmon-related projects being conducted in the field in the Dawson Area.

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PHOTOS

APPENDIX A

PUBLIC DAY

Rearing & Over-Wintering Access Restoration Project

Public Open House Summary

Prepared by: Andria Oppen

Dear Dawson District Renewable Resources Council,

The public day was again a great success. We had 44 community members attend this year, again mostly between the ages of 5-10. The children were a captive audience and were full of questions for the field workers. The field workers did an excellent job of explaining the importance of the project and provided hands on experience for the children. The visitors had an opportunity to watch the measuring process of the fish as well as help to transfer the fish between buckets. This was thrilling for the kids and certainly will provide lasting memories.

The event spread over 3 hours and included a lovely lunch provided by Bonanza Market.

My preparation of the event consisted of contacting the elders Co-ordinator at Tr'ondek Hwech'in with an invitation once the date for the event had been determined. I then contacted both Tr'inke Zho Daycare and the Dawson Daycare to invite their summer camp kids to the event. I prepared a poster and posted it in various locations around town. I confirmed transportation for the Dawson daycare and Tr'inke Zho daycare.

One the day of the event I picked up the food and went to Germaine Creek to set up the food tables and establish a plan with the project staff. I remained through the event and participated in the lesson, then cleaned up the site.

Again, wonderful feedback from those who attended, some of the children who attended in previous years remembered the types of fish and shared the details with the other children about how the traps worked.

Thank you again for the wonderful opportunity. It was a pleasure to work with the project team.

Please contact me with any questions.

Andria Oppen

andrioppen@gmail.com

APPENDIX B

Protocol for the Baiting Of G-Type Minnow Traps for the Capture of Juvenile Chinook salmon In the Yukon River Drainage Basin

Fisheries and Oceans Canada
Habitat and Enhancement Branch

Baited G-type minnow traps have proven to be an effective means of capture for juvenile Chinook salmon in the Yukon River drainage basin. Trapping has been conducted by consultants, public interest groups, and government agencies. Salmon roe was the main bait that was used to trap the juveniles. DFO Habitat developed the following Protocol in 1985 to provide a consistent methodology for G-type minnow trapping in the Yukon River Drainage basin in Canada:

Traps are baited with either Yukon River Chinook or Chum salmon roe. The roe is not salted or otherwise chemically preserved. A "walnut" sized" piece of roe is placed in a perforated thin plastic sandwich or similar bag, and the bag tied off.

(Note: roe is most easily handled when it is frozen: freeze the skeins flat, and chip off appropriate sized pieces. Thin, flexible plastic bags will remain flexible even in cold water. Zip closure bags tend to be stiff and are not recommended. Even very slight current will "pump" thin plastic bags and expel attractant from the bait. Perforations are most easily made with an "Exacto" or similar hobby knife blade: up to 15 bags may be stacked and 0.5 to 1.5 cm long cuts made through them).

The bags of roe are kept frozen for as long as possible before using, as they are most easy to handle when in this state. The potential of the odour of the roe attracting bears is also decreased.

The traps are prepared by having a tether of string or line attached to either of the halves. The trap is baited, closed, and a twist tie (paper coated wire) is used to tie the two halves together. **The minnow trap clip is not used**, as traps are often lost due to high water, etc: if the halves of the trap remain joined together, the trap will continue to capture and destroy fish. When closed by a twist-tie, the trap will quickly open and cease to capture and destroy fish.

When setting the traps in a new area, it is advisable to place the traps in all available types of habitat. Habitat utilisation by juvenile Chinook tends to vary from location to location: pre-judgement is not advisable. The traps should also be marked with survey flagging. A 24 hour set is recommended.

APPENDIX C

Analysis of 2012 DNA samples
presented with the permission of
Jody MacKenzie-Grieve
DFO

Fisheries and Oceans / Pêches et Océans

MEMORANDUM NOTE DE SERVICE

To / À: FILE- CLINTON CREEK

From / De: JODY MG-- FCSAP BIO

Security Classification - Classification de sécurité **UNCLASSIFIED**
Our file - Notre référence **05-HPAC-PA5-00204**
Your File - Votre référence
Date **June 13, 2013**

Subject
Object **2012 CLINTON CREEK JCS DNA WORK**

INTRODUCTION

The Clinton Creek mine is an abandoned asbestos mine located in near the US border in central Yukon that operated between 1967 & 1978. The mine is located adjacent to Clinton Creek which is a tributary to the Forty Mile River. The site is of particular interest to Fisheries & Oceans Canada (DFO) because it is used extensively by juvenile chinook salmon for non-natal rearing and overwintering. Utilization of the creek by jcs has been monitored regularly by DFO for nearly 8 years. Preliminary assessment of stock of origin for jcs utilizing Clinton Creek was completed in 2009 (Mackenzie-Grieve 2010).

METHODS

During the summer of 2012, the Dawson District Renewable Resource Council (DDRRC) completed a series of sampling events at a number of creeks in the Dawson Area including Clinton Creek (Fraser 2009). Part of the intent of the DDRRC's work on Clinton Creek was to restore access to the upper creek for rearing jcs; beaver activity within the creek regularly limits the extent to which jcs can migrate upstream. Jcs were captured in baited minnow traps (following the Yukon River Panel Protocol) that were soaked overnight. Captures were processed (mass, fork length, tissue sampling) and released near Wolverine Creek (tributary to Clinton Creek within the footprint of the mine) upstream of most of the beaver dams. Tissue sampling was completed on August 7, 2012.

During processing, jcs captures were given a unique identifier and length and mass measurements were recorded for each individual. Captures were measured to the nearest mm and fish were blotted prior to weighing. The DDRRC crew also took 200 samples of jcs anal fin tissue and stored samples in 100% ethanol in 2 mL individually identified vials. This approach allowed size data and DNA data to be attributed to individual fish. Tissue samples were sent to the Pacific Biological Station (PBS) in the fall of 2012 and results were obtained in the spring of 2013.

Length-frequency analyses were subsequently completed by assigning individuals to arbitrarily-developed length ranges (bins). Condition of fish was assessed by linearizing the data using a log transformation of length and mass data, plotting the data, and then regressing fork length on mass. Compared to the 'index' approach (e.g., Fulton's condition factor) for fish condition, this approach is preferable because it does not assume isometric growth and is considered to be a more accurate method of examining the weight-length relationships for fish populations (Cone 1989).

Analyses completed by the PBS DNA laboratory (Beacham lab) consisted of assigning the jcs samples of unknown origin (i.e., Clinton Creek samples) to stocks of origin using a probability approach (bootstrapping/Monte Carlo analysis in an adapted version of BAYES used by PBS) based on stocks currently represented in the Chinook baseline for

the Yukon River. Unfortunately, the baseline is still considered to be limited for most stocks (P. Milligan, Fisheries & Oceans Canada, personal communication), and only the most numerous Yukon River Chinook stocks are currently part of the baseline. For example, only 5 spawning populations were sampled to develop the baseline for the Stewart River, although many more populations may be spawning at other sites within the drainage.

RESULTS AND DISCUSSION

The majority of jcs captured in lower Clinton Creek in August were of 'Yukon main' origin (61 %; Figure 1). The 'Yukon main' zone of the Yukon River is between the mouth of Tatchun Creek and the mouth of the Pelly River. The sampling used to develop the baseline for that zone, however, was only completed at one site in the Minto area (P. Milligan, Fisheries & Oceans Canada, personal communication). There may be other spawning sites within this section of the Yukon River which are not currently included in the baseline. The remaining jcs captured were from Little Salmon (14 %), Teslin (13 %), Klondike (4 %), Mayo (2 %), Nordenskiold (2 %), Mayo (2 %), Little & Big Kalzas (2 %), Whitehorse (1 %) and Big Salmon (1%) stocks.

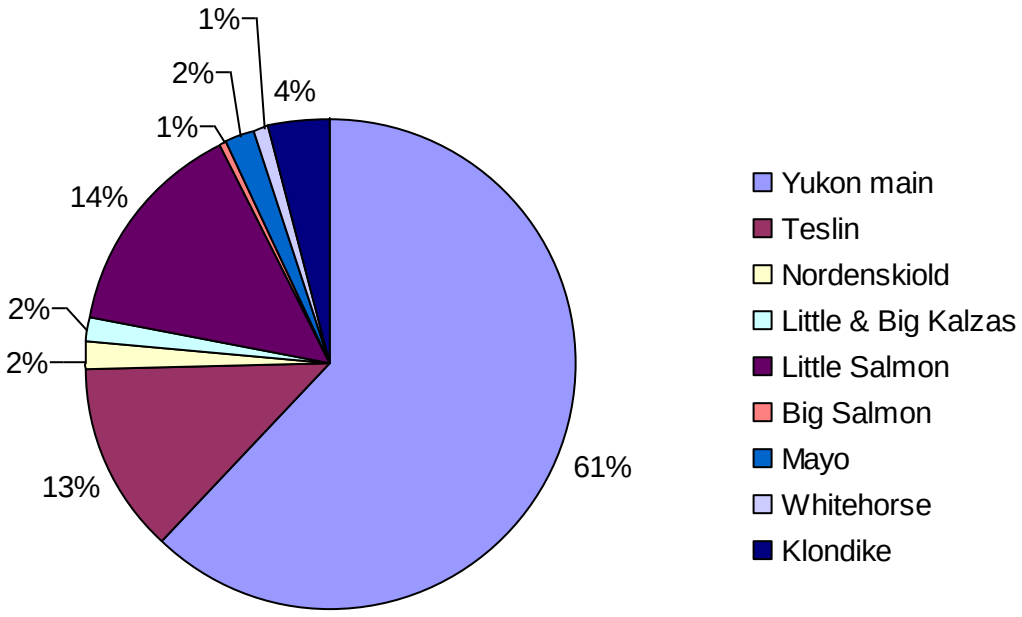

Figure 1. Origin of juvenile Chinook salmon captured in lower Clinton Creek on August 7, 2012 (n=200).

Juvenile Chinook between 61 and 65 mm fork length were the most common in August 2012 samples (Figure 2) and accounted for nearly half of the jcs sampled (Figure 3). When Big salmon (1 sample) and Whitehorse (2 samples) groups were removed from the

analyses, length was not related to stock of origin ($F_{(6, 190)} = 1.904$, $p = 0.05$). Mean fork length of jcs overall (not stock specific) was 65 mm (SE: 0.37) and mean mass was 2.77 g (SE: 0.05).

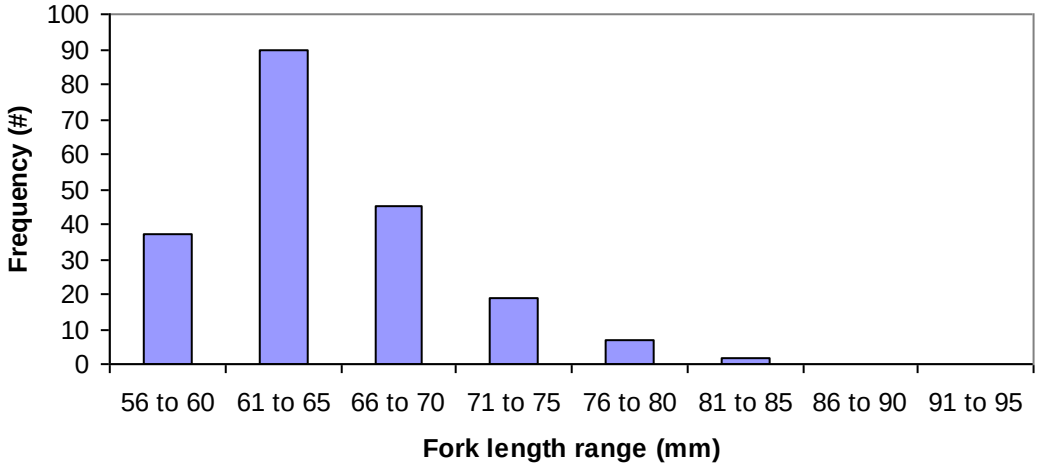

Figure 2. Length-frequency distribution of jcs captured in lower Clinton Creek on August 7, 2012 (n=200).

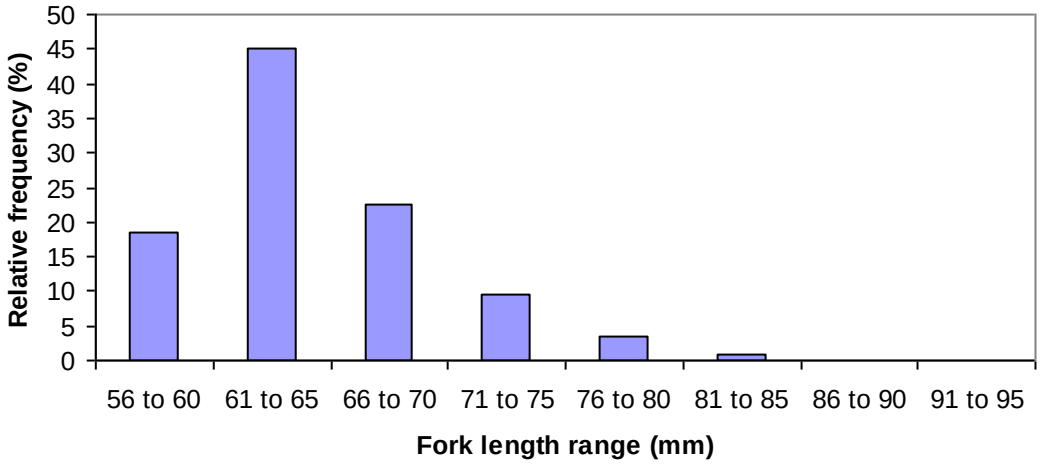

Figure 3. Relative frequency of juvenile chinook length ranges in lower Clinton Creek on August 7, 2012 (n=200).

Condition, as represented by linearized mass regressed against linearized length is shown in Figure 4.

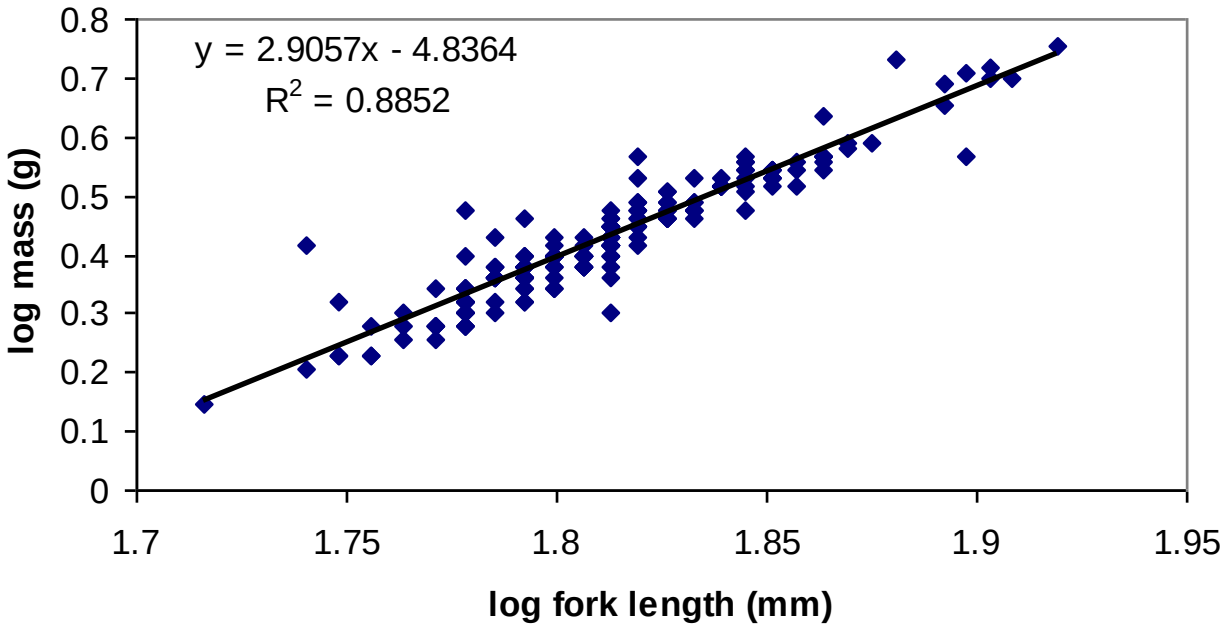

Figure 4. Condition, as represented by log mass regressed against log fork length, of jcs samples from lower Clinton Creek on August 7, 2012 (n=200).

In 2009, the DDRRC collected jcs tissue samples in mid-August and mid-September from lower Clinton Creek and from the release location near Wolverine Creek. Data collected in 2012 are slightly different than those collected in 2009. In mid-August of 2009, jcs of 'Yukon main' origin were most common in lower Clinton Creek (94 %), but jcs of Teslin (2%), Big Salmon (2%), and Hoole (2%) origin were also collected. In mid-September of 2009, samples from lower Clinton Creek suggested that jcs from Yukon main origin were again most common (78%), however jcs of Teslin (14%), Mayo (6%) and Chandindu (2%) origin were also identified. Samples collected in 2012 included a much wider range of stocks from lower Clinton Creek but in contrast to 2009 samples from the Wolverine Creek area and from lower Clinton Creek, no jcs of Hoole, Glenlyon Chandindu or Stewart origin were identified.

In 2009, jcs between 66 and 70 mm fork length were most common in mid-August yet in 2012, jcs between 61 and 65 mm were most common at a similar time of year. Although sampling in 2009 occurred a week later than in 2012, these differences can perhaps be explained by spring temperatures and timing, and the subsequent influence on jcs development and food availability for jcs.

Compared to 2012 samples, jcs captured in August 2009 were heavier at a given length (condition) and had higher growth rates; the slope of the regression line was steeper in 2009 (3.267) compared to 2012 (2.9057). Also, the regression line fit the 2009 data (R^2 = 0.9669) better than the 2012 data (R^2 = 0.8852) suggesting much less variation in condition in 2009 compared to 2012.

This work highlights the importance of Clinton Creek to rearing jcs: the creek is utilized by jcs from a wide range of stocks and, although Yukon main and Teslin stocks are most common, a wide range of other stocks in a wide range of proportions also utilize the creek as non-natal overwintering habitat.

JMG

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APPENDIX D

Yukon River North Mainstem Salmon Restoration and Enhancement – Record of Activities

Fortymile River Drainage

Clinton Creek

Drainage Area: 206 sq. km
Clinton Creek is the first west bank tributary upstream of the mouth of the Fortymile River. The watershed has been much affected by the abandoned Clinton Creek asbestos mine. Failures of waste rock dumps have resulted in the creation of Hudgeon Lake and in significant contributions of sediment to the lower creek. Storage of water in the upper drainage may be buffering flows sufficiently that beaver are able to maintain dams across the creek. Beaver dams were identified as a probable obstruction in 2005

Activities in 2006
DDRRC Stewardship crew relocated 782 juvenile Chinook salmon from the lower creek to the Wolverine Creek area. Salmon appeared in large numbers in the lower creek, between July 7 – July 12. DFO reported 17 beaver dams between the mouth and the mine site in August.
Activities in 2007
DDRRC Stewardship crew relocated 2070 juvenile Chinook salmon from the lower creek to the Wolverine Creek area. Salmon appeared in large numbers in the lower creek when trapping was initiated on July 18.
Activities in 2008
58 Juvenile Chinook were captured and restored to productive habitat. Very high flows affected trapping success and resulted in the breach of most upstream beaver dams.
Activities in 2009
901 Juvenile Chinook were captured and restored to productive habitat. 200 juvenile Chinook DNA samples were acquired.
Activities in 2010
587 Juvenile Chinook were captured and restored to productive habitat. Fork lengths were measured of a target of 30 jcs/day.
Activities in 2011
15 Juvenile Chinook were captured and restored to productive habitat.
Activities in 2012
702 Juvenile Chinook salmon were captured and restored. Fork lengths and weights were measured of a target of 30 jcs/day. 200 juvenile Chinook DNA samples were acquired.
Activities in 2013
685 Juvenile Chinook salmon were captured and restored. Fork lengths and weights were measured of a target of 30 jcs/day. 159 juvenile Chinook DNA samples were acquired.

Recommendations for 2014

Continue to capture juveniles in lower Clinton Creek and restore them to productive habitat near the minesite. Continue with fork length and weight measurements if numbers warrant. Collect tissue samples for DNA analysis.

Mickey Creek

Drainage area: 63 sq. km

Mickey Creek is the first east bank tributary of size of the Fortymile River. Wildfires burned the majority of the drainage basin in 2004. A perched culvert at the Clinton Creek Road crossing was identified as a partial obstruction in 2005.

Activities in 2006

DDRRC Stewardship crew relocated 34 Chinook salmon, but the project ended before large numbers entered the stream.

Activities in 2007

DDRRC Stewardship crew relocated 1273 Chinook salmon. Salmon appeared in large numbers in early August, and probably continued on past the project end.

Activities in 2008

32 juvenile Chinook salmon were relocated over the culvert.

Activities in 2009

9 Juvenile Chinook salmon were captured and relocated.

Activities in 2010

247 Juvenile Chinook salmon were captured and relocated.

Activities in 2011

No Juvenile Chinook salmon were captured.

Activities in 2012

The culvert was backwatered due to a sediment wedge moving downstream. No Juvenile Chinook salmon were captured.

Activities in 2013

The culvert continued to be backwatered due to a sediment wedge moving downstream. No intervention was necessary.

Recommendations for 2014

Monitor and capture/restore to creek above culvert as required.

Klondike River Drainage

Lower Klondike River Juvenile Chinook Salmon DNA collection

This is to determine whether jcs in the lower river are of Klondike origin or are from other spawning stocks

Activities in 2013

50 samples were collected.

Recommendations for 2014

Continue to collect samples.

Louse town Pond

This pond is a mining cut in the centre of Lousetown. It floods from the Klondike River during high water.

Activities in 2009
No salmon were caught in the 19 traps that were set for two days.
Recommendations:
As the pond is on TH land, only work there at TH's request.

Bonanza Creek

Area: not determined
Bonanza Creek flows north and enters the Klondike River downstream of the main Bridge. The drainage basin has been intensively placer mined.
Activities in 2008
47 juvenile Chinook salmon and 11 sculpin were captured in 15 trap-nights with the traps set between 5 and 8 kilometres up from the mouth.
Recommendations
No further actions are recommended.

Un-named Creek #1 – at north end of Henderson Corner

Classified as a Moderate-High Fish Habitat Suitability stream.
Activities in 2012
Sampled as part of Placer Fish Habitat Suitability Map investigations
Activities in 2013
There was no flow in the creek and it was not sampled
Recommendations for 2014.
Sample as part of Placer Fish Habitat Suitability Map investigations – Year 3

Alki Creek

Classified as a Moderate-High Fish Habitat Suitability stream.
Activities in 2012
Sampled as part of Placer Fish Habitat Suitability Map investigations
Activities in 2013
Sampled but no fish were captured.
Recommendations for 2014.
Sample as part of Placer Fish Habitat Suitability Map investigations – Year 3

Germaine Creek

Classified as a Moderate-High Fish Habitat Suitability stream.
Activities in 2012
Sampled as part of Placer Fish Habitat Suitability Map investigations
Activities in 2013
Sampled at Dawson Road crossing – low numbers of Chinook and sculpin captured
Recommendations for 2014.
Sample as part of Placer Fish Habitat Suitability Map investigations – Year 3 and walk upstream to check for defined channels

Germaine Creek area salvage

The Klondike River has developed a new channel in this area. The old channel carries water in the spring. As water levels fall, the Klondike River no longer enters the channel. A series of isolated pools remain and extend downstream to the mouth of Germaine Creek.

Activities in 2007

1279 Chinook fry were salvaged and returned to the Klondike River.

Activities in 2008

8 Chinook fry were salvaged and returned to the Klondike River. Water levels were very high throughout the summer

Activities in 2009

419 Chinook fry were salvaged and returned to the Klondike River.

Activities in 2010

248 Chinook fry were salvaged and returned to the Klondike River.

Activities in 2011

51 Chinook fry were salvaged and returned to the Klondike River.

Activities in 2012

299 Chinook fry were salvaged and returned to the Klondike River.
Fork lengths and weights were measured of 30 jcs.

Activities in 2013

3 Chinook fry were salvaged and returned to the Klondike River.
Abundance of jcs in the Klondike was very low in 2013.

Recommendations for 2014

Continue to salvage juveniles from the isolated pools and release them into open waters. Weigh & measure 30 salmon.

Goring Creek

Area: not determined

Goring Creek flows north from a defined valley into a series of wetlands and then to the Klondike River

Activities in 2008

No juvenile Chinook salmon or other fish were captured in 5 trap-nights at the Klondike Highway crossing.

Activities in 2009

No sampling occurred.

Activities in 2012

Sampled as part of Placer Fish Habitat Suitability Map investigations

Activities in 2013

Sampled but no fish captured

Recommendations for 2014.

Sample as part of Placer Fish Habitat Suitability Map investigations – Year 3

Leroy Creek

Classified as a Moderate-High Fish Habitat Suitability stream.

Activities in 2012

Sampled as part of Placer Fish Habitat Suitability Map investigations

Activities in 2013

Sampled but no fish captured

Recommendations for 2014.

Sample as part of Placer Fish Habitat Suitability Map investigations – Year 3

Un-named Creek #3

Classified as a Moderate-High Fish Habitat Suitability stream.

Activities in 2012

Sampled as part of Placer Fish Habitat Suitability Map investigations

Activities in 2013

Sampled and one Slimy Sculpin captured

Recommendations for 2014.

Sample as part of Placer Fish Habitat Suitability Map investigations – Year 3

Dempster Bridge area salvage

A series of pools extend down the right (north) side of the river. Connection with the river depends on ground water inflows

Activities in 2007

Salvage took place, resulting in the return of 101 fry to the Klondike River.

Activities in 2008

The crew checked this area but the pools were not isolated due to the high flows.

Activities in 2009

No isolated pools in this area.

Activities in 2010

No isolated pools in this area.

Activities in 2011

No isolated pools in this area.

Activities in 2012

No isolated pools in this area.

Activities in 2013

No isolated pools in this area.

Recommendations for 2014

Monitor and salvage juveniles if necessary.

Logjam on left side Klondike River upstream of Dempster Bridge

This is a large and persistent log jam, and is a candidate for a "Klondike River juvenile Chinook abundance and growth station.

Activities in 2012

Limited sampling took place. No juvenile Chinook were captured.

Activities in 2013

Limited sampling took place. No juvenile Chinook were captured.

Recommendation for 2014

Sample when water levels permit to conduct safely.

Boat Launch Monitoring Station on Klondike River

This is an accessible and relatively stable area. It is the first "Klondike River juvenile Chinook abundance and growth program" station.

Activities in 2012

Sampling was successfully conducted in July and September.

Activities in 2013

Sampling conducted in July and September was unsuccessful due to very low numbers of juvenile Chinook Salmon in 2013.

Recommendation for 2014
Retain as a monitoring station - sample in July and September.

Too Much Gold Creek

Area: not determined
Too Much Gold Creek flows from a narrow valley into a series of wetlands extending to the Klondike River.
Activities in 2008
No juvenile Chinook salmon or other fish were captured in 6 trap-nights at the Klondike Highway crossing.
Activities in 2011.
Sampling took place in September, and no fish were captured.
Activities in 2012
Sampled as part of Placer Fish Habitat Suitability Map investigations
Activities in 2013
Sampled but no fish captured
Recommendations for 2014
Sample as part of Placer Fish Habitat Suitability Map investigations – Year 3

Leotta Creek

Leotta Creek is 2 km east of Dempster junction and west of Flat Creek. The water flows narrowly from the hills and flows into the Klondike River.
Activities in 2008
No juvenile Chinook salmon or other fish were captured in 2 trap-nights at the Klondike Highway crossing.
Activities in 2012
Sampled as part of Placer Fish Habitat Suitability Map investigations
Activities in 2013
Sampled but no fish captured
Recommendations for 2014.
Sample as part of Placer Fish Habitat Suitability Map investigations – Year 3

All Gold Creek

All Gold Creek enters the South Klondike River immediately west of the mouth of Flat Creek. The drainage basin has been intensively placer mined, and the creek is unstable.
Activities in 2008
No Juvenile Chinook salmon were captured 4 slimy sculpin were captured in 8 trap-nights at the Klondike Highway crossing.
Recommendations
Maintain as a candidate for periods when the Klondike River is too high to work in

Flat Creek

Area: not determined

Flat Creek enters the South Klondike River from the south. The Klondike Highway crosses the creek near the mouth.

Activities in 2008

No juvenile Chinook salmon were captured in 6 trap-nights. 3 burbot were captured at the Klondike Highway crossing

Recommendations

Maintain as a candidate for periods when the Klondike River is too high to work in

North Klondike River Drainage

North Klondike River - salvage

Activities in 2008

There was no work done due to high water levels

Activities in 2009

One isolated pool with juvenile salmon was located at the North Fork intake

Activities in 2010

No isolated pools were observed

Activities in 2011

No isolated pools were observed

Activities in 2012

No isolated pools were observed

Activities in 2013

No isolated pools were observed

Recommendations for 2014

Monitor area and salvage juveniles as necessary

Viceroy Channel

Drainage area: Not applicable

Viceroy Channel is a small, ground water fed channel. It is crossed by the Viceroy Mine Road about 800 meters upstream from its mouth. A beaver dam was established about 300 meters upstream from the mouth in the summer of 2005.

Activities in 2006

A total of 13 Chinook were restored to the channel above the beaver dam.

Activities in 2007

A total of 13 Chinook were restored to the channel above the beaver dam.

Activities in 2008

The North Klondike River was high. No salmon were trapped.

Activities in 2009

The abandoned beaver dam was breached.

Activities in 2010

The channel was monitored and was not obstructed. Sampling at the Viceroy Road crossing resulted in the capture of 80 juvenile Chinook salmon.

Activities in 2011

The channel was monitored and was not obstructed. Sampling at the Viceroy Road crossing resulted in the capture of 10 juvenile Chinook salmon.

Activities in 2012
The channel was monitored and was not obstructed. Sampling at the Viceroy Road crossing did not result in the capture of juvenile Chinook salmon. The channel was mapped.
Activities in 2013
The channel was monitored and was not obstructed. Sampling at the Viceroy Road crossing resulted in the capture of 3 juvenile Chinook salmon.
Recommendations for 2014
Monitor channel at road crossing to determine whether juveniles have migrated into the creek. Walk downstream to the confluence with the Klondike to ensure that the channel is not obstructed.

Upstream of North Fork Bridge

Off-channel habitat on the left side of the North Fork Bridge.
Activities in 2011
Sampling took place and low numbers of juvenile Chinook were captured
Activities in 2012
Sampling took place and a single juvenile Chinook was captured
Activities in 2013
Sampling took place and 2 juvenile Chinook were captured
Recommendation for 2014
Maintain as an index of juvenile Chinook salmon implied abundance and growth in the North Klondike River and as a candidate for periods when the Klondike River is too high to work in.

At North Fork Intake

Complex channel resulting from past river engineering.
Activites in 2011
Sampling took place and low numbers of juvenile Chinook were captured
Activities in 2012
Sampling took place and low numbers of juvenile Chinook were captured
Activities in 2013
Sampling took place and low numbers of juvenile Chinook were captured
Recommendation for 2014
Maintain as an index of juvenile Chinook salmon implied abundance and growth in the North Klondike River and as a candidate for periods when the Klondike River is too high to work in.

Abandoned Hatchery site at Km 10 Dempster

Complex, ground water fed channel resulting from past river engineering
Activities in 2011
Sampling took place. No juvenile Chinook were captured
Recommendations
Maintain as a candidate for periods when the Klondike River is too high to work in.

North Klondike River at Benson Creek

Access to North Klondike River – salmon have been documented spawning in the locality.

Activities in 2011

Sampling took place. No juvenile Chinook were captured

Recommendation

Maintain as a candidate for periods when the Klondike River is too high to work in.

North Klondike at Highway Camp at 42 Mile.

This is the upstream limit of local reports of spawning Chinook salmon

Activities in 2011

Sampling took place. No juvenile Chinook were captured

Recommendation

Maintain as a candidate for periods when the Klondike River is too high to work in.

APPENDIX E

STUDENT STEWARD REPORTS

Dear Renewable Resources,

In the summer of 2013, I had the wonderful chance to work as a Salmon Field Assistant with Hans and Emma. We had many various tasks like saving fish from isolated pools, counting salmon, recording water temperatures, and taking DNA samples. And on rainy days we would go back to the office and learn about fish. This job took us to lots of interesting locations near the Klondike River and Forty Mile.

I thought this job was fun and fascinating. It also gave me a much different insight of the preservation of salmon. I loved working outdoors and going exploring for new locations. As well I liked working with my co-workers Emma and Hans. Emma and I learned a lot of new things from our best friend Hans. He told us about the history of the places and gave us information about salmon.

Although I loved this job, I wished there wasn't as much driving. And perhaps in the future you could consider a boat.

However all in all I immensely enjoyed this job! Thank you for this amazing opportunity!

Regards Emily Hume

Renewable Resources Report

For Renewable Resources,

I would like to start by thanking Hans for being such a great supervisor and Linda for giving me the opportunity to have such an amazing job. Working here gave me many great learning opportunities and lots of good memories. I had a blast working with my best buddies Hans and Emily; they definitely made the job interesting.

I also liked that we met many other people over the summer. For example, the biologist, and all the locals who wanted to know about and sometimes share their love and knowledge of salmon.

I had a great time in 40 mile trapping, studying and re-habilitating the fry as well as learning about how to be safe in bear country. My two favourite things about the job were that we were always learning something, and always making interesting memories that I will love to look back on and talk about in the future. Two things that I would change about the job would be to try and limit the amount of time spent driving (I know this is hard, driving is just part of the job) and just being a bit more organized. Overall, it was an awesome job, I would both recommend it to others or take the job again in a heartbeat!

Sincerely,
Emma Morin