Regional Operational Plan SF.2A.2017.07

Operational Plan: Alexander Creek Northern Pike Suppression

by

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and

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April 2017

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.2017.07

OPERATIONAL PLAN: ALEXANDER CREEK NORTHERN PIKE SUPPRESSION

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April 2017

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SIGNATURE PAGE

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Division, Region, and Area	Division of Sport Fish, Region II, Palmer Office
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Field Dates:	Approximately May 2017 and May 2018
Plan Type:	Category II

Approval

Title	Name	Signature	Date
Project co- leader	Kristine Dunker		3/30/17
Project co-leader	Cody Jacobson		3/30/17
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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 2017 and 2018. Netting will be conducted in up to 67 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 have historically generated an average of 13,700 angler-days of effort annually for the 20-year period from 1980 to 1999 (Oslund et al. 2013). During that same period, the Chinook salmon (*Oncorhynchus tshawytscha*) fishery contributed greater than 90% of the expended effort, and an average of 2,880 Chinook salmon were harvested annually (Oslund et al. 2013). From 1977to 2010, the peak of the sport fishery occurred in 1991 with a reported 26,235 days of effort and 6,548 Chinook salmon harvested (Whitmore and Sweet 1998), a more recent average (2003–2012) for sport fishing effort on Alexander Creek was about 2,800 angler days (Oslund et al. 2013). Approximately 8 lodges operated during this time period in which Chinook salmon were primarily targeted.

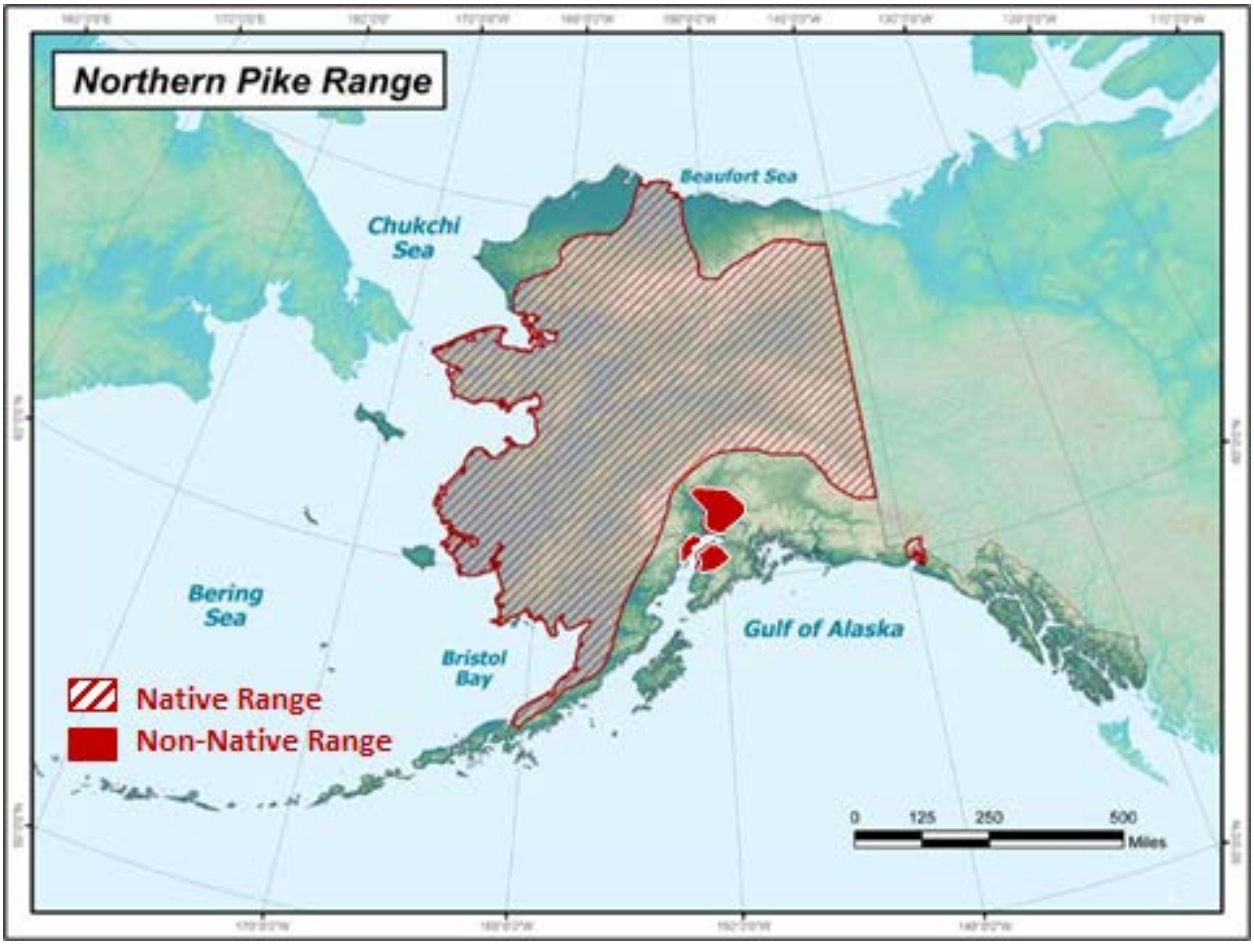

Figure 1.–Northern pike range in Alaska.

Since the late 1990s, northern pike have probably been the biggest factor in the reduced population sizes 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 designating Alexander Creek Chinook salmon as a "Stock of Concern" in 2011. The Sustainable Escapement Goal 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 2004, ranging from 757 fish in 2005 to only 10 fish reported in 2008 (Oslund et al. 2013). The once popular and abundant rainbow trout and grayling fisheries were also closed to harvest in 1996 (Whitmore and Sweet 1998). Despite these fisheries becoming catch-and-release, catch rates have declined over the past 20 years for both species.

Since 2011, in an attempt to reduce northern pike abundance and increase salmonid productivity within Alexander Creek, ADF&G has been implementing a long-term northern pike suppression program. The planned efforts for 2017 and 2018 are described in detail in this operational plan. Northern pike suppression is accomplished by intensively gillnetting side-channel sloughs

(Figure 2) of Alexander Creek each year until seasonal catch rates of northern pike decrease by 85%. For the last 3 years (2014–2016), 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.

The Alaska State Legislature provided funding for a portion of this work in the fall of 2010, and this was used as a 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.

OBJECTIVES

This project continues a long-term project with the 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 in 2017 and 2018 are as follows:

PRIMARY OBJECTIVES

1) Reduce the number of northern pike in up to 67 side channel sloughs of Alexander Creek between May 1 and June 30 such that the final daily catch in each slough is equal to or less than 15% of the peak daily catch or such that the catch remains at less than 2 pike for 3 consecutive days.
2) Calculate the CPUE of juvenile salmonids from minnow trap surveys in Alexander Creek during the netting season to evaluate if abundance is increasing over time.

SECONDARY OBJECTIVES

1) Calculate the mean and range of fork length (FL) measured from northern pike in gillnet catches.
2) Document stomach content, sex, and maturity information of northern pike in gillnet catches.
3) Monitor gillnet catches for PIT-tagged northern pike originating in Alexander Lake.
4) Index the adult Chinook salmon run in Alexander Creek through an aerial survey.
5) Measure a subsample of salmonids in minnow traps to document mean and range of fork length (FL) for each species sampled.
6) Estimate the species composition of juvenile salmonids in Alexander Creek.

Figure 2.–Photograph 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).

METHODS

STUDY AREA

Alexander Creek is a tributary to the Susitna River (Figure 3). 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 at one point part of the mainstem channel. Side channels are typically shallow, stagnant waters with low flows and 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

The primary goal of this project is to reduce the impact of invasive northern pike on rearing salmonids by removing as many spawning northern pike from Alexander Creek as possible. Complete eradication of northern pike in this drainage would most likely be cost 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. Increased salmon productivity in the Alexander Creek drainage coupled with reductions in the northern pike population could eventually drive the fish community toward an equilibrium with sustained salmonid populations. 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 are unable to avoid predation and this explains their drastic population declines (Oslund et al. 2017). Through annual suppression of the northern pike population, ADF&G hopes to eventually restore salmonid production to levels that allow salmon fisheries to re-open 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 side-channel sloughs of Alexander Creek. Netting will take place in May and early June during the northern pike spawning period and will strive to achieve an 85% reduction in northern pike catch in each of the targeted sloughs. 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.

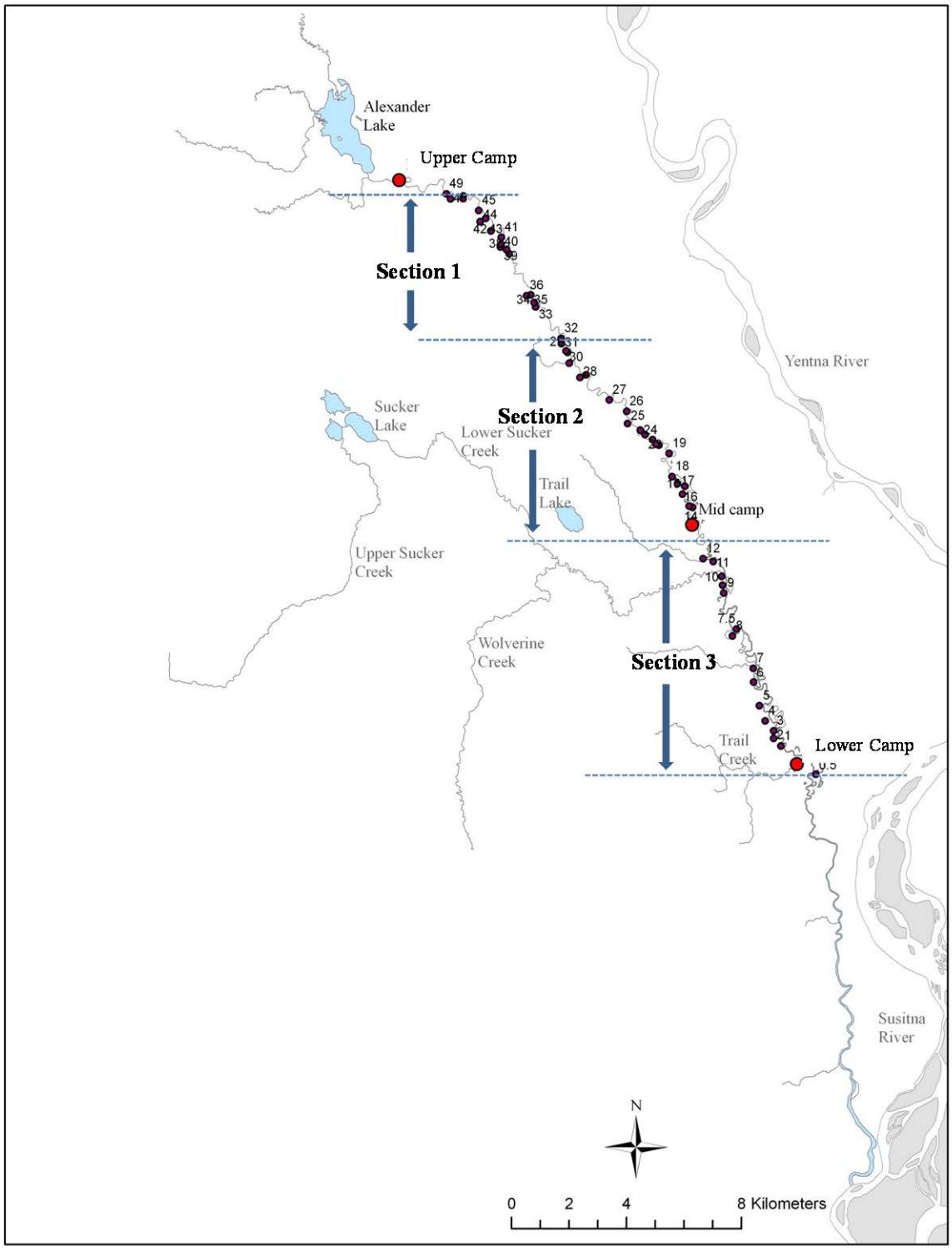

Figure 3.–Map of Alexander Creek showing field camps and "lower" (Section 1), "middle" (Section 2), and "upper" (Section 3) regions with numbered sampling net locations indicated by small dark circles.

From 2011 through 2013, ADF&G conducted a radiotelemetry study of adult northern pike to investigate movement patterns between Alexander Lake and Alexander Creek. Northern pike movement data from the radiotelemetry study demonstrated that few (≈7%) radio-tagged 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 and Dunker *In prep*[1]). This result supported the idea that working solely within Alexander Creek sloughs and not focusing on the far costlier endeavor of pike suppression in Alexander Lake would be sufficient to meet our goal of increasing salmon production in the creek. However in 2014, an invasive plant, *Elodea canadensis*, or "elodea" was discovered in the 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 pike (Heather Stewart and Dave Rutz, personal observations). The Alaska Department of Natural Resources is currently treating Alexander Lake with herbicides to eradicate elodea, but it is unknown how this significant change in habitat structure within the lake might have affected northern pike distribution in the drainage. It is possible that some adult northern pike may have been displaced downstream. The northern pike catch in ADF&G gillnets did increase slightly in 2016 (Figure 4), although whether this is significant or whether there is any association between this result and the spread of elodea is conjecture at best. Nevertheless, the potential for elodea to displace northern pike downstream is concerning because replacement of fish removed by ADF&G nets could reduce the effectiveness of suppression efforts until the elodea population is under control. In the winter of 2017, ADF&G staff will ice fish for northern pike in Alexander Lake, and all caught fish will be tagged with a passive integrated transponder (PIT) tag and a visual Floy[2] tag. A netting crew residing at the lake outlet will continue tagging fish caught by open water angling in the lake during their field seasons. The crews in the spring of 2017 and 2018 will then monitor their nets for these fish. Any tagged fish will be immediately recorded along with GPS coordinates of their locations. Funds are not available to repeat a full movement study of adult northern pike, but this small effort may provide qualitative insight into whether movement patterns of adult northern pike have shifted after the elodea infestation, especially if CPUEs of northern pike captured in gillnets increase again during this study period.

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 continue annually in May and 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.

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[1] Rutz, D. S., and K. J. Dunker. *In prep*. Alexander Creek Northern Pike Suppression. Alaska Department of Fish and Game, Fishery Data Series Report. Anchorage.

[2] Product names in this publication are included for completeness and do not constitute product endorsement.

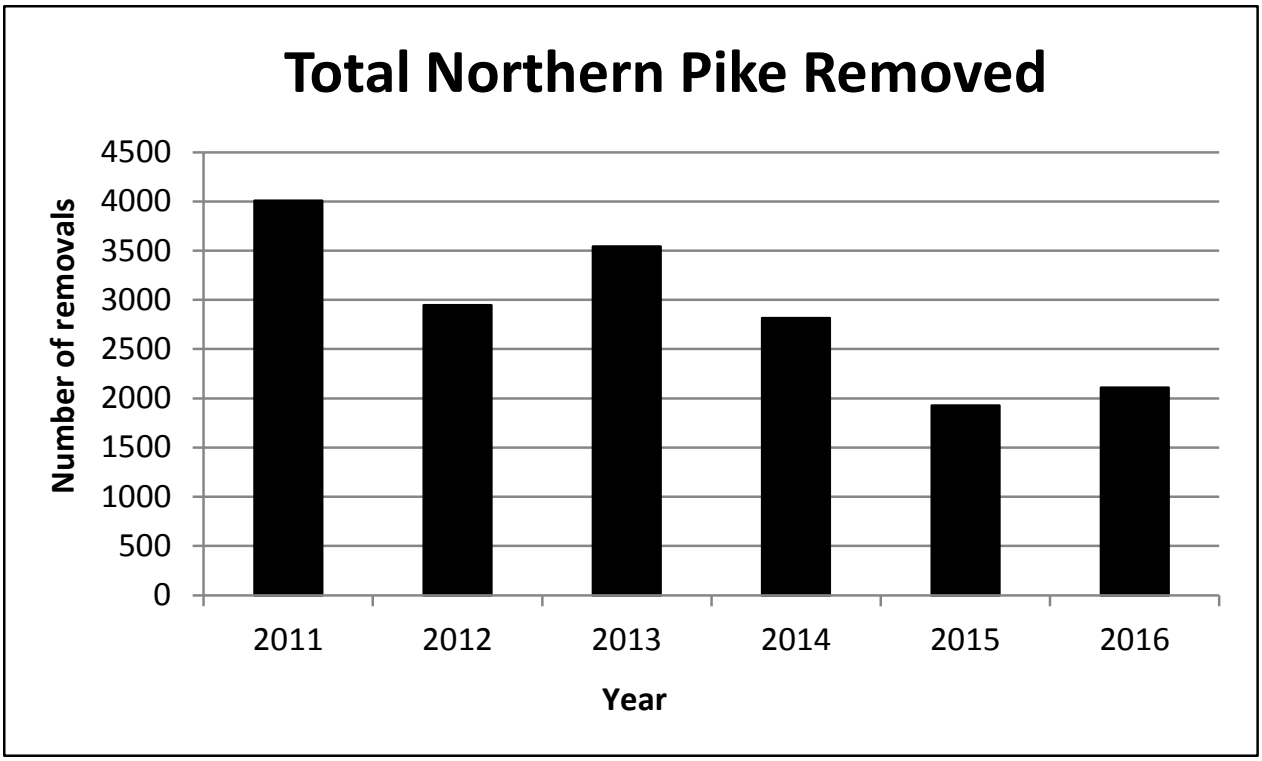

Figure 4.–Total number of northern pike caught in Alexander Creek sloughs since this project began.

Note: A total of 17,349 northern pike have been removed to date.

Northern Pike Suppression

In May though early June in 2017 and 2018, a large-scale gillnetting operation will continue in side-channel sloughs of Alexander Creek. Northern pike will be targeted with up to 75 gillnets while congregated for spawning in side-channel sloughs from approximately one month following ice out. Two field camps will be set up along the mainstem of Alexander Creek. One will be located in the lower river between the mouth of Alexander Creek and Sucker Creek and the other will be located at the Alexander Lake outlet. Two technicians will be assigned to each field camp and will be responsible for gillnetting sloughs assigned to them. Each crew will target approximately 34 side channel sloughs for a total of 68 sloughs in all. The actual number of sloughs that are netted are based on water levels because, at low water, some sloughs cannot be accessed. Earlier years of this project demonstrated that northern pike, in many of the side-channel sloughs, can be reduced by 85% within about 1 week of continuous gillnetting (Rutz and Dunker *In prep*). Sloughs furthest downstream in each river section will be fished first. Sloughs will be fished with enough gillnets to fully cover the area. This will progress upstream until either all sloughs are 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. Slough numbers will remain as designated for annual consistency. 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 juxtaposed in increasing order of 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 monofilament with a three-eighths in (9.5 mm) foam top line and 30 lb 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. Before a gillnet is checked, the crew will disturb the weed bed by either walking or driving a boat through it to potentially scatter more northern pike into the gillnets prior to sampling. If necessary, nets may be moved or more nets set to optimize catches. If and when this happens, it will be documented in field notebooks. Netting will cease for a particular slough once a day's (24-hour period) catch is equal to or less than 15% of the previous peak catch or until fewer than 2 pike are represented in the catch over a 3-day period. Sloughs remaining hydrologically connected with the mainstem river and where increased catches are observed due to postspawning movement, will be continually fished until either an 85% reduction in northern pike catch is achieved or the catch remains at 1 fish for a period of 3 consecutive days. Given past experience, it is likely that each slough will be netted for at least 4 consecutive days. All northern pike removed from gillnets will be dispatched, identified to gender (determined via expression of eggs or milt or via dissection), and measured for fork length to the nearest millimeter.

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). 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, Northern Rocky Mountain Science Center, 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 latest study highlight the need to remain vigilant in Alexander Creek northern pike suppression.

Northern Pike Movement Inquiry

To continue investigating potential movements of northern pike out of Alexander Lake, field crews will catch northern pike in Alexander Lake with hook and line (as time allows during winter fuel transport trips and in the evenings during the field season) and will implant all captured fish with Passive Integrated Transponder (PIT) tags. The tags (Biomark HTP 12, 134.2 kHz) are 12 mm long and can safely be implanted in fish >50 mm in length (Biomark, personal communication). PIT tags are uniquely numbered so each fish will have an individual ID. Tags are inserted in the posterior body cavity using an injector needle manufactured for the specific tag model. Once implanted, the fish can be detected using a portable scanner which receives the tag frequency and registers the unique ID number. All tagged northern pike will be measured to the nearest millimeter and released back into the lake. The date each fish was captured, tagged, and released will also be recorded along with the PIT-tag number and GPS coordinates of the fish's location at the time of release. Beginning in 2017, both netting crews will have PIT-tag scanners and will quickly scan all fish captured in gillnets during the suppression efforts. The location of the gillnet in which each pike is recovered will indicate how far the fish moved within the time since tagging. This will be valuable to investigate whether northern pike

distribution patterns in the drainage have changed since the telemetry project ended and elodea subsequently became established in Alexander Lake.

Salmonid Monitoring Protocol

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

This project will continue the long-term data set begun in 2011. The minnow trap monitoring protocol will serve to answer the following 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?

Two minnow trap sampling events will take place annually in May and June, corresponding with the northern pike netting season. Each field crew will be responsible for setting and checking half of 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 crews. There are 36 sample sites along the creek corridor that correspond to regions previously identified as "lower", "middle," and "upper" Alexander Creek (Figure 3). 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 in each of the sample sites (n = 36). Therefore, the 2 field crews will be responsible for setting and sampling 90 minnow traps for a total of 180 traps per overall 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 and enumerated, and a random subsample of the salmonids in each minnow trap will be measured for fork length. Trends in CPUE and species composition of all captured species will be monitored over time. Northern pike suppression will be considered progressive if salmonid CPUE, specifically for juvenile Chinook and coho salmon, continues to increase annually and begins to show a significant relationship between catch and years of pike suppression. To date, there appears to have been a significant increase in salmonid catch overall (all salmonid species combined) with the number of years of pike suppression (slope = 0.026, P = 0.010, Figure 5) as well as an increase in juvenile coho salmon abundance (slope = 0.024, P = 0.003, Figure 6). However, the relationship among juvenile Chinook salmon catches alone, remains insignificant (slope = 0.003, P = 0.513, Figure 7). 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 in the literature (Jackson and Harvey 1997; Layman and Smith 2001; Hubert et al. 2012) 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 has to 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 pike suppression is benefitting salmonid productivity in the drainage.

In addition to the juvenile salmonid minnow trap monitoring, shifts in northern pike diet will be investigated over time 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 (Figure 8). Stomach contents will be recorded in the field to taxonomic order for undigested invertebrates and to genus for undigested fish. Shifts in northern pike diet will be evaluated by observing changes in the species composition of prey over time.

ADF&G's final metric for measuring changes in salmon productivity will follow established protocols presently in place in the Alexander Creek system to count adult Chinook salmon returning to Alexander Creek. Currently, a single pass aerial index of the spawning escapement of Chinook salmon is flown by helicopter over all 40 miles of the Alexander Creek mainstem and the Sucker and Wolverine Creek tributaries (Figure 3). This project has been in effect since 1979, and formulation of the Chinook escapement goal is based on these index counts. Index surveys are anticipated to continue under a separate funding source as a method of monitoring run strength and any changes in the distribution of spawners as a result of suppression efforts.

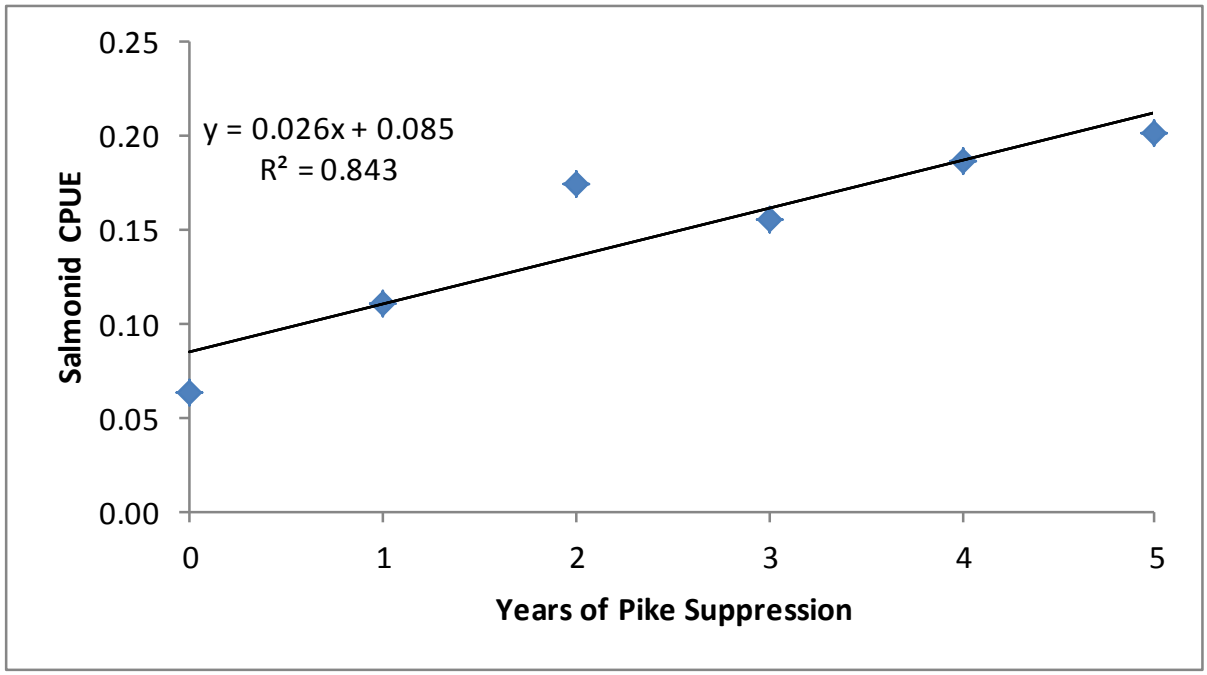

Figure 5.–Mean CPUE of all salmonids combined by the number of years of northern pike suppression.

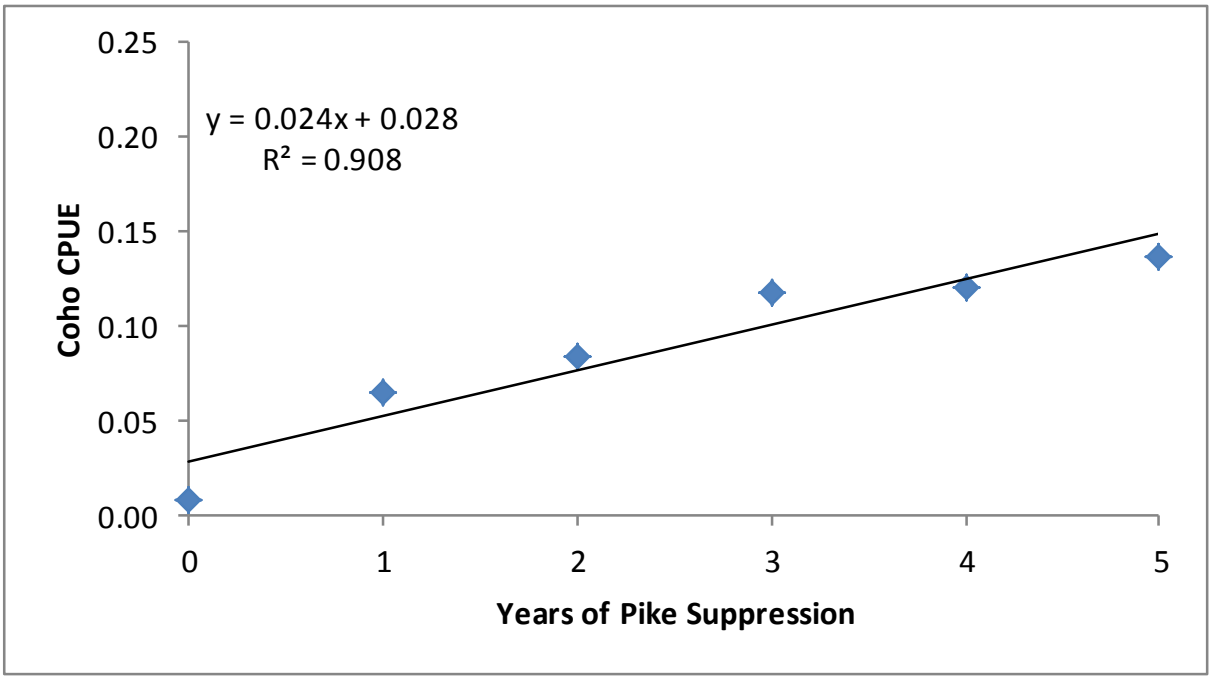

Figure 6.–Mean CPUE of juvenile coho salmon by the number of years of northern pike suppression.

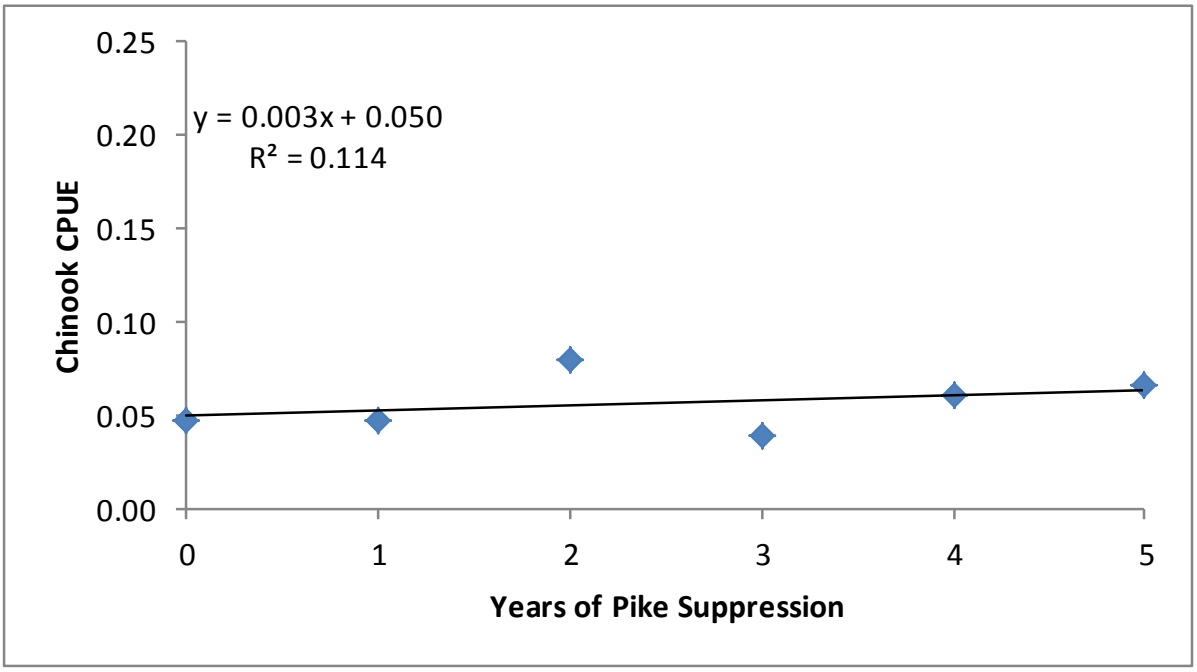

Figure 7.–Mean CPUE of juvenile Chinook salmon by the number of years of northern pike suppression.

Figure 8.–Photograph showing juvenile salmonids in the stomach of a northern pike caught in an Alexander Creek gillnet.

DATA COLLECTION

At 0800 hours each day, field personnel at each site will record environmental data on the Environmental Log Form (Appendix A1). These data will include time of day, water level, water temperature, and weather conditions (percent cloud cover, precipitation and wind).

Northern Pike Suppression

All fish captured in the northern pike suppression gillnets will be counted and identified to species. Catch of other species will be recorded on the bycatch form and released immediately (Appendix A2). All northern pike will be measured for fork length (FL) to the nearest millimeter and recorded. Soak times will be recorded for each approximately 24-hour set. Each slough will be referenced by number (see corresponding Study Design section above) in consecutive order beginning with the slough furthest downstream. The number of northern pike to be sampled for stomach content, sex, and maturity in the field will be determined by the daily work load of field staff, although it is anticipated that all of the captured pike will be dissected for these data. Biological information will be recorded in a field notebook and later transferred to a sampling form (Appendix A3) at the field camp. Guidelines for completing the catch and sampling forms are found in Appendix A4.

Northern Pike Movement Inquiry

Northern pike that are captured with hook and line in Alexander Lake will be measured for fork length to the nearest millimeter and implanted with PIT tags. Each fish, its length, and its corresponding PIT-tag number will be recorded on a data sheet (Appendix A5) along with the date. Beginning in May 2017, field crews will scan all northern pike captured in gillnets in Alexander Creek sloughs to look for PIT-tagged fish. When a tagged fish is found in a gillnet, the ID number, the date, and the slough number will be recorded on a datasheet (Appendix A6). All tagged northern pike that are recovered in gillnets will be measured again to the nearest millimeter and dissected for stomach contents, and these data will also be recorded on the datasheet.

Salmonid Monitoring

All animals captured in minnow traps during salmonid monitoring will be enumerated by species. Invertebrates will be identified to the lowest known taxonomic level and recorded as bycatch. All salmonid individuals will be measured to fork length in millimeters, except for large catches where measurements will not be taken after 20 individuals have been sampled. After the samples have been measured, all animals will be released alive. Data for each catch will be recorded in a field book and transferred to datasheets (Appendices A7 and A8) back at the field camp.

Another metric for monitoring salmonids in the Alexander Creek drainage will involve sampling stomach contents of gillnetted northern pike. All captured northern pike will be dissected by ADF&G staff in the field. For dissected pike, all stomach contents will be identified to the lowest possible taxonomic level and enumerated. Data will be recorded in field notebooks and later transferred to the northern pike sampling data sheets back at field camp (Appendix A3).

A Fishery Biologist I will regularly travel to the field camps to provide needed supplies. During these trips, that person will collect all datasheets for transfer back to the Palmer ADF&G office.

DATA REDUCTION

Paper data forms completed by field crews for the northern pike suppression, juvenile pike movement study and salmonid monitoring will be entered into Microsoft Excel data files.

DATA ANALYSIS

CPUE of northern pike will continue to be calculated for each slough during the suppression gillnetting to determine when an 85% reduction has been reached. Afterward, CPUEs of the spring gillnetting will be calculated for all pooled catch data to look for differences between years.

For any PIT-tagged northern pike that are caught and released in Alexander Lake, the downstream distances of each recovered fish will be measured to document the spatial extent of their movements. Graphically, the movements of all PIT-tagged northern pike will be mapped in ArcGIS by year to illustrate observed movement patterns. The overall proportion of the tagged fish that are recovered during the course of this study will be calculated.

For the salmonid monitoring, the CPUE of all juvenile salmonids in the minnow trap surveys will be calculated annually. 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. Following the survey,

all catch data will be pooled and CPUE will be calculated for all salmonids combined and for each species separately as follows:

$$\text{CPUE} = \frac{\text{Number of fish captured (all salmonids or a single species)}}{\text{Total number of 24-hour trap sets}}. \quad (1)$$

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 as well:

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

where

n_i = the number of salmonids of species *i*,

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

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

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

The aerial indices of adult Chinook salmon escapement will continue to be tabulated according to the templates and procedures already used by ADF&G.

SCHEDULE AND DELIVERABLES

Dates	Activity
April 2017	Purchase equipment and field camp gear Hire field crews
May 2017	Establish field camps Begin gillnet suppression Northern pike stomach content analysis Begin minnow trap sampling events
June 2017	Conclude spring gillnet suppression event Second minnow trap sampling event
April 2018	Purchase equipment and field camp gear Hire field crews
June 2018	Conclude spring gillnet suppression event Second minnow trap sampling event
July 2018	Analyze data and write project report for submittal to the Mat-Su Borough

RESPONSIBILITIES

Kristine Dunker, Fishery Biologist III, ADF&G Division of Sport Fish

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.

Pat Hansen, Biometrician IV, ADF&G, Division of Sport Fish, Research and Technical Services

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

Cody Jacobson, Fishery Biologist I, ADF&G, Division of Sport Fish

Duties: Serve as the primary project biologist; plan, coordinate, and supervise all field logistics; assist with project reporting and presentations to the public.

Fish and Wildlife Technicians (4)

Duties: Assist with field activities.

BUDGET SUMMARY

FY 17

Line item	Category	Budget ($K)
100	Personal Services	
200	Travel	
300	Contractual	
400	Commodities	
500	Equipment	
Total		

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APPENDIX A: DATA FORMS

Appendix A1.–Field data form for environmental data at the Alexander Creek field camps.

2014 Alexander Field Camp Environmental Log										
Date	**Camp #** (1=Rip&Ann 2=Hump 3=Lake)	**Time**	**Sampler Initials**	**Water Level** (ft) (H=high M=Medium L=Low)	**Water Temp ©**	**Wind Speed** (S=Strong S=Slight C=Calm)	**Wind Origin** (N E S W)	**Air Temp ©**	**Cloud Cover** (C=Clear,PC =Partly Cloudy,O=Overcast)	**Comments**
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Appendix A2.–Field data form for recording bycatch in gillnets.

2014 Alexander Creek Bi- Catch Form Date Set _____Date Checked

Camp *(1=Rip&Anns 2=Hump 3=Lake)*	Month	Slough#	GPS Location	Hours Fished	Gear	# of Nets	# Pike	Morthality (M) or Relased Alive (A) [a]	Arctic Grayling	Whitefish	Sucker	Rainbow Trout	Burbot	Chinook Salmon	Coho Salmon	Dolly Varden	Muskrat	Beaver	Vole	Bird Bycatch	Comments
				24	1																
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				24	1																

[a] Record "M" if Bi-Catch was a Mortality or "A" if Bi-Catch was Released Alive

Appendix A3.–Northern pike sampling form.

Alexander Creek Northern Pike Sampling Form, 2014								
Date:		**Slough Number:**			Collectors:		Page:	
Fish #	All Northern Pike	Fork Length (mm)	Reprod. Product (M,E,or A	Maturity (M,I or U)	Sex (M or F)	Stomach contents (E or N)	Stomach Content	Comments about fish or stomack content Such as: Tag #, deformatie, anything out of the ordinary etc…

Appendix A4.–Definitions of terms for catch and sampling forms for Northern Cook Inlet northern pike.

Term	Definition
Slough #	Each slough numbered consecutively beginning furthest downstream.
GPS loc	Mouth of slough.
# Nets	Total number of nets checked by slough.
Species	Record everything caught, even birds and mammals.
Mort	"X" for mortality of bycatch only. All pike are assumed to be killed.
Reproductive products	Before dissection of fish, squeeze to observe release of sex product: M = milt E = eggs A = absent
Maturity	Dissect fish: M = mature (gonads enlarged) I = immature (gonads not developed) U = unknown
Sex	Mark only if absolutely known after dissection of fish: M = male F = female U = unknown
Stomach contents	Common abbreviations for species are as follows: KS = king (Chinook) salmon *Oncorhynchus tshawytscha* SS = silver (coho) salmon *O. kisutch* RS = red (sockeye) salmon *O. nerka* CS = chum salmon *O.keta* PS = pink salmon *O. gorbuscha* WF = white fish *Coregonus* spp. LS = long nose sucker *Catostomus catostomus* SB = stickleback *Gasterosteus cognatus* or *Pungitius pungitius* RT = rainbow trout *O. mykiss* GR = grayling *Thymallus arcticus* NP = northern pike *Esox lucius* BB = burbot *Lota lota* DV = Dolly Varden *Salvelinus malma* SC = slimy sculpin *Cottus cognatus* PL = pacific lamprey Other catch could include macroinvertebrates, rodents, other mammals, birds, leeches or frogs.

Appendix A5.–Juvenile northern pike PIT-tag data sheet.

2014 Alexander Creek Passive Integrated Transponder Tags (PIT) Deployment Form				
Sampler:				Page #
Capture Location:				
Date	Time	Tag Number	Fork Length	Comments

Appendix A6.–Data sheet for recaptures of PIT-tagged northern pike.

2014 Alexander Creek Passive Integrated Transponder Tags (PIT) Recovery Form					
Sampler:					Page #
Capture Location:					
Date	Time	Tag Number	Slough Number	Fork Length	Comments

Appendix A7.–Data form for Alexander Creek juvenile fish captured by minnow trap.

2014 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*	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*	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										3.5									
3.2										M - 3.1									
3.3										3.2									
3.4										3.3									
3.5										3.4									
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 A8.–Alexander Creek juvenile fish measurement form.

2014 Alexander Creek Juvenile Fish Minnow Trapping Form				
Sampler:				Page #1
Date:				
Trap #[a]	Camp #[b]	Species	Fork Length (mm)[c]	Comments