2018 KDFN Michie Creek Monitoring Project

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with
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Cover Photo: Cheyenne Bradley standing on a colony of *Didymosphenia geminate,* commonly known as didymo, a species of diatom identified in upper Michie Creek, 2018.

ABSTRACT

This project included assessment of a portion of the migratory habitat in Michie Creek to ensure that adult salmon were not obstructed during their migration and the monitoring of stream flows and temperatures at the primary Chinook salmon spawning area in upper Michie Creek. Two potential obstructions in the form of a beaver dams were located in upper Michie Creek during the 2018 summer program. Only one was remediated as the other was not considered to be a barrier to upstream migration.

Stream flow in Michie Creek throughout the early summer and into the August spawning period was thought to be well below average and near historic minimums. Water temperatures, however, were near normal during the Chinook spawning period in August. There were no significant contributions of sediment or turbidity into the upper Michie Creek spawning area from Slump Creek which in years past was a point source. The below average run of Chinook salmon enumerated at the Whitehorse Rapids Fish Ladder (691) combined with the skewed male sex ratio resulted in a low number of redds being counted (18) in the upper Michie Creek index area in 2018. Trend analysis spanning the period from 2004 to 2018 suggests a temporal decline in both counts of female Chinook salmon enumerated at the WRFL and their associated redds in the Michie Creek index area

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INTRODUCTION

This project is a continuation of a multi-year program that monitors several biological and physical parameters of the environment that constitutes the upper Michie Creek Chinook salmon spawning area. Michie Creek is a tributary of the M'Clintock River, a watershed that lies within the Traditional Territory of the Kwanlin Dün First Nation and is located in the south central portion of the Yukon Territory. The M'Clintock River drainage forms part of the headwaters of the Yukon River Basin and supports one of the longest spawning runs of Chinook salmon in North America, with annual adult upstream migration of over 3,000 kilometers. The migration virtually tracks the entire length of the Yukon River that extends across the interior of Alaska and into northwestern Canada.

The continued conservation and maintenance of the Michie Creek Chinook salmon population is an important management objective for both the Kwanlin Dün First Nation Government (KDFN) and the Federal Department of Fisheries and Oceans Canada (DFO). The Yukon River Panel (YRP), who oversees management programs related to the maintenance, restoration and enhancement of Yukon River salmon stocks, provides yearly funding for this project. This project meets the YRP budget priorities framework that focuses on the conservation of specific stocks. The project also provides for unobstructed access to and from, and use of, existing migration, spawning and rearing habitats as stipulated in the Yukon River Salmon Agreement.

OBJECTIVES

In keeping with its vision of resource stewardship, management, responsible planning, and awareness, KDFN encourages programs to understand salmon resources in their Traditional Territory. The long-term goal of KDFN is to participate with other management agencies to maintain and if needed, restore and in some cases rebuild salmon populations to sustainable levels, and protect salmon habitat from conflicting land uses. KDFN continues to provide learning opportunities for staff related to stewardship, land management, and habitat monitoring activities

within its Traditional Territory. The specific objectives of the 2018 Michie Creek Chinook salmon monitoring project were:

1. Maintaining access by adult Chinook salmon to the primary spawning area in Michie Creek near the outlet of Michie Lake;
2. Continuation of environmental monitoring of the physical environment of the Michie Creek spawning area including summer temperature, flow, and any sediment influxes from melting permafrost;
3. Monitoring of Chinook escapement to Michie Creek, by enumerating redds and spawning population (live fish and carcasses) and sampling for age, sex, and length (ASL data) on both wild and coded wire/sonar tagged spawners including tag recoveries;
4. To provide the KDFN project team with survey results to allow for the management, maintenance and protection of salmon stocks and their habitat within their Traditional Territory.

The First Nation continues to be involved in the development of a Southern Lakes Management Plan for the region and currently reviews land use applications within the M'Clintock River watershed and broader upper Yukon River Basin. As landowners of several large land parcels in the watershed, the First Nation encourages the participation of community members to comment on land use proposals and land use planning processes in their Traditional Territory. This project involves hands-on participation of First Nation technicians in fieldwork that uses various technical assessment approaches to collect information about this unique stock while providing community participation and a historic context of the traditional use of the area.

STUDY AREA

The M'Clintock River watershed is situated in the mountains of the Yukon Plateau north of Marsh Lake, about 110 km southeast of Whitehorse. The watershed is contained entirely within KDFN Traditional Territory. It is located in the Boreal Cordillera ecozone that is characterized with rolling hills and plateaus that are dissected by streams (Smith *et al* 2004). The region has been previously glaciated and contains widespread surficial deposits. A detailed description of the surficial geography is included in the M'Clintock Watershed Management Plan (KDFN 2003).

Michie Creek is the largest tributary in the M'Clintock River watershed and is the principle spawning area of Chinook salmon migrating above the Whitehorse Rapids dam. Each year the focus of stewardship activities is on the upper Michie Creek index area, a section of stream between the outlet of Michie Lake and its confluence with Byng Creek, a distance of about 5 km (Figure 1). The index area is the primary spawning location for adult Chinook salmon that populate the M'Clintock River watershed every year during the months of August and September. Site M1 has been the principle monitoring location for water temperature and flow for over two decades. It is approximately 1.5 km downstream of the Michie Lake outlet and each year there are near-by salmon redds. The site is also just downstream of a unique Chinook salmon spawning location that is characterized with a series of channel spanning spawning dunes.

Slump Creek, a small tributary flowing directly into the primary spawning area, is visually inspected during each field trip. The creek discharges into Michie Creek just upstream of site M1 and has in the past been a significant source of sediment and turbidity entering the upper Michie Creek spawning area. Inputs of sediment were first observed during the summer of 2011 and since 2014 sediment inputs have mostly subsided. Sediment accumulations are still visible in depositional areas along the channel margins of upper Michie Creek. The source of the material was determined to be melting permafrost associated with an area of thermokarst in this small tributary (Collins *pers. com.* 2014).

METHODS

Three field trips were made into the upper Michie Creek Chinook index area between May and September in 2018. Field trips were completed in stat-weeks 22, 32 and 36. Access to the Michie Creek outlet is through the use of a small aluminum boat that is stored at campsite located on Michie Lake. The Michie Lake campsite was reached by aircraft. The index area and site M1 is surveyed by foot each year (Figure 1).

Instantaneous water discharge in upper Michie Creek was estimated on May 29, August 7 and September 4. For each discharge estimate a section of stream

channel having a uniform cross section was used for the measurement. A Swoffer current meter was used to determine depth and average column water velocities. A surveyors' tape was stretched perpendicular across the creek and a minimum of 10 depth and velocity measurements were recorded (BCME 2009). Discharge was calculated using measured velocities, depths and computed cross-sectional areas. A staff gauge allowed for water levels to be visually recorded to coincide with each water discharge estimate. The staff gauge elevation relative to a benchmark (nail at the base of a tree) was calculated with a surveyor's level and rod to correct for any year to year variation.

A Solinst combination water level and temperature data logger measured water level and stream temperatures on an hourly basis in Michie Creek throughout the summer of 2018. The logger was suspended below the water line in PVC tubing that was anchored to the streambed by secured rebar. A separate Solinst barologger suspended in a tree measured atmospheric pressure. Both loggers were encased in a stainless steel housing and powered by an internal battery. Logger data files were uploaded onto a laptop computer during site visits in August and September. An additional Hobo® Water Temperature Pro that measured water temperatures throughout the previous winter was retrieved from site M1 on May 29.

To measure ambient water temperatures at the Whitehorse Rapids Fish Ladder (WRFL), a single Hobo® Water Temperature Pro data logger was installed during early June. The data logger was attached to a brick and encased in a white protective boot. It was submerged and secured with aircraft cable to a wooden crossbeam. The logger was positioned just upstream of the public viewing window which is about the midway point of the fish ladder. Data from the logger data was retrieved using a laptop computer once the salmon migration in the fish ladder ceased in early September.

A foot survey on August 6 in the index area of upper Michie Creek, from the Michie Lake outlet to the Byng Creek confluence, was undertaken to identify and mitigate any barriers that would otherwise limit access of migrating Chinook salmon adults to the primary spawning area near the Michie Lake outlet. This

survey was timed to correspond with the period just before the arrival the first migrating salmon to the creek.

Redds were enumerated during a second foot survey of the upper Michie Creek index area on September 3. Redds were identified in the streambed by their oval shape, size and distinct appearance that was free of periphyton and interstitial sediment. Carcasses were also enumerated during this time and any salmon heads containing coded wire tags (CWTs) were removed from those carcasses that had an adipose clip. Each year collected salmon heads with CWTs and associated ASL data are delivered to the DFO Whitehorse office for analysis and entered into a database.

RESULTS AND DISCUSSION

Upper Michie Creek Water Discharge and Temperature

Average daily discharges could not be calculated in 2018 due to the logger files becoming corrupted in several of the Solinst pressure loggers. Those that were problematic were sent to the manufacturer (*Vanessen, Canada*) to have the data extracted. Unfortunately, the data files were not recoverable. Discharge over the course of the summer could therefore not be compared to the historical data sets from 2004 to 2017 (Figure 2). None-the-less, the instantaneous measurements are suggestive of record low discharges throughout the spring, summer and fall seasons in Michie Creek. Of the three measurements over the course of the summer the highest was recorded on May 29 at only 3.0 m^3/sec.

On average, snowpack conditions in the upper Yukon River watershed were slightly below normal during the spring of 2018. The basin-wide snow-water equivalent from March to May was estimated to be 88 per cent of normal as the southern Yukon continued to be drier than normal (Environment Yukon 2018). The Yukon River at Whitehorse also experienced below normal streamflow during the month of March.

The total amount of precipitation for the months of March and April in 2018 were above average however May was a very dry month and well below the 1981 to 2010 Canadian Climate average (Environment Canada 2018). The wet conditions during June, however, likely augmented flow somewhat in Michie Creek during the

summer. Estimated discharges during the summer months in upper Michie Creek appeared to be at or below historical minimums suggesting the low snowpack and dryer climatic conditions prevailed as was the situation over the last few years.

Average daily water temperatures in Michie Creek during the Chinook migration ranged declined from a high of 17.5° C on August 2 to 14.8° C on August 23 when the logger was tampered with and removed from the stream presumably by an animal (Figure 3). While the data is somewhat limited it does suggest water temperatures were near normal during the Chinook spawning period in 2018.

Cumulative average daily water temperatures over the winter of 2017/18 in Michie Creek, expressed as Thermal Heat Units (ATUs), were compared to four other Chinook salmon spawning areas in the Yukon River basin (Figure 4). An accumulated thermal unit (ATU) is a unit of measurement used to describe the cumulative effect on egg development over time. For simplicity temperature data used for the ATU comparison are those that have accrued from September 1. It is recognized, however, that the Chinook incubation period in these streams often starts several weeks earlier. Average daily water temperatures throughout the winter accumulated the slowest in the Ibex River. ATUs in Michie Creek, Tatchun Creek and the Takhini River were similar until December after which Michie Creek and Tatchun Creek appeared to reach an asymptote of about 600 units at the end of March. The Takhini River continued to slowly accumulate ATUs throughout the winter reaching 800 units by the end of March. Chinook salmon eggs are assumed to reach the hatch stage between 512 and 526 ATUs (DFO 2011). The Ibex River is the only watershed of the three whose water temperatures are not influenced by a large lake situated near the head waters that moderate downstream water temperatures.

Whitehorse Rapids Fish Ladder Temperature

With the logger data becoming corrupted at the Michie Creek monitoring site (M1) a complete data set for summer water temperatures was not available. However, based on previous monitoring years, the pattern of water temperatures at the Whitehorse Rapids Fish Ladder (WRFL) is a good proxy for stream temperatures at Michie Creek. Water temperatures at the WRFL were near average

through June and into early July before decreasing to historic lows by the middle of July (Figure 5). Water temperatures then increased to a summer maximum of 18.7° C on July 30 at 1700 hours and coincided with the passage of the first migrating salmon through the WRFL. Water temperatures subsequently decreased to near average values by August 10 and remained there throughout the Chinook migration period that was completed on September 5. Water temperatures in the WRFL averaged 15.5° C throughout the Chinook migration. While temperatures reached their maximum during the early portion of the Chinook migration, subsequent water temperatures were in a range that is tolerated by summer and fall migratory Chinook elsewhere (Bjornn and Reiser 1991). Water temperatures in the WRFL were such that they did not negatively influence the quality of eggs that were obtained from female Chinook salmon as part of the Whitehorse Rapids Hatchery Program (Vano *pers. comm.* 2018).

Slump Creek Sediment

Slump Creek, a potential source of sediment and turbidity entering Michie Creek, was clear when inspected during each of the three field trips (Figure 6). It is assumed that Slump Creek did not contribute any significant quantities of sediment or turbidity into upper Michie Creek throughout the open water season of 2018 and was of no consequence to downstream spawning habitat based on surveys immediately before and after the spawning peak. In years past Slump Creek has been a major source of sediment input with accumulations of fine-grained material still clearly visible in upper Michie Creek for several kilometers downstream of its confluence.

Upper Michie Creek Adult Chinook Salmon

An obstruction survey was completed on August 6 of the upper Michie Creek index area in preparation for the arrival of adult salmon into the drainage. No adult salmon were observed during the survey. Two beaver dams were however located with the first in the primary spawning area upstream of site M1 (Figure 1). The dam appeared to be under construction as it did not span the entire creek channel. The structure was completely removed to discourage repair (Figure 8). The second dam,

first discovered and remediated in 2016, was still active in 2018. This dam is situated in the main channel near the inflow of a small seepage originating from Trout Lake. As was the case in 2017, the structure did not pose a barrier to migrating fish as a free-flowing side channel separated from the dam by a small island allowed for unobstructed passage. The modest flows in Michie Creek throughout the summer appeared to once again be a contributing factor that encouraged beaver to construct dams on the main channel.

The second foot survey of the upper Michie Creek index area occurred on September 3. During this survey only 18 redds and 23 adult Chinook salmon (carcasses and live fish) were enumerated (Table 1). As in previous years the majority of the redds (78 %) were located in the primary spawning area between the Michie Lake outlet and site M1 (Figure 9). At the time of the survey female spawners were visible guarding redds and a few still actively digging. Most of the observed carcasses were heavily scavenged and, in some instances, only fragments remained. Only four carcasses were sampled which resulted in the recovery of a head with an embedded coded wire tag from a hatchery origin fish. This tagged fish was a 5-year-old male that originated from the Whitehorse Rapids Fish Hatchery and planted into upper Michie Creek in 2013. A spent wild female carcass was also sampled that contained 218 residual eggs (Figure 7).

The combination of a below average count of Chinook salmon passing through the WRFL (691) and the male skewing of the run (2 males to each female) resulted in a low redd count (18) in upper Michie Creek in 2018 (Figure 10). While statistics vary greatly amongst years, trend analysis spanning the period from 2004 to 2018 suggests a temporal decline in both counts of female Chinook salmon enumerated at the WRFL and their associated redds in the Michie Creek index area (Figures 11 and 12). While run strength allowed for a limited subsistence fishery both in Canada and the US, the low number of enumerated salmon redds and the downward temporal trend is cause for some concern related to the long term maintenance of this spawning stock.

CONCLUSIONS

1. The low snow-pack, dry and cool weather conditions during the early spring and throughout May and July resulted in flows that were well below the historic average for upper Michie Creek in 2018.
2. Water temperatures in upper Michie Creek were thought to be above the historic average until the end of July then subsequently declined to near normal averages in August and throughout the Chinook spawning period.
3. Water temperatures in upper Michie Creek generally remained below the maximum lethal temperature recommended for incubation and spawning during the Chinook spawning period in 2018.
4. Water temperatures in the Whitehorse Rapids Fish Ladder were well above average until late July after which they declined to near normal averages that were below the maximum recommended for migrating Chinook 2018.
5. Daily water temperatures throughout the winter of 2017/18 accumulated the slowest in the Ibex River compared to Michie Creek, Takhini River and Tatchun Creek.
6. Slump Creek did not contribute any significant sediment or turbidity into the upper Michie Creek spawning area in 2018.
7. The low number of redds enumerated in the index area of upper Michie Creek were coincident with the below the average count of migrating Chinook salmon through the Whitehorse Rapids Fish Ladder in 2018.
8. Trend analysis spanning the period from 2004 to 2018 suggests a temporal decline in both counts of female Chinook salmon enumerated at the WRFL and their associated redds in the Michie Creek index area
9. Obstructions did not restrict the upstream movement of migrating adult Chinook salmon into upper Michie Creek despite continued beaver activity and dam construction coincident with lower flows in 2018.

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Vano, L. 2017. Hatchery Manager. Whitehorse Rapids Fish Hatchery. Number 2 Miles Canyon Road, Box 5920, Whitehorse, Yukon Y1A 6S7 E-mail: chinook@northwestel.net

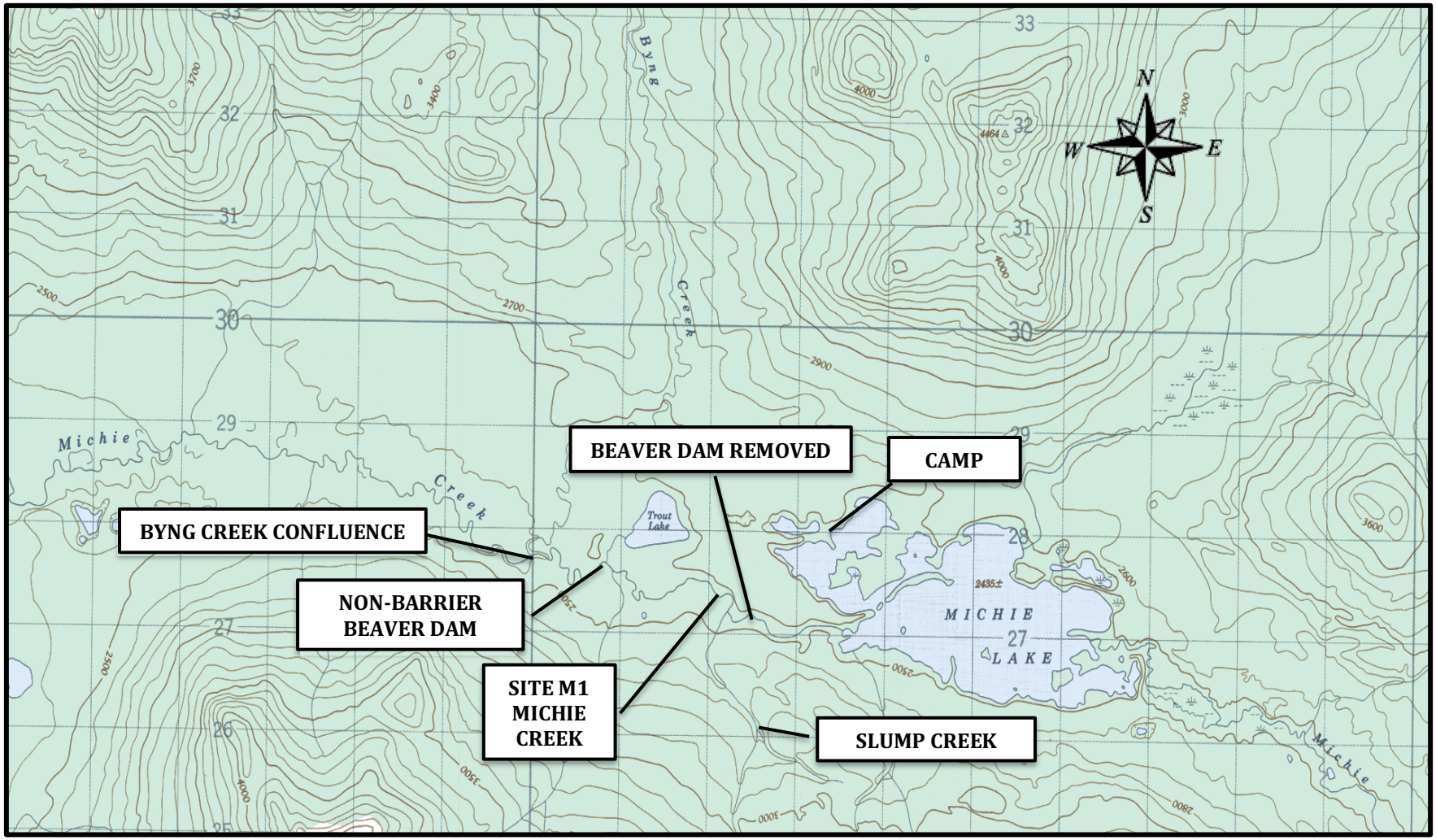

Figure 1 Upper Michie Creek Study Area.

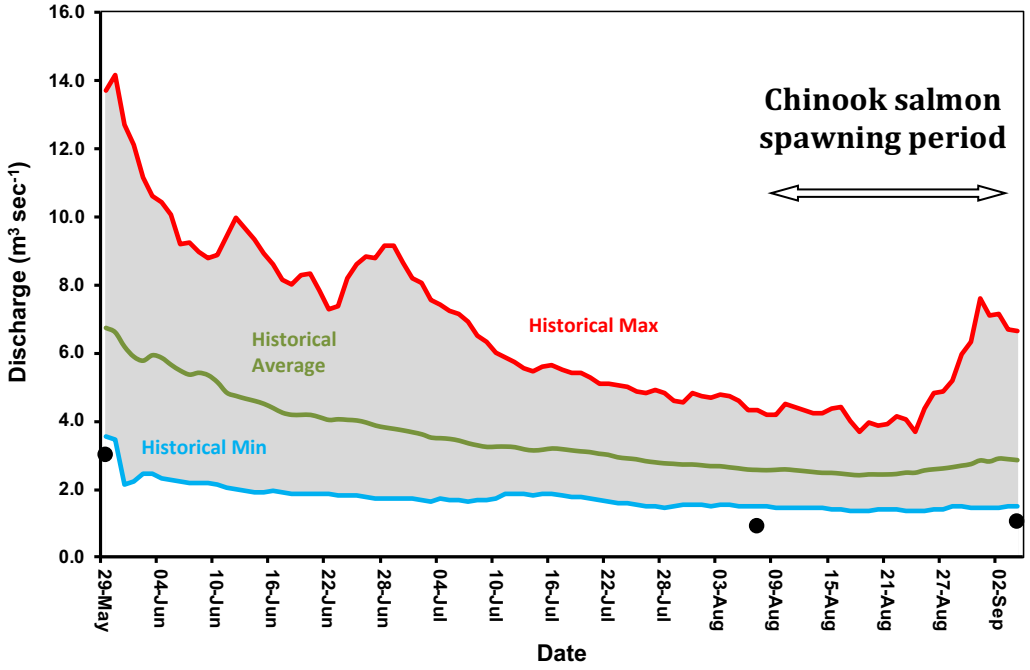

Figure 2 Comparison of three instantaneous discharge estimates (●) at site M1 in 2018 to the historical daily average, minimum and maximum discharges derived from data sets collected from 2004 to 2017 in upper Michie Creek.

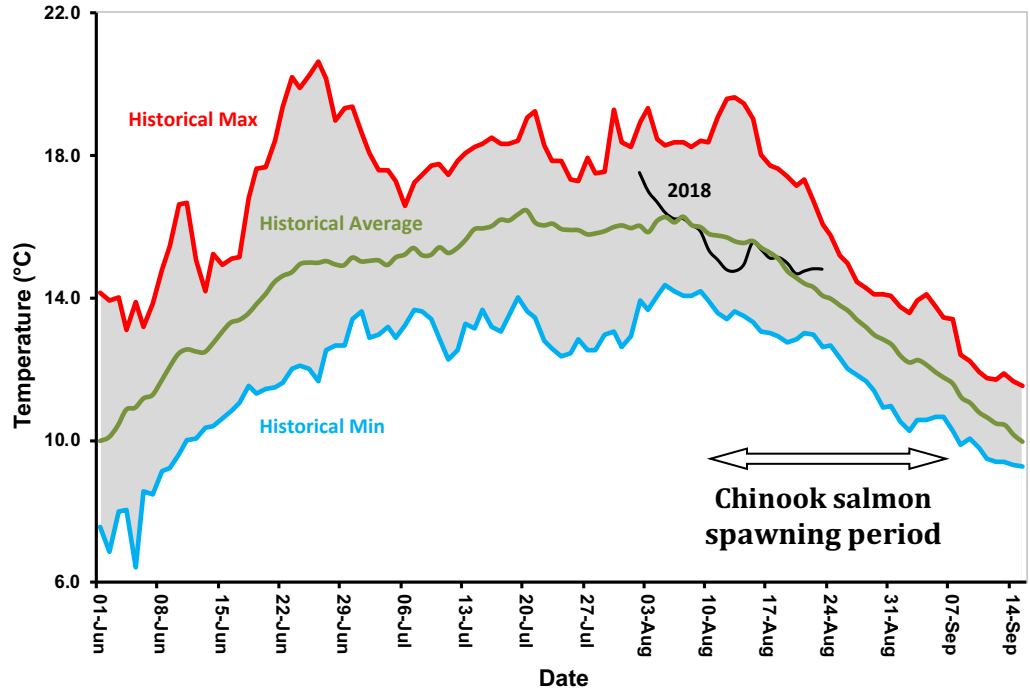

Figure 3 Comparison of 2018 daily summer water temperatures at site M1 to the historical average, minimum and maximum water temperatures derived from data collected from 2003 to 2017 in upper Michie Creek.

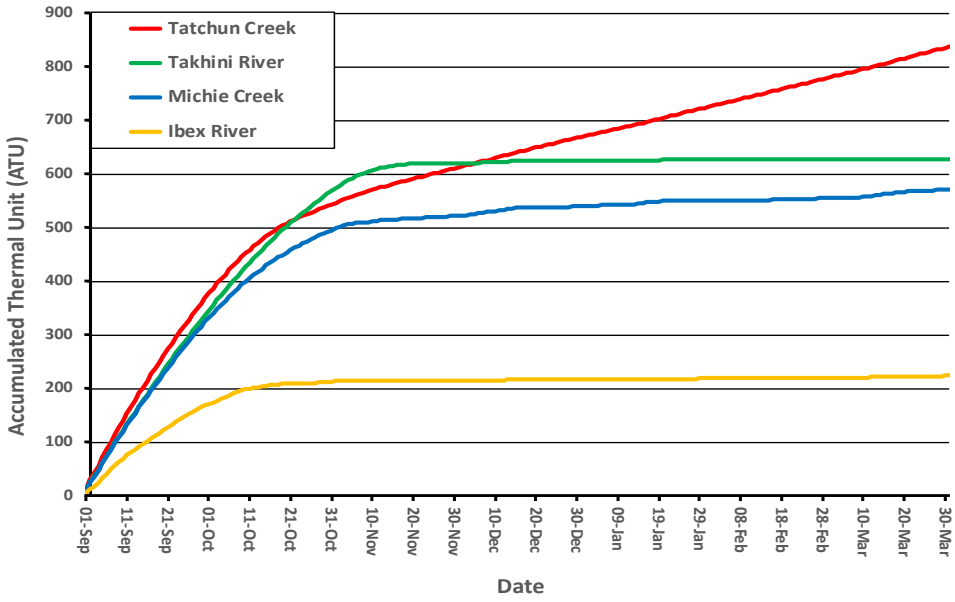

Figure 4 Comparison of Accumulated Thermal Units (ATUs) derived from daily average water temperatures collected at Chinook salmon spawning locations in the Ibex River, Michie Creek, Takhini River and Tatchun Creek during the winter of 2017/18.

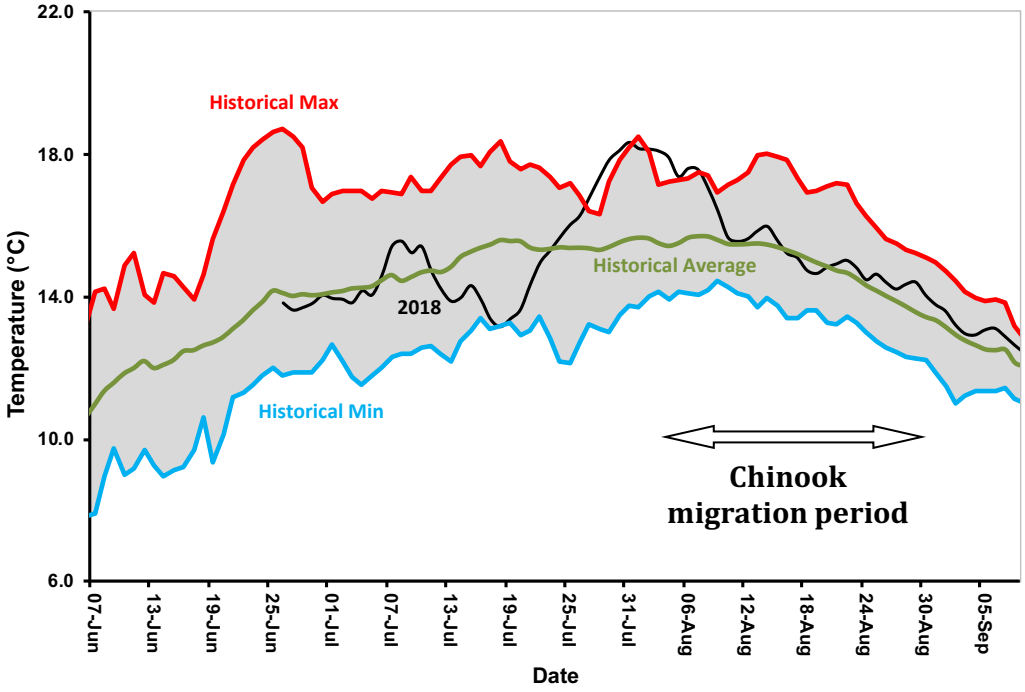

Figure 5 Comparison of 2018 daily summer water temperatures to the historical average, maximum and minimum derived from data collected from 2003 to 2017 at the Whitehorse Rapids Fish Ladder.

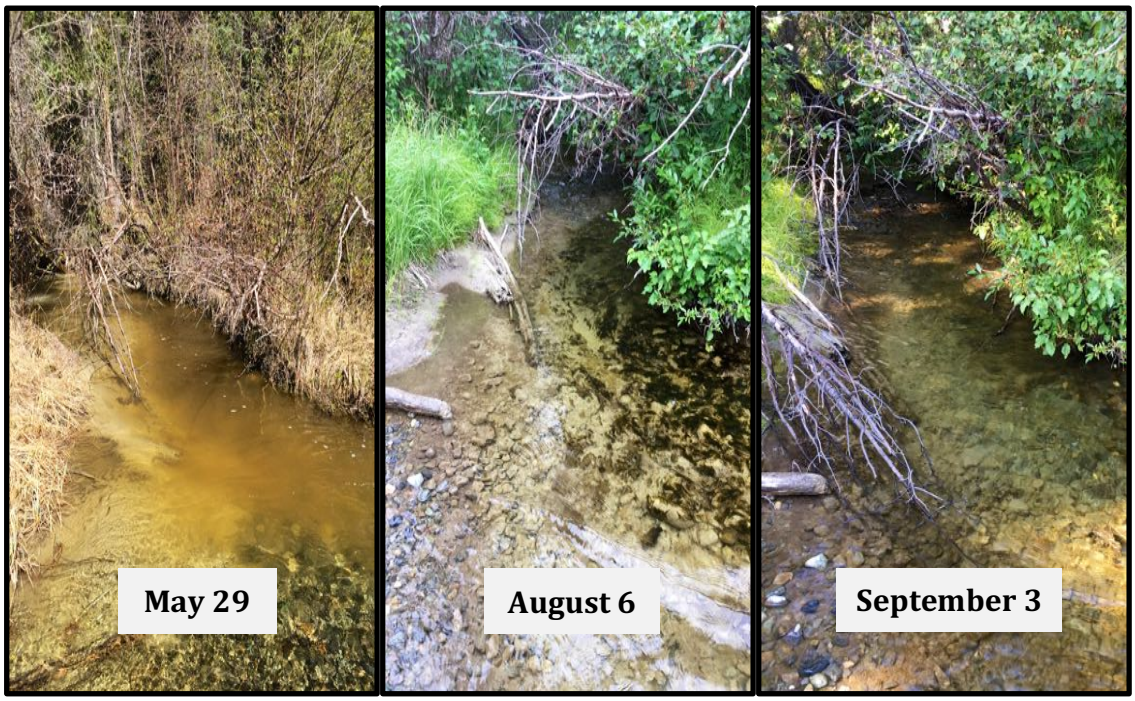

Figure 6 Clear waters originating from Slump Creek discharging into the upper Michie Creek spawning area during May, August and September, 2018.

Figure 7 Sampling a wild origin female Chinook carcass to determine the number of residual eggs.

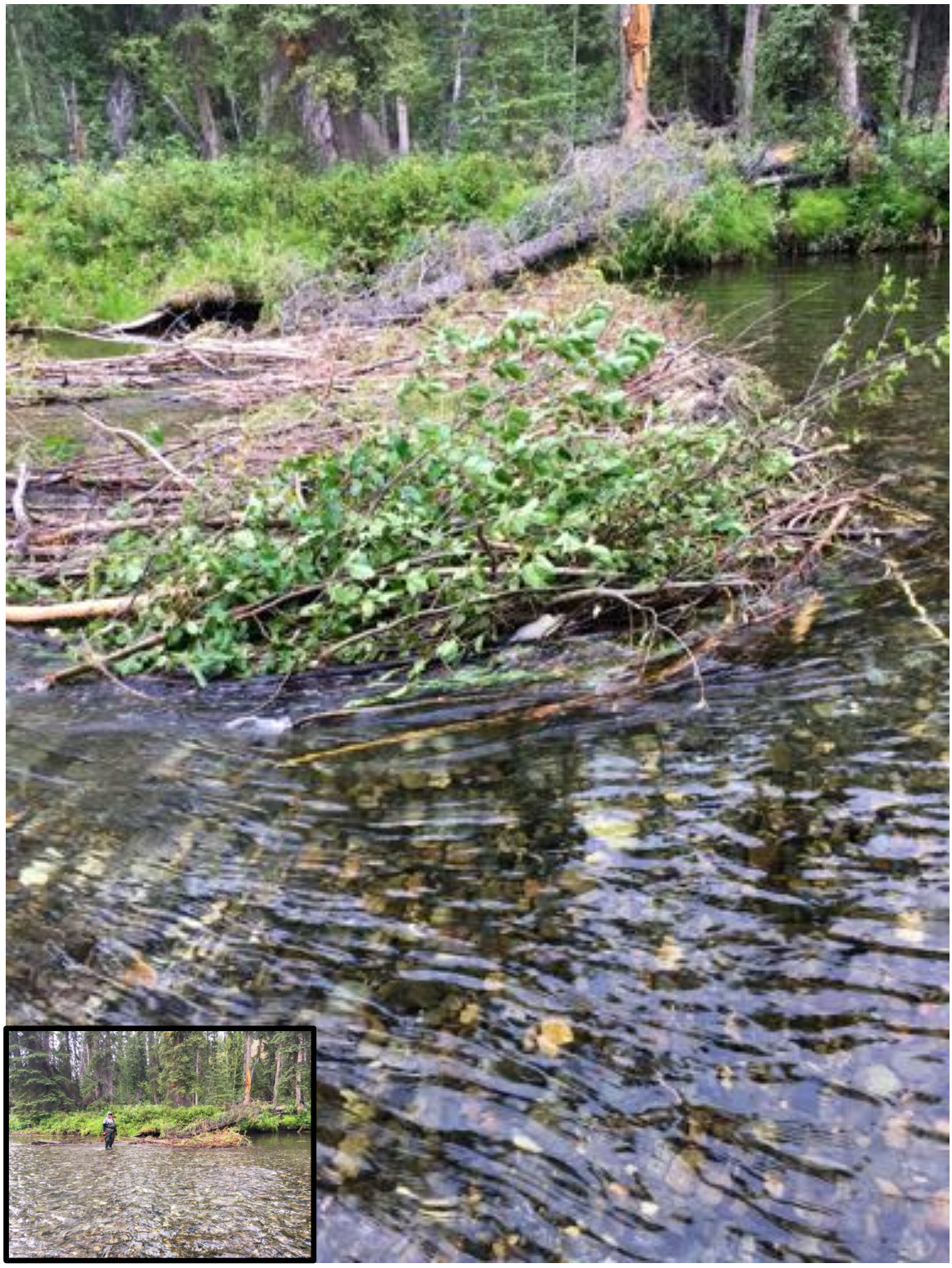

Figure 8 Before and after (insert) photos of the removal of a beaver dam situated in the primary spawning area of upper Michie Creek.

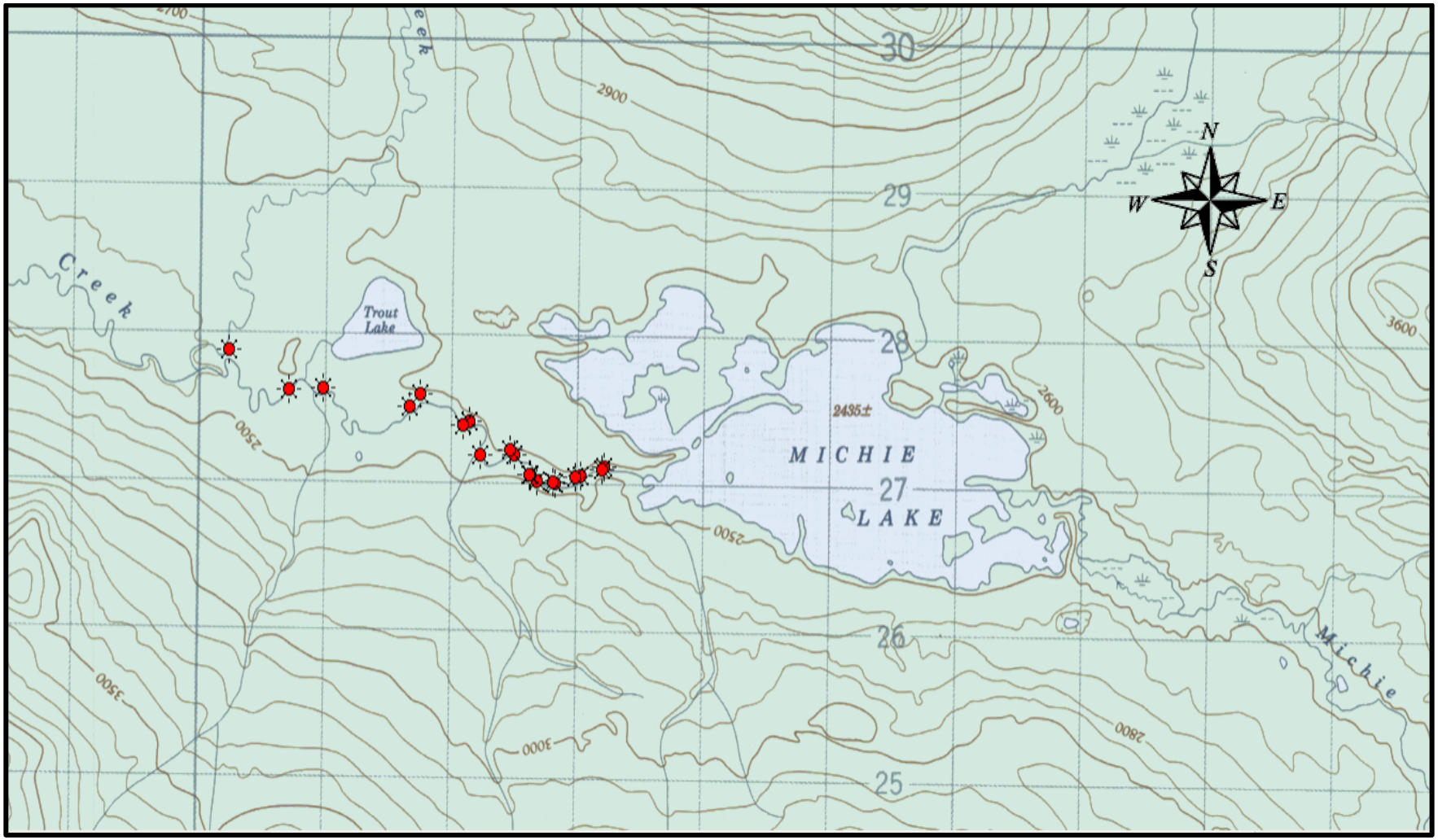

Figure 9 Georeferenced locations of enumerated redds during a foot survey of the upper Michie Creek index area on September 3, 2018.

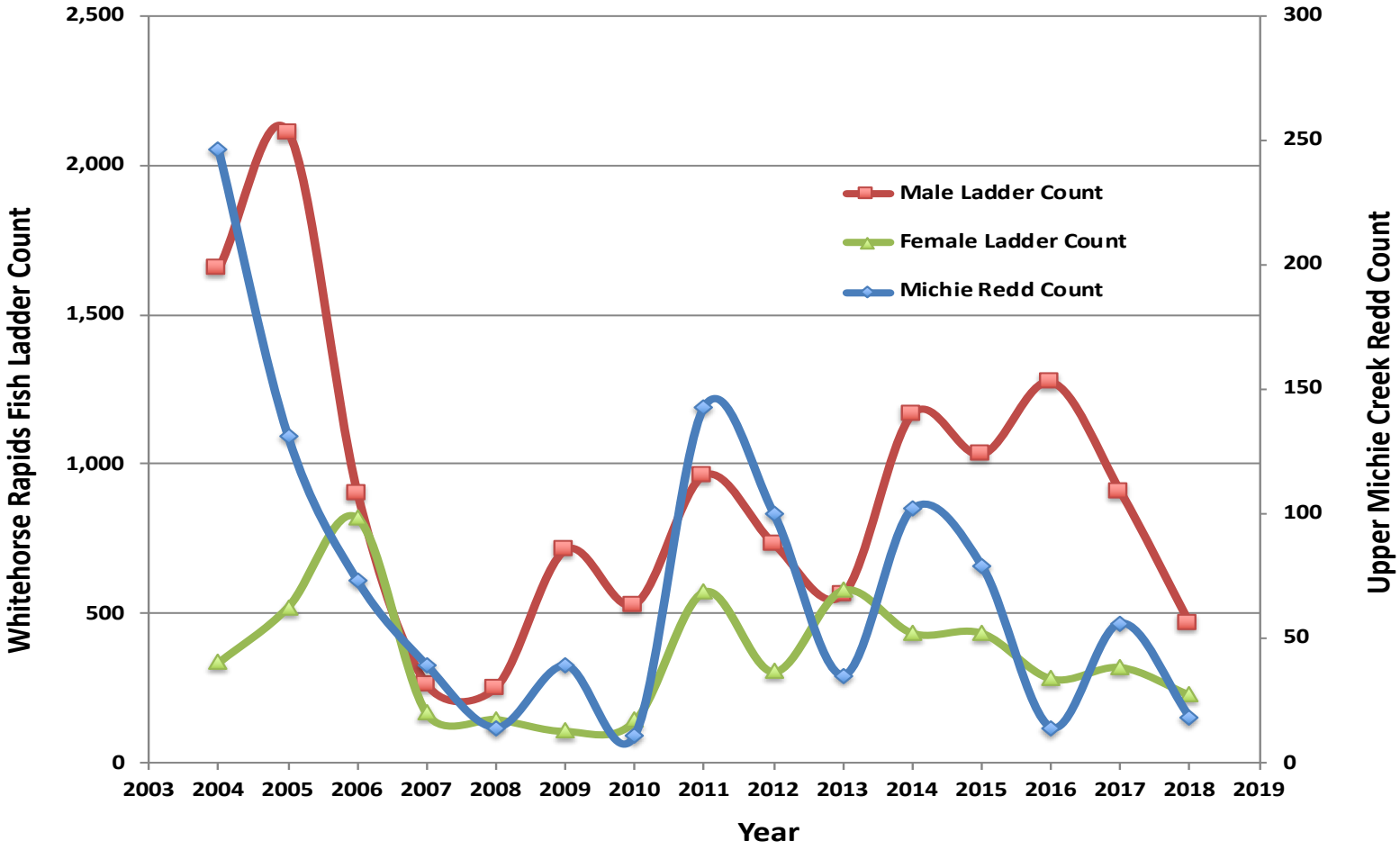

Figure 10 Chinook salmon adult male and female counts at the Whitehorse Rapids Fish Ladder compared to the number of enumerated redds in upper Michie Creek, 2004 to 2018.

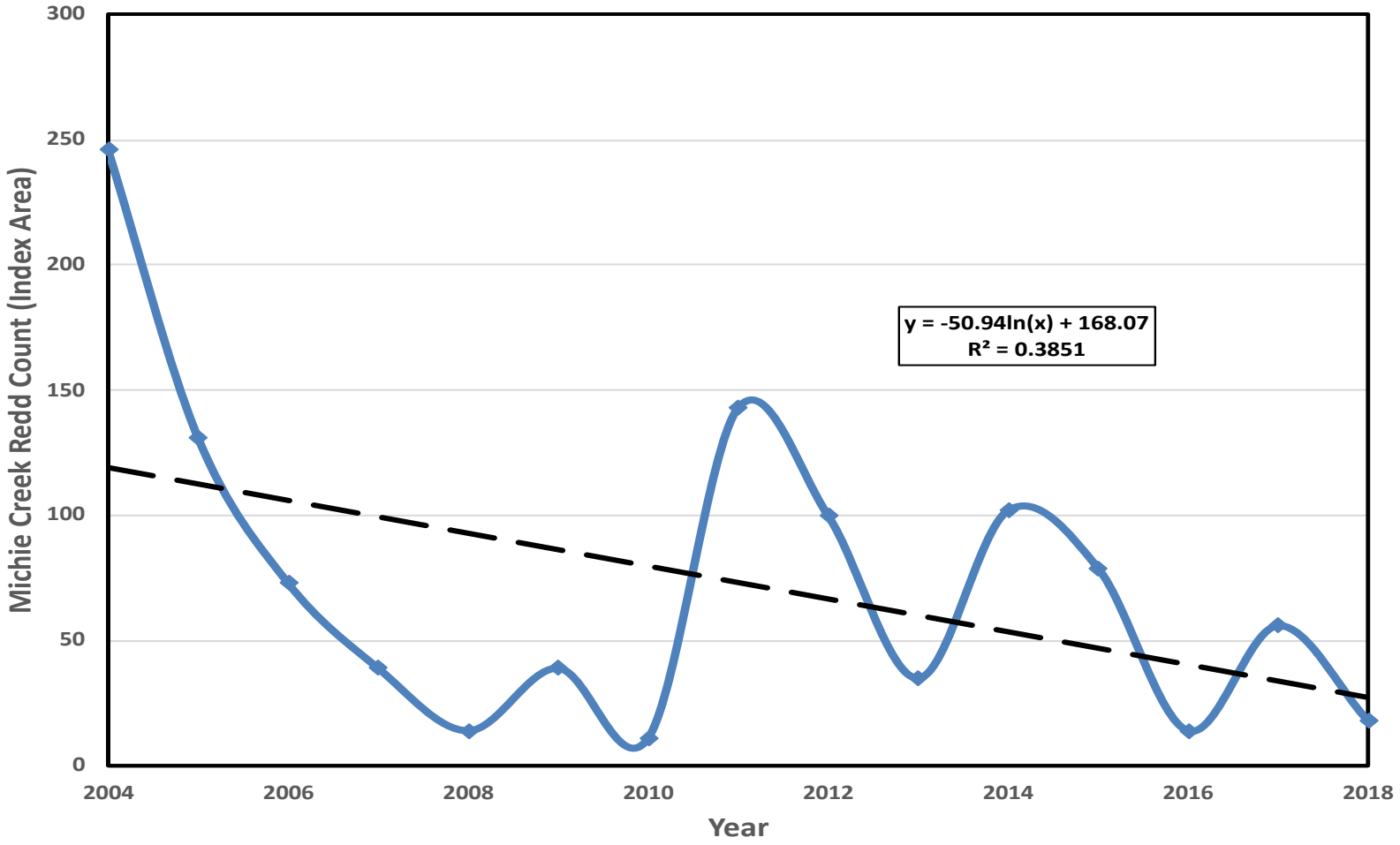

Figure 11 Graph showing the trend in the number of enumerated redds in upper Michie Creek from 2004 to 2018.

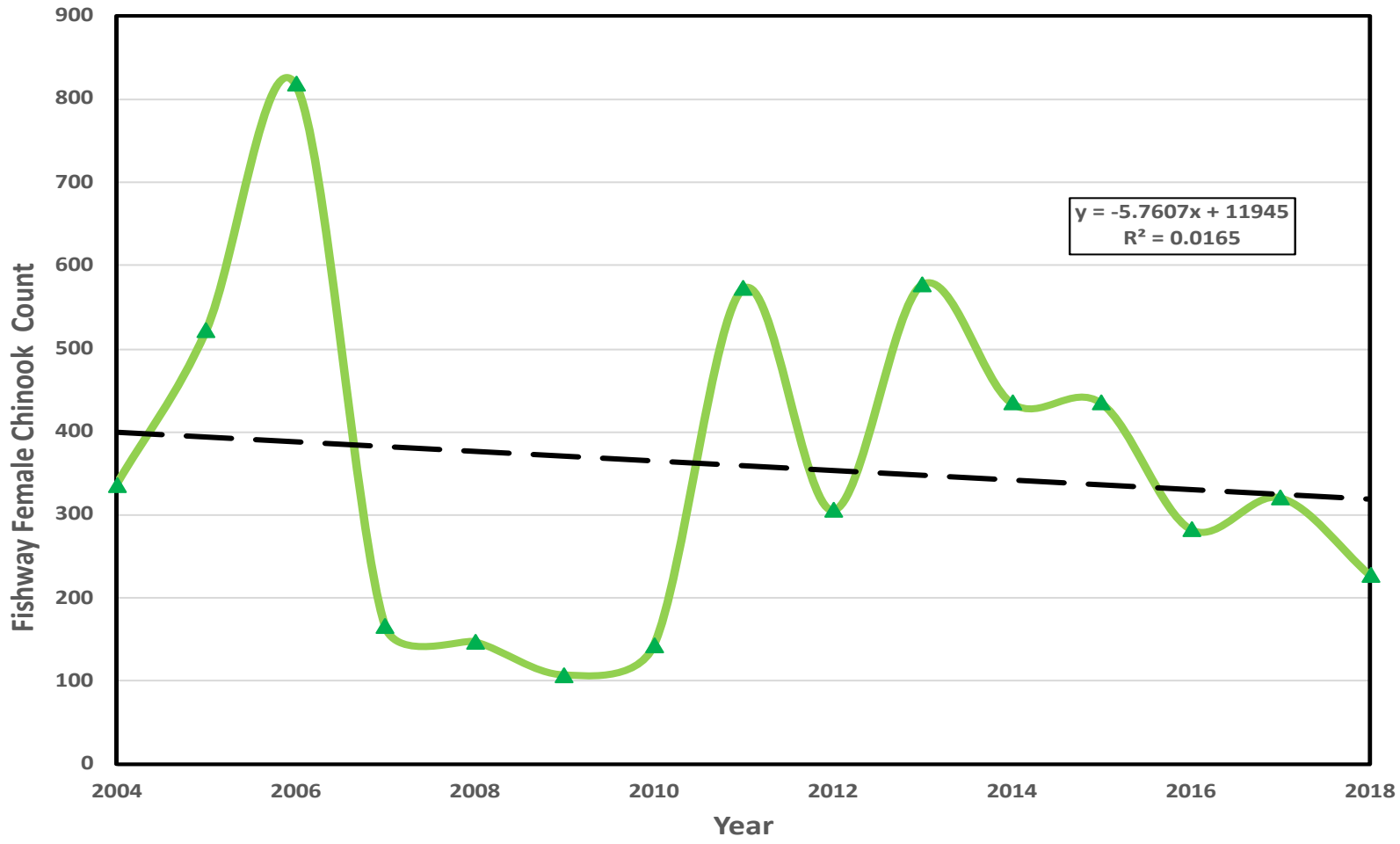

Figure 12 Graph showing the trend of the total number of Chinook salmon adult females enumerated at the Whitehorse Rapids Fish Ladder from 2004 to 2018.

Table 1 Yearly adult Chinook salmon statistics from Michie Creek index area and the Whitehorse Rapids Fish Ladder from 2004 to 2018.

Year	Adult Chinook Salmon Count			Michie Creek Redd Count (Survey Date)	Michie Creek Remediated Obstructions
	Fishway Total	Fishway Females	Michie Creek Total		
2004	1,989	337	155	246 (16-Sep)	3
2005	2,632	522	340	131 (31-Aug)	1
2006	1,720	819	34	73 (31-Aug)	1
2007	427	167	47	39 (31-Aug)	0
2008	399	148	35	14 (31-Aug)	0
2009	819	108	82	39 (5-Sep)	0
2010	672	143	1*	11 (11-Sep)	1
2011	1,534	573	247	143 (29-Aug)	0
2012	1,037	306	213	100 (3-Sep)	0
2013	1,139	578	41	35 (6-Sep)	0
2014	1,601	435	245	102 (31-Aug)	1
2015	1,465	435	143	79 (3-Sep)	0
2016	1,556	283	21	14 (6-Sep)	1
2017	1,226	321	195	56 (31-Aug)	1
2018	691	228	23	18 (3-Sep)	1

* Survey conducted about a week later than other survey years.

APPENDIX I

FISHWAY COUNTS 1961 TO 2018

Appendix I: Yearly counts of hatchery and wild adult Chinook salmon migrating through the Whitehorse Rapids Fish Ladder from 1961 to 2018.