Regional Operational Plan SF.2A.2014.13

Operational Plan: Alexander Creek Northern Pike Suppression

by

Kristine Dunker,

and

Dave Rutz

February 2015

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

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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

Kristine Dunker and Dave Rutz

Alaska Department of Fish and Game, Division of Sport Fish, Anchorage

Alaska Department of Fish and Game
Division of Sport Fish

February 2015

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Kristine Dunker and Dave Rutz
Alaska Department of Fish and Game, Division of Sport Fish,
333 Raspberry Road, Anchorage, AK 99518-1565, USA

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SIGNATURE PAGE

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Plan Type:	**Category II**

Approval

Title	Name	Signature	Date
Project co- leader	Kristine Dunker		4/25/14
Project co-leader	Dave Rutz		5/10/14
Biometrician	Adam Craig		5/7/14
Research Coordinator	Timothy McKinley		5/13/14

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ABSTRACT

The northern pike is an invasive predatory fish in Southcentral Alaska and is responsible for the loss of several fisheries across the region. Alexander Creek in the Susitna River basin is one of the most heavily impacted systems. This project will continue to restore the quality of salmon rearing habitat by annually reducing the number of northern pike spawners in the slow backwaters of Alexander Creek. Research projects will also be conducted to better understand movement patterns of juvenile northern pike in Alexander Creek and evaluate the success of the suppression effort in increasing salmon productivity within the system.

Key words: Northern pike, Esox lucius, Invasive species, Alexander Creek, Gill nets, Pike control

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, 181, and 559 fish respectively for 2006-2013 (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%. For the last three years, northern pike gillnetting has been 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 provided funding for a portion of this work. In the fall of 2010, this funding was used as non-Federal match to acquire $635K from the Alaska Sustainable Salmon Fund (AKSSF) to support the associated project activities between 2011 and 2013. In the winter of 2013, ADF&G was again awarded AKSSF funding ($563K) to continue this work between 2014 and 2016. With this new grant, ADF&G will continue the large-scale gill-netting effort in the spring, add a fall netting season, conduct a tagging study to investigate movement patterns of juvenile northern pike out of Alexander Lake and temporally expand monitoring efforts for juvenile salmonids 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 2014 are to:

1. Reduce the number of northern pike in up to 67 side channel sloughs of Alexander Creek between May 7 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 two pike for three consecutive days.
2. Reduce the number of northern pike in 20 side channel sloughs of Alexander Creek between August and September for 3-5 days each until the final daily catch in each slough is equal to or less than 15% of the fall peak daily catch.
3. Calculate the catch per unit effort (CPUE) of young of the year and 1-year-old northern pike captured in fyke nets downstream of the outlet of Alexander Lake and estimate the

proportion of this catch that migrates to Alexander Creek sloughs between May 7, 2014 – September 30, 2016 **

4. Calculate the mean CPUE of juvenile salmonids from minnow trap surveys in Alexander Creek in May and June to evaluate if a 60% increase in mean CPUE above the 2011 baseline of 0.06 has occurred.

*** Precision criteria are not included in this objective because this won't be a representative sample of all juvenile northern pike in Alexander Lake and it is presently unknown how many juvenile pike will be captured and tagged in the fyke nets.*

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 minnow traps in July, August and September in 2014 to establish a baseline from which minnow traps fished during these months in 2015 and 2016 can be compared.**
6. Calculate the mean CPUE of juvenile salmonids from minnow trap surveys in the Deshka River.
7. 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.
8. 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.

*** Beginning in 2014, minnow trapping for juvenile salmonids will be temporally expanded to include trapping during the months of July, August and September. From 2011-2013 minnow trapping only occurred in May and June.*

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

BACKGROUND

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. 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 pike catch in each of the targeted sloughs. Beginning in 2014, a fall netting period will be added in August and September to further suppress the pike population. 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.

From 2011 through 2013, ADF&G conducted a radio telemetry study of adult northern pike to investigate movement patterns between Alexander Lake and Alexander Creek. The next component of this project is to determine if juvenile northern pike (YOY and 1-year old fish) are emigrating from Alexander Lake to rear in side-slough channels of the creek. Northern pike movement data from the radio telemetry 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*). It is currently unknown, however, if movement patterns of juvenile northern pike between Alexander Lake and Alexander Creek are similar to those exhibited by larger fish. Decreasing the abundance of juvenile northern pike in Alexander Creek is vital to achieving a long-term decline in the overall northern pike population in the creek. Alexander Lake has a very dense northern pike population. Northern pike are cannibalistic in Alexander Lake but infrequently exhibit cannibalism in the creek (Sepulveda et al. 2013). As a predator avoidance strategy, juvenile northern pike could be emigrating from the lake to rear in the side channel sloughs. If this is occurring, many more juvenile northern pike could be available to replace larger fish that are removed with gillnets than anticipated. This concern is conjecture as it could be just as likely that juvenile northern pike remain hidden and relatively immobile in bogs and vegetation in Alexander Lake, but the uncertainly warrants investigation. If it is discovered that juvenile northern pike are moving out of Alexander Lake, ADF&G will need to consider the much more costly endeavor of initiating northern pike suppression in Alexander Lake. To address this question, a passive integrated transponder (PIT) tag study of juvenile northern pike downstream of the Alexander Lake outlet will be implemented between 2014 and 2016.

Finally, data on the CPUE and relative abundance of juvenile salmonids in Alexander Creek and in the Deshka River will be collected through minnow trap surveys to continue establishing a baseline dataset needed for eventual evaluation of the long-term success of the northern pike suppression efforts in increasing salmon productivity. These surveys will continue annually and, beginning in 2014, be temporally expanded to continue throughout the open water season. 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. Based on the life cycles of the salmonid species, 2014 is the first year that increases in juvenile salmonid abundances are expected.

STUDY DESIGN

Northern Pike Suppression

In May and June, 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 30 June. 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 22 side channel sloughs will be targeted for a total of 67 sloughs in all. The actual number of sloughs that are netted are based on water levels because at low water levels some sloughs dewater before they can be netted. The first three years of this project demonstrated that northern pike in most side-channel sloughs could be reduced by 85% within about one 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 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 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 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. 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. Beginning in FY14, ADF&G will try to increase catch rates by using backpack electroshockers to herd northern pike into the gillnets in the sloughs. 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.

Beginning in August of 2014, ADF&G will also add a fall gillnetting period for each year of the project to further suppress northern pike abundance in Alexander creek. Northern pike will be targeted with 75 gillnets from approximately 15 August through 20 September. The fall gillnetting period will be scaled down from the spring period since most of the sloughs will be smaller in extent this late in the season. This decrease in the spatial extent of the sloughs will also facilitate northern pike capture because the fish will be much more concentrated in these areas as observed during the 2011-2013 Alexander Creek northern pike telemetry study (*Rutz, personal communication*). Two technicians will conduct a roving gillnet operation in each of the sloughs, and each gillnet will be fished for 3-5 days. If no fish are caught in a slough during the first day's soak, nets will be removed and redeployed to another slough location downstream. Fall gillnetting efforts will begin at the first slough downstream of the outlet of Alexander Lake and continue downstream until all sloughs have been netted. Netting will again cease for a particular slough once a day's (24-hour period) catch is equal to or less than 15% of the peak day's catch.

It is expected that catch rates of northern pike will rebound between years of netting which is why annual netting will be necessary. However, after three 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 during this project period. 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 (Sepulveda et al. *In Prep*).

Juvenile Northern Pike Movement Assessment

As discussed earlier, it is imperative to the long-term success of this project to determine if movement patterns of juvenile northern pike (YOY and age-1) are similar to those observed with adult northern pike during the radio telemetry study (Rutz and Dunker *In Prep*). Unfortunately, juvenile northern pike are notoriously difficult to capture because they do not recruit well to gill nets or minnow traps. To address this question, the upper creek gillnetting crew will attempt capturing juvenile northern pike from the outlet of Alexander Lake with two fyke nets with twenty five foot leads (Figure 2). During each year of this project, the fyke nets will be placed on both banks of the river just downstream of the lake outlet. Net placement will be adjacent to the river's bank with the opening (throat end) of the trap facing upstream and the codd end facing downstream. The leads will be positioned to surround the submerged macrophytes that juvenile northern pike would be moving through and using for cover. Fyke nets will have a 1.5 meter opening (mouth), and mesh size will be less than ¼ inch stretched to ensure that both YOY and

age-1 northern pike will not be able to pass through the mesh. Each year the fyke nets will be installed and operated once the lake is free of ice which is usually in mid-late May and will be fished continuously through 10 June. Nets will be checked at least twice a day. After 10 June nets will be fished the remainder of June to coincide with minnow trapping operations. During spawning, northern pike do not forage frequently (Mann 1982), so it is unlikely that many juvenile northern pike in the fyke nets will be lost if adult northern pike are captured in them. Frequent checking of the fyke nets should further ensure that any adult fish caught can be quickly removed. The CPUE of juvenile northern pike, itself, will be an indicator of whether there is emigration of these cohorts out of Alexander Lake. To further study the movements of any fish that are found to move out of the lake, the field crew will implant all captured fish with Passive Integrated Transponder (PIT) tags. The tags (Biomark® HTP 12, 134.2 kHz) are 12mm long and can safely be implanted in fish > 50 mm (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 juvenile pike that are tagged will be measured to the nearest mm and released outside of the fyke net. The date each fish was captured, tagged and released will also be recorded. Beginning in 2015, all netting crews will have PIT tag scanners and will quickly scan all fish captured in gillnets during the suppression efforts. The location of the gill net in which the pike is recovered will indicate how far and, relatively within what time frame, the fish moved. As with the radio telemetry study, it is anticipated that PIT-tagged fish will eventually be captured in gillnets once they've grown to a recruitable size. The proportion of PIT-tagged northern pike that are recovered relative to those that are not will provide an idea of how effective the suppression program is in capturing lake-emigrating juvenile fish and generally how long it takes to recover them. This will be critical information for understanding if northern pike suppression efforts in Alexander Lake should be implemented to meet the overall goal of increasing salmonid productivity within the Alexander Creek drainage.

Salmonid Monitoring Protocol

The third component of this proposed 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 system including annual minnow trap surveys of juvenile salmonids, an investigation of temporal shifts in northern pike diets, aerial surveys of adult returners, and the installation of a Chinook weir at the mouth of Alexander Creek, the latter two of which are not funded as part of this project but will complement the overall monitoring program.

This project period is likely when increases in juvenile salmonid abundance will be observable. Therefore, this project will continue and expand on the long-term data set begun in 2011. For comparison to a system that still has healthy salmonid populations, concurrent minnow trapping will take place in Deshka River, but at a smaller scale than in Alexander Creek. Deshka river minnow trapping will take place once a month annually between June and August. 30 minnow traps will be fished for 24 hours in the mainstem of the Deshka River, and 30 traps will be fished for 24 hours in side-channel sloughs. In Alexander Creek where the primary monitoring program will occur, the minnow trap monitoring protocol will serve to answer the following question: Does relative abundance and CPUE of juvenile salmonids increase with each year of northern pike suppression? Eight bimonthly minnow trap sampling events will take place annually from

June through September. Alexander Creek will be divided into the three sections discussed in the northern pike suppression methods (Figure 1), and the two technician field crew that is responsible for gillnetting those sections will also complete the minnow trapping during May and June. From July through September, a crew of two technicians will travel the creek to conduct the remaining surveys. Sampling locations will be fixed. 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 will contain 12 sample sites. Six sample sites will be located in the mainstem of Alexander Creek, and 6 sample sites will be located in side-channel sloughs. Five minnow traps will be set in each of the sample sites. Therefore, the field crews will be responsible for setting and sampling 60 minnow traps for a total of 180 traps per overall sampling event. 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 relative abundance of all captured species will be monitored over time. Northern pike suppression will be considered successful if large, significant, increases in salmonid CPUE and relative abundances, specifically among Chinook and coho juveniles, can be observed by 2016. This duration is necessary to accommodate the life cycles of the salmon species in the system. Following this delay, there should be a corresponding increase in CPUE with the number of years of suppression. Differences will have to be biologically meaningful for a determination of success to be made. 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 in the literature (Hubert et al 2012, 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 a. 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 target increase of a 60% CPUE beyond the mean CPUE for 2011, the first year of Alexander Creek northern pike suppression, would be sufficient evidence that the gillnetting work is achieving the overall goal of this 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 of this project period, however, the focus will be on gathering the monitoring data set from which the overall northern pike suppression initiative will eventually be evaluated.

Another compliment to the juvenile salmonid minnow trap monitoring will be to investigate shifts in northern pike diet 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. Stomach contents will be recorded in the field to taxonomic order for undigested invertebrates and genus for undigested fish, the latter of which will be fixed with ethanol and sent to ADF&G's genetics laboratory for confirmation of species ID. 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.

ADF&G's final metrices 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 1). 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. Finally, beginning in 2014, the Alaska State Legislature has funded a Chinook salmon weir at the mouth of Alexander Creek to further evaluate Chinook escapement into the river, and hence, the success of the overall northern pike suppression effort.

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 on the Bi-Catch form and released immediately (Appendix 3). All pike will be measured to the nearest millimeter of fork length (FL) and recorded. 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. 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 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 4) at the field camp. Guidelines for completing the catch and sampling forms are found in Appendix 5.

Juvenile Northern Pike Movements

YOY or age-1 northern pike that are captured in fyke nets at the outlet of Alexander Lake will be measured to the nearest mm and implanted with PIT tags. Each fish, its measurements and its corresponding PIT tag number will be recorded on a data sheet (Appendix 6) along with the date. Beginning in May 2015, technicians will scan all 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 7). All tagged pike that are recovered in gillnets will be measured again to the nearest mm and dissected for stomach contents, and these data will also be recorded on the datasheet.

Salmonid Monitoring

All animals captured in minnow traps during the salmonid monitoring will be enumerated by species. 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 8 and 9) 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. All 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.

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. Seasonal CPUEs of the spring gillnetting and the fall gillnetting will also be calculated as will annual CPUEs of all pooled catch data to look for differences between years.

For the PIT-tagged juvenile northern pike that are released outside the fyke nets at the Alexander Lake outlet, 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 pike will be mapped in ArcMap by season 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 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 bimonthly samples in Alexander Creek and the monthly June - August sampling for the Deshka River (i.e. X # of Chinook salmon fry/ 60 minnow traps) each year. The relative abundance of each fish species will be compiled for the pooled minnow trap surveys as well. 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

February 2014:	Hire Research Fishery Biologist II position to be available at the commencement of this project on April 1, 2014.
April 2014:	Purchase equipment and field camp gear.
May 2014:	Establish field camps/ Begin gillnet suppression/ Northern Pike stomach content analysis/ Juvenile pike trapping and marking
June 2014:	Conclude spring gillnet suppression event & juvenile pike

	trapping and marking/ Begin minnow trap sample events
Mid- Aug 2014:	Begin fall gillnet suppression event
Mid Sept 2014:	Conclude fall gillnet suppression event/ Order replacement gillnets
Late-Sept 2014:	End Minnow trap sampling events
April 2015:	Purchase equipment and field camp gear.
May 2015:	Establish field camps/ Begin gillnet suppression/ Juvenile pike trapping and marking / Northern pike stomach content analysis
June 2015:	Conclude spring gillnet suppression event/ Juvenile pike trapping and marking/ Begin minnow trap sample events
Mid- Aug 2015:	Begin fall gillnet suppression event
Mid Sept 2015:	Conclude fall gillnet suppression event/ Order replacement gillnets
Late-Sept 2015:	End minnow trap sampling events
April 2016:	Purchase equipment and field camp gear.
May 2016:	Establish field camps/ Begin gillnet suppression/ Juvenile pike trapping and marking/ Northern pike stomach content analysis
June 2016:	Conclude spring gillnet suppression event/ Juvenile pike trapping and marking/ Begin minnow trap sample events
Mid- Aug 2016:	Begin fall gillnet suppression event
Mid Sept 2016:	Conclude fall gillnet suppression event/ Order replacement gillnets
Late-Sept 2016:	End Minnow trap sampling events
December 2016:	Analyze data and write project report (Fishery Data Series) for submittal to AKSSF

RESPONSIBILITIES

Personnel:	Kristine Dunker, Fishery Biologist III, Alaska Department of Fish and Game, Sport Fish Division
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.
Personnel:	Adam Craig, Biometrician III, Alaska Department of Fish and Game, Sport Fish Division.
Duties:	Provide guidance on study design; Assist with post-season data analysis. Review project operational plans and reports.
Personnel:	Dave Rutz, Fishery Biologist II, Alaska Department of Fish and Game, Sport Fish Division.
Duties:	Serve as the primary project biologist; plan, coordinate, and supervise all field logistics; Prepare project reporting and presentations to the public.

Personnel:	Cody Jacobson, Fishery Biologist I, Alaska Department of Fish and Game, Sport Fish Division.
Duties:	Assist with field procedures and supply field camps.

During each field season, six fish and wildlife technicians will be hired to assist with the field activities.

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FIGURES

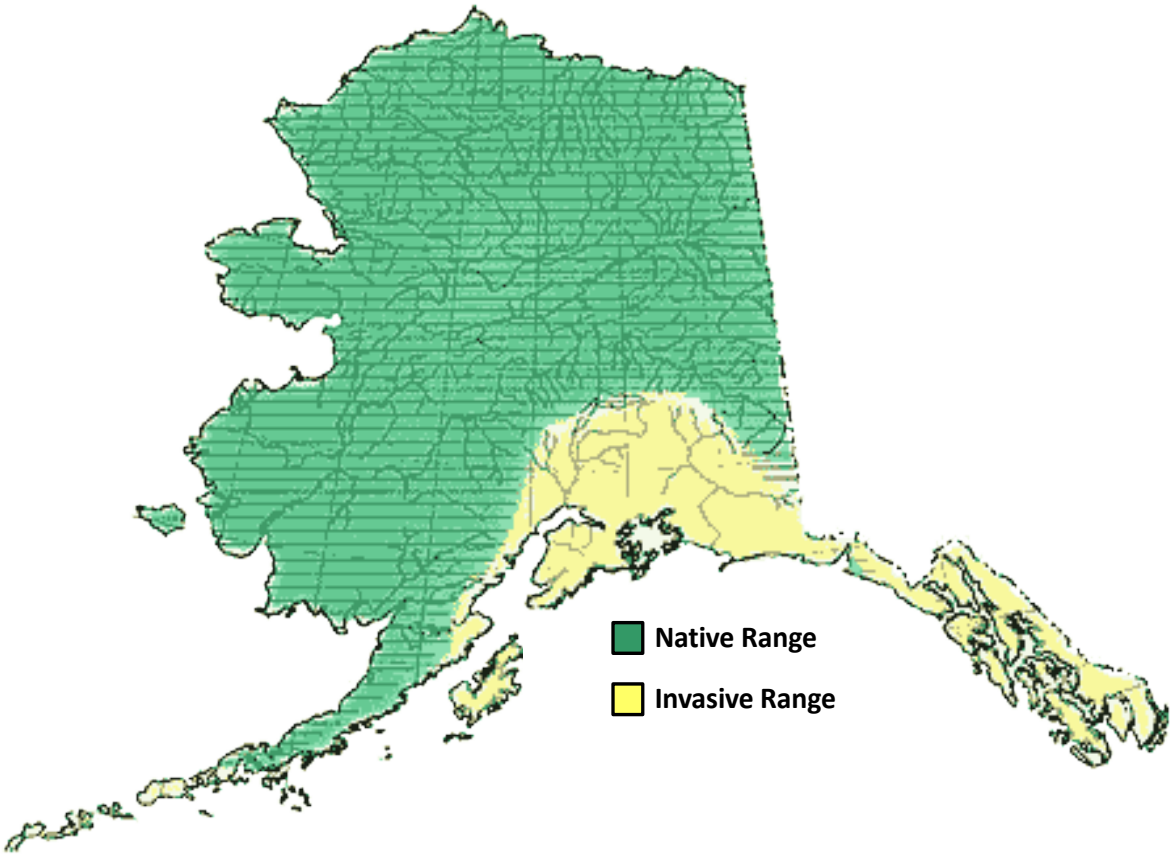

Figure 1.–Native and invasive ranges of northern pike; Yellow indicated invasive range.

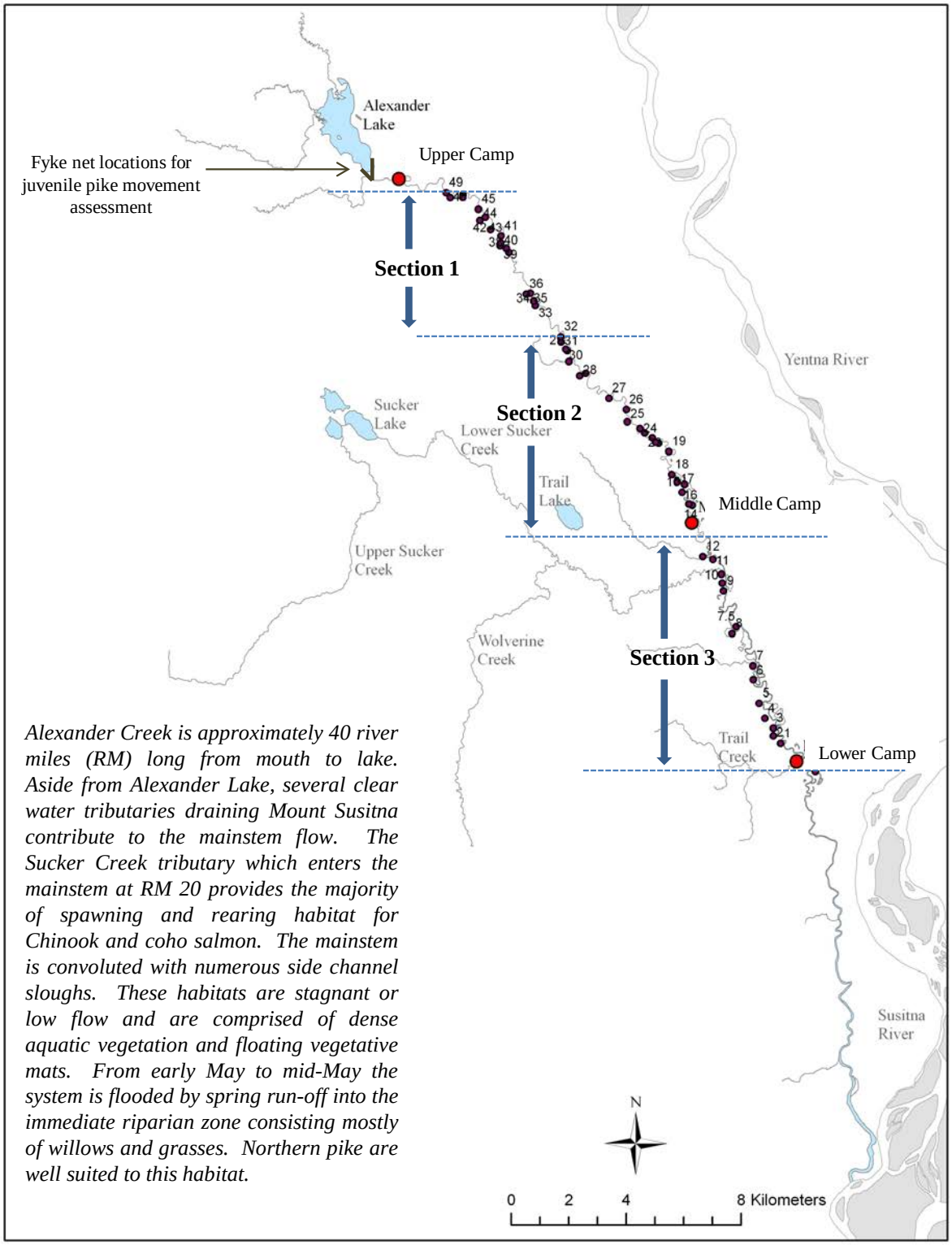

Figure 2.–Map of Alexander Creek.

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.

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**
		8:00								
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		8:00								
		8:00								
		8:00								
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Appendix 3.–Bi- Catch Form.

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																
				24	1																
				24	1																
				24	1																
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[a] Record "M" if Bi-Catch was a Mortality or "A" if Bi-Catch was Released Alive

Appendix 4.–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 5.–NCI Pike: Definition of Terms for Catch & Sampling Forms.

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.–Juvenile Northern Pike PIT Tag Data.

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

Appendix 7.–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 8.–Alexander Creek Juvenile Fish Minnow Trapping Form

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 9.–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