

Deadman Creek Chinook Restoration and Instream Incubation Trial



Prepared For
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EXECUTIVE SUMMARY

This project involved a trial to test the use of instream egg incubation to restore a Chinook spawning population to Deadman Creek, a tributary of Teslin Lake in the Teslin River watershed. Local knowledge indicates that the stream once had a small spawning population; however, the specific reason for and the timing of the loss of the spawning population is unknown. The project involved the following components: establishment of a walking trail along lower Deadman Creek, water temperature monitoring, juvenile monitoring, instream egg incubation and success monitoring.

The juvenile monitoring was conducted during June and August 2016 to update baseline information on juvenile habitat utilization in the stream. No juvenile Chinook were captured during June although relatively high numbers were captured in early August.

The instream egg incubation component involved site preparations in both Deadman Creek and the control stream (Morley River) to construct artificial redds with stream substrate to mimic natural conditions. Brood stock for the project was collected in Morley River and eggs and milt were transported to Deadman Creek. A cumulative total of 6,524 eggs were planted at five discrete sites in the lower 2 km of Deadman Creek and 5,957 eggs were planted in Morley River in the vicinity of the Alaska Highway crossing to serve as controls. Eggs were deployed in both streams using a combination of open and closed incubation media including: Whitlock Vibert boxes, Jordan Scotty incubators and egg tubes. Eggs were also planted directly in the artificial redds through the use of egg insertion pipes.

Success monitoring employed a variety of methods to determine hatching success in both streams. Hatching success was generally very high in Morley River with survival as high as 96% in some incubation media. Hatching data from Deadman Creek was highly variable between sites and incubation media; however, hatching success was as high as 74% and averaged approximately 50%.

Water temperatures and associated ATU (accumulated thermal unit) data were considerably different between Morley River and Deadman Creek. Egg development was considerably quicker in Morley River, with egg hatching taking place during early to mid-October. Due to colder water temperatures, egg hatching occurred in Deadman Creek during early to mid-February and at ATUs which were considerably lower than as published for this species. Monitoring of alevin development in Deadman Creek was done on a trial basis during the spring of 2017 and documented emergent fry present during early June.

The methods used for this trial project and the results gathered suggest that the approach used has merit for reintroducing a spawning population to Deadman Creek. A number of lessons were used over the duration of the 2016/2017 field studies and these experiences can be incorporated into an expanded operational trial of the project during future years.



ACKNOWLEDGEMENTS

Gillian Rourke of the Teslin Tlingit Council contributed significantly to all aspects of this project and along with Tommy Dewhurst, assisted with numerous field components of the project. Sean Collins and Maggie Wright (Fisheries and Oceans Canada) assisted with project permitting and provided advice on overall project direction. Y2C2 (Yukon Youth Conservation Corps) crew members Shyloh van Delft, Marika Kitchen, Kali Parr, Jake Wykes and Luka Van Randen assisted with the site preparation work for the egg planting component of the project. TTC summer students, Nick Hogan, Shania Hogan, and Susanna Carlick also assisted with site preparation, and trail cutting was completed by Earl Douville and Tom Dickson Jr. Funding for this project was provided by the Yukon River Panel's Restoration and Enhancement Fund.

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1 INTRODUCTION

Chinook salmon are a vitally important resource for Teslin Tlingit Citizens, being both culturally significant and important for subsistence. Chinook salmon must successfully migrate through all fisheries on the mainstem Yukon River in both Alaska and Yukon to return to the Teslin River watershed; additionally there are environmental threats such as predators and changing water conditions along the length of the river. Given the length of the Chinook salmon migration back to the Teslin watershed, the health of this run has long been understood by the Teslin Tlingit as an important indicator of the overall health and strength of the Yukon River Chinook salmon run. In response to alarming and enduring declines in returning Chinook salmon, Teslin Tlingit Council (TTC) has been taking action for over 15 years, on a local, territorial, and international scale to conserve the Chinook run for future generations, the health of the environment, and for all fishers throughout the watershed.

Chinook salmon in the Teslin River watershed have one of the longest salmon migrations in North America with the headwaters of the Teslin River being nearly 3,000 km upstream from the Bering Sea. During the 2002 and 2003 drainage-wide Chinook telemetry project, the longest distance travelled by a tagged Chinook was located in the Teslin River watershed. This individual was relocated in the McNeil River, a tributary of the upper Nisutlin River; this fish had travelled nearly 2,700 km upstream from the tagging site on the lower Yukon River (Mercer and Eiler 2004). The Teslin River watershed is also a major spawning destination for Canadian-origin Chinook. The results from the Teslin River sonar (and in-season genetic analysis at Eagle) during 2014 and 2015 have indicated that approximately 25% of passage of Canadian-origin Chinook are destined for the Teslin River watershed.

Deadman Creek is a clear water tributary of Teslin Lake which flows into the lake 30 km north of the community of Teslin, YT (Figure 1). The total drainage area of the watershed is approximately 150 km² and the stream is relatively accessible with the lower reaches accessed from the Alaska Highway crossing and an adjacent gravel pit. Adult Chinook salmon have not been observed in the creek in recent years (Wilson 2003), although local knowledge indicates that the stream once had a spawning population. Chinook carcasses were observed in the stream, and had been incidentally caught by local fishers before there were large beaver dams in the creek. It is presumed that when the lower 10-15 kms of the creek were burned by a forest fire that this created ideal habitat for beaver due to the regrowth of deciduous vegetation (Wilson 2003). The creek was the focus of active beaver management and monitoring of juvenile Chinook utilization by TTC between 2001 and 2006 (Wilson 2003, 2005, 2006, and 2007). This monitoring indicated various beaver dams in varying conditions; juvenile Chinook were, however, captured upstream of all dams including the uppermost sampling station located 8 km upstream of Teslin Lake. At the time of these surveys, the creek was actively forming a new channel around the largest beaver dam located in the lower reaches of the creek. Previous reports consistently recommended that methods to restore a spawning Chinook population to Deadman Creek be investigated.

The current project was designed to build on a 2015 project funded by a Restoration & Enhancement project to identify a Chinook salmon stock restoration project in the Teslin River watershed. The 2015 project identified Deadman Creek as a suitable candidate for such a project due to the current lack of a

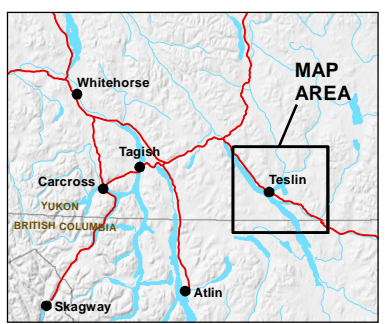
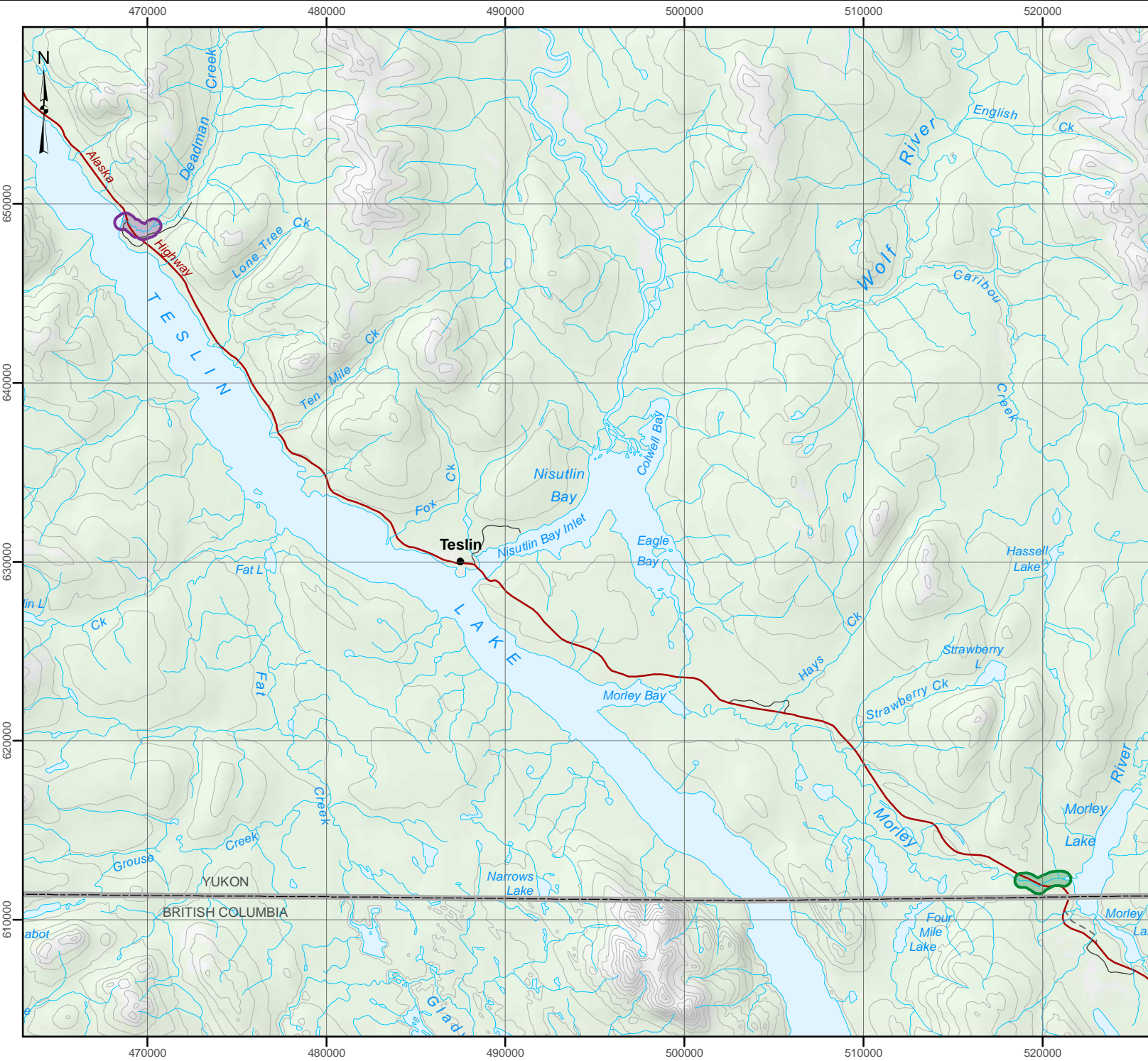


spawning population and local/traditional knowledge which indicated that this was once a spawning stream. Habitat observations made during 2015 indicated appropriate flow and substrate for Chinook spawning and highly suitable juvenile rearing habitat. Consideration of this information resulted in the development of the 2016 pilot project to re-introduce a spawning population of Chinook salmon using in-stream egg incubation methods, and to establish control sites in Morley River, which is a spawning area currently used by Chinook. The inclusion of the egg deployment sites in the Morley River allowed for the same methods used in Deadman Creek to be tested in a location with habitat currently known to be suitable for egg incubation, providing additional perspective on the effectiveness of these methods as a restoration tool. Additional components of the 2016 project included: water temperature monitoring in Deadman Creek and the Morley River, juvenile Chinook monitoring in Deadman Creek (June and August), clearing of a walking trail along the lower reaches of Deadman Creek, and provision of local training/capacity building.

1.1 OBJECTIVES

The overall objective of this project was to conduct a trial project to restore a self-sustaining Chinook spawning population through the use of egg planting which is a culturally appropriate method for the TTC. The project also provided a unique learning opportunity to test the egg planting methods to determine the utility of this method for restoring Chinook stocks elsewhere in the Yukon River watershed. The specific objectives of the project were as follows:

- Deploy approximately 10,000 fertilized Chinook eggs into Deadman Creek and the Morley River (combined) to test the feasibility of egg planting methods to restore Chinook stocks in the Teslin River watershed.
- Conduct follow up monitoring during the winter and spring to determine the fate of the planted eggs in both streams.
- Conduct a juvenile Chinook sampling program during the summer of 2016 to collect data on habitat utilization by non-natal juveniles and the current status of beaver dams and/or other barriers.
- Provide local capacity building and technical training/employment for one local technician for 15 days.



Legend

-
- Alaska Highway
- Secondary Road
- - - Trail
- 🟪 Egg Deployment
- 🟩 Brood Stock Collection and Egg Deployment Area

Overview Map of Study Area

Data Sources
1:250,000 and 1:1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

Digital Elevation Model, 1:250,000 and 1:1,000,000 National Topographic Database (NTDB) provided by Geomatics Yukon - Yukon Government via online source (Corporate Spatial Warehouse) www.geomatics.yukon.ca.

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2 METHODS

2.1 WALKING TRAIL ESTABLISHMENT

Hand clearing of the walking trail was conducted by a crew of two local TTC individuals and required two days to complete. The trail followed the riparian zone of Deadman Creek and was limited to a narrow foot trail in order to prevent ATV access. This trail was necessary to allow for the egg planting and associated monitoring to be carried out in an effective manner.

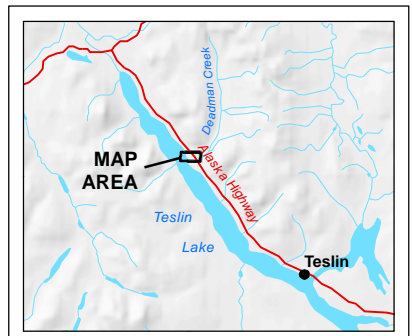
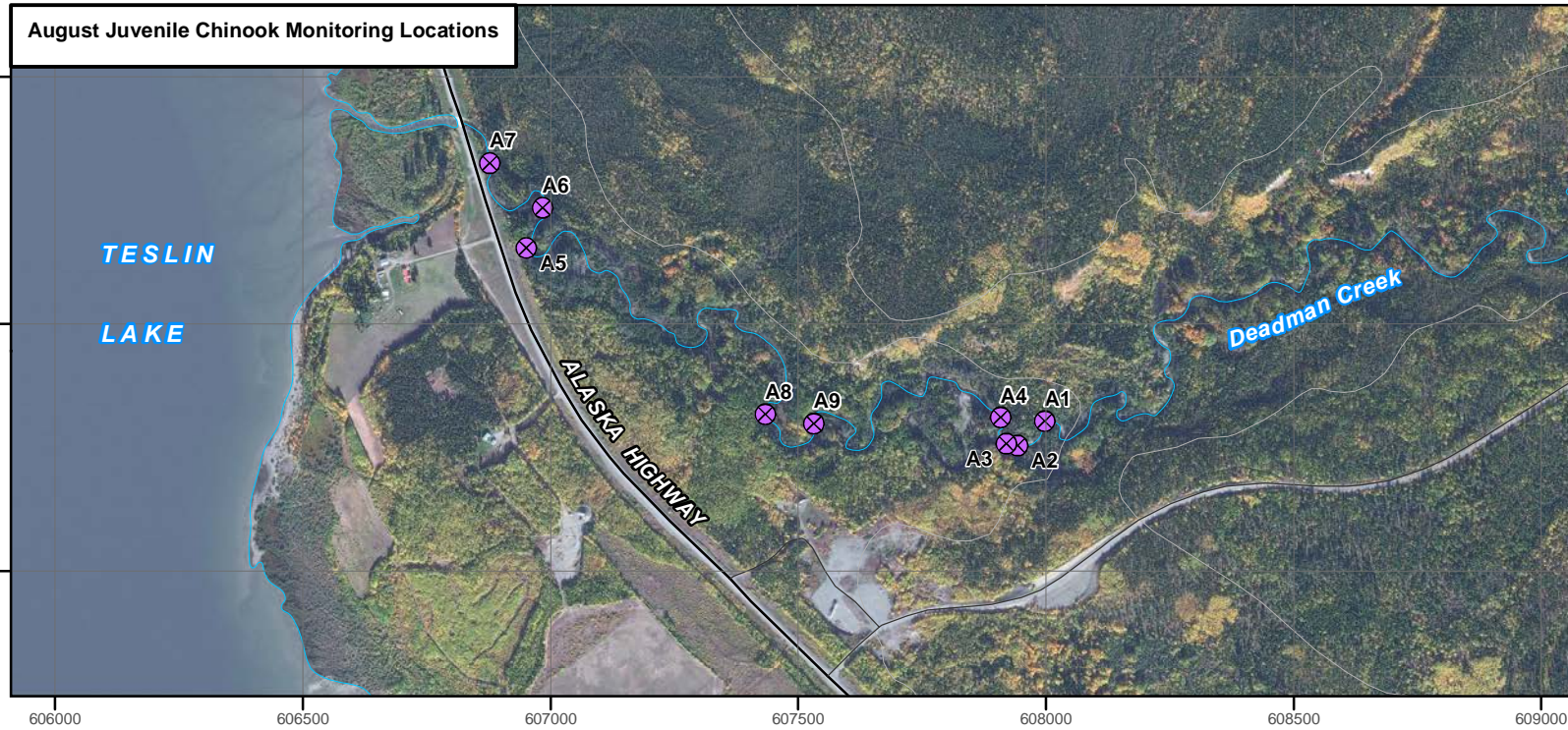
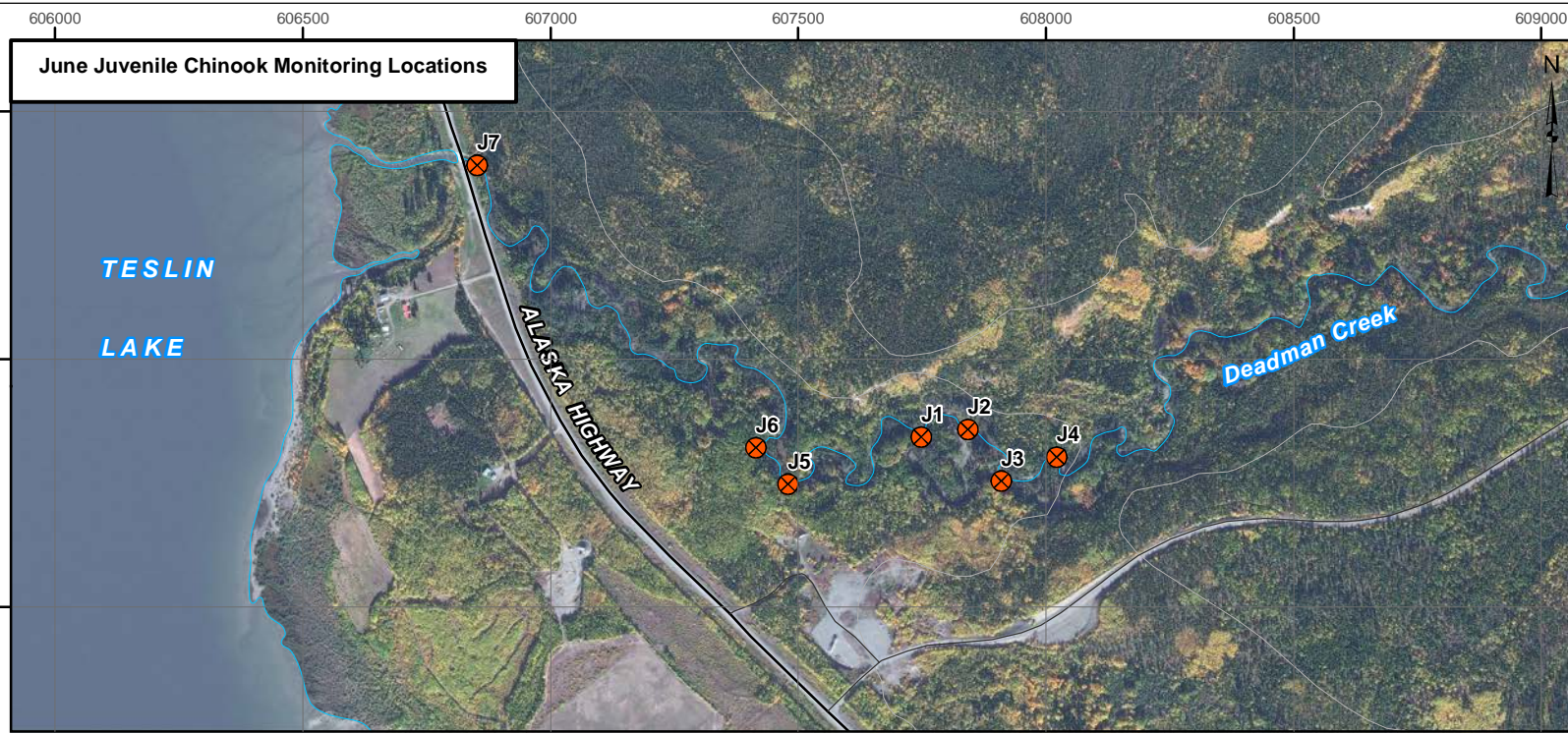
2.2 WATER TEMPERATURE MONITORING

Water temperature monitoring during 2016 involved the retrieval and redeployment of temperature loggers originally deployed during 2015 (EDI 2016) in Deadman Creek and Morley River. New loggers were also deployed during 2016 in conjunction with the five egg planting sites in each of Deadman Creek and Morley River (see egg planting section below for additional information).

2.3 JUVENILE MONITORING

Sampling for juvenile Chinook was conducted in Deadman Creek on two occasions under a Scientific Fish Collection License issued by DFO; June 22-23 and August 8-9. Previous work conducted in the watershed by Wilson (2003, 2004, 2005, 2006, and 2007) noted that non-natal Chinook did not appear to be present during June and started to arrive in early July with numbers increasing later in the summer. The June sampling event was intended to confirm these previous observations and determine if sampling in future years during this time of year may provide an indication of natal Chinook abundance in the stream. The August sampling event was intended to coincide with higher non-natal juvenile Chinook abundance in the stream and to begin determining the relative abundance and extent of habitat utilization in the stream. Both sampling events are planned to continue (and be expanded) in future years of the restoration project to monitor these parameters in Deadman Creek.

A total of 19 minnow traps were set at seven stations during the June sampling event with 2-3 traps set at each station. The August sampling event included 27 traps set in nine stations with 3 traps set per station (Photo 1). During both sampling events, traps were set in the lower 2 km of the stream. All traps were baited with Yukon River origin salmon roe following Yukon River Panel (2007) protocols and left to soak overnight. In-situ water quality parameters (water temperature, pH, specific conductance and dissolved oxygen) were collected for each station along with water depth and a general description of habitat. Digital photos were collected for all sampling stations along with GPS co-ordinates and set/pull times. Upon retrieval of the traps, all fish were counted and identified to species with 10 individuals of each species from each trap measured for fork length. Observations of the status of beaver dams and other potential barriers to fish passage were also recorded during the June and August sampling events.



Legend

— Alaska Highway
 — Secondary Road

Juvenile Chinook Monitoring Locations

⊗ June
 ⊗ August

Juvenile Chinook Monitoring Locations in Deadman Creek

Data Sources
 1:50,000 and 1:1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.
 High Resolution Satellite Imagery provided by Yukon government, 2017.
 Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. (2016) was obtained using Garmin GPS technology.
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2.4 INSTREAM EGG INCUBATION

The project underwent a YESAB project review and permits were issued for the work by Fisheries and Oceans Canada (DFO) including a Scientific Fish Collection License for the brood stock collection and an Introduction, Transplant and Transport (ITT) permit for the egg planting in both streams.

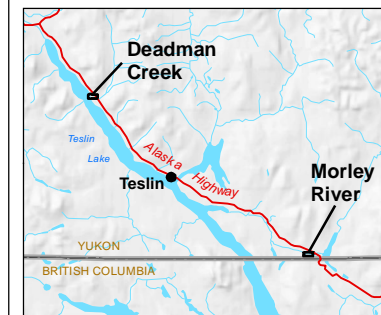
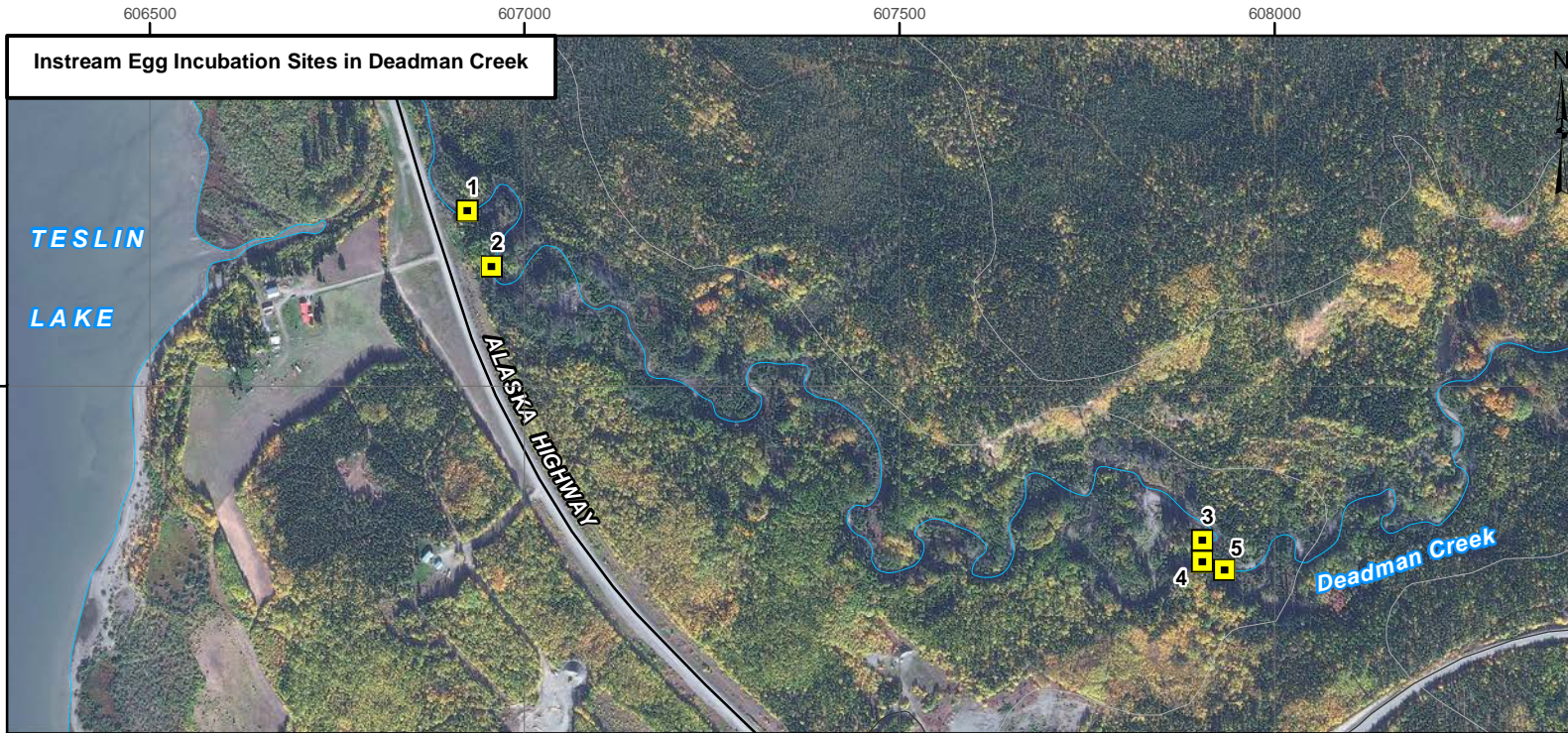
The egg planting involved four components: (1) site selection and preparation, (2) brood stock collection, (3) egg fertilization and (4) egg deployment.

2.4.1 SITE PREPARATION

Five sites were selected in each of Deadman Creek and Morley River; these sites were selected based upon ease of accessibility and similarity to natural Chinook spawning areas including substrate (cobbles and large gravel) and stream morphology (pool tail-outs). At each of the sites, working/cleaning of the substrate was required to mimic the natural redd construction and to prepare each of these sites for the egg planting (Photo 2, Photo 3). This was accomplished by digging/raking of the streambed, and in Deadman Creek, a specially modified pressure washer was also used to remove fine sediment from the streambed. In Morley River, care was taken to avoid disturbance to natural Chinook redds of which numerous were observed in the vicinity of the deployment sites. GPS co-ordinates were collected for all 10 sites and a rock with a unique combination of colored flagging tape was placed on each prepared site to facilitate relocation of the sites. The final step of site preparation was to move all cleaned substrate to the sides of the deployment area between the two egg insertion pipes, thus leaving a trench. It was within this trench that the Jordan Scotty incubators, Whitlock-Vibert boxes and egg tubes were placed during the egg deployment (Section 2.4.4).

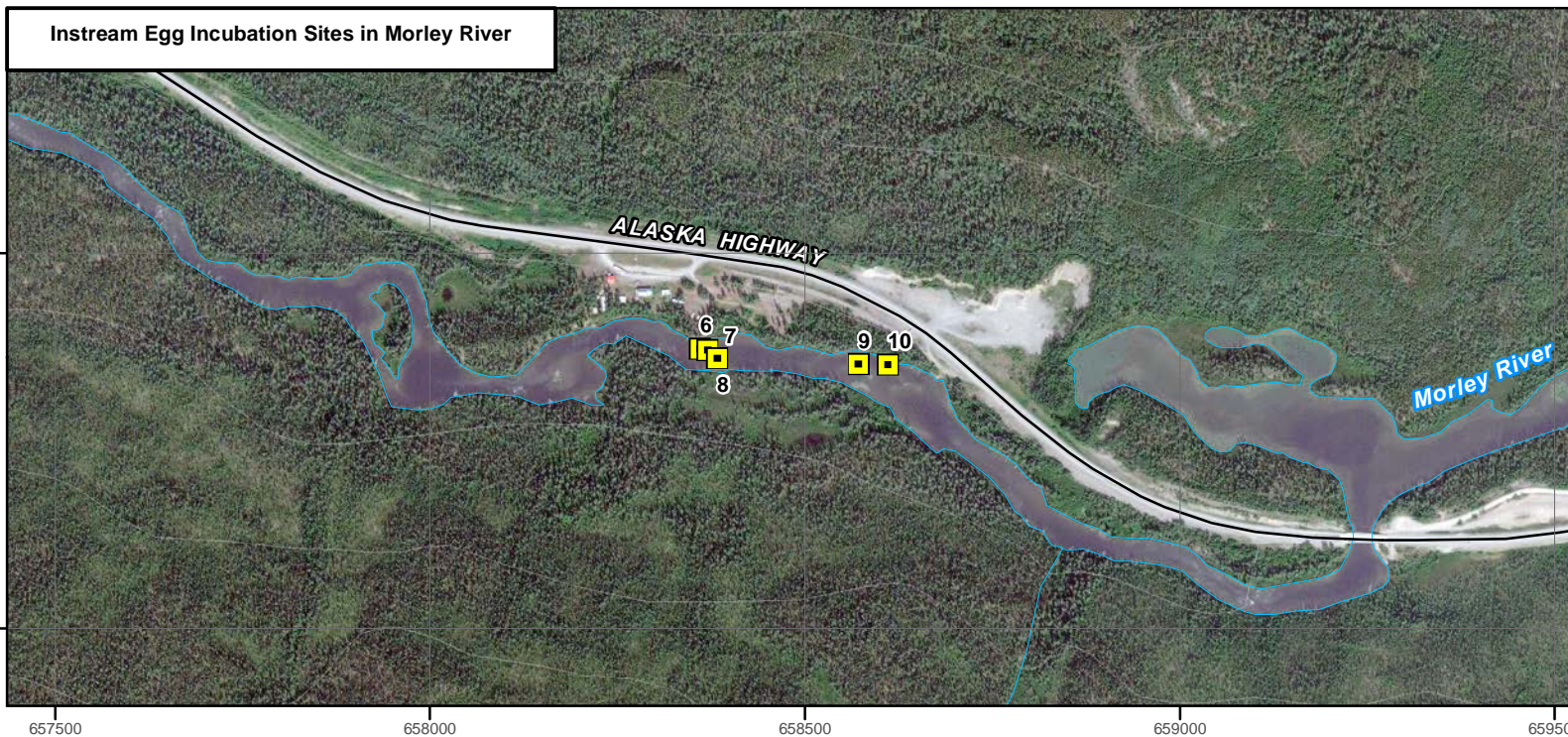
2.4.2 BROOD STOCK COLLECTION

Brood stock collection was conducted on the Morley River in the vicinity of the Alaska Highway crossing from August 17-21. The majority of fish were captured by angling/snagging; however, some fish were also captured using a large mesh (6.5 inch) gillnet used as a seine. All Chinook captured were measured for standard length, sexed, and sampled for scales and genetics (paired auxiliary processes; Photo 4). Scale and genetic samples were provided to (DFO) for analysis. Fish not suitable for brood stock collection were released promptly and those to be used for brood stock were temporarily placed in holding tubes to allow for eggs and milt to be collected simultaneously.



Legend

- Instream Egg Incubation Sites
- Alaska Highway
- Secondary Road



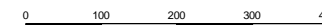
Instream Egg Incubation Sites in Deadman Creek and Morley River

Data Sources
 1:50,000 and 1:1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

High Resolution Satellite Imagery provided by Yukon government, 2017

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2.4.3 EGG FERTILIZATION

When a sufficient number of males and females were captured to conduct an egg take, each fish was carefully wiped dry and the eggs/milt were placed in new and dry plastic containers (Photo 5, Photo 6). Eggs were enumerated by weight to obtain an estimate of the total number collected. Eggs and milt were placed in a clean dark cooler with an ice pack to keep cool until fertilization.

Egg fertilization was conducted in close proximity to each egg planting site to reduce the amount of handling and transport into the stream. A clean and sterilized heath tray was set up at the site with a small gas powered water pump to provide a continuous flow of water from the stream. An umbrella was set up over the heath tray to provide shelter from the rain and sun during the fertilization and water hardening process. Prior to fertilization, all eggs were mixed such that individual sites did not have eggs from any single female. The fertilization was done in batches with only enough eggs for one site fertilized at once to reduce the amount of holding time of the eggs until planted into the stream. Eggs were weighed to estimate the number required for each site and milt from three males was used for each batch of fertilization. After being fertilized, the eggs were placed in the heath tray to water harden and flush for 30 minutes before being loaded into the various incubation media for planting in the stream.

2.4.4 EGG DEPLOYMENT

The egg deployment at each site involved the use of five methods of egg planting including: open and closed Jordan Scotty incubators (Photo 7), Whitlock-Vibert boxes (Photo 8), egg tubes (Photo 9) and artificial redds (Photo 10). The closed incubators consisted of a fine mesh wrap around the incubators to allow for the fate of all eggs/alevin to be determined following retrieval. Each Jordan Scotty incubator contained 200 eggs and was fastened to the streambed with rebar, marked with flagging, and then buried with the previously cleaned substrate. Each Whitlock-Vibert box contained 100 eggs, and was marked with flagging and buried in the substrate. The egg tubes contained 100-250 eggs depending upon the size of the tubes used and similar to the Whitlock-Vibert boxes, were flagged and buried in the substrate. The artificial redds involved the use of a metal pipe inserted into the cleaned substrate. Two such pipes were used at each site with 200 to 500 eggs placed into each pipe depending on substrate size (larger amount of substrate = more eggs). Half of the eggs were placed into the pipe at a depth of approximately 25 cm (below the pile surface) which was then carefully lifted up 5-10 cm with the remainder of eggs placed. Following the placement of all eggs at each site, previously cleaned substrate was piled into a mound to protect the eggs and mimic the construction of a natural Chinook redd.

2.5 SUCCESS MONITORING

The success monitoring included three events, which took place during the fall of 2016, winter of 2016/2017, and the spring of 2017. The objective of this monitoring was to determine the egg hatching in all incubation media in both Morley River and Deadman Creek. Methods were also explored in Deadman Creek to retain a number of alevins into the early summer to determine survival to the fry stage. Given that



the project was a trial of the egg planting method, a considerable portion of the success monitoring should be considered a trial in terms of methods and timing.

2.5.1 FALL 2016

The first monitoring event took place on October 6–7, 2016. During this monitoring trip, crews installed time-lapse cameras at each of the streams to monitor winter ice conditions, and retrieved one Whitlock-Vibert Box (WVB) from each stream to observe the status of egg development. In Morley River, the WVB was retrieved from Site 6; the eggs and alevin were temporarily removed to be enumerated and survival determined.

In Deadman Creek, Accumulated Thermal Unit (ATU) data was calculated to ensure that there was sufficient thermal units (280) for the eggs to be at the eyed stage. Once it was determined that this was the case, the WVB was retrieved from Site 4.

Based on the results, including some sedimentation observed in the WVBs in Deadman Creek, a second monitoring event took place on October 17-18, 2016. During this event the intention was to retrieve all egg incubation media from the Morley River to determine hatching success and to observe the status of the planted eggs in Deadman Creek in light of concerns regarding sedimentation of the planted eggs. The crew wore drysuits and snorkels to work under the water surface.

Morley River

At each of the five egg planting sites on Morley River, the crew carefully removed the egg incubation media. The egg planting insertion locations were excavated by hand, removing one rock at a time and counting all dead eggs and alevin that were exposed. All WVBs and egg tubes were removed and brought to shore to process the contents. The open Jordan Scotty incubators were removed and opened in separate bins to ensure the contents were accurately determined. When opening the Jordan Scotty incubators, the number of dead eggs and alevin were recorded as well as the number of alevin that had not yet emerged from the incubator. The closed Jordan Scotty incubators (ones placed in mesh bags) were processed in the same manner as the open incubators although the contents of the mesh bag enclosure were all counted to obtain a total count of all 200 eggs loaded into each incubator. Across all egg incubation media, the dead eggs and alevins were discarded and all remaining live alevin and eggs were replanted into the substrate using an egg insertion pipe with substrate piled around it.

Deadman Creek

Field investigations at Deadman Creek during October involved the partial removal of two of the five egg planting sites (Sites 3 and 4). At Site 4, the WVB box was removed in addition to both the open and closed Jordan Scotty incubators. Consistent with the Morley River sites, one of the egg planting insertion pipe locations (upstream) was also investigated. At Site 3, the WVB and egg tube were removed and all other incubation media were left undisturbed. All field methods were consistent with those used at the



Morley River. The water temperature logger at Site 4 was retrieved and downloaded and all live eyed eggs were placed back into the substrate using methods consistent with the initial planting activities.

A supplemental monitoring event was conducted at Site 2 on Deadman Creek on November 9 to investigate two of the WVBs and one of the egg insertion pipe locations. The WVBs were retrieved, live/dead eggs enumerated and the live eggs redeployed into the WVBs at the same locations. The egg insertion pipe location was sampled for planted eggs using a Surber sampler with all live/dead eggs enumerated and any live eggs replanted at the initial collection location.

2.5.2 WINTER 2016/2017

The first winter monitoring event was conducted on February 28 and March 1, 2017 to document winter conditions and collect in-situ water quality parameters at all egg planting sites in Deadman Creek and Morley River. Ice cover was removed from each of the sites using hand tools where required and digital photos were collected at each site. A stream discharge measurement was collected using an acoustic doppler velocity (ADV) meter downstream of Site 1 on Deadman Creek following the clearing of a stream channel cross section of ice. One WVB was also temporarily retrieved from Site 2 on Deadman Creek during this monitoring event and it was found that the eggs had hatched.

The March 21-24 monitoring was conducted exclusively at Deadman Creek with the intent of removing all egg incubation media to determine hatching success. A considerable amount of ice was removed at each site using hand tools and a gas-powered auger to allow for all incubation media to be removed. Each incubator/WVB was removed from the stream and placed in a large container filled with water. The incubator/WVB was then carefully removed to determine the fate of all eggs within each. All temperature loggers initially deployed with the incubators during August 2016 were also retrieved to allow for the calculation of ATUs at each site.

The majority of live alevin were returned to the substrate; however, a portion of the alevin were placed in closed containers and buried back into the substrate to allow for survival and development to be monitored until the fry stage. Two such containers were used, the first was perforated metal box filled with Bio-rings (artificial substrate) placed within a fine mesh bag closed with a zipper and then buried in the substrate. One of these containers was used at Site 1 and was loaded with 99 live alevins. The second container involved a fine mesh bag (closed with a zipper) filled with Bio-rings and secured within two rigid perforated plastic bins which were secured to one and other with heavy duty zip ties. One such container was loaded with 122 live alevin and deployed at Site 2. Temperature loggers were deployed within each of the two containers to allow for later calculation of ATUs.



2.5.3 SPRING 2017

The spring monitoring included two single site visits to Sites 1 and 2 at Deadman Creek on April 22 and June 9, 2017. The objective of these visits was to check on the development of the alevins contained in the closed containers at each site. The container at Site 1 was readily emptied and a count of live/dead alevins was conducted on April 22; however, an accurate count could not be made at Site 2 without completely emptying the container. On June 9, all alevin had developed into fry and were therefore released into the creek following enumeration.



3 RESULTS

3.1 WALKING TRAIL ESTABLISHMENT

A walking trail was established along Deadman Creek to provide access to the five egg planting sites in the lower reaches of the stream. The rough trail extends from the Alaska Highway crossing upstream to the uppermost egg planting site (DC-5), a stream channel distance of approximately two kilometres. The clearing of this trail was essential to allow for the carrying of egg planting equipment into and out of each site. It is envisioned that this walking trail will be expanded upon in future years of the restoration project to continue to allow for more efficient walking access to the stream during the juvenile Chinook sampling and egg planting and to possibly incorporate interpretive signage.

3.2 WATER TEMPERATURE MONITORING

Surface water temperature loggers in Deadman Creek and Morley River were retrieved, downloaded and redeployed on August 21, 2016. Water temperatures in Morley River are warmer than those in Deadman Creek for the entire period of record (Figure 4). Water temperatures in the Morley River displayed fewer fluctuations during night and day measurements. Warmest temperatures in both watercourses were noted in mid-July, and the lowest temperatures were seen in early December 2015 through early March 2016.

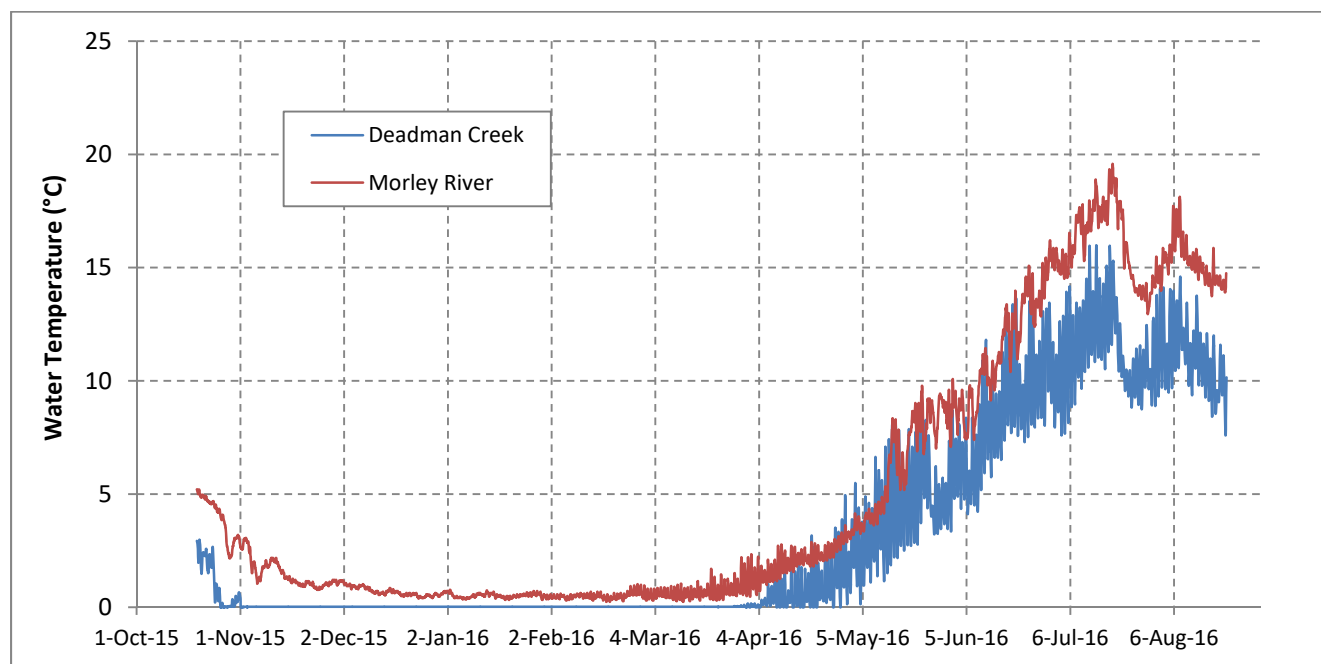


Figure 4. Hourly water temperature in the Morley River and Deadman Creek from November 2015 through mid-August 2016.



New loggers were deployed in each of the five egg deployment sites in Deadman Creek and Morley River. These loggers were attached to the bottom of a Jordan Scotty incubator. Water temperatures in Deadman Creek decreased rapidly from late August through early October 2016, and remained at or just above zero until the loggers were removed during the late winter of 2017 when the incubation media were retrieved (Figure 5). In the Morley River, water temperatures decrease more gradually from a high of just over 14°C in late August 2016 to a daytime high of 4°C when the loggers were removed in mid-October 2016 (Figure 6). There was very little difference in water temperatures between the sites in each of Deadman and the Morley River.

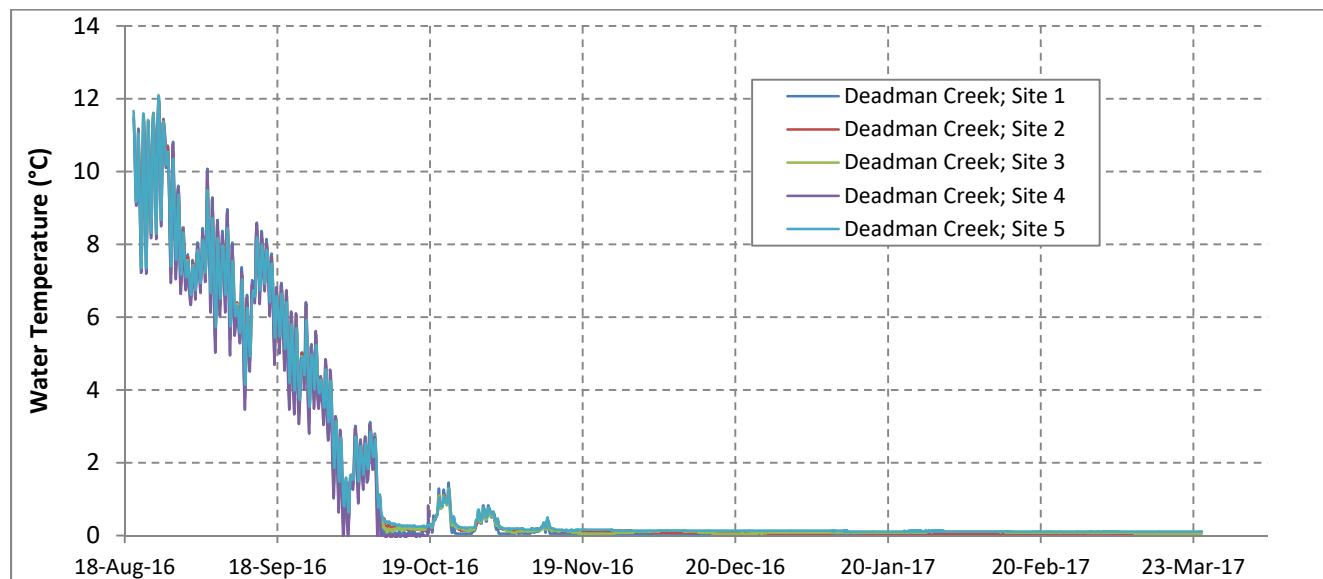


Figure 5. Hourly water temperatures from each egg planting location in Deadman Creek; data collected from egg planning on August 20/21, 2016 through detection of alevins in March 2017.

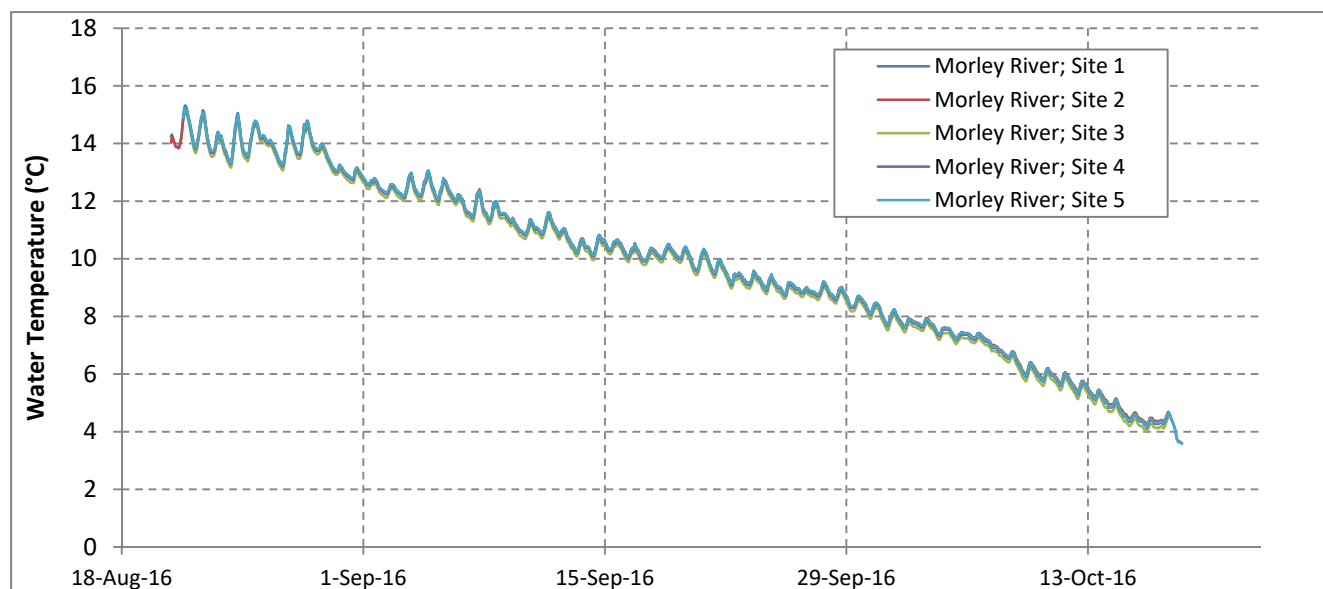


Figure 6. Hourly water temperatures from each egg planting location in the Morley River; data collected from egg planning on August 20/21, 2016 through detection of alevins in October 2016.



3.3 JUVENILE MONITORING

The juvenile Chinook sampling events captured 336 fish of three species, with the catch dominated by slimy sculpin in June and juvenile Chinook in August (Table 1). Zero Chinook were captured during the June sampling event and nearly all traps set during August captured this species. The sampling stations near the highway crossing had the lowest capture rates during August with higher catches upstream where the habitat appears to be more suitable (cover and in-stream woody debris). The juvenile Chinook captured during August ranged in fork length from 61 to 99 mm and an average of 73.1 mm (Figure 7).

Table 1. Summary of Deadman Creek juvenile Chinook sampling, June and August 2016.

Sampling Event	Species	Average CPUE (Number/24 trap hours)	Total Individuals	Number of Traps with fish Captured
June 2016 (19 traps set)	Burbot	0.14	1	1
	Slimy Sculpin	3.06	27	10
	Chinook Salmon	0.00	0	0
August 2016 (27 traps set)	Burbot	0.16	2	1
	Slimy Sculpin	0.48	6	4
	Chinook Salmon	23.48	300	22

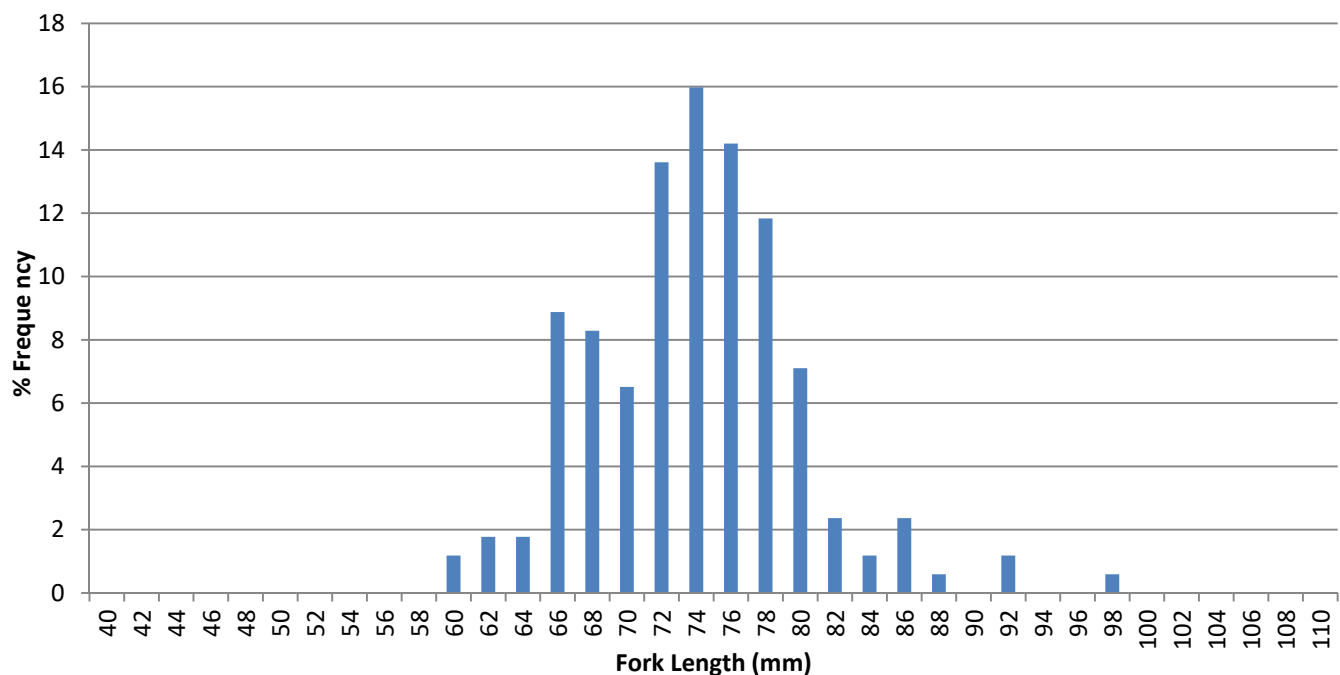
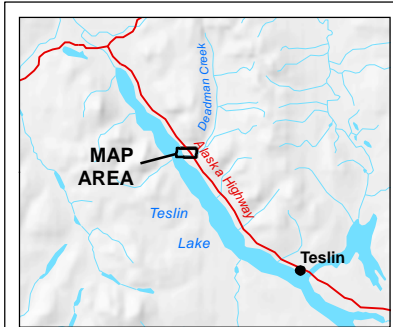


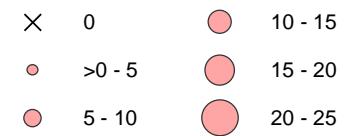
Figure 7. Length frequency of juvenile Chinook captured in Deadman Creek (n=168).



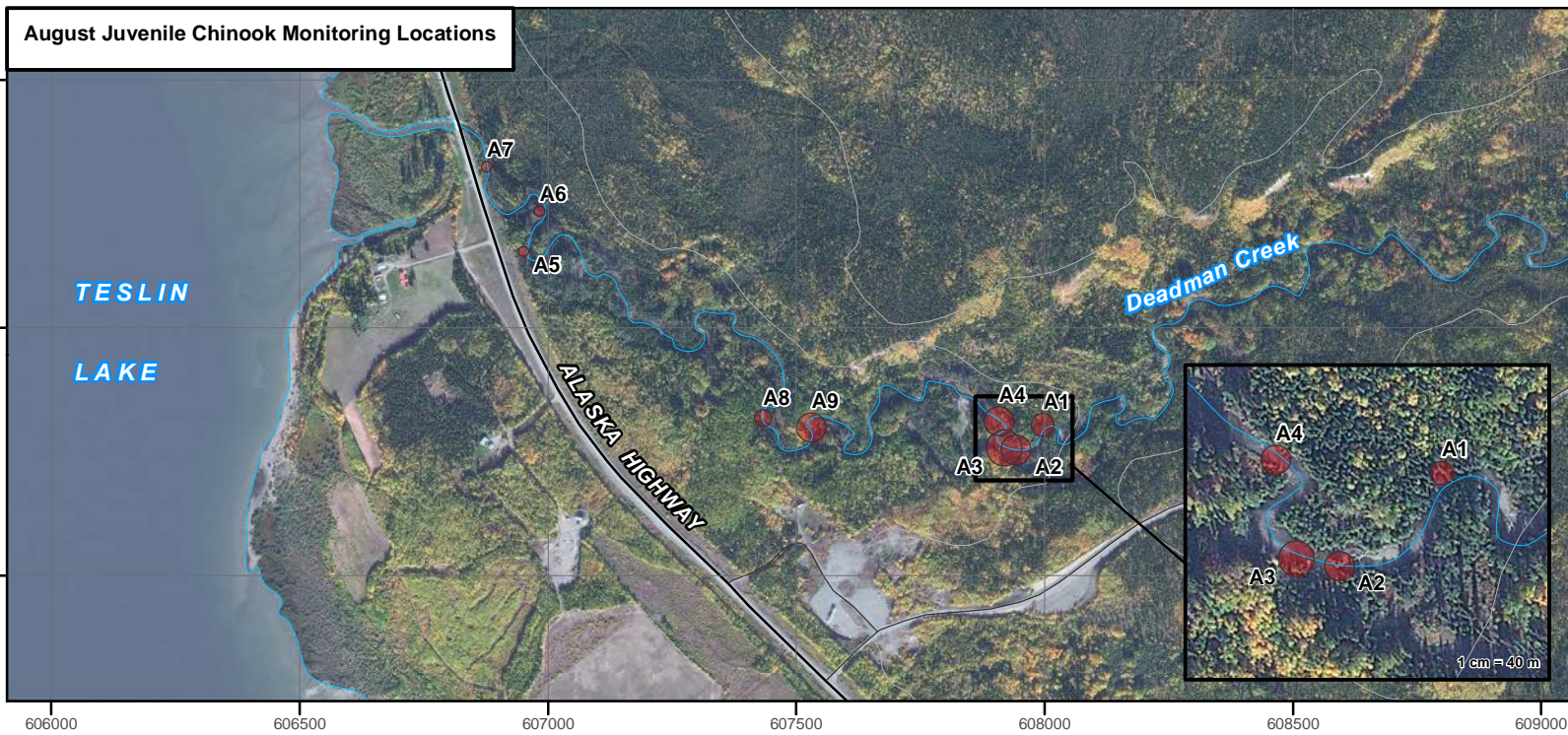
Legend

- Alaska Highway
- Secondary Road

Juvenile Chinook CPUE¹



¹Catch per unit effort: number captured per 24 hours (average of 2-3 traps per site).



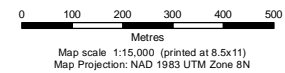
Juvenile Chinook Monitoring Results in Deadman Creek

Data Sources
1:50,000 and 1:1,000,000 Topographic Spatial Data courtesy of Her Majesty the Queen in Right of Canada, Department of Natural Resources. All Rights Reserved.

High Resolution Satellite Imagery provided by Yukon government, 2017.

Project data displayed is site specific. Data collected by EDI Environmental Dynamics Inc. (2016) was obtained using Garmin GPS technology.

Disclaimer
This document is not an official land survey and the spatial data presented is subject to change.



Drawn: HG	Checked: BSc/MP	Date: 9/6/2017	FIGURE 8
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3.4 INSTREAM EGG INCUBATION

3.4.1 SITE PREPARATION

The preparation of the 10 egg planting sites required 1.5 days to complete. This work involved a crew of up to 12 individuals including TTC summer students and a Yukon Youth Conservation Corps (Y2C2) crew.

3.4.2 BROOD STOCK COLLECTION

The brood stock collection and egg fertilization was conducted in batches in an attempt to allow for sufficient time to plant the eggs within a given day and thus minimize egg handling time. The timing of brood stock collection appeared to coincide with the tail end of the Chinook spawning period and this caused some challenges with obtaining the required number of eggs. A total of six females were live spawned for brood stock; however, three of these individuals were mostly spent and yielded a small number of eggs (less than a thousand each). The remaining females were of moderate size (750 to 800 mm fork length) and yielded the remainder (approximately 8,000) of the eggs used for the planting. Milt was collected from a total of 10 males with at least three males being used to fertilize each batch of eggs with some males used more than once depending upon the amount and quality of milt obtained. A total of 38 Chinook were captured while attempting to obtain brood stock with the majority of these fish being spent and unsuitable for the collection of eggs or milt. Age/sex/length data and genetic samples were collected from all of these Chinook and were provided to DFO on August 26, the results of which indicated that the majority of Chinook aged were from the 2011 brood year (86%) with the 2010 and 2012 brood years each comprising 7%. The Chinook sampled during brood stock collection had mid-eye hypural lengths ranging from 610 to 895 mm with an average of 722.8 mm; the females sampled were slightly larger than the males captured (Figure 9).

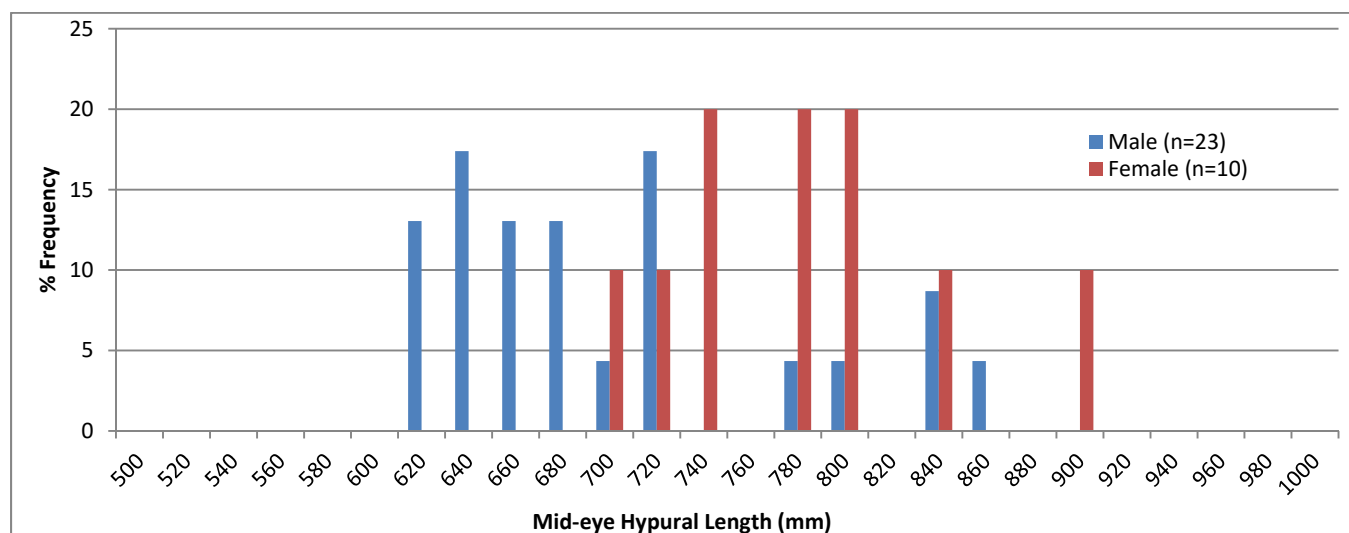


Figure 9. Length frequency of adult Chinook sampled during brood stock collection in Morley River.



3.4.3 EGG FERTILIZATION AND DEPLOYMENT

A total of 12,481 eggs were fertilized and planted during this project with slightly more eggs planted in Deadman Creek (6,524) as compared to Morley River (5,957). This was slightly above the initial target of 10,000 eggs in total and was a result of a measurement error when enumerating the eggs by weight. In Deadman Creek, open and closed Jordan Scotty incubators were used with Whitlock-Vibert boxes and egg insertion pipes at all sites with egg tubes also used at a portion of the sites (Table 2). In Morley River, the same methods were used although Jordan Scotty incubators were not used at all sites.

Table 2. Summary of egg planting in Deadman Creek and Morley River.

Stream	Site	Incubation Media (№ of units/№ of eggs)					Total Eggs Planted
		Jordan Scotty Incubators (open)	Jordan Scotty Incubators (closed)	Whitlock-Vibert Boxes	Egg Tubes	Egg Insertion Pipes	
Deadman Creek	1	2 / 400	1 / 200	2 / 200	-	2 / 1,000	1,800
	2	3 / 600	1 / 200	2 / 200	1 / 190	2 / 500	1,690
	3	1 / 200	1 / 200	1 / 100	1 / 108	2 / 496	1,104
	4	1 / 200	1 / 200	1 / 100	-	2 / 400	900
	5	1 / 200	1 / 200	1 / 100	-	2 / 530	1,030
	ALL	8 / 1,600	5 / 1,000	7 / 700	2 / 298	10 / 2,926	6,524
Morley River	6	1 / 200	1 / 200	1 / 100	-	2 / 800	1,300
	7	1 / 200	1 / 200	1 / 100	-	2 / 800	1,300
	8	-	-	1 / 100	2 / 235	2 / 600	935
	9	1 / 200	1 / 200	1 / 100	-	2 / 600	1,100
	10	1 / 200	-	1 / 100	2 / 200	2 / 822	1,322
	ALL	4 / 800	3 / 600	5 / 500	4 / 435	10 / 3,622	5,957

3.4.4 SUCCESS MONITORING

Success monitoring was during the fall of 2016, winter of 2016/2017 and the spring of 2017. The results of this monitoring are separated below for Morley River and Deadman Creek. Monitoring was conducted at Morley River during the fall and winter only with monitoring at Deadman Creek conducted during all three periods.

3.4.4.1 Morley River

Fall 2016

On October 7, 2016, a WVB was retrieved from Site 6 in Morley River to check on the development of the planted eggs. The WVB was found to be very clean and free of sediment with the majority of eggs and alevin alive. A total of 100 eggs had initially been loaded into this WVB; contents found at retrieval included 5 dead eggs, 12 live alevins and 83 very advanced eyed eggs near hatching. The dead eggs were discarded and the live eggs/alevins were reloaded into the WVB and redeployed into the river at the same location.



A second monitoring event was conducted from October 17-18 to retrieve all incubation media from Morley River (all eggs had hatched). Water temperature loggers were retrieved from each of the egg planting sites in Morley River which showed a range of 561 to 584 ATUs across the five sites (Table 3). Chinook salmon typically require 280 ATUs to be eyed eggs and 480 to 540 ATUs to hatch into alevin¹.

Table 3. Summary of accumulated thermal units in Chinook egg planting sites on Morley River.

Site	Egg Incubation Date Range	Total Accumulated Thermal Units (ATUs)
6	20 August - 16 October	584.3
7	20 August - 16 October	584.3
8	21 August - 16 October	560.8
9	21 August - 17 October	572.0
10	21 August - 17 October	574.7

Each of the egg planting sites on Morley River contained a single WVB that each contained 100 eyed eggs at the time of deployment. The design of these boxes does not allow for the eggs to exit the box and the fish must be alevin to be able to exit the box and enter the surrounding substrate. Very few dead or live eggs and alevin were found in the boxes and it is inferred that the majority of alevins had already exited the box. The WVBs had relatively high inferred survival rate with a range of 71 to 93% and an average of 82.8% (Table 4; Photo 11). Of particular interest is the difference in inferred survival between sites 6/7 and 8/9/10. Sites 6 and 7 were planted with the same batch of fertilized eggs as sites 8, 9 and 10; however, the holding time for these eggs were very different. The eggs planted in sites 6 and 7 were held for 8 to 10 hours prior to fertilization and planting whereas the eggs planted in sites 8, 9 and 10 were held for 20 to 21 hours prior to fertilization (with fresh milt) and subsequent planting.

Table 4. Summary of Morley River Whitlock-Vibert box results (October 17-18).

Site	Total Eggs Planted	Dead Eggs	Dead Alevin	Live Eyed Eggs	Live Alevin	Inferred Survival ^B (%)
6	100	6 ^A	1			93.0
7	100	4	4		3	92.0
8	100	9	15	3	6	76.0
9	100	7	11			82.0
10	100	18	11		1	71.0

^A Included in this count of dead eggs are the 5 dead eggs removed on October 6.

^B Inferred survival assumes that a large proportion of the alevins had already exited the WVB.

A total of four egg tubes were used to plant fertilized eggs at two of the planting sites on Morley River (Table 5). The tubes are typically used in a hatchery setting as they do not provide much separation of the eggs as is the case with the WVBs and the Jordan Scotty incubators. This incubation media was used on a trial basis during 2016 to determine their utility during future years of the project. After hatching, the alevin are unable to exit the tube and therefore the validity of the survival estimate is questionable given that the

¹ Vano, L. Personal communication with Lawrence Vano, Manager of the Whitehorse Rapids Fish Hatchery. October 25, 2016.



dead alevin found in the tube may have survived if able to exit the tubes. It was also apparent during the egg tube retrieval that some clusters of dead eggs had fungus growth which appeared to have killed some of the alevins which could not exit the tube (Photo 12). In the WVB this is not a concern as the dead eggs and associated fungus are separated from the alevins which can move to the lower section of the box. The egg survival in the egg tubes was quite variability with a range of 38 to 90% survival across the four tubes in Morley River.

Table 5. Summary of Morley River egg tube results (October 17-18).

Site	Egg Tube	Total Eggs Planted	Dead Eggs	Dead Alevin	Live Eyed Eggs	Live Alevin	Survival (%)
8	1	100	46	2	9	38	38.0
	2	135	11	3		121	89.6
10	1	100	7	8		85	85.0
	2	100	39	13		48	48.0

A combination of open and closed Jordan Scotty incubators were used in the Morley River planting sites. These incubators comprised 200 individual egg compartments which allow each egg to incubate without contacting other eggs. The open incubators allowed for the alevin to hatch and exit the incubator whereas the closed incubators were wrapped in a pouch made of small mesh fabric to contain all alevin in place. These pouches were found to contain both live and dead alevin upon retrieval; however, the mesh bag would have limited alevin movement into natural bed material and likely affected alevin survival. As such, survival to the emergent stage (the ability to exit the incubator) is more relevant than survival at time of removal. With this considered, both the open and closed incubators had relatively high inferred survival with a range of 83 to 96% (Table 6, Table 7, Photo 13).

Table 6. Summary of Morley River open Jordan Scotty incubator results (October 17-18, 2016).

Site	Total Eggs Planted	Dead Eggs	Dead Alevin	Live Eyed Eggs	Live Alevin	Empty Cells	Inferred Survival ^A (%)
6	200	33	1		5	161	83.0
7	200	19	2			179	89.5
9	200	16			2	182	91.0
10	200	22	2	4	5	167	86.0

^A Inferred survival assumes that empty egg cells indicate successful egg hatching and emergence from the incubator. This value is calculated by summing the number of empty cells, live alevin and live eyed eggs and then dividing by the total number of cells (200).

Table 7. Summary of Morley River closed Jordan Scotty incubator results (October 17-18, 2016).

Site	Total Eggs Planted	Inside Incubator			Outside Incubator		Inferred Survival ^A (%)
		Dead Eggs	Dead Alevin	Live Alevin	Dead Alevin	Live Alevin	
6	200	9		4	21	166	95.5
7	200	16	2		24	158	91.0
9	200	7	10	6	92	85	91.5

^A Inferred survival is calculated by summing the live alevin inside the incubator with all alevins outside the incubator and then dividing by the total number of eggs initially planted in the incubator (200).



The egg insertion pipes planted a number of fertilized eggs directly into the substrate of the river and they were therefore not contained. Estimating the egg survival in these areas was planned to be based upon the presence of live or dead eggs/alevin at the initial planting site. Upon examination of these sites, primarily dead eggs and dead alevins were observed and it presumed that the live alevins had dispersed into the surrounding substrate. The few live alevins observed were observed to be very mobile and quickly moved into the substrate when disturbed. If it is assumed that only the dead eggs and dead alevins remained at the planting site and that all of these would be visible during examination of the area, egg mortality in these areas appeared to be relatively low (10% or less; Table 8).

Table 8. Summary of Morley River egg insertion pipe investigations (October 17-18, 2016).

Site	Total Eggs Planted	Dead Eggs	Dead Alevin	Live Eyed Eggs	Live Alevin	Observed Mortality (%)
6	400	34	6			10.0
7	400	16	9		4	6.3
8	300	13	9			7.3
9	300	~70 ^A	9	3		-
10	322	13	5			5.6

^A Unable to obtain an accurate count due to clusters of dead eggs/fungus.

Winter 2016/2017

The winter site visit was conducted at Morley River to document winter habitat conditions in the vicinity of the egg planting sites. All of the egg planting sites were primarily free of ice cover (Photo 14), water temperatures were slightly above freezing and dissolved oxygen sufficient to support development of Chinook alevins (Table 9).

Table 9. Summary of field measured water quality parameters at site conditions at the Morley River egg planting sites on March 1, 2017.

Site	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Ice Thickness (m)	Water Depth (m)	Bed to Bottom of Ice (m)	Snow Depth (m)
6	-	-	-	0.0	0.35	No ice cover present	
7	0.3	10.63	0.05	0.0	0.31		
8	-	-	-	0.0	0.50		
9	-	-	-	0.0	*		
10	0.4	10.80	0.09	0.0	*		

* Unsafe access to planting sites.



3.4.4.2 Deadman Creek

Fall 2016

On October 7, 2016, a WVB was retrieved from Site 4 in Deadman Creek to check on the development of the planted eggs. ATU data for the stream indicated that sufficient thermal units (280) had been attained for the eggs to be at the eyed stage. Upon retrieval, it was evident that there was significant amount of sediment accumulated within the WVB since planting. All of the sediment had accumulated in the lower section on the WVB and therefore the eggs were not affected. It was confirmed that the majority of eggs were eyed (81) with a total of 19 dead eggs. Prior to placing the live eggs back in the WVB and redeploying it, the sediment was rinsed out of the lower compartment.

Deadman Creek was revisited on October 17 to further check on the development of the planted eggs. The previously retrieved WVB at Site 4 was again retrieved and found to not have accumulated any additional sediment. A second WVB was also retrieved from Site 3 and found to have five dead eggs and 95 live eyed eggs (95% alive) with some accumulated sediment but considerably less than previously found at Site 4 (Photo 15). The egg tube at Site 3 was also retrieved on October 17; however, the cap became dislodged in the rocks and although some dead eggs were observed, a full count could not be made.

Both the open and closed Jordan Scotty incubators were retrieved from Site 4 and although some sediment was present in the incubators, both had relatively high rates of live eyed eggs with 92% in the open and 96.5% in the closed (Photo 16, Photo 17). Interestingly, the closed incubator had accumulated less sediment than the open incubator, presumably due to the presence of the mesh pouch which may have helped to prevent the entry of sediment.

A total of 200 eggs had initially been planted at the egg insertion pipe location at Site 4, and high numbers of live eyed eggs were observed with a count of 15 dead eggs while carefully examining this area underwater (Photo 18).

Winter 2016/2017

The first winter field investigation was conducted at Deadman Creek on February 28, 2017. All sites were ice covered with ice thickness ranging from 0.10 to 0.36 m (Table 10). Adequate water flow was observed all sites and water depth below the ice surface ranged from 0.22 to 0.52 m. Water temperatures were 0.0°C at sites and the water was well oxygenated at all sites. Stream discharge at Site 1 was determined using an ADV flow meter as was 0.2526 m³/s (APPENDIX B).



Table 10. Summary of field measured water quality parameters at site conditions at the Deadman Creek egg planting sites on February 28, 2017.

Site	Water Temperature (°C)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Ice Thickness (m)	Water Depth (m)	Bed to Bottom of Ice (m)	Snow Depth (m)
1	0.0	11.53	0.57	0.36	0.58	0.22	0.19
2	0.0	11.59	0.72	0.34	0.54	0.34	0.24
3	0.0	11.72	-	0.15	0.36	0.41	0.34
4	0.0	11.72	0.97	0.10	0.42	0.40	0.16
5	0.0	11.70	-	0.16	0.68	0.52	0.34

One of the WVBs was retrieved from Site 2 to check on the development of the eggs, and it was found that the eggs had recently hatched into alevin. Upon retrieval, the WVB contained 3 dead eggs, 1 live eyed egg and 80 live alevins (Photo 20).

The second winter monitoring event was conducted from March 21-24, 2017 in order to retrieve all remaining incubation media from Deadman Creek to determine hatching success. A considerable amount of ice removal was required from the sites in order to access the planting sites. This was particularly evident at Site 1 where there was a considerable buildup of overflow ice.

Accumulated thermal units (ATUs) from the egg planting sites in Deadman Creek indicated a range of 317.6 to 338.6 ATUs from the time of planting to the time of retrieval on March 24 (Table 11). Chinook eggs typically require 480-540 ATUs to hatch; however, the eggs planted in Deadman Creek hatched with considerably fewer ATUs. It is presumed that this may be in response to the relatively cold water in the stream and suggests that the eggs may continue to development at a minimum rate, provided that they do not freeze.

Table 11. Summary of accumulated thermal units in Chinook egg planting sites on Deadman Creek.

Site	Egg Incubation Date Range	Total Accumulated Thermal Units (ATUs)
1	20 August – 24 March	317.6
2	20 August - 24 March	321.7
3	19 August - 24 March	327.7
5	19 August - 24 March	338.6

A total of seven WVBs were initially deployed in Deadman Creek, each of which contained 100 fertilized eggs. Three of these WVBs were retrieved during previous monitoring and a fourth box at Site 1 could not be located during the late March monitoring². The remaining three WVBs were retrieved on March 24 and had an inferred survival (hatching) rate ranging from a low of 50% at Site 5 to a high of 90% at Site 2 (Table 12;). It is important to note that Site 5 was the first site planted during August 2016 and the conditions at this site may not have been as favorable as some of the other sites (amount of substrate and burial technique).

² The missing fourth WVB was found in July 2017 and found to contain 27 dead eggs.

**Table 12. Summary of Deadman Creek Whitlock-Vibert box results (March 24).**

Site	Total Eggs Planted	Dead Eggs	Dead Alevin	Live Eyed Eggs	Live Alevin	Inferred Survival ^B (%)
1	100	27	0	0	0	73
2	100	10	0	0	1	90
5	100	50	0	0	3	50

^A Inferred survival assumes that the majority of the alevins had already exited the WVB.

A total of two egg tubes were used to plant fertilized eggs at two of the planting sites in Deadman Creek. One of the tubes (Site 3) was retrieved in October 2016 and the second tube (Site 2) was retrieved on March 24. Upon retrieval, this tube was completely filled with compacted sand and only a single live alevin was present. Seven additional dead alevins were located and the remaining 82 eggs initially planted in the tube were dead and undiscernible as un-eyed or eyed eggs.

A combination of open and closed Jordan Scotty incubators were used in the Deadman Creek planting sites. All of these incubators remained in place leading up to the late March monitoring event with the exception of single open and closed incubators at Site 4 which were retrieved in October 2016. The overall inferred survival from the open incubators was 47.9% and ranged from a low of 31.5% at Site 1 to a high of 74% at Site 2 (Table 13; Photo 22). Upon retrieval, many of the open incubators were found to have accumulated a considerable amount of sediment which likely accounts for the relatively high number of dead alevin contained within the incubators. The closed incubators were wrapped in a pouch made of small mesh fabric to contain all alevins in place. These pouches were found to contain both live and dead alevins upon retrieval (Table 14); however, the mesh bag would have limited alevin movement into natural bed material and likely affected alevin survival. The contents of the closed incubators were not separated into what was present inside and outside of the incubators and therefore, an inferred survival rate cannot be determined.

Monitoring of the egg insertion pipe sites in Deadman Creek was found to be unpractical during the winter months due to ice thickness and water depths. In order to better assess egg survival in these areas, new success monitoring methods need to be developed and tested in future years of the project.

**Table 13. Summary of Deadman Creek open Jordan Scotty incubator results (March 24, 2017).**

Site	Total Eggs Planted	Dead Eggs	Dead Alevin	Live Eyed Eggs	Live Alevin	Empty Cells	Inferred Survival ^A (%)
1	200	61	47	0	34	58	46.0
	200	27	110	0	23	40	31.5
2	200	36	16	0	122	26	74.0
	200	13	101	0	45	61	53.0
	200	18	95	0	74	13	43.5
3	200	78	54	0	25	43	34.0
5	200	70	23	0	65	42	53.5
ALL SITES COMBINED	1,400	303	446	0	388	283	47.9

^A Inferred survival assumes that empty egg cells indicate successful egg hatching and emergence from the incubator. This value is calculated by summing the number of empty cells, live alevin and live eyed eggs and then dividing by the total number of cells (200).

Table 14. Summary of Deadman Creek closed Jordan Scotty incubator results (March 24, 2017).

Site	Total Eggs Planted	Dead Eggs	Dead Alevin	Live Alevin
1	200	17	141	42
2	200	16	7	177
3	200	88	93	19
5	200	106	77	17

Spring 2017

The focus of the spring monitoring was to check on the development and survival of the live alevins placed within closed containers at sites 1 and 2 in Deadman Creek on March 24, 2017. On April 22, the water temperature at both sites was 0.3°C and the creek was still completely ice covered but the cover appeared to be deteriorating. Upon retrieval of the container at Site 1, 79 of the 99 alevins initially placed into the container were found to be alive and did not appear to have developed considerably since late March. All alevin were replaced back into the container after being enumerated and the container re-buried in the substrate. At Site 2, 5 dead alevins were removed (122 initially deployed in late March) and a total count of the live alevin could not be made while also being able to redeploy them into the stream. Both containers had accumulated very little sediment since the March deployment.

The second spring site visit took place on June 9, 2017 and following a period of air temperatures in the range of 25-30°C, water temperatures at sites 1 and 2 were 10.7°C. A total of 31 emergent fry were found within the container at Site 1 which had accumulated a considerable amount of sediment since late April, presumably due to being present in the stream during spring freshet. A similar amount of sediment was present in the container at Site 2 which was found to contain 45 live emergent fry (Photo 23). Eight of the emergent fry from sites 1 and 2 were measured and had fork lengths ranging from 28 to 35 mm with an



average of 30.5 mm. All of the emergent fry appeared to be buoyant and actively swimming and therefore they were released in a quiet water area of the stream.

Accumulated thermal unit data from sites 1 and 2 in Deadman Creek indicate that the rate of development was considerably different than the typical development for Chinook salmon (Table 15). Yukon River Chinook typically become eyed eggs around 280 ATUs and hatch into alevin at 480 to 540 ATUs (Vano Pers. Comm. 2016). The Deadman Creek eggs were recently hatched alevin on February 28 at 316 to 320 ATUs. Emergence as fry typically occurs from 900-1000 ATUs (Vano Pers. Comm. 2016); however, very advanced alevin at or near emergence were documented at less than 500 ATUs.

Table 15. Accumulated thermal units for fertilized eggs planted at sites 1 and 2 on Deadman Creek from August 20, 2016 to June 9, 2017.

Site	Accumulated Thermal Units (ATUs) / life stage observed				
	October 17, 2016	February 28, 2017	March 24, 2017	April 22, 2017	June 9, 2017
1	303 / eyed eggs	316 / alevin	318 / alevin	320 / alevin	493 / emergent fry
2	304 / eyed eggs	320 / alevin	322 / alevin	323 / alevin	494 / emergent fry



4 DISCUSSION

The juvenile Chinook monitoring during 2016 confirmed that Deadman Creek is used for rearing by non-natal juveniles. The lack of Chinook captured in the stream during June followed by moderately high numbers during August is also consistent with previous sampling by Wilson 2004, 2005, 2006 and 2007. It appears likely that the non-natal juveniles originate further upstream in the Teslin River watershed and enter Deadman Creek during the mid-summer to take advantage of the high quality rearing habitats. If conducted in combination with egg planting in future years of the project, juvenile monitoring could provide a means of assessing the effectiveness of the egg planting efforts. Sampling in future years should be conducted further up the watershed and at various times during the summer months as it is possible that sampling earlier in the summer could provide a better indication of natal juveniles.

The high egg hatching rate at the control sites in Morley River suggest that the methods used to fertilize and plant the eggs are valid and that egg incubation conditions in this location are very good. The lower overall egg hatching success in Deadman Creek may be due to a number of reasons, the most likely of which is the amount of sediment transport observed. It is important to note that there was a very high water flow event in the stream during mid-September 2016 due to a period of heavy rainfall. Water levels during this time were similar to spring freshet conditions and the stream was visibly turbid during this event (Photo 24). Future habitat monitoring efforts in the stream should consider the deployment of a water level monitoring station to track such events and ultimately determine if this event may have reduce egg hatching success and overall survival of the planted eggs.

The WVBs and open Jordan Scotty incubators provide the best estimate of egg hatching success in Deadman Creek and some of the differences between sites can explained by habitat observations. At Site 1, winter flow conditions changed considerably during the mid-winter with very low water velocities and back flooding of water on top of the ice. These observations may help to explain why egg survival was relatively low at this site. Conversely, Site 2 appeared to have higher water velocities than all other sites and may account for the higher egg survival. Future monitoring efforts should include the collection of water velocities at all planting sites which combined with substrate size classification (Wolman pebble counts) could provide another variable which can be considered when assessing egg survival.

The placement of alevin into customized closed containers at sites 1 and 2 at Deadman Creek was successful in retaining a small number of individuals into the early summer. This allowed for the development of the alevin to be determined and provides a general estimate of alevin survival. However, it is important to note that this method involved a considerable amount of handling which may have caused additional mortality of the alevin. Success monitoring in future years of the project should involve the deployment of additional closed containers which remain in place throughout the incubation period and should not be disturbed until late spring.

The ATU data collected at sites 1 and 2 in Deadman Creek suggests that the planted eggs developed at an accelerated rate compared to published information for Chinook salmon. This indicates that the eggs continue to develop at some minimum rate, despite very cold temperatures. Water temperatures declined



below 2°C in early October in Deadman Creek. ATUs on October 1 were at approximately 300 and would in theory have required an additional 200 ATUs over a period of 123 days to hatch by February 1, 2017. The actual ATUs gained over this period were less than 10 and an approximate calculation suggests that the minimal accrual of ATUs would be 1.6 per day to reach 500 ATUs by February 1, 2017. This value could provide a minimum development rate in Deadman Creek, provided that water flow remains sufficient and the eggs do not freeze.

Preparation of the egg planting site prior to the collection of brood stock was a critical step in allowing the egg planting to be done efficiently. Future site selection of planting sites in Deadman Creek should consider the logistics of site access and it may be beneficial to locate new planting sites in clusters as site conditions allow. This could also help to better document egg planting success by having an increased sample size of incubation media under a similar set of variables including water temperature, substrate and flow level. Efforts should also be made to locate areas of potential groundwater inflows which may result in warmer water temperatures during the winter months.

The methods used for the instream egg incubation were largely successful; however, some refinements are likely required in the future. Brood stock collection via angling/snagging was successful in obtaining a sufficient number of eggs and amount of milt despite the timing of the collection likely being near the end of the run. In future years of the project, the timing of the brood stock collection should be 7-10 days earlier depending upon seasonal run timing. Future years of the project will likely require the collection of a higher number of brood stock to be collected and based upon the results of the trial, this should be feasible.

Given that all eggs are being planted as green, un-eyed eggs, efforts are required to only collect enough eggs/milt which can be planted in the same day. Holding eggs for over 12 hours is not a preferred option as results from the Morley River control sites suggest a decrease in survival of approximately 20% if this is the case, despite the use of fresh milt.



5 CONCLUSION

The current project was intended as a trial of various egg planting methods and associated success monitoring in Deadman Creek with Morley River being used as a control. The project was successful in this regard and although the overall egg survival in Deadman Creek was lower than that of Morley River, there was still a notable level of survival which suggests that additional trials are warranted. A number of lessons were learned during all stages of the project during 2016/2017 and this experience will be valuable during the implementation of the project during 2017/2018. This final report was initially intended to provide a more detailed plan to future egg planting efforts and associated monitoring during 2017/2018, however, the results gained to date should be considered preliminary, and survival results from additional trials will be required before final egg planting targets can be determined.



6 LITERATURE CITED

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- Wilson, J. 2003.** Beaver management in Deadman Creek (CRE-34-01). Prepared by J. Wilson & Associates on behalf of the Teslin Tlingit Council. Prepared for the Yukon River Panel.
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APPENDIX A. PHOTOGRAPHS

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Photo 1. Minnow trap set in a debris jam on Deadman Creek (Site J2 shown, June 23, 2016).



Photo 2. Using hand tools and a pressure washer to prepare an egg planting site in Deadman Creek (Site 2 shown, August 16, 2016).



Photo 3. Site preparation complete at egg planting Site 2 on Deadman Creek (August 16, 2016). Note the presence of the egg insertion pipes (red) already in place.



Photo 4. Collecting a length measurement on a male Chinook salmon in Morley River (August 18, 2016).



Photo 5. Conducting an egg take from a female Chinook at Morley River (August 20, 2016).



Photo 6. Collecting milt from a male Chinook at Morley River (August 21, 2016).



Photo 7. Closed (left) and open (right) Jordan Scotty incubators deployed at Site 9 in Morley River (prior to backfilling with substrate; August 21, 2016).



Photo 8. Whitlock Vibert box loaded with 100 fertilized eggs being deployed at Site 9 in Morley River (prior to backfilling with substrate; August 21, 2016).



Photo 9. Egg tube loaded with 100 fertilized eggs being deployed at Site 8 in Morley River (August 21, 2016).



Photo 10. Fertilized eggs being deployed in an egg insertion pipe at Site 9 in Morley River (August 21, 2016).



Photo 11. Live alevin retrieved from a WVB at Site 6 in Morley River (October 18, 2016).



Photo 12. Cluster of dead eggs and live alevin retrieved from an egg tube at Site 8 in Morley River (October 18, 2016).



Photo 13. Contents of an open Jordan Scotty incubator at Site 6 in Morley River (October 18, 2016). Note the low number of dead eggs and lack of sediment present in the cells.



Photo 14. Morley River winter conditions in the vicinity of egg planting sites 6, 7 and 8 (March 1, 2017).



Photo 15. Whitlock-Vibert box retrieved from site 3 in Deadman Creek (October 18, 2016). Note eyed eggs in upper chamber and sediment accumulation in bottom chamber.



Photo 16. Open Jordan Scotty incubator from site 4 in Deadman Creek. Note live eyed eggs are translucent and dead eggs are white/light orange.

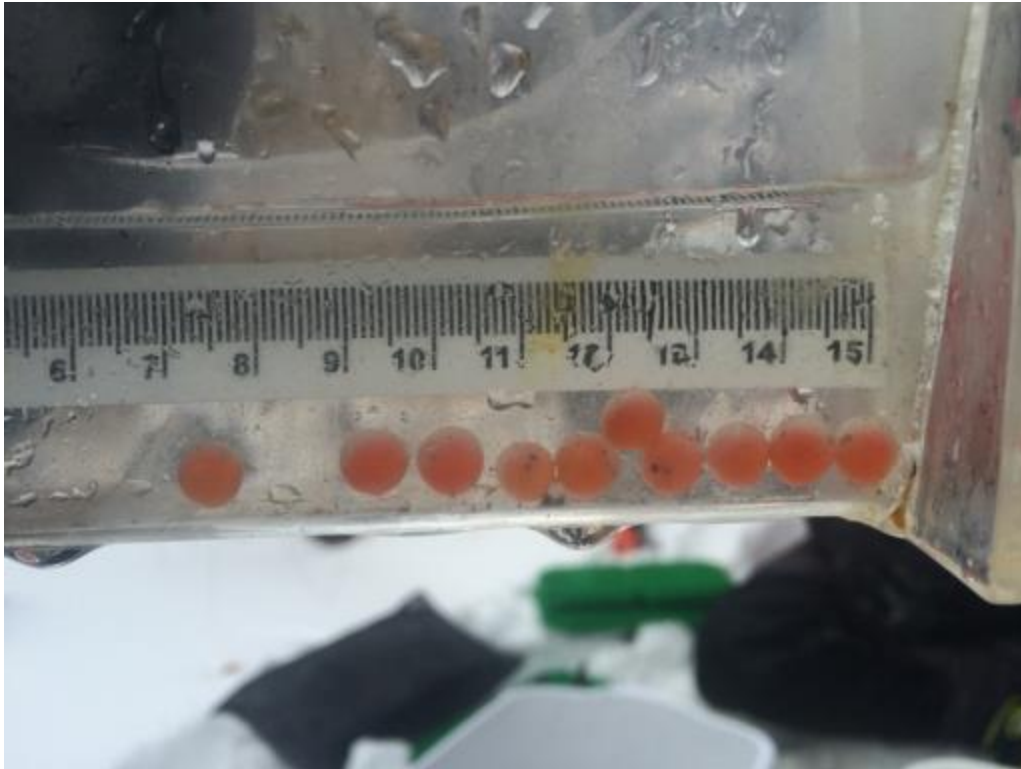


Photo 17. Live eyed eggs retrieved from an open Jordan Scotty incubator at Site 4 in Deadman Creek (October 18, 2016).



Photo 18. Live eyed eggs dislodged from an egg insertion site at Site 4 in Deadman Creek (October 18, 2016).



Photo 19. Cross channel view of egg planting Site 2 in Deadman Creek (February 28, 2017).



Photo 20. Contents of WVB retrieved from Site 2 in Deadman Creek (February 28, 2017).



Photo 21. Considerable (white) overflow ice accumulation at Site 1 in Deadman Creek (March 22, 2017).

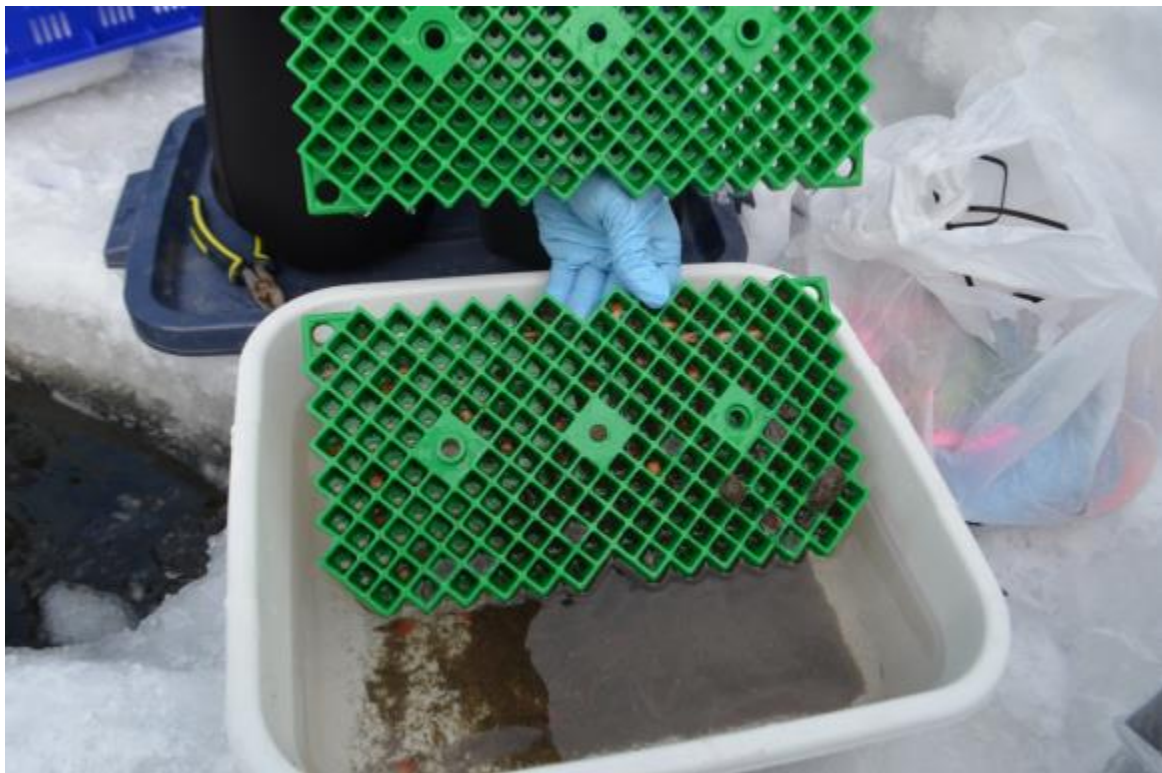


Photo 22. Contents of Jordan Scotty incubator retrieved from Site 2 in Deadman Creek (March 22, 2017).



Photo 23. Emergent fry retrieved from the closed incubation container at Site 2 on Deadman Creek (June 9, 2017).



Photo 24. High water levels observed near Site 2 on Deadman Creek during the fall of 2016 (September 10, 2016).



APPENDIX B. STREAM DISCHARGE DATA SUMMARY

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Discharge Measurement Summary

Date Generated: Sat Mar 4 2017

File Information

File Name DEADMAN28Feb2017.WAD
Start Date and Time 2017/02/28 16:04:56

Site Details

Site Name DEADMAN1
Operator(s) DH

System Information

Sensor Type FlowTracker
Serial # P4385
CPU Firmware Version 3.7
Software Ver 2.30
Mounting Correction 0.0%

Units (Metric Units)

Distance m
Velocity m/s
Area m²
Discharge m³/s

Discharge Uncertainty

Category	ISO	Stats
Accuracy	1.0%	1.0%
Depth	0.3%	2.4%
Velocity	0.7%	6.5%
Width	0.1%	0.1%
Method	1.7%	-
# Stations	2.2%	-
Overall	3.0%	7.0%

Summary

Averaging Int. 40 # Stations 23
Start Edge REW Total Width 5.400
Mean SNR 13.7 dB Total Area 1.257
Mean Temp -0.12 °C Mean Depth 0.233
Disch. Equation Mid-Section Mean Velocity 0.2009
Total Discharge 0.2526

Measurement Results

St	Clock	Loc	Method	Depth	%Dep	MeasD	Vel	CorrFact	MeanV	Area	Flow	%Q
0	16:04	7.30	None	0.140	0.0	0.0	0.0000	1.00	0.2108	0.018	0.0037	1.5
1	16:07	7.05	0.6	0.160	0.6	0.064	0.2108	1.00	0.2108	0.040	0.0084	3.3
2	16:09	6.80	0.6	0.180	0.6	0.072	0.1710	1.00	0.1710	0.045	0.0077	3.0
3	16:10	6.55	0.6	0.170	0.6	0.068	0.2289	1.00	0.2289	0.043	0.0097	3.9
4	16:14	6.30	0.6	0.200	0.6	0.080	0.2587	1.00	0.2587	0.050	0.0129	5.1
5	16:15	6.05	0.6	0.220	0.6	0.088	0.2428	1.00	0.2428	0.055	0.0134	5.3
6	16:17	5.80	0.6	0.240	0.6	0.096	0.2740	1.00	0.2740	0.060	0.0164	6.5
7	16:18	5.55	0.6	0.240	0.6	0.096	0.2359	1.00	0.2359	0.060	0.0142	5.6
8	16:20	5.30	0.6	0.240	0.6	0.096	0.2051	1.00	0.2051	0.060	0.0123	4.9
9	16:21	5.05	0.6	0.260	0.6	0.104	0.2073	1.00	0.2073	0.065	0.0135	5.3
10	16:23	4.80	0.6	0.260	0.6	0.104	0.2214	1.00	0.2214	0.065	0.0144	5.7
11	16:24	4.55	0.6	0.240	0.6	0.096	0.1872	1.00	0.1872	0.060	0.0112	4.4
12	16:26	4.30	0.6	0.180	0.6	0.072	0.0656	1.00	0.0656	0.045	0.0030	1.2
13	16:28	4.05	0.6	0.240	0.6	0.096	0.2181	1.00	0.2181	0.060	0.0131	5.2
14	16:30	3.80	0.6	0.280	0.6	0.112	0.2355	1.00	0.2355	0.070	0.0165	6.5
15	16:32	3.55	0.6	0.260	0.6	0.104	0.1190	1.00	0.1190	0.065	0.0077	3.1
16	16:34	3.30	0.6	0.280	0.6	0.112	0.2406	1.00	0.2406	0.070	0.0168	6.7
17	16:37	3.05	0.6	0.260	0.6	0.104	0.0986	1.00	0.0986	0.065	0.0064	2.5
18	16:38	2.80	0.6	0.220	0.6	0.088	0.2394	1.00	0.2394	0.055	0.0132	5.2
19	16:39	2.55	0.6	0.220	0.6	0.088	0.1714	1.00	0.1714	0.055	0.0094	3.7
20	16:42	2.30	0.6	0.340	0.6	0.136	0.1432	1.00	0.1432	0.085	0.0122	4.8
21	16:44	2.05	0.6	0.280	0.6	0.112	0.2451	1.00	0.2451	0.056	0.0137	5.4
22	16:44	1.90	None	0.150	0.0	0.0	0.0000	1.00	0.2451	0.011	0.0028	1.1

Rows in italics indicate a QC warning. See the Quality Control page of this report for more information.

Discharge Measurement Summary

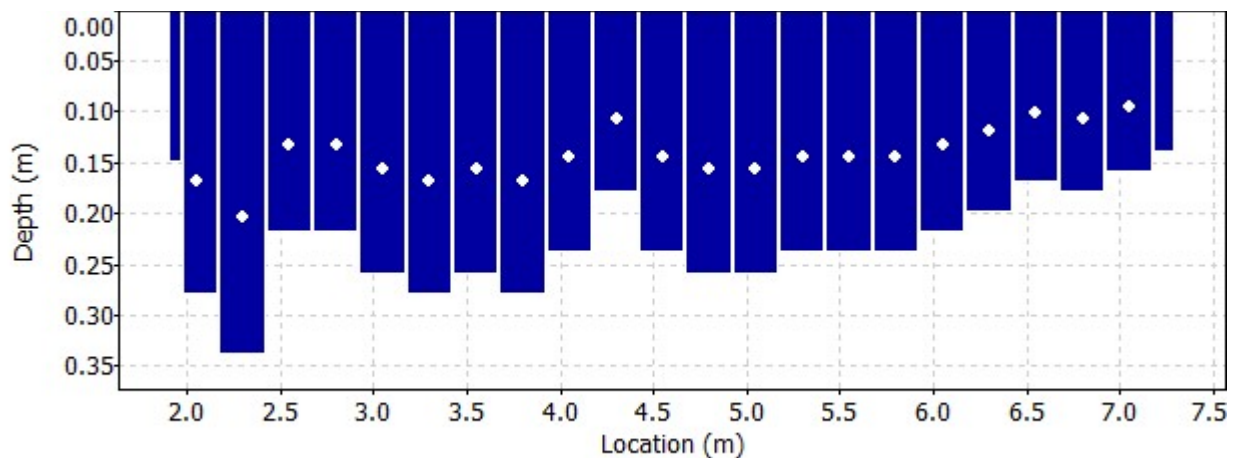
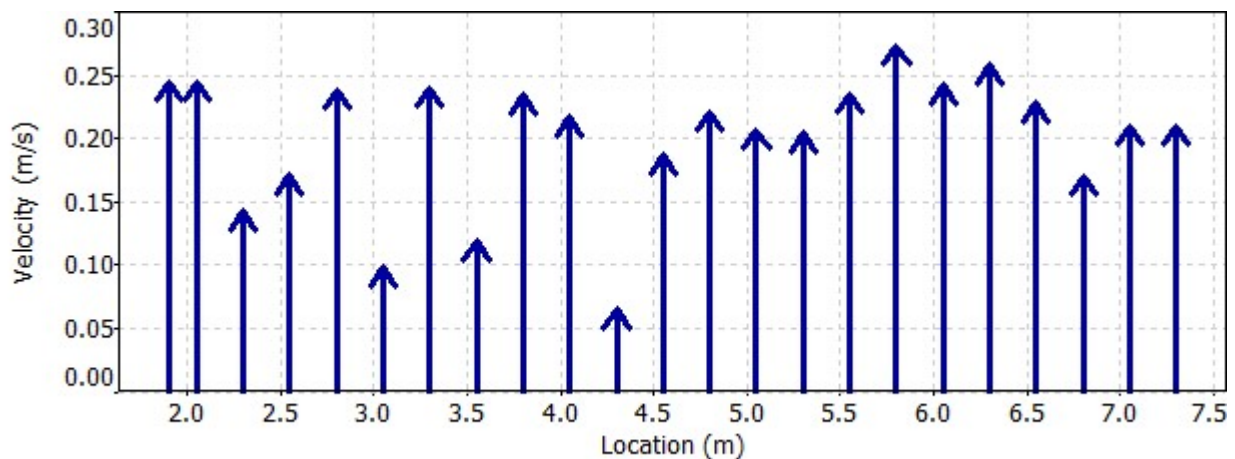
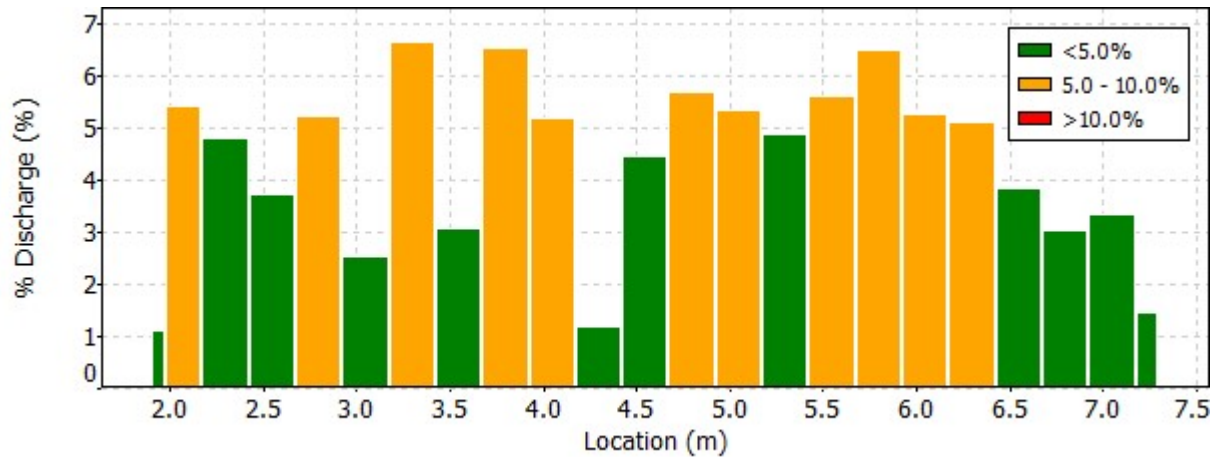
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Site Details

Site Name DEADMAN1
Operator(s) DH



Discharge Measurement Summary

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File Information

File Name DEADMAN28Feb2017.WAD
Start Date and Time 2017/02/28 16:04:56

Site Details

Site Name DEADMAN1
Operator(s) DH

Quality Control

St	Loc	%Dep	Message
15	3.55	0.6	Boundary QC is Good; possible boundary interference
19	2.55	0.6	Boundary QC is Fair; possible boundary interference

Discharge Measurement Summary

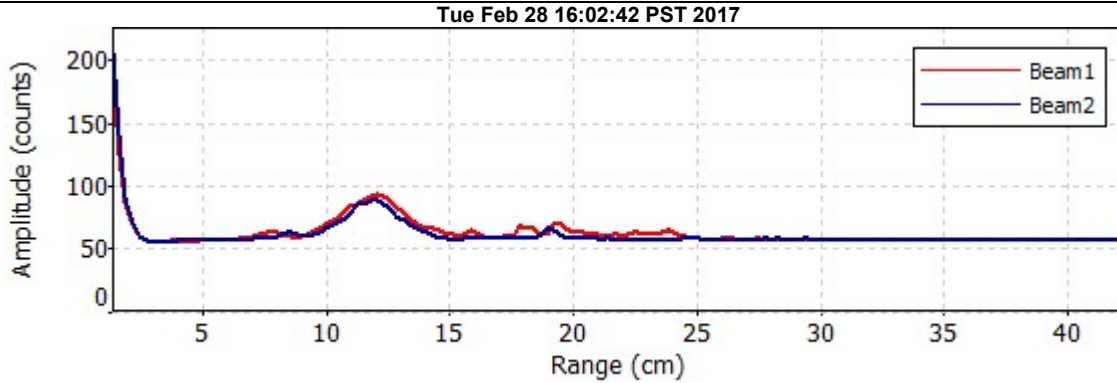
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Start Date and Time 2017/02/28 16:04:56

Site Details

Site Name DEADMAN1
Operator(s) DH

Automatic Quality Control Test (BeamCheck)

- ✓ Noise level check - Pass
- ✓ SNR check - Pass
- ✓ Peak location check - Pass
- ✓ Peak shape check - Pass