Regional Operational Plan SF.2A.2019.04

Operational Plan: Alexander Creek Northern Pike Suppression, 2019-2021

by

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and

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April 2019

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

REGIONAL OPERATIONAL PLAN SF.2A.2019.04

OPERATIONAL PLAN: ALEXANDER CREEK NORTHERN PIKE SUPPRESSION, 2019-2021

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SIGNATURE/TITLE PAGE

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Period Covered	April 2019–June 2021
Field Dates:	Approximately May 2019–June 2021
Plan Type:	Category II

Approval

Title	Name	Signature	Date
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ABSTRACT

This project will continue to address the goal of increasing salmon abundance and restoring fisheries in the Alexander Creek drainage by suppressing the invasive northern pike population during 2019–2021. Netting will be conducted in up to 69 side channel sloughs of Alexander Creek to catch northern pike. In addition, minnow traps will be used to determine catch per unit effort of juvenile salmonids for comparison of abundance over time.

Key words: invasive species, northern pike, *Esox lucius,* Alexander Creek, juvenile salmonids

INTRODUCTION

PURPOSE

The mission of the Alaska Department of Fish and Game (ADF&G) Division of Sport Fish (SF) is "to protect and improve the state's recreational fisheries resources," and an objective of the SF strategic plan is to "minimize impacts of invasive species on fish stocks, recreational fisheries, and fish habitat." Removing northern pike from vital salmon rearing habitat directly relates to this objective. ADF&G has an aquatic nuisance species management plan (Fay 2002) and an invasive northern pike management plan (ADF&G 2007). Goals and objectives in these plans address the need to remove invasive northern pike where possible and improve salmon populations that have been impacted by northern pike. Alexander Creek is recognized as SF's highest invasive northern pike control priority (ADF&G 2010, unpublished memorandum, Region II Invasive Northern Pike Priorities). The activities proposed in this project are aligned with several plans and initiatives, and ADF&G believes this project will result in the eventual re-establishment of salmon and trout fisheries in Alexander Creek.

BACKGROUND

Invasive northern pike (*Esox lucius*) pose a significant threat to salmon habitats in Southcentral Alaska (ADF&G 2007). Northern pike are native throughout much of the state but do not naturally occur south and east of the Alaska Range (Figure 1). They were introduced by anglers to the Yentna River drainage in the late 1950s and subsequently spread throughout the Susitna River basin through flood events and further illegal stockings (Mills 1986). It is believed that northern pike were introduced to Alexander Lake in the late 1960s, although there was no harvest record of them prior to 1985 (Mills 1986). Anecdotal accounts from Alexander Creek area residents suggest that dispersal of northern pike from the lake to the lower river occurred slowly over 10–20 years. Anglers first caught them in the lower river in the mid-1990s. Today, northern pike are widespread throughout the system. A large portion of the drainage is shallow and densely vegetated, making it ideal northern pike habitat (Morrow 1980).

Sport fisheries of Alexander Creek historically generated an average of 13,700 angler-days of effort annually for the 20-year period from 1980 to 1999 (Oslund et al. 2017: Table 4, page 70). During that same period, on average 2,880 Chinook salmon (*Oncorhynchus tshawytscha*) were harvested annually from the Alexander Creek fishery, which historically supported one of the largest Chinook salmon fisheries in the Westside Susitna Management Unit (Oslund et al. 2017: Table 26, page 112). Between 1977 and 2008 (when harvests dropped to zero) the peak of the sport fishery occurred in 1991, with a reported 26,235 days of effort and 6,548 Chinook salmon harvested (Oslund et al. 2017); a more recent average (2001–2008) for sport fishing effort on Alexander Creek was about 6,112 angler-days (Oslund et al. 2017). Approximately 8 lodges operated during this time period in which Chinook salmon were primarily targeted. From 2008 to

2014, when Chinook salmon were no longer harvested, average annual effort for Alexander Creek dropped to about 1,300 angler-days (Oslund et al. 2017).

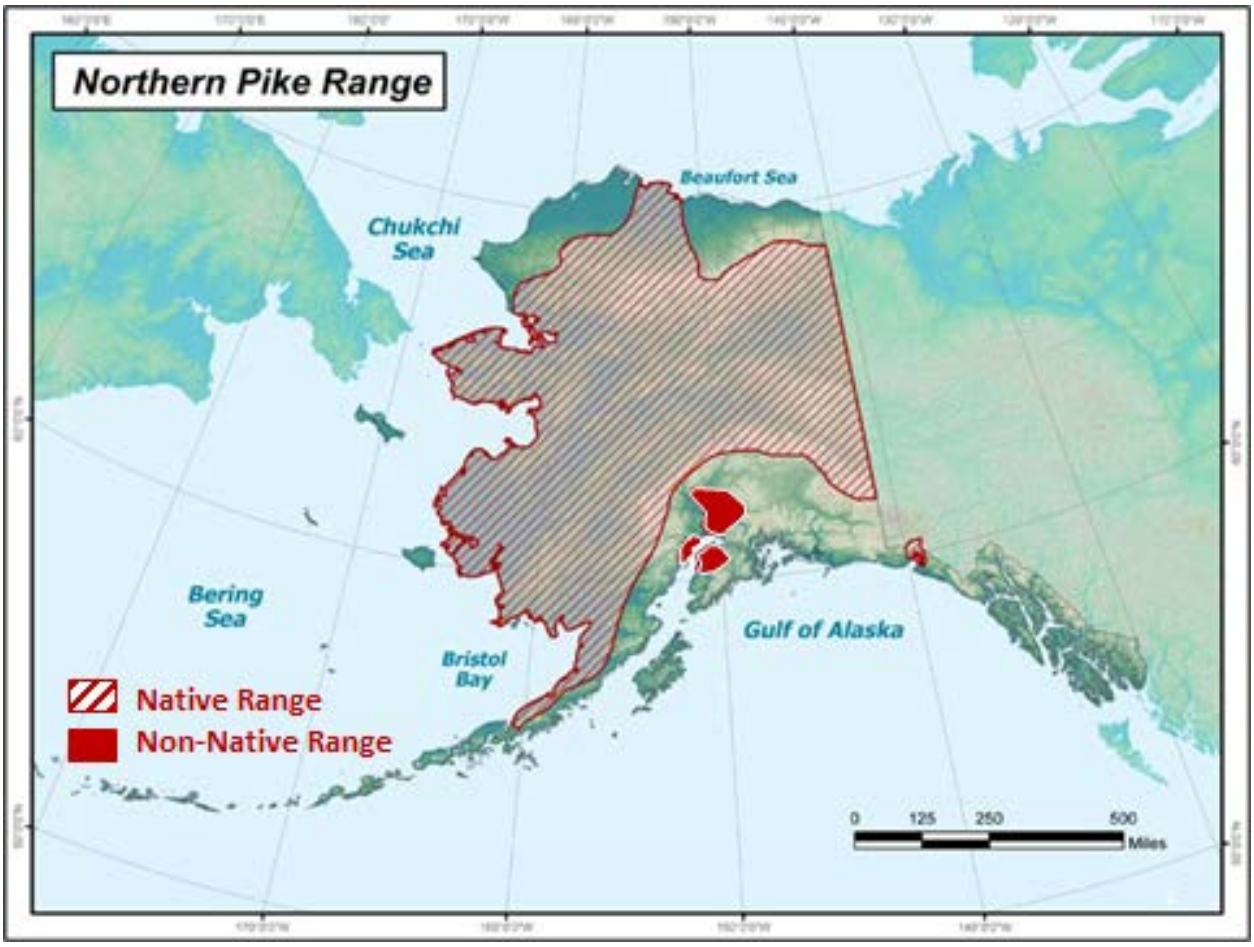

Figure 1.–Northern pike range in Alaska.

Since the late 1990s, northern pike may have been the biggest factor in the reduced populations of multiple fish species in the Alexander Creek drainage. Aerial indices of escapement have shown a downward trend in Chinook salmon spawners over the past 2 decades culminating in the Alaska Board of Fisheries (BOF) designating Alexander Creek Chinook salmon as a "stock of concern" (SOC) in 2011. The sustainable escapement goal (SEG) for Chinook salmon is 2,100–6,000 fish, but escapement counts dropped to less than 100 fish by 2009 (Oslund et al. 2017). The Chinook salmon sport fishery has been closed since 2008. Aerial surveys have also shown a change in the distribution of Chinook salmon spawners. Since 1992, Chinook salmon spawners have disappeared from the tributaries upstream of Alexander Lake and by 1998 they had stopped spawning in the upper mainstem of Alexander Creek between Sucker Creek and Alexander Lake. Harvest of coho salmon has been below the 1980–1999 historical average of 1,531 since 2005, ranging from 757 fish in 2005 to only 10 fish in 2008 (Oslund et al. 2017: Table 45, page 127). The once popular and abundant rainbow trout and Arctic grayling fisheries were also closed to harvest in 1997 (Oslund et al. 2017). Despite these fisheries becoming catch-and-release, catch rates of rainbow trout have declined in Alexander Creek since 1990 (Oslund et al. 2017: Table 60, page 154).

Since 2011, ADF&G has been implementing a long-term northern pike suppression program to reduce northern pike abundance and increase salmonid productivity within Alexander Creek. The planned efforts for 2019 through 2021 are described in detail in this operational plan. Past northern pike suppression efforts have been accomplished by intensively gillnetting the side-channel sloughs (depicted in Appendix A1) of Alexander Creek each year until seasonal catch rates of northern pike decrease by 85%. Northern pike gillnetting has been conducted during the peak spawning period (approximately the month of May) when northern pike are most mobile and concentrated in the Alexander Creek sloughs. Recently, spring gillnetting and reports from anglers show native species such as rainbow trout, Arctic grayling, burbot, and even sockeye salmon are becoming more numerous and occupying habitat in Alexander Lake and the upper stretches of Alexander Creek, whereas they had been in very low abundance since northern pike arrived. As a result, ADF&G will be implementing a program focused on incentivizing the public to fish Alexander Lake for northern pike in the winter as part of this operational plan.

The Alaska State Legislature provided funding for a portion of this work. In the fall of 2010, this funding was used as non-Federal match to acquire $635K from the Alaska Sustainable Salmon Fund (AKSSF) to support the associated project activities between 2011 and 2013. In the winter of 2013, ADF&G was again awarded AKSSF funding ($563K) to continue this work between 2014 and 2016. In 2016, ADF&G was awarded a $223.6K grant from the Matanuska–Susitna Borough to continue a slightly scaled down version of this program in 2017 and 2018. For this planning period (2019–2021), the program will be primarily funded through the State Wildlife Grant program through the U.S. Fish and Wildlife Service.

OBJECTIVES

This project will continue to advance ADF&G's long-term goal of increasing salmon abundance and restoring fisheries in the Alexander Creek drainage by suppressing the invasive northern pike population. Specific objectives of this project for 2019–2021 are as follows:

PRIMARY OBJECTIVES

1) Annually set gillnets in up to 69 side sloughs for 3 days in each between May 1 and June 30 to target northern pike.
2) Calculate the catch per unit effort (CPUE) of juvenile salmonids from minnow trap surveys in Alexander Creek after the netting season each year (June).
3) Annually PIT–tag 200 northern pike in Alexander Lake in late summer.
4) Annually remove northern pike in Alexander Lake in the winter through an incentivized angler harvest program.

SECONDARY OBJECTIVES

1) Calculate the mean and range of fork lengths measured for northern pike caught in gillnets.
2) Document stomach contents, sex, spawning condition, and maturity information from northern pike caught in gillnets.
3) Monitor gillnet catches for northern pike tagged with a passive integrative transponder (PIT tag) originating in Alexander Lake.

4) Calculate the mean and range of fork lengths measured for each species of salmonid caught in minnow traps.
5) Document the species composition of juvenile salmonids caught in minnow traps in Alexander Creek.

METHODS

STUDY AREA

Alexander Creek is a tributary to the Susitna River (Figure 2). The creek is approximately 40 river miles (RM) long from its mouth at the Susitna River to Alexander Lake and can be characterized as low-gradient and tannin-stained. Aside from Alexander Lake, several clear water tributaries draining Mount Susitna contribute to the mainstem flow. Sucker Creek enters the mainstem at RM 20 and currently provides the majority of spawning and rearing habitat for Chinook and coho salmon. The mainstem of Alexander Creek is convoluted with numerous side channel sloughs, most of which were once part of the mainstem channel. Side channels are typically shallow, stagnant waters with low flows that can contain dense aquatic vegetation. Northern pike are well suited to these side-channel habitats (Morrow 1980; Inskip 1982) and are currently widespread throughout the system.

STUDY DESIGN

Background

The primary goals of this project are to reduce the impact of invasive northern pike on rearing salmonids by removing northern pike from Alexander Creek and to investigate the feasibility of an angler-assisted Alexander Lake northern pike removal program. Complete eradication of northern pike in this drainage would most likely be costly and logistically prohibitive. However, relieving some of the predation pressure on salmon fry and smolt should increase their abundance by contributing to greater survival (Muhlfeld et al. 2008). Over time, greater survival of juvenile salmon may result in larger annual returns of adult Chinook salmon. In other parts of Alaska where northern pike are native, and even in other drainages in Southcentral Alaska where they are not (e.g., the Deshka River), northern pike and salmonids are capable of coexisting; however, habitat complexity that allows salmonids opportunities for predator avoidance is hypothesized to be a strong factor in mediating predator-prey interactions within these fish communities (Sepulveda et al. 2013). In Alexander Creek, where the entire system is composed of homogenous habitat providing ideal conditions for northern pike, salmonids may be unable to avoid predation and therefore their populations drastically declined (Oslund et al. 2017). Through annual suppression of northern pike, ADF&G hopes to eventually restore salmonid production to levels that will allow salmon fisheries to reopen in Alexander Creek.

To accomplish this, a long-term northern pike gillnetting program was established in 2011 and will continue annually. As in past years, all gillnetting will take place in the side-channel sloughs of Alexander Creek. Netting will take place in the spring during the northern pike spawning period. Stomach contents will be identified from gillnetted northern pike to look for shifts in diet over time as the suppression continues from year to year. Additionally, a new program will be implemented in the winters of 2019/2020 and 2020/2021 to encourage members of the public to remove northern pike in Alexander Lake through angling.

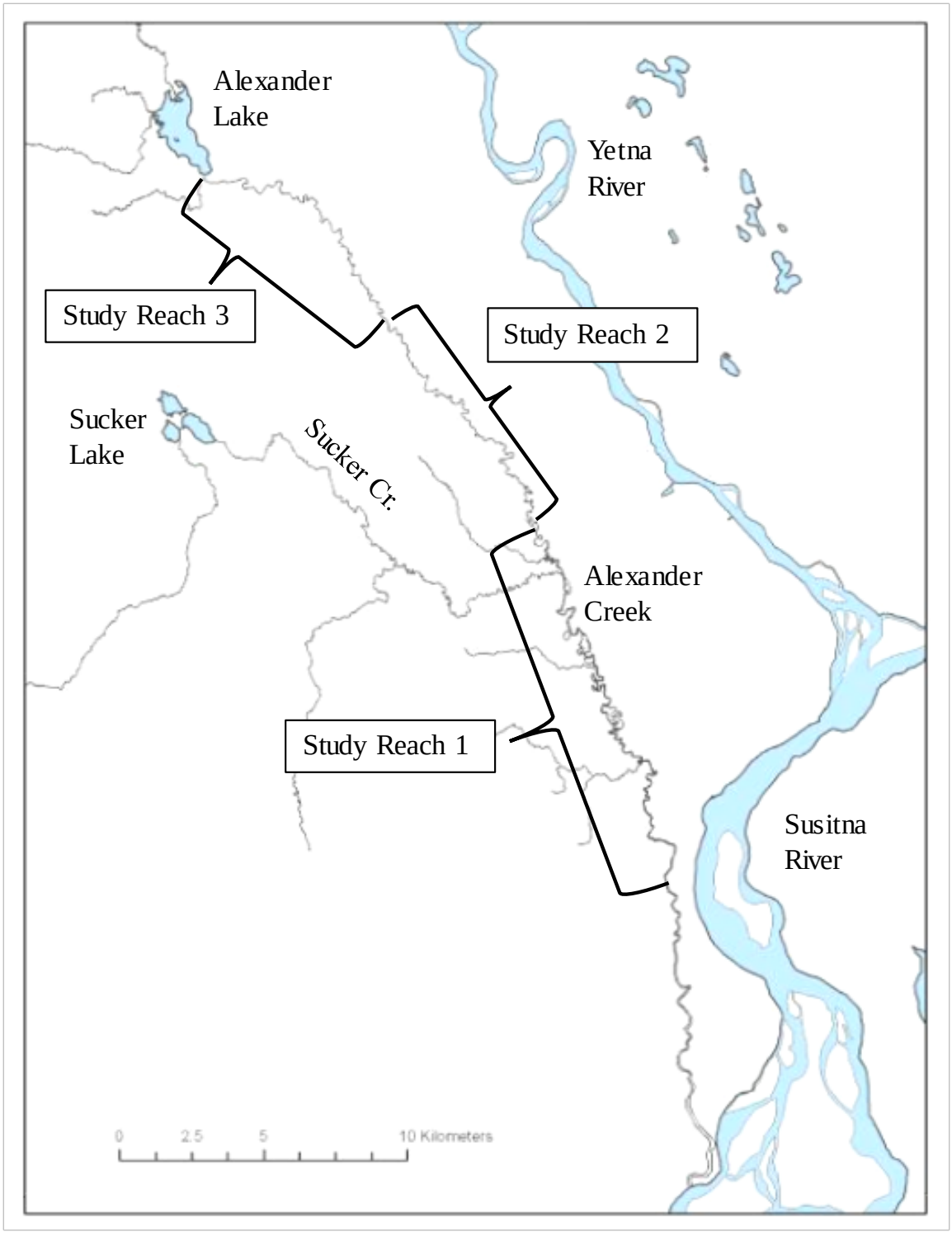

Figure 2.–Map of Alexander Creek and study reaches 1–3.

From 2011 through 2013, ADF&G conducted radiotelemetry studies of adult northern pike to investigate movement patterns between Alexander Lake and Alexander Creek. Northern pike movement data from radiotelemetry demonstrated that few (~6%) radiotagged adult northern pike left the lake and moved downstream into the creek, and those that did were all captured in

gillnets in the sloughs (Rutz et al. *In prep-b*). This result supported the idea that working solely within Alexander Creek sloughs and not focusing on far costlier suppression efforts in Alexander Lake would be sufficient to meet our goal of increasing salmon production in the creek. However, in 2014, the invasive plant elodea (*Elodea canadensis*) was discovered in Alexander Lake. Between 2014 and 2016, elodea spread to encompass approximately 500 acres within Alexander Lake, and some areas of growth were observed to be dense enough to preclude movement by adult northern pike (Heather Stewart, Invasive Weeds and Agricultural Pest Management Coordinator, Department of Natural Resources, and Dave Rutz, Division Director, ADF&G, personal observations). The Alaska Department of Natural Resources treated Alexander Lake with herbicides in 2016 but was unsuccessful in eradicating the elodea. The lake is now nearly completely infested. It is possible that some adult northern pike may have been displaced downstream. Catch rates of northern pike in gillnets has been increasing since 2015 (Figure 3), but it is unknown if elodea is the cause. Nevertheless, the potential displacement of northern pike downstream by elodea is concerning because replacement of fish removed by ADF&G nets could reduce the effectiveness of suppression efforts until elodea is under control. At the same time, there is evidence of native fish species beginning to recover in the upper stretches of the creek and into Alexander Lake itself. Given this evidence, additional suppression of elodea in the lake may improve the recovery of those species.

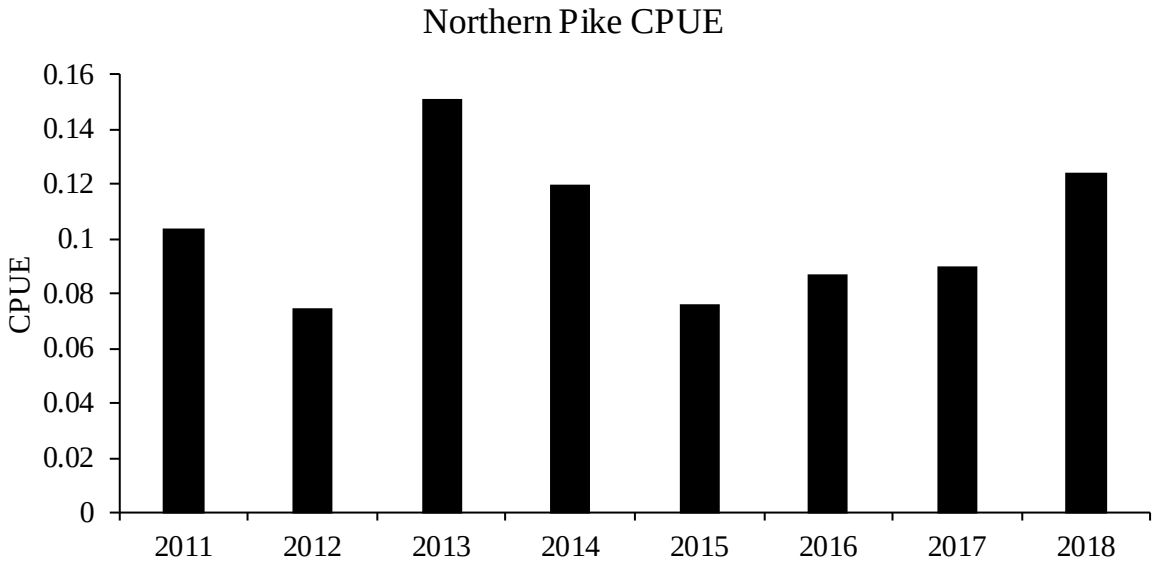

Figure 3.–Number of northern pike captured per net hour (CPUE) in Alexander Creek, 2011–2018.

Finally, data on the CPUE and species composition of juvenile salmonids in Alexander Creek will be collected through minnow trap surveys to detect trends in CPUE and changes in composition. These surveys will occur annually in June. All northern pike collected in gillnets will also be dissected for stomach content analyses which will also provide insight into the productivity of the prey base. In addition to the minnow trap surveys, ADF&G will continue indexing adult Chinook salmon runs to Alexander Creek via aerial surveys in July.

Northern Pike Suppression

In May though early June each year, a large-scale gillnetting operation will continue in the side-channel sloughs of Alexander Creek. Northern pike will be targeted with up to 75 gillnets while

they congregate for spawning in side-channel sloughs for approximately 2 weeks following ice out. Two field camps will be set up along the mainstem of Alexander Creek, one located in the lower river between the mouth of Alexander Creek and Sucker Creek and the other located at the Alexander Lake outlet. Two technicians will be assigned to each field camp and will be responsible for gillnetting the sloughs assigned to them. Each crew will target approximately 34 side channel sloughs for a total of 69 sloughs in all. The actual number of sloughs that are netted will be based on water levels because at low water some sloughs cannot be accessed. Earlier years of this project demonstrated that catch of northern pike in many of the side-channel sloughs can be reduced by 85% within about 1 week of continuous gillnetting (Rutz et al. *In prep*-a). Recently, however, that target has been met within 3-4 days. Sloughs furthest downstream in each river section will be fished first and with enough gillnets to fully cover the area. Netting will progress upstream until either all sloughs have been set or all the available gillnets are deployed. Each slough has documented GPS coordinates and has been assigned a number beginning with the slough furthest downstream. For annual consistency, slough numbers will not be changed.

Suspended variable mesh gillnets will be used at each site. Gillnet dimensions are 36 m in length by 2 m in depth and composed of 4 panels of different mesh sizes. The 4 panels of mesh are ordered in increasing mesh size along the gillnet: 1.25 in (3.1 cm), 1.5 in (3.8 cm), 1.75 in (4.4 cm), and 2 in (5.1 cm). Nets are made of monofilament with a three-eighths-inch (9.5 mm) foam top line and a 30 lb (13.6 kg) lead line. One gillnet will be set within or surrounding each weed bed in a slough. Two gillnets may be fished together if the weed bed is large. If there are more weed beds than gillnets to achieve complete coverage, gillnets will be distributed as evenly as possible throughout the entire slough. Gillnets will be fished overnight and checked once every 24 hours. The first gillnet set will be the first checked and others will follow in order of setting. If necessary, nets may be moved or more nets set to optimize catches. If this happens, it will be documented in field notebooks. Netting will continue for 3 days in each slough. Exceptions to this protocol will be made as follows:

1) If zero northern pike are captured in a slough in a day's check, the nets will be pulled and moved to another slough.
2) If catches of northern pike remain at or above 5 fish in a slough, nets will remain in the slough until catches fall below 5 fish.
3) If significant bycatch occurs, nets will be pulled and moved to another slough.

If any of the 3 criteria are not met, nets in a slough will be moved after the third day. Significant bycatch is defined as catching more Arctic grayling and rainbow trout combined than northern pike in a slough. Depending on conditions, individual nets with the highest bycatch can be pulled or moved to other areas of the slough, or all nets in the slough can be pulled. All northern pike removed from gillnets will be dispatched, measured for fork length to the nearest millimeter, identified to sex, assessed for spawning condition (green, ripe, or spent), assessed for maturity (mature or immature), and have stomach contents identified.

It is anticipated that catch rates of northern pike will rebound between years of netting, which is why annual netting is necessary (Glick and Willette 2016). However, a study on the effectiveness of gillnetting to remove invasive northern pike from lakes on the Kenai Peninsula demonstrated that catch rates of northern pike could be substantially reduced within 2 years of continuous northern pike suppression (Massengill 2010). Northern pike populations in larger systems with

more northern pike habitat are more difficult to suppress. For example, in the Yampa River, Colorado, suppression efforts initially reduced the population of northern pike, but eventually the population stopped decreasing (Zelasko et al. 2016). However, northern pike suppression efforts in Box Canyon Reservoir in Washington have resulted in a 98% decrease in relative abundance from 2012 to 2017 (Joe Maroney, Director of Fishery and Water Resources, Kalispel Natural Resource Department, personal communication). Bioenergetics modeling of other large-scale invasive fish control programs, such as the systematic removal of lake trout (*Salvelinus namaycush*) to conserve cutthroat trout (*O. clarki*) stocks in Yellowstone Lake, demonstrate that these suppression projects can dramatically reduce the predation pressure on native fishes and bolster their recovery (Ruzycki et al. 2003; Syslo et al. 2011). However, bioenergetics modeling conducted by the U.S. Geological Survey, suggests the near elimination of northern pike from Alexander Creek will be necessary for recovery of salmon productivity in the drainage (Sepulveda et al. 2015). Results of this study highlight the need to remain vigilant in Alexander Creek northern pike suppression.

Salmonid Monitoring Protocol

The second objective of this project involves collecting data needed for long-term monitoring of juvenile salmon abundance to evaluate the success of the northern pike suppression efforts. Several metrics will be included to monitor salmonid recovery in the Alexander system including annual minnow trap surveys of juvenile salmonids and an investigation of temporal shifts in northern pike diets.

This project will continue the long-term data collection begun in 2011. The minnow trap monitoring protocol will answer the following 2 questions: 1) Does CPUE of juvenile salmonids increase with each year of northern pike suppression? 2) Does the species composition of juvenile salmonids change with each year of northern pike suppression? One minnow trap sampling event will take place annually in June. One field crew will be responsible for setting and checking the minnow traps during each sampling event. Sampling locations are fixed based on previous years' surveys, and GPS coordinates of sampling locations will be provided to the field crew. There are 36 sampling sites along the Alexander Creek corridor that correspond to regions previously identified as "lower, middle, and upper" Alexander Creek (Figure 2). Half of the sample sites are located in the mainstem of Alexander Creek, and half are located in side-channel sloughs. During sampling events, 5 minnow traps will be set at each of the 36 sampling sites. Therefore, the field crew will be responsible for setting and sampling a total of 180 traps per sampling event (36 sites × 5 traps). Traps will be fished for approximately 24 hours and baited with salmon roe. All fish will be recorded to species level, enumerated, and measured for fork length.

Trends in CPUE and species composition of all captured species will be monitored over time. If salmonid CPUE, specifically for Chinook and coho salmon juveniles, increases annually, this will be considered a measure of success. To date, there appears to have been a significant increase in minnow trap catch rates for coho salmon (slope = 0.025, P = 0.002; Figure 4) suggesting their abundance may be increasing. However, the minnow trap catch rates of Chinook salmon are not significantly increasing (slope = 0.003, P = 0.441; Figure 5). Minnow traps are logistically very good tools for this sort of monitoring, and Chinook and coho salmon juveniles tend to recruit well to the gear (Bryant 2000; Swales 1987). However, minnow traps have inherent biases that have been well documented (Jackson and Harvey 1997; Layman and Smith 2001; Hubert 1996) and up to 15% to 30% variability in salmonid catch rates can be expected

between years (McPherson et al. 1998; Pahlke et al. 2010). Therefore, inter-annual variation in catches must be interpreted with this is mind. However, over time, a significant increasing trend in juvenile salmonid abundance, especially among Chinook and coho salmon, will serve as a positive indicator that northern pike suppression is benefitting salmonid productivity in the drainage.

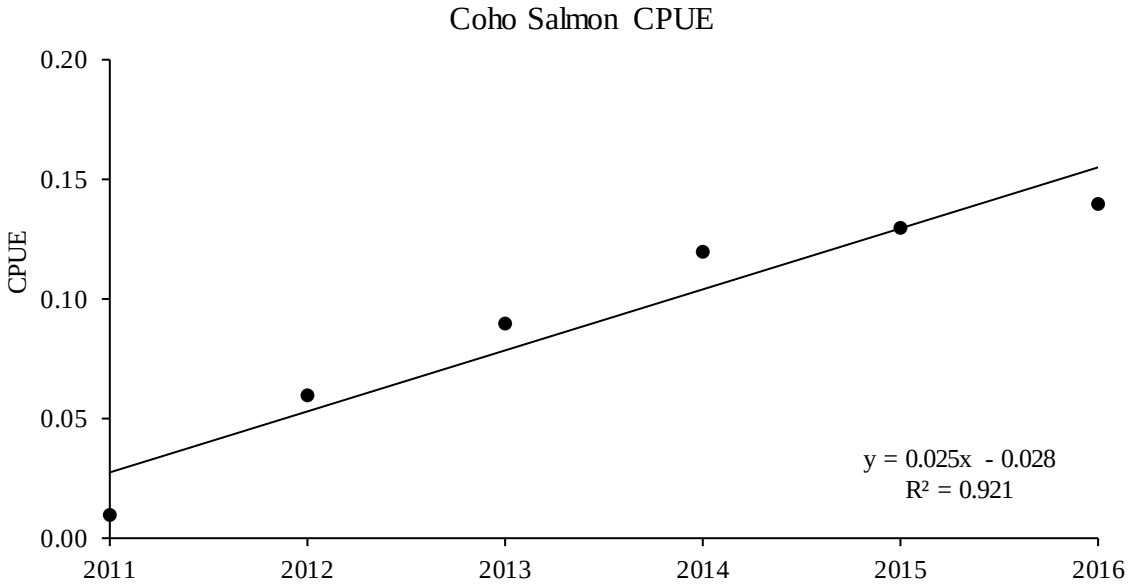

Figure 4.–Coho salmon CPUE (average number per minnow trap) in Alexander Creek, 2011–2016.

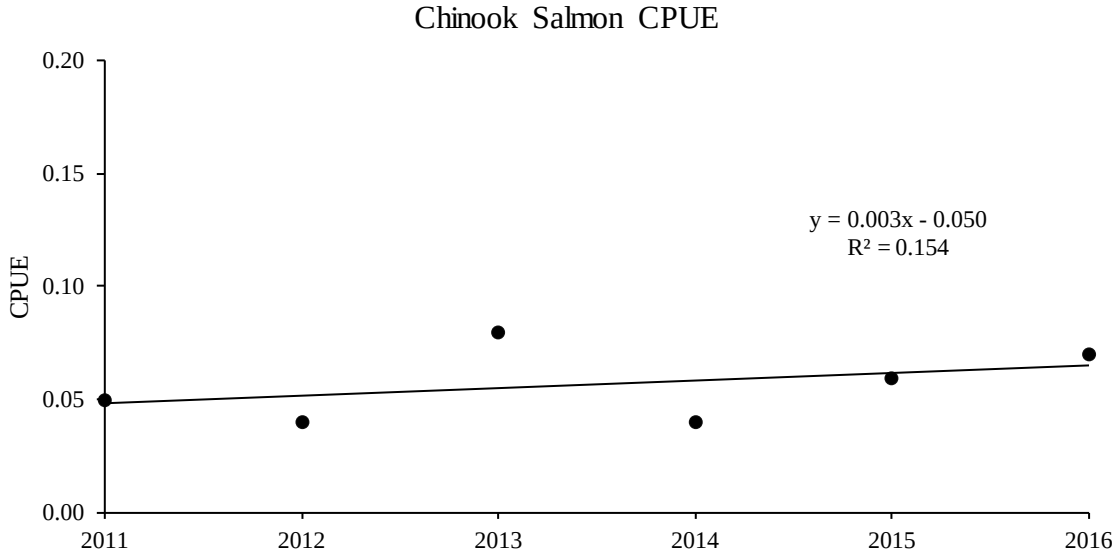

Figure 5.–Chinook salmon CPUE (average number per minnow trap) in Alexander Creek, 2011–2016.

In addition to the juvenile salmonid minnow trap monitoring, shifts in northern pike diet over time will be investigated as the suppression efforts continue. All or nearly all of the northern pike that are removed in gillnets during the suppression project will be dissected to enumerate prey species in their stomach contents (e.g., Appendix A2). Stomach contents will be recorded in the

field to taxonomic order for undigested invertebrates and lowest taxonomic level possible for undigested fish. Shifts in northern pike diet will be evaluated by observing changes in the species composition of prey over time.

Northern Pike Reward Program in Alexander Lake

The third and fourth objectives of this project involve a new program designed to remove northern pike from Alexander Lake while minimizing cost to ADF&G. ADF&G staff will insert a small PIT tag in the cheek muscle of approximately 200 northern pike in the late summers of both 2019 and 2020. Tagging will be conducted by at least 2 personnel using hook and line and fyke nets for capture gear throughout Alexander Lake. Tagging of 200 pike is expected to be completed within 4-5 days. Captured northern pike will be tagged and released at their capture location. The first reward program will begin in January 2020 and will be advertised to anglers that a reward will be offered on returned tags. The tags will not be visible to the angler, so anglers will be encouraged to retain the heads of all the northern pike they catch. Heads brought to the Palmer ADF&G office will be scanned with a PIT-tag reader. Only northern pike found to have a tag will be eligible for a reward in order to encourage the harvest of northern pike from Alexander Lake. The first program will end in April 2020. The program will be repeated the following year and an additional 200 northern pike will be tagged in late summer 2020. The second reward program will begin in January 2021 and end in April 2021. Only northern pike PIT-tagged in 2020 will be eligible for the 2021 reward.

For every PIT-tagged northern pike head turned in by an angler, a Visa gift card worth $100 will be awarded to that angler. However, due to budget and policy constraints, only 37 Visa gift cards will be available each winter for this program. Once 37 PIT-tagged northern pike heads have been turned in, no more $100 Visa gift cards will be available. However, for every PIT-tagged northern pike head turned in, the angler's name will be entered in a drawing at the end of the season for a Visa gift card worth $1,000. For example, if an angler turns in 5 PIT-tagged northern pike heads, their name will be entered 5 times into the end-of-the-season drawing. The open water season will not be included in this program to discourage additional floatplane traffic on Alexander Lake while it is heavily infested with elodea.

DATA COLLECTION

Northern Pike Suppression

Gillnet set and check times will be recorded for each slough, along with the slough reference number on a catch form (Appendix B1). All fish captured in the northern pike suppression gillnets will be counted, identified to species, and recorded on the catch form (Appendix B1). All northern pike will be measured to the nearest millimeter for fork length and recorded, and other biological information such as sex, maturity, spawning condition, and stomach contents will also be recorded for each northern pike on a northern pike sampling form (Appendix B2).

Salmonid Monitoring

All fish captured in minnow traps during juvenile salmonid monitoring will be enumerated by species. All salmonid individuals will be measured for fork length in millimeters. After the fish have been measured, they will be released alive. Data for each catch will be recorded on a trapping form and a fish measurement form (Appendices B3 and B4).

Northern Pike Reward Program in Alexander Lake

When an angler turns in northern pike heads to the Palmer ADF&G office, the total number of heads and the estimated number of hours fished by the angler will be recorded (to estimate CPUE), and all heads will be scanned with a PIT-tag reader. If a tag is detected, we will record the tag number, along with the angler's contact information for their entry into the $1,000 Visa gift card drawing. In addition, $100 Visa gift cards will be awarded for the first 37 PIT tags turned in each year.

When the annual reward programs end in April of 2020 and 2021, the total number of northern pike harvested along with total project costs will be calculated for a cost–benefit analysis to determine if this program should be expanded to other water bodies.

DATA ANALYSIS

Northern pike CPUE can be calculated for each slough, each section of the creek, or all data pooled together using Equation 1. For the salmonid monitoring, the CPUE of all juvenile salmonids in the minnow trap surveys will be calculated annually by dividing the number of salmonids captured by the number of traps set. Efforts will be made to keep a consistent 24-hour soak time for each trap, although deployment and check times will be recorded for each trap.

$$CPUE = \frac{Number\ of\ fish\ captured}{Total\ Net\ Hours\ (Duration\ of\ net\ sets*Number\ of\ net\ sets)} \quad (1)$$

Simple linear regression analysis will be used to evaluate if CPUE of juvenile salmonids is increasing as the northern pike suppression continues.

The species composition of juvenile salmonids will be estimated from the pooled minnow trap surveys by determining the proportional abundance as follows:

$$\hat{p}_i = \frac{n_i}{n} \quad (2)$$

where

n_i = the number of salmonids of species i, and

n = the total number of salmonids captured in the minnow traps.

The variance of the proportion will be estimated (Cochran 1977) as follows:

$$V[\hat{p}_i] = \frac{\hat{p}_i(1-\hat{p}_i)}{n-1}. \quad (3)$$

SCHEDULE AND DELIVERABLES

Dates	Activity
April 2019	Purchase equipment and field camp gear Hire field crews
May 2019	Establish field camps Conduct gillnet suppression
June 2019	Conduct minnow trap sampling event
August 2019	PIT tag 200 northern pike
October 2019	Analyze data and write FDS report
April 2020	Purchase equipment and field camp gear Hire field crews Conclude first year of northern pike reward program
May 2020	Establish field camps Conduct gillnet suppression
June 2020	Conduct minnow trap sampling event
August 2020	PIT tag 200 northern pike
October 2020	Analyze data and write FDS report
April 2021	Purchase equipment and field camp gear Hire field crews Conclude second year of northern pike reward program
May 2021	Establish field camps Conduct gillnet suppression
June 2021	Conduct minnow trap sampling event

RESPONSIBILITIES

Parker Bradley, Fishery Biologist II

Duties: Serve as the primary project biologist; plan and coordinate field logistics; author project report and presentations to the public.

Cody Jacobson, Fishery Biologist I

Duties: Assist with planning and coordinating field logistics; train field crews; assist with project reporting and presentations to the public.

Kristine Dunker, Fishery Biologist III

Duties: Provide oversight and make recommendations on study designs and project plans; assist with data analysis and project reporting; coordinate and assist with the completion of project deliverables.

Ben Buzzee, Biometrician I

Duties: Provide guidance on study design; assist with postseason data analysis; review project operational plans and reports.

4 Fish and Wildlife Technicians

Duties: Assist with field activities.

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APPENDIX A: HABITAT AND PREDATION PHOTOS

Appendix A1.–Photographs of a section of Alexander Creek from the air (top) and an example of a side channel slough along the mainstem of Alexander Creek (bottom).

Appendix A2.–Photograph showing juvenile salmonids in the stomach of a northern pike caught in an Alexander Creek gillnet.

APPENDIX B: DATA FORMS

Appendix B1.–Catch form.

2019 Alexander Ck. Catch Form Date Checked _____ _____ Samplers_____ Camp#																	
SAMPLE ID #	Slough #	TIME SET	TIME CHECKED	# of Nets	# Northern Pike	Arctic Grayling	Whitefish	L. Nose Sucker	Rainbow Trout	Burbot	Chinook Salmon	Coho Salmon	Dolly Varden	Muskrat	Beaver	Bird Bycatch	Comments

Note: Sample ID # format is as follows: slough #-Date; e.g., 12-51719 (slough 12-May 27, 2019).

Appendix B2.–Northern pike sampling form.

Alexander Creek Northern Pike Stomach Sampling Form

Date:				**Slough # :**			**Samplers:**	**Page:**
Fish #	**Sample ID #**	**Fork Length (mm)**	**Sex (M, F, U)**	**Maturity (M or I)**	**Cond. (G, R, S)**	Stomach content **(Y or N)**	Stomach Content	Comments about fish or stomach content; I.E. : Tag #, deformatie

Fish #: Fish numbered consecutively

Sample ID#: Slough#-Date, i.e. **12-51719** (slough 12 , May 17 2019)

Sex: Mark only if absolutely known after dissection of fish. M = male F = female U = unknown

Maturity: Dissect fish. M = mature (Gonads enlarged) I = immature (Gonads not developed)

Condition of spawn: Before dissection, squeeze to observe release of sex product G= green (pre-spawn), R= ripe (spawing) S= spent (post spawn) *This column does not apply to immature fish*

Stomach Contents: N = None Y = yes, stomach has contents

Stomach Contents list: common abbreviations for species. KS=king salmon; SS=silver salmon; RS=red salmon; CS=chum salmon; PS=pink salmon; WF=white fish; LNS=long nose sucker; SB=stickleback; RT=rainbow; GR=grayling; NP=northern pike; BB=burbot; DV=dolly varden; SC=sculpin; PL=pacific lamprey. Other catch could be: macro invertebrates, rodents, other mammals, birds, leeches, and frogs

Appendix B3.–Alexander Creek juvenile fish minnow trapping form.

2019 Alexander Creek Juvenile Fish Minnow Trapping Form																						
Sampler:						Set			Checked													
Note: all sets are 24 hr. sets		Sample Dates:																				
Trap # S=Slough M=Mainstem	Camp # (1,2,or 3)	Location [a] (GPS if mainstem or Slough #)	*Stickleback*	*Chinook Salmon*	*Coho Salmon*	*Rainbow Trout*	*Arctic Grayling*	*Dolly Varden*	*Longnose Sucker*	Comments	Trap # S=Slough M=Mainstem	Camp # (1,2,or 3)	Location [a] (GPS if mainstem or Slough #)	*Stickleback*	*Chinook Salmon*	*Coho Salmon*	*Rainbow Trout*	*Arctic Grayling*	*Dolly Varden*	*Longnose Sucker*	Comments
S - 1.1											M -1.1											
1.2											1.2											
1.3											1.3											
1.4											1.4											
1.5											1.5											
S - 2.1											M -2.1											
2.2											2.2											
2.3											2.3											
2.4											2.4											
2.5											2.5											
S - 3.1											M -3.1											
3.2											3.2											
3.3											3.3											
3.4											3.4											
3.5											3.5											
S - 4.1											M -4.1											
4.2											4.2											
4.3											4.3											
4.4											4.4											
4.5											4.5											
S- 5.1											M -5.1											
5.2											5.2											
5.3											5.3											
5.4											5.4											
5.5											5.5											
S- 6.1											M -6.1											
6.2											6.2											
6.3											6.3											
6.4											6.4											
6.5											6.5											
[a] Camp # 1=Rip&Ann 2= Knob 3=Lake											Note: .1=furthest trap downstream .5=Furthest trap Upstream											

Appendix B4.–Alexander Creek juvenile fish measurement form.

2019 Alexander Creek Juvenile Fish Minnow Trapping Form				
Sampler:				Page #
Date:				
Trap #[a]	Camp #[b]	Species	Fork Length (mm)[c]	Comments
[a] Complete Trap Number **(Example: S-1.1, M-1.1)**				
[c] **Measure all individuals if there are five or less of each fish species.**				
Otherwise, representatively subsample to collect **five length measurements**				
[b] Camp 1 = Rip & Annes, Camp 2 = Knob, Camp 3 = Lake				
Common abbreviations for species: KS=king salmon; SS=silver salmon; RS=red salmon; CS=chum salmon;				
PS=pink salmon; WF=white fish; LNS=long nose sucker;				
SB=stickleback; RT=rainbow; GR=grayling; NP=northern pike;				
BB=burbot; DV=dolly varden; SC=sculpin; PL=pacific lamprey.				