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Abundances, Length and Age Compositions, and CPUE of Northern Pike Within Selected Sloughs of the Nowitna River, 1997

by

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and

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August 2003

Alaska Department of Fish and Game **Division of Sport Fish**

Symbols and Abbreviations

The following symbols and abbreviations, and others approved for the Système International d'Unités (SI), are used in Division of Sport Fish Fishery Manuscripts, Fishery Data Series Reports, Fishery Management Reports, and Special Publications without definition.

Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
metric ton	mt
milliliter	ml
millimeter	mm

Weights and measures (English)

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

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	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	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

All commonly accepted abbreviations.	e.g., Mr., Mrs., a.m., p.m., etc.
All commonly accepted professional titles.	e.g., Dr., Ph.D., R.N., etc.
and	&
at	@
Compass directions:	
east	E
north	N
south	S
west	W
Copyright	©
Corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
et alii (and other people)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
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
number (before a number)	# (e.g., #10)
pounds (after a number)	# (e.g., 10#)
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S. state and District of Columbia abbreviations	use two-letter abbreviations (e.g., AK, DC)

Mathematics, statistics, fisheries

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	C.I.
correlation coefficient	R (multiple)
correlation coefficient	r (simple)
covariance	cov
degree (angular or temperature)	°
degrees of freedom	df
divided by	÷ or / (in equations)
equals	=
expected value	E
fork length	FL
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.
mideye to tail fork	MEF
minute (angular)	'
multiplied by	x
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
standard length	SL
total length	TL
variance	var

FISHERY DATA SERIES NO. 03-16

ABUNDANCES, LENGTH AND AGE COMPOSITIONS, AND CPUE OF NORTHERN PIKE WITHIN SELECETED SLOUGHS OF THE NOWITNA RIVER, 1997

by

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TABLE OF CONTENTS

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ABSTRACT

Abundances, compositions, and catch per unit effort (CPUE) of northern pike *Esox lucius* within Johnson, Titus, and Pat Moore sloughs of the Nowitna River were described using mark-recapture techniques. Variability in abundance and composition of northern pike among these small areas were examined to determine if future population assessment could be simplified by sampling small areas with a minimum of effort as an index of the larger area. Estimated abundance and density of northern pike varied by slough and month. Estimated abundances ranged from 20 fish (SE = 5) in Pat Moore Slough in August to 1,247 fish (SE = 375) in Titus Slough in August. Estimated densities ranged from 1.6 fish per hectare (SE = 0.4) in Pat Moore Slough in August to 39.9 fish per hectare (SE = 15.1) in Johnson Slough in June. The average length of northern pike sampled ranged from 606 mm FL (SD = 140) in July from Johnson Slough to 744 mm FL (SD = 148) in June from Pat Moore Slough. The minimum age sampled was age-2 and the maximum age-15. There were significant differences between length distributions of northern pike sampled by slough ($T_{akn} = 4.85$; $P < 0.01$), month ($T_{akn} = 4.55$; $P < 0.01$), and gear ($T_{akn} = 2.09$; $P = 0.04$). CPUE with gill nets ranged from 2.51 northern pike per hour in June from Titus Slough to 0.09 per hour in July from Pat Moore Slough. CPUE with hoop traps ranged from 0.28 northern pike per hour in June from Titus Slough to 0.02 per hour in July from Titus Slough. CPUE with hook-and-line ranged from 2.3 northern pike per hour in June from Johnson Slough to 0.0 per hour in August from Titus Slough. There was no obvious correlation between CPUE and abundance. This study does not support the hypothesis that investigators can take a quick look at a small area within the lower Nowitna River to assess the health of the northern pike population in general.

Key Words: Northern pike, *Esox lucius*, population abundance, age composition, length composition, Nowitna River, Yukon River, mark-recapture, CPUE

INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) initiated northern pike *Esox lucius* studies in the Arctic-Yukon-Kuskokwim Region of Alaska (AYK) to ensure that annual harvests do not exceed surplus production of northern pike. Objectives designed to meet this goal have included estimates of abundance, length composition, age composition, mortality rates, recruitment, and movements of northern pike within selected lakes and wetland complexes in AYK. These efforts have focused upon the more accessible fisheries. The Nowitna River, while remote, was recently identified for study due to the increased effort of guided and unguided anglers.

The goal of this study was to obtain information on the current stock of northern pike inhabiting the lower Nowitna River. Mark-recapture experiments were conducted within three sloughs at three times during the summer of 1997 to examine variability in abundance and composition among selected locations within the lower river. The hypothesis was that if there were little variability, future assessment could be simplified by examining small areas, with a minimum of effort, as an index of the larger area.

RESEARCH OBJECTIVES

Abundances, compositions, catches per unit effort of northern pike within selected sloughs of the Nowitna River were determined in 1997. The research objectives were to:

1) estimate the abundance of northern pike ≥ 400 mm FL inhabiting Johnson, Titus, and Pat Moore sloughs during sample periods in June, July, and August such that the estimates are within 25% of the actual value 90% of the time;
2) estimate length and age compositions of northern pike inhabiting Johnson, Titus, and Pat Moore sloughs during sample periods in June, July, and August such that the estimates are within 10 percentage points of the actual value 95% of the time; and,

3) estimate catch per unit effort (CPUE) of northern pike with three gear types: hoop nets, gill nets, and hook-and-line.

DESCRIPTION OF THE NOWITNA RIVER STUDY AREA

The Nowitna River, a Yukon River tributary, is located approximately 130 km downstream from the mouth of the Tanana River. This nationally designated Wild River flows north into the Yukon River and forms a meandering flood plain that varies in width from 1 to 10 km. The lower 80 km of the river is characterized by a mud-sand bottom and variable water conditions by season, which are influenced by breakup conditions both from the Nowitna drainage and from flooding and backup from the Yukon River. In early summer water velocities exceed 1.5 m/s, and water depths generally range from 6 to 10 m with maximum depths of 18 m or more. In late summer water velocities reduce to 1 – 1.5 m/s, stream widths to 60 – 140 m, and water depths to 1 – 8 m. A detailed description of the Nowitna River morphology and a listing of the fish fauna are provided in USFWS (1991).

The study area was located within the lower 30 km of the Nowitna River and consisted of three old river channels (oxbows or sloughs) that are still connected to the main river. These sloughs were easily blocked off to ensure a closed population during each experiment. Extremely variable water levels and flows in the main river precluded effective sampling in the mainstream.

DESCRIPTION OF THE NOWITNA RIVER NORTHERN PIKE FISHERY

During the most recent five-year period (1993-1997), estimated angler effort has averaged approximately 1,000 angler-days by about 300 guided and unguided anglers (Mills 1994, Howe et al. 1995 - 1998). The number of angling guides officially operating in the refuge has increased from zero in 1992 to six in 1997 (J. Goode, Koyukuk/Nowitna Refuge, Galena, personal communication). Sport fishing occurs throughout the open water season, however, anecdotal reports indicate that the majority of the fishing effort and harvest occurs during September concurrent with hunting activities and within the lower 30 km of the river.

Catch and release fishing for northern pike appears to be an important component of the Nowitna River northern pike fishery. Between 1993 and 1997, the estimated harvest of northern pike averaged about 200 fish while estimated northern pike catch averaged about 2,600 fish (Mills 1994, Howe et al. 1995 - 1998). In contrast, during 1991, an estimated 1,600 northern pike were harvested from an estimated catch of 2,700 (M. Mills, ADF&G, Anchorage, personal communication). Between 1993 and 1997, excluding the Tanana River drainage, the Nowitna River drainage accounted for an average of 18% of the estimated catch and an average of 10% of the harvest of northern pike in the Yukon River drainage (Mills 1994, Howe et al. 1995 - 1998).

METHODS

The 1997 Nowitna River study was designed to estimate abundances, length and age compositions, and CPUE of northern pike within three sloughs of the Nowitna River at three different times through the summer (May 29 – June 9; July 18 – 27; and August 21 - 28). The three sloughs selected for this study were Johnson Slough, Titus Slough (up river of Johnson Slough), and Pat Moore Slough (down river of Johnson Slough; Figure 1). Six-panel multi-filament gill nets (length 45 m, depth 2 m; panels alternating 2.5 cm, 3.8 cm, and 5 cm mesh bar-size), seven-hoop nylon hoop traps (1-m diameter mouth, 4.5-m length), with variable length 2-m

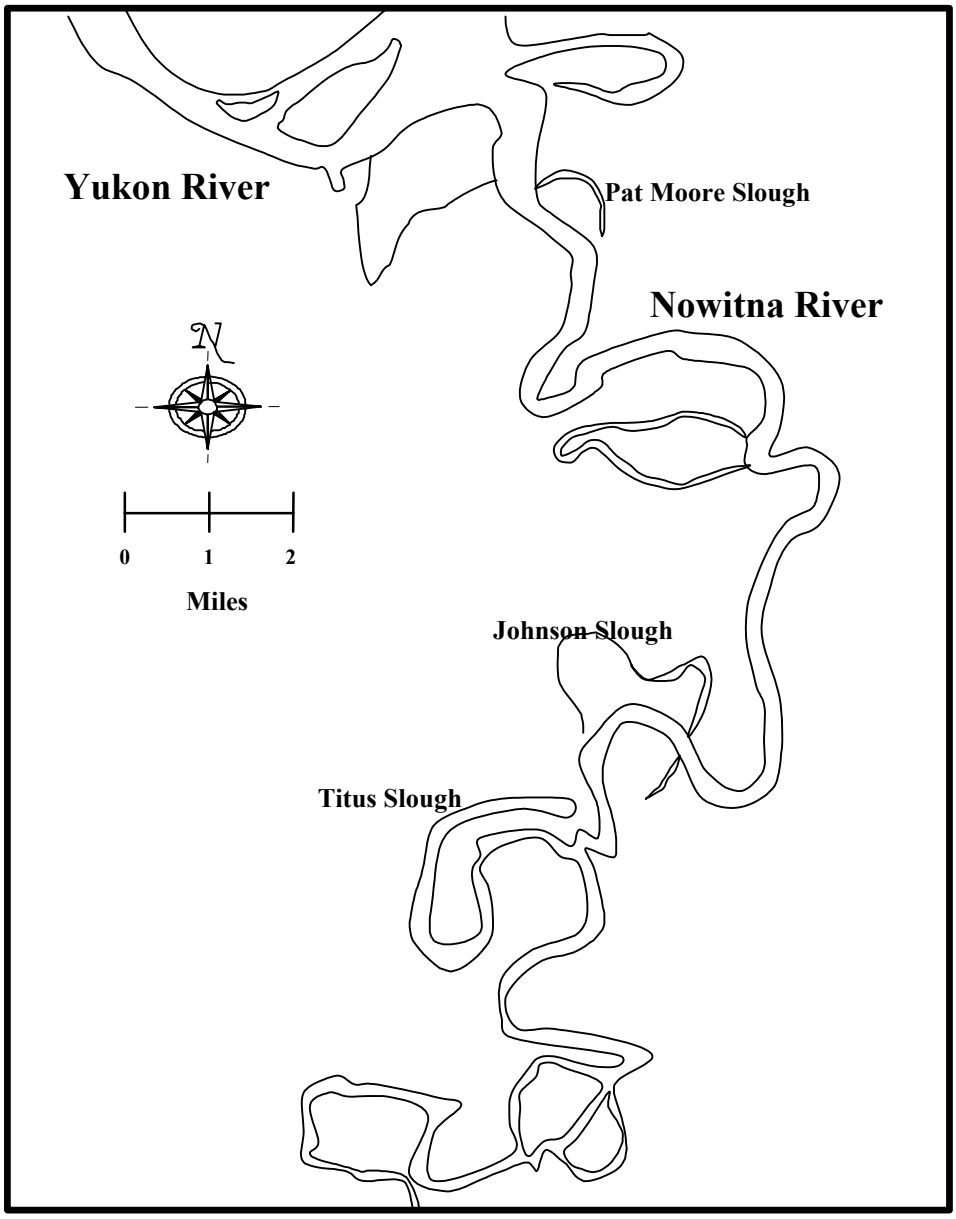

Figure 1.—Nowitna River study area.

Table 1.—Fin clips used as secondary marks during the marking and recapture events by month.

Month	Event	
	Marking Event	Recapture Event
June	Lower Caudal	Upper Caudal
July	Left Pelvic	Right Pelvic
August	Left Pectoral	Right Pectoral

deep wings, used as funnels and for blocking), and standard hook and line gear were used to sample northern pike.

SAMPLING TECHNIQUES

The mouths of each slough were blocked with winged hoop-traps such that fish moving in and out of the slough were determined. These blocking nets were checked at least twice daily. All northern pike were sampled as described below. Within each slough gill nets were deployed evenly and as uniformly as possible by moving nets to new sites within the area throughout the day. All healthy northern pike were released immediately after data collection away from the capture sites.

Northern pike were sampled during the marking event. Fish were measured to the nearest 1 mm FL. A minimum of two scales were taken from the preferred zone adjacent to the lateral line above the pelvic fins as described by Williams (1955). Both the left and right side of the dorsal fin were examined for the presence of a Floy tag. If a Floy tag was present, the color and number of the tag recorded; or if not present, a new Floy FD-68 internal anchor tag inserted at the left base of the dorsal fin and the number recorded. A fin of all newly tagged fish was slightly clipped as a secondary mark (Table 1). Northern pike killed during the sampling procedure were not tagged but all other data recorded and the fate (K) clearly noted. Fish leaving or entering the sloughs were clearly identified. During the recapture event, the same procedures were used with the addition that fins were examined closely for recent clips, and a fin slightly clipped to signify capture during the event (Table 1). Tag loss (TL) was clearly noted for northern pike without a Floy tag but with a recent tag wound or recent fin clip. Number of fish captured and length of time gear was fished were recorded.

Scales collected in the field on gummed cards were impressed on 20 mil acetate sheets using a Carver press at 241,315 kPa (35,000 psi) heated to 150°C for 150-s. Ages were determined from impressions using a Micron 770 microfiche reader (32X) according to criteria established by Williams (1955), and Casselman (1967).

All data files used to estimate parameters of the Nowitna River northern pike population are listed in Appendix A1. Floy tag numbers used for this experiment are listed in Appendix B1.

ESTIMATION OF ABUNDANCE

Abundances were estimated using a Petersen mark-recapture experiment (Seber 1982) based on the following assumptions:

1) the population was closed;

2) all northern pike had the same probability of capture during the marking event or the same probability of capture during the recapture event or marked and unmarked northern pike mixed completely between events;

3) marking northern pike did not affect their subsequent probability of capture;

4) northern pike did not lose their mark between events; and,

5) all marked northern pike were reported when recovered.

Blocking off the mouths of each slough during the time of the experiment ensured the validity of assumption 1. Individual northern pike that either exited or entered the study slough during the marking period of the experiments were excluded from the calculation of abundance. Mortality and growth, which may contribute to the violation of assumption 1, were assumed negligible because of the short duration of each experiment. The validity of assumptions 2 and 3 was inferred by uniformly sampling each slough. Chi-square tests to compare catchability (probability of capture) among areas within each slough during the recapture events (the frequency of fish with marks to the frequency of fish without marks) were not performed because of the low number of recaptures. Capture probabilities, however, were assumed similar due to the small area of each of the sloughs. Kolmogorov-Smirnov two-sample tests to determine bias in estimated abundances due to size selectivity were also not performed because of the low number of recaptures. The validity of assumption 4 was ensured by double marking (Floy tag and fin-clip) each northern pike. Tag loss was noted when a fish was recovered with the specific fin clip but without a Floy tag. The validity of assumption 5 was ensured by a thorough examination of fins for fin-clips and the recording of fin clips and Floy tag numbers for all captured northern pike.

Estimated abundances of northern pike were calculated from the number of northern pike marked, examined for marks, and recaptured. The Chapman estimator (Seber 1982) was used:

$$\hat{N} = \frac{(M+1)(C+1)}{R+1} - 1 \qquad (1)$$

where: M = the number of northern pike marked and released alive during the marking event;

C = the number of northern pike examined for marks during the recapture event;

R = the number of northern pike recaptured during the recapture event; and,

$\hat{N}$ = estimated abundance of northern pike at the time of marking.

Variances of the abundance estimates (Seber 1982) were estimated as:

$$\hat{V}\left[\hat{N}\right] = \frac{(M+1)(C+1)(M-R)(C-R)}{(R+1)^2(R+2)}. \qquad (2)$$

ESTIMATION OF LENGTH AND AGE COMPOSITION

Length proportions of northern pike captured were estimated for the selected sloughs of the Nowitna River. The proportion and variance estimators used were:

$$\hat{p}_k = \frac{x_k}{n}, \text{ and} \tag{3}$$

$$\hat{V}[\hat{p}_k] = \frac{\hat{p}_k(1-\hat{p}_k)}{n-1} \tag{4}$$

where: $\hat{p}_k$ = the proportion of northern pike that were length group *k*;

x_k = the number of northern pike sampled that were length group *k*; and,

n = the number of northern pike sampled that were measured.

Age composition was estimated using the same equations for proportions and variances of proportions used to estimate length composition except ages were substituted for lengths. Length and age composition data were archived (Appendices B2, B3).

The length distributions of northern pike caught by gear, month, and slough were compared using the Anderson-Darling k-sample test (Scholz and Stephens 1987).

ESTIMATION OF CPUE

CPUE was calculated by slough and month for northern pike captured by hoop traps, gill nets, and hook and line as the number of fish captured divided by the total time the gear was fished.

RESULTS

There were no recaptured fish < 550 mm FL, therefore, only fish ≥ 550 mm FL were used in estimating abundances of northern pike in Johnson, Titus, and Pat Moore sloughs. Of 752 unique northern pike ≥ 550 mm FL handled during the mark-recapture experiments, 353 were tagged and released alive during the marking events and 451 were examined for marks during the recapture events of which 52 were recaptures from the marking events (Table 2). During the experiments, water temperatures varied from as low as 14° C in June, as high as 24° in July, and as low as 15° in August. During the experiment, 52 northern pike ≥ 550 mm FL (< 7% of fish handled) were inadvertently killed. Twenty-three of these were killed during the recapture event during June in Titus Slough due to lengthy soak times in warm water. Soak times of the gear were reduced accordingly for the remainder of the experiments.

Estimated abundances of northern pike within the selected sloughs of the Nowitna River were germane to fish ≥ 550 mm FL. Recapture rates (fish recaptured divided by fish examined for marks in the recapture event; R/C) ranged from 0.00 to 0.50 (Table 2). Bias from unequal catchability by length, gear, or area within a slough could not be determined satisfactorily due to the low number of recaptures in any one slough. By default, abundance was estimated using the

Table 2.—Number of northern pike ≥ 550 mm FL marked (M), captured and examined for marks (C), recaptured with marks (R), and recapture rates (R/C) by study area and month.

Study Area	Month	Number of Northern Pike			R/C
		Marked	Captured	Recaptured	
Johnson Slough	June	26	78	4	0.05
	July	39	29	11	0.38
	August	34	17	6	0.35
Titus Slough	June	52	103	8	0.08
	July	83	49	8	0.16
	August	91	121	8	0.07
Pat Moore Slough	June	7	33	0	0.00
	July	11	13	3	0.23
	August	10	8	4	0.50

unstratified Chapman estimator based on the hypergeometric probability distribution. Estimated abundances ranged from 20 fish (SE = 5) in Pat Moore Slough in August to 1,247 fish (SE = 375) in Titus Slough in August (Table 3). Estimated densities ranged from 1.6 fish per hectare (SE = 0.4) in Pat Moore Slough in August to 39.9 fish per hectare (SE = 15.1) in Johnson Slough in June (Figure 2).

Selectivity by length within any one slough was not reconciled satisfactorily by diagnostic tests because of the low number of recaptures. Therefore, both events were combined and all fish sampled were used to describe the length composition of the catch in each slough. The minimum length of northern pike sampled ranged from 305 mm FL in July from Johnson Slough to 485 mm FL in June from Pat Moore Slough (Table 4; Figure 3). The maximum length of northern pike sampled ranged from 905 mm FL in July from Pat Moore Slough to 1,114 mm FL in July from Johnson Slough (Table 4; Figure 3). The average length of northern pike sampled ranged from 606 mm FL (S.D. = 140) in July from Johnson Slough to 744 mm FL (S.D. = 148) in June from Pat Moore Slough (Table 4; Figure 3). The minimum age sampled was age-2 and the maximum age-16 (Figure 4).

There were significant differences between length distributions of northern pike sampled by slough ($T_{akn} = 4.85$; $P < 0.01$), month ($T_{akn} = 4.55$; $P < 0.01$), and gear ($T_{akn} = 2.09$; $P = 0.04$). Samples from Pat Moore Slough contributed the most to the difference by slough, samples in July contributed the most to differences by month, and samples taken with hook and line contributed the most to differences by gear (Figure 5).

CPUE with gill nets ranged from 2.51 northern pike per hour in July from Johnson Slough to 0.09 per hour in August from Titus Slough (Figure 6). CPUE with hoop traps ranged from 0.28 northern pike per hour in June from Titus Slough to 0.02 per hour in July from Titus Slough (Figure 6). CPUE with hook and line ranged from 2.30 northern pike per hour in June from Johnson Slough to 0.00 per hour in August from Titus Slough (Figure 6).

Table 3.—Estimated abundances and 95% confidence intervals of northern pike ≥ 550 mm FL by study area and month.

Study Area	Month	Number of Northern Pike	
		$\hat{N}$	95% CI
Johnson Slough	June	427	273 – 1,231
	July	100	78 – 152
	August	90	64 – 176
Titus Slough	June	612	426 – 1,204
	July	467	326 – 908
	August	1,247	854 – 2,524
Pat Moore Slough	June	-	-
	July	42	28 – 122
	August	20	14 – 38

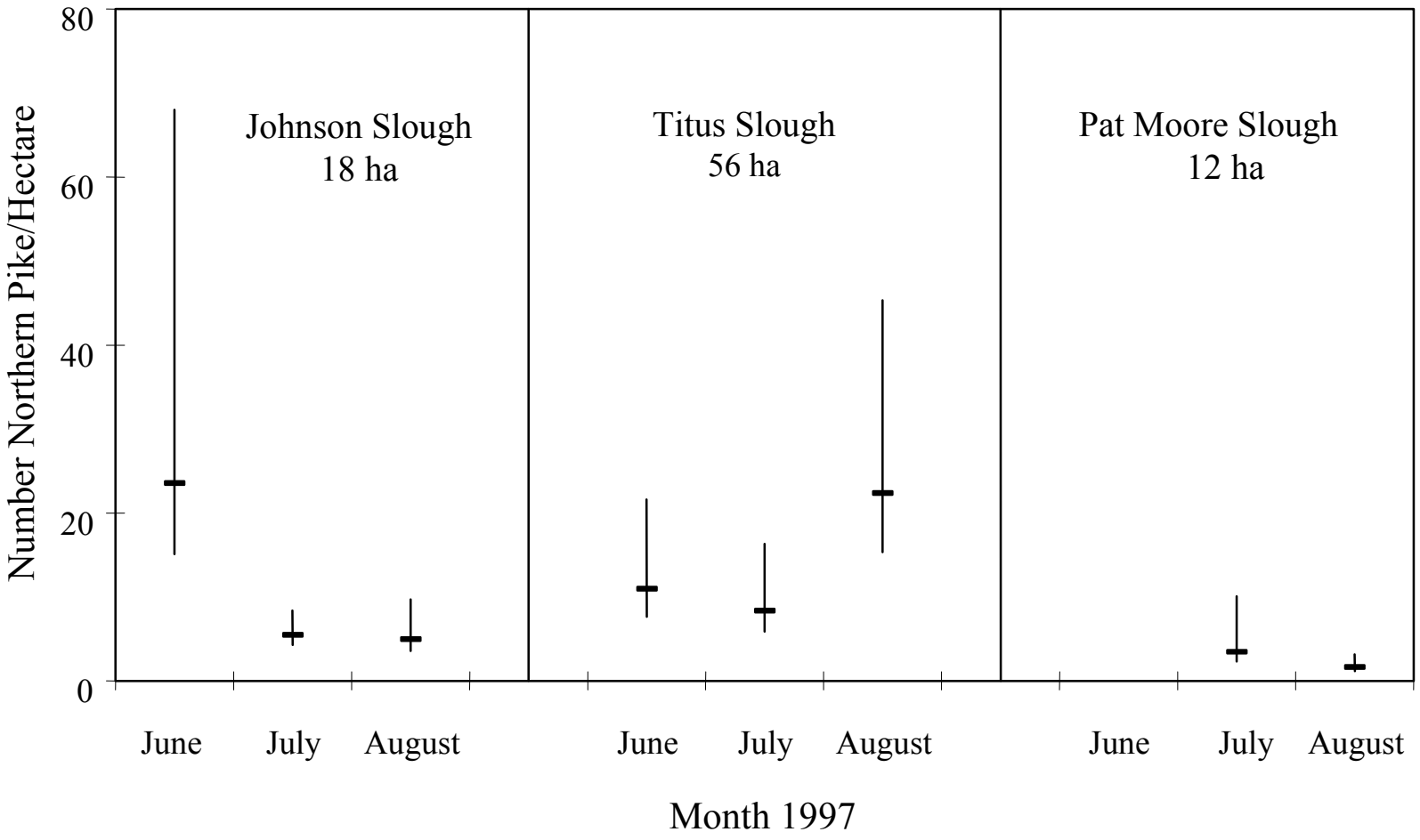

Figure 2.—Estimated densities (northern pike per hectare) and 95% confidence intervals of northern pike ≥ 550 mm FL by study area and month.

Table 4.—Minimum, maximum, average, and standard deviation of northern pike lengths sampled by study area and month.

Study Area	Month	Length (mm FL)			
		Minimum	Maximum	Average	S.D.
Johnson Slough	June	440	1,060	699	128
	July	305	1,114	606	140
	August	407	1,121	671	129
Titus Slough	June	330	1,020	661	111
	July	401	1,010	668	117
	August	325	1,127	681	118
Pat Moore Slough	June	485	1,055	744	148
	July	455	905	701	99
	August	408	961	649	114

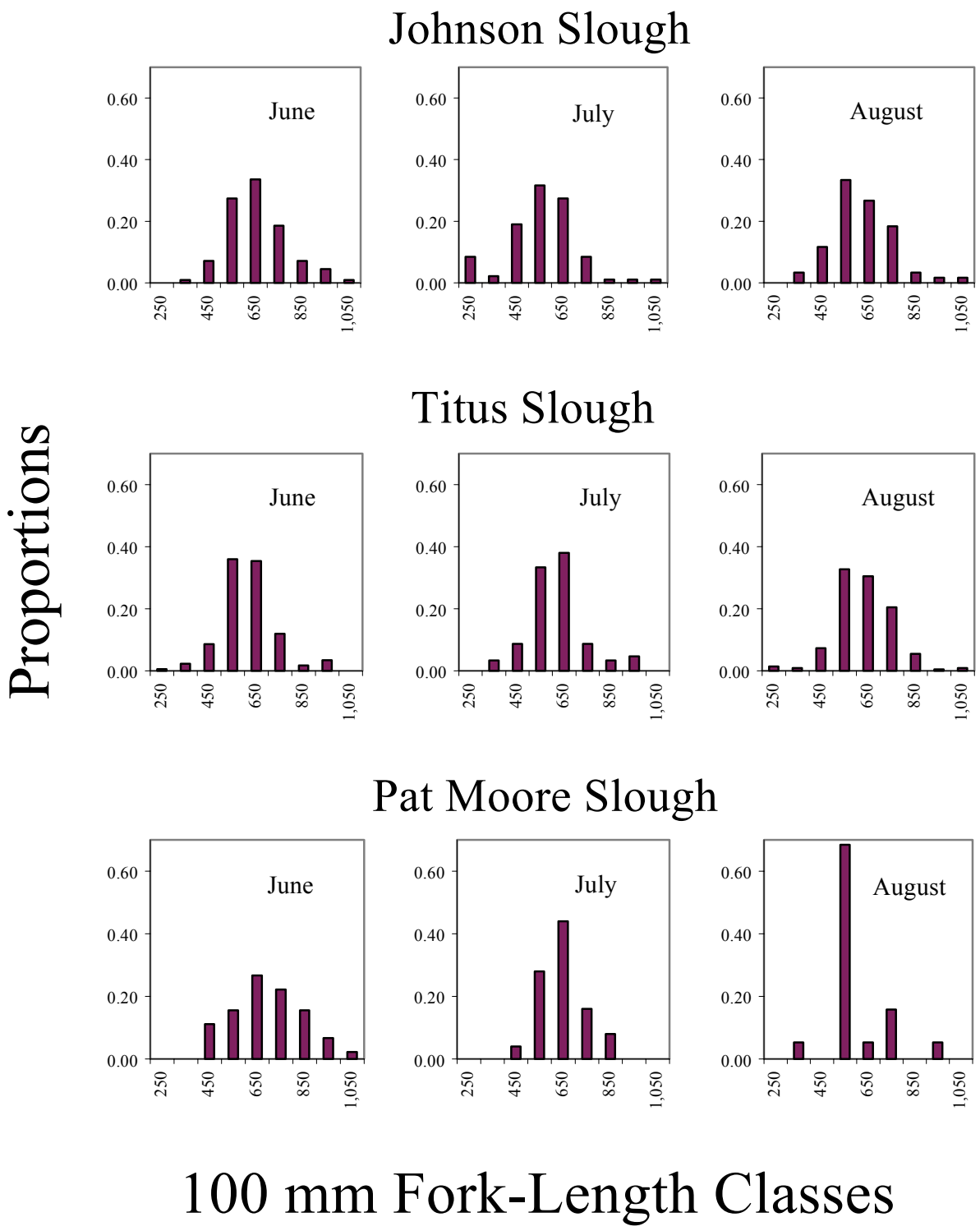

Figure 3.—Proportions by length class of northern pike sampled by study area and month. Sample sizes by length category are listed in Appendix B2.

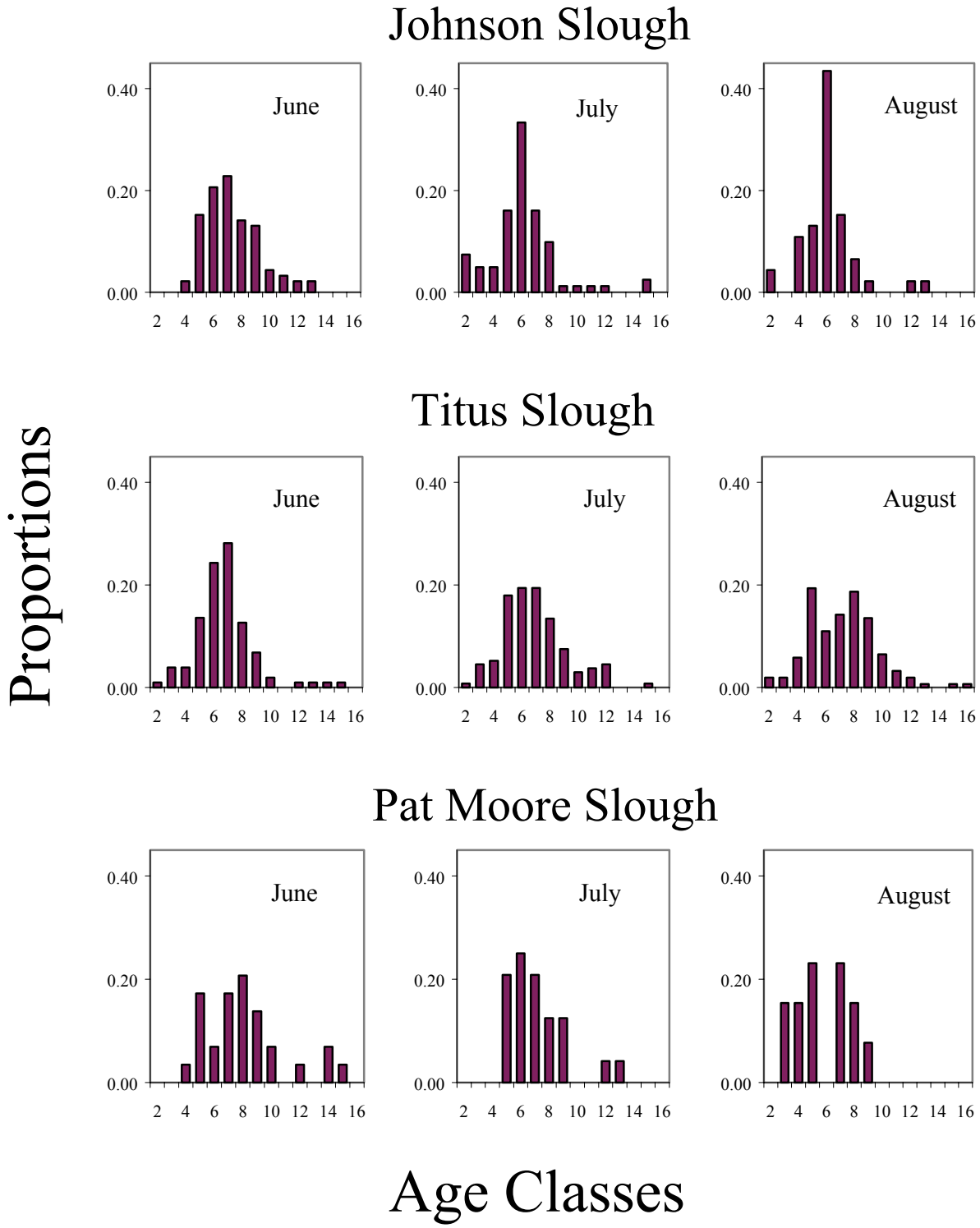

Figure 4.—Proportions by age class of northern pike sampled by study area and month. Sample sizes by age class are listed in Appendix B3.

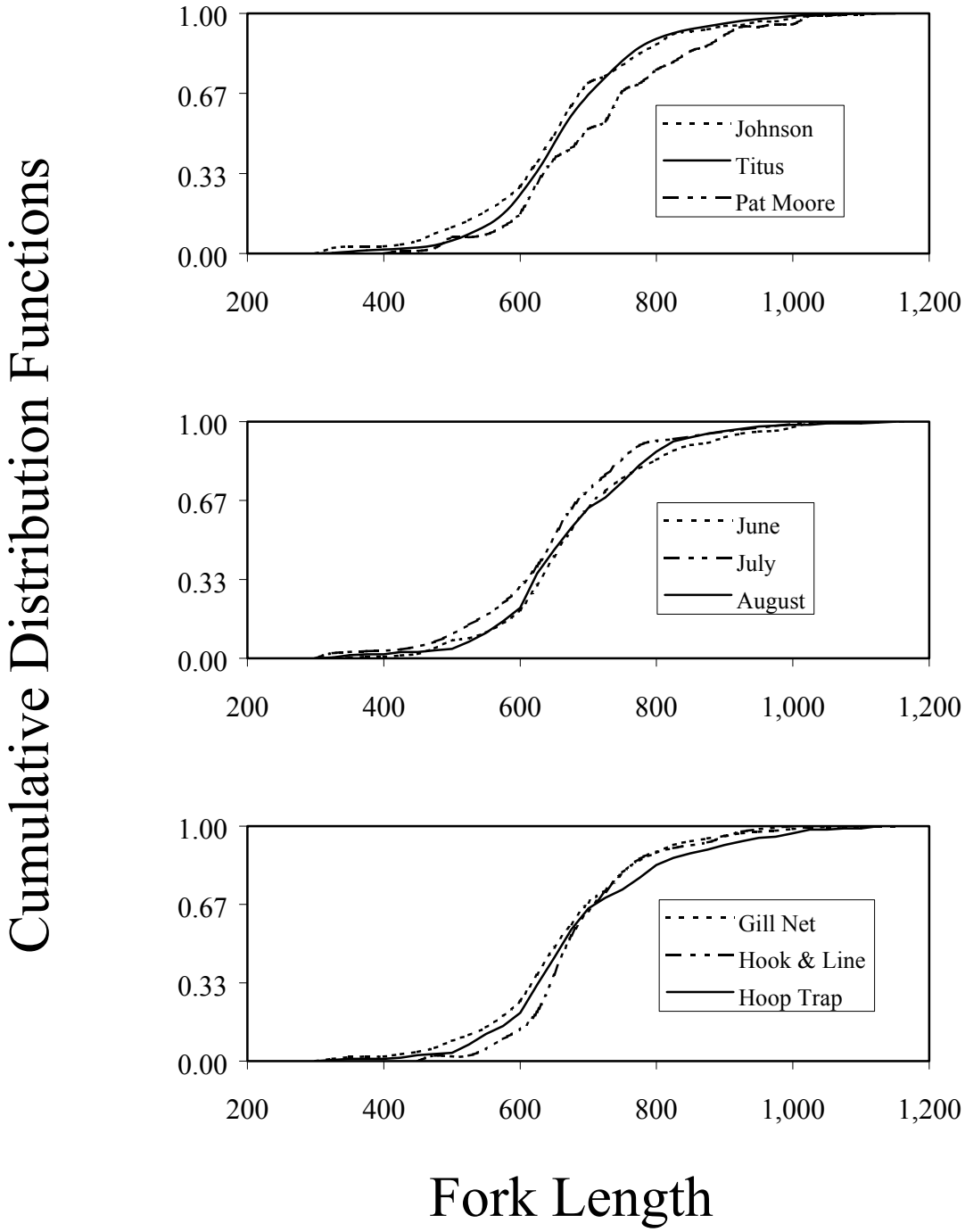

Figure 5.—Cumulative length distributions of northern pike sampled by study area, month, and gear.

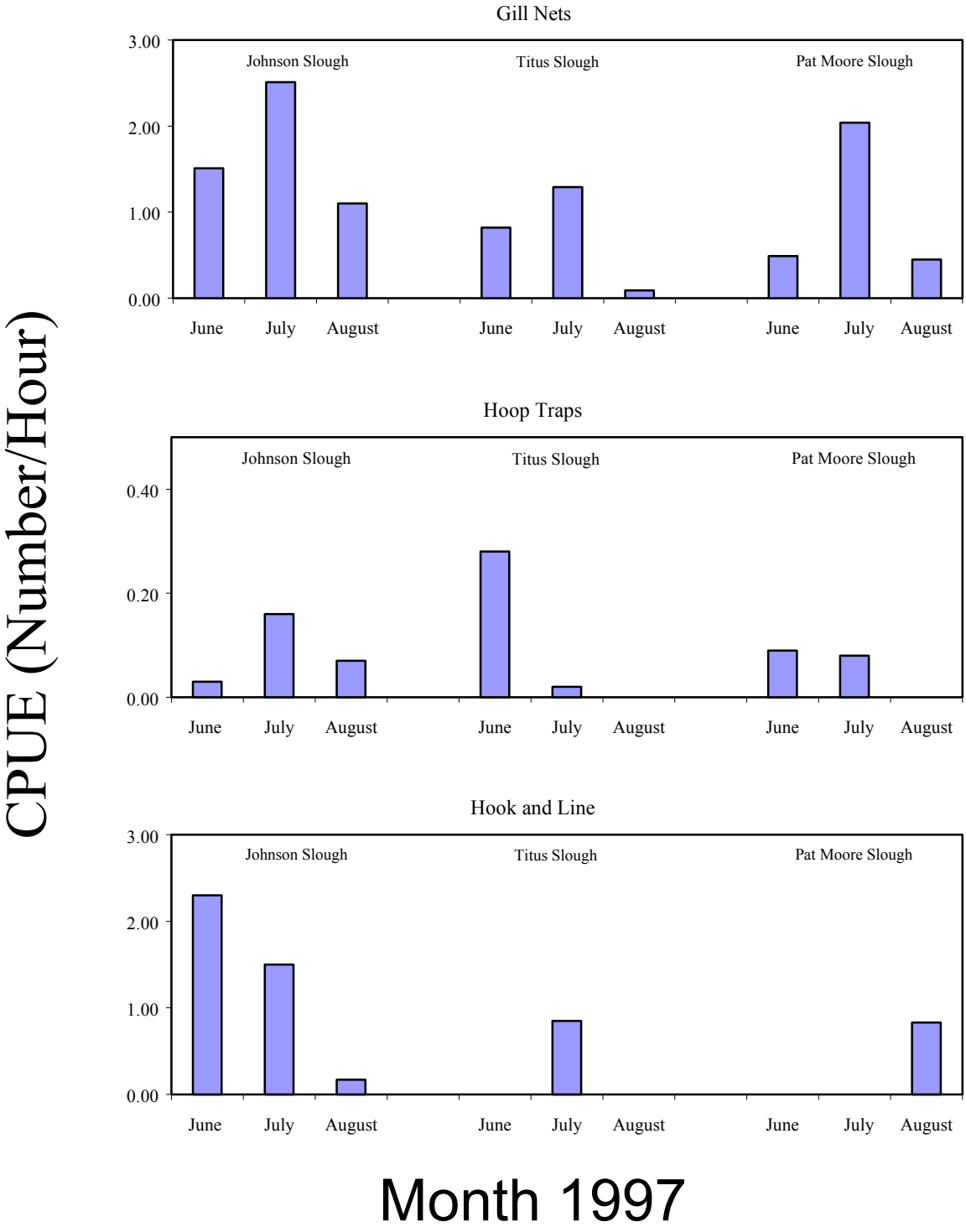

Figure 6.—CPUE of northern pike by study area, month, and gear.

DISCUSSION

The paucity of recaptured fish was a nagging problem for the Nowitna River northern pike study. Fish moving into and out of the study sloughs confounded the estimation of abundance by reducing the number of fish available for each experiment. Although careful records were maintained, the consequence of the immigration and emigration was to reduce the number of marked fish available for recapture and hence to reduce the viability of the mark-recapture experiments. Abundances were estimated with as few as three and at most eleven recaptures. Diagnostic tests for equal catchability by length and area were not satisfactory because the low power resultant from few recaptures rendered the tests of little value. Increasing the duration of each experiment or increasing the fishing effort may have improved number of recaptures.

The density of northern pike in Johnson Slough was considerably greater in June than in July or August and also greater than in Titus Slough in June. This along with the habitat characteristics of Johnson Slough—shallow water depth and emergent vegetation—suggests that Johnson Slough is a primary spawning area for the lower Nowitna River. This study also indicated that northern pike moved out of Johnson Slough and into Titus Slough—deepest of the three sloughs studied—through the summer as water depth and temperature changed throughout the lower river. Headrick and Carline (1993) reported that northern pike moved to cooler water once the water temperature exceeded 20° C. Furthermore, there is some evidence that smaller fish moved into Johnson Slough after larger spawning-size fish moved out in July or remained in Johnson Slough later than the larger fish. This supports the findings of Neumann and Willis (1995), which showed that several samples taken from a northern pike population from narrow periods of time may indicate differences in length structure when there is no underlying population difference. They suggested that variable activity and habitat use by sex and size in any one location might account for these differences.

The data from this study do not support the hypothesis that investigators can take a "snap-shot" look at any one slough during any month of the summer to assess the health of the northern pike population in the lower Nowitna River. Within the same summer, densities and average lengths varied considerably by slough and month. This can be attributed to a preference for spawning area, changing water levels through the summer, and changing water temperatures. Furthermore, there is no reason to believe that these conditions in any one slough would not be variable from one year to the next. In addition, CPUE was not reflective of abundance and provided little information about aggregations of northern pike. This indicated that it is unlikely that a CPUE index from a small area can be used as a surrogate for mark-recapture experiments to assess abundance in a much larger area. Casselman (1978) and Diana (1980) also found that catch rates were not always reflective of population size. This may be attributed to a time specific increase or decrease in northern pike activity at a given location (Roach 1993; 1998a).

This study demonstrates some of the problems with attempting to assess the health of a population inhabiting a large area by taking a quick look at a small portion of the total area. By looking at any one site at any single time, investigators can arrive at a myriad of interpretations on the status of the stock.

A better method of assessing age and size composition in the Nowitna River northern pike stock would be to select sampling locations throughout the lower 60 to 100 km of the river and to use a

combination of gear types to collect the samples. Roach (1998b) found that gear induced size selectivity can be minimized by using a combination of actively fished gill nets and hoop nets.

To obtain a more complete assessment of the northern pike stock, a mark recapture experiment would be necessary to better understand biases associated with sampling. The study area and the timing of the experiment must be carefully selected due to the open nature of the river and the potential magnitude of movement of the fish. Radio telemetry has been successfully used in other areas to help design mark/recapture experiments for northern pike in open systems. Roach et al. (1998a) used information from movements of radio tagged pike in Minto Flats to select study areas and time periods which would minimize bias introduced by fish moving into or out of study area(s). A radio telemetry study to describe the timing and magnitude of seasonal movements of Nowitna northern pike is recommended when additional stock status information is required.

The Nowitna River continues to be one of the most important destinations for anglers targeting northern pike in the Yukon drainage. Sport fishing regulations are currently very liberal; the daily bag and possession limit for northern pike is ten per day with no size limit. A sustained increase in fishing effort and or harvest will be used as a trigger for assessment of this population. The ADF&G will continue to monitor the statewide harvest survey as a means for detecting changes in use of this fish stock.

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APPENDIX A
DATA FILE LISTING

Appendix A1.—Data files used to estimate parameters of Nowitna River northern pike, 1997.

Data file[a]	Description
NWT97DAT.XLS	Sampling data for northern pike captured during June, 1997.
JULY97.XLS	Sampling data for northern pike captured during July, 1997.
AUG97JC.XLS	Sampling data for northern pike captured during August, 1997.

[a] Data files were archived at and are available from the Alaska Department of Fish and Game, Sport Fish Division, Research and Technical Services, 333 Raspberry Road, Anchorage, Alaska 99518-1599.

APPENDIX B

RECORD OF TAG COLORS AND TAG NUMBERS

Appendix B1.-Floy tag numbers used for Nowitna River northern pike mark-recapture experiments by year and color.

Year	Tag Color		
	Green	Blue	Gray
1997	37,561 - 38,003	64,394 – 64,699	2,375 – 2,625
	68,459 – 68,499		18,860 – 18,999
			34,600 – 34,977

Appendix B2.-Sample sizes by length category for Nowitna River northern pike, 1997.

Length	Johnson Slough			Titus Slough			Pat Moore Slough		
	June	July	August	June	July	August	June	July	August
300 – 349	-	8	-	1	-	3	-	-	-
350 – 449	1	2	2	4	5	2	-	-	1
450 – 549	8	18	7	15	13	16	5	1	-
550 – 649	31	30	20	63	50	72	7	7	13
650 – 749	38	26	16	62	57	67	12	11	1
750 – 849	21	8	11	21	13	45	10	4	3
850 – 949	8	1	2	3	5	12	7	2	-
950 – 1,049	5	1	1	6	7	1	3	-	1
≥ 1,050	1	1	1	-	-	2	1	-	-
All	208	95	60	175	150	220	45	25	19

Appendix B3.-Sample sizes by age for Nowitna River northern pike, 1997.

Age	Johnson Slough			Titus Slough			Pat Moore Slough		
	June	July	August	June	July	August	June	July	August
1	-	-	-	-	-	-	-	-	-
2	-	6	2	1	1	3	-	-	-
3	-	4	-	4	6	3	-	-	2
4	2	4	5	4	7	9	1	-	2
5	14	13	6	14	24	30	5	5	3
6	19	27	20	25	26	17	2	6	-
7	21	13	7	29	26	22	5	5	3
8	13	8	3	13	18	29	6	3	2
9	12	1	1	7	10	21	4	3	1
10	4	1	-	2	4	10	2	-	-
11	3	1	-	-	5	5	-	-	-
12	2	1	1	1	6	3	2	1	-
13	2		1	1	-	1	1	1	-
14			-	1	-	-	-	-	-
15			-	1	1	1	-	-	-
16			-	-	-	1	-	-	-

Appendix B4.-Location of release and recapture of northern pike in the Nowitna River within and between sampling periods in 1997.

June - June

Marked	Recaptured JSN[a]	PMS[b]	TITUS[c]	RIVER[d]
JSN	20[e]		6	
PMS		2		
TITUS			8	
RIVER		1		

June - July

Marked	Recaptured JSN	PMS	TITUS	RIVER
JSN	6			
PMS				
TITUS			4	
RIVER				

July - July

Marked	Recaptured JSN	PMS	TITUS	RIVER
JSN	23	5	5	
PMS	2	3	1	
TITUS	1		8	
RIVER				

June - August

Marked	Recaptured JSN	PMS	TITUS	RIVER
JSN	2		1	1
PMS		1		
TITUS				
RIVER				

August - August

Marked	Recaptured JSN	PMS	TITUS	RIVER
JSN	8		1	
PMS		4		
TITUS			11	1
RIVER				

July - August

Marked	Recaptured JSN	PMS	TITUS	RIVER
JSN	4		1	
PMS		2		
TITUS			5	1
RIVER				

[a] Johnson Slough (mile 11)

[b] Pat Moore Slough (mile 1.5)

[c] Titus Slough (mile 13)

[d] Test net sets in Nowitna River between JSS and Titus (mile 12)

[e] The number of fish marked and recaptured in each slough during each experiment is often greater than the number of recaptures listed in Table 2. The additional numbers reflect fish that moved out of each slough during the marking periods of the experiments.