Columbia Basin Invasive Northern Pike (*Esox lucius*) Suppression and Monitoring, British Columbia (2019 – 2020)

Okanagan Nation Alliance Program: Year 1




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Submitted to:

Columbia Basin trust | Fisheries and Oceans Canada | British Columbia — Ministry of Forests, Lands, Natural Resource Operations and Rural Development

February 2020

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Cover Photos

Top Left: Six juvenile Northern Pike removed from Zuckerberg Pond in Castlegar, BC on August 28 2019. Photo: Evan Smith, Okanagan Nation Alliance.

Top Right: Andrew Clark and Autumn Solomon (Okanagan Nation Alliance) electrofishing for Northern Pike behind Waldie Island on the Columbia River near Castlegar, BC on August 22 2019. Photo: Evan Smith Okanagan Nation Alliance.

Bottom Left: Eleanor Duifhuis (Okanagan Nation Alliance) with a 24.6 lb female Northern Pike removed from the Pend d'Oreille River at Buckley Campground near Trail, BC on May 2 2019. Photo: Autumn Solomon, Okanagan Nation Alliance.

Bottom Right: Juvenile Northern Pike removed from behind Waldie Island on the Columbia River near Castlegar, BC on August 22 2019. Photo: Evan Smith, Okanagan Nation Alliance.

Additional Funding Provided by:

Teck BC hydro FWCP Fish & Wildlife COMPENSATION PROGRAM

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Citation: Okanagan Nation Alliance. 2020. Columbia Basin Invasive Northern Pike (*Esox lucius*) Suppression and Monitoring, British Columbia (2019 – 2020). Okanagan Nation Alliance Program: Year 1. Prepared for the Ministry of Forests Lands and Natural Resource Operations and Rural Development, Nelson BC. p. 37 + 10 app.

Executive Summary

Northern Pike (*Exos lucius*) are a carnivorous fish with a circumpolar distribution. In Canada and the United States, they are native east of the Rocky Mountain Range; excluding Canadian Maritime Provinces and the Atlantic Coastal Plain (east of the Appalachian Mountain Range) in the United States. Northern Pike have been introduced (legally and illegally) to systems outside of their native distribution for the purposes of sport fishing. When introduced, Northern Pike are known to have detrimental effects on native fish populations, including salmonids. In 2004 introduced Northern Pike were observed in the Pend d'Oreille River Box Canyon Reservoir in Pend Oreille County, Washington; this population is suspected to have seeded the lower Columbia River population first observed in 2010 (in Canada) in the Robson Reach near Castlegar, BC via the Pend d'Oreille River. Within the Columbia River, Northern Pike pose a risk to resident fish including Species at Risk Act listed species such as White Sturgeon (*Acipenser transmontanus*), Shorthead Sculpin (*Cottus confusus*) and Umatilla Dace (*Rhinichthys umatilla*). Active suppression of Northern Pike has resulted in 414 Northern Pike being removed between the Columbia and Pend d'Oreille Rivers from 2014 to 2018.

In 2019 active suppression continued in the Columbia and Pend d'Oreille Rivers and expanded to monitoring at Christina Lake. A variety of methods were utilized during the suppression program including gillnetting, electrofishing, seining, and angling. These methods were implemented in a manner that ensured comparability to similar suppression programs (Box Lake, Boundary, Lake Roosevelt) and past efforts on the Columbia and Pend d'Oreille Rivers. When required, methods were adjusted/added based on site-specific conditions to improve capture opportunities; comparability of data was considered when using adjusted methods.

In total 45 Northern Pike (35 – Columbia River; 10 – Pend d'Oreille River; 0 – Christina Lake) were captured and euthanized over 35 crew-days in 2019 as part of this targeted program. The majority of Northern Pike were captured through gillnetting (44) with one Northern Pike captured through angling. Suppression and monitoring efforts took place between April 15 2019 and August 30 2019. Gillnetting was the most utilized method in the 2019 suppression program with 169 sets totaling 1,024.8 hours of soak time (time gillnets were in the water actively fishing), followed by electrofishing (16 sites totaling 4.2 hours over 9.8 km), and some effort angling (11 occurrences totaling 27 hours) and seine netting (two sites totaling 104 m^3 of water seined). The highest effort for all methods was spent in the Pend d'Oreille River, followed by the Columbia River, with the least amount of effort in Christina Lake. Comparable (similar nets and timing of sampling) spring Catch per Unit Effort was 0.60 Northern Pike/8hr; an increase of 0.19 Northern Pike/8hr from 2018. Though 2019 Catch per Unit Effort increased over 2018, it remained below 2014 and 2016 suppression efforts and was 83% lower than when suppression began in 2014. This may indicate a slight increase in population from 2018 to 2019, or be a result of more effort between mid-April and mid-June.

Acknowledgements

This project was possible due to funding from the Columbia Basin Trust, Department of Fisheries and Oceans Canada, Ministry of Forest Lands and Natural Resource Operations and Rural Development, and Teck Resources Limited.

The Okanagan Nation Alliance would like to thank/acknowledge the following people and organizations:

Columbia Basin Trust (Funder):

Tim Hicks	Senior Manager, Delivery of Benefits
Krista Watts	Environment Lead; Project Manager

Department of Fisheries and Oceans Canada (Funder):

Kim Hardacre	Project Manager

Ministry of Forest Lands and Natural Resource Operations and Rural Development (Funder):

Matt Neufeld	Ministry Contact (Nelson); Project Planning Assistance
Tara White	Ministry Contact (Penticton); eDNA; Project Planning Assistance

Teck Resources Limited (Funder):

Adam Brooks	Fieldwork Assistance
Daniel Bouillon	Fieldwork Assistance

Colville Confederated Tribes:

Holly McLellan	Field Planning Assistance/Guidance (Suppression and eDNA); SPIN Net Donation

Kalispel Tribe of Indians:

Nick Bean	Field Planning Assistance/Guidance (Suppression); SPIN Net Donation

Spokane Tribe of Indians:

Elliot Kittel	Field Planning Assistance/Guidance (Suppression); SPIN Net Donation
Kaitlin Thurman	Field Planning Assistance/Guidance (Suppression); SPIN Net Donation

Christina Lake Stewardship Society:

Suzanne Vincent	Stewardship Coordinator; Fieldwork Assistance
Jeff Olsen	Christina Lake Stewardship Society President; Fieldwork Assistance

Penticton Indian Band:

Jalissa Kruger	Field Technician

National Genomics Center for Wildlife and Fish Conservation

Kellie Carim	Aquatic Research Biologist; eDNA Assay Development

BC Hydro:

Guy Martel	Provided access to BC Hydro unpublished data

Okanagan Nation Alliance:

Amy Duncan	Project Manager (2019); Initial Project Development and Field Planning
Michael Zimmer	Report Editor; Project Development and Support
Evan Smith	Interim Project Manager (2019); Field Lead and Author
Eleanor Duifhuis	Field Lead; Data Entry and Co-Author
Dave Derosa	Biologist/Fieldwork
Autumn Solomon	Field Technician
Andrew Clark	Field Technician
Dave Tom	Field Technician
Paul Snow	Field Technician
Chad Fuller	Contributing Author (eDNA); Aging and eDNA Work

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1.0 Introduction

Northern Pike (*Exos lucius*) are a carnivorous fish with a circumpolar distribution. In Canada and the United States, they are native to the east of the Rocky Mountain Range; excluding Canadian Maritime Provinces and the Atlantic Coastal Plain (east of the Appalachian Mountain Range) in the United States (Fig 1; McPhail 2007; Hatfield and Pollard 2009). Northern Pike have been introduced (legally and illegally) to systems outside of their native distribution in Canada and the United States for the purposes of sport fishing (Hatfield and Pollard 2009; Runciman and Leaf 2009). Because Northern Pike are a prolific predatory fish species, when introduced to a new system they are known to have detrimental effects on native fish populations, including salmonids (Baxter and Neufeld 2015, Muhlfield et al. 2008).

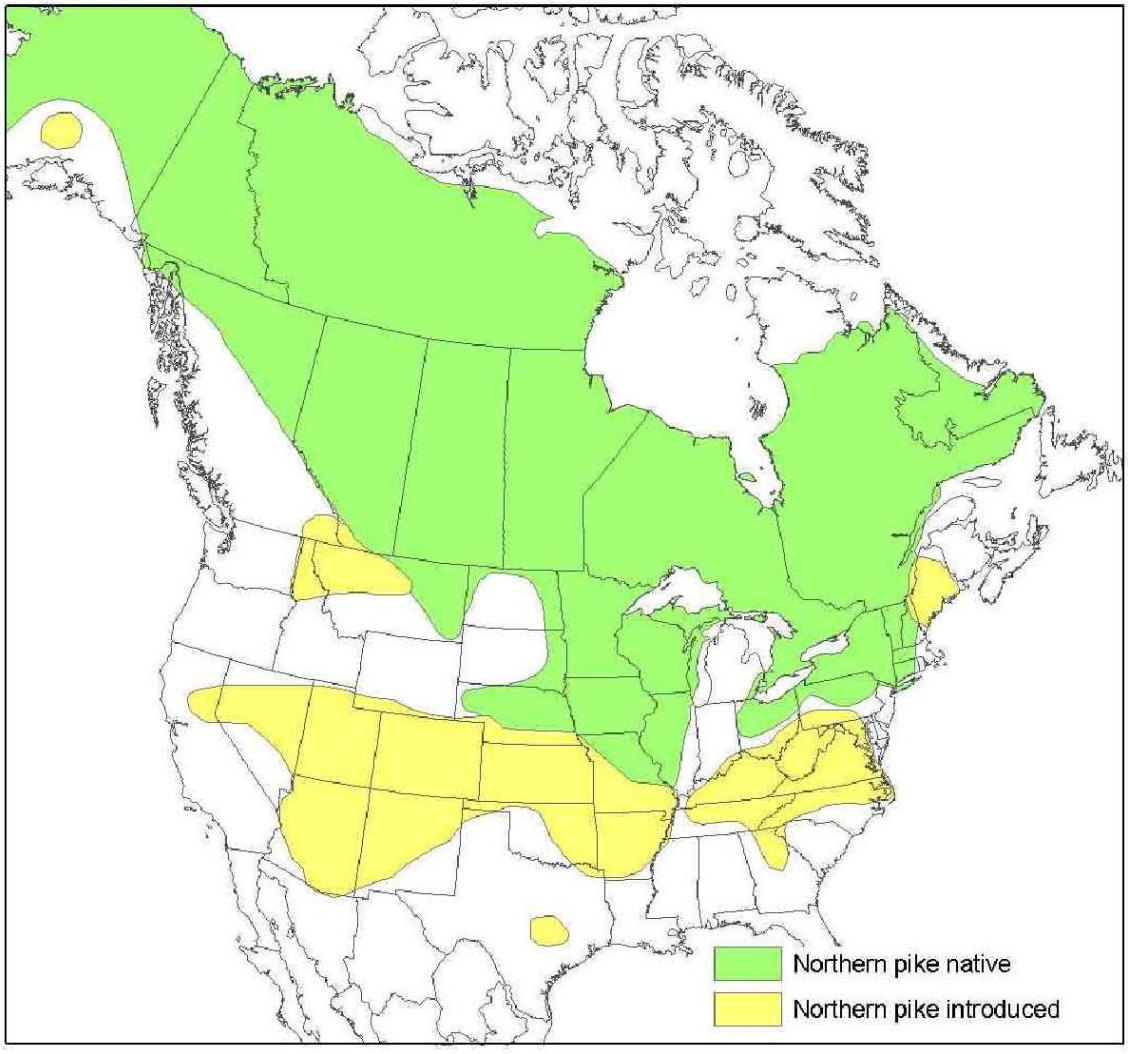

Figure 1. North American distribution of Northern Pike identifying their native and non-native (introduced) range (figure from Harvey 2009).

Introduced (a species living outside its native distributional range due to human activity, either intentional or accidental) Northern Pike were observed in the Koocanusa Reservoir in 1995 by the Montana Department of Fish, Wildlife, and Parks (Parnell 1996; Runciman and Leaf 2009). This population is suspected to have seeded British Columbia's first Northern Pike introduction observation in 2005 at Ha Ha Lake near Warder, BC (Harvey 2009; Runciman and Leaf 2009; Davis 2011). In 2004 introduced Northern Pike were observed in the Pend d'Oreille River Box Canyon Reservoir in Pend Oreille County, Washington (WDFW and KTI 2012; Bartholdt 2018). This population is expected to have seeded the lower Columbia River (LCR) population first observed in 2010 (in Canada) in the Robson Reach near Castlegar, BC via the Pend d'Oreille River (Ford and Thorley 2011). These non-native (introduced) populations are considered invasive (a species that can spread to a degree that causes damage to the environment, human economy or human health) in the Columbia River (Harvey 2009). Within the LCR, Northern Pike pose a risk to resident fish including Species at Risk Act (SARA) listed species such as White Sturgeon (*Acipenser transmontanus*), Shorthead Sculpin (*Cottus confusus*) and Umatilla Dace (*Rhinichthys umatilla*).

Northern Pike are monomorphic (males and females look the same, though females tend to be larger at age) and are easily identified by their duckbill-shaped head, elongated body and posteriorly-placed dorsal and anal fins, which allow rapid acceleration; one feature making them a successful predator (Doyon 1988; Hubbs and Lagler 2004; McPhail 2007).

1.1 Previous Suppression and Monitoring Efforts

Since the introduction of Northern Pike to south-eastern British Columbia, north-eastern Montana, northern Idaho, and north-eastern Washington, a number of suppression programs have been implemented in effort to reduce and/or eliminate them. Most of these programs utilized gillnetting and electrofishing as suppression techniques. The suppression of Northern Pike has been a transboundary effort with multiple organizations involved. Today, Northern Pike are known to inhabit the Kettle River in addition to the Pend d'Oreille River and Columbia River; some photo evidence indicates they may have reached Christina Lake, Christina Lake BC via the Kettle River.

1.1.1 United States Suppression Efforts (Pend d'Oreille and Columbia Rivers)

In 2012 the Kalispel Tribe of Indians (KTI) and the Washington Department of Fish and Wildlife began an active suppression program in the Box Canyon Reservoir, which has resulted in the removal of 17,464 Northern Pike as of 2018 (WDFW and KTI 2019[1]). An additional program was implemented in the Boundary Reservoir that resulted in the removal of 546 Northern Pike in 2018 alone (WDFW and KTI 2019[2]).

In 2015 a dedicated Lake Roosevelt Northern Pike Suppression Program was initiated to address Northern Pike population growth in the reservoir and has removed 8,865 Northern Pike between 2015 and 2018; with 2,836 Northern Pike being removed in 2018 alone (McLellan et *al*. 2019). This program was implemented in partnership with the

Confederated Tribes of the Colville Indian Reservation, Spokane Tribe of Indians, and the Washington Department of Fish and Wildlife.

1.1.2 Canadian Suppression and Efforts (Pend d'Oreille and Columbia Rivers)

In 2014 a gillnetting program, funded by Teck Resources Limited, the Columbia Basin Trust (CBT), and the Ministry of Forests Lands and Natural Resource Operations and Rural Development (FLNRORD), was initiated resulting in the removal of 372 Northern Pike between 2014 and 2017 (Baxter and Lawrence 2018). An angler reward program was initiated by FLRNORD in 2013/14 and 2015/16 resulting in the removal of 34 Northern Pike from the Columbia River (AMEC 2017).

In 2015 and 2016 additional detection programs were implemented to target young-of-year (YOY/juvenile) Northern Pike through projects by the Castlegar and District Wildlife Association and Golder Associates (2015) and Okanagan Nation Alliance (ONA; 2016). The 2015 project was a pilot program aiming to capture larval Northern Pike utilizing light traps, however, the presence of larval Northern Pike were not detected during this study (Golder 2015). In 2016 the ONA conducted a juvenile Northern Pike sampling program in the Robson Reach of the Columbia River resulting in the capture of one YOY Northern Pike; indicating Northern Pike were now spawning in the Columbia River rather than immigrating from the Pend d'Oreille River (ONA 2016). This theory was supported by Doutaz (2019) who used microchemistry analysis to determine 49 of 50 Northern Pike sampled from the Columbia River had hatched there.

In 2018 suppression efforts continued, resulting in the removal of 27 Northern Pike from the LCR and 15 from the Pend d'Oreille River (Canadian Reach; Wood 2019). An ONA lead Bounty Program was run in 2018 that resulted in the documented removal of four Northern Pike (A. Solomon, pers. comm. 2019). Three were removed from the Columbia River and one from the Pend d'Oreille River. The ONA also conducted a brief adult suppression program (3,031 seconds electrofishing and 47.83 hours gillnetting) in the LCR and Pend d'Oreille Rivers in 2018, though no Northern Pike were captured.

1.2 Project Goals and Objectives

The primary goal of the 2019 program was to continue efforts to suppress adult and juvenile Northern Pike in the Columbia and Pend d'Oreille Rivers (within Canada), while working to identify previously undiscovered Northern Pike hot-spots and monitoring range expansion. Specific goals and objectives are detailed below:

Goal 1: *Reduce Northern Pike Population in the Columbia and Pend d'Oreille Rivers*

Objective 1.1: Utilize existing Northern Pike suppression methodologies from similar programs to ensure comparability (Catch Per Unit Effort compared between years and programs)

Objective 1.2:	Investigate and implement additional/new Northern Pike control actions that could further support suppression efforts
Objective 1.3:	Identify and treat high quality spawning/rearing habitat
Objective 1.4:	Minimize mortality of native species and Species at Risk (SARA)

Goal 2: Impede Northern Pike range expansion into susceptible locations

Objective 2.1:	Utilize eDNA to monitor for Northern Pike presence outside of the current known range
Objective 2.2:	Develop a rapid response plan to quickly suppress Northern Pike in newly detected areas

Goal 3: Promote stewardship and public involvement in Northern Pike suppression

Objective 3.1:	Engage local stewardship groups through conferencing, outreach and education
Objective 3.2:	Develop a bounty/lottery program to involve/reward anglers for participating in Northern Pike suppression

2.0 Suppression/Monitoring Area

Active suppression occurred in two primary locations; the Columbia River, and the Pend d'Oreille River, while monitoring for Northern Pike occurred at Christina Lake (Fig 2).

The Columbia River is approximately 1600 km long originating in Columbia Lake near Canal Flats, BC and draining into the Pacific Ocean near Portland Oregon, Washington State (WA). The Columbia River is one of the world's largest sources of hydroelectric power and is impacted by many other anthropogenic activities such as industrial activity, logging, mining, and urbanization. Nearly 800 km of the Columbia River is located in Canada and Northern Pike (in the Canadian Columbia River) are currently known to occupy the ~ 56 km reach between Hugh L. Keenleyside (HLK) Dam, Castlegar BC and the Canada/United States Border. The 2019 suppression effort in the Columbia River were focused between HLK Dam and Zuckerberg Island, Castlegar BC because of the well documented Northern Pike presence and high value habitat (Baxter and Neufeld 2015; Baxter 2016; Baxter and Doutaz 2017; Baxter and Lawrence 2018; Wood 2019). This area includes the lower reach of the Kootenay River between the Columbia/Kootenay River confluence upstream approximately 2.6 km to Brilliant Dam. For the purposes of this report the "Columbia River" will refer to the reach between HLK dam and Zuckerberg Pond, and the Kootenay River as previously described.

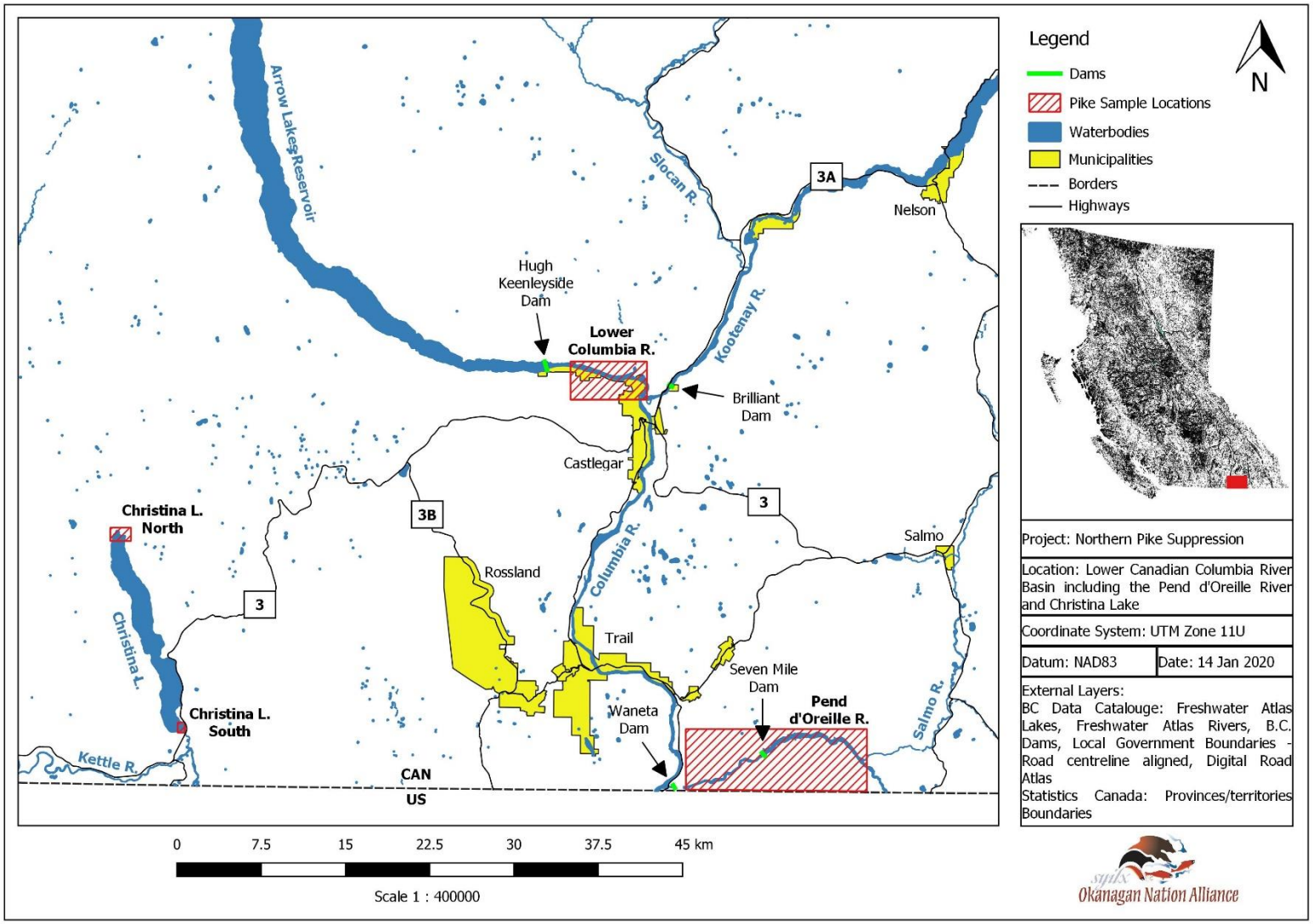

Figure 2: Active Northern Pike suppression locations within the Columbia and Pend d'Oreille Rivers, and Christina Lake (2019).

The Pend d'Oreille River is a tributary of the Columbia River and is approximately 209 km long originating in Lake Pend Oreille near Sandpoint Idaho. The majority of the river is located in the United States before entering Canada downstream of Boundary Dam; located north of Metaline Falls, WA. Approximately 25 km of the Pend d'Oreille River flows through southern BC before draining into the Columbia River just north of the Canada/United States Border. Within the Canadian Reach there are two reservoirs; Waneta Reservoir and Seven Mile Reservoir. The Waneta Reservoir was formed with the Construction of Waneta Dam and extends from the forebay of Waneta Dam to the tailrace of Seven Mile Dam (9.5 km). The Seven Mile Reservoir originates behind Seven Mile Dam to the Boundary Dam tailrace (14 km). Active suppression occurred in both Waneta and Seven Mile Reservoirs due to the documented presence of Northern Pike (Baxter and Neufeld 2015; Baxter 2016; Baxter and Doutaz 2017; Baxter and Lawrence 2018; Wood 2019).

Christina Lake is located between Grand Forks and Castlegar, BC, and drains into the Kettle River; a tributary to the Columbia River. The lake is roughly 18 km long and has a surface area of 25.489 km^2 providing high recreational value. Locally it's known as the warmest timber-lined lake in BC. Christina Lake was identified as a high priority monitoring location and a candidate for exploratory sampling because of the high potential for Northern Pike introduction through the Kettle River, which has confirmed Northern Pike presence. The south end of the lake near the outlet to Christina Creek and the Nature Park, and the north end of the lake near Sander Creek were sampled. Both of these locations had similar habitat characteristics to areas with Northern Pike in the Columbia and Pend d'Oreille Rivers (i.e., shallow, dense marcrophyte).

Suppression began on April 15 2019, prior to the anticipated Northern Pike spawning window, which allowed the crew to monitor for signs of Northern Pike spawning. Sampling conducted prior to the spawning window gave indication of the effectiveness of suppression efforts during this time. Spring suppression occurred from April 15 2019 through June 2019, with minor effort in the summer (July 2019 – August 15 2019), and some effort in the fall (August 15 – 30 2019). Additionally, Northern Pike were captured and removed, as encountered during Large River Fish Indexing Program – Lower Columbia River (BC Hydro CLBMON 45, September 25 – November 03 2019).

3.0 Methods

All methods used for this program were implemented in accordance with Department of Fisheries and Oceans SARA Permit 19-HPAC-00031 (Columbia River) and MFLNRORD Scientific Collection Permits CB19-476955 (Columbia and Pend d'Oreille Rivers) and PE19-547315 (Christina Lake).

3.1 Sampling Methods

A variety of methods were utilized during the suppression program including gillnetting, electrofishing, seining, and angling. These methods were implemented in a manner that ensured comparability to similar suppression programs (Box Lake Reservoir, Boundary

Reservoir, Lake Roosevelt) and past efforts on the Columbia and Pend d'Oreille Rivers. When required, methods were adjusted/added based on site-specific conditions to improve capture opportunities; comparability of data was considered when using adjusted methods.

3.1.1 Gillnetting

Two different gillnet types were used to target the different life stages of Northern Pike. Spring Pike Index Nets (SPIN), were deployed from March through August 2019 to target adult Northern Pike (Table 1). Individual nets were constructed of five different mesh size panels (2", 2.5", 3", 3.5", 4"), with a total length of 45.72 m and depth of 1.83 m. Juvenile nets (1" monofilament nets, 45.72 m x 1.83 m) were deployed in August 2019 to target YOY Northern Pike. Gillnets were deployed from a jet boat at all sites except those in Zuckerberg Pond due to shallow water and access issues; here gillnets were deployed via canoe (Fig 3).

Table 1. Individual panel specifications that comprise a typical Spring Pike Index Net used for suppression/monitoring in the Columbia River, Pend d'Oreille River, and Christina Lake including panel length (m), panel depth (m) mesh size (inch; stretched), monofilament material number (indicates type of monofilament from manufacture), monofilament diameter (mm) and test strength (lbs).

Panel Number	Panel Length (m)	Panel Depth (m)	Mesh Size (inch)	Monofilament Material Number	Diameter (mm)	Net test Strength (lbs)
1	9.144	1.83	2.0	#104/#4	0.33	11
2	9.144	1.83	2.5	#104/#4	0.33	11
3	9.144	1.83	3.0	#139/#6	0.40	17
4	9.144	1.83	3.5	#139/#6	0.40	17
5	9.144	1.83	4.0	#139/#6	0.40	17

Gillnets were set in areas of known or suspected Northern Pike habitat (shallow, slow moving, abundant aquatic vegetation). Whenever possible, gillnets were set perpendicular to shore with the shallow end in ~1 m of water. SPIN nets were deployed with the smallest mesh size close to shore and the largest mesh size in deeper water. The length of net and percentage of intact netting were recorded for every set (percentage of intact netting was subtracted with each hole or break the net sustained). Gillnets were left to soak for up to four hours in the Columbia River, up to 24 hours in the Pend d'Oreille River, and two hours in Christina Lake in accordance with applicable permitting. Soak time in the Columbia River was reduced to 2 hours when White Sturgeon capture rate was high.

Figure 3. Example of gillnet deployment via canoe in Zuckerberg Pond, Castlegar BC. Photo: Evan Smith Okanagan Nation Alliance.

3.1.2 Electrofishing (boat)

Boat electrofishing was conducted with a Smith-Root Model SR-18H (GPP 7.5). Day and night sampling occurred in a depth range of 0.5 – 3.0 m. Voltage was adjusted to reach a target amperage output of ~1.75 A, at a frequency of 30 Hz direct current, as these levels were shown to reduce potentially negative effects on non-target and listed species (Golder 2004 and 2005). Considering a large area of the Robson Reach is annually electrofished between September and November for CLBMON 45, and Northern Pike are captured during this sampling, the decision was made to forgo any intensive electrofishing in the Robson Reach and Kootenay River in 2019 to reduce adverse impacts on native species and species at risk. Spring electrofishing for Northern Pike during spawning may be considered in 2020.

Constant electrofishing was conducted within the defined depths while traveling in a pre-determined site. All Northern Pike and other invasive species successfully netted were put in a live-well until the site was completed, then processed, including euthanasia. Non-target species were not netted. To reduce impacts to non-target species, power from the boat was turned off if a non-target species was within the electric field for an extended period (> 5 seconds), and power was immediately turned off if White Sturgeon were

observed (as per the Columbia River White Sturgeon Recovery Program Protocol). Conductivity, amperage, voltage, sample time, and bycatch were recorded for each site.

3.1.3 Electrofishing (backpack)

Backpack electrofishing was completed with a Smith-Root Model LR-24. Minimal backpack electrofishing occurred and was limited to Zuckerberg Pond for YOY/Larvae detection and to chase adult Northern Pike into deployed gillnets.

3.1.4 Seine Netting

Seine netting was conducted with a 10 m x 1 m seine net and was limited to sampling in Zuckerberg Pond for YOY/larvae. One crew member would hold the seine close to shore while the other crew member waded into the pond; the two would walk parallel to shore for 10 – 20 m before creating the purse and sampling the fish. Information recorded for each seine net included: species captured, minimum and maximum length for each species, and length of site sampled.

3.1.5 Angling

Angling for Northern Pike occurred opportunistically with various lures while gillnets were soaking. Effort was recorded as time angling and the type of lure was recorded if a Northern Pike was captured. Other recorded angling data included the angler and bycatch. All anglers possessed a valid BC fishing license and followed applicable BC Fishing Regulations.

3.1.6 Habitat Data Collection

Specific habitat measures and water quality were collected in each site in an attempt to better understand Northern Pike habitat usage (Table 2); which will allow suppression crews to focus suppression efforts. In addition to habitat data: weather conditions, sample start time/date, and sample end time/date were recorded at all sites for all methodologies.

Long term water temperature data in the Pend d'Oreille Reservoir was collected with HOBO Pendant Temperature/Light 64K Data Loggers deployed approximately five meters below the water's surface. Water temperature for Christina Lake was provided by the Christina Lake Stewardship Society, while water temperature data and river level for the Columbia River were obtained from the Water Survey of Canada at Birtchbank (Station: 08NE049).

Table 2. Parameters recorded at 2019 suppression sites with the instrument used to measure the parameters and their associated accuracy.

Parameter	Instrument	Accuracy
Water Depth (m) Surface Water Temperature (°C)	Humminbird Helix 7x Chirp GPS G2	
UTM Location	Garmin 64st	+/- 3 m
Water Chemistry • Dissolved Oxygen (mg/L) • pH • Conductivity (µs/cm)	YSI Pro2030 (Dissolved Oxygen, Conductivity) Hanna HI98103 pH tester (pH)	 +/- 0.2
Water Clarity (m)	Secchi Disc	+/- 0.25 m

The YSI probe was calibrated at the beginning of the field season while the Hanna pH tester was calibrated bi-weekly.

3.2 Northern Pike Processing and Data Collection

All captured Northern Pike were euthanized before being measured and weighed. Photos were taken before inspecting gonads (for sexing) and stomach contents. The heads of adult Northern Pike were removed, while YOY whole body and stomach contents were taken as samples. Samples were placed in a Ziploc bag labelled with the sample number, site, date, coordinates, length and weight. Samples were frozen before being transported to the ONA kɬ cp̓əlk̓ stiḿ Fish Health and Diagnostics Laboratory in Penticton BC. Adult tissue samples were used to develop a region-specific eDNA primer and all samples were used for aging. Future additional analyses of these samples may include tissue toxicity, pathogen, and/or genetic analyses.

Northern Pike were aged using the Cleithrum with methods described by Faust et *al*. (2013). Cleithra were briefly (15 - 30 seconds) submerged in boiling water to loosen attached tissue, which was subsequently removed by hand. The process was repeated until cleithra were clean. Once completely dry (1 - 2 days), cleithra were placed in a black dish and submerged in water to improve visibility of annuli. Annuli were counted with the naked eye, or with a microscope depending on the inherent visibility of annuli. This method was chosen over otolith aging due to its reliability (specifically for Northern Pike) and its comparatively simple sample preparation (Faust et *al.* 2013).

All captured fish were scanned for a PIT tag and measured. Native bycatch was identified, measured, and scanned before being released back into the river (gillnetting). All invasive fish species were euthanized and disposed of at the point of capture. In the Columbia and Pend d'Oreille Rivers, Walleye were considered a non-native sportfish and were not euthanized. Similarly, in Christina Lake, field-crews were asked not to euthanize non-native sport fishes (bass; *Micropterus* sp.); though applicable permits allowed this.

3.3 Data Management and Mapping

All field data was recorded on a project specific datasheet (Appendix A) with supplemental data recorded in field notebooks. Over the course of a field day, pictures of datasheets were taken as a backup at the discretion of the field crew. At the end of the day all datasheets were scanned and transferred to the ONA shared network. Field data were entered into an excel database and QA/QC'd (Quality Assurance – Quality Control), while GPS data were stored in Garmin Basecamp (Version 4.7.0).

All mapping was completed on Q-GIS (Version 3.4.14-Madeira) with 2019 field data collected by the ONA and open source external layer sources from the BC Data Catalog and Statistics Canada. All satellite imagery is open source from the ESRI World Imagery service and the year of the imagery is identified in each map. Individual layers are identified in each map and their sources can be found in the references section under *7.2 Map Layer Sources*.

3.4 Data Analysis

Microsoft Excel (2010) was used for all summary statistics and graphs, and geographical analysis were completed using Q-GIS.

3.4.1 Catch per unit Effort

Gillnet Catch Per Unit Effort (CPUE) was calculated using two methods: (1) catch per 8-hour period (Northern Pike/ (total gillnet hours' x 8-hour net)) and (2) catch per net-unit (Eq 1). The catch per 8-hour period ($CPUE_{8hr}$) method is used to compare CPUE to previous years (Baxter and Neufeld 2015; Baxter 2016; Baxter and Doutaz 2017; Baxter and Lawrence 2018; Wood 2019). However, the catch per net-unit method ($CPUE_{nu}$) adjusts for net area (length (m) x depth (m)) and the percent of net fishing, which provides a more accurate representation of effort. CPUE was compared between years when the timing and method of suppression was similar.

Equation 1. Catch per net-unit equation used to find catch per unit effort.

$$CPUE^2(GN) = \left(\left(\frac{A}{100m^2}\right) \times \left(\frac{T}{24h}\right)\right) \times \#\ NORTHERN\ PIKE\ CAPTURED$$

$Where$:
$A = the\ area\ (m^2)\ of\ net\ mesh\ actively\ fishing$: $Net\ Length\ (m)\ \times Net\ Depth\ (m) \times intact\ netting\ (\%)$
$T = the\ amount\ of\ time\ the\ gillnet\ was\ soaking\ in\ hours$

Electrofishing CPUE is expressed as Northern Pike per hour using the calculation: Northern Pike captured / time sampled in hours. Electrofishing CPUE was compared between years and between waterbodies (Columbia and Pend d'Oreille Rivers, and Christina Lake).

Seine CPUE is expressed as Northern Pike per meter-cubed using the calculation: Northern Pike captured / ((estimated water depth (m) x estimated effective seine width (m) x length of seine (m)). The estimated effective seine width is defined as the distance between the two ends of the seine net at the time of the seine; as this may change with site water depth, debris in the site, and crew.

Angling CPUE is expressed as Northern Pike per hour angling using the calculation: Northern Pike captured / hour angling. Angling CPUE was compared between years and between waterbodies. Lure type was not accounted for during CPUE calculations.

3.4.2 Northern Pike Population Dynamics

A variety of Northern Pike population dynamics were explored including a relative population estimate, male/female ratios, identification of juvenile habitat, length-age relationships, length/weight relationships (size), and condition factor.

The 2019 Northern Pike population estimate was limited to a designation of “higher” or “lower” than previous years based on the comparative CPUE. A quantified population estimate was not determined in 2019 as a mark-recapture study would require Northern Pike to be released back into the system. Since Northern Pike are prolific spawners, the decision was made to avoid re-introducing Northern Pike whenever possible. Along with CPUE comparisons, male/female ratios will be monitored as a partial indication of the program’s success. Specifically, a reduction in captures of spawning females may indicate a reduction in population assuming equal catchability between males and females.

Juvenile Northern Pike rearing habitat was primarily identified by the density of juvenile Northern Pike captured or observed in a location. Habitat parameters were compared between sites with high juvenile presence and sites with no, or low, juvenile presence.

Length/age relationships for 2019 were graphed to compare growth rates between systems (if any). Length/weight relationships for 2019 were graphed to compare general differences in Northern Pike size between systems (if any). Length and weight data were also used to find the condition factor (Eq 2), which was compared between systems. The condition factor equation used a species-specific population-fitted exponent developed by Doyon et *al*. (1988); the value 10^5 transforms the value to bring it closer to 0.

Equation 2. **Condition factor equation used to quantify the condition of Northern Pike in various system.**

$$K_n = \frac{(10^5 \times W)}{L^3}$$

$Where$:
$K_n = Condition\ factor\ of\ Northern\ Pike\ n$
$W = Weight\ of\ Northern\ Pike\ (g)$
$L = Length\ of\ Northern\ Pike\ (mm)$

3.5 eDNA Sampling and Processing

In 2019 preliminary steps were completed to implement an environmental DNA (eDNA) assay protocol for Northern Pike within the ONA kɬ cp̓əlk̓ stiḿ Fish Health and Diagnostics Laboratory. This included a lab exercise to compare the effectiveness of two published Northern Pike assays, and a preliminary field exercise using data collected by the MFLNRORD at Christina Lake and in the Kettle River (MFLNRORD unpublished data).

3.5.1 eDNA Lab Exercise

Northern Pike heads were collected from various locations in the Columbia River and Pend d’Oreille River through an ONA angler incentive program (2018) and active suppression (2019). Total nucleic acid was extracted from selected tissues of 27 Northern Pike heads using the Zymo research Quick-DNA/RNA MagBead Kit according to the manufactures recommended protocol. Each purified nucleic acid sample was split into two, stored at -80°C, and subsequently used as template in the quantitative polymerase chain reaction (qPCR). A number of different primer concentrations and temperatures

were tested to ensure the assays were performing according to expectations. Two published assays (Olsen et *al*. 2015 and Cairm et *al*. 2019) were compared using DNA extracted from the 27 Northern Pike tissue.

A lab-spiked positive water sample was also created by soaking a Northern Pike head in a 20 L bucket of tap water for 4 hours. Two 500 ml samples were collected onto a 0.45 um filter membrane. The filter membranes were roughly cut into 1 mL of 1xDNA/RNA and stored at -80°C until extraction. The total nucleic acid was extracted using the Zymo research Quick-DNA/RNA MagBead Kit. Briefly, 4 µL of Proteinase K and 800 µL of DNA/RNA buffer was added to the filter membrane in DNA/RNA shield and incubated at 37°C for 30 min. The buffer was transferred to a new micro vial and extracted according to the manufactures recommendations and eluted using 100 4 µL of molecular grade water. A 10-fold dilution series (10^{-1} to 10^{-5}) was prepared from extracted DNA for seven samples. The limit of detection was determined as the quantification cycle (Cq) that produced consistent result. The Cq value is the number of cycles (replications) before Northern Pike DNA is detected; therefore, a lower Cq value indicates more DNA in the sample.

3.5.2 Christina Lake Field Exercise

Water samples were collected and filtered by MFLNRORD from various locations in Christina Lake and the Kettle River. The filter membranes were roughly cut into 1 mL of 1xDNA/RNA later and stored at -80°C until extraction using Zymo research Quick-DNA/RNA MagBead Kit according to the method described above. Each extracted sample was first tested for viability using eplant qPCR assay according to Veldhoen et *al*. (2016). All extracted water samples were tested by two different technicians in either 8 or 16 PCR replicates

4.0 Results

In total 45 Northern Pike (35 – Columbia River; 10 – Pend d'Oreille River; 0 – Christina Lake) were captured and euthanized over 35 crew-days in 2019. The majority of Northern Pike were captured through gillnetting (44) with one Northern Pike captured through angling. Water quality parameters (Conductivity, Dissolved Oxygen, pH, and Secchi Depth) were measured, but the data is difficult to compare as the different waterbodies were not always sampled in the same month. A summary of the water quality data is available in Appendix B.

An additional, 17 Northern Pike were captured in the Columbia River during the CLBMON 45 program through boat electrofishing over four sampling events between HLK Dam and Sturgeon Island (September 30 – November 3 2019; BC Hydro unpublished data 2019).

4.1 Effort

Suppression efforts took place between April 15 2019 and August 30 2019. Gillnetting was the most utilized method in the 2019 suppression program with 169 sets totaling 1,024.8 hours of soak time (time gillnets were in the water actively fishing), followed by electrofishing with 16 sites totaling 4.21 hours over 9.8 km (with an additional 12.13 hours of electrofishing between HLK Dam and Sturgeon Island during CLBMON 45), and some effort angling (11 occurrences totaling 27 hours) and seine netting (two sites totaling 104 m^3 of water seined). The highest effort for all methods was spent in the Pend d'Oreille River, followed by the Columbia River, with the least amount of effort in Christina Lake. A summary of all sample sites by method is available in Appendix C.

4.2 Northern Pike Catch per Unit Effort

Gillnetting had the highest CPUE followed by angling. Electrofishing in the suppression program had a CPUE of zero, while CPUE for Northern Pike during the CLBMON 45 program was 1.40 Northern Pike/hour (when only considering effort between HLK dam and Sturgeon Island); for a combined electrofishing CPUE of 1.04 Northern Pike/hour (BC Hydro unpublished data 2019; Table 3). Gillnetting had the highest effort and caught the most Northern Pike. Maps of effort are provided in Appendix D.

Table 3. Summary of total effort and catch per unit effort (CPUE) for the methods used between April 15 2019 and August 30 2019 (September 30 – November 3 2019 for CLBMON 45 data). Gillnetting $CPUE_{8hr}$ is catch per 8-hour period and $CPUE_{nu}$ is catch per net-unit, while Angling CPUE is catch per angling hour. Electrofishing effort is presented as suppression program/CLBMON 45 program (in red; BC Hydro unpublished data 2019).

Sample Method	Northern Pike Captured	Total Effort	CPUE
Gillnetting	44	1024.80 hrs	$0.34_{8hr}/1.25_{nu}$
Angling	1	27.00 hrs	0.04
Electrofishing	0/17	4.21 hrs/12.13 hrs	0.00/1.40
Seine Netting	0	104 m^3	0.00

The Pend d'Oreille River had the highest gillnet effort due to the possibility of overnight sets, where the soak times in the Columbia River and Christina Lake were limited to four hours and two hours respectively (Table 4). However, the Columbia River had the highest CPUE. A description of gillnet effort by season, location, and gear type is provided in Appendix E.

Table 4. Summary of gillnetting total effort and catch per unit effort (CPUE) by location between April 15 and August 30 2019. $CPUE_{8hr}$ is catch per 8-hour period and $CPUE_{nu}$ is catch per net-unit.

Location	Total Effort (hrs)	$CPUE_{8hr}$	$CPUE_{nu}$
Columbia River	357.82	0.76	2.79
Pend d'Oreille River	625.67	0.13	0.46
Christina Lake	41.32	0.00	0.00

The Pend d'Oreille River had the highest electrofishing effort (in both hours and length sampled) during the suppression program (Table 5). Due to the consideration of CLBMON 45 sampling in the Columbia River between late September and November 2019, the decision was made to limit suppression program electrofishing effort in the Columbia River to reduce effects on native and listed species. Northern Pike were not captured through electrofishing in the 2019 Northern Pike suppression program but one Northern Pike was observed during night electrofishing on the Pend d'Oreille River. 17 Northern Pike (1 adult and 16 juvenile) were captured during CLBMON 45 electrofishing sampling (BC Hydro unpublished data 2019).

Table 5. Summary of electrofishing total effort (time in hours and length sampled in meters) and catch per unit effort (CPUE) by location between April 15 and August 30 2019, and September 30 and November 3 2019 (shaded; BC Hydro unpublished data 2019).

Location	Time Sampled (hrs)	Length Sampled (m)	Northern Pike Captured	CPUE (NP / EF Hour)
Columbia River	0.23	500	0	0.00
Pend d'Oreille River	2.98	6,850	0	0.00
Christina Lake	1.00	2,525	0	0.00
Columbia River (CLBMON 45)	12.13	-	17	1.40
Total	16.34	9,875	17	1.04

Angling and seining effort was minor compared to gillnetting and electrofishing. Seining effort was limited to Zuckerberg Pond, adjacent to the Columbia River; while angling occurred opportunistically in the Columbia and Pend d'Oreille Rivers. The Pend d'Oreille River had the highest angling effort, but the only Northern Pike capture was in the Columbia River, specifically Zuckerberg Pond (Table 6).

Table 6. Summary of angling total effort (angling hours) and catch per unit effort (CPUE) by location for the 2019 Northern Pike suppression program. Effort in Zuckerberg Pond is identified independent of the rest of the Columbia River.

Location	Angling Hours	Northern Pike Captured	CPUE (NP / Angling Hour)
Columbia River	9	0	0.00
Zuckerberg Pond	3	1	0.33
Pend d'Oreille River	15	0	0.00
Total	27	1	0.04

4.3 Northern Pike Population Dynamics and Growth

More Northern Pike were caught in the Columbia River (35 fish; 52 when including CLBMON 45 data) than the Pend d'Oreille River (10 fish); while zero Northern Pike were captured at Christina Lake in 2019 (Table 7). Of the adult Northern Pike confidently sexed, the Columbia River had a lower percentage of females (28.6% of catch females; 33.3% when including CLBMON 45 data) than the Pend d'Oreille River (70% of catch females). However, the only YOY Northern Pike were captured in the Columbia River.

Table 7. Summary of Northern Pike captured between April 15 2019 and August 30 2019 by waterbody differentiating between males, females, unknown sex, young of year (YOY) including Northern Pike captured during the CLBMON 45 program September 30 – November 3 2019 (shaded; BC Hydro unpublished data 2019).

Location	Adult			YOY	Total
	Male	Female	Unknown		
Columbia River	10	4	1	20	35
Pend d'Oreille River	3	7	0	0	10
Christina Lake	0	0	0	0	0
Columbia River (CLBMON 45)	0	1	0	16	17

Northern Pike ranged in length from 150 mm – 1,055 mm (1,084 mm when including CLBMON 45 data) and were aged between YOY to 5 years old (young of year were determined based on length and literature (McPhail 2007) until proper aging can occur). Generally, Northern Pike caught in the Pend d'Oreille River were older than individuals caught in the Columbia River (Fig 4). In addition, YOY were not detected in the Pend d'Oreille River. The largest (length x weight) Northern Pike (aged at 5 years) was captured in the Seven Mile Reservoir (Pend d'Oreille River), near Buckley Campground, and was 1,055 mm (41.5 inches) and weighed 11,140 g (24.6 lbs). The smallest Northern Pike was captured near Waldie Island (Columbia River) and was 150 mm (5.9 inches) and weighed 24 g (0.05 lbs or 0.85 oz; Fig 5). All Northern Pike biological data is available in Appendix F.

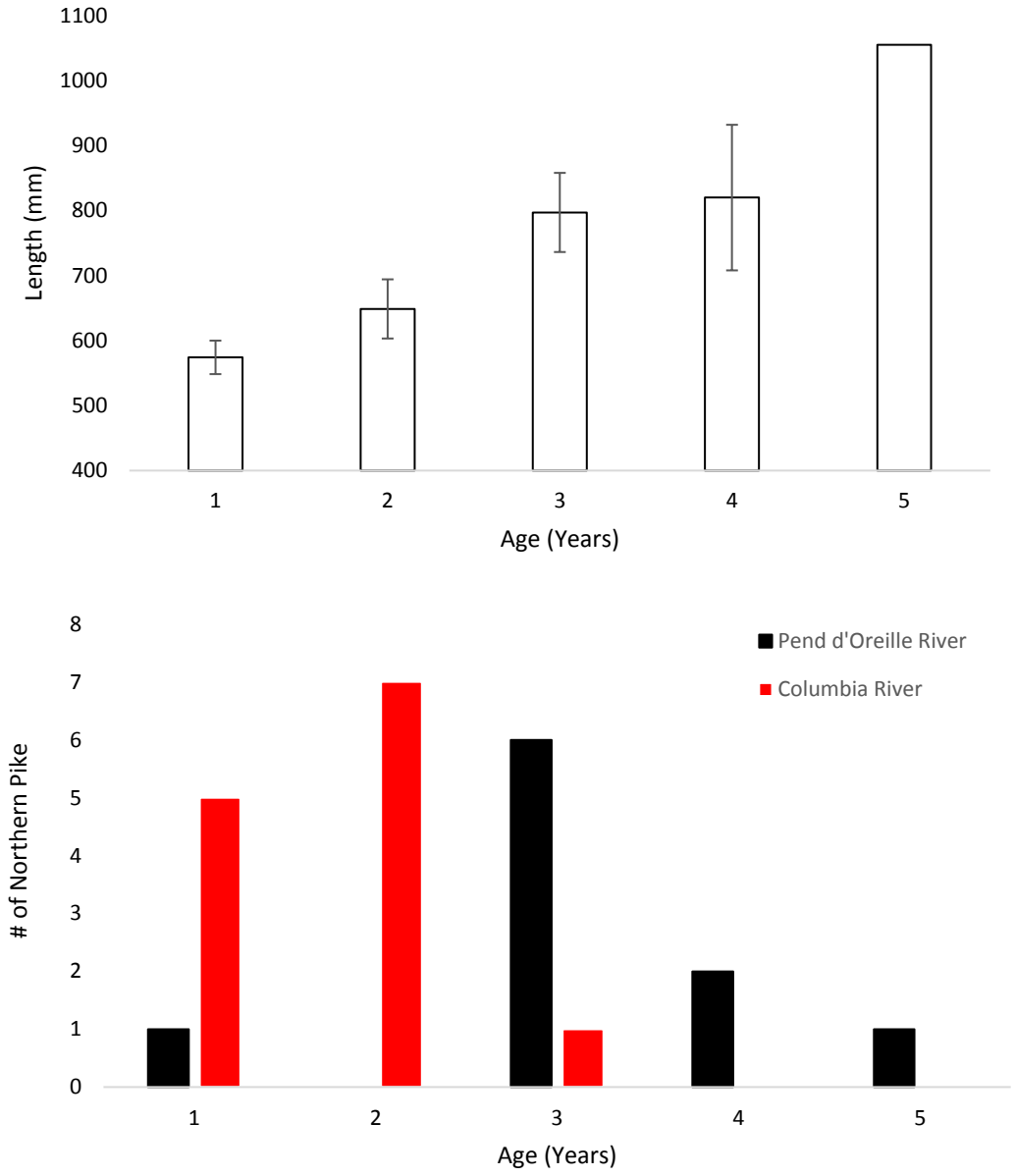

Figure 4. (Top) Age of Northern Pike caught between April 15 2019 and August 30 2019 by average length (mm) with 95% confidence intervals where Age 1 (n = 6) Age 2 (n = 7) Age 3 (n = 7); Age 4 (n = 7) and Age 5 (n = 1); (bottom) age of Northern Pike caught between April 15 and August 30 2019 by waterbody.

Figure 5. (Top) Largest Northern Pike caught between April 15 2019 and August 30 2019 (aged 5 years) held by Autumn Solomon (Okanagan Nation Alliance) on May 2 2019 in the Seven Mile Reservoir; (bottom) smallest Northern Pike caught between April 15 2019 and August 30 2019 (aged young of year) on August 22 2019 by Waldie Island in the Columbia River. Photo: (top) Eleanor Duifhuis, Okanagan Nation Alliance; (bottom) Evan Smith, Okanagan Nation Alliance.

In the Columbia River, the majority of adult Northern Pike were captured along the right downstream bank (river right) between Pike Bay (downstream of Celgar Mill) and the Robson Bridge; while 19 of the 20 YOY Northern Pike were in Zuckerberg Pond (Fig 6). In the Pend d'Oreille River the majority of Northern Pike were captured near Buckley Campground on the river right downstream side, but were more dispersed than in the Columbia River (Fig 7). For locations of all 2019 juvenile Northern Pike captures, including those captured in the CLBMON 45 Indexing Program (BC Hydro unpublished data 2019), see Appendix G.

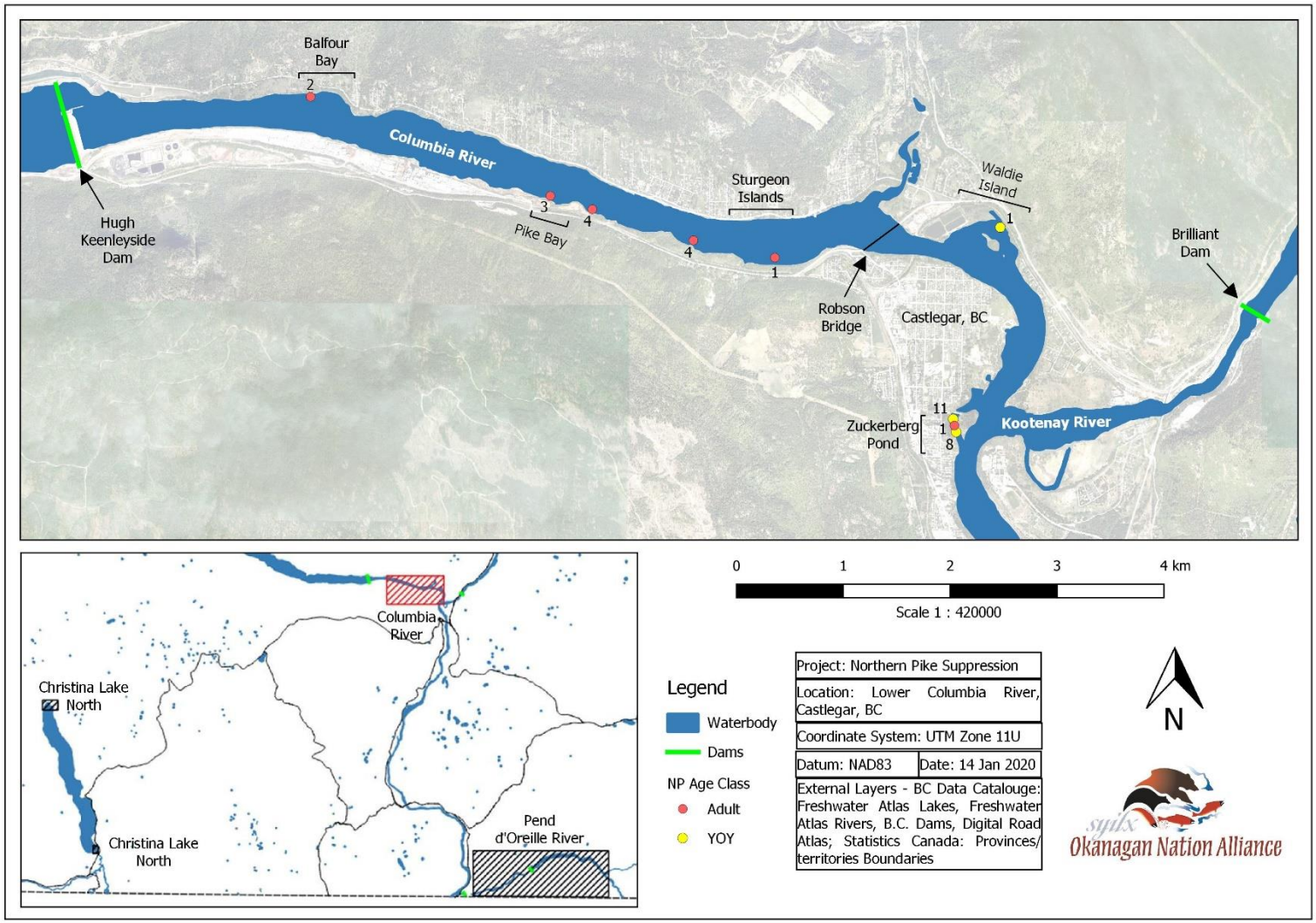

Figure 6. Locations of Northern Pike captured between April 15 2019 and August 30 2019 in the Columbia River differentiating between adults and young of year (YOY) with values indicating the number of Northern Pike Caught at each location (ESRI World Imagery 2017 and 2018).

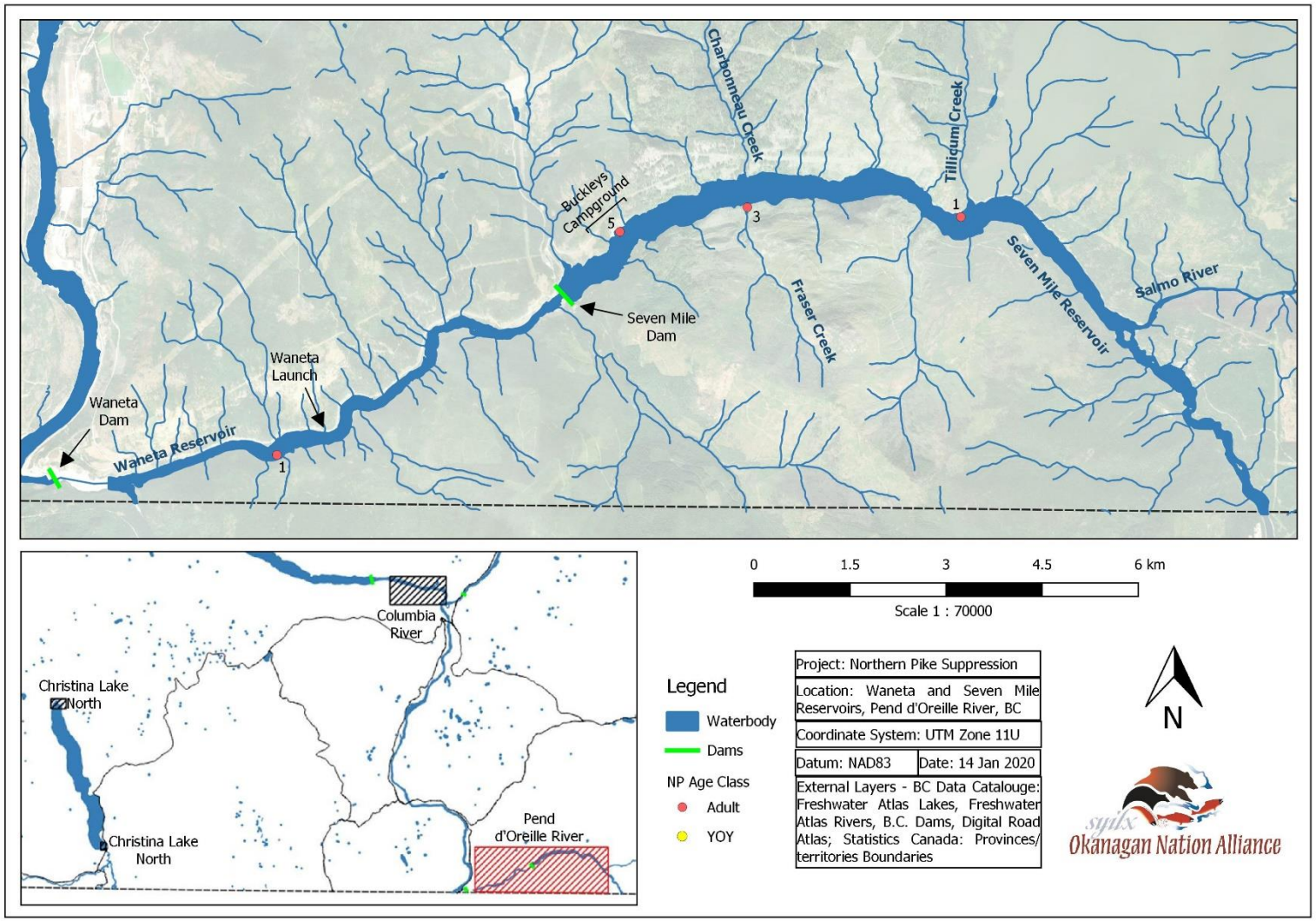

Figure 7. Locations of Northern Pike captured between April 15 2019 and August 30 2019 in the Pend d'Oreille River with values indicating the number of Northern Pike Caught at each location (ESRI World Imagery 2014, 2017 and 2018).

Adult Northern Pike caught during the suppression program in the Columbia River had an average length of 641 mm (+/- 44.3 mm; n = 15) and an average weight of 2,549 g (+/- 642.7 g; n = 15), while adult Northern Pike in the Pend d'Oreille River were larger; having an average length of 808 mm (+/- 78.7 mm; n = 10) and an average weight of 5,364 g (+/- 1,660.9 g; n = 10). Juvenile Northern Pike had and average length of 340 mm (+/- 23.0 mm; n = 19) and an average weight of 226 g (+/- 39.1 g; n = 19). Overall size of Northern Pike (length x weight) was larger in the Pend d'Oreille River than the Columbia River but the condition factor of adult Northern Pike did not change between waterbodies (Fig 8).

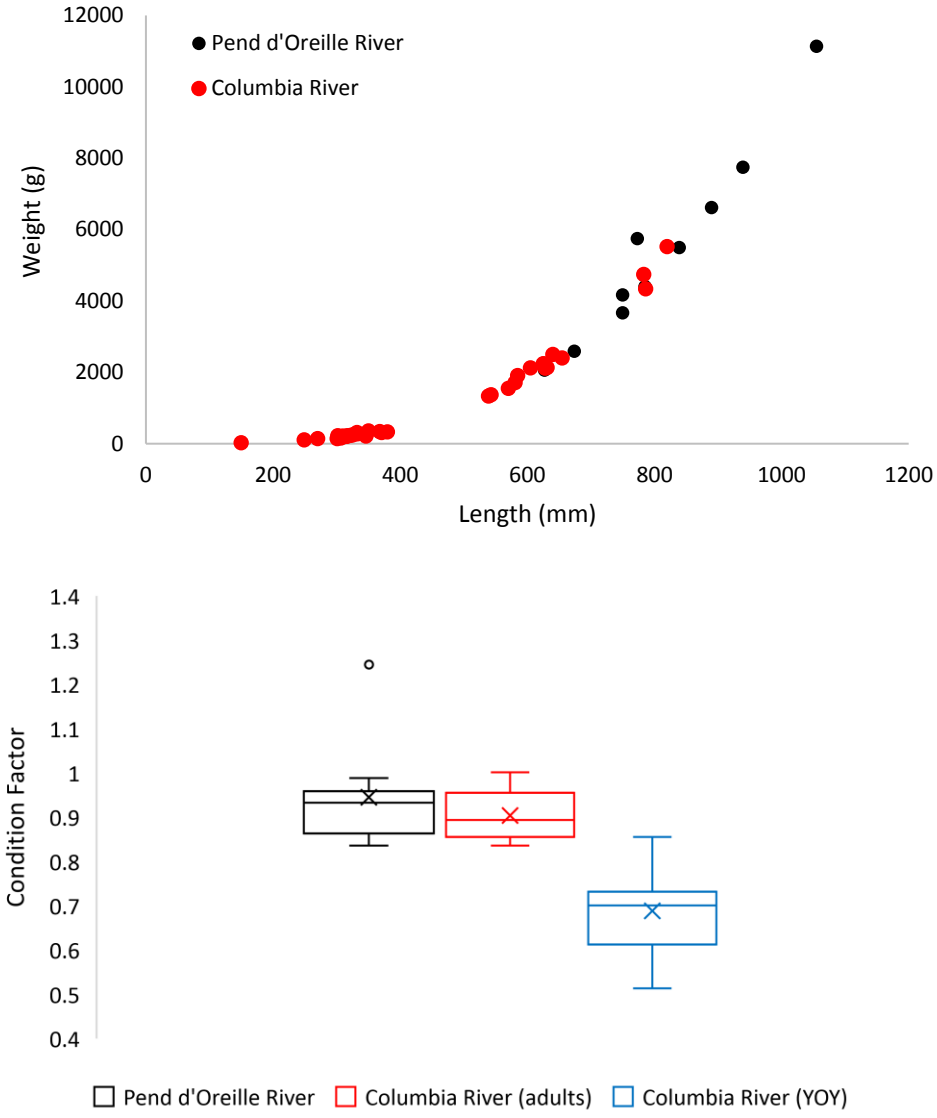

Figure 8. (Top) Size (length by weight) of Northern Pike captured between April 15 2019 and August 30 2019 in the Columbia and the Pend d'Oreille Rivers. (bottom) condition factor of adult Northern Pike caught in the Pend d'Oreille and the Columbia Rivers, and YOY Northern Pike (blue) caught between April 15 2019 and August 30 2019.

Fish or fish parts were identified in 45% of the Northern Pike who had their stomachs inspected (n = 44). Unidentified fish or fish parts were the most common stomach contents (60% of Northern Pike), these included caudal fins, scales, fins, vertebra, etc. Identified prey included Rainbow Trout (*Oncorhynchus mykiss*), Suckers (*Catostomidae* sp.), Mountain Whitefish (*Prosopium williamsoni*), Sculpins (*Cottoidea* sp.), Longnose Dace (*Rhinichthys cataractae*), and Yellow Perch (*Perca flavescens*). The largest prey observed was a 324 mm/428 g Mountain Whitefish found in an adult male Northern Pike (820 mm 5,520 g) in the Columbia River (Fig 9). Other stomach contents included an earth worm, acoustic tag (most likely from prey), and a fishing jig. Parasites were found in the stomach or intestines of 52% of sampled fish and 92% of adults. These parasites were primarily observed in the stomach and/or intestines and resembled tapeworms, but formal identification was not conducted.

Figure 9. Male Northern Pike (820 mm and 5,520 g) caught in Balfour Bay (Columbia River) with a 324 mm/428 g Mountain Whitefish found in its stomach on June 6 2019. Photo: Evan Smith, Okanagan Nation Alliance.

The presence of sculpin and dace species in the stomachs of Northern Pike indicate they are a predatory risk to the SARA listed Shorthead Sculpin and Umatilla Dace. In the following years, stomach contents containing unidentified dace and sculpin species will be preserved and sent to the ONA kɬ cp̓əlk̓ stiḿ Fish Health and Diagnostics Laboratory to identify to species through DNA analysis.

One juvenile Northern Pike was caught in the Columbia River Mainstem (Waldie Island) during suppression activities; while another 16 were captured during the CLBMON 45 Indexing Program between October 1 2019 and November 3 2019 (BC Hydro unpublished data 2019). This was the highest number of juvenile Northern Pike captured in a year during CLBMON 45 since 2013; when 43 juveniles were captured (BC Hydro unpublished data 2019). Captures were most likely high in 2013 due to population size, which was estimated to be between 478 and 2,759 Northern Pike in 2014 with a $CPUE_{8hr}$ of 3.48 (Baxter and Neufeld 2015). Population of Northern Pike are thought to have declined based on the relative declining trend in $CPUE_{8hr}$ from 2014 to 2019. The spike of juvenile captures in the Columbia River Mainstem in 2019 may have been due to river level (Fig

10). It appears juvenile Northern Pike captures were more likely when the Columbia River water level was < 3.5 m at Birchbank Station. At lower river levels, the boat electrofisher could more effectively sample aquatic weed beds that provide cover for juvenile Northern Pike and are typically unaffected/less affected by the electrical current at higher water levels (pers. obs.).

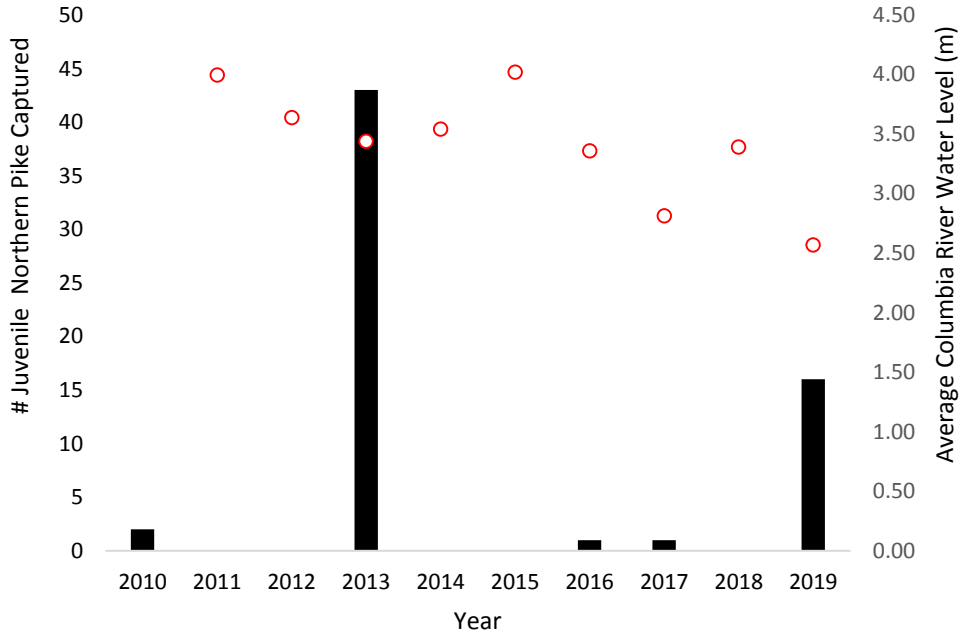

Figure 10. The number of juvenile Northern Pike (length < 350 mm) caught in the Columbia River Mainstem between 2010 and 2019 during the CLBMON 45 Indexing Program (typically the last week of September to first week of November annually; black bars; BC Hydro unpublished data 2010 - 2019) and the annual average October Columbia River water level (red circles; Water Survey of Canada Station 08NE049 Data 2011 – 2019).

The majority of YOY Northern Pike captured in the suppression program between April 15 2019 and August 30 2019 were from Zuckerberg Pond (Fig 11). When flows recede in the Columbia River, Zuckerberg Pond is isolated from the Mainstem, inhibiting fish movement. In 2019 this occurred around mid-August; the relationship between the Columbia River level and the point of the isolation of Zuckerberg Pond has yet to be determined. When isolated, Zuckerberg Pond was approximately 2 m at its deepest point and contained an abundance of aquatic vegetation. Due to the abundance of shallow, weedy habitat, coupled with the warmer water temperatures (18.0 – 23.4 °C between July and August 2019 compared to 13.3 – 19.0 in the Columbia River Mainstem), non-native species appeared to be thriving in Zuckerberg Pond and are likely seeding the Columbia River Mainstem. This assumption is based on 97% of the non-native bycatch captured in the Columbia River between April 15 2019 and August 30 2019 were from Zuckerberg Pond, and non-native species bycatch out-numbered native species bycatch in Zuckerberg Pond 8:1; with 0.39% of total bycatch in Zuckerberg Pond consisting of a native recreational species (Rainbow Trout). No listed species were observed in Zuckerberg Pond.

Figure 11. Young of year Northern Pike captured in Zuckerberg Pond on August 28 2019 with juvenile gillnets. Photo: Evan Smith, Okanagan Nation Alliance.

Suppression activities in Zuckerberg Pond began on July 11 2019 following a reported Northern Pike sighting by a Castlegar resident to the MFLNRORD. A crew responded and conducted an assessment of the pond. Based on the assessment, gillnets were deployed by canoe. As a result, one adult Northern Pike was captured over two days while no juvenile Northern Pike were detected through gillnetting or seining. Considering YOY Northern Pike don't typically reach 30 – 150 mm until late summer (McPhail 2007), the decision was made to return to Zuckerberg Pond in late August when YOY Northern Pike might be large enough to recruit to sampling gear. Between August 27 and 30 2019, gillnetting in Zuckerberg Pond resulted in 19 captured YOY Northern Pike. CPUE for YOY Northern Pike in Zuckerberg Pond was 4.57/31.52 ($CPUE_{8hr}/CPUE_{nu}$) compared to 0.31/1.12 ($CPUE_{8hr}/CPUE_{nu}$) in the Columbia River Mainstem (Appendix E). It is likely the high concentration, rather than the overall population, of YOY Northern Pike in Zuckerberg Pond, resulted in a higher CPUE. However, this result indicated (1) Zuckerberg Pond provides rearing habitat, and possibly by extension spawning habitat for Northern Pike, and (2) suppression of Northern Pike in Zuckerberg Pond is highly effective and can prevent a large number of juvenile Northern Pike from entering the Columbia River Mainstem.

Juveniles captured in Zuckerberg Pond were larger than those captured in the Columbia River Mainstem (323 mm +/- 33.4 mm and 237 g +/- 34.3 g on average at Zuckerberg Pond [n = 18] and 232 mm +/- 28.7 mm and 99 g +/- 32.8 g on average for Columbia River Mainstem [n = 17]), further indicating the high value of rearing habitat Zuckerberg Pond provides Northern Pike. The difference in size may be attributed to temperature, as water temperature is known to have a large effect on Northern Pike size (McPhail 2007; Harvey 2009; Fig 12).

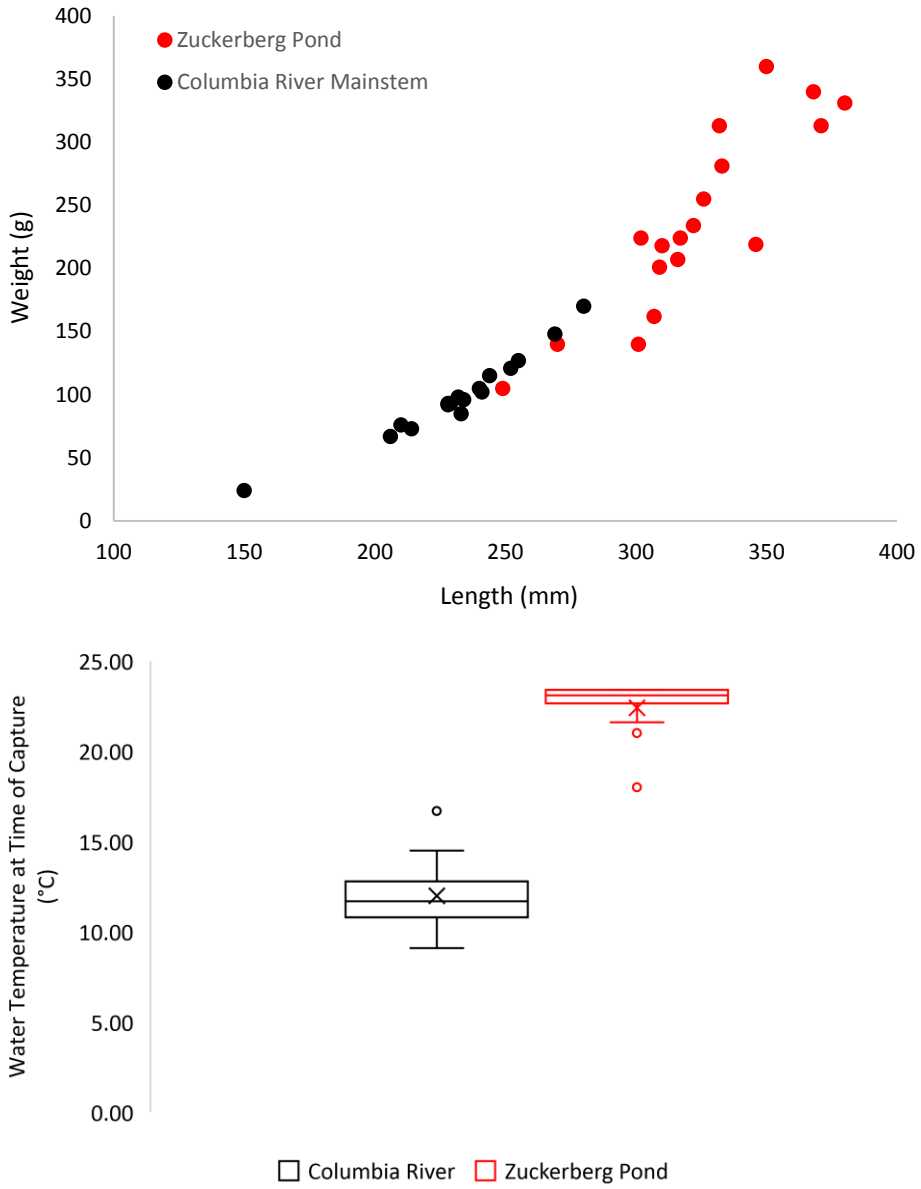

Figure 12. (Top) Size (length by weight) of juvenile Northern Pike captured between August 27 2019 and November 3 2019, including data from the CLBMON 45 Indexing Program (BC Hydro unpublished data 2019; n = 16), in the Columbia River Mainstem and Zuckerberg Pond; (bottom) water temperature of the Columbia River Mainstem (n = 17) and Zuckerberg Pond (n = 18) at time of juvenile Northern Pike Capture.

4.4 Bycatch

In total 2,376 fish of 22 different species were captured as bycatch during suppression activities. Of the 2,376 fish, 508 (21%) were native species and 1,868 (79%) were non-native species; with Yellow Perch consisting of 64% of the total bycatch (Table 8). All non-native species (excluding Walleye in the Pend d'Oreille and Columbia Rivers, and Bass in Christina Lake) were euthanized in accordance with applicable permitting. In total 1,721 non-native fish (excluding walleye and Northern Pike) were removed during this program. For information regarding total bycatch by location and sample method see Appendix H.

Table 8. Total bycatch by species captured between April 15 2019 and August 30 2019 in the Columbia River "1", Pend d'Oreille River "2" and Christina Lake "3" for all suppression and monitoring methods.

Species	Scientific Name	Status	# Caught
White Sturgeon[1]	*Acipenser transmontanus*	Native	29
Rainbow Trout[1,2]	*Oncorhynchus mykiss*	Native	23
Kokanee[1]	*Oncorhynchus nerka*	Native	2
Bull Trout[2]	*Salvelinus confluentus*	Native	4
Mountain Whitefish[1,2]	*Prosopium williamsoni*	Native	134
Northern Pikeminnow[1,2,3]	*Ptychocheilus oregonensis*	Native	77
Peamouth Chub[1]	*Mylocheilus caurinus*	Native	3
Longnose Sucker[3]	*Catostomus catostomus*	Native	6
Sucker sp.[1,2,3]	*Catostomidae* sp.	Native	216
Redside Shiner[1]	*Richardsonius balteatus*	Native	9
Sculpin sp.[1]	*Cottoidea* sp.	Native	5
Lake Whitefish[1]	*Coregonus clupeaformis*	Non-Native	111
Yellow Perch[1,2,3]	*Perca flavescens*	Non-Native	1,519
Bass sp.[2,3]	*Micropterus* sp.	Non-Native	117
Walleye[1,2]	*Sander vitreus*	Non-Native	36
Pumpkinseed[2,3]	*Lepomis gibbosus*	Non-Native	32
Tench[1,2,3]	*Tinca tinca*	Non-Native	39
Common Carp[1,3]	*Cyprinus carpio*	Non-Native	3
Black Bullhead[3]	*Ameiurus melas*	Non-Native	2
Brook Trout[1]	*Salvelinus fontinalis*	Non-Native	3
Lake Trout[2]	*Salvelinus namaycush*	Non-Native	1
Brown Trout[2]	*Salmo trutta*	Non-Native	5

4.4.1 Native Species Bycatch

The Columbia River had the most instances of native species bycatch with 327 fish of 9 species (64.5% of total native species bycatch); followed by the Pend d'Oreille River with 174 fish of 6 species (34.5% of native species bycatch), and Christina Lake with 7 fish of 2 species (1% of native species bycatch; Table 9). The combined mortality rate of native species for all sampling methods was 6.5%. However, gillnetting was the only method which caused mortality (9.9%); mortality of SARA-listed species did not occur.

Table 9. Native species bycatch by location from April 15 2019 to August 30 2019.

Location	Species	Scientific Name	# Caught
Columbia River	Kokanee	*Oncorhynchus nerka*	2
	Sucker sp.	*Catostomidae* sp.	82
	Mountain Whitefish	*Prosopium williamsoni*	133
	Northern Pikeminnow	*Ptychocheilus oregonensis*	48
	Rainbow Trout	*Oncorhynchus mykiss*	17
	White Sturgeon	*Acipenser transmontanus*	29
	Peamouth Chub	*Mylocheilus caurinus*	2
	Redside Shiner	*Richardsonius balteatus*	9
	Sculpin sp.	*Cottoidea* sp.	5
Pend d'Oreille River	Bull Trout	*Salvelinus confluentus*	4
	Sucker sp.	*Catostomidae* sp.	134
	Mountain Whitefish	*Prosopium williamsoni*	1
	Northern Pikeminnow	*Ptychocheilus oregonensis*	28
	Peamouth Chub	*Mylocheilus caurinus*	1
	Rainbow Trout	*Oncorhynchus mykiss*	6
Christina Lake	Longnose Sucker	*Catostomus catostomus*	6
	Northern Pikeminnow	*Ptychocheilus oregonensis*	1

White Sturgeon were scanned for a PIT tag whenever possible, some individuals escaped gillnets before they could be scanned. White Sturgeon were removed from the gillnets while in the river, and were only brought on-board the vessel when necessary. All White Sturgeon were released in good health and gillnet set times were reduced from 4 hours to 2 hours once the occurrence of White Sturgeon bycatch increased. To further reduce instances of White Sturgeon bycatch, sampling was reduced at sites with multiple White Sturgeon captures. For PIT tag information of White Sturgeon see Appendix I.

4.4.2 Non-Native Species Bycatch

The Pend d'Oreille River had the highest amount of non-native species bycatch with 1,013 fish of 7 species (54% of total non-native species bycatch); followed by the Columbia River with 815 fish of 6 species (44% of total non-native species bycatch) and Christina Lake with 40 fish of 6 species (2% of total non-native species bycatch; Table 10). Zuckerberg Pond near Castlegar BC contained 84% of the total Columbia River non-native bycatch.

Table 10. Non-native species bycatch by location from April 15 2019 to August 30 2019.

Location	Species	Scientific Name	# Caught
Pend d'Oreille River	Bass sp.	*Micropterus* sp.	107
	Brown Trout	*Salmo trutta*	5
	Lake Trout	*Salvelinus namaycush*	1
	Pumpkinseed	*Lepomis gibbosus*	24
	Tech	*Tinca tinca*	8
	Yellow Perch	*Perca flavescens*	848
	Walleye	*Sander vitreus*	20

Columbia River	Brook Trout	*Salvelinus fontinalis*	3
	Lake Whitefish	*Coregonus clupeaformis*	111
	Walleye	*Sander vitreus*	16
	Yellow Perch	*Perca flavescens*	669
	Common Carp	*Cyprinus carpio*	1
	Tench	*Tinca tinca*	15
Christina Lake	Bass sp.	*Micropterus* sp.	10
	Common Carp	*Cyprinus carpio*	2
	Pumpkinseed	*Lepomis gibbosus*	8
	Tench	*Tinca tinca*	16
	Yellow Perch	*Perca flavescens*	2
	Black Bullhead	*Ameiurus melas*	2

Most non-native species were found in multiple locations except for Brown Trout (*Salmo trutta*; Pend d'Oreille River), Lake Trout (*Salvelinus namaycush*; Pend d'Oreille River), Brook Trout (*Salvelinus fontinalis*; Columbia River), Lake Whitefish (*Coregonus clupeaformis;* Columbia River), and Black Bullhead (*Ameirurus melas*; Christina Lake).

4.5 eDNA Sampling Development

Optimal primer concentrations and sample conditions for the ONA laboratory equipment, when using Brilliant III Ultra-Fast Probe Low ROX QPCR master mix (Agilent), were identified through testing (Appendix J-1). Based on a 10-fold dilution series (10^{-1} to 10^{-5}) from seven samples, the limit of detection was determined as the Cq that produced consistent results between the two assays (Appendix J-2). Except for sample 19220028, Cq's greater than 35 (most commonly occurring at concentrations of 10^{-4} and 10^{-5}) produced stochastic results. In sample 19220026, the linear range tails at lower concentrations indicated inefficient amplification at the limit of detection. It is possible this sample had mutations in either a primer or probe, impacting the sensitivity of the assay.

The Olsen et *al*. (2015) assay's mean Cq was 1.6 lower than the Cairm et *al*. (2019) assay for an undiluted template. This difference did not impact the limit of detection of the assay. The Cairm et *al*. (2019) assay detected all 27 fish, while the Olsen et *al*. (2015) assay missed two fish and showed limited sensitivity for a third (Appendix J-3). Both lab-spiked positive samples were detected using the Cairim et *al*. (2019) assay, and neither sample was detected using the Olsen et *al*. assay. Negative water samples from previous environmental DNA monitoring studies were tested in both assays and no Cq was observed.

In total 15 eDNA samples were taken at five sites between Christina Lake (2), Christina Creek (1), and the Kettle River (2) by the MFLNRORD (T. White, pers. com. 2020). Each site had three replicate samples taken on the same day at the same location. All samples were valid and no Northern Pike DNA were detected.

5.0 Discussion

In general, the 2019 Northern Pike Suppression Program was successful having removed 45 Northern Pike from the Columbia and Pend d'Oreille Rivers (42 in 2018; Wood 2019) with an additional 17 removed during the CLBMON 45 Indexing Program (BC Hydro unpublished data 2019). Methods used during 2019 were similar to past years and yielded similar results.

5.1 Northern Pike in the Columbia and Pend d'Oreille Rivers

Comparable (effort in April - June in the Columbia River when water temperatures were > 7°C) $CPUE_{8hr}$ increased by 0.19 Northern Pike/8hr from 2018 to 2019 but are still below 2014 and 2016 suppression efforts and 83% lower than when suppression began in 2014 (Table 11). However, more Northern Pike were caught in 2018 than 2019 during the compared time. This may indicate a slight increase in population, but is likely a result of more effort between April and June.

Table 11. Northern Pike CPUE in Northern Pike per 8-hour period and per net-unit from 2014 to 2019 using capture data for spring (April – June). 2014 – 2018 CPUE (shaded) are from past suppression efforts (Baxter and Neufeld 2015; Baxter 2016; Baxter and Doutaz 2017; Baxter and Lawrence 2018; Wood 2019)

Year	Total Northern Pike	CPUE (NP/8hr)	CPUE (NP/Net-Units)
2014	92	3.48	-
2015	85	1.52	-
2016	49	1.02	-
2017	18	0.33	-
2018	19	0.41	-
2019	14	0.60	2.19

Suppression activities in 2019 started on April 15 2019, earlier than previous years, in an attempt to identify the start of the Northern Pike spawning season. One female Northern Pike, not fully gravid, was captured on April 17 2019 in the Seven Mile Reservoir with water temperature around 7.0°C. The next Northern Pike to be captured in the Pend d'Oreille River was caught on May 2 2019 with water temperature of 8.7°C and was a fully gravid female. This indicates Northern Pike begin to spawn in late April/early May or when water temperature is over 8°C. Capture rates increased through May 2019 in the Pend d'Oreille River and in late May/June 2019 in the Columbia River. CPUE increased in the Columbia River when water temperatures were over 7°C (Appendix E).

Specific juvenile Northern Pike rearing habitat sites have not been identified in the Pend d'Oreille River, but will continue to be assessed in future years. Zuckerberg Pond (Columbia River) was identified as having high quality rearing habitat for juvenile Northern Pike (among other invasive species) given that juvenile Northern Pike captured at Zuckerberg Pond were, on average, 90 mm longer and weighed 138 g more than those caught in the Columbia River Mainstem. This can be attributed to optimal YOY growing water temperatures (22 - 23ºC; Casselman 1996 in Harvey 2009) and the availability of

prey (427 Yellow Perch observed in 104 m^3 of water during seining and a total of 668 Yellow Perch observed over 4 days) in Zuckerberg Pond. This is significant considering fecundity of Northern Pike is proportional to body size, which can be 9,000 eggs per pound (454 g; Scott and Crossman 1973). Therefore, individuals rearing in Zuckerberg Pond have the potential to become more prolific spawners, due to their accelerated growth rate, than those rearing in the Columbia River Mainstem. Hence suppression activities targeting juvenile Northern Pike should prioritize Zuckerberg Pond and similar habitats.

Instances of parasitization in adult Northern Pike was high (92% of sampled adults), though taxa-level identification of parasites did not occur in 2019. Based on observations of field crews, the majority of parasites were likely some type of tapeworm. Further investigation into parasitic species observed during the program should occur, given parasites can cause behavioural changes and adverse health effects in fish depending on: host and parasite species, concentration and diversity of parasites in the host, and environmental stressors (pollution, temperatures, angling pressure, etc.; Dick and Watson 1997; Barber et *al*. 2000). Of particular interest is the species *Triaenophorus crassus*, a tapeworm closely associated with whitefish and Northern Pike (Dick and Watson 1977; J. Burrows pers. com. 2020). *Triaenophorus crassus* typically begins its life cycle by parasitizing a small copepod (*Cyclops bicuspidatus*), and only continues its lifecycle when ingested by a plankton feeding cisco or whitefish; the final stage of *Triaenophorus crassus* occurs when it is by a Northern Pike (Dick and Watson 1977). The possible presence of *Triaenophorus crassus* in the Columbia and Pend d'Oreille Rivers is concerning when considering ongoing salmon re-introduction efforts to the Columbia River above the Grand Coulee Dam by various Tribal and Frist Nation organizations (including the ONA) and Canada and United States governments, as a high percentage of Sockeye (*Oncorhynchus nerka*) smolts were documented to be parasitized by *Triaenophorus crassus* in the Wood River Lakes, Alaska (Groot and Margolis 1991). Presently, the Bering Sea drainage (Alaska) is the only know instance of *Triaenophorus crassus* parasitizing Sockeye due to the co-existence of Sockeye and Northern Pike in local lakes (Groot and Margolis 1991). Dick and Watson (1977) identified Northern Pike removal as the easiest way to reduce *Triaenophorus crassus* in waterbodies.

5.2 Northern Pike Range Expansion Monitoring

Northern Pike range expansion monitoring will consist of two components: eDNA sampling in waterbodies adjacent to waterbodies known to have Northern Pike presence and active monitoring conducted by response crews to sites with anecdotal evidence of Northern Pike incursion. In 2019 the eDNA aspect of this project was focused on developing valid methods for sample collections and lab processing.

5.2.1 eDNA Program Development

The preliminary ONA lab assessment of eDNA processing protocol and available Northern Pike assays was a valuable exercise. Through this process, a sampling framework was essentially QA/QC'd and validated. Therefore, future ONA eDNA sampling will consist of three replicate samples for each site, with a control site of known Northern Pike presence

collected within the same timeframe (within a week). The samples will be collected and preserved in accordance with methods described in Section *3.5.2 Christina Lake Field Exercise*. Lab samples will be tested using the Cairim et *al*. (2019) assay and will only be considered "positive" for Northern Pike presence if at least two of the three replicate samples at a given site have a Cq value. Should one of three replicate samples contain a Cq value, the site will be considered a false positive but will be explored with further sampling. The Cairim et *al*. (2019) assay was chosen for ONA sample processing over the Olsen et *al*. (2015) assay because the Cairim et al. (2019) assay had a higher detection rate for Northern Pike samples collected in the ONA operating area. The intention of this exercise was a preliminary assessment of the published assays and should not be considered a complete validation.

False negatives may occur while using the Cairim et *al*. (2019) assay due to genetic diversity of individual Northern Pike between the population used to create the assay (Lake Roosevelt/Columbia River – United States) and the population being monitored for range expansion (Christina Lake, Columbia River – Canada, Lower Arrow Lakes Reservoir, Brilliant Headpond/Kootenay River). Though these populations are expected to be similar genetically, a control sample collected in waterbodies known to contain Northern Pike should assist in accounting for false negatives and false positives. Primarily, eDNA sampling will be utilized to monitor possible Northern Pike range expansion.

5.2.2 Active Monitoring Activities

Since 2017 there have been anecdotal observations of Northern Pike in Christina Lake, including a sighting by a diver, photo of a Northern Pike caught by an angler, and a suspected false positive eDNA sample. To verify these accounts, a monitoring crew was deployed to Christina Lake on August 21 – 25 2019. Though Northern Pike were not detected, additional monitoring activities should occur during the spawning season (April-May) when CPUE tends to be high.

5.3 Observations of Other Non-Native Species

Juvenile Walleye were observed at the mouth of Tillicum Creek in the Seven Mile Reservoir (Pend d'Oreille River) on April 15 2019 (Fig 13). These Walleye were captured during electrofishing; the total number of juvenile Walleye observed is unknown as they may have been recorded as Yellow Perch. The presence of juvenile Walleye indicates probable spawning activity in the Seven Mile Reservoir and possibly at the mouth of Tillicum Creek. These Walleye are estimated to be 1+ years given YOY Walleye typically reach 110 mm in their first growing season (in their native habitat in northeast BC and northern Alberta; McPhail 2007). However, since growth rate is dependent on water temperature and food availability, the more temperate southern BC water temperatures may have accelerated growth; in which case these individuals may be YOY (McPhail 2007). These Walleye were released so exact age cannot be determined.

Figure 13. Two juvenile Walleye (~173 mm) captured at the mouth of Tillicum Creek in the Seven Mile Reservoir (Pend d'Oreille River) on April 15 2019 while electrofishing for Northern Pike. Photo: Evan Smith, Okanagan Nation Alliance.

A Brown Trout (*Salmo trutta*) containing a PIT tag (989001004904984) and an acoustic tag was captured in the Waneta Reservoir (Pend d'Oreille River) on April 26 2019 (Fig 14). A similar acoustic tag was observed in the stomach of a Northern Pike and may have originally been implanted in a prey species. Inquiries were sent to various transboundary organizations (i.e., Tribes, Agencies) who work in the area to identify the origin and purpose of the tags, but at the time of this report it is still unknown.

Figure 14. Brown Trout captured on April 26 2019 in the Waneta Reservoir (Pend d'Oreille River) containing a PIT and Acoustic Tag for an unknown project. Photo: Eleanor Duifhuis, Okanagan Nation Alliance.

6.0 Recommendations

The following are recommended to improve the Northern Pike Suppression and Monitoring Program:

1. Spring sampling effort for adult Northern Pike should be focused during the Northern Pike spawning window in the Columbia River, Pend d'Oreille River, and Christina Lake (monitoring) using SPIN nets and electrofishing. Night electrofishing should occur in the Pend d'Oreille and Columbia River after Northern Pike start spawning.

   Fall sampling effort for juvenile Northern Pike should be focused in late August to late October using 1" monofilament nets. In the Columbia River, juvenile nets should be placed in locations where juvenile Northern Pike were caught and observed in 2019 (Appendix G). Sampling may also include Millennium Pond and Kootenay Oxbow (UTMs 11U 452487, 5463135/ 452848, 5462394, respectively), which were not sampled in 2019. Night electrofishing for juvenile should occur in the Pend d'Oreille Reservoir to identify juvenile Northern Pike rearing habitat and in the Robson Reach if other gillnetting or electrofishing programs are not occurring.

   Based on 2019 and past efforts, the rough schedule should be as follows:

   a. Pend d'Oreille River April 20 to May 15 & August 20 – October 30
   b. Christina Lake April 20 to May 15
   c. Columbia River May 4 to June 15 & August 20 – October 30

   Actual spring sampling dates may change based on field conditions and Northern Pike encounters.

2. Spring Northern Pike spawn monitoring should occur at Zuckerberg Pond and other backchannel habitats like Kootenay Oxbow, Waldie Island, Birchbank Snye (UTM 11U 447399, 5446340), and the Genelle Backchannel (UTM 11U 448658, 5450312). The correlation between Zuckerberg Pond's isolation from the Columbia River Mainstem and the river level measured at Birchbank Station should be identified to direct timing of suppression activities. In addition to gillnetting in late August, the use of light traps should be considered as a method to capture Northern Pike Larvae in July. This method was used by Golder Associates (2015) in the Robson Reach without success but, the isolation of Zuckerberg Pond may present a more suitable location. Other, more intrusive options to control Northern Pike in Zuckerberg Pond should be explored, such as:
   a. Draining Zuckerberg Pond and removing all invasive species while salvaging native species (short-term), and
   b. Permanently re-connect Zuckerberg Pond to the Columbia River Mainstem to reduce habitat for non-native species (increase flow, lower water temperature, reduce available aquatic vegetation), or

c. Permanently isolate Zuckerberg Pond from the Columbia River Mainstem to reduce seeding of non-native species

3. Parasites from the stomach, intestines, mussel tissues, and gills (if/when present) from at least five Northern Pike in each of the Columbia and Pend d'Oreille Rivers should be collected and sent to the ONA kł cp̓əlk̓ stiḿ Fish Health and Diagnostics Laboratory in Penticton, BC for identification. Multiple samples should be collected on each fish, and at each location, in an attempt to identify parasitic diversity in affected organs. Alternative disposal methods should be explored for Northern Pike organs and/or tissues with confirmed parasite presence; this may involve additional permitting and should be conducted in accordance with applicable laws and regulations. Additional samples may be collected at the direction of the ONA kł cp̓əlk̓ stiḿ Fish Health and Diagnostics Laboratory, or when a previously un-sampled parasite is observed.

4. Implement the eDNA sampling program, with consideration of similar programs to avoid duplicate sampling, to monitor Northern Pike range expansion (through natural migration of the introduced population and/or anthropogenic introductions) in the Columbia Basin at high risk sites which may include but are not limited to
    - Christina Lake (South) (UTM 11U 411539, 5433064)
    - Christina Lake (North) (UTM 11U 405817, 5450693)
    - Christina Creek/Kettle River Confluence (UTM 11U 412140, 5431472)
    - Hugh Keenleyside Dam Forebay (East) (UTM 11U 441778, 5465902)
    - Hugh Keenleyside Dam Forebay (West) (UTM 11U 443334, 5465080)
    - Syringa Provincial Park (UTM 11U 436681, 5465733)
    - Brilliant Headpond (UTM 11U 455230, 5464280)
    - Glade (UTM 11U 460400, 5471570)
    - Revelstoke Wetlands (East) (UTM 11U 417283, 5646158)
    - Revelstoke Wetlands (North) (UTM 11U 415658, 5647599)
    - Revelstoke Wetlands (South) (UTM 11U 417318, 5645621)

5. Implement a Northern Pike public outreach program which includes an angler incentive component in collaboration with the MFLNRORD to encourage the capture and removal of Northern Pike. Angler education and outreach will occur through presentations and conferencing.

6. Suppression activities at Christina Lake presents a unique opportunity. The CLSS is highly interested in Northern Pike monitoring and eager to participate. The ONA recommends the CLSS obtain SPIN and juvenile nets for Christina Lake and conduct additional monitoring activities with training, field assistance, and general project oversite provided by the ONA.

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7.1 Personal Communications (order of appearance):

Tara White, Senior Fisheries Biologist, Ministry of Forest Lands and Natural Resource Operations and Rural Development, via email dated Feb 3 2020.

Jeff Burrows, Senior Fish Biologist, Ministry of Forest Lands and Natural Resource Operations and Rural Development, via email dated February 17 2020.

7.2 Map Layer Sources

British Columbia Data Catalogue:

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ESRI World Imagery:

https://server.arcgisonline.com/arcgis/rest/services/World_Imagery/MapServer

Appendix A: Project Specific Data Sheet

Northern Pike Suppression 2019 - Gillnetting Data Sheet								
Waterbody:				Project Code: 748				
Date:				Crew:				
Gillnet ID:		Net: SPIN / FWIN / 2" mono		Weather:				
Waypoint ID	UTMs			DO	pH	Cond.	Secchi	
	Easting		Northing					
	(s)			Instream Velocity				
	(e)			Low (<0.5 m/s) Medium (0.5-1.0 m/s) High (>1.0 m/s)				
Instream Cover Type and % Available								
Intersticies:		Woody debris:			Turbulence:			
Aquatic veg:		Terra veg:			Shallow water:			
Deep water:		**Sediment Type:**						
Orientation to Flow	Depth	Set			Check 1			
		Date	Time	Temp	Date	Time	Temp	
	Min:							
		Check 2			Pull			
		Date	Time	Temp	Date	Time	Temp	
	Max:							

Fish ID	PIT Tag #	Panel Size	Fin Clip #	Age Class	Sex	FL (mm)	Weight (g)
NP_Date_PDO/ LCR_Capture #				A / J	M / F		
	Stomach Contents:						
	Samples Taken / Notes:						
				A / J	M / F		
	Stomach Contents:						
	Samples Taken / Notes:						
				A / J	M / F		
	Stomach Contents:						
	Samples Taken / Notes:						
				A / J	M / F		
	Stomach Contents:						
	Samples Taken / Notes:						
				A / J	M / F		
	Stomach Contents:						
	Samples Taken / Notes:						
				A / J	M / F		
	Stomach Contents:						
	Samples Taken / Notes:						
				A / J	M / F		
	Stomach Contents:						
	Samples Taken / Notes:						
				A / J	M / F		
	Stomach Contents:						
	Samples Taken / Notes:						

RECORD OF BYCATCH		
Species	**Tally**	**Comments**
Rainbow Trout		
Mountain Whitefish		
Walleye		
Sucker spp.		
Sculpin spp.		
Kokanee		
Redside Shiner		
Brook Trout		
Bull Trout		
Burbot		
Carp		
Cutthroat Trout		
Lake Whitefish		
Northern Pikeminnow		
Peamouth		
White Sturgeon		
Smallmouth Bass		
Largemouth Bass		
Tench		
Yellow Perch		

Appendix B: Water Quality Data (Monthly Summary)

Table 12. Monthly water quality measurements including conductivity, dissolved oxygen, pH, and secchi depth in the Pend d'Oreille and Columbia Rivers, Zuckerberg Pond, and Christina Lake with the number of measurements in the month represented in brackets; measurements were taken multiple times a day at multiple locations.

Month	Site	Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	pH	Secchi Depth (m)
April	Pend d'Oreille River	115.51 (38)	12.89 (30)	-	3.13 (15)
May	Columbia River	98.75 (15)	13.85 (15)	-	6.67 (15)
	Pend d'Oreille River	116.40 (12)	13.08 (12)	-	2.67 (12)
June	Columbia River	113.74 (29)	11.56 (29)	7.83 (29)	5.52 (29)
July	Zuckerberg Pond	153.40 (8)	8.81 (8)	7.20 (8)	0.50 (8)
	Christina Lake	76.06 (17)	8.32 (17)	7.41 (17)	10.50 (17)
August	Columbia River Mainstem	125.66 (5)	-	-	-
	Zuckerberg Pond	241.50 (12)	10.71 (12)	7.90 (12)	-
	Pend d'Oreille River	164.14 (14)	8.34 (14)	8.63 (14)	-

Appendix C: Northern Pike Suppression and Monitoring Sites by Method

Appendix C-1: Gillnet Sites

Table 13. Gillnet sites by waterbody (Seven Mile Reservoir and Waneta Reservoir = Pend d'Oreille River; Columbia Mainstem and Zuckerberg Pond = Columbia River; Christina Lake North and South = Christina Lake) with coordinates, set depths (m), dates, set/pull times and temperatures (°C), and Northern Pike (NP) presence. "N/R" = Not Recorded.

Set	Waterbody	Site ID	Location (UTM Zone 11U)				Depth (m)		Set			Pull			# NP
			Start		End										
			Easting	Northing	Easting	Northing	Min	Max	Date	Time	Temp (°C)	Date	Time	Temp (°C)	
1	Seven Mile Reservoir	GNPDO01	N/R	N/R	464184	5431973	3.0	12.0	2019-Apr-17	12:50	7.2	2019-Apr-17	15:33	7.6	1
2	Seven Mile Reservoir	GNPDO02	N/R	N/R	464376	5432126	5.0	15.0	2019-Apr-17	13:00	7.2	2019-Apr-17	16:03	7.2	0
3	Seven Mile Reservoir	GNPDO03	N/R	N/R	469571	5432375	4.5	10.0	2019-Apr-17	13:13	7.2	2019-Apr-17	16:37	7.0	0
4	Seven Mile Reservoir	GNPDO04	N/R	N/R	469574	5432412	4.6	6.0	2019-Apr-17	13:18	7.4	2019-Apr-17	16:47	7.2	0
5	Seven Mile Reservoir	GNPDO05	N/R	N/R	469850	5432143	1.0	20.0	2019-Apr-17	13:25	7.3	2019-Apr-17	17:00	7.2	0
6	Seven Mile Reservoir	GNPDO06	N/R	N/R	470102	5432157	1.5	1.8	2019-Apr-17	13:32	7.4	2019-Apr-17	17:17	8.9	0
7	Seven Mile Reservoir	GNPDO07	N/R	N/R	470217	5432228	1.0	20.0	2019-Apr-17	13:38	7.4	2019-Apr-17	17:25	7.2	0
8	Seven Mile Reservoir	GNPDO08	N/R	N/R	469945	5432404	2.0	15.0	2019-Apr-17	13:44	6.9	2019-Apr-17	17:36	7.0	0
9	Seven Mile Reservoir	GNPDO09	N/R	N/R	464184	5431973	3.0	12.0	2019-Apr-17	15:35	7.1	2019-Apr-18	10:15	7.1	0
10	Seven Mile Reservoir	GNPDO10	464081	5431977	N/R	N/R	6.0	12.0	2019-Apr-17	16:30	7.1	2019-Apr-18	10:40	7.2	0
11	Seven Mile Reservoir	GNPDO11	N/R	N/R	469571	5432375	6.0	12.0	2019-Apr-17	16:44	7.3	2019-Apr-18	11:10	7.1	0
12	Seven Mile Reservoir	GNPDO12	469502	5432213	N/R	N/R	3.0	20.0	2019-Apr-17	16:54	6.9	2019-Apr-18	11:35	7.2	0
13	Seven Mile Reservoir	GNPDO13	N/R	N/R	470217	5432228	10.0	26.0	2019-Apr-17	17:30	7.1	2019-Apr-18	11:48	6.9	0
14	Seven Mile Reservoir	GNPDO14	468822	5432189	N/R	N/R	3.0	9.0	2019-Apr-17	17:44	7.1	2019-Apr-18	12:20	7.0	0
15	Seven Mile Reservoir	GNPDO15	463971	5431869	N/R	N/R	7.0	10.0	2019-Apr-17	18:00	7.0	2019-Apr-18	12:30	7.1	0
16	Waneta Reservoir	GNPDO16	459236	5428589	459215	5428631	3.0	7.0	2019-Apr-24	12:35	8.0	2019-Apr-25	10:11	8.6	0
17	Waneta Reservoir	GNPDO17	459117	5428591	459099	5428646	2.9	6.8	2019-Apr-24	12:45	8.0	2019-Apr-25	10:29	8.7	0
18	Waneta Reservoir	GNPDO18	458897	5428496	458858	5428530	0.9	8.0	2019-Apr-24	12:55	8.2	2019-Apr-25	10:37	8.6	0

Set	Waterbody	Site ID	Location (UTM Zone 11U)				Depth (m)		Set			Pull			# NP
			Start		End										
			Easting	Northing	Easting	Northing	Min	Max	Date	Time	Temp (°C)	Date	Time	Temp (°C)	
19	Waneta Reservoir	GNPDO19	458792	5428436	458762	5428473	1.1	17.8	2019-Apr-24	13:04	8.1	2019-Apr-25	11:35	8.8	0
20	Waneta Reservoir	GNPDO20	458670	5428365	458670	5428425	4.8	10.6	2019-Apr-24	13:20	8.0	2019-Apr-25	11:43	8.6	0
21	Waneta Reservoir	GNPDO21	458961	5428534	458944	5428579	4.3	7.5	2019-Apr-24	13:29	8.0	2019-Apr-25	11:51	8.7	0
22	Waneta Reservoir	GNPDO22	456539	5427692	456523	5427750	1.5	8.9	2019-Apr-25	11:02	8.4	2019-Apr-25	14:05	9.3	0
23	Waneta Reservoir	GNPDO23	456563	5427786	456512	5427790	7.3	12.9	2019-Apr-25	11:13	8.3	2019-Apr-25	14:15	9.0	0
24	Waneta Reservoir	GNPDO24	456603	5427952	456600	5427990	7.6	20.3	2019-Apr-25	11:24	8.4	2019-Apr-25	14:42	8.8	0
25	Waneta Reservoir	GNPDO25	460220	5429299	460189	5429264	6.2	18.5	2019-Apr-25	12:47	8.8	2019-Apr-26	11:56	9.1	0
26	Waneta Reservoir	GNPDO26	460043	5429363	460044	5429308	4.5	10.3	2019-Apr-25	13:00	8.9	2019-Apr-26	12:43	9.1	0
27	Waneta Reservoir	GNPDO27	459223	5428589	459241	5428631	3.5	6.8	2019-Apr-25	13:12	8.8	2019-Apr-26	11:46	9.1	0
28	Waneta Reservoir	GNPDO28	456536	5427728	456524	5427768	4.7	11.5	2019-Apr-25	14:31	9.0	2019-Apr-26	10:57	9.4	0
29	Waneta Reservoir	GNPDO29	458779	5428441	458745	5428477	4.6	20.4	2019-Apr-25	14:55	8.9	2019-Apr-26	11:15	9.1	0
30	Waneta Reservoir	GNPDO30	458979	5428545	458953	5428585	4.0	7.1	2019-Apr-25	15:04	8.9	2019-Apr-26	11:31	9.1	0
31	Columbia Mainstem	GNLCR01	448177	5464923	448211	5464971	4.3	15.2	2019-May-01	10:10	5.9	2019-May-01	13:10	6.7	0
32	Columbia Mainstem	GNLCR02	448666	5464813	448695	5464853	4.7	14.7	2019-May-01	10:24	5.8	2019-May-01	13:35	6.0	0
33	Columbia Mainstem	GNLCR03	448947	5464662	448979	5464678	3.6	12.2	2019-May-01	10:35	5.8	2019-May-01	13:52	5.9	0
34	Columbia Mainstem	GNLCR04	449486	5464541	449500	5464588	4.2	16.6	2019-May-01	10:45	5.9	2019-May-01	14:02	5.9	0
35	Columbia Mainstem	GNLCR05	449802	5464387	449806	5464435	4.3	13.8	2019-May-01	10:55	5.8	2019-May-01	14:26	5.9	0
36	Columbia Mainstem	GNLCR06	450338	5464244	450326	5464277	2.4	9.6	2019-May-01	11:07	5.9	2019-May-01	14:41	5.9	0
37	Columbia Mainstem	GNLCR07	448494	5464896	448491	5464839	6.9	17.2	2019-May-01	13:25	6.0	2019-May-01	16:20	5.9	0
38	Columbia Mainstem	GNLCR08	448616	5465082	448604	5465035	4.0	13.0	2019-May-01	13:45	5.9	2019-May-01	16:30	5.9	0
39	Columbia Mainstem	GNLCR09	448947	5464662	448979	5464678	3.6	12.2	2019-May-01	14:00	5.9	2019-May-01	17:02	6.0	0
40	Columbia Mainstem	GNLCR10	450226	5464556	450260	5464504	5.0	11.3	2019-May-01	14:17	5.9	2019-May-01	17:17	5.9	0

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			Start		End										
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41	Columbia Mainstem	GNLCR11	449802	5464387	449806	5464435	4.3	13.8	2019-May-01	14:36	5.9	2019-May-01	17:31	6.0	0
42	Columbia Mainstem	GNLCR12	450625	5464593	450620	5464551	2.3	8.3	2019-May-01	14:54	5.8	2019-May-01	17:39	6.0	0
43	Seven Mile Reservoir	GNPDO31	472081	5430520	472061	5430482	2.3	5.4	2019-May-02	10:35	8.2	2019-May-02	14:35	7.1	0
44	Seven Mile Reservoir	GNPDO32	469434	5432202	469426	5432164	2.0	15.3	2019-May-02	10:50	8.7	2019-May-02	14:58	8.7	1
45	Seven Mile Reservoir	GNPDO33	465949	5432756	465958	5432714	6.9	24.6	2019-May-02	11:05	8.9	2019-May-02	15:32	8.8	0
46	Seven Mile Reservoir	GNPDO34	466081	5432275	466092	5432312	1.8	5.0	2019-May-02	11:15	9.3	2019-May-02	15:54	10.3	2
47	Seven Mile Reservoir	GNPDO35	464071	5431964	464103	5431932	3.9	8.3	2019-May-02	11:28	9.2	2019-May-02	16:29	9.5	2
48	Seven Mile Reservoir	GNPDO36	463978	5431693	463987	5431619	4.5	12.3	2019-May-02	11:36	9.0	2019-May-02	16:54	8.8	1
49	Seven Mile Reservoir	GNPDO37	466085	5432280	466084	5432328	2.0	8.0	2019-May-07	10:35	10.6	2019-May-07	14:25	11.2	1
50	Seven Mile Reservoir	GNPDO38	464072	5431965	464079	5431927	2.0	5.1	2019-May-07	10:46	10.5	2019-May-07	14:54	10.7	1
51	Seven Mile Reservoir	GNPDO39	463961	5431751	464002	5431712	7.5	18.3	2019-May-07	10:55	10.7	2019-May-07	15:10	10.1	0
52	Waneta Reservoir	GNPDO40	458769	5428396	458751	5428447	1.8	8.9	2019-May-07	11:43	10.0	2019-May-08	10:17	10.5	1
53	Waneta Reservoir	GNPDO41	458927	5428524	458887	5428562	3.4	8.5	2019-May-07	11:52	10.0	2019-May-08	10:31	10.2	0
54	Waneta Reservoir	GNPDO42	459706	5428826	459751	5428840	2.0	5.5	2019-May-07	12:08	9.9	2019-May-08	10:37	10.2	0
55	Columbia Mainstem	GNLCR13	448668	5464828	448698	5464854	5.6	16.9	2019-May-14	9:50	8.8	2019-May-14	13:11	9.4	0
56	Columbia Mainstem	GNLCR14	448319	5464860	448338	5464902	4.8	12.6	2019-May-14	10:00	8.8	2019-May-14	13:30	9.0	0
57	Columbia Mainstem	GNLCR15	446378	5465762	446342	5465719	1.2	4.9	2019-May-14	10:10	8.8	2019-May-14	13:45	9.0	0
58	Columbia Mainstem	GNLCR16	449781	5464365	449783	5464411	0.7	10.5	2019-May-14	10:38	8.7	2019-May-14	14:00	9.2	2
59	Lower Kootenay River	GNLCR17	452715	5462825	452765	5462808	1.2	8.0	2019-May-14	10:50	9.1	2019-May-14	14:40	9.0	0
60	Lower Kootenay River	GNLCR18	452717	5462868	452731	5462823	2.0	5.0	2019-May-14	11:02	8.8	2019-May-14	14:45	8.9	0

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61	Columbia Mainstem	GNLCR19	448758	5464747	448748	5464786	2.0	16.3	2019-May-14	13:20	8.9	2019-May-14	16:00	8.8	0
62	Columbia Mainstem	GNLCR20	448291	5464878	448299	5464913	1.4	9.3	2019-May-14	13:35	8.9	2019-May-14	16:09	8.8	0
63	Columbia Mainstem	GNLCR21	446487	5465648	446457	5465627	1.5	8.4	2019-May-14	13:50	8.7	2019-May-14	16:19	8.2	0
64	Columbia Mainstem	GNLCR22	449781	5464365	449783	5464411	0.7	10.5	2019-May-14	14:20	8.8	2019-May-14	16:30	8.8	0
65	Columbia Mainstem	GNLCR23	449612	5464451	449630	5464491	1.8	12.5	2019-May-15	10:20	7.8	2019-May-15	13:43	8.0	1
66	Columbia Mainstem	GNLCR24	449729	5464413	449762	5464447	1.4	12.8	2019-May-15	10:25	7.7	2019-May-15	14:09	7.9	0
67	Columbia Mainstem	GNLCR25	449943	5464337	449950	5464381	1.9	14.0	2019-May-15	10:35	7.6	2019-May-15	14:20	7.9	0
68	Columbia Mainstem	GNLCR26	450288	5464243	450274	5464293	2.1	11.8	2019-May-15	10:40	7.6	2019-May-15	14:32	8.7	0
69	Columbia Mainstem	GNLCR27	450674	5464239	450689	5464284	1.4	5.0	2019-May-15	10:45	7.5	2019-May-15	14:40	8.0	0
70	Columbia Mainstem	GNLCR28	450476	5464226	450491	5464269	1.5	8.0	2019-May-15	10:55	7.6	2019-May-15	14:50	8.0	1
71	Columbia Mainstem	GNLCR29	450335	5464237	450337	5464269	1.2	9.4	2019-Jun-05	9:30	15.5	2019-Jun-05	13:27	15.8	0
72	Columbia Mainstem	GNLCR30	449815	5464384	449834	5464430	2.4	14.2	2019-Jun-05	9:39	15.6	2019-Jun-05	13:47	15.6	0
73	Columbia Mainstem	GNLCR31	448749	5464751	448776	5464772	2.0	13.7	2019-Jun-05	9:50	15.6	2019-Jun-05	14:13	15.7	1
74	Columbia Mainstem	GNLCR32	448455	5464819	448459	5464867	1.7	14.0	2019-Jun-05	10:10	15.6	2019-Jun-05	14:46	15.6	0
75	Columbia Mainstem	GNLCR33	446490	5465612	446451	5465591	2.2	12.7	2019-Jun-05	10:19	15.3	2019-Jun-05	15:13	15.1	0
76	Columbia Mainstem	GNLCR34	446306	5465744	446312	5465692	1.0	11.5	2019-Jun-05	10:25	15.2	2019-Jun-05	15:42	14.8	0
77	Columbia Mainstem	GNLCR35	448749	5464751	448776	5464772	2.0	13.7	2019-Jun-05	14:15	15.6	2019-Jun-05	16:55	15.3	0
78	Columbia Mainstem	GNLCR36	448455	5464819	448459	5464867	1.7	14.0	2019-Jun-05	14:48	15.3	2019-Jun-05	17:10	15.3	1
79	Columbia Mainstem	GNLCR37	448835	5464703	448866	5464735	0.8	14.7	2019-Jun-06	9:45	14.3	2019-Jun-06	13:35	14.0	1
80	Columbia Mainstem	GNLCR38	448362	5464859	448398	5464899	3.2	14.3	2019-Jun-06	9:55	14.1	2019-Jun-06	14:00	14.0	0
81	Columbia Mainstem	GNLCR39	446146	5465773	446180	5465743	1.3	9.0	2019-Jun-06	10:05	13.8	2019-Jun-06	14:15	14.1	1

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82	Columbia Mainstem	GNLCR40	452219	5464501	452254	5464466	2.5	8.6	2019-Jun-06	10:25	14.8	2019-Jun-06	15:02	14.7	0
83	Lower Kootenay River	GNLCR41	452729	5462861	452733	5462810	3.0	6.4	2019-Jun-06	10:35	13.5	2019-Jun-06	15:23	13.9	0
84	Lower Kootenay River	GNLCR42	452822	5462812	452787	5462781	0.8	6.6	2019-Jun-06	10:45	13.1	2019-Jun-06	15:35	13.8	0
85	Columbia Mainstem	GNLCR43	448835	5464703	448866	5464735	0.8	14.7	2019-Jun-06	13:40	13.9	2019-Jun-06	16:10	13.9	1
86	Columbia Mainstem	GNLCR44	448362	5464859	448398	5464899	2.0	14.0	2019-Jun-06	14:05	13.9	2019-Jun-06	16:29	13.9	0
87	Columbia Mainstem	GNLCR45	446146	5465773	446192	5465734	1.3	11.0	2019-Jun-06	14:20	14.1	2019-Jun-06	16:49	14.1	1
88	Columbia Mainstem	GNLCR46	450130	5464595	450144	5464550	3.0	11.1	2019-Jun-10	9:45	12.2	2019-Jun-10	15:16	11.7	0
89	Columbia Mainstem	GNLCR47	449796	5464338	449816	5464383	1.2	3.0	2019-Jun-10	9:53	12.2	2019-Jun-10	15:23	11.5	0
90	Columbia Mainstem	GNLCR48	448817	5464691	448821	5464732	1.5	11.6	2019-Jun-10	10:00	12.1	2019-Jun-10	15:33	11.4	1
91	Columbia Mainstem	GNLCR49	448317	5464848	448344	5464891	1.5	10.8	2019-Jun-10	10:10	12.1	2019-Jun-10	15:43	11.5	2
92	Columbia Mainstem	GNLCR50	446128	5465789	446137	5465749	2.1	11.8	2019-Jun-10	10:23	11.7	2019-Jun-10	16:00	11.5	0
93	Lower Kootenay River	GNLCR51	452747	5462857	452751	5462795	2.3	7.5	2019-Jun-10	10:45	11.5	2019-Jun-10	14:30	11.7	0
94	Columbia Mainstem	GNLCR52	450121	5464596	450154	5464544	3.2	11.5	2019-Jun-11	8:40	12.6	2019-Jun-11	14:43	13.1	0
95	Columbia Mainstem	GNLCR53	450221	5464250	450247	5464286	1.9	12.1	2019-Jun-11	8:45	12.6	2019-Jun-11	14:56	13.1	0
96	Columbia Mainstem	GNLCR54	449788	5464353	449824	5464389	1.8	8.8	2019-Jun-11	9:08	12.6	2019-Jun-11	15:13	13.2	1
97	Columbia Mainstem	GNLCR55	448757	5464722	448791	5464752	2.1	14.3	2019-Jun-11	9:16	12.7	2019-Jun-11	15:23	13.1	0
98	Columbia Mainstem	GNLCR56	448317	5464852	448354	5464889	1.5	11.2	2019-Jun-11	9:23	12.8	2019-Jun-11	15:32	13.2	0
99	Columbia Mainstem	GNLCR57	446158	5465784	446160	5465736	2.5	13.8	2019-Jun-11	9:32	12.9	2019-Jun-11	15:47	13.0	0
100	Zuckerberg Pond	GNLCR58	452181	5462831	452165	5462778	0.0	2.5	2019-Jul-15	10:45	21.5	2019-Jul-15	14:30	21.5	0
101	Zuckerberg Pond	GNLCR59	452182	5462680	452149	5462670	0.0	1.5	2019-Jul-15	10:57	21.5	2019-Jul-15	14:55	21.5	0

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102	Zuckerberg Pond	GNLCR60	452125	5462771	452161	5462752	0.0	2.3	2019-Jul-15	11:19	21.5	2019-Jul-15	15:15	21.5	0
103	Zuckerberg Pond	GNLCR61	452173	5462725	452131	5462724	0.0	1.8	2019-Jul-15	11:33	21.5	2019-Jul-15	16:35	21.5	1
104	Zuckerberg Pond	GNLCR62	452185	5462775	452142	5462784	0.0	2.8	2019-Jul-18	11:00	22.8	2019-Jul-18	14:30	22.8	0
105	Zuckerberg Pond	GNLCR63	452121	5462746	452158	5462737	0.0	1.5	2019-Jul-18	11:10	22.8	2019-Jul-18	14:45	22.8	0
106	Zuckerberg Pond	GNLCR64	452170	5462706	452145	5462701	0.0	1.3	2019-Jul-18	11:25	22.8	2019-Jul-18	15:00	22.8	0
107	Zuckerberg Pond	GNLCR65	452201	5462647	452173	5462634	0.0	2.0	2019-Jul-18	11:35	22.8	2019-Jul-18	15:15	22.8	0
108	Christina Lake South	GNCL01	411467	5433522	411418	5433522	0.6	6.5	2019-Jul-23	10:27	21.3	2019-Jul-23	14:35	23.4	0
109	Christina Lake South	GNCL02	411552	5433126	411497	5433143	0.6	1.2	2019-Jul-23	10:54	22.0	2019-Jul-23	14:50	24.5	0
110	Christina Lake South	GNCL03	411394	5433453	411432	5433435	4.6	6.0	2019-Jul-23	11:20	22.1	2019-Jul-23	15:17	23.1	0
111	Christina Lake South	GNCL04	411405	5433360	411450	5433382	2.0	2.6	2019-Jul-23	11:27	22.1	2019-Jul-23	15:32	23.1	0
112	Christina Lake South	GNCL05	411461	5433538	411423	5433519	0.9	5.3	2019-Jul-24	9:45	21.2	2019-Jul-24	14:02	21.6	0
113	Christina Lake South	GNCL06	411490	5433479	411472	5433447	0.8	1.7	2019-Jul-24	9:55	21.3	2019-Jul-24	14:12	21.8	0
114	Christina Lake South	GNCL07	411338	5433256	411297	5433269	1.0	2.2	2019-Jul-24	10:39	21.7	2019-Jul-24	14:24	21.9	0
115	Christina Lake South	GNCL08	411436	5433346	411689	5433373	2.6	4.6	2019-Jul-24	10:51	21.5	2019-Jul-24	14:29	21.7	0
116	Christina Lake North	GNCL09	405774	5450597	405778	5450632	0.9	3.0	2019-Jul-25	9:55	21.0	2019-Jul-25	12:10	22.1	0
117	Christina Lake North	GNCL10	405783	5450692	405740	5450697	1.1	2.9	2019-Jul-25	10:03	21.1	2019-Jul-25	12:32	22.3	0
118	Christina Lake North	GNCL11	405687	5450754	405685	5450705	0.9	2.1	2019-Jul-25	11:11	21.1	2019-Jul-25	13:06	22.5	0
119	Christina Lake North	GNCL12	405649	5450637	405684	5450659	1.2	4.0	2019-Jul-25	10:17	21.1	2019-Jul-25	12:54	22.1	0
120	Columbia Mainstem	GNLCR66	449800	5464340	449815	5464369	1.0	1.8	2019-Aug-21	9:52	16.3	2019-Aug-21	14:21	16.8	0
121	Columbia Mainstem	GNLCR67	448716	5464759	448720	5464802	2.0	15.0	2019-Aug-21	10:03	16.3	2019-Aug-21	14:36	16.5	0
122	Columbia Mainstem	GNLCR68	448406	5464814	448420	5464850	1.1	11.0	2019-Aug-21	10:20	16.3	2019-Aug-21	14:52	16.4	0
123	Columbia Mainstem	GNLCR69	446200	5465791	446189	5465754	2.7	9.6	2019-Aug-21	10:38	16.4	2019-Aug-21	15:10	16.4	0

Set	Waterbody	Site ID	Location (UTM Zone 11U)				Depth (m)		Set			Pull			# NP
			Start		End										
			Easting	Northing	Easting	Northing	Min	Max	Date	Time	Temp (°C)	Date	Time	Temp (°C)	
124	Seven Mile Reservoir	GNPDO43	472022	5430547	472018	5430500	4.7	6.8	2019-Aug-21	11:38	22.5	2019-Aug-21	15:50	22.7	0
125	Seven Mile Reservoir	GNPDO44	469505	5432148	469490	5432199	3.5	18.0	2019-Aug-21	11:55	22.9	2019-Aug-21	16:30	22.7	0
126	Seven Mile Reservoir	GNPDO45	466090	5432282	466092	5432344	4.7	13.8	2019-Aug-21	12:14	23.8	2019-Aug-21	17:10	24.4	0
127	Seven Mile Reservoir	GNPDO46	463958	5431784	464004	5431774	8.0	13.8	2019-Aug-21	12:30	23.8	2019-Aug-21	17:35	23.3	0
128	Seven Mile Reservoir	GNPDO47	463720	5431524	463741	5431487	3.0	7.9	2019-Aug-21	12:40	23.9	2019-Aug-21	18:58	23.4	0
129	Lower Kootenay River	GNLCR70	452738	5462857	452723	5462814	2.0	7.1	2019-Aug-22	9:45	18.9	2019-Aug-22	15:15	19.8	0
130	Columbia Mainstem	GNLCR71	452612	5464562	452589	5464543	1.3	1.9	2019-Aug-22	10:05	16.7	2019-Aug-22	15:42	18.1	1
131	Columbia Mainstem	GNLCR72	450587	5464222	450625	5464264	2.2	4.0	2019-Aug-22	10:20	16.6	2019-Aug-22	15:55	17.6	0
132	Columbia Mainstem	GNLCR73	450218	5464250	450224	5464302	1.2	12.1	2019-Aug-22	10:37	16.6	2019-Aug-22	13:35	17.0	0
133	Columbia Mainstem	GNLCR74	450275	5464608	450283	5464568	1.2	4.5	2019-Aug-22	11:30	16.8	2019-Aug-22	13:44	17.0	0
134	Seven Mile Reservoir	GNPDO48	463953	5431706	463977	5431665	1.0	14.9	2019-Aug-22	10:45	22.9	2019-Aug-22	14:07	23.1	0
135	Seven Mile Reservoir	GNPDO49	466049	5432827	466064	5432783	4.0	5.2	2019-Aug-22	11:02	23.2	2019-Aug-22	14:26	24.5	0
136	Seven Mile Reservoir	GNPDO50	466084	5432278	466102	5432319	5.4	8.0	2019-Aug-22	11:10	23.2	2019-Aug-22	14:34	24.6	0
137	Seven Mile Reservoir	GNPDO51	468834	5432209	468864	5432235	2.4	6.5	2019-Aug-22	11:24	23.4	2019-Aug-22	14:46	24.1	0
138	Seven Mile Reservoir	GNPDO52	469532	5432360	469539	5432314	4.1	6.7	2019-Aug-22	11:33	23.4	2019-Aug-22	13:45	24.1	0
139	Seven Mile Reservoir	GNPDO53	463723	5431514	463710	5431479	3.1	7.2	2019-Aug-23	10:21	22.7	2019-Aug-23	12:00	23.2	0
140	Seven Mile Reservoir	GNPDO54	463940	5431678	463982	5431653	3.6	14.1	2019-Aug-23	10:29	22.8	2019-Aug-23	14:22	23.3	0
141	Seven Mile Reservoir	GNPDO55	466084	5432276	466083	5432316	4.2	7.4	2019-Aug-23	10:40	22.9	2019-Aug-23	14:33	23.3	0
142	Seven Mile Reservoir	GNPDO56	466039	5432829	466034	5432788	4.3	13.2	2019-Aug-23	10:47	23.9	2019-Aug-23	14:44	23.4	0
143	Seven Mile Reservoir	GNPDO57	469544	5432376	469563	5432328	4.6	9.6	2019-Aug-23	11:01	22.6	2019-Aug-23	14:56	23.0	0
144	Zuckerberg Pond	GNLCR75	452162	5462646	452181	5462678	0.0	1.5	2019-Aug-27	10:36	21.6	2019-Aug-27	13:51	21.6	0

Set	Waterbody	Site ID	Location (UTM Zone 11U)				Depth (m)		Set			Pull			# NP
			Start		End										
			Easting	Northing	Easting	Northing	Min	Max	Date	Time	Temp (°C)	Date	Time	Temp (°C)	
145	Zuckerberg Pond	GNLCR76	452126	5462781	452166	5462742	0.0	1.0	2019-Aug-27	10:40	21.6	2019-Aug-27	14:15	21.6	1
146	Zuckerberg Pond	GNLCR77	452176	5462760	452140	5462770	0.0	2.0	2019-Aug-27	11:16	21.6	2019-Aug-27	14:47	21.6	0
147	Zuckerberg Pond	GNLCR78	452209	5462627	452171	5462631	0.0	2.0	2019-Aug-28	10:33	23.1	2019-Aug-28	14:22	23.1	4
148	Zuckerberg Pond	GNLCR79	452169	5462742	452122	5462750	0.0	2.0	2019-Aug-28	10:48	23.1	2019-Aug-28	14:40	23.1	0
149	Zuckerberg Pond	GNLCR80	452154	5462772	452183	5462766	0.0	2.5	2019-Aug-28	11:34	23.1	2019-Aug-28	15:18	23.1	2
150	Seven Mile Reservoir	GNPDO58	470232	5432184	470231	5432226	5.0	17.0	2019-Aug-28	11:15	22.7	2019-Aug-28	15:18	23.8	0
151	Seven Mile Reservoir	GNPDO59	469488	5432219	469479	5432181	2.5	10.0	2019-Aug-28	11:27	22.7	2019-Aug-28	15:30	22.8	0
152	Seven Mile Reservoir	GNPDO60	466097	5432296	46603	5432343	7.0	13.0	2019-Aug-28	11:43	22.7	2019-Aug-28	15:43	22.8	0
153	Seven Mile Reservoir	GNPDO61	464234	5432099	464262	5432067	5.0	15.0	2019-Aug-28	11:58	22.7	2019-Aug-28	15:50	22.8	0
154	Columbia Mainstem	GNLCR81	452600	5464565	452553	5464548	1.0	1.2	2019-Aug-29	10:30	17.5	2019-Aug-29	13:13	17.8	0
155	Columbia Mainstem	GNLCR82	452693	5464389	452692	5464368	2.5	5.0	2019-Aug-29	10:43	17.5	2019-Aug-29	13:29	17.6	0
156	Columbia Mainstem	GNLCR83	449807	5464341	449824	5464376	1.0	1.8	2019-Aug-29	11:01	17.3	2019-Aug-29	13:46	17.5	0
157	Columbia Mainstem	GNLCR84	449621	5464475	449681	5464484	5.0	13.0	2019-Aug-29	11:12	17.3	2019-Aug-29	14:00	17.5	0
158	Columbia Mainstem	GNLCR85	448775	5464728	448778	5464770	2.5	10.0	2019-Aug-29	11:27	17.3	2019-Aug-29	14:14	17.5	0
159	Zuckerberg Pond	GNLCR86	452197	5462648	452167	5462644	0.0	2.0	2019-Aug-29	9:10	23.0	2019-Aug-29	13:11	23.0	3
160	Zuckerberg Pond	GNLCR87	452168	5462697	452158	5462691	0.0	0.5	2019-Aug-29	9:17	23.0	2019-Aug-29	13:25	23.0	0
161	Zuckerberg Pond	GNLCR88	452183	5462769	452139	5462776	0.0	2.5	2019-Aug-29	9:25	23.4	2019-Aug-29	13:48	23.4	5
162	Zuckerberg Pond	GNLCR89	452200	5462650	452173	5462628	0.0	2.0	2019-Aug-30	9:37	18.0	2019-Aug-30	13:50	21.0	1
163	Zuckerberg Pond	GNLCR90	452123	5462769	452184	5462774	0.0	2.5	2019-Aug-30	9:50	18.0	2019-Aug-30	14:05	21.0	2
164	Zuckerberg Pond	GNLCR91	452176	5462804	452169	5462783	0.0	2.5	2019-Aug-30	9:56	18.0	2019-Aug-30	14:50	20.1	0
165	Seven Mile Reservoir	GNPDO62	463728	5431515	463745	5431472	1.7	7.4	2019-Aug-30	10:23	22.4	2019-Aug-30	13:03	22.5	0

Set	Waterbody	Site ID	Location (UTM Zone 11U)				Depth (m)		Set			Pull			# NP
			Start		End										
			Easting	Northing	Easting	Northing	Min	Max	Date	Time	Temp (°C)	Date	Time	Temp (°C)	
166	Seven Mile Reservoir	GNPDO63	463950	5431694	463988	5431660	2.8	10.9	2019-Aug-30	10:31	22.5	2019-Aug-30	13:19	22.6	0
167	Seven Mile Reservoir	GNPDO64	466026	5432826	466028	5432790	3.7	9.2	2019-Aug-30	10:50	22.7	2019-Aug-30	13:49	22.7	0
168	Seven Mile Reservoir	GNPDO65	466082	5432288	466093	5432315	4.2	7.8	2019-Aug-30	10:57	22.6	2019-Aug-30	14:00	22.6	0
169	Seven Mile Reservoir	GNPDO66	468833	5432209	468836	5432243	3.3	7.8	2019-Aug-30	11:15	22.4	2019-Aug-30	14:33	22.3	0

Appendix C-2: Electrofishing Sites

Table 14. Electrofishing sites by waterbody (Seven Mile Reservoir and Waneta Reservoir = Pend d'Oreille River; Columbia Mainstem and Zuckerberg Pond = Columbia River; Christina Lake North and South = Christina Lake) with coordinates, set depths (m), dates, set/pull times, effort in seconds and length sampled (m), temperatures (°C), and Northern Pike (NP) presence.

Waterbody	Site ID	Location (UTM Zone 11U)				EF Specifications				Start		End		Average Depth (m)	Clarity
		Start		End											
		Easting	Northing	Easting	Northing	Time (s)	Site Length (m)	Voltage	Amps	Date	Time	Date	Time		
Christina Lake South	EFCL01	411365	5433349	411456	5433500	215	225	137	3.5	7/23/2019	11:57	7/23/2019	12:05	2.0	High
Christina Lake South	EFCL02	411374	5433349	411486	5433094	364	350	137	3.6	7/23/2019	12:05	7/23/2019	12:17	2.0	High
Christina Lake South	EFCL03	411456	5433500	411486	5433094	878	550	137	3.6	7/24/2019	11:07	7/24/2019	11:24	1.8	High
Christina Lake South	EFCL04	411486	5433094	411374	5433349	390	350	147	3.9	7/24/2019	11:35	7/24/2019	11:42	2.0	High
Christina Lake North	EFCL05	406370	5450311	405638	5450558	1747	1050	146	3.5	7/25/2019	10:29	7/25/2019	11:03	1.8	High
Seven Mile Reservoir	EFPDO01	463621	5431418	464001	5431690	710	525	140	4.2	4/15/2019	19:55	4/15/2019	20:15	1.5	Low
Seven Mile Reservoir	EFPDO02	463983	5431720	464536	5432228	2034	825	147	4.7	4/15/2019	20:24	4/15/2019	20:50	2.0	Low
Seven Mile Reservoir	EFPDO03	465016	5432061	465916	5432345	1296	1000	150	4.5	4/15/2019	21:06	4/15/2019	21:29	2.0	Low
Seven Mile Reservoir	EFPDO04	466283	5432449	466066	5432356	546	375	125	4.2	4/15/2019	21:37	4/15/2019	21:49	2.0	Low
Seven Mile Reservoir	EFPDO05	471986	5430429	471860	5430648	1368	750	170	4.2	4/15/2019	22:07	4/15/2019	22:32	2.3	Medium
Seven Mile Reservoir	EFPDO06	469812	5432362	469172	5432228	1249	900	130	4	4/15/2019	22:50	4/15/2019	23:15	1.8	Low
Seven Mile Reservoir	EFPDO07	469734	5432021	470268	5432162	763	875	143	4.3	4/15/2019	23:25	4/15/2019	23:41	1.3	Low
Seven Mile Reservoir	EFPDO08	465792	5432717	465283	5432482	781	650	140	4.4	4/15/2019	23:54	4/16/2019	0:10	2.1	Low
Columbia Mainstem	EFLCR01	452731	5464228	452454	5464602	832	500	145	4.1	8/22/2019	14:30	8/22/2019	15:00	1.0	High
Seven Mile Reservoir	EFPDO09	471976	5430409	471921	5430596	1631	575	88	4.8	8/30/2019	11:30	8/30/2019	11:42	2.2	High
Seven Mile Reservoir	EFPDO10	463950	5431620	463626	5431444	336	375	88	4.9	8/30/2019	12:30	8/30/2019	12:37	1.7	High

Appendix C-3: Angling and Seine Sites

Table 15. Angling sites by waterbody with effort in angler hours and Northern Pike captures.

Date	Waterbody	Angler hours	Northern Pike	CPUE (NP/hr)
2019-Apr-17	Pend d'Orelle River – Seven Mile Reservoir	3	0	0
2019-Apr-24	Pend d'Oreille River – Waneta Reservoir	3	0	0
2019-Apr-25	Pend d'Oreille River – Waneta Reservoir	3	0	0
2019-May-01	Columbia River – Robson Reach	3	0	0
2019-May-02	Pend d'Orelle River – Seven Mile Reservoir	3	0	0
2019-May-07	Pend d'Orelle River – Seven Mile Reservoir	3	0	0
2019-May-14	Columbia River – Robson Reach	3	0	0
2019-May-15	Columbia River – Robson Reach	3	0	0
2019-Jul-15	Columbia River – Zuckerberg Pond	1	0	0
2019-Jul-18	Columbia River – Zuckerberg Pond	1	0	0
2019-Aug-27	Columbia River – Zuckerberg Pond	1	1	1

Table 16. Seine sites in Zuckerberg Pond (Columbia River) with coordinates, set depths (m), dates, start/end times, effort in site length (m), and temperatures (°C); Northern Pike were not captured during seining.

Waterbody	Site ID	UTM Zone	Easting	Northing	Set Date	Start Time	End Time	Temp (°C)	Site Length (m)	Depth (max; m))
Zuckerberg Pond	SNLCR01	11	452220	5462570	2019-Jul-11	11:50	12:57	21	20	1
Zuckerberg Pond	SNLCR02	11	452147	5462794	2019-Jul-11	13:05	14:00	21	40	0.8

Appendix D: Maps of Suppression Effort

Appendix D-1: Columbia River

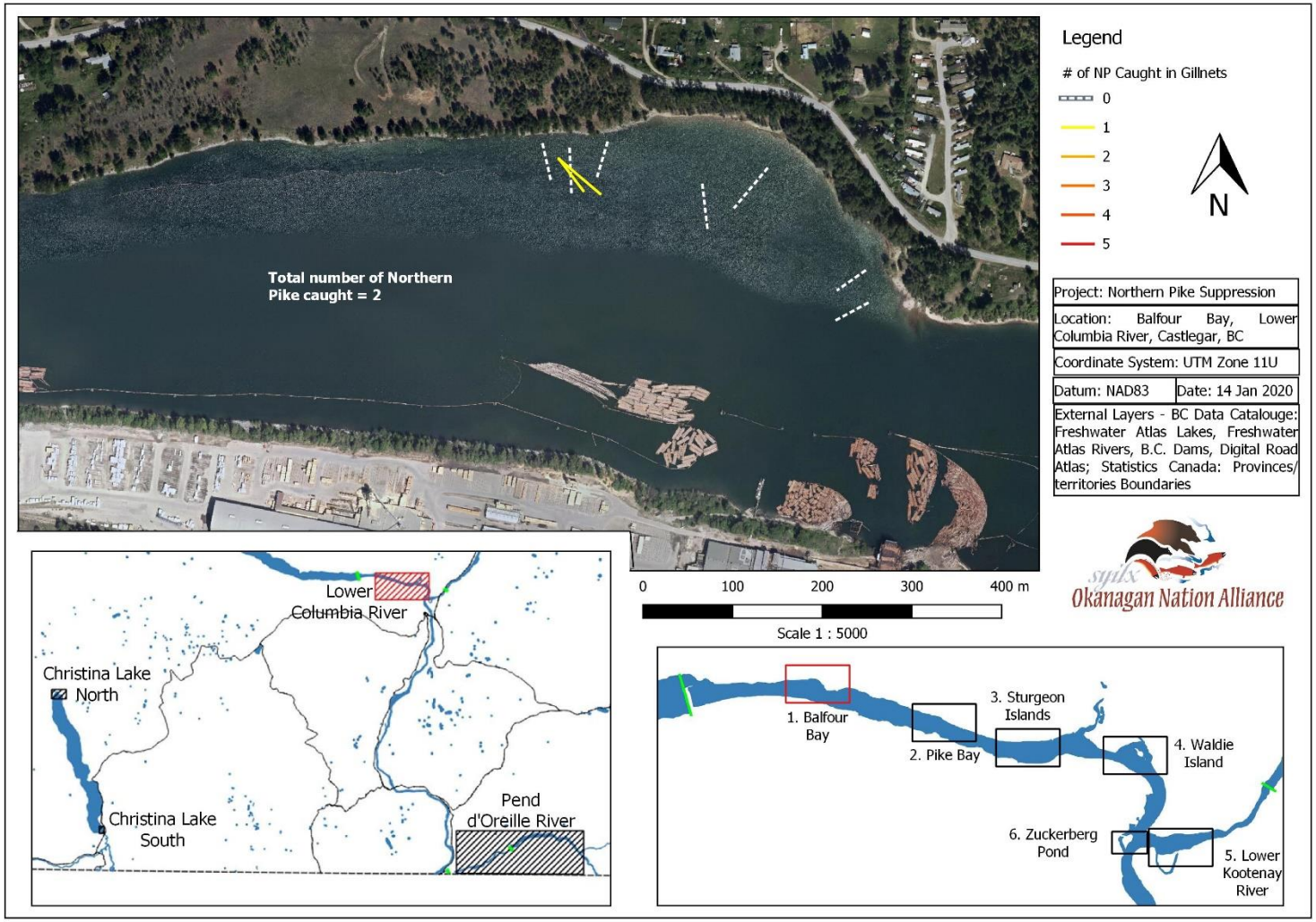

Figure 15. Balfour Bay in the Columbia River depicting gillnet effort (lines) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2018).

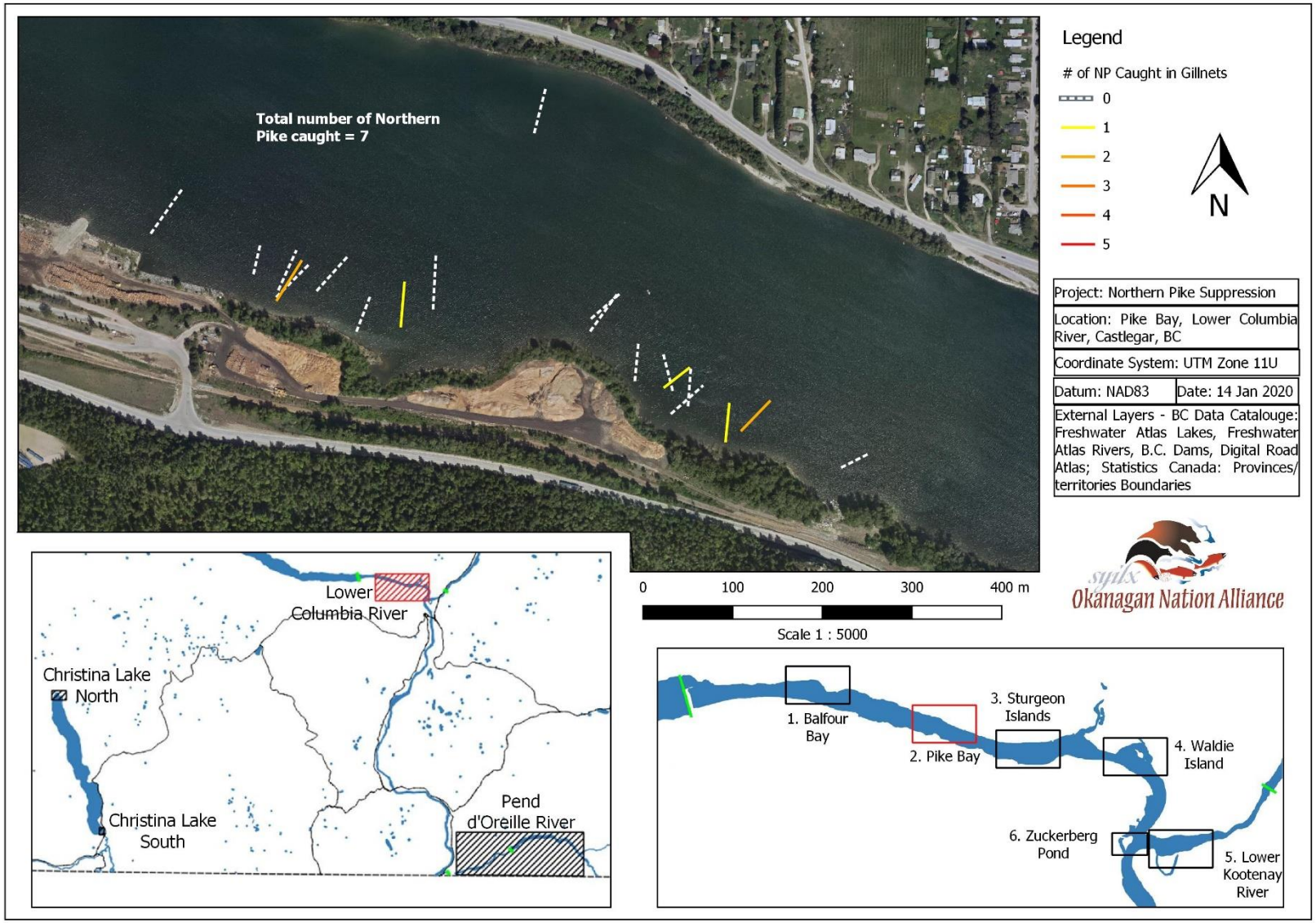

Figure 16. Pike Bay in the Columbia River depicting gillnet effort (lines) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2018).

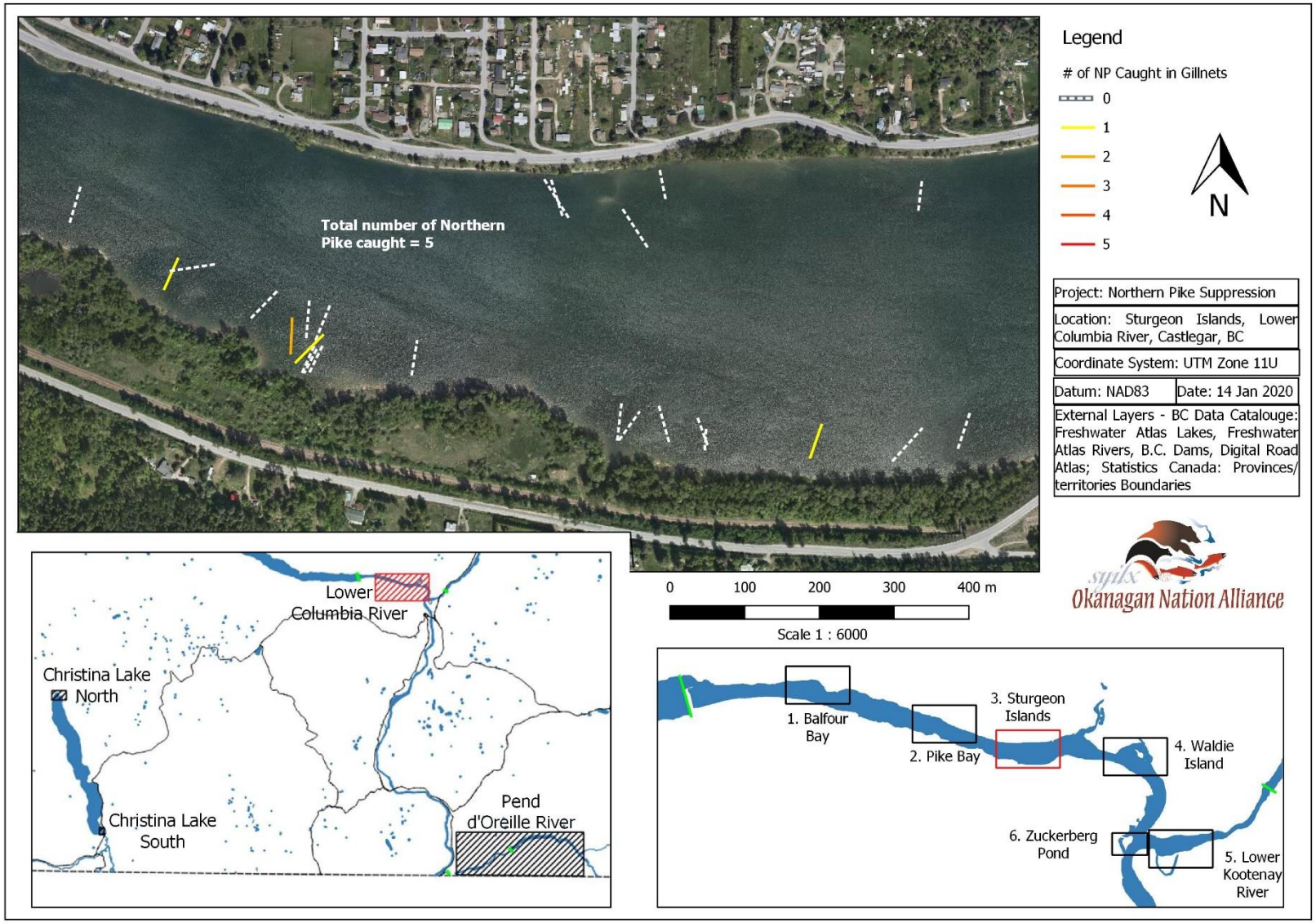

Figure 17. Sturgeon Islands in the Columbia River depicting gillnet effort (lines) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2018).

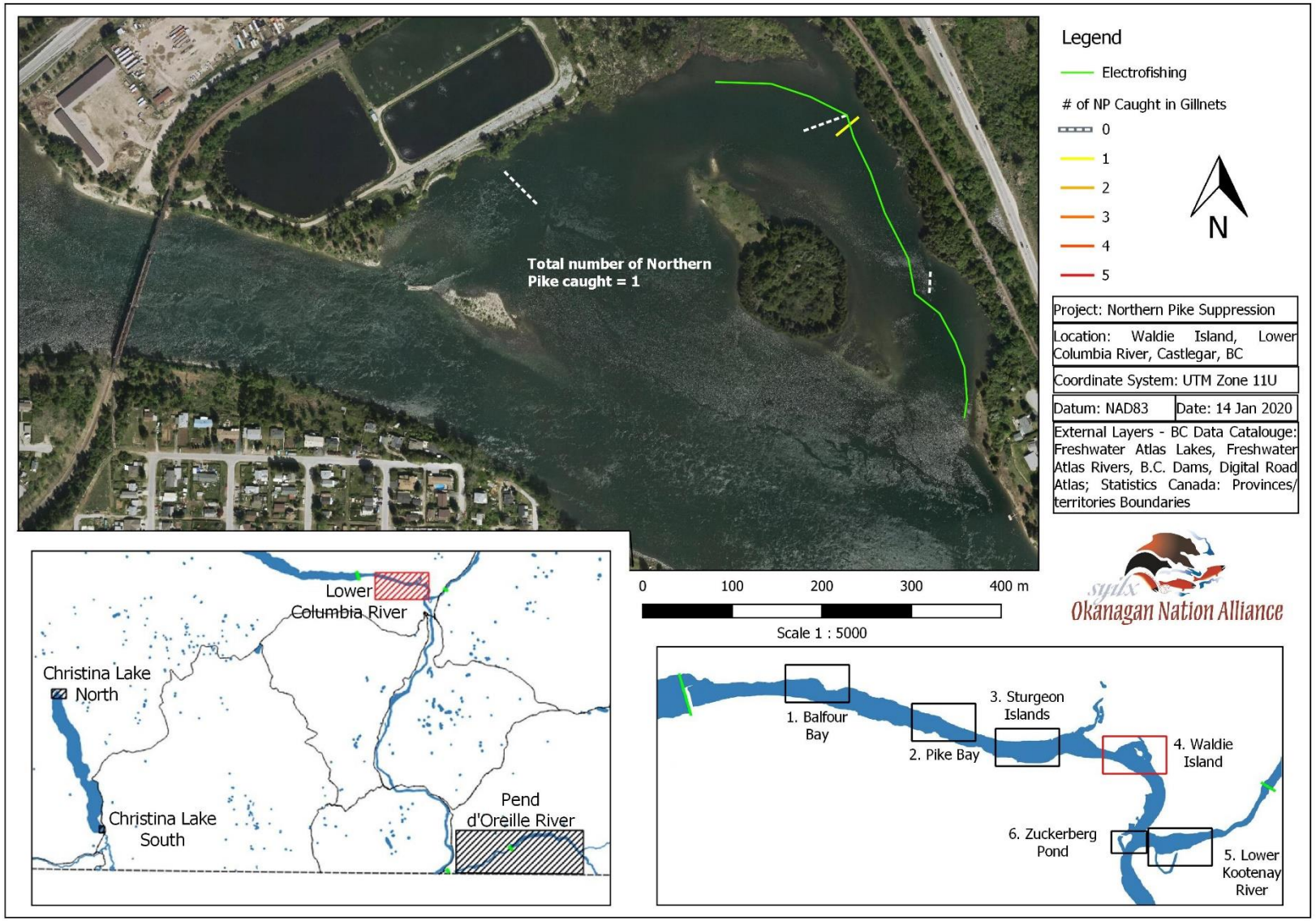

Figure 18. Waldie Island in the Columbia River depicting gillnet effort (short lines) and electrofishing effort (green line) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2018).

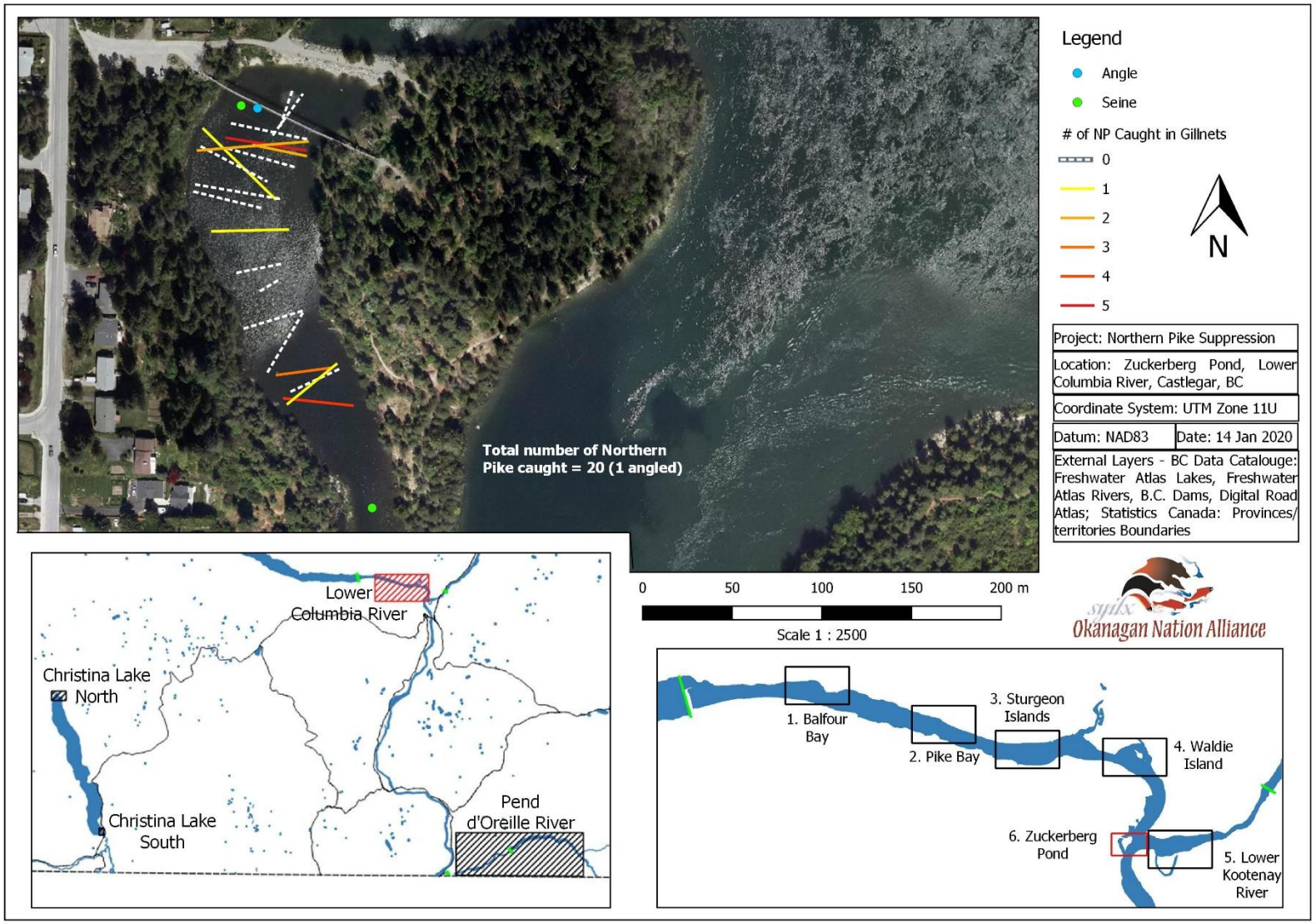

Figure 19. Zuckerberg Pond in the Columbia River depicting gillnet effort (short lines), successful angling location (blue point) and seine net sites (green points) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2018).

Appendix D-2: Pend d'Oreille River

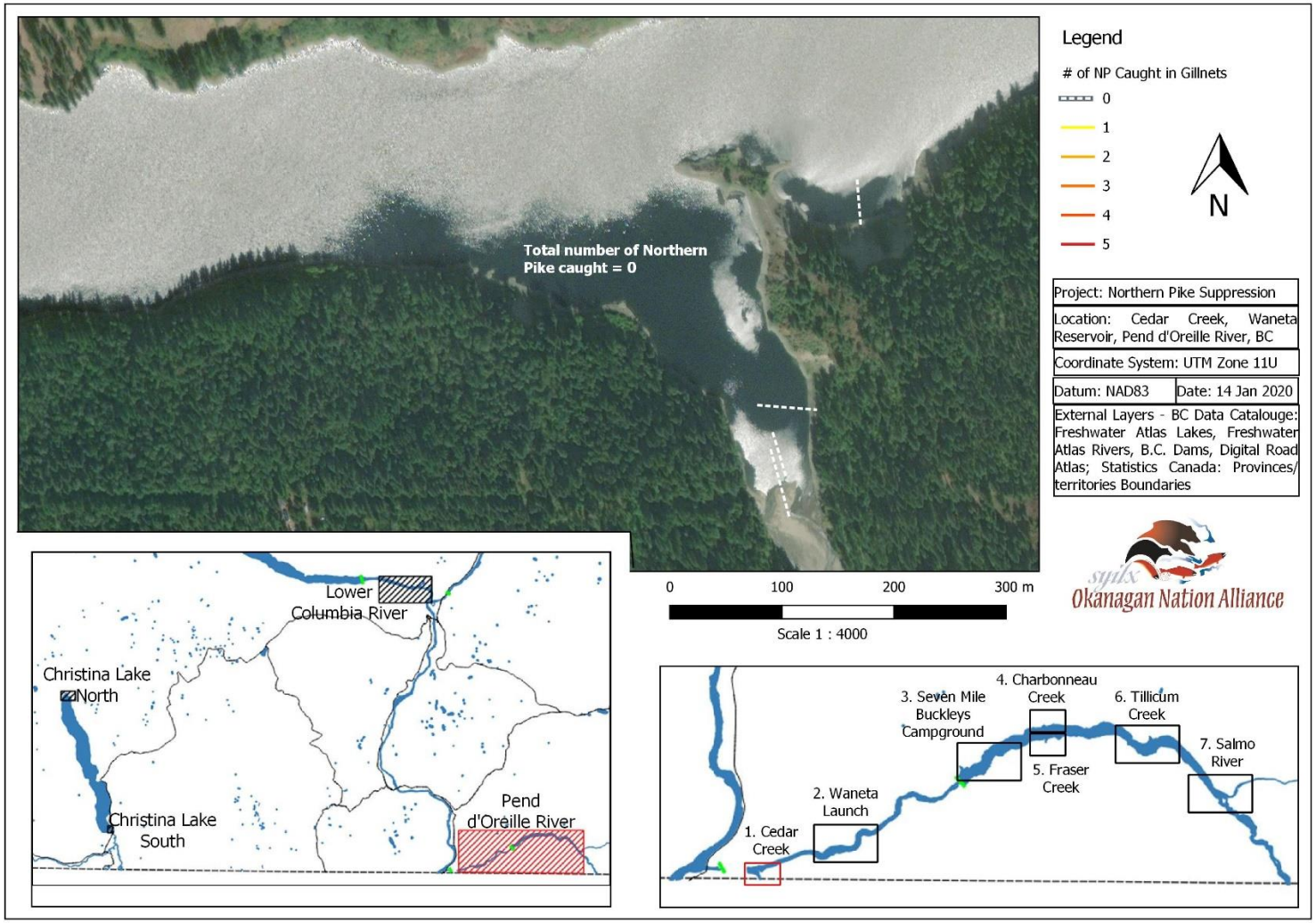

Figure 20. Cedar Creek in Waneta Reservoir (Pend d'Oreille River) depicting gillnet effort (short lines) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2017).

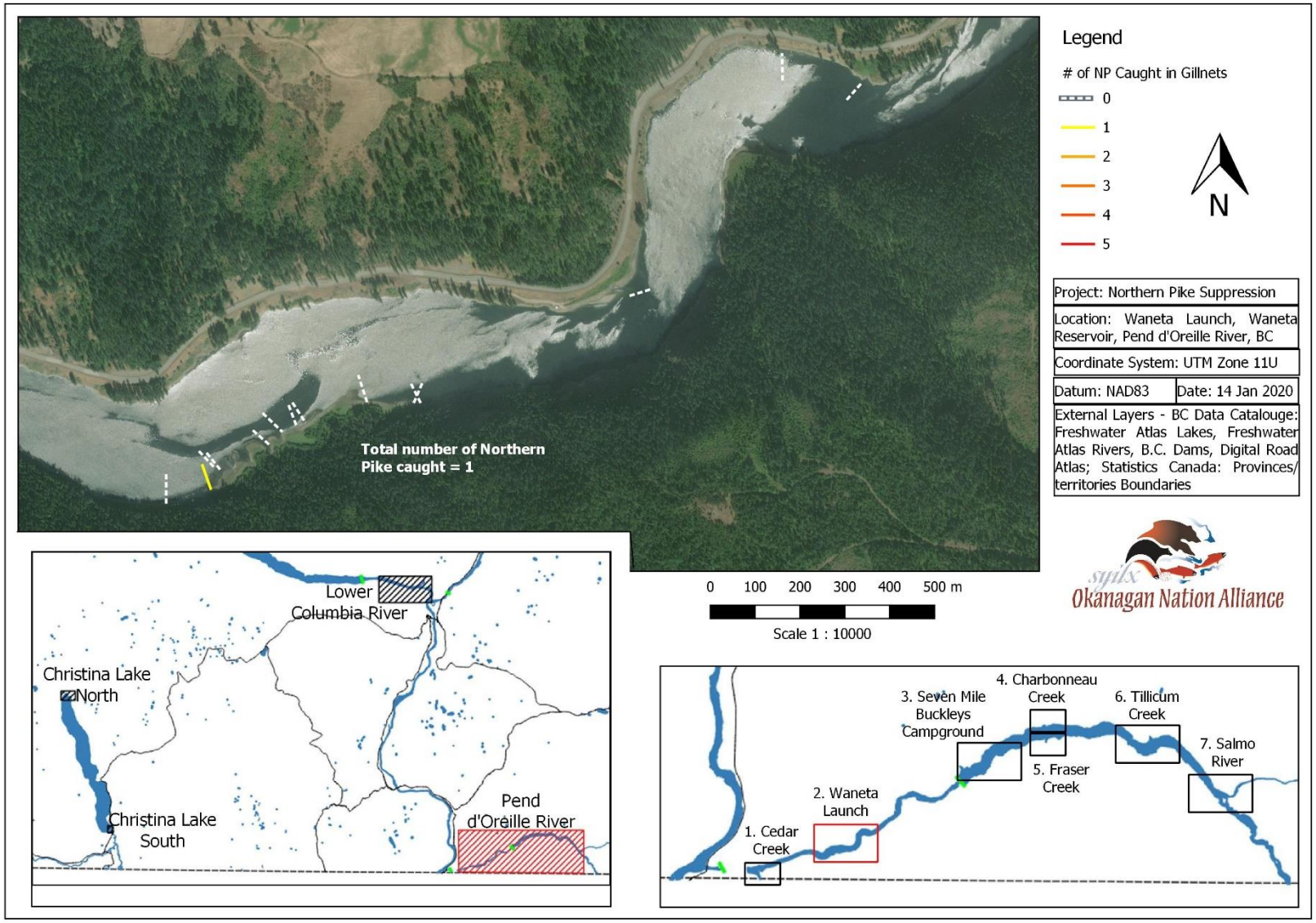

Figure 21. Waneta Launch in the Waneta Reservoir (Pend d'Oreille River) depicting gillnet effort (short lines) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2017).

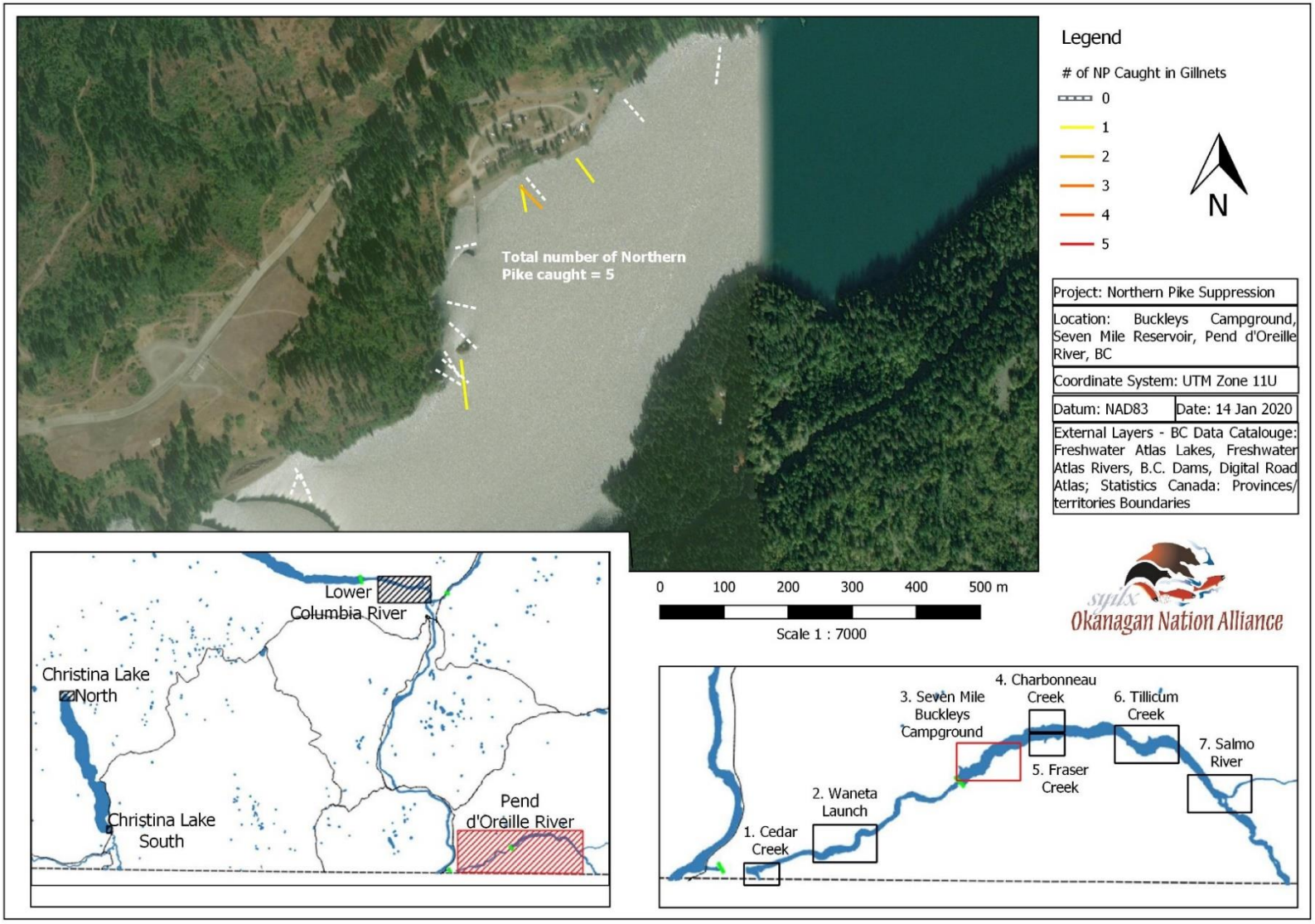

Figure 22. Buckley's Campground in the Seven Mile Reservoir (Pend d'Oreille River) depicting gillnet effort (short lines) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2014 and 2017).

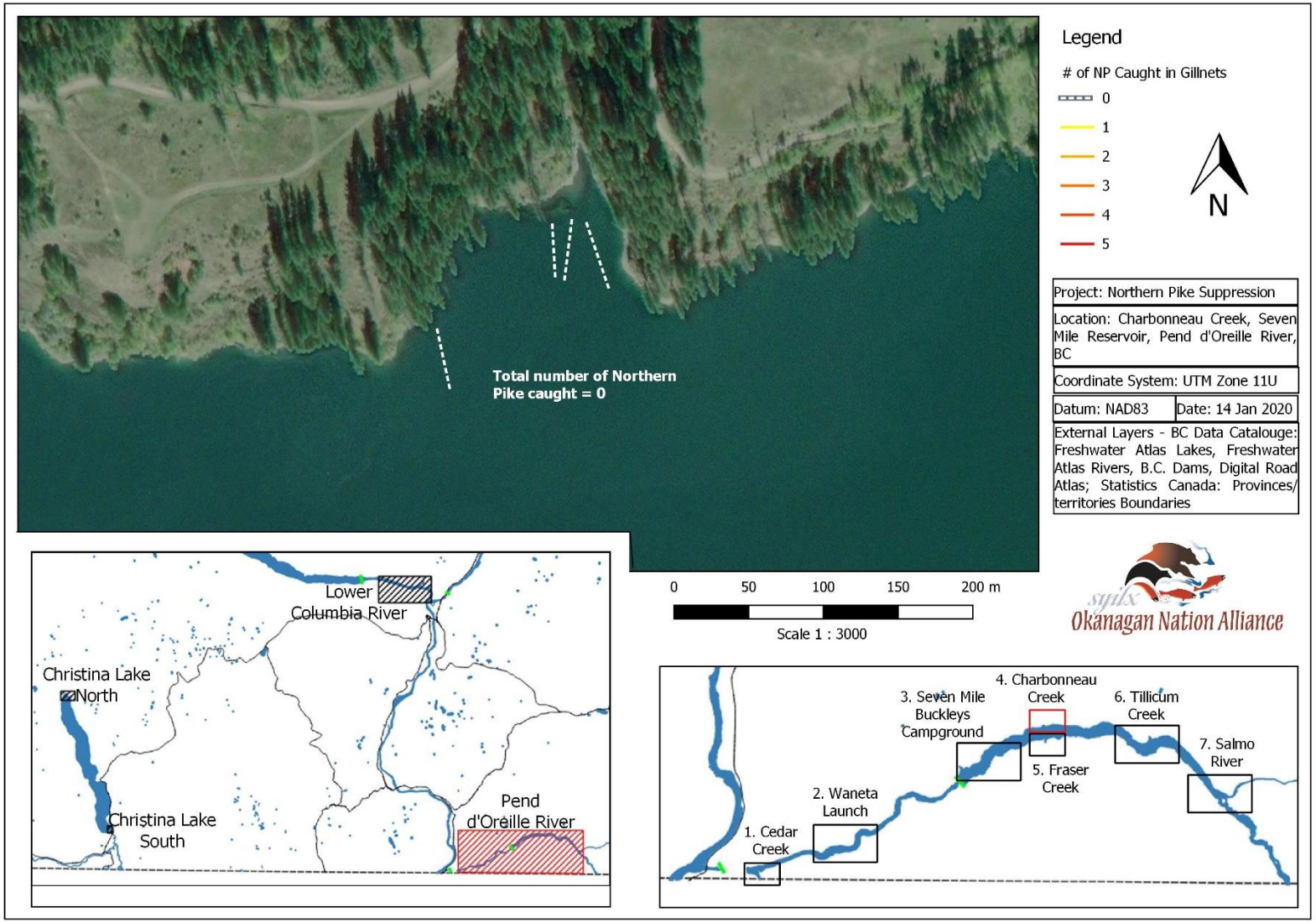

Figure 23. Charbonneau Creek in the Seven Mile Reservoir (Pend d'Oreille River) depicting gillnet effort (short lines) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2014).

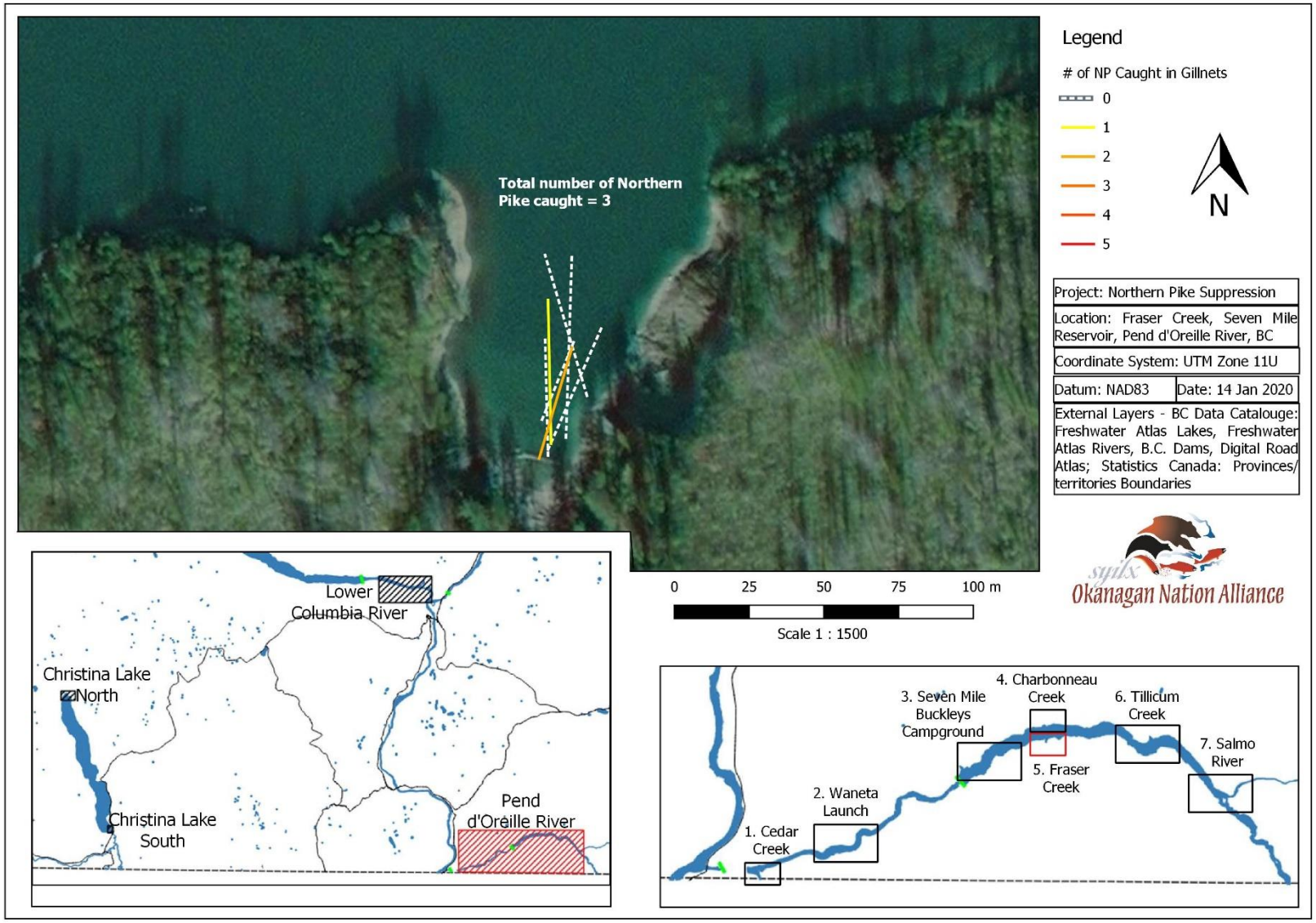

Figure 24. Fraser Creek in the Seven Mile Reservoir (Pend d'Oreille River) depicting gillnet effort (short lines) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2014).

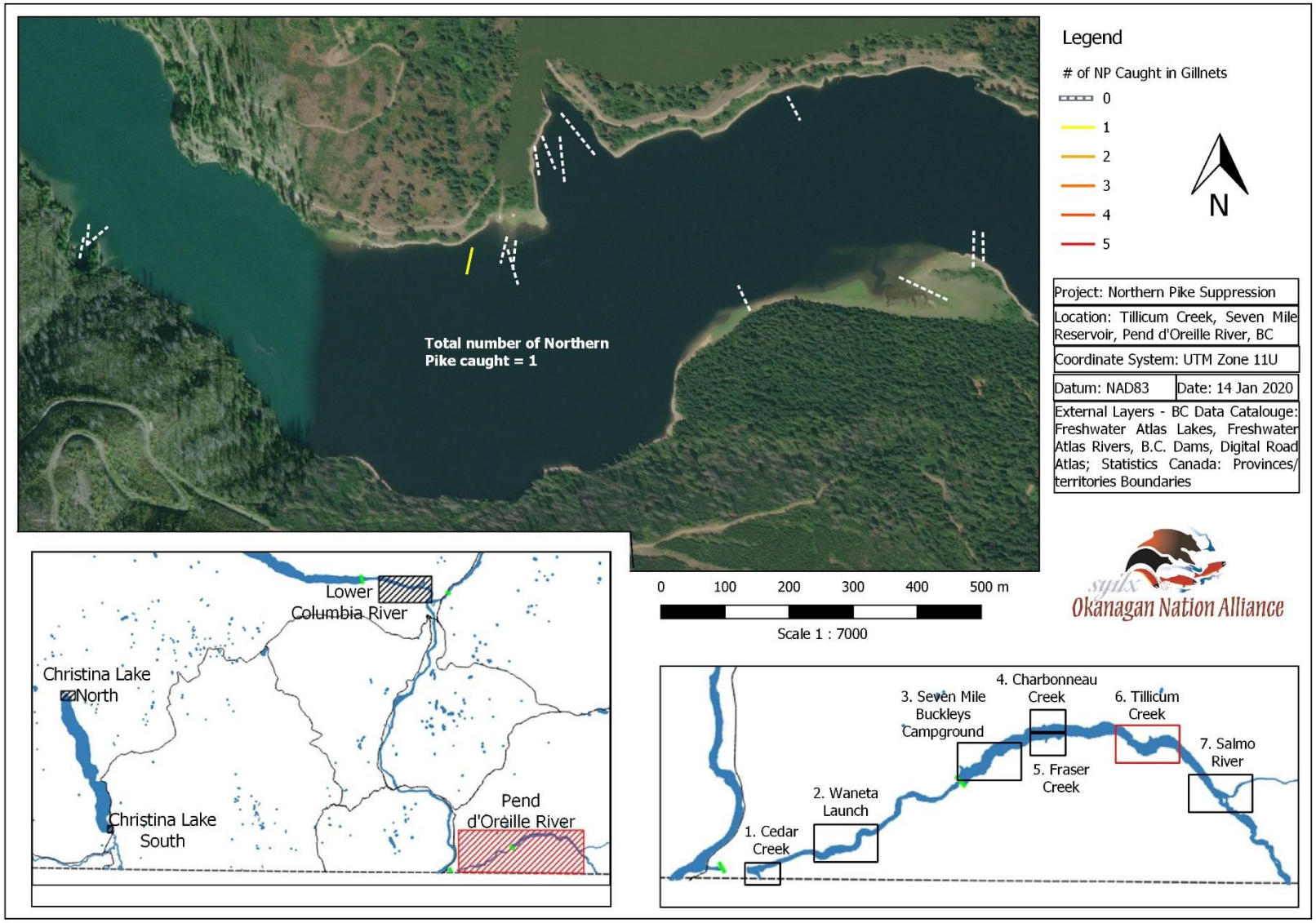

Figure 25. Tillicum Creek in the Seven Mile Reservoir (Pend d'Oreille River) depicting gillnet effort (short lines) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2014 and 2018).

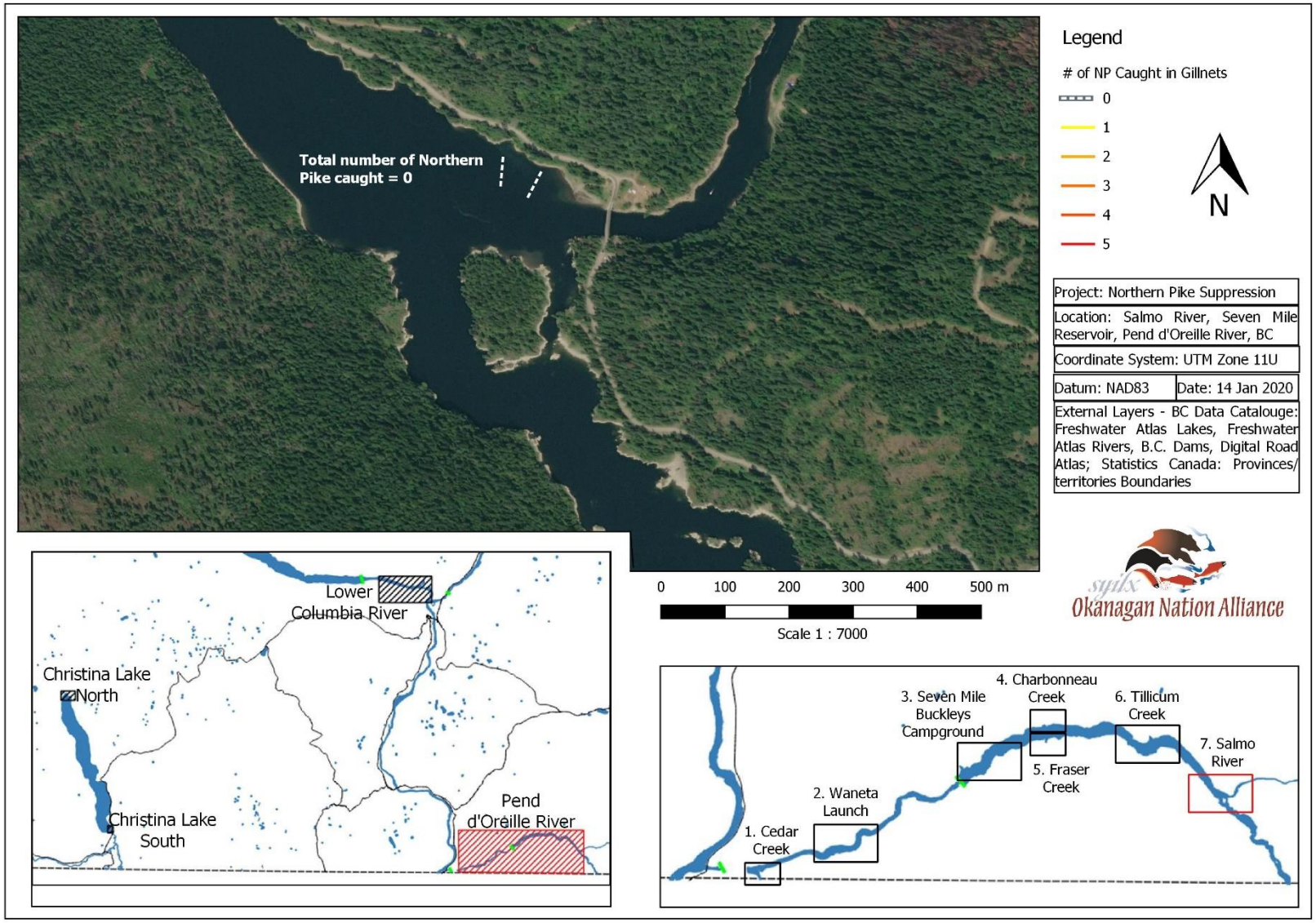

Figure 26. Salmo River in the Seven Mile Reservoir (Pend d'Oreille River) depicting gillnet effort (short lines) differentiating between number of Northern Pike caught by gillnet between April 15 2019 and August 30 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2018).

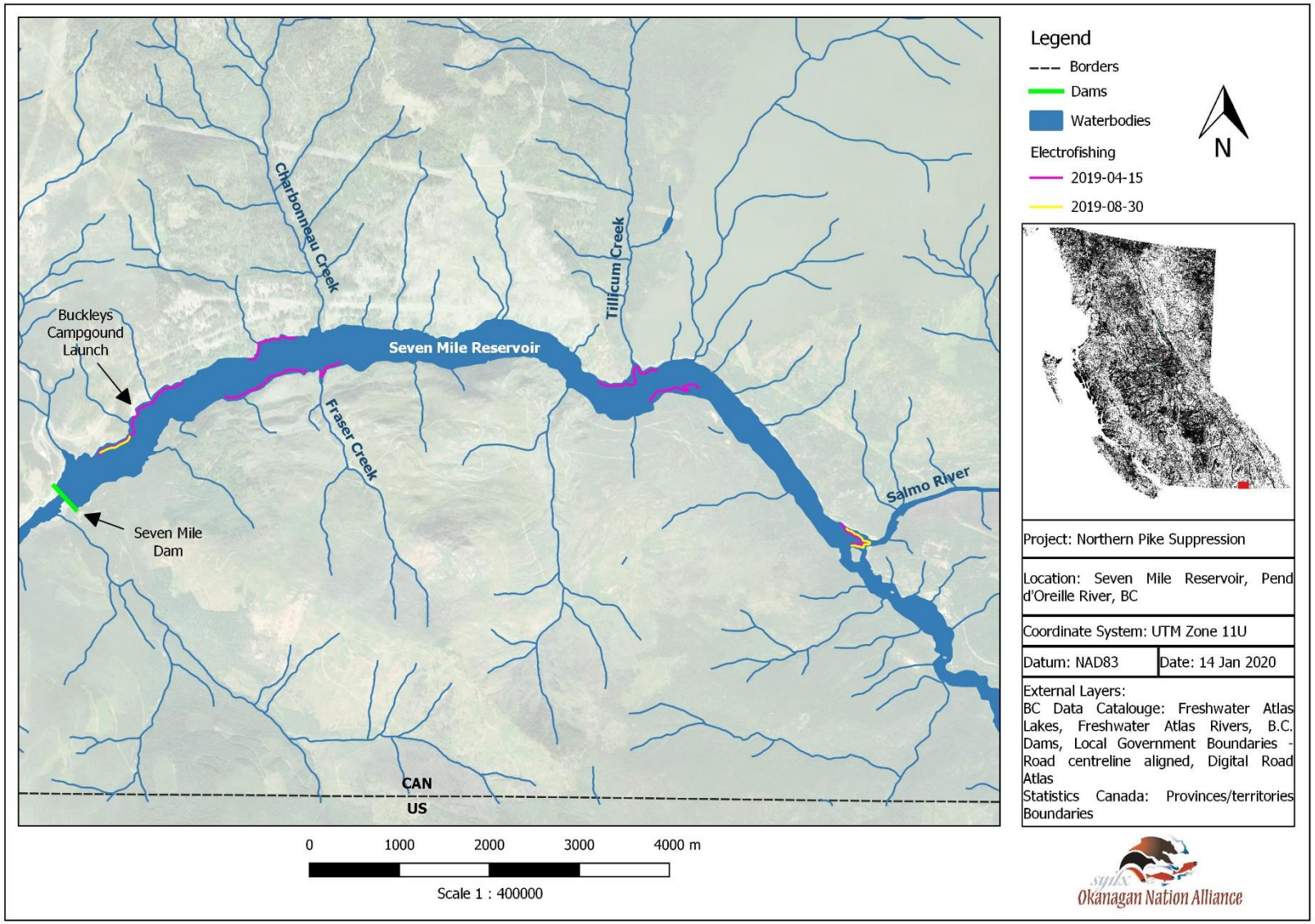

Figure 27. Electrofishing effort in the Seven Mile Reservoir (Pend d'Oreille River) on April 15 2019 (purple) and August 30 2019 (yellow; ESRI World Imagery 2014, 2017 and 2018).

Appendix D-3: Christina Lake

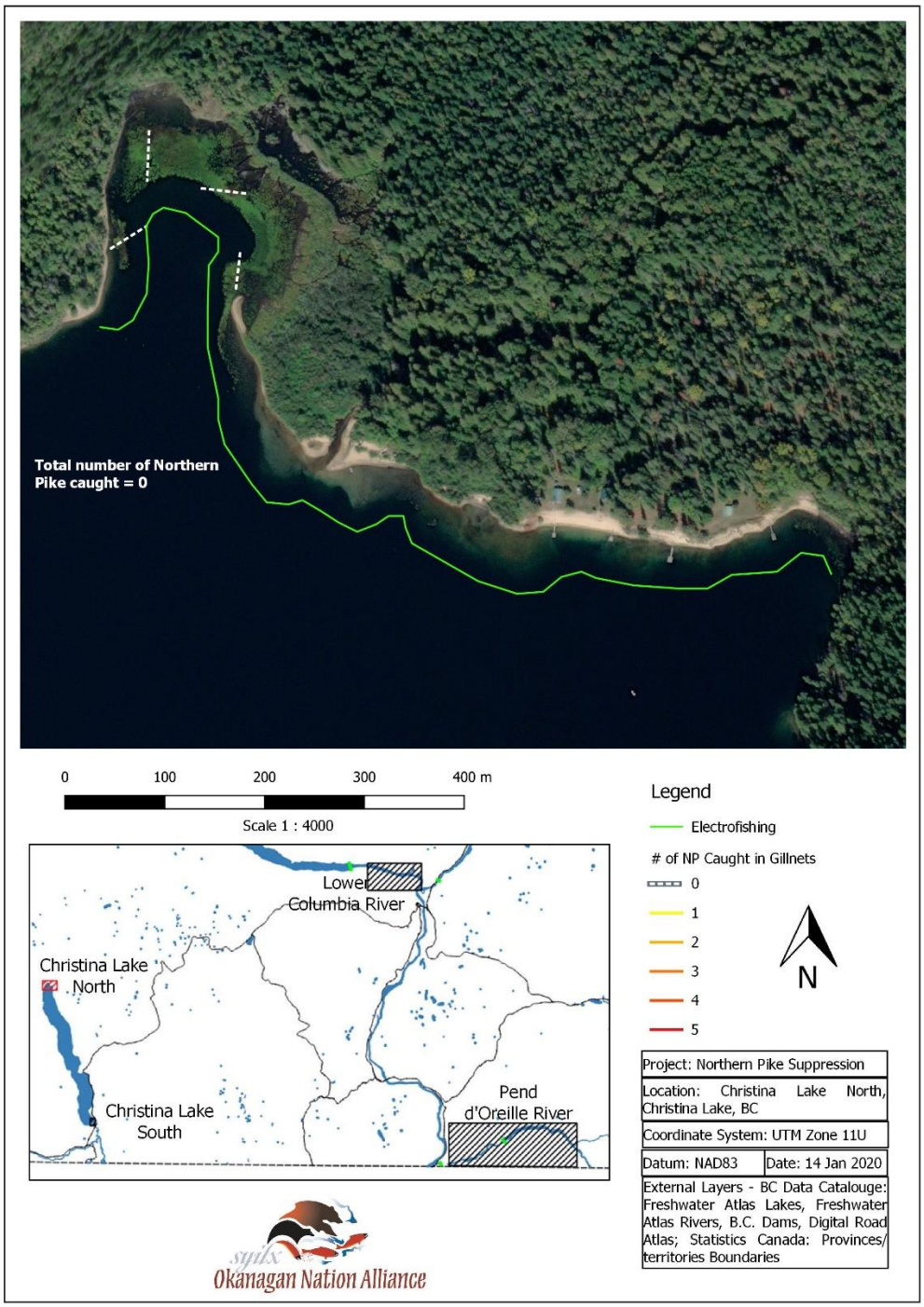

Figure 28. The north end of Christina Lake depicting gillnet effort (short lines), and electrofishing differentiating between the number of Northern Pike caught by gillnet between July 21 2019 and July 25 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2014).

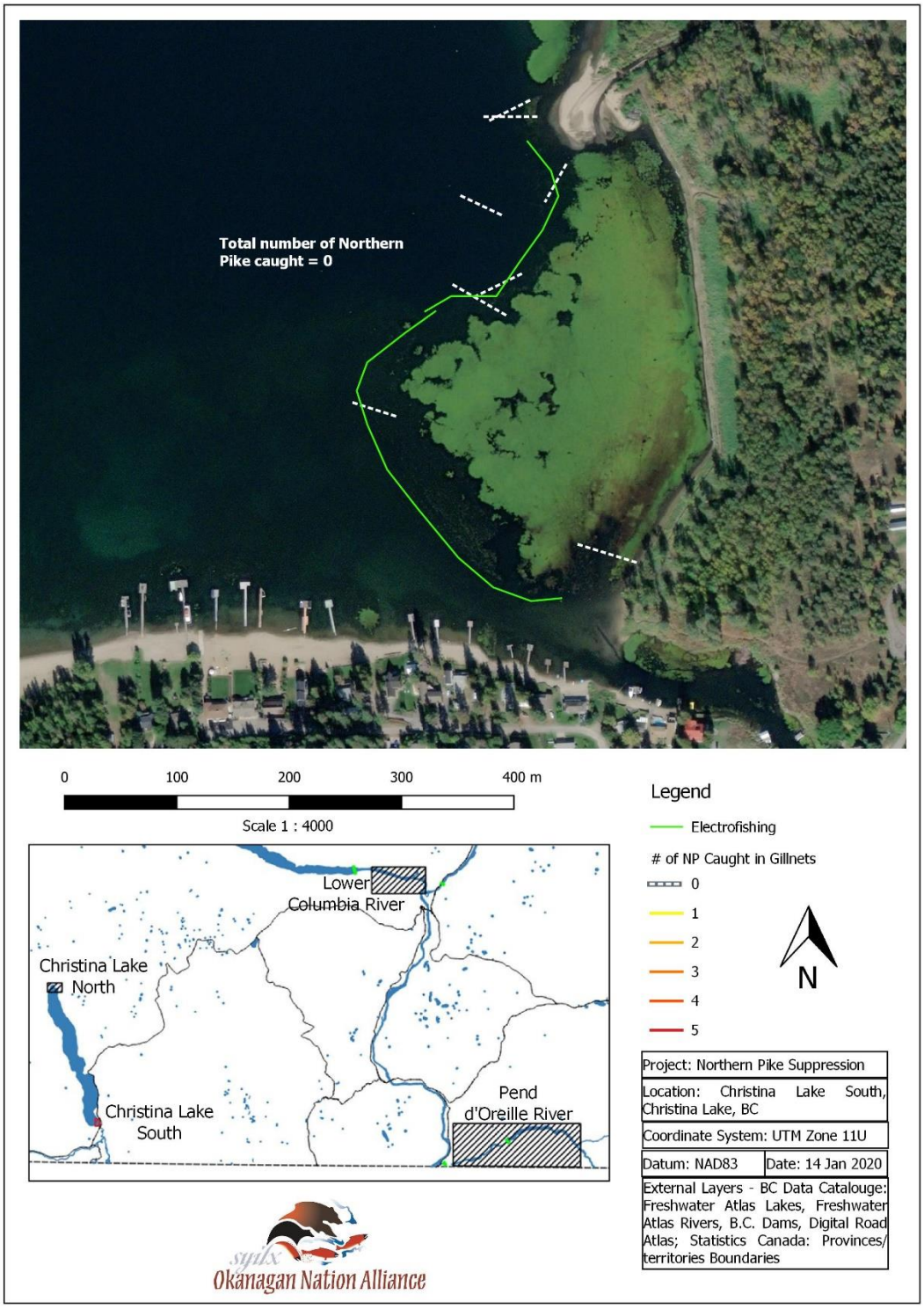

Figure 29. The south end of Christina Lake depicting gillnet effort (short lines), and electrofishing differentiating between the number of Northern Pike caught by gillnet between July 21 2019 and July 25 2019 where 0 = white hatched line, 1 = yellow line, 2 = orange line, 3 = amber line, 4 = red line, 5 = dark red line and a total number of Northern Pike displayed (ESRI World Imagery 2014).

Appendix E: Summary of Gillnet Effort by Season, Location, and Gillnet Type

Table 17. Summary of gillnet effort in total net-units, average net-units, count (# of sets) and total net hours by location, season, and gear (SPIN = Spring Pike Index Netting; JUV = Juvenile Netting) with resulting catch per unit effort (CPUE) in Northern Pike (NP) per net-units, Np per net hours, and NP per 8 net-hours.

	Location	Total Net-Units	Average Net-Units	Count	Total NP	Total Net Hours	CPUE (# NP / Net-Units)	CPUE (NP / Net Hours)	CPUE (NP / 8 Net Hours)
Totals	**Pend d'Oreille River**	**21.60**	**0.33**	**66**	**10**	**625.67**	**0.46**	**0.02**	**0.13**
	Columbia River	9.54	0.13	71	15	279.13	1.57	0.05	0.43
	Zuckerberg Pond	2.66	0.13	20	19	78.68	7.15	0.24	1.93
	Total Columbia River	**12.20**	**0.13**	**91**	**34**	**357.82**	**2.79**	**0.10**	**0.76**
	Pend d'Oreille and Columbia Rivers	33.80	0.22	157	44	983.48	1.30	0.04	0.36
	Christina Lake	**1.28**	**0.11**	**12**	**0**	**37.20**	**0.00**	**0.00**	**0.00**
	All Sites	35.24	0.21	169	44	1024.80	1.25	0.04	0.34
Spring (SPIN) April 01 - Jun 30	Seven Mile	6.83	0.28	24	9	196.75	1.32	0.05	0.37
	Waneta	11.70	0.65	18	1	340.03	0.09	0.00	0.02
	Pend d'Oreille River	18.53	0.44	42	10	536.78	0.54	0.02	0.15
	Columbia River*	1.28	0.11	12	0	37.00	0.00	0.00	0.00
	Columbia River**	9:18	0.14	45	14	188.12	2.19	0.07	0.60
	Columbia River Total	7.67	0.14	57	14	225.32	1.83	0.06	0.50
Summer (SPIN) July 01 - Aug 19	Zuckerberg Pond	1.021	0.128	8	1	31.02	0.98	0.03	0.26
	Christina Lake South	1.117	0.140	8	0	32.05	0.00	0.00	0.00
	Christina Lake North	0.323	0.081	4	0	9.27	0.00	0.00	0.00
Fall (SPIN + JUV) Aug 20 - Sep 30	Seven Mile Reservoir (SPIN + JUV)	3.069	0.128	24	0	88.88	0.00	0.00	0.00
	Columbia River (SPIN)	0.982	0.123	8	0	28.20	0.00	0.00	0.00
	Columbia River (JUV)	0.892	0.149	6	1	25.62	1.12	0.04	0.31
	Columbia River (SPIN + JUV nets)	1.87	0.13	14	1	53.82	0.53	0.02	0.15
	Zuckerberg Pond (SPIN)	0.54	0.13	4	0	16.15	0.00	0.00	0.00
	Zuckerberg Pond (JUV)	1.10	0.14	8	18	31.52	16.39	0.57	4.57
	Zuckerberg Pond (SPIN + JUV)	1.64	0.14	12	18	47.67	10.99	0.38	3.02

* Columbia River when water was less than 7°C

** Columbia River when water was more than 7°C

Appendix F: Northern Pike Biological Data

Table 18. Northern Pike biological and sample information of Individuals captured between April 15 2019 and August 30 2019 including length (mm), weight (g), sex, maturity, age structure used for aging, age (years), genetic structure collected for future analysis, Okanagan Nation Alliance lab reference number, panel size the Northern Pike was captured in inches, stomach contents (LSU = Longnose Sucker (*Catostomus catostomus*); MW = Mountain Whitefish (*Prosopium williamsoni*); RB = Rainbow Trout (*Oncorhynchus mykiss*); SU = Sucker sp. (*Catostomidae* sp.); YP = Yellow Perch (*Perca flavescens*)).

#	Sampling Method	Length (mm)	Weight (g)	Sex	Maturity	Age Structure	Age	Genetic Structure	Lab Reference #	Mesh Panel Size (inches)	Stomach Contents	Samples Taken	Comments
1	gillnet	785	4402	female	Mature	cleithrum	3+	fin ray	19220015	3.0	Vertebrae, fins, & worm	Head	Not quite gravid (eggs weigh 533 g)
2	gillnet	750	4169	female	Spawning	cleithrum	4+	fin ray	19220007	3.0	Empty	Head	Fully gravid (egg sacks gone), ripe Parasites in stomach
3	gillnet	773	5750	male	Mature	cleithrum	3+	fin ray	19220011	4.0	Empty	Head	Just pre-spawning Parasites in intestines
4	gillnet	839	5493	female	Spawning	cleithrum	3+	fin ray	19220009	4.0	Empty	Head	Fully gravid Parasites in intestines
5	gillnet	674	2590	male	Mature	cleithrum	3+	fin ray	19220008	3.0	Acoustic tag	Head	Pre-spawning Parasites in intestines
6	gillnet	939	7750	female	Spawning	cleithrum	3+	fin ray	19220010	3.0	Unidentifiable fish	Head	Fully gravid Parasites in intestines
7	gillnet	1055	11140	female	Spawning	cleithrum	4+/5	fin ray	19220016	2.0	Empty	Head	Fully gravid Parasites in intestines
8	gillnet	627	2061	male	Spawning	cleithrum	1+	fin ray	19220012	4.0	Unidentifiable fish vertebrae	Head	Spawning Parasites in intestines
9	gillnet	890	6620	female	Spawning	cleithrum	4+	fin ray	19220014	3.5	Empty	Head	Dead / dying in net Parasites in intestines
10	gillnet	750	3669	female	Spawning	cleithrum	3+	fin ray	19220013	3.5	Empty	Head	Fully gravid Parasites in intestines
11	gillnet	786	4339	female	Mature	cleithrum	2+	fin ray	19220028	3.0	Empty	Head	Not quite gravid (eggs weigh 724 g) Parasites in intestines Larger than other year 2
12	gillnet	628	2112	male	Mature	cleithrum	2+	fin ray	19220025	3.0	Earthworm, scales	Head	Pre-spawning Parasites in intestines

#	Sampling Method	Length (mm)	Weight (g)	Sex	Maturity	Age Structure	Age	Genetic Structure	Lab Reference #	Mesh Panel Size (inches)	Stomach Contents	Samples Taken	Comments
13	gillnet	570	1548	male	Spawning	cleithrum	1+	fin ray	19220024	3.5	Empty	Head	Spawning Parasites in stomach
14	gillnet	783	4744	female	Mature					3.5	Empty	Head	Not quite gravid (eggs weigh 757 g) Parasites in intestines Not sent to lab
15	gillnet	585	1905	male	unknown	cleithrum	1+	fin ray	19220026	2.0	2 LSU (115 mm, 123 mm) 2 RB (55 mm +/-, 82 mm +/-) 2 unknown fish (90 mm +/-, 55 mm +/-)	Head	Not spawning Parasites in intestines
16	gillnet	640	2505	unknown	unknown	cleithrum	2+	fin ray	19220017	2.0	1 SU (62 +/-) 1 unknown fish vertebrae	Head	Intestinal parasites
17	gillnet	581	1709	female	unknown	cleithrum	1+	fin ray	19220029	2.5	Empty	Head	Not spawned this year, eggs undeveloped but visible (124 g)- Parasites in intestines
18	gillnet	631	2134	male	unknown	cleithrum	2+	fin ray	19220027	2.5	Unidentifiable fish vertebrae	Head	Not ripe Parasites in intestines
19	gillnet	605	2124	male	unknown	cleithrum	2+	fin ray	19220020	2.0	Few rocks	Head	Not spawning Parasites in intestines
20	gillnet	820	5520	male	unknown	cleithrum	3+	fin ray	19220019	2.5	MW (324 mm, 428 g)	Head	Parasites in intestines
21	gillnet	539	1340	male	unknown	cleithrum	1+	fin ray	19220021	2.5	MW (114 mm)	Head	Parasites in intestines
22	gillnet	626	2228	male	unknown	cleithrum	2+	fin ray	19220018	2.5	RB (mostly digested; 125 mm +/-)	Head	Parasites in intestines
23	gillnet	625	2243	male	unknown	cleithrum	2+	fin ray	19220022	2.5	Jig with rubber worm Sculpin (78 mm +/-)	Head	Parasites in intestines
24	gillnet	543	1372	male	unknown	cleithrum	1+	fin ray	19220023	3.0	Empty	Head	Parasites in intestines
25	gillnet	655	2406	female	unknown					2.5	Empty	Head	Sex difficult to determine
26	gillnet	150	24	unknown	Immature					1.0	Longnose Dace	Whole Fish; Stomach Contents	Waldie Island
27	gillnet	309	201	unknown	Immature					1.0	Empty	Whole Fish	
28	gillnet	302	224	unknown	Immature					1.0	Unidentifiable fish vertebrae	Whole Fish; Stomach Contents	

#	Sampling Method	Length (mm)	Weight (g)	Sex	Maturity	Age Structure	Age	Genetic Structure	Lab Reference #	Mesh Panel Size (inches)	Stomach Contents	Samples Taken	Comments
29	gillnet	333	281	unknown	Immature					1.0	Empty	Whole fish	
30	gillnet	332	313	unknown	Immature					1.0	Unidentifiable fish vertebrae	Whole Fish; Stomach Contents	
31	gillnet	326	253	unknown	Immature					1.0	Unidentifiable fish vertebrae	Whole Fish; Stomach Contents	
32	gillnet	270	140	unknown	Immature					1.0	Empty	Whole Fish	
33	gillnet	249	105	unknown	Immature					1.0	Empty	Whole Fish	
34	gillnet	380	331	unknown	Immature					1.0	Empty	Whole Fish	
35	gillnet	371	313	unknown	Immature					1.0	Empty	Whole Fish	
36	gillnet	307	162	unknown	Immature					1.0	Unidentifiable fish parts	Whole Fish; Stomach Contents	
37	gillnet	301	140	unknown	Immature					1.0	Empty	Whole Fish	
38	gillnet	346	219	unknown	Immature					1.0	Possible Sucker	Whole Fish; Stomach Contents	
39	gillnet	368	340	unknown	Immature					1.0	Unidentifiable fish caudal fin	Whole Fish; Stomach Contents	
40	gillnet	317	224	unknown	Immature					1.0	Yellow Perch	Whole Fish; Stomach Contents	
41	gillnet	316	207	unknown	Immature					1.0	Unidentifiable fish	Whole Fish; Stomach Contents	
42	gillnet	322	234	unknown	Immature					1.0	Empty	Whole Fish	
43	gillnet	350	360	unknown	Immature					1.0	Empty	Whole Fish	

#	Sampling Method	Length (mm)	Weight (g)	Sex	Maturity	Age Structure	Age	Genetic Structure	Lab Reference #	Mesh Panel Size	Stomach Contents	Samples Taken	Comments
44	gillnet			unknown	Immature					1.0		no sample	Dead; fell off net
45	angling	310	218	unknown	Immature						Empty	Whole Fish	Caught in Zuckerberg Pond off point under bridge

Appendix G: 2019 Juvenile Northern Pike Captures

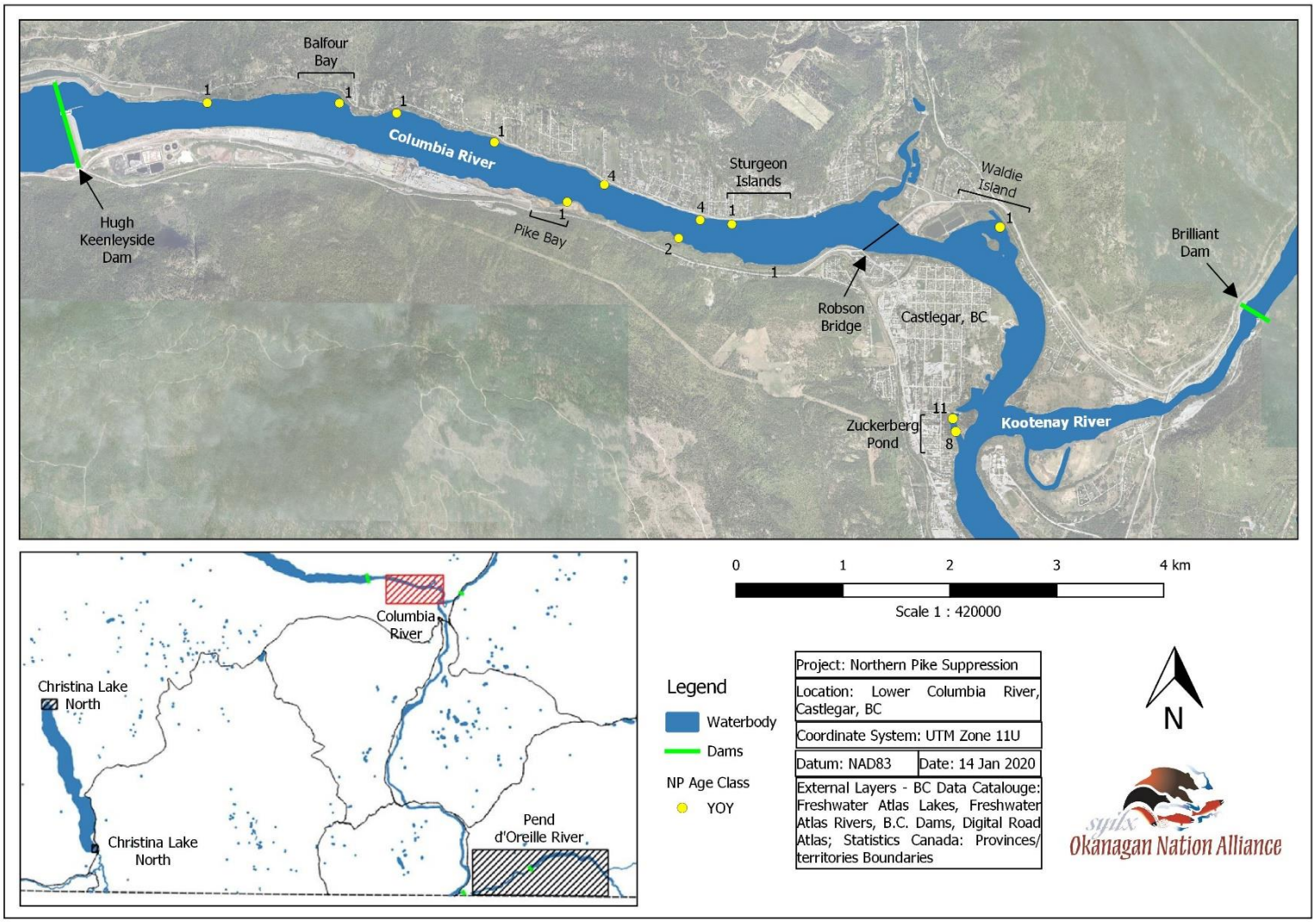

Figure 30. Juvenile Northern Pike locations in the Columbia River Robson Reach captured in 2019 during the Northern Pike Suppression Program and CLBMON 45 (BC Hydro unpublished data 2019).

Appendix H: Bycatch Data

Table 19. Bycatch by method in the Columbia River Mainstem and Lower Kootenay River, and Zuckerberg Pond.

Location	Sample Type	Species	Scientific Name	Status	Total Number
Columbia River Mainstem + Lower Kootenay River	Angling	No Bycatch Caught			
	Electrofishing	No Bycatch Caught			
	Gillnetting	Brook Trout	*Salvelinus fontinalis*	Non-native	3
		Kokanee	*Oncorhynchus nerka*	Native	2
		Lake Whitefish	*Coregonus clupeaformis*	Non-native	111
		Sucker sp.	*Catostomidae* sp.	Native	52
		Mountain Whitefish	*Prosopium williamsoni*	Native	133
		Northern Pikeminnow	*Ptychocheilus oregonensis*	Native	12
		Rainbow Trout	*Oncorhynchus mykiss*	Native	14
		Walleye	*Sander vitreus*	Non-native	16
		White Sturgeon	*Acipenser transmontanus*	Native	29
		Yellow Perch	*Perca flavescens*	Non-native	1
Zuckerberg Pond	Angling	No Bycatch Caught			
	Seine Net	Northern Pikeminnow	*Ptychocheilus oregonensis*	Native	35
		Peamouth Chub	*Mylocheilus caurinus*	Native	2
		Rainbow Trout	*Oncorhynchus mykiss*	Native	3
		Redside Shiner	*Richardsonius balteatus*	Native	9
		Sculpin sp.	*Cottoidea* sp.	Native	5
		Yellow Perch	*Perca flavescens*	Non-native	427
	Gillnetting	Common Carp	*Cyprinus carpio*	Non-native	1
		Sucker sp.	*Catostomidae* sp.	Native	30
		Northern Pikeminnow	*Ptychocheilus oregonensis*	Native	1
		Tench	*Tinca tinca*	Non-native	15
		Yellow Perch	*Perca flavescens*	Non-native	241

Table 20. Bycatch by method in the Pend d'Oreille River differentiating between Seven Mile Reservoir and Waneta Reservoir.

Location	Sample Type	Species	Scientific Name	Status	Total Number
Seven Mile Reservoir	Angling	No Bycatch Caught			
	Electrofishing	No Bycatch Caught			
	Gillnetting	Bass sp.	*Micropterus* sp.	Non-native	107
		Brown Trout	*Salmo trutta*	Non-native	1
		Bull Trout	*Salvelinus confluentus*	Native	4
		Lake Trout	*Salvelinus namaycush*	Non-native	1
		Sucker sp.	*Catostomidae* sp.	Native	54
		Mountain Whitefish	*Prosopium williamsoni*	Native	1
		Northern Pikeminnow	*Ptychocheilus oregonensis*	Native	17
		Peamouth Chub	*Mylocheilus caurinus*	Native	1
		Pumpkinseed	*Lepomis gibbosus*	Non-native	24
		Rainbow Trout	*Oncorhynchus mykiss*	Native	3
		Tench	*Tinca tinca*	Non-native	7
		Walleye	*Sander vitreus*	Non-native	15
		Yellow Perch	*Perca flavescens*	Non-native	836
Waneta Reservoir	Angling	No Bycatch Caught			
	Gillnetting	Brown Trout	*Salmo trutta*	Non-native	1
		Northern Pikeminnow	*Ptychocheilus oregonensis*	Native	11
		Rainbow Trout	*Oncorhynchus mykiss*	Native	3
		Sucker sp.	*Catostomidae* sp.	Native	80
		Tench	*Tinca tinca*	Non-native	1
		Walleye	*Sander vitreus*	Non-native	5
		Yellow Perch	*Perca flavescens*	Non-native	12

Table 21. Bycatch by method in Christina Lake differentiating between the north end of the lake and the south end.

Location	Sample Type	Species	Scientific Name	Status	Total Number
Christina Lake South	Electrofishing	Bass sp.	*Micropterus* sp.	Non-native	1
	Gillnetting	Bass sp.	*Micropterus* sp.	Non-native	4
		Common Carp	*Cyprinus carpio*	Non-native	2
		Longnose Sucker	*Catostomus catostomus*	Native	1
		Northern Pikeminnow	*Ptychocheilus oregonensis*	Native	4
		Pumpkinseed	*Lepomis gibbosus*	Non-native	2
		Tench	*Tinca tinca*	Non-native	13
		Yellow Perch	*Perca flavescens*	Non-native	2
Christina Lake North	Electrofishing	Bass sp.	*Micropterus* sp.	Non-native	1
		Black Bullhead	*Ameiurus melas*	Non-native	1
		Pumpkinseed	*Lepomis gibbosus*	Non-native	3
	Gillnetting	Bass sp.	*Micropterus* sp.	Non-native	4
		Black Bullhead	*Ameiurus melas*	Non-native	1
		Northern Pikeminnow	*Ptychocheilus oregonensis*	Native	2
		Pumpkinseed	*Lepomis gibbosus*	Non-native	3
		Tench	*Tinca tinca*	Non-native	3

Table 22. Bycatch by species at a given site including the number of individuals captured in the site with the minimum and maximum lengths; method and date of capture are also included.

Location	Site	Method	Date	Species	Number	Min length (mm)	Max length (mm)
Christina Lake	GNCL01	Gillnet	2019-07-23	Bass sp.	2	230	350
Christina Lake	GNCL04	Gillnet	2019-07-23	Bass sp.	1	210	210
Christina Lake	GNCL05	Gillnet	2019-07-24	Bass sp.	1		
Christina Lake	GNCL10	Gillnet	2019-07-25	Bass sp.	2	312	368
Christina Lake	GNCL11	Gillnet	2019-07-25	Bass sp.	1	292	292
Christina Lake	GNCL12	Gillnet	2019-07-25	Bass sp.	1	211	211
Christina Lake	EFCL04	Boat Electrofishing	2019-07-24	Bass sp.	1	257	257
Christina Lake	EFCL05	Boat Electrofishing	2019-07-25	Bass sp.	1	323	323
Pend d'Oreille River	GNPDO33	Gillnet	2019-05-02	Bass sp.	1		
Pend d'Oreille River	GNPDO37	Gillnet	2019-05-07	Bass sp.	1		
Pend d'Oreille River	GNPDO43	Gillnet	2019-08-21	Bass sp.	1	128	128
Pend d'Oreille River	GNPDO44	Gillnet	2019-08-21	Bass sp.	5	189	264
Pend d'Oreille River	GNPDO45	Gillnet	2019-08-21	Bass sp.	5	194	298
Pend d'Oreille River	GNPDO46	Gillnet	2019-08-21	Bass sp.	4	193	305
Pend d'Oreille River	GNPDO47	Gillnet	2019-08-21	Bass sp.	4	117	126
Pend d'Oreille River	GNPDO48	Gillnet	2019-08-22	Bass sp.	14	203	356
Pend d'Oreille River	GNPDO50	Gillnet	2019-08-22	Bass sp.	3	189	202
Pend d'Oreille River	GNPDO51	Gillnet	2019-08-22	Bass sp.	9	212	282
Pend d'Oreille River	GNPDO53	Gillnet	2019-08-23	Bass sp.	2	134	141
Pend d'Oreille River	GNPDO54	Gillnet	2019-08-23	Bass sp.	6	235	329
Pend d'Oreille River	GNPDO56	Gillnet	2019-08-23	Bass sp.	16	204	325
Pend d'Oreille River	GNPDO57	Gillnet	2019-08-23	Bass sp.	3	208	314
Pend d'Oreille River	GNPDO58	Gillnet	2019-08-28	Bass sp.	6	204	464
Pend d'Oreille River	GNPDO59	Gillnet	2019-08-28	Bass sp.	1	121	121
Pend d'Oreille River	GNPDO60	Gillnet	2019-08-28	Bass sp.	3	220	295
Pend d'Oreille River	GNPDO62	Gillnet	2019-08-30	Bass sp.	4	267	330
Pend d'Oreille River	GNPDO64	Gillnet	2019-08-30	Bass sp.	16	169	333
Pend d'Oreille River	GNPDO65	Gillnet	2019-08-30	Bass sp.	1	198	198
Pend d'Oreille River	GNPDO66	Gillnet	2019-08-30	Bass sp.	2	120	136
Christina Lake	GNCL09	Gillnet	2019-07-25	Black Bullhead	1	288	288
Christina Lake	EFCL05	Boat Electrofishing	2019-07-25	Black Bullhead	1	208	208
Columbia River	GNLCR23	Gillnet	2019-05-15	Brook Trout	1		
Columbia River	GNLCR30	Gillnet	2019-06-05	Brook Trout	1		
Kootenay River	GNLCR51	Gillnet	2019-06-10	Brook Trout	1		
Pend d'Oreille River	GNPDO26	Gillnet	2019-04-26	Brown Trout	1		
Pend d'Oreille River	GNPDO31	Gillnet	2019-05-02	Brown Trout	1		
Pend d'Oreille River	GNPDO09	Gillnet	2019-04-18	Bull Trout	2		
Pend d'Oreille River	GNPDO31	Gillnet	2019-05-02	Bull Trout	1	407	407
Pend d'Oreille River	GNPDO34	Gillnet	2019-05-02	Bull Trout	1		
Christina Lake	GNCL01	Gillnet	2019-07-23	Common Carp	1	733	733

Location	Site	Method	Date	Species	Number	Min length (mm)	Max length (mm)
Christina Lake	GNCL03	Gillnet	2019-07-23	Common Carp	1	670	670
Zuckerberg Pond	GNLCR79	Gillnet	2019-08-28	Common Carp	1	180	180
Columbia River	GNLCR82	Gillnet	2019-08-29	Kokanee	1	245	245
Kootenay River	GNLCR70	Gillnet	2019-08-22	Kokanee	1	200	200
Pend d'Oreille River	GNPDO10	Gillnet	2019-04-18	Lake Trout	1		
Columbia River	GNLCR02	Gillnet	2019-05-01	Lake Whitefish	1		
Columbia River	GNLCR03	Gillnet	2019-05-01	Lake Whitefish	1		
Columbia River	GNLCR05	Gillnet	2019-05-01	Lake Whitefish	3		
Columbia River	GNLCR08	Gillnet	2019-05-01	Lake Whitefish	1		
Columbia River	GNLCR09	Gillnet	2019-05-01	Lake Whitefish	1		
Columbia River	GNLCR10	Gillnet	2019-05-01	Lake Whitefish	2		
Columbia River	GNLCR14	Gillnet	2019-05-14	Lake Whitefish	2		
Columbia River	GNLCR15	Gillnet	2019-05-14	Lake Whitefish	1		
Columbia River	GNLCR16	Gillnet	2019-05-14	Lake Whitefish	8		
Columbia River	GNLCR19	Gillnet	2019-05-14	Lake Whitefish	2		
Columbia River	GNLCR20	Gillnet	2019-05-14	Lake Whitefish	2		
Columbia River	GNLCR22	Gillnet	2019-05-14	Lake Whitefish	3		
Columbia River	GNLCR25	Gillnet	2019-05-15	Lake Whitefish	1		
Columbia River	GNLCR26	Gillnet	2019-05-15	Lake Whitefish	1		
Columbia River	GNLCR30	Gillnet	2019-06-05	Lake Whitefish	2		
Columbia River	GNLCR31	Gillnet	2019-06-05	Lake Whitefish	2		
Columbia River	GNLCR32	Gillnet	2019-06-05	Lake Whitefish	1		
Columbia River	GNLCR33	Gillnet	2019-06-05	Lake Whitefish	1		
Columbia River	GNLCR34	Gillnet	2019-06-05	Lake Whitefish	5		
Columbia River	GNLCR35	Gillnet	2019-06-05	Lake Whitefish	2		
Columbia River	GNLCR40	Gillnet	2019-06-06	Lake Whitefish	10		
Columbia River	GNLCR43	Gillnet	2019-06-06	Lake Whitefish	1		
Columbia River	GNLCR45	Gillnet	2019-06-06	Lake Whitefish	2		
Columbia River	GNLCR46	Gillnet	2019-06-10	Lake Whitefish	3		
Columbia River	GNLCR47	Gillnet	2019-06-10	Lake Whitefish	1		
Columbia River	GNLCR48	Gillnet	2019-06-10	Lake Whitefish	2		
Columbia River	GNLCR49	Gillnet	2019-06-10	Lake Whitefish	5		
Columbia River	GNLCR50	Gillnet	2019-06-10	Lake Whitefish	14		
Columbia River	GNLCR52	Gillnet	2019-06-11	Lake Whitefish	1		
Columbia River	GNLCR53	Gillnet	2019-06-11	Lake Whitefish	4		
Columbia River	GNLCR54	Gillnet	2019-06-11	Lake Whitefish	5		
Columbia River	GNLCR55	Gillnet	2019-06-11	Lake Whitefish	1		
Columbia River	GNLCR56	Gillnet	2019-06-11	Lake Whitefish	2		
Columbia River	GNLCR57	Gillnet	2019-06-11	Lake Whitefish	4		
Columbia River	GNLCR68	Gillnet	2019-08-21	Lake Whitefish	1	445	445
Columbia River	GNLCR85	Gillnet	2019-08-29	Lake Whitefish	1	433	433

Location	Site	Method	Date	Species	Number	Min length (mm)	Max length (mm)
Kootenay River	GNLCR17	Gillnet	2019-05-14	Lake Whitefish	3		
Kootenay River	GNLCR42	Gillnet	2019-06-06	Lake Whitefish	9		
Columbia River	GNLCR19	Gillnet	2019-05-14	Largescale Sucker	1		
Columbia River	GNLCR33	Gillnet	2019-06-05	Largescale Sucker	2		
Columbia River	GNLCR49	Gillnet	2019-06-10	Largescale Sucker	1		
Columbia River	GNLCR53	Gillnet	2019-06-11	Largescale Sucker	1		
Kootenay River	GNLCR41	Gillnet	2019-06-06	Largescale Sucker	1		
Kootenay River	GNLCR42	Gillnet	2019-06-06	Largescale Sucker	1		
Pend d'Oreille River	GNPDO44	Gillnet	2019-08-21	Largescale Sucker	9	353	424
Pend d'Oreille River	GNPDO51	Gillnet	2019-08-22	Largescale Sucker	1	410	410
Pend d'Oreille River	GNPDO52	Gillnet	2019-08-22	Largescale Sucker	1	264	264
Pend d'Oreille River	GNPDO64	Gillnet	2019-08-30	Largescale Sucker	1	397	397
Christina Lake	GNCL08	Gillnet	2019-07-24	Longnose Sucker	1	447	447
Columbia River	GNLCR29	Gillnet	2019-06-05	Longnose Sucker	1		
Columbia River	GNLCR32	Gillnet	2019-06-05	Longnose Sucker	1		
Columbia River	GNLCR34	Gillnet	2019-06-05	Longnose Sucker	10		
Columbia River	GNLCR37	Gillnet	2019-06-06	Longnose Sucker	1		
Columbia River	GNLCR38	Gillnet	2019-06-06	Longnose Sucker	3		
Columbia River	GNLCR40	Gillnet	2019-06-06	Longnose Sucker	1		
Columbia River	GNLCR46	Gillnet	2019-06-10	Longnose Sucker	4		
Columbia River	GNLCR48	Gillnet	2019-06-10	Longnose Sucker	1		
Columbia River	GNLCR52	Gillnet	2019-06-11	Longnose Sucker	1		
Columbia River	GNLCR53	Gillnet	2019-06-11	Longnose Sucker	1		
Columbia River	GNLCR54	Gillnet	2019-06-11	Longnose Sucker	1		
Columbia River	GNLCR72	Gillnet	2019-08-22	Longnose Sucker	1	230	230
Kootenay River	GNLCR18	Gillnet	2019-05-14	Longnose Sucker	1		
Kootenay River	GNLCR42	Gillnet	2019-06-06	Longnose Sucker	2		
Pend d'Oreille River	GNPDO01	Gillnet	2019-04-17	Longnose Sucker	1		
Pend d'Oreille River	GNPDO45	Gillnet	2019-08-21	Longnose Sucker	1	414	414
Zuckerberg Pond	GNLCR59	Gillnet	2019-07-15	Longnose Sucker	1	265	265
Zuckerberg Pond	GNLCR65	Gillnet	2019-07-18	Longnose Sucker	1	255	255
Columbia River	GNLCR01	Gillnet	2019-05-01	Mountain Whitefish	7		
Columbia River	GNLCR02	Gillnet	2019-05-01	Mountain Whitefish	1		
Columbia River	GNLCR03	Gillnet	2019-05-01	Mountain Whitefish	2		
Columbia River	GNLCR05	Gillnet	2019-05-01	Mountain Whitefish	2		
Columbia River	GNLCR07	Gillnet	2019-05-01	Mountain Whitefish	1		
Columbia River	GNLCR08	Gillnet	2019-05-01	Mountain Whitefish	5		
Columbia River	GNLCR09	Gillnet	2019-05-01	Mountain Whitefish	3		
Columbia River	GNLCR15	Gillnet	2019-05-14	Mountain Whitefish	1		
Columbia River	GNLCR16	Gillnet	2019-05-14	Mountain Whitefish	1		
Columbia River	GNLCR24	Gillnet	2019-05-15	Mountain Whitefish	1		

Location	Site	Method	Date	Species	Number	Min length (mm)	Max length (mm)
Columbia River	GNLCR25	Gillnet	2019-05-15	Mountain Whitefish	4		
Columbia River	GNLCR28	Gillnet	2019-05-15	Mountain Whitefish	2		
Columbia River	GNLCR29	Gillnet	2019-06-05	Mountain Whitefish	6		
Columbia River	GNLCR30	Gillnet	2019-06-05	Mountain Whitefish	1		
Columbia River	GNLCR31	Gillnet	2019-06-05	Mountain Whitefish	1		
Columbia River	GNLCR32	Gillnet	2019-06-05	Mountain Whitefish	2		
Columbia River	GNLCR33	Gillnet	2019-06-05	Mountain Whitefish	2		
Columbia River	GNLCR34	Gillnet	2019-06-05	Mountain Whitefish	4		
Columbia River	GNLCR35	Gillnet	2019-06-05	Mountain Whitefish	2		
Columbia River	GNLCR37	Gillnet	2019-06-06	Mountain Whitefish	2		
Columbia River	GNLCR38	Gillnet	2019-06-06	Mountain Whitefish	2		
Columbia River	GNLCR39	Gillnet	2019-06-06	Mountain Whitefish	3		
Columbia River	GNLCR44	Gillnet	2019-06-06	Mountain Whitefish	1		
Columbia River	GNLCR45	Gillnet	2019-06-06	Mountain Whitefish	3		
Columbia River	GNLCR46	Gillnet	2019-06-10	Mountain Whitefish	2		
Columbia River	GNLCR48	Gillnet	2019-06-10	Mountain Whitefish	2		
Columbia River	GNLCR49	Gillnet	2019-06-10	Mountain Whitefish	1		
Columbia River	GNLCR50	Gillnet	2019-06-10	Mountain Whitefish	6		
Columbia River	GNLCR53	Gillnet	2019-06-11	Mountain Whitefish	3		
Columbia River	GNLCR54	Gillnet	2019-06-11	Mountain Whitefish	1		
Columbia River	GNLCR55	Gillnet	2019-06-11	Mountain Whitefish	1		
Columbia River	GNLCR56	Gillnet	2019-06-11	Mountain Whitefish	1		
Columbia River	GNLCR57	Gillnet	2019-06-11	Mountain Whitefish	2		
Columbia River	GNLCR67	Gillnet	2019-08-21	Mountain Whitefish	14	280	365
Columbia River	GNLCR68	Gillnet	2019-08-21	Mountain Whitefish	11	300	415
Columbia River	GNLCR72	Gillnet	2019-08-22	Mountain Whitefish	2	420	455
Columbia River	GNLCR74	Gillnet	2019-08-22	Mountain Whitefish	1	290	290
Columbia River	GNLCR84	Gillnet	2019-08-29	Mountain Whitefish	6	310	370
Columbia River	GNLCR85	Gillnet	2019-08-29	Mountain Whitefish	8	255	385
Kootenay River	GNLCR17	Gillnet	2019-05-14	Mountain Whitefish	1		
Kootenay River	GNLCR41	Gillnet	2019-06-06	Mountain Whitefish	10		
Kootenay River	GNLCR42	Gillnet	2019-06-06	Mountain Whitefish	2		
Kootenay River	GNLCR70	Gillnet	2019-08-22	Mountain Whitefish	1	360	360
Pend d'Oreille River	GNPDO31	Gillnet	2019-05-02	Mountain Whitefish	1		
Christina Lake	GNCL03	Gillnet	2019-07-23	Northern Pikeminnow	1		
Christina Lake	GNCL05	Gillnet	2019-07-24	Northern Pikeminnow	1	305	305
Christina Lake	GNCL08	Gillnet	2019-07-24	Northern Pikeminnow	2	246	258
Christina Lake	GNCL10	Gillnet	2019-07-25	Northern Pikeminnow	1	270	270
Christina Lake	GNCL12	Gillnet	2019-07-25	Northern Pikeminnow	1	401	401
Columbia River	GNLCR24	Gillnet	2019-05-15	Northern Pikeminnow	1		
Columbia River	GNLCR57	Gillnet	2019-06-11	Northern Pikeminnow	1		

Location	Site	Method	Date	Species	Number	Min length (mm)	Max length (mm)
Columbia River	GNLCR66	Gillnet	2019-08-21	Northern Pikeminnow	2		
Columbia River	GNLCR71	Gillnet	2019-08-22	Northern Pikeminnow	1	110	110
Columbia River	GNLCR74	Gillnet	2019-08-22	Northern Pikeminnow	1	230	230
Columbia River	GNLCR84	Gillnet	2019-08-29	Northern Pikeminnow	1	211	211
Kootenay River	GNLCR17	Gillnet	2019-05-14	Northern Pikeminnow	1		
Kootenay River	GNLCR41	Gillnet	2019-06-06	Northern Pikeminnow	4		
Pend d'Oreille River	GNPDO05	Gillnet	2019-04-17	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO09	Gillnet	2019-04-18	Northern Pikeminnow	3		
Pend d'Oreille River	GNPDO11	Gillnet	2019-04-18	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO13	Gillnet	2019-04-18	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO16	Gillnet	2019-04-25	Northern Pikeminnow	2		
Pend d'Oreille River	GNPDO18	Gillnet	2019-04-25	Northern Pikeminnow	2		
Pend d'Oreille River	GNPDO24	Gillnet	2019-04-25	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO25	Gillnet	2019-04-26	Northern Pikeminnow	2		
Pend d'Oreille River	GNPDO29	Gillnet	2019-04-26	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO30	Gillnet	2019-04-26	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO31	Gillnet	2019-05-02	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO32	Gillnet	2019-05-02	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO33	Gillnet	2019-05-02	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO34	Gillnet	2019-05-02	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO36	Gillnet	2019-05-02	Northern Pikeminnow	1		
Pend d'Oreille River	GNPDO40	Gillnet	2019-05-08	Northern Pikeminnow	2		
Pend d'Oreille River	GNPDO44	Gillnet	2019-08-21	Northern Pikeminnow	1	405	405
Pend d'Oreille River	GNPDO45	Gillnet	2019-08-21	Northern Pikeminnow	1	420	420
Pend d'Oreille River	GNPDO47	Gillnet	2019-08-21	Northern Pikeminnow	1	129	129
Pend d'Oreille River	GNPDO56	Gillnet	2019-08-23	Northern Pikeminnow	1	395	395
Pend d'Oreille River	GNPDO57	Gillnet	2019-08-23	Northern Pikeminnow	1	466	466
Pend d'Oreille River	GNPDO60	Gillnet	2019-08-28	Northern Pikeminnow	1	370	370
Zuckerberg Pond	GNLCR89	Gillnet	2019-08-30	Northern Pikeminnow	1	137	137
Zuckerberg Pond	SNLCR01	Seine Netting	2019-07-11	Northern Pikeminnow	35	39	94
Zuckerberg Pond	SNLCR01	Seine Netting	2019-07-11	Peamouth Chub	2	40	60
Pend d'Oreille River	GNPDO14	Gillnet	2019-04-18	Peamouth Chub	1		
Christina Lake	GNCL01	Gillnet	2019-07-23	Pumpkinseed	1	170	170
Christina Lake	GNCL05	Gillnet	2019-07-24	Pumpkinseed	1	120	120
Christina Lake	GNCL09	Gillnet	2019-07-25	Pumpkinseed	1	123	123
Christina Lake	GNCL10	Gillnet	2019-07-25	Pumpkinseed	1	145	145
Christina Lake	GNCL12	Gillnet	2019-07-25	Pumpkinseed	1	133	133
Christina Lake	EFCL05	Boat Electrofishing	2019-07-25	Pumpkinseed	3	96	125
Pend d'Oreille River	GNPDO47	Gillnet	2019-08-21	Pumpkinseed	14	72	83
Pend d'Oreille River	GNPDO49	Gillnet	2019-08-22	Pumpkinseed	2	81	88
Pend d'Oreille River	GNPDO53	Gillnet	2019-08-23	Pumpkinseed	8	66	78

Location	Site	Method	Date	Species	Number	Min length (mm)	Max length (mm)
Columbia River	GNLCR10	Gillnet	2019-05-01	Rainbow Trout	1		
Columbia River	GNLCR16	Gillnet	2019-05-14	Rainbow Trout	1		
Columbia River	GNLCR20	Gillnet	2019-05-14	Rainbow Trout	1		
Columbia River	GNLCR39	Gillnet	2019-06-06	Rainbow Trout	1		
Columbia River	GNLCR45	Gillnet	2019-06-06	Rainbow Trout	1		
Columbia River	GNLCR46	Gillnet	2019-06-10	Rainbow Trout	1		
Columbia River	GNLCR48	Gillnet	2019-06-10	Rainbow Trout	3		
Columbia River	GNLCR50	Gillnet	2019-06-10	Rainbow Trout	1		
Columbia River	GNLCR56	Gillnet	2019-06-11	Rainbow Trout	2		
Columbia River	GNLCR67	Gillnet	2019-08-21	Rainbow Trout	1	375	375
Columbia River	GNLCR72	Gillnet	2019-08-22	Rainbow Trout	1	370	370
Pend d'Oreille River	GNPDO18	Gillnet	2019-04-25	Rainbow Trout	1		
Pend d'Oreille River	GNPDO27	Gillnet	2019-04-26	Rainbow Trout	1		
Pend d'Oreille River	GNPDO28	Gillnet	2019-04-26	Rainbow Trout	1		
Pend d'Oreille River	GNPDO32	Gillnet	2019-05-02	Rainbow Trout	1		
Pend d'Oreille River	GNPDO34	Gillnet	2019-05-02	Rainbow Trout	2		
Zuckerberg Pond	SNLCR02	Seine Netting	2019-07-11	Rainbow Trout	3	29	38
Zuckerberg Pond	SNLCR01	Seine Netting	2019-07-11	Redside Shiner	9	30	50
Zuckerberg Pond	SNLCR02	Seine Netting	2019-07-11	Sculpin sp.	5	79	82
Columbia River	GNLCR06	Gillnet	2019-05-01	Sucker sp.	2		
Columbia River	GNLCR16	Gillnet	2019-05-14	Sucker sp.	1		
Columbia River	GNLCR27	Gillnet	2019-05-15	Sucker sp.	2		
Columbia River	GNLCR30	Gillnet	2019-06-05	Sucker sp.	1		
Columbia River	GNLCR32	Gillnet	2019-06-05	Sucker sp.	1		
Columbia River	GNLCR35	Gillnet	2019-06-05	Sucker sp.	1		
Columbia River	GNLCR36	Gillnet	2019-06-05	Sucker sp.	1		
Columbia River	GNLCR43	Gillnet	2019-06-06	Sucker sp.	2		
Columbia River	GNLCR44	Gillnet	2019-06-06	Sucker sp.	3		
Columbia River	GNLCR67	Gillnet	2019-08-21	Sucker sp.	1	390	390
Pend d'Oreille River	GNPDO05	Gillnet	2019-04-17	Sucker sp.	4		
Pend d'Oreille River	GNPDO07	Gillnet	2019-04-17	Sucker sp.	2		
Pend d'Oreille River	GNPDO09	Gillnet	2019-04-18	Sucker sp.	3		
Pend d'Oreille River	GNPDO10	Gillnet	2019-04-18	Sucker sp.	2		
Pend d'Oreille River	GNPDO11	Gillnet	2019-04-18	Sucker sp.	2		
Pend d'Oreille River	GNPDO12	Gillnet	2019-04-18	Sucker sp.	2		
Pend d'Oreille River	GNPDO13	Gillnet	2019-04-18	Sucker sp.	3		
Pend d'Oreille River	GNPDO14	Gillnet	2019-04-18	Sucker sp.	4		
Pend d'Oreille River	GNPDO16	Gillnet	2019-04-25	Sucker sp.	9		
Pend d'Oreille River	GNPDO18	Gillnet	2019-04-25	Sucker sp.	4		
Pend d'Oreille River	GNPDO19	Gillnet	2019-04-25	Sucker sp.	1		
Pend d'Oreille River	GNPDO21	Gillnet	2019-04-25	Sucker sp.	2		

Location	Site	Method	Date	Species	Number	Min length (mm)	Max length (mm)
Pend d'Oreille River	GNPDO22	Gillnet	2019-04-25	Sucker sp.	2		
Pend d'Oreille River	GNPDO23	Gillnet	2019-04-25	Sucker sp.	14		
Pend d'Oreille River	GNPDO24	Gillnet	2019-04-25	Sucker sp.	1		
Pend d'Oreille River	GNPDO25	Gillnet	2019-04-26	Sucker sp.	15		
Pend d'Oreille River	GNPDO26	Gillnet	2019-04-26	Sucker sp.	7		
Pend d'Oreille River	GNPDO28	Gillnet	2019-04-26	Sucker sp.	2		
Pend d'Oreille River	GNPDO29	Gillnet	2019-04-26	Sucker sp.	5		
Pend d'Oreille River	GNPDO30	Gillnet	2019-04-26	Sucker sp.	6		
Pend d'Oreille River	GNPDO32	Gillnet	2019-05-02	Sucker sp.	2		
Pend d'Oreille River	GNPDO33	Gillnet	2019-05-02	Sucker sp.	2		
Pend d'Oreille River	GNPDO35	Gillnet	2019-05-02	Sucker sp.	4		
Pend d'Oreille River	GNPDO38	Gillnet	2019-05-07	Sucker sp.	2		
Pend d'Oreille River	GNPDO39	Gillnet	2019-05-07	Sucker sp.	3		
Pend d'Oreille River	GNPDO40	Gillnet	2019-05-08	Sucker sp.	1		
Pend d'Oreille River	GNPDO42	Gillnet	2019-05-08	Sucker sp.	11		
Pend d'Oreille River	GNPDO56	Gillnet	2019-08-23	Sucker sp.	1	433	433
Pend d'Oreille River	GNPDO57	Gillnet	2019-08-23	Sucker sp.	4	374	408
Zuckerberg Pond	GNLCR77	Gillnet	2019-08-27	Sucker sp.	3	143	145
Zuckerberg Pond	GNLCR88	Gillnet	2019-08-29	Sucker sp.	5	143	165
Zuckerberg Pond	GNLCR89	Gillnet	2019-08-30	Sucker sp.	4	131	153
Zuckerberg Pond	GNLCR90	Gillnet	2019-08-30	Sucker sp.	10	123	147
Zuckerberg Pond	GNLCR91	Gillnet	2019-08-30	Sucker sp.	6	195	250
Christina Lake	GNCL01	Gillnet	2019-07-23	Tench	4	260	431
Christina Lake	GNCL02	Gillnet	2019-07-23	Tench	1	378	378
Christina Lake	GNCL04	Gillnet	2019-07-23	Tench	1	270	270
Christina Lake	GNCL05	Gillnet	2019-07-24	Tench	2	322	370
Christina Lake	GNCL06	Gillnet	2019-07-24	Tench	1	356	356
Christina Lake	GNCL07	Gillnet	2019-07-24	Tench	3	155	316
Christina Lake	GNCL08	Gillnet	2019-07-24	Tench	1	353	353
Christina Lake	GNCL09	Gillnet	2019-07-25	Tench	3	355	393
Pend d'Oreille River	GNPDO40	Gillnet	2019-05-08	Tench	1		
Pend d'Oreille River	GNPDO47	Gillnet	2019-08-21	Tench	4	94	112
Pend d'Oreille River	GNPDO51	Gillnet	2019-08-22	Tench	1	434	434
Pend d'Oreille River	GNPDO53	Gillnet	2019-08-23	Tench	2	89	120
Zuckerberg Pond	GNLCR60	Gillnet	2019-07-15	Tench	2	203	250
Zuckerberg Pond	GNLCR61	Gillnet	2019-07-15	Tench	4	172	193
Zuckerberg Pond	GNLCR62	Gillnet	2019-07-18	Tench	2	181	255
Zuckerberg Pond	GNLCR64	Gillnet	2019-07-18	Tench	1	490	490
Zuckerberg Pond	GNLCR65	Gillnet	2019-07-18	Tench	1	230	230
Zuckerberg Pond	GNLCR75	Gillnet	2019-08-27	Tench	1	270	270
Zuckerberg Pond	GNLCR77	Gillnet	2019-08-27	Tench	1	168	168

Location	Site	Method	Date	Species	Number	Min length (mm)	Max length (mm)
Zuckerberg Pond	GNLCR79	Gillnet	2019-08-28	Tench	1	159	159
Zuckerberg Pond	GNLCR89	Gillnet	2019-08-30	Tench	2	135	136
Columbia River	GNLCR07	Gillnet	2019-05-01	Walleye	1		
Columbia River	GNLCR30	Gillnet	2019-06-05	Walleye	1		
Columbia River	GNLCR32	Gillnet	2019-06-05	Walleye	3		
Columbia River	GNLCR33	Gillnet	2019-06-05	Walleye	1		
Columbia River	GNLCR34	Gillnet	2019-06-05	Walleye	2		
Columbia River	GNLCR35	Gillnet	2019-06-05	Walleye	1		
Columbia River	GNLCR36	Gillnet	2019-06-05	Walleye	3		
Columbia River	GNLCR37	Gillnet	2019-06-06	Walleye	1		
Columbia River	GNLCR38	Gillnet	2019-06-06	Walleye	1		
Columbia River	GNLCR44	Gillnet	2019-06-06	Walleye	1		
Columbia River	GNLCR57	Gillnet	2019-06-11	Walleye	1	678	678
Pend d'Oreille River	GNPDO09	Gillnet	2019-04-18	Walleye	4		
Pend d'Oreille River	GNPDO10	Gillnet	2019-04-18	Walleye	1		
Pend d'Oreille River	GNPDO11	Gillnet	2019-04-18	Walleye	4		
Pend d'Oreille River	GNPDO15	Gillnet	2019-04-18	Walleye	3		
Pend d'Oreille River	GNPDO16	Gillnet	2019-04-25	Walleye	1		
Pend d'Oreille River	GNPDO17	Gillnet	2019-04-25	Walleye	1		
Pend d'Oreille River	GNPDO18	Gillnet	2019-04-25	Walleye	1		
Pend d'Oreille River	GNPDO19	Gillnet	2019-04-25	Walleye	1		
Pend d'Oreille River	GNPDO33	Gillnet	2019-05-02	Walleye	1		
Pend d'Oreille River	GNPDO41	Gillnet	2019-05-08	Walleye	1		
Pend d'Oreille River	GNPDO46	Gillnet	2019-08-21	Walleye	1	436	436
Pend d'Oreille River	GNPDO60	Gillnet	2019-08-28	Walleye	1	340	340
Columbia River	GNLCR22	Gillnet	2019-05-14	White Sturgeon	1		
Columbia River	GNLCR26	Gillnet	2019-05-15	White Sturgeon	1		
Columbia River	GNLCR29	Gillnet	2019-06-05	White Sturgeon	2		
Columbia River	GNLCR30	Gillnet	2019-06-05	White Sturgeon	9		
Columbia River	GNLCR31	Gillnet	2019-06-05	White Sturgeon	1		
Columbia River	GNLCR33	Gillnet	2019-06-05	White Sturgeon	1		
Columbia River	GNLCR36	Gillnet	2019-06-05	White Sturgeon	1		
Columbia River	GNLCR37	Gillnet	2019-06-06	White Sturgeon	2		
Columbia River	GNLCR38	Gillnet	2019-06-06	White Sturgeon	1		
Columbia River	GNLCR44	Gillnet	2019-06-06	White Sturgeon	1		
Columbia River	GNLCR45	Gillnet	2019-06-06	White Sturgeon	2		
Columbia River	GNLCR53	Gillnet	2019-06-11	White Sturgeon	2		
Columbia River	GNLCR68	Gillnet	2019-08-21	White Sturgeon	2		
Columbia River	GNLCR84	Gillnet	2019-08-29	White Sturgeon	1		
Kootenay River	GNLCR41	Gillnet	2019-06-06	White Sturgeon	1		
Kootenay River	GNLCR42	Gillnet	2019-06-06	White Sturgeon	1		

Location	Site	Method	Date	Species	Number	Min length (mm)	Max length (mm)
Christina Lake	GNCL01	Gillnet	2019-07-23	Yellow Perch	1	240	240
Christina Lake	GNCL03	Gillnet	2019-07-23	Yellow Perch	1	243	243
Columbia River	GNLCR05	Gillnet	2019-05-01	Yellow Perch	1		
Pend d'Oreille River	GNPDO18	Gillnet	2019-04-25	Yellow Perch	3		
Pend d'Oreille River	GNPDO21	Gillnet	2019-04-25	Yellow Perch	1		
Pend d'Oreille River	GNPDO27	Gillnet	2019-04-26	Yellow Perch	1		
Pend d'Oreille River	GNPDO30	Gillnet	2019-04-26	Yellow Perch	4		
Pend d'Oreille River	GNPDO40	Gillnet	2019-05-08	Yellow Perch	2		
Pend d'Oreille River	GNPDO41	Gillnet	2019-05-08	Yellow Perch	1		
Pend d'Oreille River	GNPDO43	Gillnet	2019-08-21	Yellow Perch	10	113	178
Pend d'Oreille River	GNPDO46	Gillnet	2019-08-21	Yellow Perch	1	194	194
Pend d'Oreille River	GNPDO47	Gillnet	2019-08-21	Yellow Perch	515	111	171
Pend d'Oreille River	GNPDO49	Gillnet	2019-08-22	Yellow Perch	13	111	253
Pend d'Oreille River	GNPDO51	Gillnet	2019-08-22	Yellow Perch	1	199	199
Pend d'Oreille River	GNPDO53	Gillnet	2019-08-23	Yellow Perch	156	111	178
Pend d'Oreille River	GNPDO54	Gillnet	2019-08-23	Yellow Perch	7	173	193
Pend d'Oreille River	GNPDO59	Gillnet	2019-08-28	Yellow Perch	1	116	116
Pend d'Oreille River	GNPDO62	Gillnet	2019-08-30	Yellow Perch	12	160	196
Pend d'Oreille River	GNPDO63	Gillnet	2019-08-30	Yellow Perch	33	118	181
Pend d'Oreille River	GNPDO64	Gillnet	2019-08-30	Yellow Perch	8	175	215
Pend d'Oreille River	GNPDO66	Gillnet	2019-08-30	Yellow Perch	79	110	177
Zuckerberg Pond	GNLCR58	Gillnet	2019-07-15	Yellow Perch	1	214	214
Zuckerberg Pond	GNLCR59	Gillnet	2019-07-15	Yellow Perch	7	193	228
Zuckerberg Pond	GNLCR60	Gillnet	2019-07-15	Yellow Perch	11	174	233
Zuckerberg Pond	GNLCR61	Gillnet	2019-07-15	Yellow Perch	2	176	180
Zuckerberg Pond	GNLCR62	Gillnet	2019-07-18	Yellow Perch	7	180	200
Zuckerberg Pond	GNLCR76	Gillnet	2019-08-27	Yellow Perch	11	107	149
Zuckerberg Pond	GNLCR77	Gillnet	2019-08-27	Yellow Perch	17	110	152
Zuckerberg Pond	GNLCR78	Gillnet	2019-08-28	Yellow Perch	52	108	185
Zuckerberg Pond	GNLCR80	Gillnet	2019-08-28	Yellow Perch	25	100	215
Zuckerberg Pond	GNLCR86	Gillnet	2019-08-29	Yellow Perch	39	52	198
Zuckerberg Pond	GNLCR88	Gillnet	2019-08-29	Yellow Perch	21	104	162
Zuckerberg Pond	GNLCR89	Gillnet	2019-08-30	Yellow Perch	24	105	155
Zuckerberg Pond	GNLCR90	Gillnet	2019-08-30	Yellow Perch	24	106	216
Zuckerberg Pond	SNLCR01	Seine Netting	2019-07-11	Yellow Perch	111	20	30
Zuckerberg Pond	SNLCR02	Seine Netting	2019-07-11	Yellow Perch	316	20	46

Appendix I: White Sturgeon PIT Tag Information

Table 23. White Sturgeon capture data including date of capture, location (UTM coordinates), and PIT tag number when recorded (missing PIT tag numbers indicate the individual was not scanned).

#	Date	UTM Zone 11U		Pit Tag Number
		Easting	Northing	
1	14-May-19	449783	5464411	-
2	15-May-19	450274	5464293	985120032421489
3	5-Jun-19	450337	5464269	985121006313298
4	5-Jun-19	450337	5464269	98512014110495
5	5-Jun-19	449834	5464430	985121006366320
6	5-Jun-19	449834	5464430	985121013118165
7	5-Jun-19	449834	5464430	985120029812063
8	5-Jun-19	449834	5464430	985121006397754
9	5-Jun-19	449834	5464430	985120023688315
10	5-Jun-19	449834	5464430	985120029783155
11	5-Jun-19	449834	5464430	985120014115004
12	5-Jun-19	449834	5464430	985120030478711
13	5-Jun-19	449834	5464430	985121002629970
14	5-Jun-19	448776	5464772	985121005700394
15	5-Jun-19	446451	5465591	985120032427733
16	5-Jun-19	448459	5464867	985121021559051
17	6-Jun-19	448866	5464735	985120027017041
18	6-Jun-19	448866	5464735	985120026965216
19	6-Jun-19	448398	5464899	985120032589461
20	6-Jun-19	452733	5462810	-
21	6-Jun-19	452787	5462781	985120030483556
22	6-Jun-19	448398	5464899	4203437C18
23	6-Jun-19	446192	5465734	-
24	6-Jun-19	446192	5465734	-
25	11-Jun-19	450247	5464286	985120013012334
26	11-Jun-19	450247	5464286	985120023647014
27	21-Aug-19	448420	5464850	985121012610230
28	21-Aug-19	448420	5464850	985120013063548

* All sturgeon were caught in 3.5" - 4.0" mesh

Appendix J: eDNA Preliminary Assessment Data

Appendix J-1: Optimal Primer Concentrations and Sample Conditions

Table 24. Optimal primer concentrations (a) and sample conditions (b) for processing eDNA samples at the Okanagan Nation Alliance Fisheries Laboratory.

(a) Reagent	µL
Brilliant III 2x master mix	7.5
Forward primer (10uM)	0.75
Reverse primer (10uM)	0.75
Probe (10uM)	0.375
Water	3.625
Template DNA	2

(b) Cycling Parameters:	Hot start	Amplification Cycles	
			45x
Temp (°C)	95	95	60
Time	3 min	5 sec	10 sec

Appendix J-2: eDNA Limit of Detection Exercise

Table 25. Results of a comparison of the Olsen et *al*. (2015) and the Cairm et *al*. (2019) assay used to determine the limits of detection (determined when the Cq value of a given dilution varies noticeably from the two assays; often when the Cq value is > 35).

Sample Reference	Dilution	Olsen Assay	Cairm Assay
19220023	10^{-1}	25.22	25.07
	10^{-2}	28.75	28.55
	10^{-3}	32.42	32.19
	10^{-4}	35.18	35.52
	10^{-5}	39.78	44.83
19220024	10^{-1}	23.73	23.27
	10^{-2}	26.53	26.48
	10^{-3}	30.55	30.44
	10^{-4}	34.74	34.23
	10^{-5}	38.52	No Cq
19220025	10^{-1}	26.71	26.73
	10^{-2}	30.24	29.41
	10^{-3}	33.5	33.33
	10^{-4}	37.99	35.7
	10^{-5}	No Cq	41.7
19220026	10^{-1}	25.9	25.82
	10^{-2}	29.11	28.71
	10^{-3}	35.48	35.31
	10^{-4}	37.91	39.51
	10^{-5}	No Cq	No Cq
19220027	10^{-1}	25.36	25.2
	10^{-2}	28.42	28.31
	10^{-3}	31.61	31.19
	10^{-4}	35.49	35.63
	10^{-5}	No Cq	No Cq
19220028	10^{-1}	25.72	26.52
	10^{-2}	29.38	29.09
	10^{-3}	32.99	32.95
	10^{-4}	36.44	35.97
	10^{-5}	39.56	39.38
19220029	10^{-1}	25.88	26.15
	10^{-2}	29.5	29.62
	10^{-3}	32.68	32.93
	10^{-4}	35.71	35.59
	10^{-5}	39.91	No Cq

Appendix J-3: Comparison of Olsen et *al*. (2015) Assay and Carim et *al*. (2019) Assay

Table 26. Comparison of the Olsen et *al*. (2015) assay and the Carim et *al*. (2019) assay to assess suitability for the Okanagan Nation Alliance eDNA program using various Northern Pike Tissues (operc [operculum] punch, gill filaments, pectoral fins, lab-spiked water samples, and control samples.

Lab Reference	Fish no.	Species	Date caught	Process date	Tissue	Olsen Assay	Carim Assay	Extraction method
19220001	1	Northern Pike	No details	2/13/2019	Operc. Punch	19.37	20.5	Magbead 50ul elution
19220002	2	Northern Pike	7/30/2018	2/13/2019	Operc. Punch	21.92	22.51	Magbead 50ul elution
19220003	3	Northern Pike	7/29/2018	2/13/2019	Operc. Punch	22.83	24	Magbead 50ul elution
19220004	4	Northern Pike	7/1/2018	2/13/2019	Operc. Punch	20.43	21.74	Magbead 50ul elution
19220005	4	Northern Pike	Duplicate Fish 4	2/13/2019	Gill filament	18.1	18.69	Magbead 50ul elution
19220006	3	Northern Pike	Duplicate Fish 3	2/13/2019	Gill filament	17.49	18.28	Magbead 50ul elution
19220007	5	Northern pike	5/2/2019	5/24/2019	Pectoral fin	20.34	22.8	Magbead 100ul elution
19220008	6	Northern pike	5/2/2019	5/24/2019	Pectoral fin	17.7	19.45	Magbead 100ul elution
19220009	7	Northern pike	5/2/2019	5/24/2019	Pectoral fin	18.04	20.13	Magbead 100ul elution
19220010	8	Northern pike	5/2/2019	5/24/2019	Pectoral fin	18.84	20.82	Magbead 100ul elution
19220011	9	Northern pike	5/2/2019	5/24/2019	Pectoral fin	18.43	20.31	Magbead 100ul elution
19220012	10	Northern pike	5/7/2019	5/27/2019	Pectoral fin	18.32	20.61	Magbead 100ul elution
19220013	11	Northern pike	5/7/2019	5/27/2019	Pectoral fin	No Cq	22.27	Magbead 100ul elution
19220014	12	Northern pike	5/7/2019	5/27/2019	Pectoral fin	No Cq	21.31	Magbead 100ul elution
19220015	13	Northern pike	5/7/2019	5/27/2019	Pectoral fin	19.86	21.98	Magbead 100ul elution
19220016	14	Northern pike	5/2/2019	5/27/2019	Pectoral fin	21.3	23.63	Magbead 100ul elution
19220017	15	Northern pike	6/5/2019	6/17/2019	Pectoral fin	19.28	21.01	Magbead 100ul elution
19220018	16	Northern pike	6/10/2019	6/17/2019	Pectoral fin	20.22	21.74	Magbead 100ul elution
19220019	17	Northern pike	6/6/2019	6/17/2019	Pectoral fin	20	21.89	Magbead 100ul elution
19220020	18	Northern pike	6/6/2019	6/17/2019	Pectoral fin	20.96	22.6	Magbead 100ul elution
19220021	19	Northern pike	6/10/2019	6/17/2019	Pectoral fin	19.95	21.73	Magbead 100ul elution
19220022	20	Northern pike	6/10/2019	6/17/2019	Pectoral fin	33.96	23.97	Magbead 100ul elution

19220023	21	Northern pike	6/11/2019	6/17/2019	Pectoral fin	19.43	21.6	Magbead 100ul elution
19220024	22	Northern pike	5/15/2019	6/17/2019	Pectoral fin	17.37	19.96	Magbead 100ul elution
19220025	23	Northern pike	5/14/2019	6/18/2019	Pectoral fin	22.19	23.45	Magbead 100ul elution
19220026	24	Northern pike	5/5/2019	6/18/2019	Pectoral fin	20.33	22.1	Magbead 100ul elution
19220027	25	Northern pike	6/6/2019	6/18/2019	Pectoral fin	19.84	21.89	Magbead 100ul elution
19220028	26	Northern pike	5/14/2019	6/18/2019	Pectoral fin	21.95	22.91	Magbead 100ul elution
19220029	27	Northern pike	6/6/2019	6/18/2019	Pectoral fin	19.88	22.7	Magbead 100ul elution
19220030	Water filter	Lab + water sample*		7/5/2019	filter	ND	22.03	Magbead 100ul elution
19220031	water filter	Lab + water sample*		7/5/2019	filter	ND	30.66	Magbead 100ul elution
19220032	env. Water	Shingle Creek		7/5/2019	filter	No Cq	No Cq	Magbead 100ul elution
19220033	env. Water	Shingle Creek		7/5/2019	filter	No Cq	No Cq	Magbead 100ul elution
19220034	env. Water	Shattford Creek		7/5/2019	filter	No Cq	No Cq	Magbead 100ul elution
19220035	env. Water	Shattford Creek		7/5/2019	filter	No Cq	No Cq	Magbead 100ul elution
19220036	env. Water	Vaseaux Creek		7/5/2019	filter	No Cq	No Cq	Magbead 100ul elution
19220037	env. Water	Vaseaux Creek		7/5/2019	filter	No Cq	No Cq	Magbead 100ul elution
19220038	env. Water	Shuttleworth Creek		7/5/2019	filter	No Cq	No Cq	Magbead 100ul elution
19220039	env. Water	Shuttleworth Creek		7/5/2019	filter	No Cq	No Cq	Magbead 100ul elution
19220040	env. Water	Inkaneep Creek		7/5/2019	filter	No Cq	No Cq	Magbead 100ul elution
19220041	env. Water	Inkaneep Creek		7/5/2019	filter	No Cq	No Cq	Magbead 100ul elution