Fishery Data Series No. 10-59

Control and Removals of Invasive Northern Pike on Kenai Peninsula, 2004

by

Robert N. Begich

September 2010

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)

Measures (fisheries)

fork length	FL
mid eye to fork	MEF
mid eye to tail fork	METF
standard length	SL
total length	TL

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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by
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ABSTRACT

Northern pike *Esox lucius* are not native to aquatic habitats of southcentral Alaska south of the Alaska Range. Introduction of northern pike into these freshwater systems may have deleterious effects on native fish, including various species of Pacific salmon. This report summarizes the continued effort to restore salmonid habitat by removing invasive northern pike from four freshwater lakes on the Kenai Peninsula. In 2004, 2,684 northern pike were captured and removed from four Kenai Peninsula area lakes. Relative comparisons of observed mean lengths of fish captured and catch per unit effort were used to establish baseline information for northern pike populations and to determine if previous removal efforts were successful in reducing populations in two of the four lakes examined. Mean fork length of northern pike was 323 mm (SE = 3 mm) at Derks Lake, 337 mm (SE = 5 mm) at East Mackey Lake, 279 mm (SE = 3 mm) at West Mackey Lake, and 445 mm (SE = 3 mm) at Sevena Lake. Catch per unit effort for gillnets was 0.128 northern pike per hour at Derks Lake, 0.056 at East Mackey Lake, 0.108 at West Mackey Lake and 0.517 at Sevena Lake. Mann-Whitney-Wilcoxon tests comparing mean length of northern pike captured from East and West Mackey lakes between 2003 and 2004 showed mean length to be significantly different ($P < 0.05$). Tests indicated catches in both lakes had higher frequencies of shorter length northern pike in 2004 compared to the mean length of northern pike taken in 2003 indicating that previous removal efforts did have a negative impact to these populations. We recommend continuing this netting program in these four Kenai Peninsula area lakes until further eradication measures may be taken.

Key words: Kenai Peninsula, Derks Lake, East Mackey Lake, West Mackey Lake, Sevena Lake, northern pike, invasive species.

INTRODUCTION

The Kenai Peninsula is one of the premier sport fishing areas in Alaska, receiving over 300,000 angler-days in 2003 (21% of the total sport fishing effort in Alaska)(Jennings et al. 2006b). Most angling effort on the peninsula occurs on the Kenai River which is renowned worldwide for its large Chinook salmon *Oncorhynchus tshawytscha* and is the site of other popular fisheries including coho salmon *O. kisutch*, sockeye salmon *O. nerka*, rainbow trout *O. mykiss*, and Dolly Varden *Salvelinus malma*.

Northern pike *Esox lucius* have been documented in a number of lakes and streams on the Kenai Peninsula and present a growing threat to sport fisheries in this area (Alaska Department of Fish and Game [ADF&G] Unpublished[1]). Northern pike are indigenous north and west of the Alaska Range (Morrow 1980; Mecklenburg et al. 2002), but not on Kenai Peninsula. This species is thought to have been illegally introduced sometime during the 1970s into Derks Lake, in the Soldotna Creek drainage, an open tributary of the Kenai River (Nelson 1994) (Figure 1). Since their initial introduction, some northern pike have moved out of Derks Lake into other freshwater habitats in and/or near the Soldotna Creek drainage. A query of the ADF&G Statewide Harvest Survey (SWHS) electronic database found northern pike harvests (fish kept) were first reported in East and West Mackey lakes[2] in 1990 and in Sevena Lake in 1992 (Kathrin Sundet, ADF&G Sport Fish Research Analyst, Anchorage, *personal communication*)[3]. In 2002, ADF&G documented northern pike in the following Soldotna Creek drainage lakes: East and West Mackey lakes, Union, Denise, Tree and Sevena (also known as Soldotna Lake) lakes (McKinley *In prep*). Northern pike have also been documented in Stormy Lake, an open tributary of the

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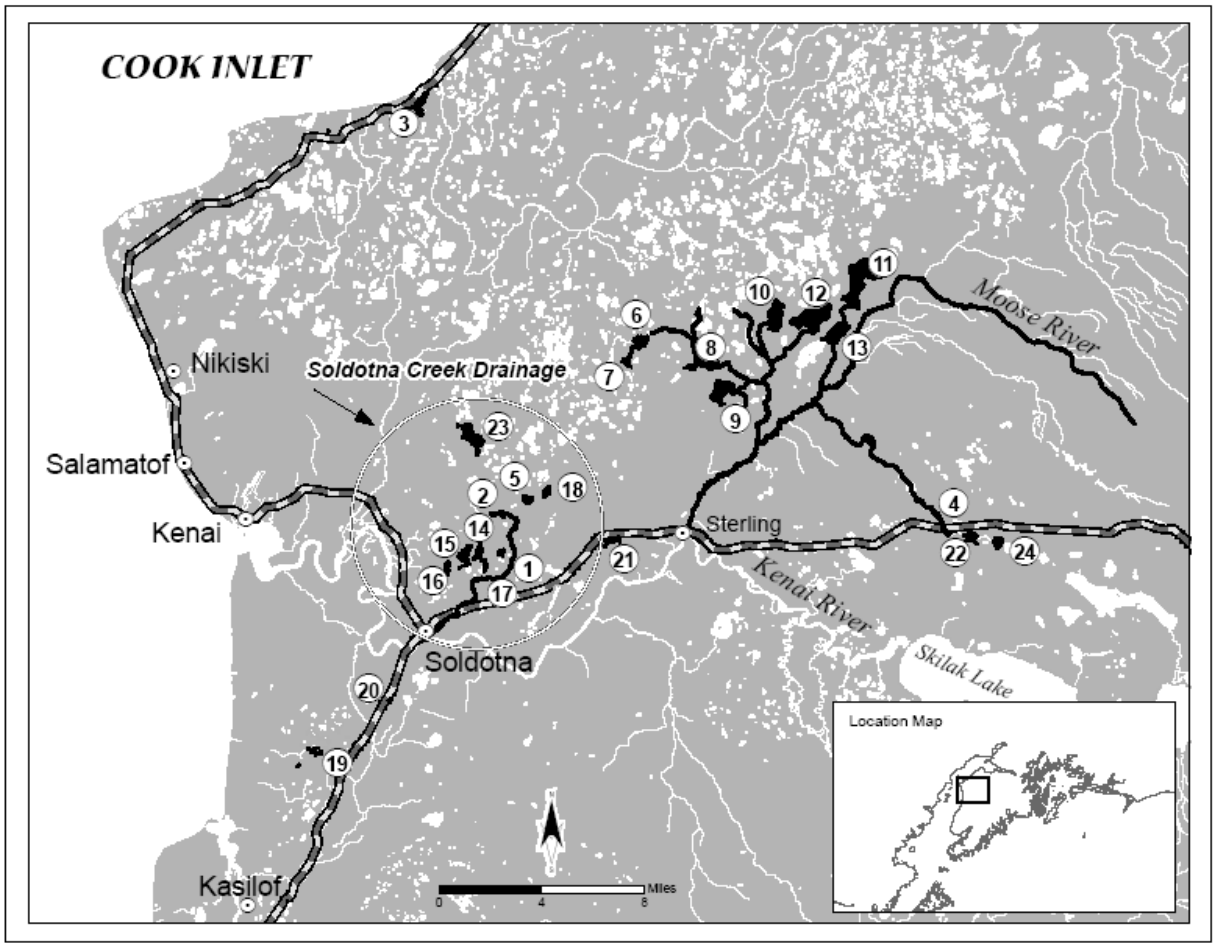
[1] Source: ADF&G. *Unpublished*. Alaska aquatic nuisance species management plan. Prepared in 2002 by Alaska Department of Fish and Game, Juneau. http:/www.sf.adfg.state.ak.us/special/invasive/ak_ansmp.pdf (Accessed June 2009).

[2] Unknown whether this reported northern pike harvest was from East Mackey Lake, West Mackey Lake, or both.

[3] However, northern pike may have been present and/or harvested at other locations and/or during earlier years than these. If the SWHS received no northern pike responses that could mean: (1) no northern pike were caught that year, (2) the SWHS did not happen to sample the households that caught northern pike that year, or (3) the sampled households did not report northern pike that they caught that year.



Locations of confirmed and unconfirmed waters at risk of invasive northern pike on the Kenai Peninsula, Alaska. Location codes: (1) Derks Lake, (2) Sevena Lake, (3) Stormy Lake, (4) Watson Lake (5) Cisca Lake, (6) Silver Lake, (7) Mosquito Lake, (8) Camp Island Lake, (9) Grebe Lake, (10) Rock Lake, (11) Swan Lake, (12) Loon Lake, (13) Moosehorn Lake, (14) East Mackey Lake, (15) West Mackey Lake, (16) Union Lake, (17) Soldotna Creek, (18) Tree Lake, (19) Tote Road Area lakes [6], (20) Arc Lake, (21) Scout Lake, (22) Egumen Lake, (23) Spirit Lake (Elephant Lake) and Peterson Lake (24).

Figure 1.-Lakes in the Soldotna Creek drainage on the Lower Kenai River and locations of Kenai Peninsula lakes that support or are at risk to support populations of northern pike, Kenai Peninsula, Alaska.

Swanson River (Begich and McKinley 2005). Several lakes in the upper Moose River drainage that are open to the Kenai River drainage are vulnerable to colonization by northern pike. Illegally introduced northern pike are also present in a series of landlocked lakes (i.e., Arc Lake, Unnamed Lake #2 [Tote Road area]) approximately 6 miles south of the city of Soldotna [P. Berkhan, ADF&G fishery biologist, Soldotna, *personal communication*] and Tote Road area

lakes [D. E. Athons, *Unpublished*, October 19, 1983, memorandum to Soldotna office sport fish management biologist. Located at: ADF&G area office, Soldotna, AK; Division of Sport Fish, Management Biologist, *Totes Road Lakes* file]).

Northern pike occupy habitat similar to that of rearing salmonids and prey on juvenile native sport fish species. Prior to their introduction, lakes of the Soldotna Creek drainage supported rainbow trout, Dolly Varden, and rearing salmon (primarily coho salmon) (ADF&G *Unpublished data*)[4]. When the production of native species in these lakes began to decline, local residents, sport fishing groups, and government natural resource agencies voiced concern that northern pike may spread to the mainstem Kenai River. Their fear was that if northern pike populations became established in the mainstem Kenai River, or other Kenai River drainages, fish species that sustain the area's largest sport fisheries could be further threatened.

In 2003, ADF&G began a northern pike reduction program which resulted in the removal of 1,535 northern pike from East and West Mackey lakes in Soldotna Creek drainage (Begich and McKinley 2005). Gillnet operations were continued at East and West Mackey lakes in 2004 and expanded to include Derks and Sevena lakes, which are also in Soldotna Creek drainage.

The goal of this project was to restore and maintain freshwater salmonid habitat on the Kenai Peninsula by reducing northern pike in selected streams and lakes and restricting their migration within these areas and to other areas.

OBJECTIVES

The objectives of this study were to:

1. Estimate the mean length of northern pike captured by gillnetting at East Mackey Lake, West Mackey Lake, Derks Lake, and Sevena Lake in 2004.
2. Estimate the catch per unit effort (CPUE) for northern pike captured by gillnetting at East Mackey Lake, West Mackey Lake, Derks Lake, and Sevena Lake in 2004.
3. Compare the mean length of northern pike captured from East and West Mackey lakes in 2004 with the mean length of northern pike captured in these lakes in 2003.
4. Compare the CPUE of gillnets set in East and West Mackey lakes in 2004 with CPUE of gillnets set in these lakes in 2003.

METHODS

STUDY DESIGN AND DATA COLLECTION

Sinking monofilament gillnets, each 120 ft long, 6 ft deep, with six 20 ft wide panels with variable mesh sizes (one each of ½ in, 5/8 in, 3/4 in, 1 in, 1 ½ in, and 2 in stretched mesh) were set in selected lakes to capture and harvest northern pike.

Lakes were sampled on an opportunistic basis throughout the open water season. Sampling began after spring ice-out on May 10 at Derks, West Mackey and East Mackey lakes and continued through June 15. From June 28 through July 18 nets were set at Sevena Lake. During autumn, all lakes were sampled intermittently until freeze-up (September 22 through

[4] ADF&G. *Unpublished data*. Kenai Peninsula lake file [database]. Located at: ADF&G, Division of Sport Fish, Area Management for Northern Kenai Peninsula files, Soldotna, AK.

October 22). Generally, ADF&G set nets on Monday through Thursday each week at each lake and nets were checked daily and removed on Friday.

Captured northern pike were harvested and measured to the nearest millimeter from the tip of the nose to fork of tail (fork length). Time of each net set and check was recorded to the nearest minute and the number of northern pike harvested from each net was recorded. Harvested fish were taken to Kenai Peninsula Food Bank for distribution to local families and to public schools for use in educational programs.

DATA ANALYSIS

Length Compositions

Mean length of sampled northern pike was estimated for each lake. Mean length estimates were calculated as the arithmetic mean of all fish lengths. Variances were calculated with the squared deviations from the mean (standard variance formula). Standard errors (SE) of the mean were calculated as the square root of the variance divided by the sample size.

Mann-Whitney-Wilcoxon tests were used to evaluate differences in mean length between years within East and West Mackey lakes. Kolmogorov-Smirnov tests (KS-test) were also used to examine whether cumulative length distributions varied between years within lakes. All tests were conducted at the 0.05 level of significance.

Length distribution data were evaluated by two methods. The first incorporated relative stock density (RSD) and the second proportional stock density (PSD) described by Gabelhouse (1984). RSD length categories were defined as follows: "juvenile," < 300 mm; "stock," 300 to 524 mm; "quality," 525 to 654 mm; "preferred," 655 to 859 mm; and "memorable," 860 to 1,079 mm. Secondly, PSD length distribution data were partitioned into sixteen 50-mm length classes beginning at 100 mm that ended at 899 mm. The proportion of northern pike for each length class category *k*, in the catch from lake *L* was calculated as:

$$p_{Lk} = \frac{n_{Lk}}{n_L} \tag{1}$$

where:

n_{Lk} = the total number of northern pike of length class category *k* from lake *L*, and

n_L = the number of northern pike caught in lake *L*.

The variance of the proportion was estimated as:

$$\hat{Var}(\hat{p}_{Lk}) = \frac{\hat{p}_{Lk}(1-\hat{p}_{Lk})}{n_L - 1} \tag{2}$$

Catch per Unit Effort

Catch per unit effort of northern pike was calculated for each lake *L* as:

$$C_L = \frac{n_L}{E_L} \tag{3}$$

where:

n_L = number of northern pike caught in lake *L*, and

E_L = time (hours) of operation of nets in lake *L*.

RESULTS

Netting operations in 2004 harvested 2,684 northern pike that ranged in length from 121 to 867 mm (Table 1). One thousand thirty-five of these were removed from West Mackey Lake (mean length 279 mm, SE = 3 mm) and 208 were harvested at East Mackey Lake (mean length 337 mm, SE = 5 mm) (Table 1). Mean length of the 748 northern pike removed from Derks Lake was 323 mm (SE = 3 mm). A total of 693 northern pike were harvested from Sevena Lake. Mean length of northern pike captured at Sevena Lake was 445 mm (SE = 3).

Table 1.-Fork length of northern pike harvested from selected lakes on Kenai Peninsula, 2003 and 2004.

		Harvest	Fork length (mm)				
Year	Lake	(no. of fish)	Minimum	Median	Maximum	Mean	SE
2003	East Mackey	709	158	324	645	335	3
	West Mackey	826	137	335	772	352	4
	Total	1,535					
2004	East Mackey	208	170	348	495	337	5
	West Mackey	1,035	121	257	582	279	3
	Derks	748	124	331	613	323	3
	Sevena	693	240	437	867	445	3
	Total	2,684					

Note: "Harvest" = fish kept; "fork length" = distance from the tip of the snout to the fork in the tail.

Separate tests comparing mean length of northern pike from East and West Mackey lakes for 2003 and 2004 showed mean length to be significantly different (Mann-Whitney-Wilcoxon, $P < 0.05$). Mean length at West Mackey decreased in 2004, while mean length at East Mackey Lake increased slightly (Table 1). Catches in both lakes had higher frequencies of smaller northern pike in 2004 compared to those taken in 2003. Separate tests of the cumulative length distributions of fish sampled from these lakes during 2003 and 2004 were significantly different; East Mackey Lake (KS-test, $D = 0.189$, $P < 0.0001$) and West Mackey Lake (KS-test, $D = 0.338$, $P < 0.0001$).

In 2004, most northern pike captured were in the "juvenile" category, except for those captured in Sevena Lake where 0.87 were in the "stock" category (Table 2). The length distribution of northern pike from Sevena Lake was comprised of fish from all RSD categories. Conversely, the RSD from East Mackey Lake was comprised of only "juvenile" and "stock," while the RSD

from West Mackey and Derks lakes included these categories and a small percentage of fish in the "quality" category.

Difference in the RSD was evident for northern pike sampled between years from East and West Mackey lakes (Table 2, Figure 2). The proportion of larger fish sampled from both lakes (those in the "preferred" and "quality" categories) declined markedly from 2003 to 2004. The percentage of "juvenile" fish sampled from East Mackey Lake declined from 61% in 2003 to 51% in 2004, whereas at West Mackey Lake the percentage of "juvenile" fish increased between years from 55% in 2003 to 80% in 2004 (Table 2). From 2003 to 2004 the percentage of fish in the "stock" category increased at East Mackey Lake and declined at West Mackey Lake (Table 2, Figure 2). Derks (PSD = 36) and West Mackey (PSD = 20) lakes fit into the low-PSD category based on the 2004 findings. Conversely, the Sevena Lake population holds a high-PSD value (87). East Mackey Lake (PSD = 49) has the approximate median PSD value for all of the lakes sampled.

During 2004 the total CPUE ranged from a high of 0.517 at Sevena Lake to 0.056 at East Mackey Lake (Table 3). The total CPUE for West Mackey and Derks lakes was 0.108 and 0.128, respectively. The overall CPUE at East Mackey Lake declined from 0.119 in 2003 to 0.056 in 2004 (Table 3). The CPUE at West Mackey Lake also showed a decrease between years from 0.143 in 2003 to 0.108 in 2004. These results indicate the netting program is negatively impacting the northern pike in the Mackey lakes and reducing the number of northern pike that may migrate to and subsequently colonize waters of the Kenai River drainage.

DISCUSSION

In this report we establish baseline information for northern pike from four lakes in Soldotna Creek drainage. The northern pike populations in the sampled lakes are dominated by shorter length fish. Our RSD values for fish of the "stock" category follow low-PSD (proportional stock density) values for northern pike. Low-PSD populations described by Willis and Scalet (1989) are populations dominated by small, slow growing fish with low condition factors. Populations with a high-PSD value may be less dense, may have better growth rates and may be in better condition.

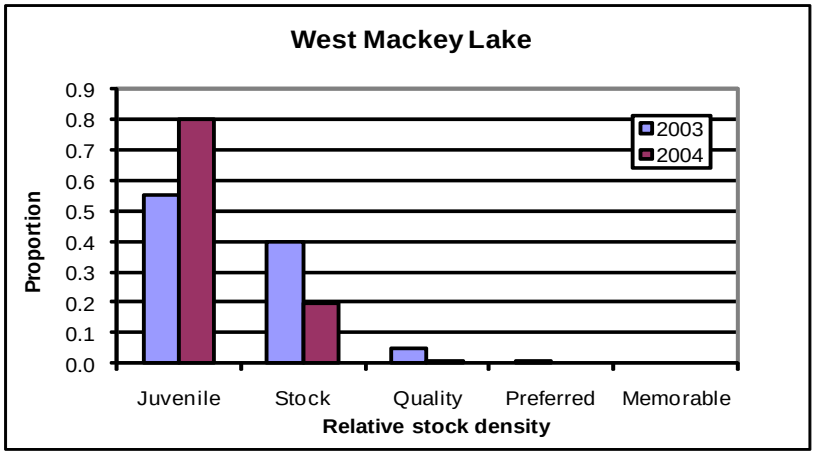
Factors contributing to the differences in the PSD between these lakes could be similar to mechanisms hypothesized to cause stunting in northern pike; these include overpopulation and competition, lack of appropriately sized prey, and lack of thermal refuges during midsummer when water temperatures are highest (Diana 1987). Interestingly, Sevena Lake supports the highest PSD and is the only sampled lake that may contain substantial numbers of fish other than northern pike. Several rearing coho salmon as well as juvenile Dolly Varden and rainbow trout were captured there in October; however, none were captured in July. In contrast, sampling at low PSD lakes such as Derks Lake yielded only one Dolly Varden, and no other fish species were captured in our nets at Mackey lakes.

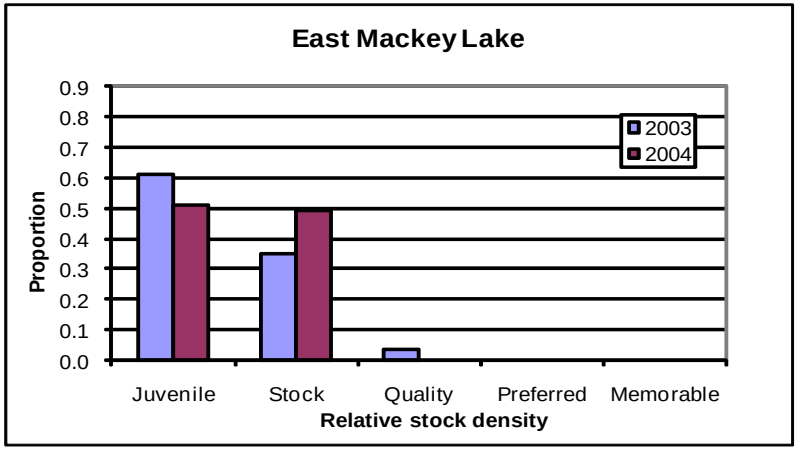
Table 2.-Relative stock density estimates for northern pike harvested from selected Kenai Peninsula lakes, 2003 and 2004.

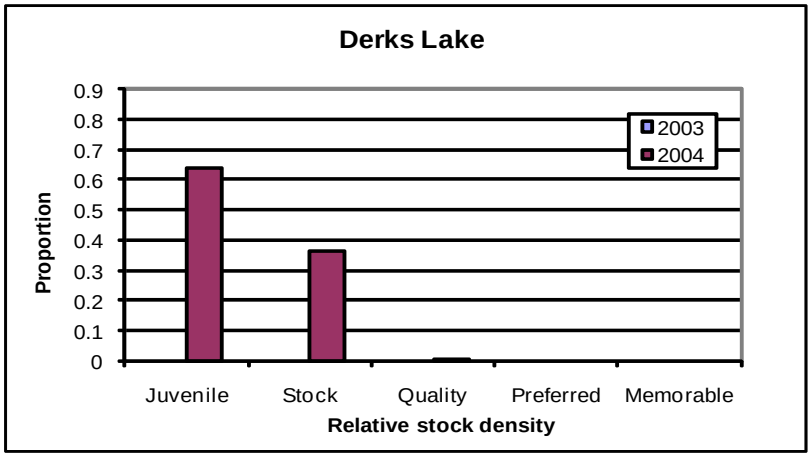
	Relative stock density (RSD) [a]		East Mackey Lake		West Mackey Lake		Derks Lake		Sevena Lake	
Year	Category	Minimum length (mm)	Harvest (no. of fish)	RSD estimate	Harvest (no. of fish)	RSD estimate	Harvest (no. of fish)	RSD estimate	Harvest (no. of fish)	RSD estimate
2003	Juvenile	< 350	435	0.614	456	0.552	ND	ND	ND	ND
	Stock	350	249	0.351	330	0.399	ND	ND	ND	ND
	Quality	530	25	0.035	39	0.047	ND	ND	ND	ND
	Preferred	710	0	0.000	1	0.002	ND	ND	ND	ND
	Memorable	860	0	0.000	0	0.000	ND	ND	ND	ND
	Total		709	1.000	826	1.000	ND	ND	ND	ND
2004	Juvenile	< 350	106	0.509	825	0.797	476	0.636	22	0.032
	Stock	350	102	0.491	206	0.199	270	0.361	601	0.869
	Quality	530	0	0.000	4	0.004	2	0.003	67	0.095
	Preferred	710	0	0.000	0	0.000	0	0.000	2	0.003
	Memorable	860	0	0.000	0	0.000	0	0.000	1	0.001
	Total		208	1.000	1,035	1.000	748	1.000	693	1.000

Note: ND = no data.

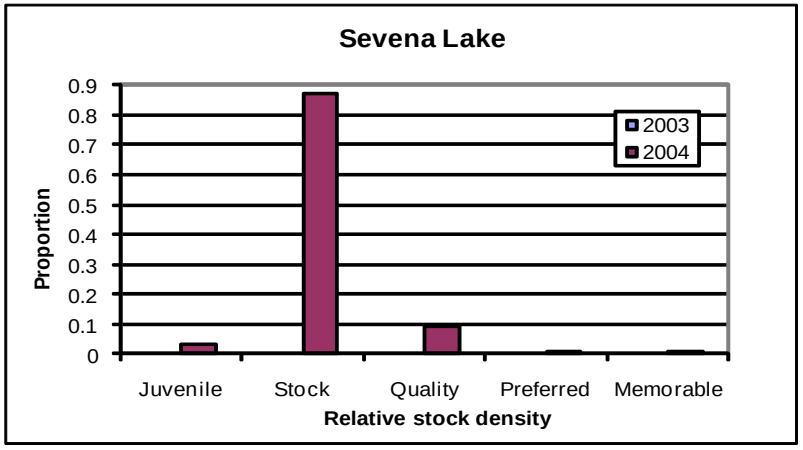
[a] Source: as described in Gabelhouse (1984).







Note: no data collected at Derks Lake in 2003



Note: no data collected at Sevena Lake in 2003

Figure 2.-Relative stock density estimates for northern pike harvested from Soldotna Creek drainage lakes, 2003 and 2004.

Table 3.-Summary of northern pike sampling effort and harvest for selected Kenai Peninsula lakes by week, 2003 and 2004.

		Sampling periods					
Year	Location	Week (no.)	Range of dates (mm/dd-mm/dd) [a]	Sets (no. of) [b]	Effort (hrs. fished)	Harvest (no. of fish)	Total CPUE [c]
2003	West Mackey Lake	7	06/28 - 07/02	33	863.69	244	0.283
		8	07/05 - 07/09	11	215.22	32	0.149
		10	09/20 - 09/24	24	287.57	44	0.153
		11	09/27 - 10/01	48	1,153.98	181	0.157
		12	10/04 - 10/08	48	1,110.49	144	0.130
		13	10/11 - 10/15	36	914.61	55	0.060
		14	10/18 - 10/22	36	861.11	97	0.113
		15	10/23 - 10/29	15	354.18	29	0.082
			Total	251	5,760.85	826	0.143
	East Mackey Lake	6	06/14 - 06/18	11	301.75	104	0.345
		7	06/28 - 07/02	44	1,079.95	172	0.159
		8	07/05 - 07/09	11	221.17	29	0.131
		10	09/20 - 09/24	32	746.22	121	0.162
		11	09/27 - 10/01	44	1,049.23	94	0.090
		12	10/04 - 10/08	44	1,050.10	95	0.090
		13	10/11 - 10/15	22	531.94	38	0.071
		14	10/18 - 10/22	31	744.93	45	0.060
		15	10/23 - 10/29	11	248.45	11	0.044
			Total	250	5,973.74	709	0.119
2004	Derks Lake	1	05/10 - 05/14	36	850.75	94	0.110
		3	05/24 - 05/28	48	1,093.88	71	0.065
		4	05/31 - 06/04	36	832.16	246	0.296
		5	06/07 - 06/11	36	842.54	111	0.132
		6	06/14 - 06/18	12	276.73	38	0.137
		10	09/20 - 09/24	36	835.96	109	0.130
		14	10/18 - 10/22	48	1,109.00	81	0.073
			Total	252	5,841.02	750	0.128
	West Mackey Lake	1	05/10 - 05/14	36	819.12	151	0.184
		2	05/17 - 05/21	48	1,122.43	163	0.145
		3	05/24 - 05/28	48	1,122.43	85	0.075
		4	05/31 - 06/04	39	980.72	43	0.044
		5	06/07 - 06/11	36	915.42	69	0.075
		6	06/14 - 06/18	12	331.26	29	0.088
		10	09/20 - 09/24	36	879.39	158	0.180
		11	09/27 - 10/01	48	1,173.16	178	0.152
		12	10/04 - 10/08	48	1,122.58	99	0.088
		13	10/11 - 10/15	48	1,175.10	65	0.055
			Total	399	9,641.61	1,040	0.108

-continued-

Table 3.–Page 2 of 2

Year	Location	Sampling periods: Week (no.)	Range of dates (mm/dd-mm/dd) [a]	Sets (no. of) [b]	Effort (hrs. fished)	Harvest (no. of fish)	Total CPUE [c]
2004	East Mackey Lake	2	05/17 - 05/21	28	79.99	4	0.050
		11	09/27 - 10/01	40	946.36	86	0.091
		12	10/04 - 10/08	40	934.34	38	0.041
		13	10/11 - 10/15	40	981.02	49	0.050
		14	10/18 - 10/22	33	786.94	32	0.041
			Total	181	3,728.65	209	0.056
	Sevena Lake	7	06/28 - 07/02	15	286.25	138	0.482
		8	07/05 - 07/09	9	211.92	122	0.576
		9	07/12 - 07/16	12	287.91	153	0.531
		13	10/11 - 10/15	10	218.49	111	0.508
		14	10/18 - 10/22	15	338.05	170	0.503
			Total	61	1,342.62	694	0.517

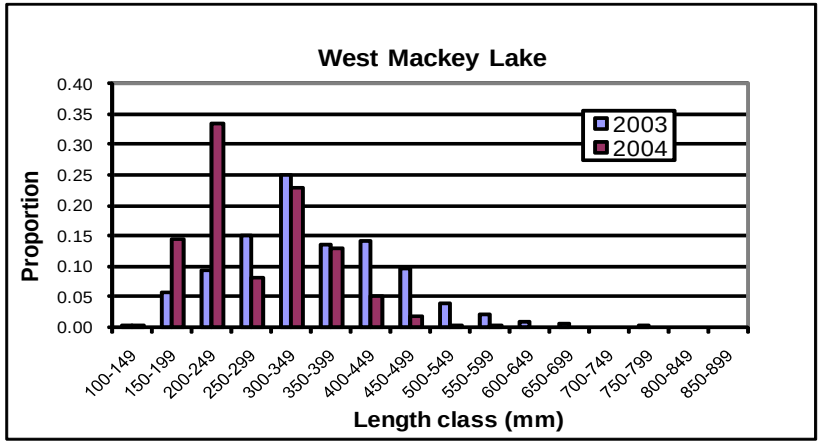
[a] "mm" = month; "dd" = day.

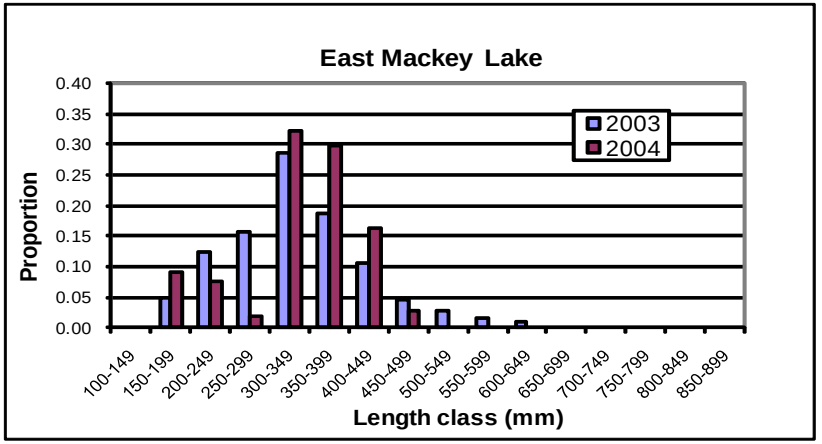
[b] On set equals one gillnet fished for approximately one 24-hour period.

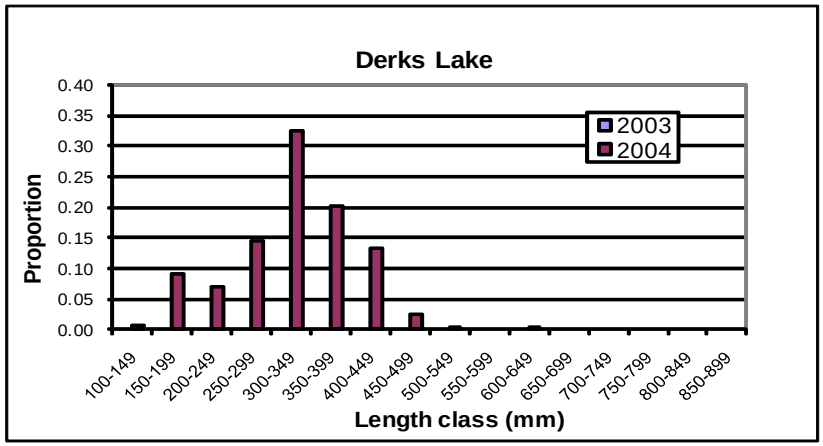
[c] "CPUE" = catch per unit effort = northern pike catch per hour of netting effort

A comparison of the RSD values between years at the Mackey lakes suggests that exploitation also affects the PSD. Differences in the RSD values between 2003 and 2004 are evident for East Mackey Lake where large fish have been eliminated (Figures 2 and 3). Similarly, the numbers of large fish at West Mackey Lake have declined sharply due to gillnet exploitation, as has the proportion of "stock" fish. In a similar field study at Camerton Lake, Minnesota 43% of northern pike greater than age-2 were removed via intensive gillnetting from a population estimated to number over 1,600 fish (Pierce and Tomcko 2003).

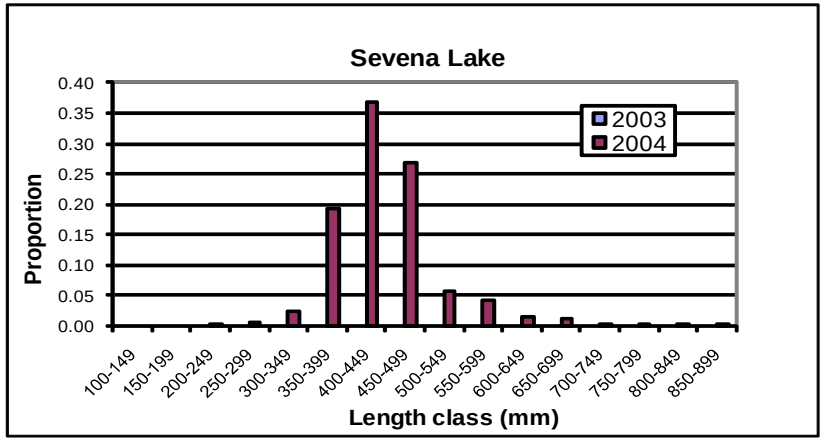
Surveys to assess northern pike populations are often conducted with gillnets (Diana 1983; Pierce et al. 1994; Neumann and Willis 1995; Rutz 1996). In general, findings from gillnet surveys of northern pike show that CPUE or mean CPUE is positively correlated with abundance (Neuman and Willis 1995, Pierce and Tomcko 2003, Paukert and Willis 2003). Therefore, if we use our CPUE estimates as a proxy for northern pike density and compare the CPUE values between years from East and West Mackey lakes, the difference in CPUE values shows that gillnetting in 2003 reduced the relative abundance of northern pike in each lake during 2004. This conclusion is based on two assumptions. The first is that higher catch rates indicate higher fish densities. Secondly, gillnets fished comparable stages of the northern pike life cycle between years (e.g., the spring post-spawn period primarily in West Mackey and the fall period in both East and West Mackey lakes) and therefore allow for a relative comparison of catch rates. To correctly interpret the relationship between CPUE and abundance, gillnet catch data







Note: no data collected at Derks Lake in 2003.



Note: no data collected at Sevena Lake in 2003.

Figure 3.-Length frequency distributions for northern pike harvested from Soldotna Creek drainage lakes, 2003 and 2004.

will need to be gathered over more years or ideally abundance would need to be estimated while sampling.

Based on the length frequency data for each lake (Figure 3) it appears that northern pike are fully recruited to the gillnet gear at approximately 300 mm. The influence of gear on the length of northern pike captured is a common observation in similar studies; however, several studies also point out that gear selectivity is negligible for fish > 300 mm (Rutz 1999; Roach 1997, 1998a-b). To better examine the numbers of smaller fish in these lakes (< 300 mm), additional gillnets with a smaller mesh size could be used to capture juvenile northern pike during future netting operations.

The management objective for the Kenai Peninsula northern pike fishery is to maximize harvest and reduce the abundance of northern pike. Consequently there is no bag or possession limit for northern pike in waters of Kenai Peninsula. Overexploitation of northern pike by sport fishing is somewhat common across their native range (Burkholder 1991; Clark et al. 1988; Kempinger and Carline 1978; Mosindy et al. 1987, Snow 1978). Although some anglers do fish for northern pike, harvest from Kenai Peninsula area waters is relatively minor. From 1985 through 2002 an estimated average of 197 fish were harvested annually (Table 4). In 2003, an estimated 699 northern pike were harvested, of which, 641 fish were from lakes and 58 fish were from Kenai River (Table 4). This harvest represents a minor increase from the 1998 through 2002 average of 454 fish. In 2004, approximately 2,321 northern pike were harvested from the Kenai Peninsula; 2,263 from lakes and 58 from the Kenai River. The increase in harvest from Kenai Peninsula lakes in 2004 may be due in part to departmental educational programs about invasive northern pike that have raised awareness, or due to possible expansion of northern pike into waters of the Kenai Peninsula.

Recommendations for future studies include:

- Continue the removal of northern pike from East Mackey Lake, West Mackey Lake, Derks Lake, and Sevena Lake with variable mesh gillnets to benefit the area's salmonid resources.
- Continue to assess the removal program's effect on northern pike populations in East Mackey Lake, West Mackey Lake, Derks Lake, and Sevena Lake. Specifically, comparison of relative stock densities and CPUE within lakes and between years will help managers determine if netting programs are effective at controlling the abundance and distribution of northern pike in the Kenai Peninsula. This information will be used to determine if measures such as chemical eradication or fish passage control structures are needed to prevent the migration of northern pike to new waters.
- Undertake additional sampling with variable mesh gillnets in other Kenai Peninsula waters thought to support northern pike (i.e., Tote Road Area lakes [Unnamed lakes #1 and #2], Denise Lake, other lakes in the Swanson River drainage near Stormy Lake, etc.).

If successful, this effort will contribute to the long-term integrity of the Kenai Peninsula sport fisheries and the economies of the communities that rely on these resources.

Table 4.-Kenai Peninsula northern pike harvest estimates, 1981-2004.

	Estimated harvest (number of fish)		
Year	Kenai Peninsula Lakes	Kenai River	Total
1981	32	ND [a]	32
1982	105	ND [a]	105
1983	294	ND [a]	294
1984	187	ND [a]	187
1985	52	69	121
1986	0	0	0
1987	0	12	12
1988	36	0	36
1989	49	18	67
1990	30	10	40
1991	86	0	86
1992	239	0	239
1993	216	26	242
1994	36	0	36
1995	219	29	248
1996	32	92	124
1997	21	7	28
1998	114	0	114
1999	329	0	329
2000	153	6	159
2001	1,288	0	1,288
2002	368	12	380
1985-2002 Mean	182	16	197
1998-2002 Mean	450	4	454
2003	641	58	699
2004	2,263	58	2,321

Note: "harvest" = fish kept; "ND" = no data.

Source: Alaska Statewide Harvest Survey (SWHS) reports (Mills 1982-1994; Howe et al. 1995, 1996, 2001 a-d; Walker et al. 2003; Jennings et al. 2004, 2006 a-b,2007).

[a] No Kenai River northern pike harvest reported by the SWHS prior to 1985 (Mills 1986).

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[5] The *FishAmerica Foundation* unites the sport fishing industry with conservation groups, government natural resource agencies, corporations, and charitable foundations to invest in fish and habitat conservation and research across the country. Source-FishAmerica Foundation website http://www.asafishing.org/faf/index.html (Accessed June 2009).

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