Regional Operational Plan SF.2A.2013.09

Alexander Creek Northern Pike Suppression

by

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and

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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

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ALEXANDER CREEK NORTHERN PIKE SUPPRESSION

by

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SIGNATURE PAGE

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Approval

Title	Name	Signature	Date
Project co- leader	Kristine Dunker		4/15/13
Project co-leader	Dave Rutz		4/16/13
Biometrician	Adam Craig		4/15/2013
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INTRODUCTION

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 1950's 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 and Mecklenburg et al. 2002).

Fisheries of Alexander Creek historically generated an average of 13,700 angler-days of effort annually for the 20-year period from 1980-1999 (Oslund and Ivey. 2013 *in prep*). 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 (Ivey et al. 2008). From 1977-2010, 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 (2001-2010) for sport fishing effort on Alexander Creek is about 2,000 angler days. Approximately eight lodges operated during this time period in which Chinook salmon were primarily targeted.

Since the late 1990s, northern pike have reduced the population size 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 decade with a dramatic drop in the past five years culminating in the Alaska Board of Fisheries designating Alexander Chinook salmon as a Stock of Concern in 2011. The Sustainable Escapement Goal for Chinook salmon is 2,100-6,000 fish. Escapement counts were 885, 440, 185, 275, 177, 83, and 181 fish respectively for 2006-2012 (Oslund and Ivey. 2013 *In prep*). 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 since about 1998, from the upper mainstem of Alexander Creek between Sucker Creek and Alexander Lake. In the past five years, few lower mainstem Chinook salmon have been observed. Presently, spawning is mostly isolated to Sucker Creek and the Wolverine Creek branch of Sucker Creek (Figure 2). Harvest of coho salmon has been below the historical average of 1,683 since 2004, ranging from 757 fish in 2005 to only 10 fish reported in 2008 (Ivey et al. 2008). 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.

In an attempt to reduce northern pike abundance and increase salmonid productivity within Alexander Creek, ADF&G is conducting a long-term northern pike suppression effort that is described in detail in this Operational Plan. Northern pike suppression is accomplished by intensively gill-netting side-channel sloughs (Appendix 1) of Alexander Creek each year until seasonal catch rates of northern pike decrease by 85%. Feasibility studies conducted in 2009 and 2010 demonstrated that such an annual goal was possible (Oslund and Ivey 2010), and in 2011, during the first year of the project, over 4,000 northern pike were removed from Alexander Creek sloughs (Dave Rutz, personal communication). Northern pike gillnetting is conducted during the pike spawning period (ice-out to early June) when pike are most mobile and concentrated in the Alexander Creek sloughs. The Alaska State Legislature has 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 to support the associated project activities. Specifically, in addition to the large-scale gill-netting effort, ADF&G is conducting a radio telemetry study to describe movement patterns of northern pike in the Alexander system and continue monitoring juvenile salmonid populations to evaluate the long-term success of the northern pike suppression efforts.

The mission of ADF&G's Sport Fish Division is "to protect and improve the state's recreational fisheries resources", and an objective of the Division's 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 (ADF&G 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 the Sport Fish Division's highest invasive northern pike control priority (ADF&G 2010). 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.

OBJECTIVES

This project lays the foundation needed to fulfill 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 residing there. Specific objectives of this project in 2013 are to:

1. Reduce the number of northern pike in 36 side channel sloughs of Alexander Creek between May 7 and June 7 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 two pike for three consecutive days.
2. Estimate the proportion of northern pike residing in Alexander Lake that migrate at least once to Alexander Creek from July 15, 2011 – June 30, 2013 such that the estimated proportion is within 15 percentage points of the true value 95% of the time.
3. Calculate the mean CPUE of juvenile salmonids from minnow trap surveys in Alexander Creek to evaluate if a 60% increase in mean CPUE above the 2011 baseline of 0.06 has occurred.

Secondary Objectives:

1. Calculate the mean length (FL) and length range of northern pike in gillnet catches.
2. Document stomach content, sex, and maturity information of northern pike in gillnet catches.
3. Index the adult Chinook salmon run in Alexander Creek through an aerial survey.

4. Measure a subsample of salmonids in minnow traps to document mean length (FL) and a length range for each species sampled.
5. Calculate the mean CPUE of juvenile salmonids from a minnow trap survey in the Deshka River.
6. Calculate relative abundance (percentage of the fish assemblage comprised of a single species) for each species captured in the minnow trap samples in Alexander Creek.
7. Calculate relative abundance (percentage of the fish assemblage comprised of a single species) for each species captured in the minnow trap samples in the Deshka River.

STUDY AREA

Alexander Creek is a tributary to the Susitna River. The creek is approximately 40 river miles long from mouth to 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 river mile 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 et al. 1982 and Mecklenburg et al. 2002), and are currently widespread throughout the system.

METHODS

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 drainage coupled with reductions in the northern pike population could eventually drive the fish community into a state of equilibrium similar to western and interior Alaska where native populations of northern pike and salmonids coexist (Pine et al. 2007 and Muhlfeld et al. 2008). Eventually, ADF&G hopes to restore salmonid production to levels observed during the 1990s when viable fisheries existed in Alexander Creek.

To accomplish this, a long-term northern pike gillnetting program was established in 2011 and will continue annually as funding allows. In 2013, as in 2011 and 2012, 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 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.

A radio-telemetry study will also be implemented to investigate movement patterns of northern pike in the Alexander Creek drainage. Specifically, ADF&G is interested in learning whether or not there is substantial movement between Alexander Lake and Alexander Creek. This study will help fisheries managers make a determination of whether or not northern pike control will be needed in Alexander Lake to accomplish the long-term goal of bolstering salmon productivity in the drainage. Besides this applied benefit, this study will also be the first comprehensive investigation of northern pike movement patterns within an open system outside of its native range in Alaska and the results will have applicability to future northern pike control or eradication projects in Southcentral Alaska. Finally, it is likely that gillnetting northern pike in Alexander Lake will be necessary if it is found that northern pike readily travel between the creek and the lake. However, removing pike from Alexander Lake will substantially add to the overall project cost and has the potential to be controversial with a small group of pike anglers in the area. The information provided by the radio telemetry investigation could provide useful justification to the need for lake gillnetting should a future decision be made to expand pike control efforts to the lake.

Finally, data on the CPUE and relative abundance of juvenile salmonids in Alexander Creek and on the Deshka River will be collected through minnow trap surveys to continue establishing a baseline data set needed for eventual evaluation of the long-term success of the northern pike suppression efforts in increasing salmon productivity. These surveys will continue annually in conjunction with the northern pike gillnetting. Data collected from the Deshka River will be used as a benchmark to compare and evaluate success of the Alexander Creek northern pike suppression efforts. In addition to the minnow trap surveys, ADF&G will continue indexing adult Chinook salmon returns to Alexander Creek via aerial surveys. It is anticipated that large-scale increases in the abundance of salmonids will not be observed for at least five years, based on the life cycles of the salmonid species. Despite the longevity of the anticipated results, the work conducted in the early years of this project will lay the foundation for a long-term initiative to restore the salmonid populations in the Alexander Creek drainage.

SAMPLING METHODS

Northern Pike Suppression

In May and early June of 2013, 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 7 May (ice-out) to 7 June which is approximately 15 days past cessation of spawning and when the majority of sloughs become non-navigable due to dropping water levels (Rutz, personal observation). Three 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 two will be located between Sucker Creek and Alexander Lake because the density of sloughs is higher in the upper portion of the river. Two technicians will be assigned to each field camp and will be responsible for gillnetting sloughs along their corresponding section of creek. In each section of creek, approximately 20 side channel sloughs will be targeted for a total of 60 sloughs in all. Feasibility studies conducted in May of 2009 and May of 2010 demonstrated that northern pike in most side-channel sloughs could be reduced by 85% within about one week of continuous gillnetting (Oslund and Ivey 2010). Sloughs furthest downstream in each river section will be fished first. Sloughs will be fished with a number of gillnets that approximately saturate the area. This will progress upstream until either all sloughs are set or all the available gillnets are deployed. Each slough was given a number and GPS (Global Positioning System) location during the 2009 and 2010 feasibility study, beginning with the slough furthest downstream. Slough numbers will remain as designated for annual consistency; however any new slough encountered will be given a number that corresponds with adjacent sloughs. For instance, if a slough is netted between sloughs 22 and 23, it shall become slough 22.5, and so on. 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 four panels of different mesh sizes. The four panels of mesh are juxtaposed in increasing order of mesh size along the gillnet: 1.25" (3.1 cm), 1.5" (3.8 cm), 1.75" (4.4 cm) and 2" (5.1 cm). Nets are monofilament with a 3/8" (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. Table 1 lists the recommended number of gillnets for each 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 two pike are represented in the catch over a three day period. Sloughs remaining hydrologically-connected with the mainstem and where increased catches are observed due to post -spawn movement, will be continually fished until either an 85% reduction in northern pike catch is achieved or the catch remains at one fish for a period of three consecutive days. Given past experience, it is likely that each slough will be netted for at least four consecutive days. It is expected that catch rates of northern pike will rebound between years of netting which is why it is anticipated that annual netting will be necessary. However, after five years of intensive removal of northern pike spawners, it is expected that initial catch rates will begin to decrease in each of the side channel sloughs. 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 two 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.) A separate project conducted by ecologists with the U.S. Geological Survey, Northern Rocky Mountain Science Center, will use bioenergetics modeling to help assess the effectiveness of the northern pike suppression efforts. Their project, though separate, will be closely coordinated with ADF&G.

Radio Telemetry Study

The second major component of this project will be to identify the spatial and temporal movement patterns of invasive northern pike in the Alexander Creek drainage through radio telemetry techniques. Northern pike movements have been described in areas of the state where northern pike naturally occur (Taube and Lubinski 1996, Roach 1998, Chythlook and Burr 2002). However, distribution and movement patterns of northern pike in the Alexander Creek drainage are not well understood. This information will help define and strengthen the northern pike suppression efforts and will also identify how northern pike use open systems outside their native range.

As described earlier, the proposed northern pike gillnetting effort will concentrate on the side channel sloughs of Alexander Creek. However, little is presently known about the degree to which northern pike move between Alexander Lake and the mainstem of Alexander Creek. Preliminary tracking data from the 1990s suggest that northern pike do not move more than 10 km in the system (Rutz 1996). However northern pike with T-bar tags from a previous study in Alexander Lake were occasionally captured further downstream in gillnets during the northern pike suppression feasibility studies in Alexander Creek (Oslund and Ivey 2010). This suggests that a more comprehensive study of northern pike movement patterns in the Alexander Drainage is necessary. This study began in 2011 and is on-going. If substantial movement between Alexander Lake and the mainstem is observed, it is likely that ADF&G will propose targeted northern pike suppression in Alexander Lake at a future date. This would be a very expensive and potentially controversial endeavor which is why this current project focuses on suppression in side channel sloughs while a determination is made about the need to expand suppression work to the lake.

To describe movement patterns of northern pike in the Alexander system, in 2011, 150 northern pike greater than 400 mm in fork length were fitted with F1845 Advanced Telemetry Systems (ATS) radio transmitters and T-bar tags using standard surgical procedures (Summerfelt and Smith 1990). At least 50% of these individuals are expected to survive the entire duration of the radio telemetry study. A sample size of 75 surviving pike will be sufficient to achieve the precision criteria as stated in project objective #2.

The northern pike used in this study were captured in Alexander Lake via hook and line, implanted with transmitters, and immediately released back to their original surroundings. Attempts were made to catch and tag northern pike throughout the entire lake. Radio-implanted northern pike were released in July of 2011 and will be tracked through June 30 of 2013. As previously stated, approximately half (49%) of radio-tagged northern pike are expected to survive the entire two-year study (Joy and Burr 2004; Roach 1998 and Taube and Lubinski 1996) yielding about 75 live pike after the second year. However, if radio tags are recovered from mortalities of tagged fish or anglers who harvest them, these will be implanted in new pike that are caught and released back into Alexander Lake. Detailed records of the tag numbers and movement distances will be kept and monitored for all tagged pike including replacement fish throughout the study.

As in 2011, six separate frequencies were used within the 150.000 - 151.999 Mhz range, and efforts were made to ensure the frequencies used will not conflict with any other ongoing radio telemetry studies. Each frequency has 25 different transmission patterns (“pulse codes”), resulting in 150 uniquely identifiable transmitters. Because northern pike can remain sedentary for long periods of time, the transmitters do include mortality indicators. Transmitters are 42 mm long, 17 mm in diameter, have a mass of 14 g, have a 30-cm external whip antenna, and a battery capacity life of 693 days (1.9 years).

Movements of radio tagged fish will continue to be monitored by repeated aerial surveys (Eiler 1995). A single engine, Piper PA-12, fixed wing aircraft will be used for aerial surveys. As in 2011 and 2012, aerial telemetry surveys will be conducted to detect northern pike movements. Information collected will include the date and time the fish is present at the site, the signal strength, and the GPS location of the fish. The aerial surveys will continue to use two Yagi antennas mounted on each wing strut with the antenna oriented forward slightly downward, and the elements vertical, to maximize the reception. Both antennas will be combined into one line to the receivers. An ATS Model 4500 radio receiver with an internal global positioning system (GPS) receiver will be programmed to continuously scan all frequencies and create a log of the tags detected and their latitude and longitude. Flight surveys and/or ground tracking will take place monthly between September and March, twice in April, May, and June.

Salmonid Monitoring Protocol

The third component of this proposed project involves collecting the baseline 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 system including annual minnow trap surveys of juvenile salmonids, an investigation of temporal shifts in northern pike diets, and aerial surveys of Chinook salmon runs. The minnow trap monitoring protocol will serve to answer the question of whether relative abundance and catch per unit effort (CPUE) of juvenile Chinook and coho salmon will increase with each year of northern pike suppression.

To continue building a long-term data set, two minnow trap sampling events will take place annually on Alexander Creek and one minnow trap sampling event will take place in the Deshka River in concert with the northern pike suppression schedule. In Alexander Creek the first sampling event will occur in the second week of May, and the second sampling event will take place during the first week of June. In the Deshka River, the sampling event will take place in mid June. Alexander Creek will be divided into the three sections discussed in the northern pike suppression methods section. Field crews responsible for gillnetting those sections will also be responsible for the minnow trap surveys in their assigned areas. Sampling locations will be fixed. In the Deshka River only one sample section will be sampled, ADF&G sport fish biologists will determine the most appropriate sampling locations prior to the first survey. GPS coordinates of each location will be taken, and the sites will be marked with numbered stakes. Each of the three creek sections on Alexander Creek and the one section on the Deshka River will contain twelve sample sites. For each of these sections six sample sites will be located in the mainstem of Alexander Creek and the Deshka River, and six sample sites will be located in side channel sloughs. Five minnow traps will be set in each of the sample sites. Therefore, each field crew will be responsible for setting and sampling 60 minnow traps for a total of 180 traps in Alexander Creek and 60 traps in the Deshka River. Traps will be fished for approximately 24 hours and baited with salmon roe. All fish will be recorded to species level and enumerated. All salmonids in each minnow trap will be measured for fork length except for large samples. In those cases length measurements will no longer be collected after 20 individuals have been measured. Trends in CPUE and relative abundance will be monitored over time. For the first three years of this monitoring protocol for Alexander Creek, it is expected that threespine stickleback *Gasterostreus aculeatus* will be the dominant species in the samples; for the Deshka River it is expected that the dominant species in the samples will be Chinook and coho salmon juveniles as the Deshka River supports much less northern pike habitat and therefore fewer invasive northern pike so salmonid production in this system is fairly stable. Northern pike suppression on Alexander Creek will be considered successful if large increases in salmonid CPUE and relative abundances, specifically among Chinook and coho juveniles, can be observed within seven years. This duration is necessary to accommodate the life cycles of the salmon species in the system. However, following this delay, there should be a corresponding increase in CPUE with the number of years of suppression. Minnow traps are logistically very good tools for this sort of monitoring, and Chinook and coho juveniles tend to recruit well to the gear (Bryant 2000 and Swales 2008). However, minnow traps have inherent biases that have been well documented (Hubert 1996, Jackson and Harvey 1997, Layman and Smith 2001) and up to 15 to 30% variability in salmonid catch rates can be expected between years (McPherson et al. 1998 and Pahlke et al. 2009). Therefore, northern pike suppression efforts will be considered successful if large increases in salmonid abundance beyond anticipated variability can be observed. For instance, an eventual increase in CPUE of 60% (double the maximum variability documented in the literature) beyond the mean CPUE for 2011 would be sufficient evidence that the gillnetting effort is achieving the overall goal of this project. In addition, trends in CPUE and relative abundance from the Deshka River minnow trap sampling events will be compared annually to those data from Alexander Creek as an additional indicator of success or failure of the Alexander Creek Pike suppression project. In the future, if such an increase is observed consistently for three years, the monitoring will be reduced to every three years rather than annually. For the near term, however, the focus will continue to be on gathering the initial monitoring data set from which the overall northern pike suppression initiative will eventually be evaluated.

Another complement to the juvenile salmonid minnow trap monitoring will be to investigate shifts in northern pike diet over time as the suppression efforts continue. All of the northern pike that are removed in gillnets during the suppression project will be dissected to identify and enumerate prey in their stomach contents. Stomach contents will be recorded in the field to order for undigested invertebrates and genus for undigested fish. In 2013, all salmonid contents will be genetically tested by ADF&G genetics staff to confirm species identifications. Shifts in northern pike diet will be evaluated by observing changes in the relative abundance of prey species over time. For example, it would be expected that the relative abundance of salmonids would increase in northern pike stomach contents with each year of the northern pike suppression as salmon productivity increases, salmonid prey becomes more abundant in the system, and intraspecific competition is reduced within the remaining northern pike population. Data collected in 2012 will continue laying the foundation by which future comparisons can be made.

ADF&G's final metric for measuring changes in salmon productivity will follow established protocols presently in place in the Alexander 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 2). This project has been in effect since 1979, and formulation of the Chinook salmon escapement goal is based on these index counts. Index surveys are anticipated to continue as a method of monitoring run strength and any changes in the distribution of spawners as a result of suppression efforts. The ultimate success of this project will be confirmed if future indices indicate that Chinook salmon escapement of 2,100 to 6,000 fish is, again, being met.

DATA COLLECTION

At 0800 hours each day, field personnel at each site will record environmental data on the Environmental Log Form (Appendix 2). 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 and released immediately. All pike will be measured to the nearest millimeter of fork length (FL). Soak times will be recorded for each approximate 24-hour set. Each slough is referenced by number (see Sampling Methods above) in consecutive order beginning with the slough furthest downstream. Catch data will be recorded in a field notebook and then transferred to a catch form (Appendix 3) at the field camp.

The number of 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 35% 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 4) at the field camp. Guidelines for completing the catch and sampling forms are found in Appendix 5.

Radio Telemetry

Radio-tagged northern pike were captured, tagged, and released in July of 2011 and will be tracked through June of 2013. Records of length, tag number, and radio transmitter frequency and pulse code were made during each of the pike surgeries. The condition of each fish upon release was also be noted as well as the GPS locations for each of the release sites (Appendix 6). If a northern pike is replaced due to mortality and subsequent recovery of the radio tag, records will be kept on which fish were replaced, when they were replaced, and which area they were released back into. This information will be recorded in the condition section of the datasheet (Appendix 6).

Movements of radio-tagged northern pike will be monitored by aerial and ground surveys. Aerial, boat, or snow machine telemetry surveys will identify fine-scale movements and the locations of radio tagged fish. Automatically recorded data will include the date and time of decoding, and the frequency, pulse code, latitude and longitude, signal strength, and activity status of each decoded transmitter. Aerial survey data will also be manually recorded on the Radio Tracking Form (Appendix 7) by the biologist conducting the survey, as a backup to the automated recording and to track the number of radio tags detected in real time.

When the radio receiver operator hears a tag, the "HOLD" button will be pressed, and the receiver will lock on the frequency to identify the pulse code. When the "HOLD" button is pressed, the frequency, pulse code, signal strength, and latitude-longitude will be automatically written to the internal memory of the receiver. The data in the internal memory will be downloaded to a Windows (Microsoft™) based personal computer after each survey. The flight path will be automatically recorded on a handheld GPS (Garmin™ E-trex) and then downloaded, using Garmin MapSource software, to a Windows (Microsoft™) based personal computer after each survey to document the drainages surveyed.

Flight / ground surveys will take place monthly between September and March, twice in April, May, and June. All data will be returned to the office, and stored in ArcMap for mapping northern pike movements.

Salmonid Monitoring

180 minnow traps will be deployed by three field crews in early May and early June in Alexander Creek and 60 will be deployed on the Deshka River to sample juvenile and small fish for CPUE and relative abundance. All minnow traps will soak for approximately 24 hours before sampling. All animals in the traps will be enumerated by species, but invertebrates will be identified down to the lowest known taxonomic level and recorded as bycatch. All salmonid individuals will be measured to fork length in mm, except for large catches where measurements will not need to 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 9 and 10) back at the field camp.

Another metric for monitoring salmonids in the Alexander Creek drainage will involve sampling stomach contents of gill-netted northern pike. Approximately 50% of the pike will be dissected by ADF&G in the field. For pike that are dissected, 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 4).

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.

Lastly, adult Chinook salmon returning to Alexander Creek will continue to be indexed annually via a single-pass aerial survey. Chinook salmon counts will be recorded during the flight into a field notebook and entered into a data file at the Palmer ADF&G office following the survey.

DATA REDUCTION

Paper data forms completed by field crews for the northern pike suppression and salmonid monitoring will be entered into a Microsoft™ Excel data file.

All raw data files regarding the telemetry data will be stored in a dedicated subdirectory on the Palmer ADF&G LAN in season as they become available. Only copies of the raw data files will be manipulated to construct a complete database that will then be used for analyses. The comma delimited ASCII files that are created daily inseason from all relocation methods will be appended into one Microsoft™ Access database for the entire 2013 season. ArcMap will then be used to visually represent each radio tagged fish's movement to determine sight fidelity, as well as temporal and spatial movement patterns. The above files will serve as the basis for all telemetry data analysis required to achieve the study objective #2.

DATA ANALYSIS

This project, in 2012, will continue laying the foundation for a much longer northern pike suppression and research initiative. As such, little data analysis will occur this year. When the radio-telemetry data collection ends in 2013, the proportion of northern pike that leave Alexander Lake will be estimated to address the question of whether or not northern pike move between the lake and the creek. The proportion of northern pike leaving Alexander Lake will be estimated as:

$$\hat{p} = \frac{s_t}{n}$$

where:

s_t = the number or radio tags detected leaving Alexander Lake

n = the total number of radio tags originally deployed

and the variance of the estimate will be:

$$Var(\hat{p}) = \frac{\hat{p}(1-\hat{p})}{n-1}$$

Note: The previous statistics may be censored by tags that are never detected following deployment, fish mortalities from tagging-related injuries, or fish that have been turned in by a member of the angling public.

Of the pike that are found to leave the lake, the maximum downstream distances of each fish will be measured to document the spatial extent of these movements. The number of tagged pike that leave the lake and then later return will also be documented. Graphically, the movements of all radio-tagged pike will be mapped in ArcMap by season to illustrate the maximum extent of the movements observed and to visually represent any seasonal movement patterns.

For the salmonid monitoring part of this project, data analysis will not take place for at least five years. However, for 2013 and in the near term, the CPUE and relative abundance of all fish species 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, CPUE will be calculated for each fish species as the # of fish/ # of traps (i.e. X # of Chinook salmon fry/ 180 minnow traps) for the May and June sampling in Alexander Creek (i.e. X # of Chinook salmon fry/ 60 minnow traps) and June sampling for the Deshka River events each year. The relative abundance of each fish species will be compiled for the pooled minnow trap surveys as well. In the future, data analysis will seek to answer the question of whether or not the CPUE and relative abundance of Chinook and coho salmon is increasing as the northern pike suppression continues. 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

April 2013- Purchase equipment and field camp gear/ Conduct radio telemetry surveys
May 2013- Establish field camps/ Begin gillnet suppression/ Collect water samples/ Northern Pike stomach content analysis/ Conduct radio telemetry surveys
Mid-May, 2013- Minnow trap sample event/ Run genetic tests on trap subsamples
June 2013- Conclude gillnetting/ Minnow trap sample event/ Conduct radio telemetry surveys.

Results of the radio telemetry project will be written up in an ADF&G fisheries data series report and submitted to a professional journal in the winter of 2013-14. Results will be presented at the Alaska Chapter American Fisheries Society Annual meeting in 2014. Progress reports on the northern pike suppression and monitoring tasks will be written semi-annually and supplied to contacts with the Alaska Sustainable Salmon Fund. An FDS report or manuscript will be written in 2014.

RESPONSIBILITIES

Personnel	Duties
Kristine Dunker, Fishery Biologist III, Alaska Department of Fish and Game, Sport Fish Division	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.
Adam Craig, Biometrician III, Alaska Department of Fish and Game, Sport Fish Division	Provide guidance on study design; Assist with post-season data analysis. Review project operational plans and reports.
Dave Rutz, Fishery Biologist II, Alaska Department of Fish and Game, Sport Fish Division	Serve as the primary project biologist; plan, coordinate, and supervise all field logistics; Prepare project reporting and presentations to the public
Cody Jacobson, Fishery Biologist I, Alaska Department of Fish and Game, Sport Fish Division	Assist with field procedures for the northern pike radio telemetry and supply field camps
Fish and Wildlife Technicians	During each field season, six fish and wildlife technicians will be hired to assist with the field activities

BUDGET SUMMARY

Line	**FY12**	**FY13**	**FY14**
100	$198,559	$240,962	242,752
200	$0	$0	$0
300	$27,144	$39,920	$31,950
400	$31,668	$32,150	$31,421
500	$0	$0	$0
Total	**$257,317**	**313,032**	**$306,123**

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TABLES

Table 1.–Evaluation of sloughs targeted with gillnets in 2009-2010 to assess feasibility of northern pike suppression on Alexander Creek.

2009 feasibility netting mouth upstream to about river mile 20 (Sucker Creek).

Analysis of objective criteria: reduce abundance by 85% of initial catch in each slough over 3-wk period. Note that project lasted 15 days.

slough	First day	Last day	# days trapped	# nets	Initial catch		Last catch	%reduction	> 85% Reduction	Date if became landlocked	Reason for pulling	Comments	Recommended # of nets
1	5/14	5/28	14	3	16		3	81	no		end of project	add 1 net; good slough	4
2	5/14	5/28	14	1	9		2	78	no		end of project	continue with 1 net	1
3	5/14	5/21	7	2	7		0	100	yes	5/21	85% reduct	hit early; mouth closes off early	2
4	5/14	5/25	11	1	8		0	100	yes		85% reduct	hit early with; add 2 nets	3
5	5/14	5/25	11	3	15		2	87	yes		85% reduct	good slough; keep at 3 nets	3
6	5/15	5/21	6	5	38		5	87	yes	5/21	85% reduct	hit very early; mouth closes off early	5
7	5/15	5/17	2	2	16		1	94	yes	5/17	85% reduct	skip unless high water; dewaters fast	2
8	5/15	5/21	6	1	8		1	88	yes	5/21	85% reduct	keep at 1 net	1
9	5/15	5/17	2	2	21		12	43	no		N/A	N/A	N/A
9	5/18	5/28	13	4	39		13	67	no		end of project	best slough; add 2 net for 6 total	6
10	5/22	5/25	3	2	1		0	100	yes		85% reduct	narrow slough; low catch; 1 net	1
11	5/22	5/27	5	3	21		4	81	no	5/27	landlocked	good slough; access limitations; net early	4
12	5/22	5/28	6	2	28		3	89	yes		85% reduct	good slough; keep at 2 nets	2

# sloughs reduced by at least 85% of initial catch:	8
Average # days to reach reduction of 85%:	6.5
# sloughs to landlock:	5

2010 feasibility netting from about river mile 20 (Sucker Creek) upstream to Alexander Lake.

Analysis of objective criteria: reduce abundance by 85% of the peak catch in each target slough over 3-wk period. Note that project lasted 16 days.

slough	First day	Last day	# days trapped	# nets	Initial catch	Peak catch	Least catch	%reduction	> 85% Reduction	Date if became landlocked	Reason for pulling	Comments	
13	5/10	5/17	7	3	23	28	5	82	no	5/17	landlocked	Access limitations; hit early: add 1 net	4
14	5/11	5/26	15	3	14	14	2	86	yes		85% reduct	end of project; good slough; 3 nets good	3
15	5/11	5/20	9	1	4	4	1	75	no	5/20	low catch	low catch, access limitations	1 or 0
16	5/11	5/18	7	2	18	18	2	89	yes		85% reduct	good slough; 2 nets good	2
17	5/11	5/21	10	1	5	6	2	67	no		end of project	expect low catch; 1 net good	1
18	5/11	5/26	15	1	11	11	2	82	no		end of project	good slough; 1 net good	1
19	5/11	5/15	4	3	20	20	3	85	yes		85% reduct	good slough; 3 nets good	3
20	5/11	5/24	13	2	18	18	1	94	yes		85% reduct	good slough; 2 nets good	2
21	5/11	5/15	4	2	6	7	1	86	yes	5/15	85% reduct	low catch;access limitations	2
22	5/11	5/12	1	1	0	0	0	#DIV/0!	#DIV/0!		low catch	few pike; skip this slough	0
23	5/11	5/17	6	2	2	10	1	90	yes	5/17	85% reduct	Access limitations; 2 nets good	2
24	5/17	5/22	5	1	2	2	1	50	no		low catch	consider not setting this slough	1 or 0
25	5/17	5/26	9	1	2	3	1	67	no		low catch	consider not setting this slough	1 or 0
26	5/17	5/26	9	1	5	5	1	80	no		end of project	set early; add 1 net	2
27	5/15	5/26	11	3	16	16	2	88	yes		85% reduct	3 nets good	3
28	5/15	5/26	11	1	9	9	1	89	yes		85% reduct	add 2 nets	3
29	5/17	5/26	9	2	14	16	5	69	no		end of project	add 1 net	3
30	5/18	5/26	8	3	10	10	2	80	no		end of project	hit early; dries up quick; add 1 net	4
31	5/22	5/26	4	2	11	11	2	82	no		end of project	hit early; dries up quick; add 1 net	3
32	5/22	5/26	4	1	7	7	2	71	no		end of project	low catch; 1 net OK	1

# sloughs reduced by at least 85% of peak catch:	8
Average # days to reach reduction of 85%:	8.9
# sloughs to landlock:	4

FIGURES

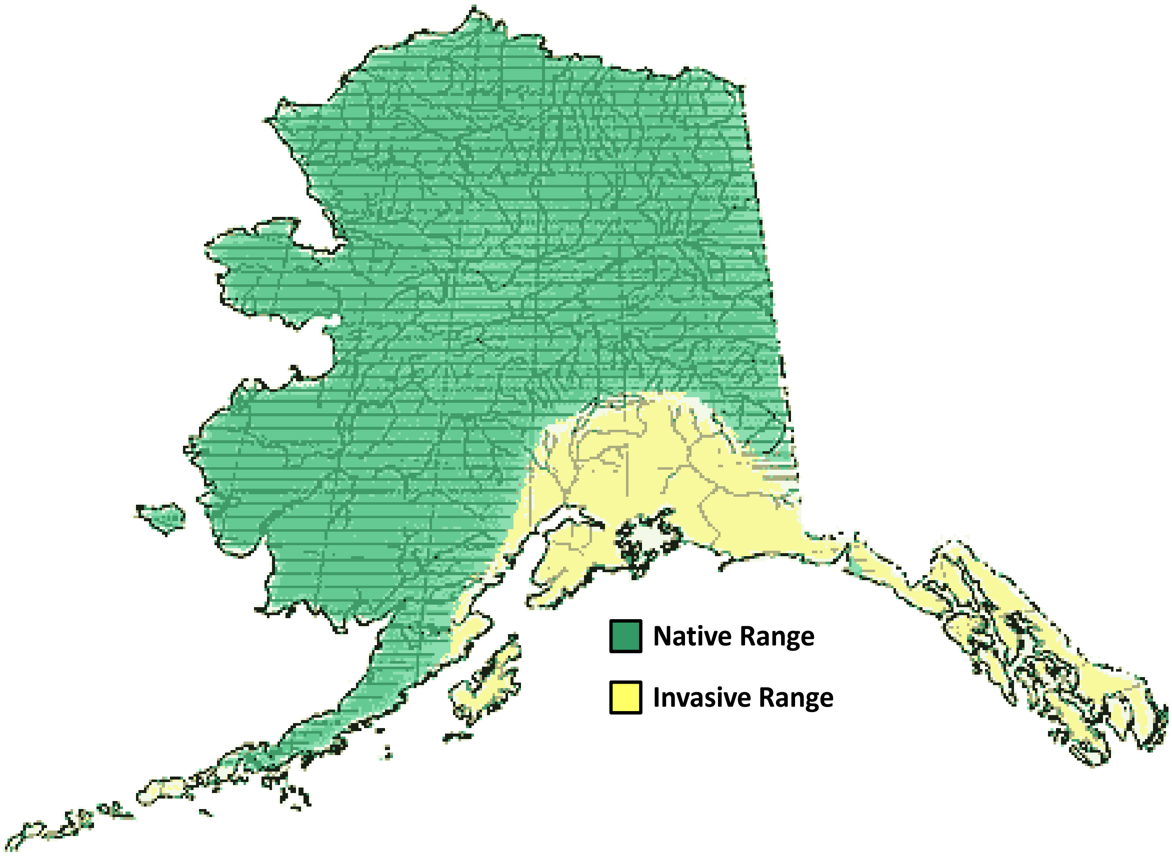

Figure 1.–Native and invasive ranges of northern pike; yellow indicates invasive range.

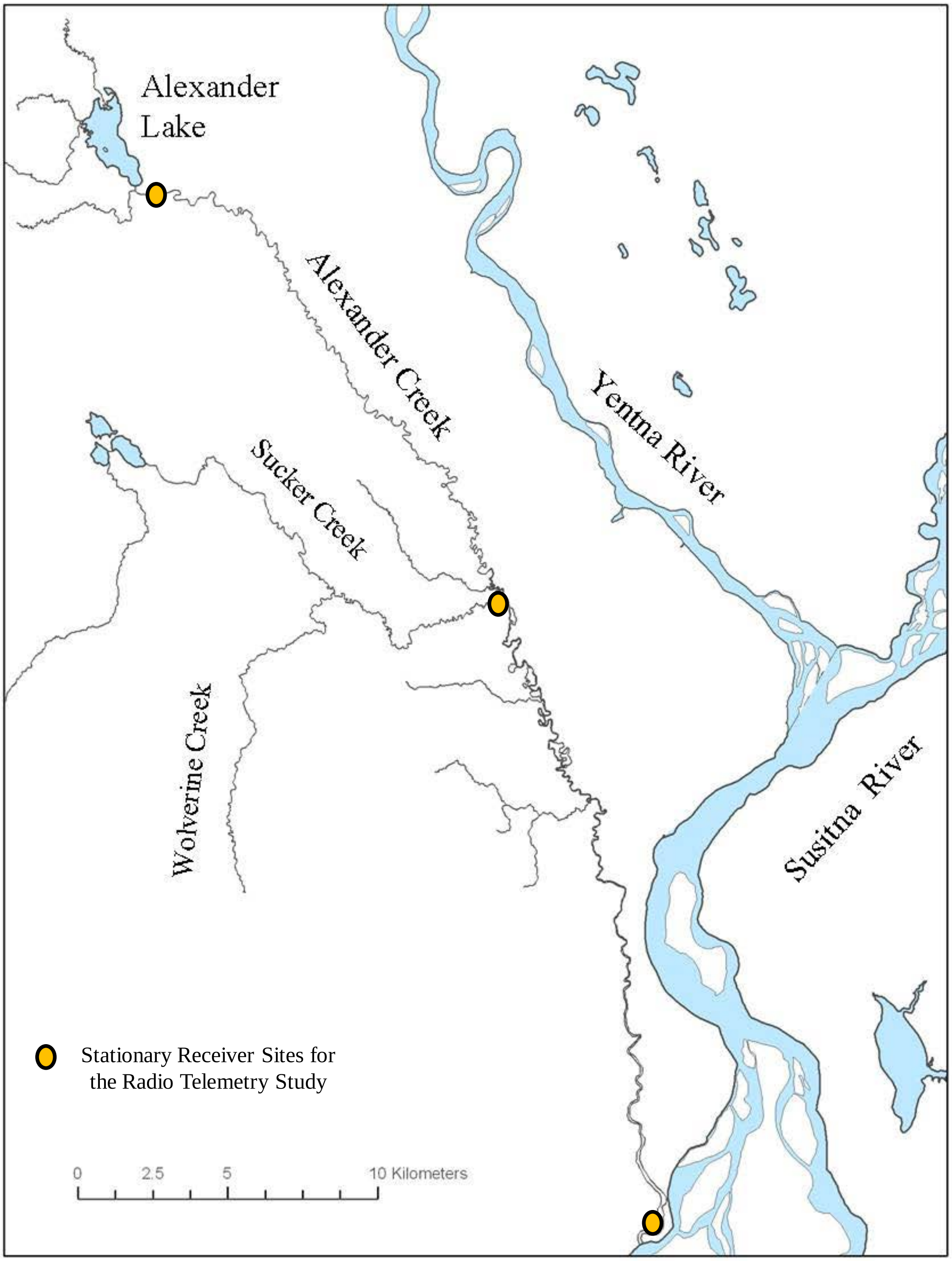

Figure 2.–Map of Alexander Creek and the locations of stationary radiotelemetry receivers.

APPENDICES

Appendix 1.–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).

Appendix 2.–Field Data Form for Environmental Data at the Alexander Creek Field Camps, 2013.

Alexander Field Camp Log, 2011

Date	Time	Sampler Initials	Water Level (ft)	Water Temp ©	Wind Speed C,B,G	Wind Origin N,E,S,W	Air Temp ©	Cloud Cover (S,PC,O)	Comments

Wind Speed: (Calm, Breezy, Gales); Cloud Cover: (Sunny, Partly Coudy, Overcast)

Appendix 3.–Northern Pike Catch Form, 2013.

Date	Slough #	GPS Loc	**# Nets**	Start time	Stop time	Soak time	# Pike	% Reduction from peak catch	Bycatch (list species & #)	Comments

Appendix 4.–Northern Pike Sampling Form, 2013.

Slough #: Collectors: Page:

Date:

Fish #	Species	Mort (only if other than pike)	F. length (mm)	Reprod. Product	Maturity	Sex	Stomach contents. "E" if Empty. "N" if nonempty	Comments about fish

Slough #: Each slough numbered consecutively beginning furthest downstream.

GPS loc: mouth of slough.

 # Nets: Total # of nets checked by slough

Species: Record everything caught, even birds and mammals

Mort: "X" for mortality of bycatch only. Pike 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.

KS=king salmon; SS=silver salmon; RS=red salmon; CS=chum salmon; PS=pink salmon; WF=white fish; LS=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, frogs…

Appendix 6.–Northern Pike Surgery Log for the Radio Telemetry Study, 2013.

Northern Pike Surgery Data											
Capture Area	Surgery Start	Surgery Stop	Length (FL)	Sex	Freq.	P. Code	Anesth.	Scale Card	Floy Tag #	Release (GPS)	Condition

Appendix 7.–Northern Pike Radio Telemetry Tracking Form for the Radio Telemetry Study, 2013.

Alexander Creek Northern Pike Tracking Form

Tracker: Date:	______			Survey Type (Circle one): Aerial Boat Snow Machine
Number	Freq.	Pulse Code	Habitat	Comments

Page #

Appendix 8.–Alexander Creek Juvenile Fish Minnow Trapping Form, 2013.

Sampler: Sample Dates:

Trap #	Deploy Time	Check Time	Site	Habitat	*Threespine stickleback*	*Chinook Salmon*	*Coho Salmon*	*Sockeye Salmon*	*Pink salmon*	*Chum Salmon*	*Longnose Sucker*	*Northern Pike*	*Slimy Sculpin*	*Alaska Blackfish*	*Lamprey*	*Rainbow Trout*	*Arctic Grayling*	*Dolly Varden*	*Whitewfish*	*Wood Frog/ Tadpoles*

Habitat: M (Mainstem) or S (Slough)

Appendix 9.–Alexander Creek Juvenile Fish Measurement Form, 2013.

Alexander Creek Juvenile Fish Minnow Trapping Form

Sampler ______________________________ Page #

Trap #	Species	Fork Length (mm)	Comments

Measure all individuals if there are 20 or fewer salmonids.