Fishery Data Series No. 99-5

Movements, Food Availability and Stomach Contents of Northern Pike in Selected Susitna River Drainages, 1996-1997

by

David S. Rutz

May 1999

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. All others must be defined in the text at first mention, as well as in the titles or footnotes of tables and in figures or figure captions.

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

Spell out acre and ton.

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
hour (spell out for 24-hour clock)	h
minute	min
second	s

Spell out year, month, and week.

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-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

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MOVEMENTS, FOOD AVAILABILITY AND STOMACH CONTENTS OF NORTHERN PIKE IN SELECTED SUSITNA RIVER DRAINAGES, 1996-1997

by

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ABSTRACT

Four tributaries within the Susitna River drainage were sampled during 1996 and 1997 to assess movement, mean length, availability of food items, and stomach contents of northern pike *Esox lucius*.

Movements of northern pike were investigated using radiotelemetry. The greatest distance a radio tagged fish traveled from capture location was 10 km; the least distance traveled was less than 1 km. Nearly all northern pike remained within the drainages where they were originally captured. Many of the radio tagged fish moved between sloughs and lakes within drainages, while only one incidence of movement was observed between drainages.

We analyzed the stomach contents of northern pike captured in four selected Susitna River drainage systems to assess differences in food availability and items in the diet of northern pike. Of the 389 stomachs examined, 249 (64%) were non-empty. Of the 249 non-empty stomachs examined, 198 (80%) contained salmonids, 4 (2%) contained invertebrates, and 17 (7%) contained threespine sticklebacks *Gasterosteus aculeatus.* All five species of pacific salmon *Oncorhynchus* were observed in northern pike stomachs. Salmonids present in northern pike stomachs by species in order of magnitude were: coho salmon *O. kisutch* (59%), sockeye salmon *O. nerka* (24%), rainbow trout *O. mykiss* (6%) chinook salmon *O. tshawytscha* (3%), chum *O. keta* and pink salmon *O. gorbuscha* (< 1%).

We set 290 minnow traps in the same four Susitna River tributaries. Equal proportions were set in locations of confirmed radio tagged northern pike signals, primarily within side sloughs and within the adjacent creek proper. Catch per trap for the traps fished near locations of confirmed radio tagged northern pike were lower for salmonids (0.4 fish/trap) and higher for sticklebacks (30.6 fish/trap), while conversely, catch per trap for the traps fished within the adjacent creek proper was higher for salmonids (10.4 fish/trap) and lower for sticklebacks (8.3 fish/trap).

Key words: Northern pike, coho salmon, sockeye salmon, chinook salmon, pink salmon, chum salmon, rainbow trout, Arctic grayling, whitefish, threespine stickleback, radiotelemetry, CPUE, movements, sex ratio, mean length, Susitna River drainage, stomach content, predation.

INTRODUCTION

HISTORY OF NORTHERN PIKE IN THE SUSITNA RIVER DRAINAGE

The Susitna River drainage (Figure 1) is a large river basin encompassing tens of thousands of square miles and is roughly the area of the state of Indiana. Northern pike *Esox lucius* are not indigenous to the Susitna River drainage and were likely established through a series of illegal introductions in the early 1950s. To date northern pike can be found throughout most of this system.

NORTHERN PIKE PREDATION

It has been theorized by the Department of Fish and Game, concerned members of the angling public, and water front property owners that marked declines in adult returns of coho salmon *Oncorhynchus kisutch*, sockeye salmon *O. nerka*, and to a lesser extent, chinook salmon *O. tshawytscha,* along with the depletion of rainbow trout *O. mykiss* and Arctic grayling *Thymallus arcticus* stocks of many Susitna basin tributaries and lakes may, in part, be a result of northern pike predation.

Preference is the inherited instinctive desire to consume one size or species of food item rather than another. Northern pike prefer soft-rayed rudd *Scardinius erythrophthalmus* over perch *Perca fluviatilus* (Eklov and Hamrin, 1989). Northern pike longer than 15 cm left threespine stickleback *Gasterosteus aculeatus* alone, while continuing to eat non-spined fish of the same size and considerably larger size (Hoogland et al. 1956). Northern pike selected golden shiners *Notemigonis crysoleucas,* fathead minnows, *Pimephales promelas* and chubsuckers *Erimyzon sucetta* over sunfish (Centrarchidae) and yellow perch *Perca flavescens* (Beyerle and Williams 1977). Soft-rayed fish species in the Susitna

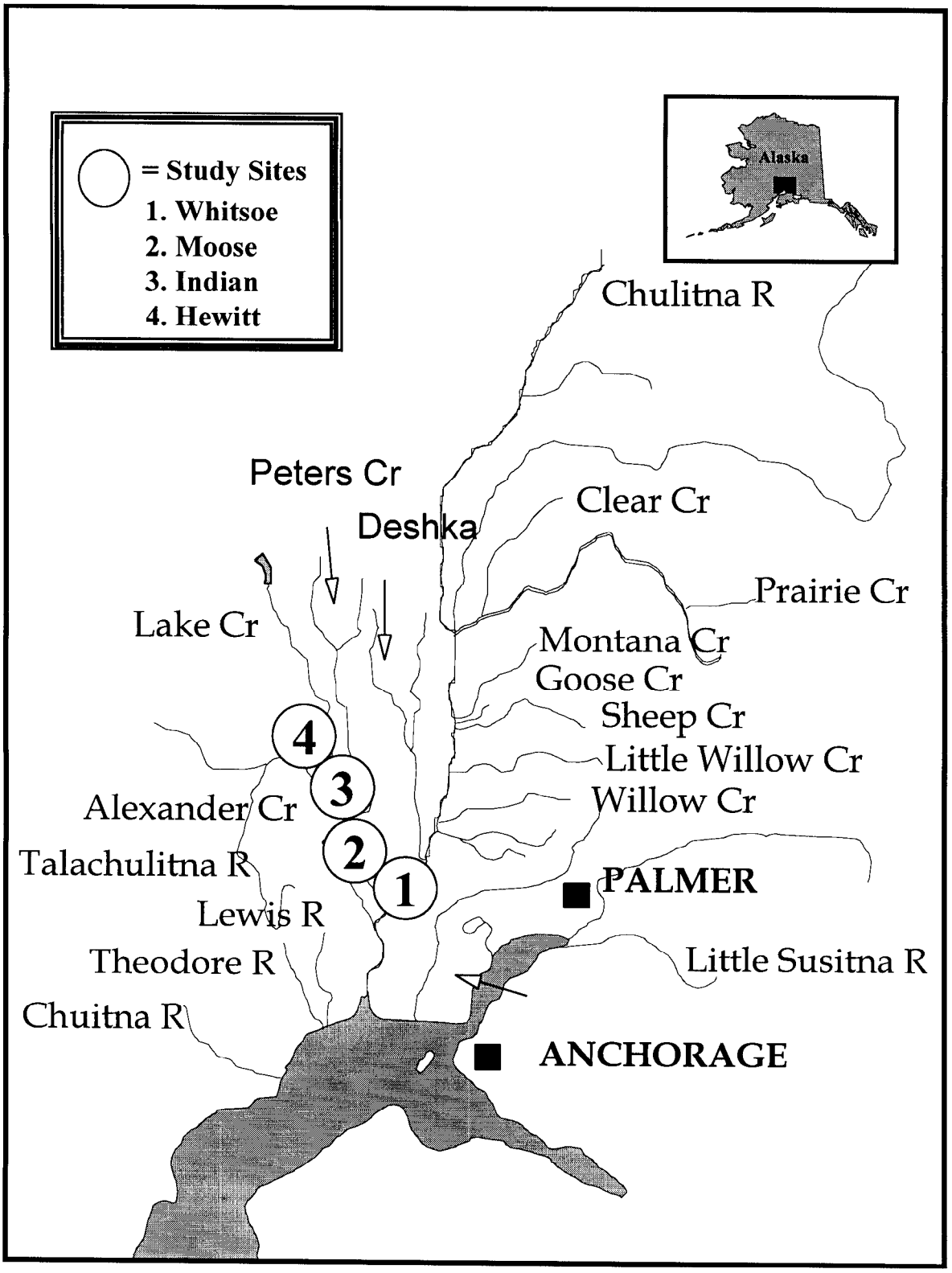


Figure 1.-Sampling locations for northern pike in the Susitna River drainage during 1996 and 1997.

River drainage include: longnose suckers *Catostomus catostomus*, salmon *Oncorhynchus*, rainbow trout, whitefish *Coregonus* and *Prosopium,* Arctic grayling *Thymallus arcticus,* char *Salvelinus,* Alaska black fish *Dallia pectoralis*, and burbot *Lota lota*. Northern pike are known to consume large proportions of stocked and migrating salmonid juveniles. Pervozvanskiy et al. (1988) showed that northern pike account for up to 35% of the stocked Atlantic salmon *Salmo salar* smolt mortality in the Keret River in Russia. Larsson (1985) found that at least 50% of migrating Baltic salmon are lost to predation from northern pike during downstream migration. Information obtained from the Por'ya River (Karelian Autonomous Republic, Old USSR) showed that in some years northern pike consume 30%-33% of migrating wild juvenile salmon (Smirnov et al. 1977). According to Movchan and Chechenkov (1979), more than 70% of juvenile hatchery salmon released in the Shuya River (White Sea Basin) from the Kem' Hatchery are eaten by northern pike.

In the Susitna River drainage, coho and sockeye salmon and rainbow trout can occupy similar habitat types to that of northern pike. Therefore they are the most likely species of salmonids to be impacted by northern pike predation. These fish species and northern pike have been shown to occupy similar habitat niches (Carbine and Applegate 1946; Diana et al. 1977; Narver 1978, Rutz 1996). Most of the 70 Susitna River drainage lakes and streams identified as containing northern pike populations once contained native populations of rainbow trout. Most of these same lakes also had previous histories of coho and/or sockeye salmon production along with various resident fish populations (rainbow trout and Arctic grayling) which were documented by stream and lake surveys conducted from the late 1950s through the present (ADF&G, Sport Fish Division, Palmer, 1800 Glenn Hwy., Palmer, Alaska 99654, unpublished data). Additional historical information on species compositions of Susitna River drainage lakes prior to pike colonization was provided by past fisheries managers and researchers along with anglers and lakeshore and stream bank property owners.

Stomach contents examined from northern pike in many of these lake systems contain only invertebrates (Rutz 1996). Mann (1985) suggested that northern pike make rapid changes to their prey selection in response to changes in abundance and vulnerability of potential prey. Once the preferred food items are no longer available, northern pike quickly adapt to alternate food sources (Eddy and Surber 1947) such as insects, leeches, snails, and clams.

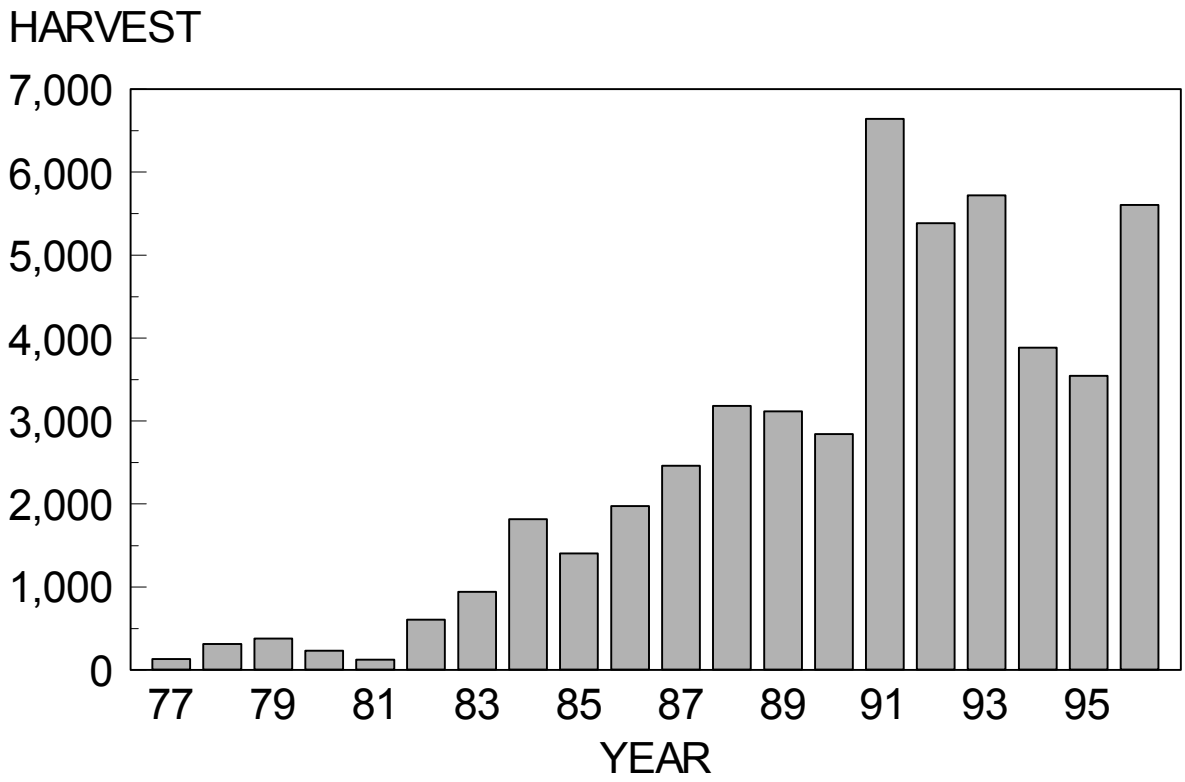
Much of the Susitna River drainage salmon production is derived from the many shallow lakes and ponds that provide the necessary rearing habitat for juvenile salmon (Roth and Stratton 1984). Some anglers and department biologists believe that northern pike have reduced or eliminated coho salmon, rainbow trout, and other sport fish species from these lakes. Northern pike were introduced to a reservoir in Colorado to control abundant populations of white suckers *Catostomus commersoni*. Once the suckers declined to a small fraction of their previous numbers, northern pike shifted to preying on stocked rainbow trout populations (Chapman et al. 1989). Mann (1985) suggested that the removal of large, older northern pike reduces predation on catchable-size rainbow trout (200-250 mm). However, stomachs examined from northern pike <500 mm FL captured during a previous study (Rutz 1996) contained rainbow trout up to 350 mm in length. Because northern pike are efficient predators, they have also been successfully introduced as

a means to reduce stunted fish populations (Powell 1973).

MANAGEMENT OPTIONS

The spread of northern pike in the Susitna River drainage has sparked both angler interest and concern. Anglers concerned about the effect northern pike predation may have on Susitna River drainage salmonid populations would like to see northern pike populations eliminated. In contrast, anglers that enjoy the sport of northern pike fishing would like to see management practices that would promote trophy size northern pike, and still other northern pike anglers would like to continue to harvest large numbers of northern pike for table fare. Based on harvest, northern pike fishing in the Susitna River drainage appears to be one of the fastest growing sport fisheries in the Northern Cook Inlet (NCI) area (Figure 2). Alaska State law mandates that Alaska's wild fisheries resources are managed under a sustainable yield concept. Given the potential of northern pike predation on other fish species desired by sport anglers, managing northern pike stocks on a sustainable yield basis while limiting predation of northern pike on coho salmon and rainbow trout stocks may be extremely difficult to achieve.

Very little information is available concerning the status of specific Susitna River drainage salmon stocks. Given the paucity of specific stock status information available for Susitna River drainage salmon stocks, in concert with the expansion of northern pike throughout most of this drainage system, it became important to collect meaningful data on pike predation and the possible impacts that it may have on other species.



From: Mills 1979-1994, Howe et al. 1995-1997.

Figure 2.-Number of northern pike harvested in Northern Cook Inlet, 1977-1996.

STUDY OBJECTIVES

This project had three components. The first component was to track the movements of northern pike in selected Susitna River drainages. The second component was to investigate northern pike predation on salmonids in four tributaries of the Susitna River drainage. The last component was to determine available food items in close proximity to confirmed locations of radio tagged northern pike. Specific objectives for this study were to:

1. Describe the movements of radio tagged northern pike in selected Susitna River drainage waters;
2. Estimate the proportion of non-empty northern pike stomachs that contained salmonids;
3. Estimate the CPUE of juvenile coho salmon and stickleback in close proximity to confirmed signals of radio –tagged northern pike in Hewitt, Indian, Moose and Whitsoe creeks (Susitna River drainage).

METHODS

STUDY AREA

The Susitna River drainage originates from two major mountain ranges (Talkeetna and Alaska), generally flowing in a southerly direction before emptying into Upper Cook Inlet (UCI). The drainage comprises hundreds of shallow lakes, high and low velocity clearwater tributaries, and sloughs supporting large beds of aquatic vegetation that are ideal spawning and rearing habitats for northern pike. Four systems of this drainage were sampled for northern pike during this study: Hewitt, Indian, Moose, and Whitsoe creeks (Figure 1).

BIOLOGICAL SAMPLING

All northern pike (including fish recaptured within a season) were measured to the nearest millimeter of fork length. Because most northern pike were sacrificed to reveal stomach content, verification of sex through examination of the gonads was possible for most of the sampled fish (excluding radio tagged fish). All fish, excluding radio tagged fish, were examined for stomach contents.

ASSESSMENT OF MOVEMENTS

Movements of northern pike were investigated using radiotelemetry. Radio locations were used to describe movements, note habitat selections, and to further facilitate field sampling.

Eighteen northern pike were captured in four tributaries of the Susitna River and surgically implanted with radio transmitters during June 4 through August 23, 1996. These sites were Hewitt (n = 4), Indian (n = 5), Moose (n = 5), and Whitsoe (n = 4) creeks. When fish were implanted with radios, care was taken to minimize trauma through proper handling. Processed fish were released near location of capture. The capture location of each radio tagged fish was recorded and transcribed on a map (Table 1, Appendices A1-A4, and B1-B18).

Radio tags were internally implanted in each fish using standard surgical procedures. Only northern pike >430 mm FL were used, given a recommendation by Winter et al. (1978) that the weight of the radio transmitter should not exceed more than 2% of the fish's body weight. Tricaine methanesulfonate (MS-222) was used to anesthetize fish to minimize trauma and stress resulting from surgical procedures. All fish were tagged prior to release with a sequentially numbered Floy anchor tag and measured to the nearest millimeter fork length. Sex was not determined for radio tagged northern pike. Locations of captured fish were verified with a Global Positioning System (GPS) unit and noted on the same map as described above.

Table 1.-Summary of northern pike radio tagged during the summer of 1996 in four tributaries of the Susitna River drainage.

System	Radio Frequency	Best Frequency	Tag	Length (mm)	Water Temp (^{0}C)	Time	Date
Hewitt	148.022	148.023	7001	434	14.50	8:00	6/4/96
Hewitt	148.413		7006	585	16.00	18:00	6/12/96
Hewitt	148.082		7007	608	16.00	18:00	6/12/96
Hewitt	148.801	Mort 7/10/96	7008	661	16.00	18:00	6/12/96
Hewitt	148.801	New Fish 7/10/96	7008	631	16.00	12:00	7/10/96
Indian	148.278	148.277	7002	627	14.50	13:41	6/4/96
Indian	148.354		7003	632	14.00	12:00	6/12/96
Indian	148.142		7004	675	14.00	12:00	6/12/96
Indian	148.503		7005	586	14.00	12:00	6/12/96
Indian	148.591	148.592	7020	628	19.80	11:00	6/19/96
Moose	148.233	Mort 8/23/96	7025	569	17.00	9:00	6/19/96
Moose	148.233	New Fish 8/23/96	7063	623	17.00	12:00	8/23/96
Moose	148.861		7064	623	15.00	13:00	8/23/96
Moose	148.474		7065	591	15.50	14:00	8/23/96
Moose	148.250		7067	592	15.50	15:00	8/23/96
Moose	148.682		7068	546	15.50	16:00	8/23/96
Witsoe	148.173		7043	525	19.00	14:00	6/21/96
Witsoe	148.562		7044	597	19.00	14:00	6/21/96
Witsoe	148.113		7047	497	19.00	14:00	6/21/96
Witsoe	148.262		7048	535	19.00	14:00	6/21/96

Radio tags were 2.5 cm long by 1.1 cm wide by 0.6 cm thick and weighed 4.5 g with an external 26 cm antenna (model CHP-1P transmitter with a TA-5LT antenna, manufactured by Telonics, Inc.[1], Mesa, Arizona). The operational life of the radio tags was 18 months, at a pulse rate of approximately 60 signals per min, and transmitted in the frequency band between 148.022 and 148.861 MHz. The receiving equipment (also from Telonics, Inc.) consisted of a TR-2 receiver mated to a TS-1 scanner-programmer, which were fed by an RA-NS-2-148-150 directional four-element external dipole "H" antenna. All radios were ground-truthed prior to deployment to detect and compensate for any frequency drift that might have occurred. All radio tracking was conducted from an 18 ft riverboat. Reception distances ranged from 0.25 km to 1 km.

Locations of radio tagged fish were monitored monthly or when practical. Thin ice and deep snow precluded tracking during most of the ice-covered months. Tracking commenced in early June 1996 and continued through June 26, 1997. Tracking consisted of programming frequencies of all deployed transmitters into the receiver/scanner (occasional frequency drift did occur, but did not interfere with adjacent transmitters), and boating to locations of the respective fish. Each time a radio location was made, date, time and locations were recorded. Locations of individual northern pike determined during a given sampling period were plotted on the electronic maps.

[1] Use of a company's name does not constitute endorsement.

Analysis and presentation of radio location data collected in the Susitna River drainages generally followed the methodology described by Pearse and Clark (1992) and Roach (1993). Range of movements and distribution of northern pike were determined by locating northern pike with radio transmitters, determining latitude and longitude with a GPS and marking locations on a corresponding electronic map (Appendices A1-A4). On final summary maps (Appendices B1-B18), locations of individual fish were shown only once for a given time period.

ASSESSMENT OF SEX AND SIZE COMPOSITIONS

Northern pike were primarily sampled during the ice-free period using variable mesh gillnets. Mesh size ranged from 13 mm to 76 mm stretched length for capture gear. Several nets were completely stretched across each slough to eliminate the chance of size selectivity. Use of multiple mesh gill nets and complete blockage of slough mouths was assumed to minimize selectivity of sampled northern pike. Several studies in interior Alaska have shown no detectable gear selectivity for northern pike >300 mm FL (Roach 1997, 1998a, 1998b).

Mean lengths 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 of the mean (SE) were calculated as the square root of the variance divided by the sample size. The proportion in each sex and length class was estimated as:

$$\hat{p}_j = \frac{n_j}{n}, \quad (1)$$

where:

n = the number of fish sampled;

n_j = the number of sampled fish in sex or length group j; and

$\hat{p}_j$ = the estimated fraction of the fish in sex or length group j.

ANALYSIS OF STOMACH CONTENTS

Sampling of northern pike stomachs was conducted on four tributaries of the Susitna River drainage during the open water period. Stomach content for northern pike may vary during the ice-covered months depending upon availability of food items. However, no sampling was conducted during this time period. Sampling took place within close proximity (±50 m) of the majority of acknowledged signals received from the radio tagged northern pike and coincided with the telemetry tracking schedule. Because most of the pike were located in the side slough channels (Area A) adjacent to the creeks, this is where we concentrated our sampling efforts (Appendices A1-A4).

No overnight sets were made in an effort to minimize catch and associated mortality of adult salmon present in all sampling locations. Initially we attempted to expel stomach products using the process of gastric lavage (Crossman and Hamilton 1978, Seaburg 1957, Foster 1977, Legler 1977, and Gerngerke et al. 1973). However, given Susitna River northern pike are an introduced species and are considered to be under no conservation threat, this method proved to be unnecessarily time consuming. Therefore, all captured northern pike were sacrificed, dissected, and their stomach removed. Stomachs were classified as either empty or non-empty depending on content. Stomach contents were either analyzed onsite or in the lab. When possible, salmonids and other major food items present were identified to species and enumerated for each stomach examined. Because some of the specimens were in various states of digestion it was necessary to bring the contents of some of the northern pike stomachs to the lab for identification.

Because both invertebrates and vertebrates were found within the same stomachs, proportions of stomachs with major food items (salmonids, invertebrates) ingested were individually calculated as a portion of the total number of non-empty stomachs. This method did not consider the amount or bulk of food types per stomach. However, it is a method of providing a crude assessment of what is being eaten at the time of sampling (Hyslop 1980). Stomach contents were collected and analyzed by methods described by researchers conducting dietary studies (Diana 1979). Percents were calculated by sex and size (large ≥500 mm, small <500 mm) for northern pike.

JUVENILE SALMONID SAMPLING

This portion of the project was planned to establish and compare the presence of juvenile salmonids in areas where northern pike locations were confirmed through radio-telemetry. Most of the radio locations were documented in the side slough channels adjacent to the main stem of the creek (Area A) and the main stem of the creek (Area B) in close proximity (<1 km) to the side slough channels (Appendices A1-A4). Sampling took place within close proximity (±50 m) of the majority of acknowledged signals received from the radio tagged northern pike and coincided with telemetry tracking schedule.

For each sampling trip, ten minnow traps, baited with salmon roe, were set at each of the four selected sampling streams. Five of these were set in the side slough channels, where most of the radio locations occurred, and the remaining five traps were set in the main creek proper adjacent to the side slough channels (Appendices A1-A4). The cylindrical traps measured 42 cm in length and approximately 22.9 cm in diameter. The entrance holes were 2.2 cm in diameter and the trap mesh was 0.6 cm square. Catch per trap was determined based on a 24-hour soaking period and calculated as number of salmonids and sticklebacks per trap. The traps were exclusively fished during the ice-free months. Sampling began immediately after the first radio transmitter was implanted (June 4, 1996).

RESULTS

MOVEMENTS

Eighteen northern pike were implanted with radio tags between June 4 and August 23, 1996 (Table 1) in side sloughs of Hewitt, Moose, Indian and Whitsoe creeks. All northern pike were located between four and eight times during the open water period to gather movement information (ices B1-B18). Only two sampling trips were conducted during the ice-covered months. For safety reasons winter sampling was discontinued.

Northern pike that were tagged ranged in length from 434 mm for a fish tagged in Hewitt Creek to 675 mm for a fish tagged in Indian Creek (Table 1). Analogous to the previous findings of Rutz 1996, there appeared to be no major movements (>10 km) observed for radio tagged northern pike, except for one fish (Appendices B1-B18).

The maximum distance from initial capture location a northern pike was observed to have traveled was 12.5 km by fish 148.562, originally captured and tagged in Whitsoe Creek (Appendix B4). This movement occurred between 12/26/96 and 5/30/97 where fish number 148.562 moved from Whitsoe Slough to Fish Creek. This fish was the only fish observed to move beyond the drainage where it was originally captured and tagged. This same fish was observed back in Whitsoe Slough on 6/27/97. The minimum movement observed by a single fish was for fish 148.861, which was tagged in Moose Creek. For all six tracking events, which were conducted between 8/23/96 and 6/26/97, fish 148.861 was observed to have moved less than 1 km (Appendix B9). For most tracking events all

radio tagged fish were found within the slough where they were originally captured (A1-A4).

For all tracking events, five of the 18 radio-tagged fish were located entirely within the slough where they were originally tagged (Appendices B1, B2, B3, B9, B13), while the remainder of the fish were located, during at least one tracking event, in adjoining outlet streams, sloughs, or adjacent connecting lakes (Appendices B4-B8, B10- B12, B14-B18).

In Whitsoe Creek slough, three of the four radio tagged fish seemed to move throughout the slough (Appendices B1, B2, B4) and one fish spent time in the mid and lower section of the slough (Appendix B3).

In Moose Creek slough, for at least one tracking event, four of the five tagged northern pike moved into the creek (Appendices B5-B8); the remaining northern pike remained within the slough where originally tagged for all tracking events (Appendix B9).

In Indian Creek slough, all but one of the tagged fish moved into Indian Creek (Appendices B10-B12 and B14) for at least one tracking event, and one of the fish remained in Indian Creek for the duration of the study (Appendix B10). A northern pike that was radio tagged (approximately 8 km) upstream of the slough moved into the slough and remained there for the duration of the study (Appendix B11). Four of the five radio tagged fish were located within a 2 km section of Indian Creek slough during most of the tracking events (Appendices B11-B14).

In Hewitt Creek slough three of the four fish moved from the slough into the lake (Appendices B16-B18). All four of the radio tagged northern pike in Hewitt Creek moved from the slough were they were originally captured into adjacent streams or connecting lakes for at least one tracking event (Appendices B15-B18). Three of the four radio tagged fish moved into Hewitt Lake near the lake outlet (Appendices B16-B18), two of the fish then moved to a bay located on the west side of the lake approximately 1.6 km north of the outlet stream (Appendices B17 and B18). One fish was observed to have moved between the slough and Hewitt Lake on two separate occasions. Visual inspection of confirmed radio locations indicated that all tracked fish were in areas of dense aquatic vegetation.

SEX AND LENGTH COMPOSITIONS

We captured 389 northern pike during 1996 and 1997 (Table 2). Of the 352 fish sexed, 197 (56%) were males and 155 (44%) were females.

For all study sites, the majority (65%) of fish sampled were between 450 mm and 700 mm (Figure 3). Most of the female fish (65%) were in the 550 mm to 700 mm categories (Figure 3) while the majority of males (64%) were somewhat smaller (450 mm to 600 mm; Figure 3).

Northern pike sampled from all locations ranged in length from 222 mm to 942 mm FL with an overall mean length of 546 mm (SE = 5 mm; Table 3). Mean length was largest for northern pike sampled from Hewitt Creek (578 mm, SE = 10 mm) and smallest for northern pike sampled from Moose Creek (516 mm, SE = 10 mm). For all study locations, mean length of male northern pike (527 mm, SE = 7 mm) was smaller than that of female northern pike (585 mm, SE = 8 mm; Figure 4). Males were largest in Indian Creek (567 mm, SE = 15 mm) and smallest in Whitsoe Creek (479 mm, SE = 22 mm). Females were largest in Hewitt Creek (619 mm, SE = 15 mm) and smallest in Moose Creek (547 mm, SE = 17 mm).

Table 2.-Summary of northern pike sampled for stomach contents from four tributaries of the Susitna River drainage, 1996 and 1997.

	Total Number of Stomachs				Stomachs Examined				Non-Empty Stomach	
System	Number Examined	Empty	Non-Empty	Number not Sexed	Male	Percent Male	Female	Percent Female	Male	Female
Hewitt	132	49	83	23	50	46	59	54	33	31
Indian	91	31	60	10	49	60	32	40	32	22
Moose	123	48	75	4	76	64	43	36	44	27
Whitsoe	43	12	31	0	22	51	21	49	17	14
Total	389	140	249	37	197	56	155	44	126	94

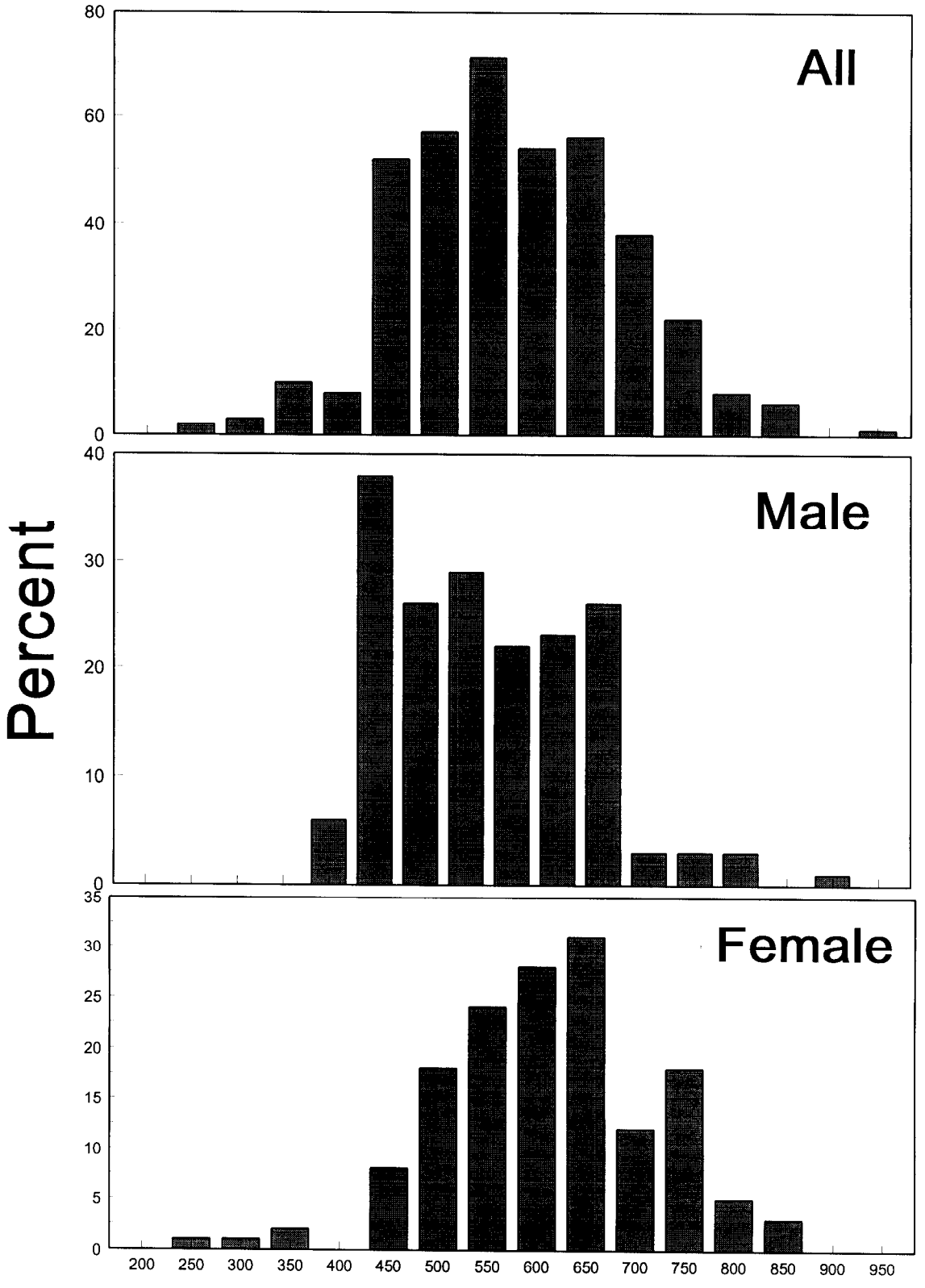


Figure 3.-Length composition of northern pike sampled from four Susitna River drainages during 1996 and 1997.

Table 3.-Mean length and standard error of northern pike sampled from four tributaries of the Susitna River drainage during 1996 and 1997.

		Mean Length (mm)		
System	N	Male	Female	Both
Hewitt	109	555 (SE=18)	619 (SE=15)	578 (SE=10)
Indian	81	567 (SE=15)	604 (SE=17)	568 (SE= 11)
Moose	119	498 (SE=12)	547 (SE=17)	516 (SE=10)
Whitsoe	43	479 (SE=22)	577 (SE= 12)	526 (SE=15)
Total	352	527 (SE= 7)	585 (SE=7)	546 (SE=5)

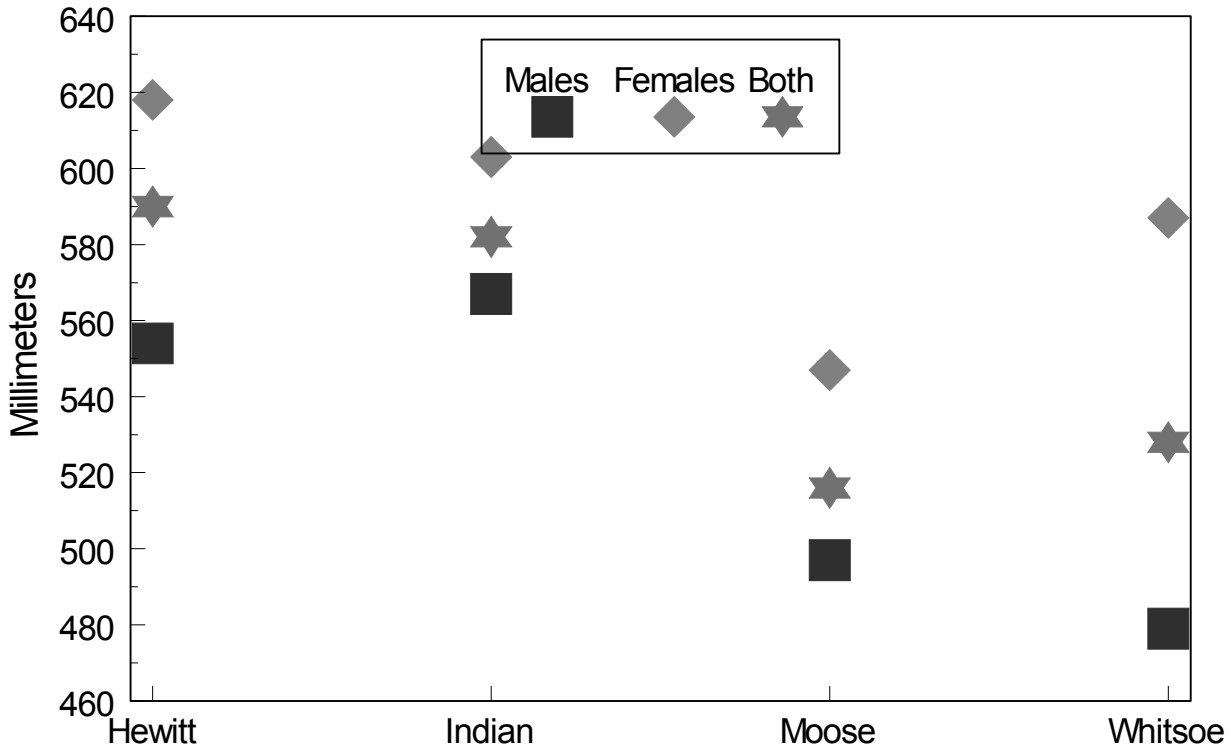


Figure 4.-Mean length of northern pike sampled from four Susitna River drainages during 1996 and 1997.

ANALYSIS OF STOMACH CONTENTS

We examined 389 northern pike stomachs from four tributaries of the Susitna River. Of the 389 stomachs examined, 36% were empty and 64% were non-empty. Northern pike from Whitsoe Creek had the highest percentage of non-empty stomachs (72%); northern pike from Indian Creek contained the smallest percent of non-empty stomachs (61%).

Large northern pike tended to have a higher percentage of empty stomachs (40% empty) than small northern pike (28% empty; Table 4).

Of the non-empty stomachs, 198 (80%) contained salmonids (Pacific salmon and rainbow trout), 17 (7%) contained sticklebacks, 140 (56%) contained other fish species (Arctic grayling, sculpins, longnose suckers, and all unidentifiable species) and only 4 (2%) contained invertebrates (Figure 5). Northern pike stomachs from Whitsoe Creek contained the highest number of salmonids (87%); northern pike from Indian Creek contained the least number of salmonids (66%; Table 5). A higher proportion of salmonids was found in the stomachs of males (85%) than in females (70%; Table 6). Stomachs examined from larger northern pike (≥500 mm) contained less salmonids (72%) than stomachs examined from smaller northern pike < 500 mm (91%; Table 4).

All five species of Pacific salmon were observed in northern pike stomachs (Table 7 and Appendix E1) along with a variety of other food items (Table 8). Of the 198 non-empty stomachs containing salmonids, 148 (59%) contained coho salmon, 59 (24%) contained sockeye salmon, 15 (6%) contained rainbow trout, 8 (3%) contained chinook salmon and less then 1% contained pink or chum salmon (Table 7 and Figure 6).

JUVENILE SALMONID SAMPLING

A total of 290 minnow traps was fished in four tributaries of the Susitna River drainage for at least 24 h (Table 9); 145 sets in areas of confirmed radio locations of radio tagged northern pike in side sloughs (Area A) and 145 in the creek proper adjacent to the sloughs (Area B, Appendices A1-A4). In Area A, catch per trap was lower for salmonids (0.4 fish/trap) and much higher for sticklebacks (30.6 fish/trap). Conversely, for Area B, catch per trap was higher for salmonids (10.4 fish/trap) than for sticklebacks (8.35 fish/trap, Figure 7).

In Area A where most of the radio tagged northern pike were located, mean catch of stickleback per trap was highest in Hewitt Creek and lowest in Moose Creek (Table 9). Conversely, mean catch per trap of salmonids was lowest in Hewitt Creek and highest in Moose Creek.

In Area B mean catch per trap of stickleback was highest in Hewitt Creek and lowest in Whitsoe Creek (Table 9), while mean catch per trap for salmonids was highest in Whitsoe Creek and lowest in Indian Creek.

DISCUSSION

TELEMETRY

We successfully documented movements of northern pike in four selected tributaries of the Susitna River using radiotelemetry. The majority of northern pike moved throughout the sloughs where they were originally tagged. Although most of the radio tagged fish were located within the side slough channels (Area A), many of these northern pike were located in the adjacent creek (Area B) and connecting lake outlet areas for at least one sampling event. These movements may be in response to salmonid rearing or smolt emigration from lake and river systems.

Table 4.-Number of non-empty and empty northern pike stomachs, and number and (percent) of stomachs containing various food items by size of fish and tributary, 1996 and 1997.

		Number Examined		Number and (percentage) of non-empty stomachs containing:									
System	Size	Non-empty	Empty	Salmonids	Coho Salmon	Sockeye Salmon	Chinook Salmon	Whitefish	Rainbow Trout	Northern Pike	Stickleback	Invertebrates	Other Fish
Hewitt	Small[a]	28	8	26 (93)	13 (46)	17 (61)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
	Large[b]	55	41	42 (76)	29 (52)	22 (40)	0 (0)	14 (25)	1 (2)	1 (2)	0 (0)	0 (0)	2 (4)
Indian	Small	17	9	15 (88)	13 (76)	1 (6)	2 (12)	2 (12)	2 (12)	0 (0)	3 (18)	0 (0)	0 (0)
	Large	43	22	25 (58)	21 (49)	0 (0)	1 (2)	10 (23)	5 (12)	4 (9)	8 (19)	0 (0)	2 (5)
Moose	Small	36	17	33 (92)	25 (69)	7 (19)	1 (2)	4 (11)	2 (6)	0 (0)	1 (2)	3 (8)	2 (6)
	Large	39	31	30 (77)	21 (54)	6 (15)	4 (10)	6 (15)	5 (13)	2 (5)	3 (8)	0 (0)	3 (8)
Whitsoe	Small	14	3	13 (92)	12 (86)	4 (29)	0 (0)	1 (7)	0 (0)	0 (0)	2 (14)	0 (0)	0 (0)
	Large	17	9	14 (82)	14 (82)	2 (12)	0 (0)	2 (12)	0 (0)	0 (0)	0 (0)	0 (0)	7 (41)
Subtotal	Small	95	37	87 (91)	63 (66)	66 (31)	3 (3)	7 (7)	4 (4)	0 (0)	6 (6)	3 (3)	2 (2)
	Large	154	103	111 (72)	85 (55)	29 (19)	5 (3)	32 (21)	11 (7)	7 (5)	11 (12)	0 (0)	14 (9)
Total		249	140	198 (80)	148 (59)	59 (24)	8 (3)	39 (16)	15 (6)	7 (3)	17 (7)	3 (1)	16 (6)

[a] Small < 500 mm FL

[b] Large ≥ 500 mm FL

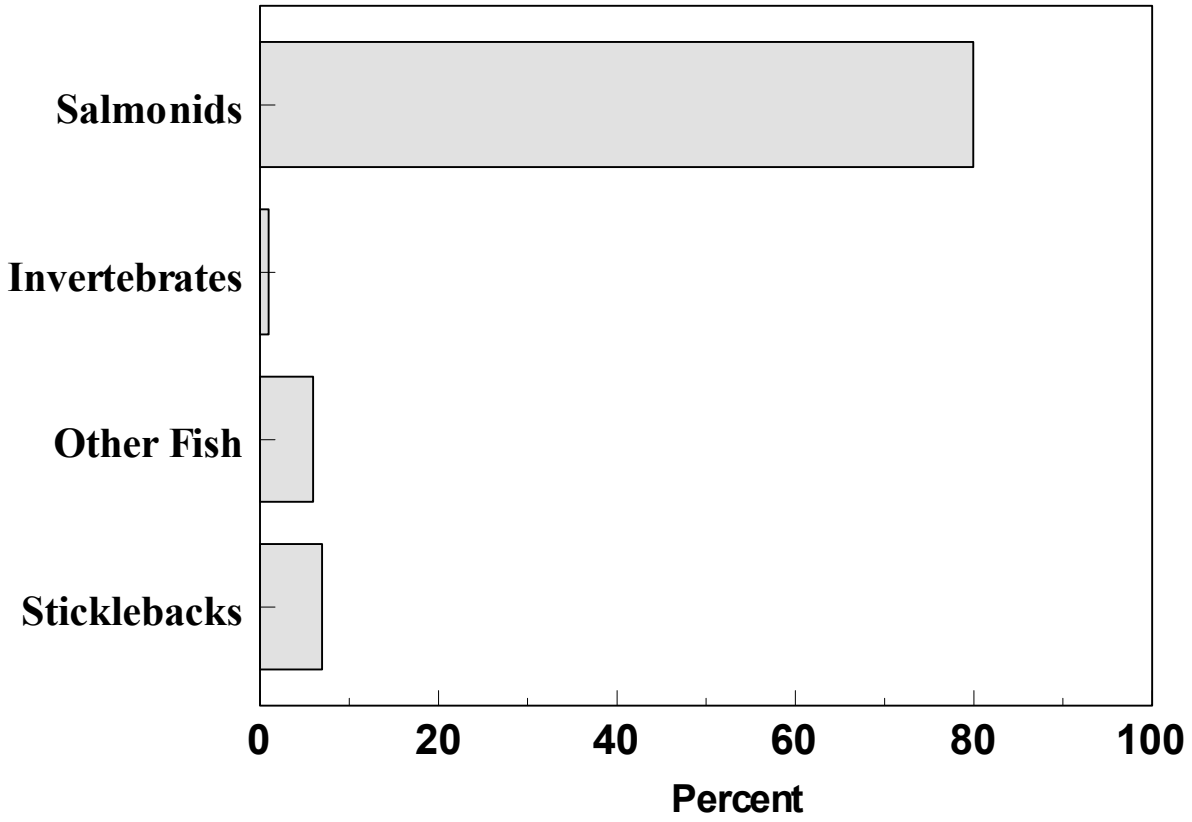


Figure 5.-Percent of non-empty stomachs containing salmonids, invertebrates, other fish, and sticklebacks sampled from four tributaries of the Susitna River drainage, 1996 and 1997.

Table 5.-Total number northern pike stomachs examined, number of non-empty stomachs, and number and (percent) of non-empty stomachs containing various food items by tributary of the Susitna River drainage, 1996 and 1997.

	Stomachs		Number and (%) of Non-Empty Stomachs Containing			
System	Stomachs	Non-empty	Salmonids[a]	Sticklebacks	Other Fish	Invertebrates
Hewitt	132	83 (63)	68 (82)	0 (0)	49(37)	1 (1)
Indian	91	60 (66)	40 (66)	11 (18)	31 (34)	0 (0)
Moose	123	75 (61)	63 (84)	4 (5)	48 (39)	3(4)
Whitsoe	43	31 (72)	27 (87)	2 (6)	12 (28)	0 (0)
Total	389	249 (64)	198 (80)	17 (7)	140 (56)	4 (2)

[a] Chinook, coho, sockeye, pink, and chum salmon and rainbow trout.

Table 6.-Number of non-empty northern pike stomachs and number and (percent) of non-empty stomachs containing various food items, by sex and tributary of the Susitna River drainage, 1996 and 1997.

	Number Examined		Male Northern Pike					Female Northern Pike				
System	Males	Females	Salmonids[a]	Coho	Sockeye	WF	RT	Salmonids[a]	Coho	Sockeye	WF	RT
Hewitt	33	31	29 (88)	14 (42)	15 (45)	3 (9)	0 (0)	21 (68)	15 (48)	12 (39)	9 (29)	0 (0)
Indian	32	22	23 (72)	18 (56)	1 (3)	8 (18)	4 (12)	13 (60)	13 (59)	0 (0)	6 (27)	2 (9)
Moose	44	27	39 (89)	30 (68)	7 (16)	7 (16)	1 (2)	21 (78)	13 (48)	6 (22)	6 (22)	5 (18)
Whitsoe	17	14	16(94)	15 (88)	6 (35)	1 (6)	0 (0)	11 (78)	11 (78)	0 (0)	2 (14)	0 (0)
Total	126	94	107 (85)	77 (61)	29 (23)	17 (13)	5 (4)	66 (70)	52 (55)	18 (19)	23 (24)	7 (7)

[a] The five species of Pacific salmon and rainbow trout.

Table 7.-Number and (percent) of 249 non-empty northern pike stomachs containing salmonids, by salmonid prey species and tributary of the Susitna River drainage, 1996 and 1997.

	Number and (Percent) of Non-empty Northern Pike Stomachs Containing						
System	Salmonids	Coho	Sockeye	Chinook	Pink	Chum	Rainbow
Hewitt	68 (82)	42 (62)	39 (57)	0 (0)	1 (1)	0 (0)	1(1)
Indian	40 (66)	34 (85)	1 (2)	3 (8)	1 (2)	0 (0)	7 (17)
Moose	63 (84)	46 (73)	13 (21)	5 (8)	0 (0)	1 (2)	7 (11
Whitsoe	27 (87)	26 (96)	6 (22)	0 (0)	0 (0)	0 (0)	0 (0)
Total	198 (80)	148 (59)	59 (24)	8 (3)	2 (1)	1 (<1)	15 (6)

Table 8.-Number of 249 non-empty northern pike stomachs containing selected food items, by tributary of the Susitna River drainage, 1996 and 1997.

Species	Hewitt	Indian	Moose	Whitsoe
Coho	42	34	46	26
Sockeye	39	1	13	6
Chinook	0	3	5	0
Pink	1	1	0	0
Chum	0	0	1	0
Rainbow	1	7	7	0
Whitefish	14	12	10	3
Stickleback	0	11	4	2
Lamprey	2	1	2	7
Smelt	0	0	1	0
Sculpin	0	0	2	0
Sucker	0	1	0	0
Grayling	0	0	0	0
Pike	1	4	2	0
Frogs	0	0	0	0
Mammals	2	3	0	0
Invertebrates	1	0	3	0
# Pike Examined	132	91	123	43
Non-Empty	83	60	75	31

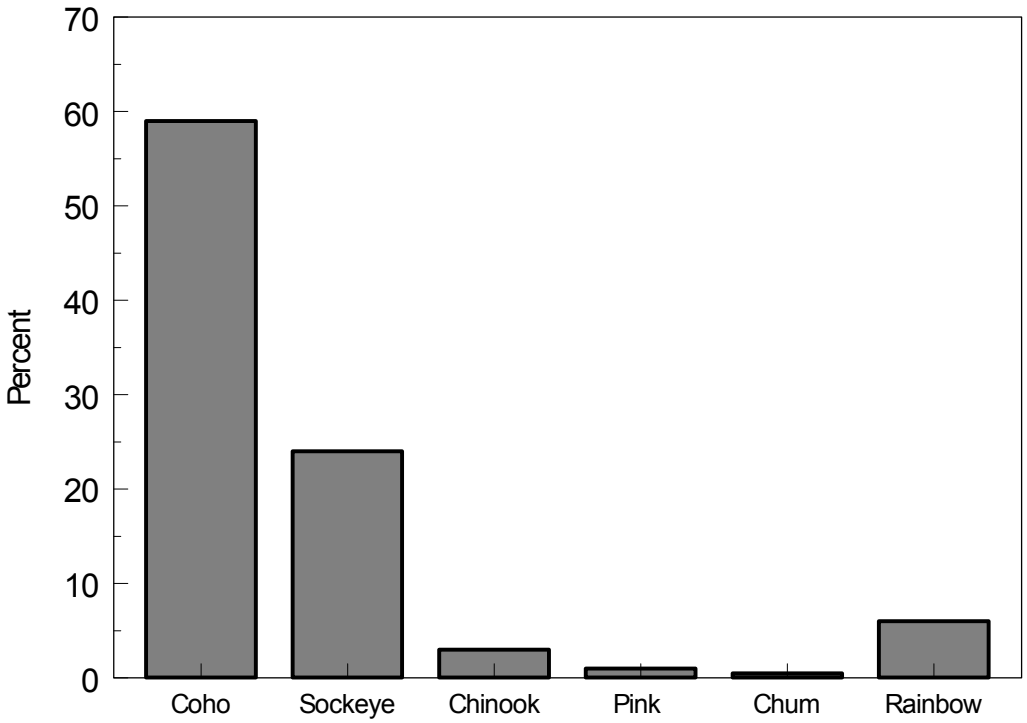


Figure 6.-Percent of non-empty stomachs with coho, sockeye, chinook, pink, and chum salmon and rainbow trout from northern pike sampled from four tributaries of the Susitna River drainage, 1996 and 1997.

Table 9.-Number of traps set, and number and mean catch per trap of juvenile salmonids and sticklebacks by area within four tributaries of the Susitna River drainage, 1996 and 1997.

System	Total Number Minnow Traps	Total Salmonids	Total Sticklebacks	CPUE for Salmonids	CPUE for Sticklebacks
Area A[a]					
Hewitt	30	4	1,780	0.13	59.33
Indian	50	19	1,977	0.38	39.54
Moose	45	25	1,183	0.55	26.28
Whitsoe	20	7	568	0.35	28.40
Total	145	55	4,438	0.37	38.60
Area B[b]					
Hewitt	30	369	500	12.30	16.66
Indian	50	356	400	7.12	8.00
Moose	45	446	260	9.91	5.77
Whitsoe	20	338	51	16.90	2.55
Total	145	1,509	1,211	10.40	8.35

[a] Traps set in close proximity to where radio tagged pike were located.

[b] Traps set in mainstem creek adjacent to sloughs where radio tagged pike were located.

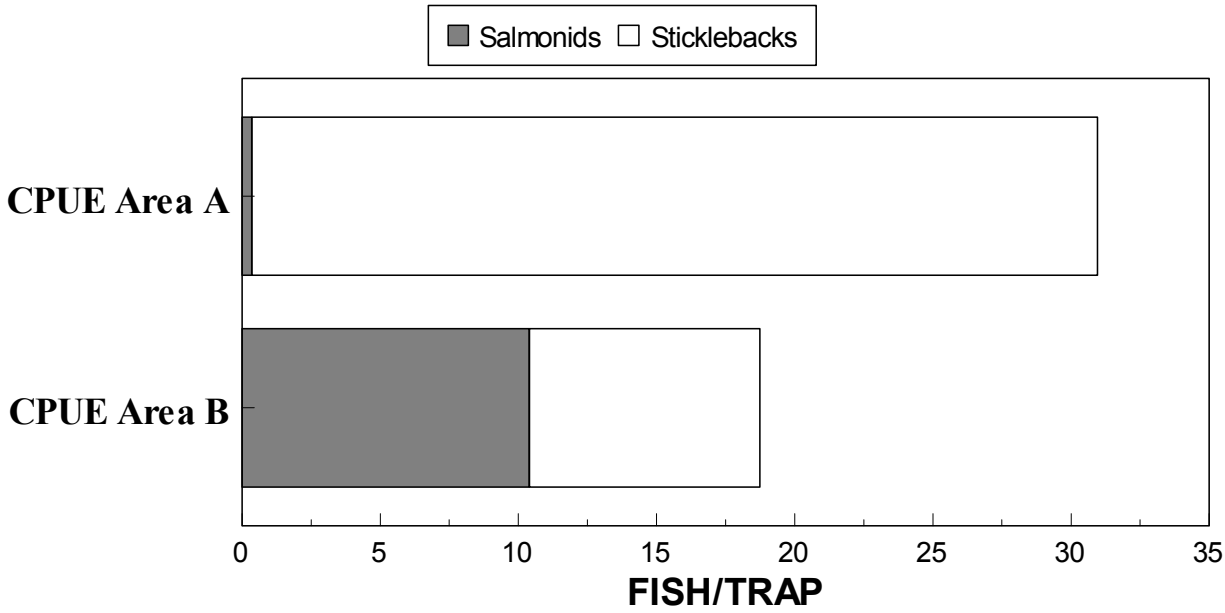


Figure 7.-Mean catch per trap for juvenile salmonids and sticklebacks caught in minnow traps for study areas A and B in four tributaries of the Susitna River drainage, 1996 and 1997.

SALMONID PREDATION

Results from this study strongly suggest that when given the option, northern pike select salmonids over sticklebacks and invertebrates (Figure 5). This statement is supported by results from minnow trapping near confirmed locations of radio tagged northern pike located in the side sloughs (Area A). Threespine stickleback were far more abundant in Area A than salmonids, although salmonids were more prevalent in northern pike stomachs than stickleback (Figure 7). This result also suggests that northern pike may be selecting salmonids over sticklebacks, but that they may have to travel out of the sloughs to prey on salmonids.

Side sloughs, where northern pike were most often located (Area A), were approximately 2-5°C warmer then the main creek channel (Appendix D1). Water temperatures influence the digestion rate of northern pike: digestion may take between 8 and 14 days during the winter and between 30 and 48 hours during the summer (Diana 1979). Given this, it may be possible that northern pike residency in side sloughs may not entirely be a function of habitat selection but may also be in part due to accelerated digestion of stomach content.

Prior to the expansion of northern pike range in NCI, many of the Susitna drainage lakes and streams that once maintained native populations of coho, chinook and sockeye salmon, rainbow trout, and Arctic grayling now contain only northern pike. These systems include: Fish Creek in Kroto Slough, Fish Lake Creek, streams flowing into Alexander Lake, Fish Creek in the Nancy Lake system, Donkey Creek, Noname Creek near the Big Bend on the Yentna along with numerous others (Rutz 1996). The literature indicates that northern pike prefer to prey on soft-rayed fish (Eklov and Hamrin 1989, Hoogland et al. 1956, Beyerle and Williams

1977). However, if preferred food items are not available then northern pike will shift to alternative food sources such as sticklebacks and invertebrates (Carbine and Applegate 1946, Diana et al. 1977, Narver 1978). The ability of northern pike to switch from one food source to another is supported by experiments conducted by Bialokoz and Krzywosz (1979). Stomachs from northern pike collected from NCI waters, devoid of other fish, contained a variety of invertebrates (Rutz 1996). The absence of fish in the diet is not reflective of invertebrates as preferred food for northern pike, rather it most likely is indicative of available food in these lakes. This presents strong evidence that northern pike have completely eliminated salmonids as a food source in many of the systems comprising slow moving tributaries and shallow interconnecting lakes and ponds (Rutz 1996). It is possible that other environmental factors may have played a role in NCI native fish declines. However, I believe this to be highly unlikely and no alternative hypotheses come to mind.

Although all five species of Pacific salmon juveniles were found in the stomachs of northern pike, coho salmon were by far the most prevalent (Table 7). This is probably more a function of habitat overlap than prey preference between the two species as they both occupy similar habitat (Roth and Stratton 1984).

POTENTIAL IMPLICATIONS OF NORTHERN PIKE PREDATION ON SALMON AND RAINBOW TROUT

Many of the Susitna River drainage systems that are productive coho salmon habitat now contain significant populations of northern pike. Given the expanse of northern pike range and overlapping habitat, it is conceivable that northern pike predation may have affected and will likely to continue to affect coho salmon production in this system.

Drainage-wide impacts of northern pike predation on sockeye salmon stocks may be less dramatic than on coho salmon. Juvenile sockeye salmon rear in lakes. Depth and shoreline development appear to be limiting factors for northern pike production in lakes (Rutz 1996). Most of the sockeye salmon production in the Susitna drainage comes from the large, deepwater lakes (Kyle et al. 1994); these systems support little northern pike habitat. In these larger, deepwater lakes, juvenile sockeye salmon are mostly pelagic feeders (Narver 1966) and seldom overlap with northern pike habitat. Therefore, predation on juvenile sockeye salmon will likely be minimal in the major sockeye salmon systems within this drainage. Sockeye salmon rearing in these large deepwater lakes may be vulnerable to northern pike predation for a short period during smolt outmigration.

Although the larger Susitna drainage sockeye salmon stocks appear to be little affected by northern pike predation, many of the drainage's smaller sockeye salmon stocks are in danger of, or may have already been decimated by, northern pike predation. Evidence of this can be found in the NCI Lake Survey Files located in the Palmer Fish and Game Office, 1800 Glenn Highway, Suite 4, Palmer, AK 99654 (unpublished data). These files contain lake survey information collected from hundreds of NCI lakes from the late 1950s through the present. Many of NCI's smaller sockeye salmon stocks rear in shallow water lake systems (<2 m mean depth) with much of the lake being covered in dense vegetative mats of both submergent and emergent vegetation. Outlet streams draining these systems are generally slow flowing and laden with aquatic vegetation. These smaller systems not only provide excellent rearing habitat for juvenile sockeye salmon, but unfortunately support ideal northern pike nursery, spawning, and rearing areas. The problem with these shallow lake systems is

that there are few sanctuary areas for sockeye salmon in these types of systems to escape northern pike predation.

Overall chinook salmon production is expected to be little affected by northern pike predation because juvenile chinook salmon generally rear in different habitat types than northern pike. Juvenile chinook salmon rear in higher velocity clear water with little overlap of northern pike habitat (Mason 1965). Chinook salmon that will be affected by northern pike predation are those that rear near slackwater side sloughs, or during out-migration pass through slow moving vegetation laden tributaries and shallow interconnecting lake systems.

In the Susitna River drainage, the least impacted species of Pacific salmon by northern pike predation will likely be pink and chum salmon, because juveniles spend very little time in fresh water (Nikolskii 1961). These two species would only be vulnerable to northern pike predation for a short time during emigration.

It is likely that many of the Susitna River drainage rainbow trout lake populations have been severely impacted by northern pike predation. Northern pike are present in more that 100 lakes and ponds draining into the Susitna River (Appendix C1). Many of these lakes have previously been surveyed by department personnel prior to the invasion by northern pike. Surveys of these lakes in the pre-northern pike days (1960s and 1970s) documented native populations of rainbow trout in all surveyed lakes (ADF&G lake files, unpublished, located at Palmer ADF&G office). These same lakes now appear to contain only northern pike.

Northern pike may also be impacting rainbow trout populations in low gradient rivers. Fortunately, most of the Susitna River drainage systems riverine rainbow trout populations reside in high-velocity, clearwater tributaries with little northern pike habitat. Consequently, northern pike predation will likely have little impact on these stocks.

RECOMMENDATIONS

Given the immense size of the Susitna River drainage and the vast range of northern pike expansion, it is probable that northern pike predation may result in a severe, yet unquantifiable, loss of salmonid production within individual tributaries. However, if we focus our efforts on major problem areas identified below, we believe a successful northern pike removal program will be effective in reducing predation on selected salmonid populations.

We recommended that a northern pike removal program be initiated on selected systems of the Susitna drainage including but not limited to the Deshka River and Moose, Indian, Whitsoe and Alexander creeks. This program would involve removal of northern pike by means of variable mesh gillnet. Nets would be set in connecting slackwater sloughs and side channels commencing immediately after ice-out and continuing until adult chinook salmon begin to migrate into Susitna River tributaries. Hill (1974) reports that up to 85% of a population of northern pike were removed from a small Iowa lake through intensive angling. Because early spring is the time when northern pike congregate to spawn, an effective northern pike removal program at this time could possibly remove a large portion of the northern pike >300 mm from these systems.

ACKNOWLEDGMENTS

I would like to thank Pat Hansen for her significant contributions to the operational planning portion of this study along with editorial comments. I would also like to thank Ron Wenzel, John McGrath, Dale (Red) Grabowski, Richard Gozinya and Craig Whitmore for assisting with the field

collection and radiotelemetry portion of this study.

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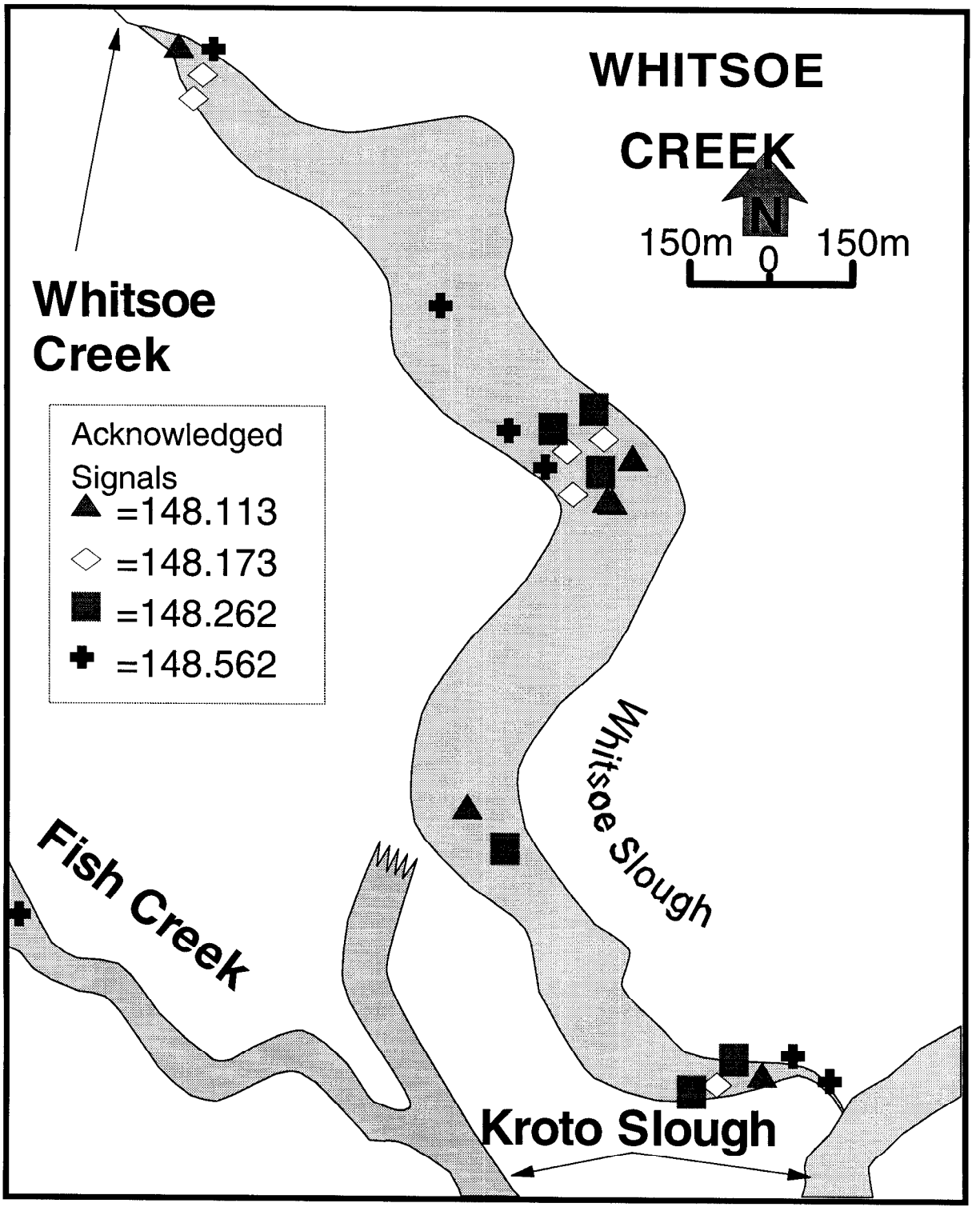
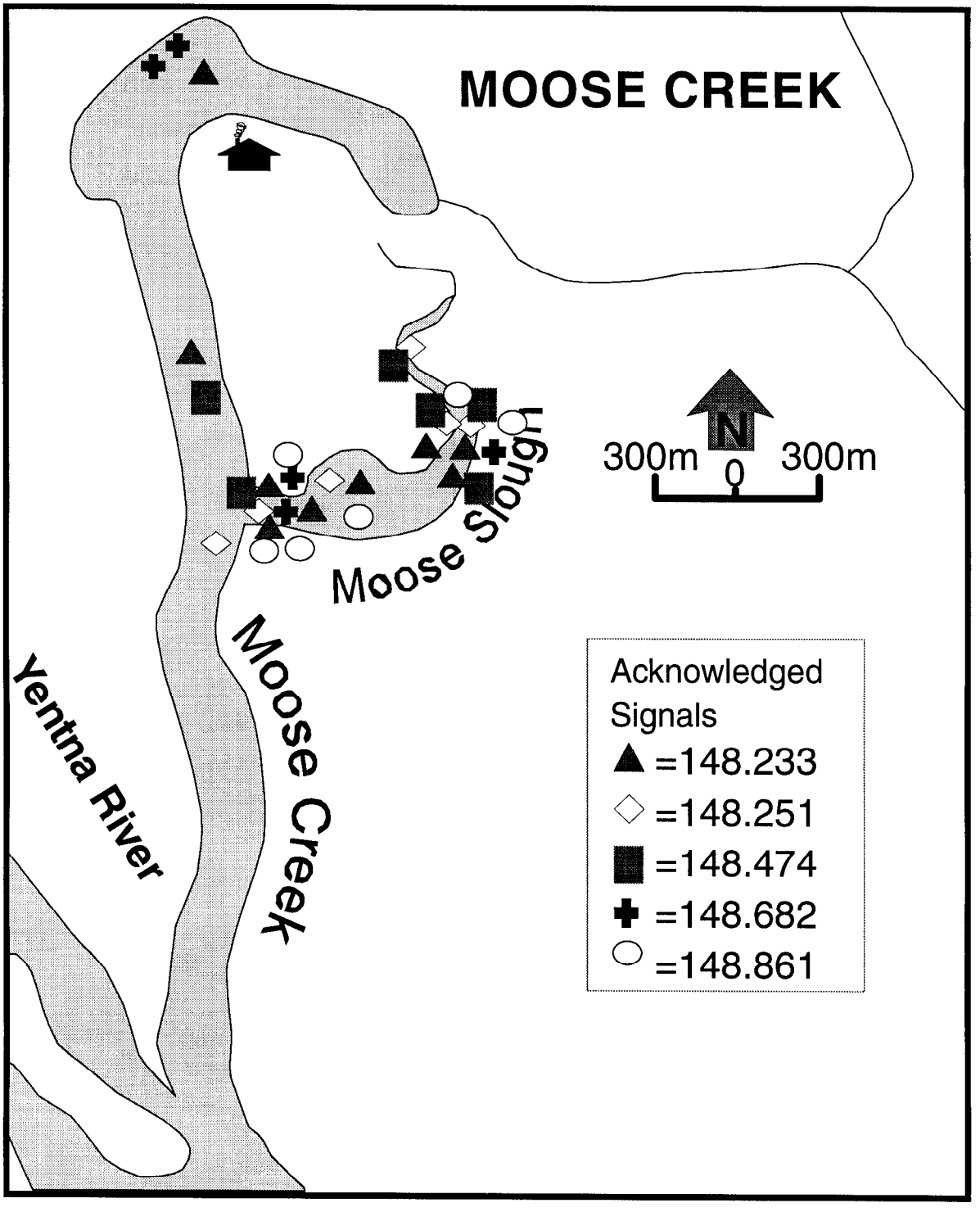
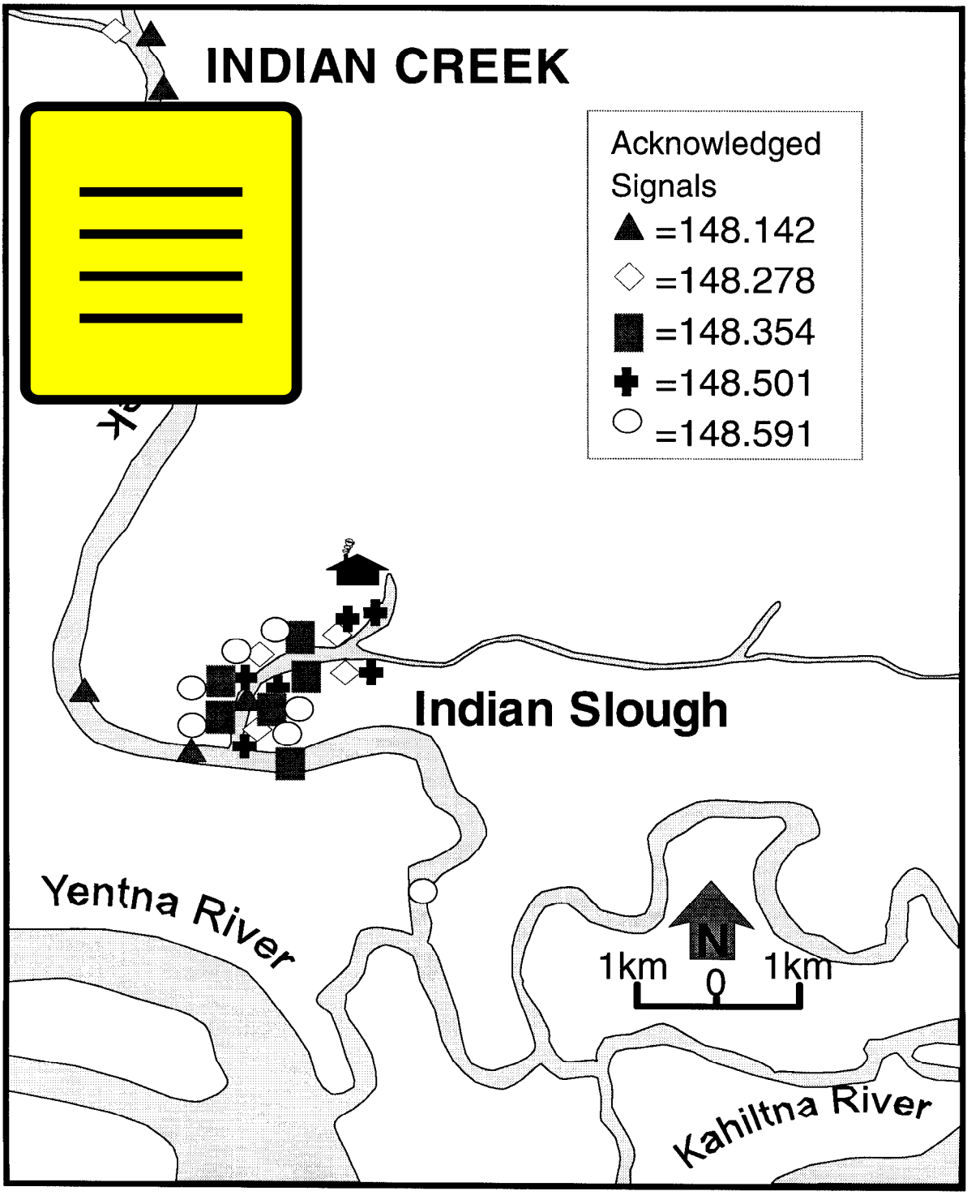
APPENDIX A. MOVEMENTS OF NORTHERN PIKE IN FOUR TRIBUTARIES OF THE SUSITNA RIVER DRAINAGE, JUNE 1996-JUNE 1997



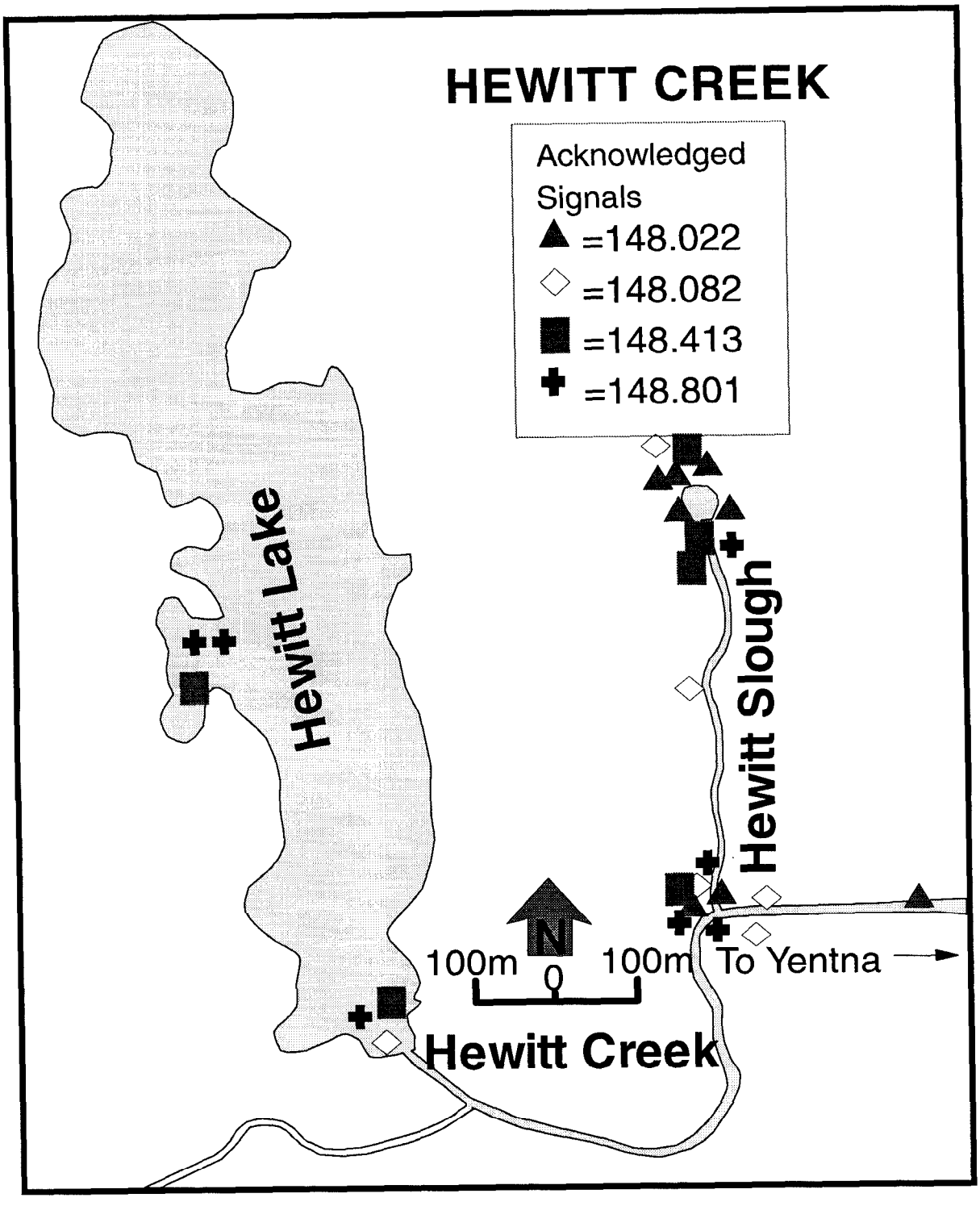
Appendix A1.-Movements of northern pike in Whitsoe Creek, June 1996-June 1997.



Appendix A2.-Movements of northern pike in Moose Creek, June 1996-June 1997.

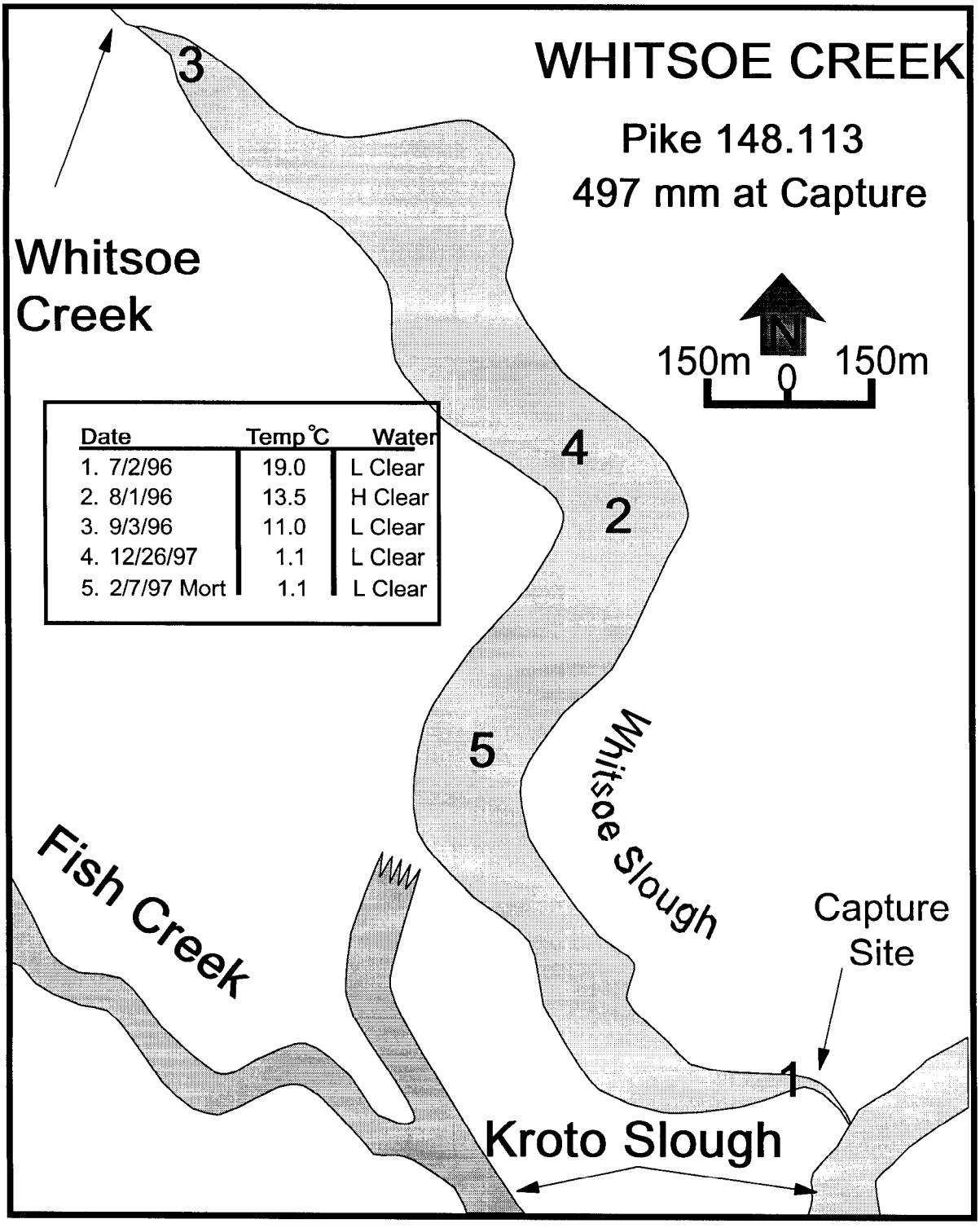


Appendix A3.-Movements of northern pike in Indian Creek, June 1996-June 1997.

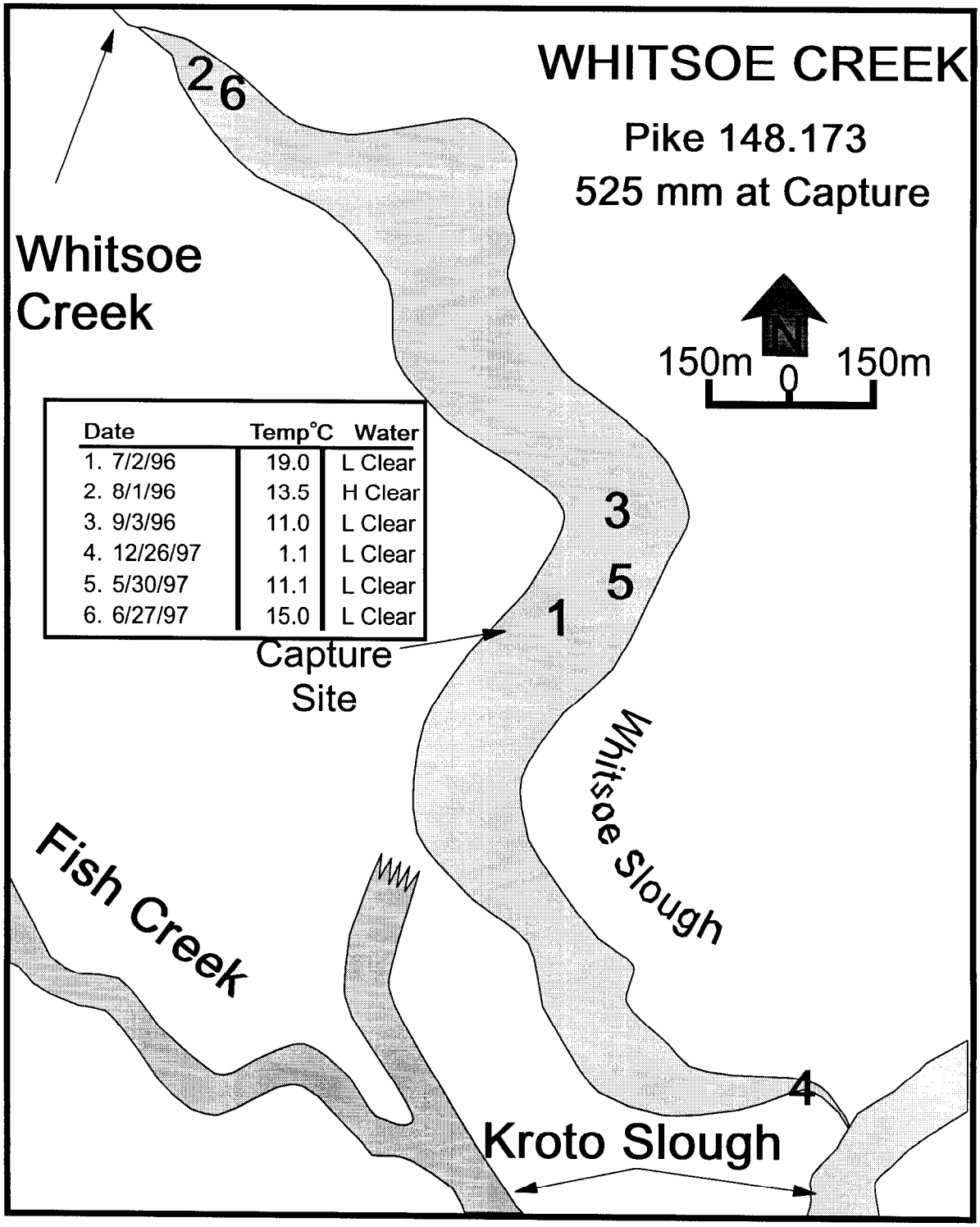


Appendix A4.-Movements of northern pike in Hewitt Creek, June 1996-June 1997.

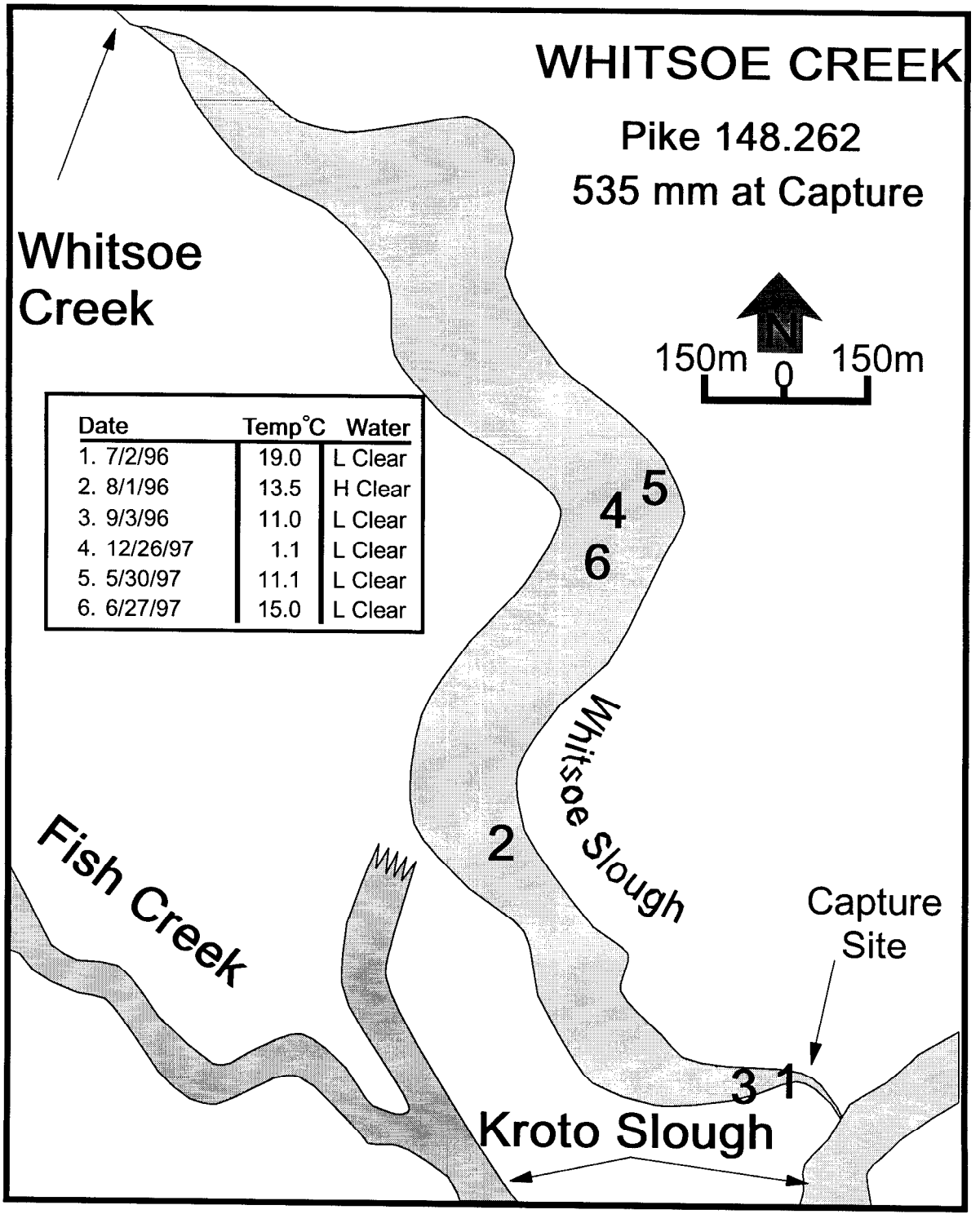
APPENDIX B. MOVEMENT OF INDIVIDUALLY RADIO TAGGED NORTHERN PIKE IN FOUR TRIBUTARIES OF THE SUSITNA RIVER DRAINAGE, JUNE 1996-JUNE 1997



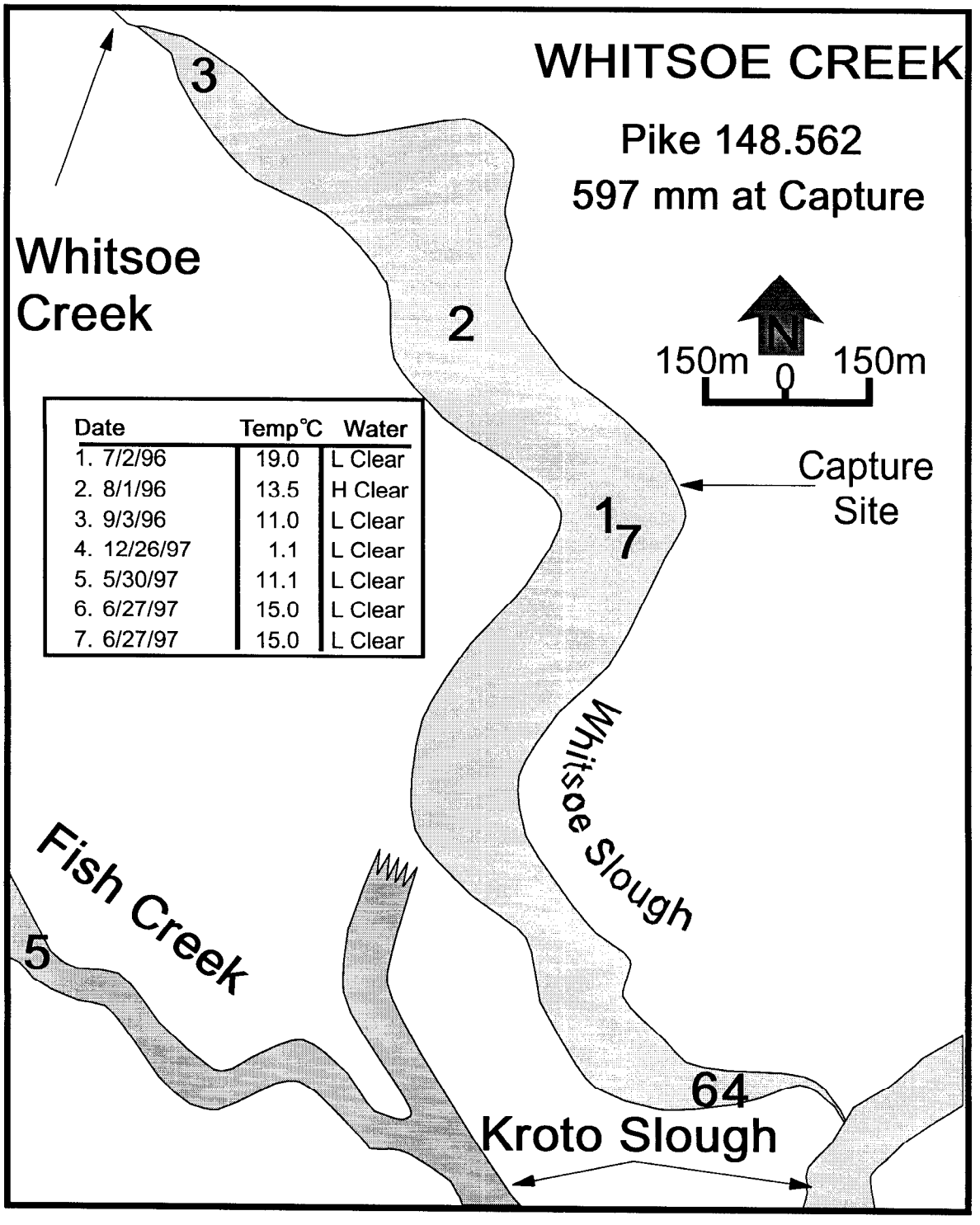
Appendix B1.-Movements of northern pike number 148.113 in Whitsoe Creek, June 1996-June 1997.



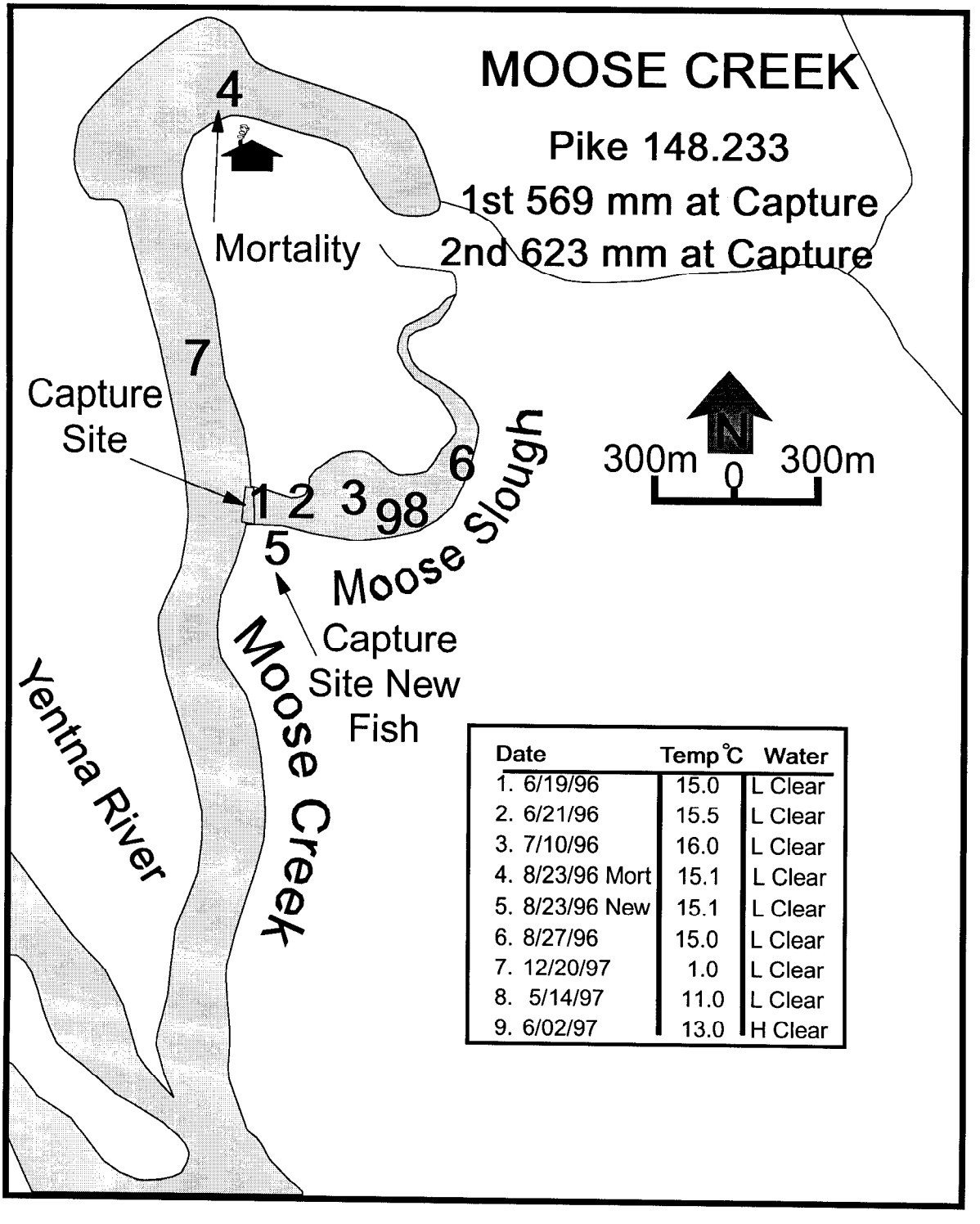
Appendix B2.-Movements of northern pike number 148.173 in Whitsoe Creek, June 1996-June 1997.



Appendix B3.-Movements of northern pike number 148.262 in Whitsoe Creek, June 1996-June 1997.

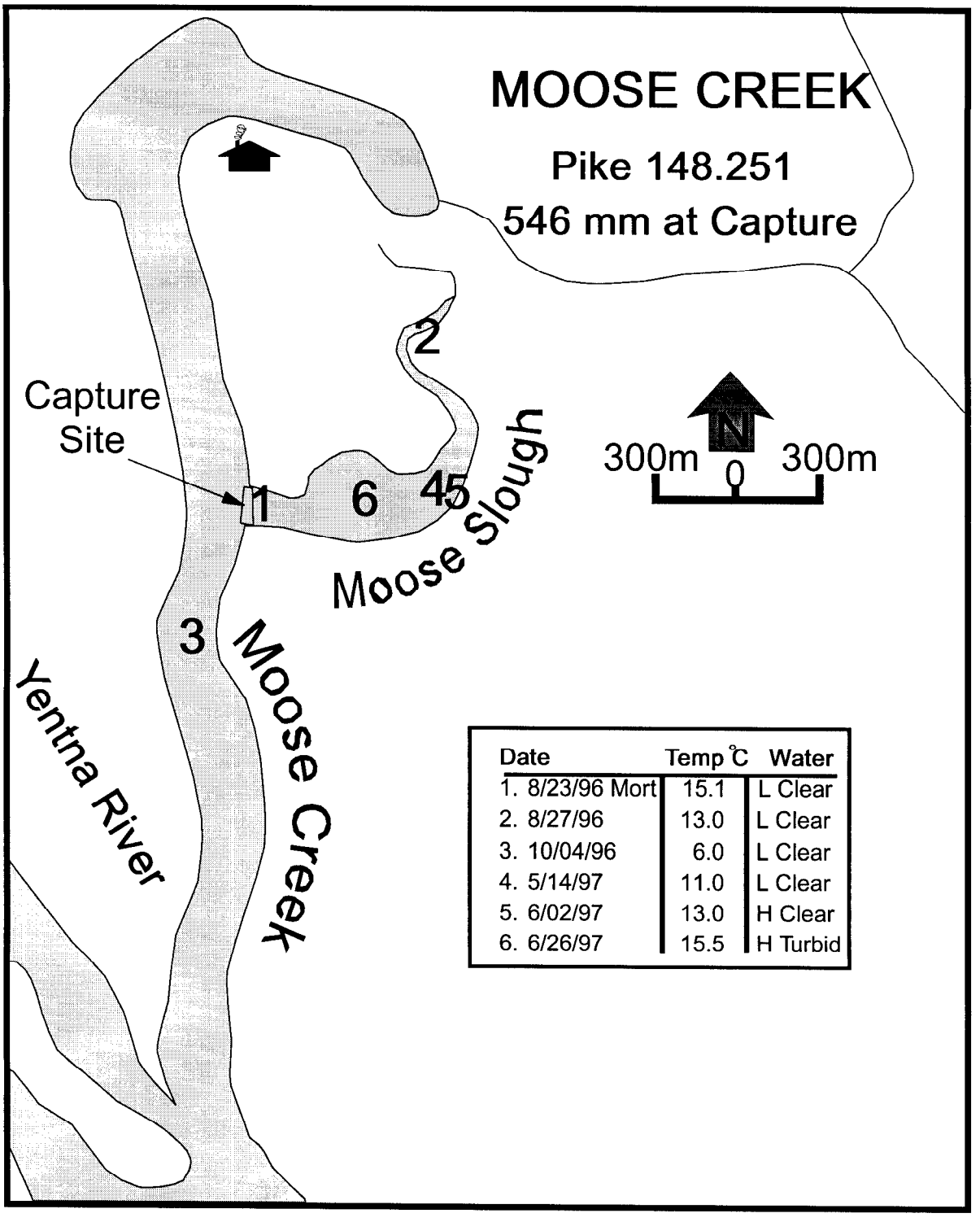


Appendix B4.-Movements of northern pike number 148.562 in Whitsoe Creek, June 1996-June 1997.

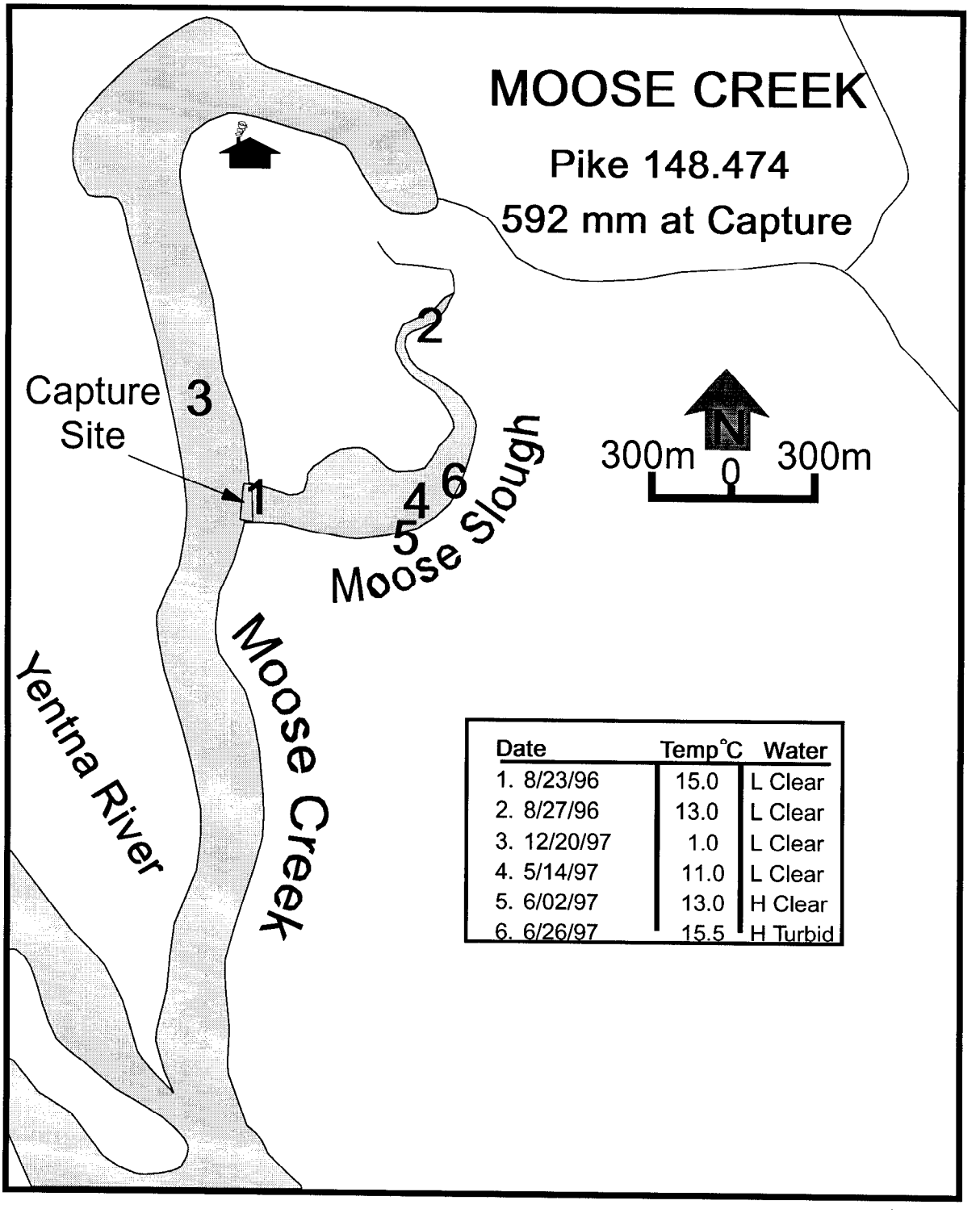


Date	Temp°C	Water
1. 6/19/96	15.0	L Clear
2. 6/21/96	15.5	L Clear
3. 7/10/96	16.0	L Clear
4. 8/23/96 Mort	15.1	L Clear
5. 8/23/96 New	15.1	L Clear
6. 8/27/96	15.0	L Clear
7. 12/20/97	1.0	L Clear
8. 5/14/97	11.0	L Clear
9. 6/02/97	13.0	H Clear

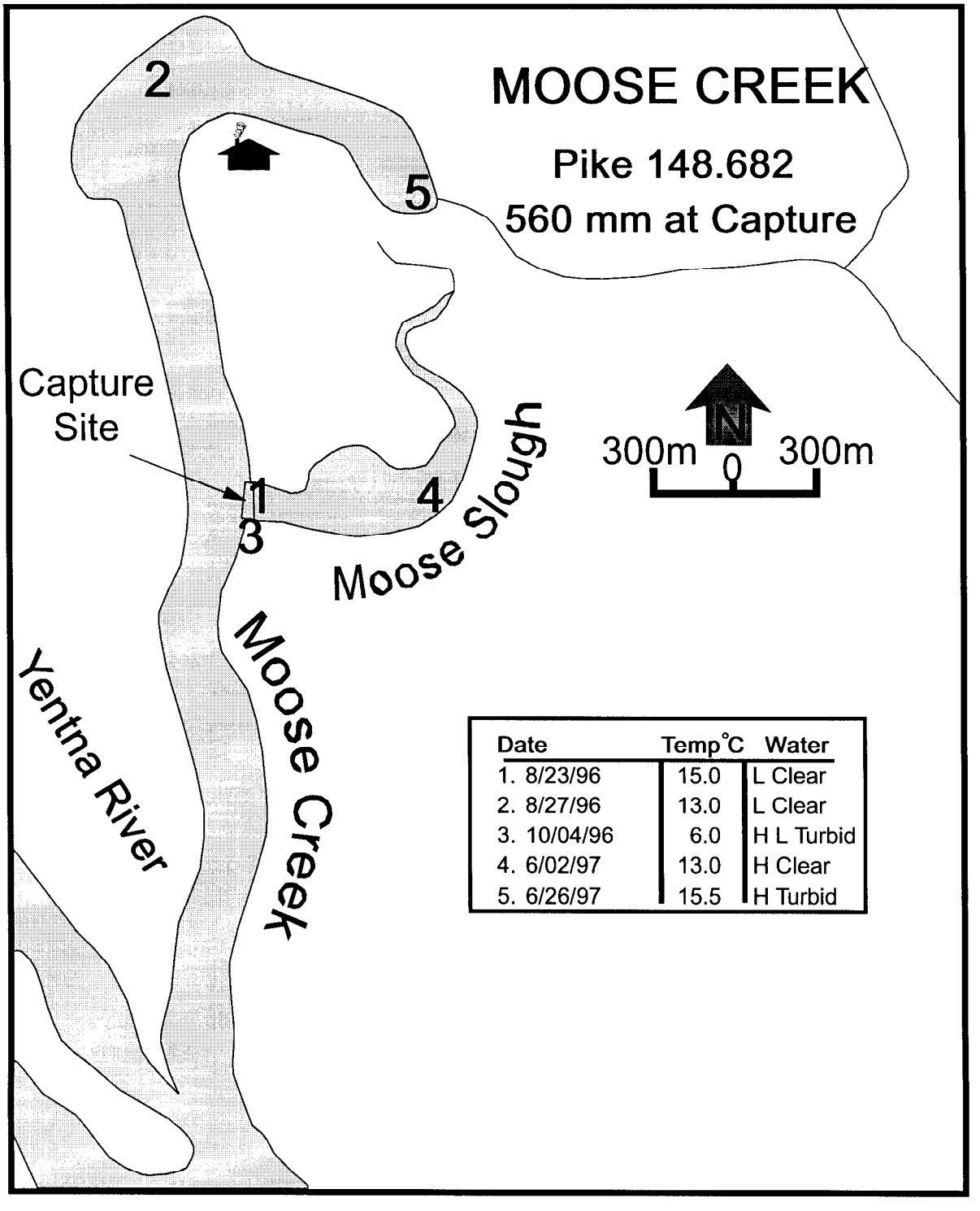
Appendix B5.-Movements of northern pike number 148.233 in Moose Creek, June 1996-June 1997.



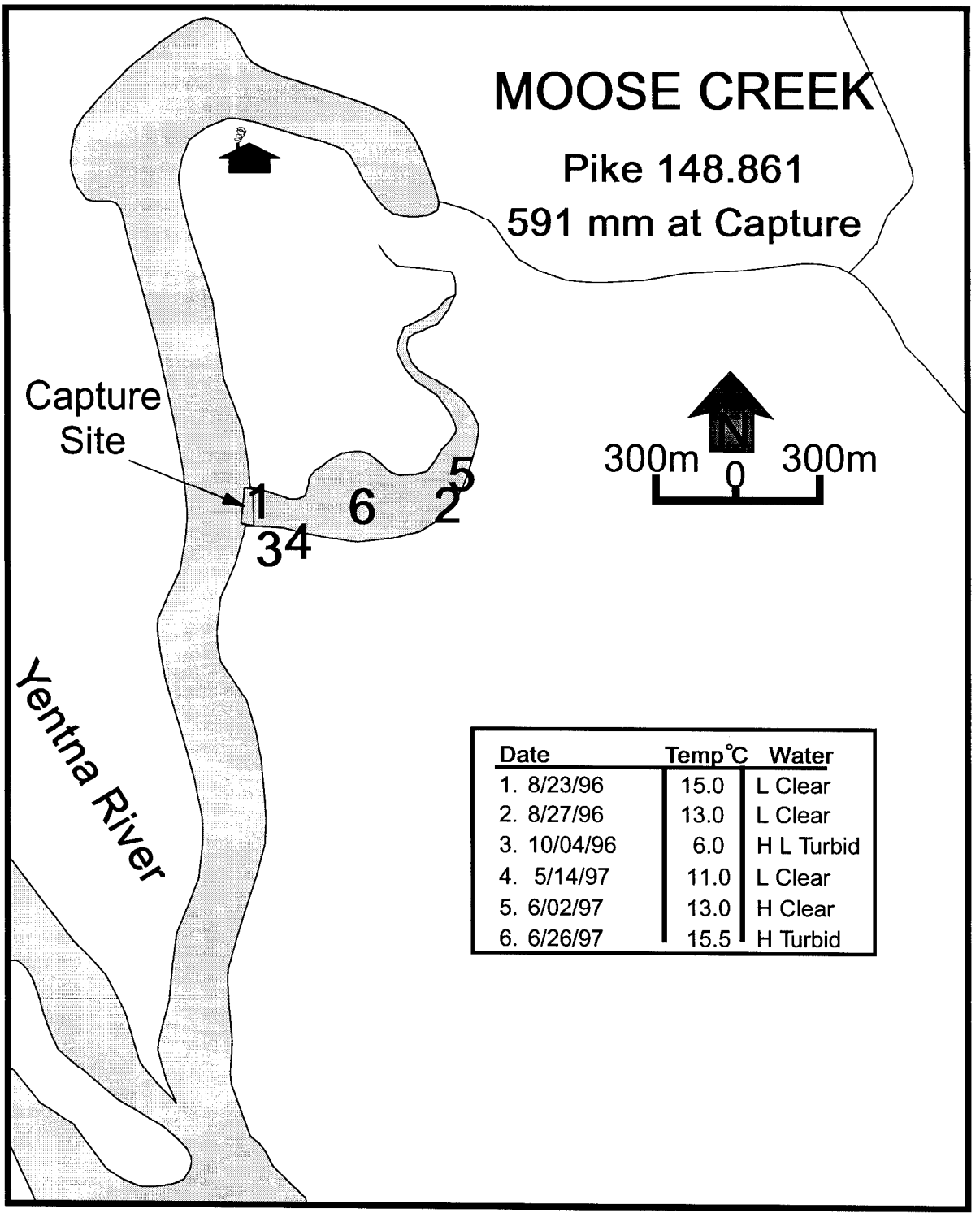
Appendix B6.-Movements of northern pike number 148.251 in Moose Creek, June 1996-June 1997.



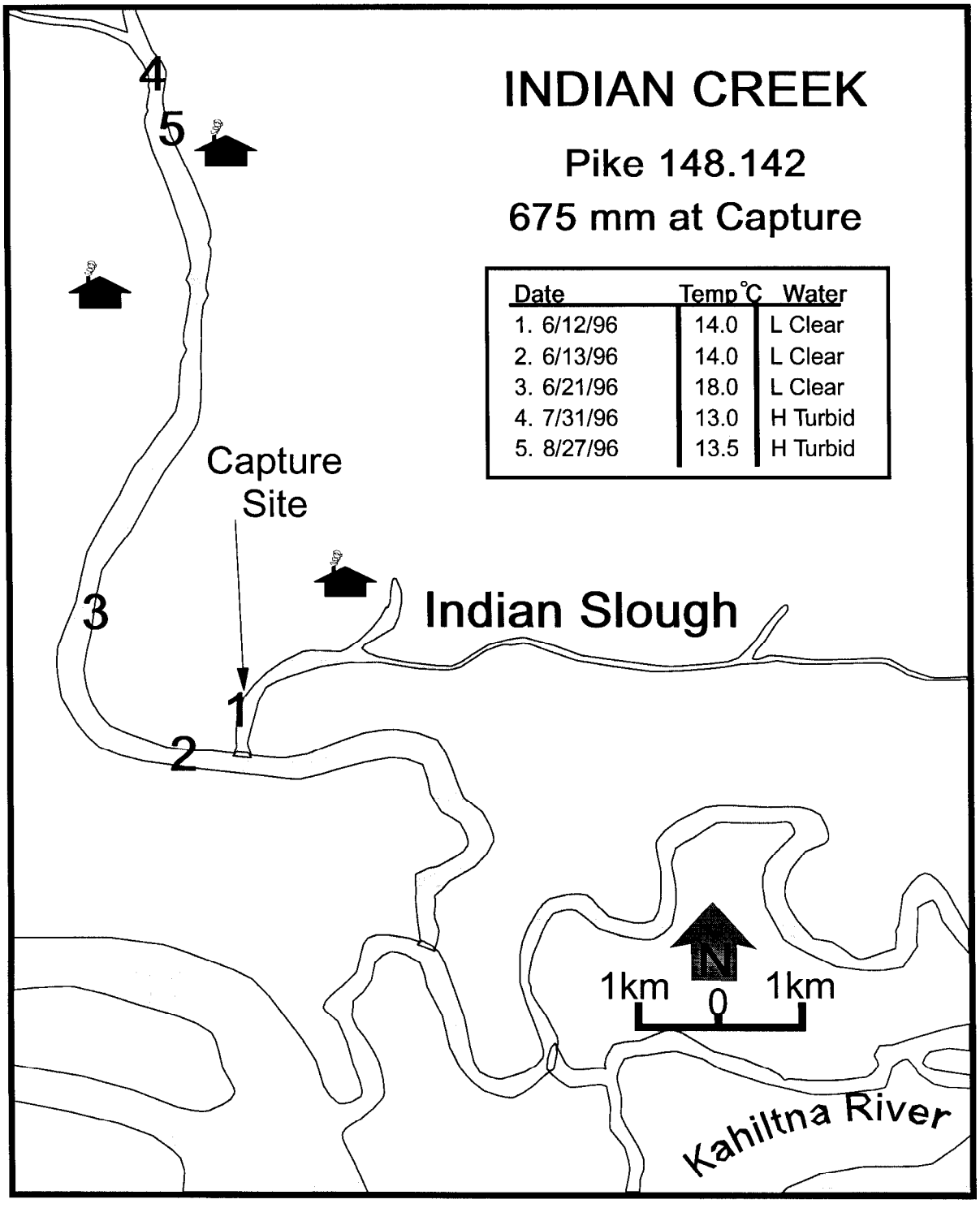
Appendix B7.-Movements of northern pike number 148.474 in Moose Creek, June 1996-June 1997.



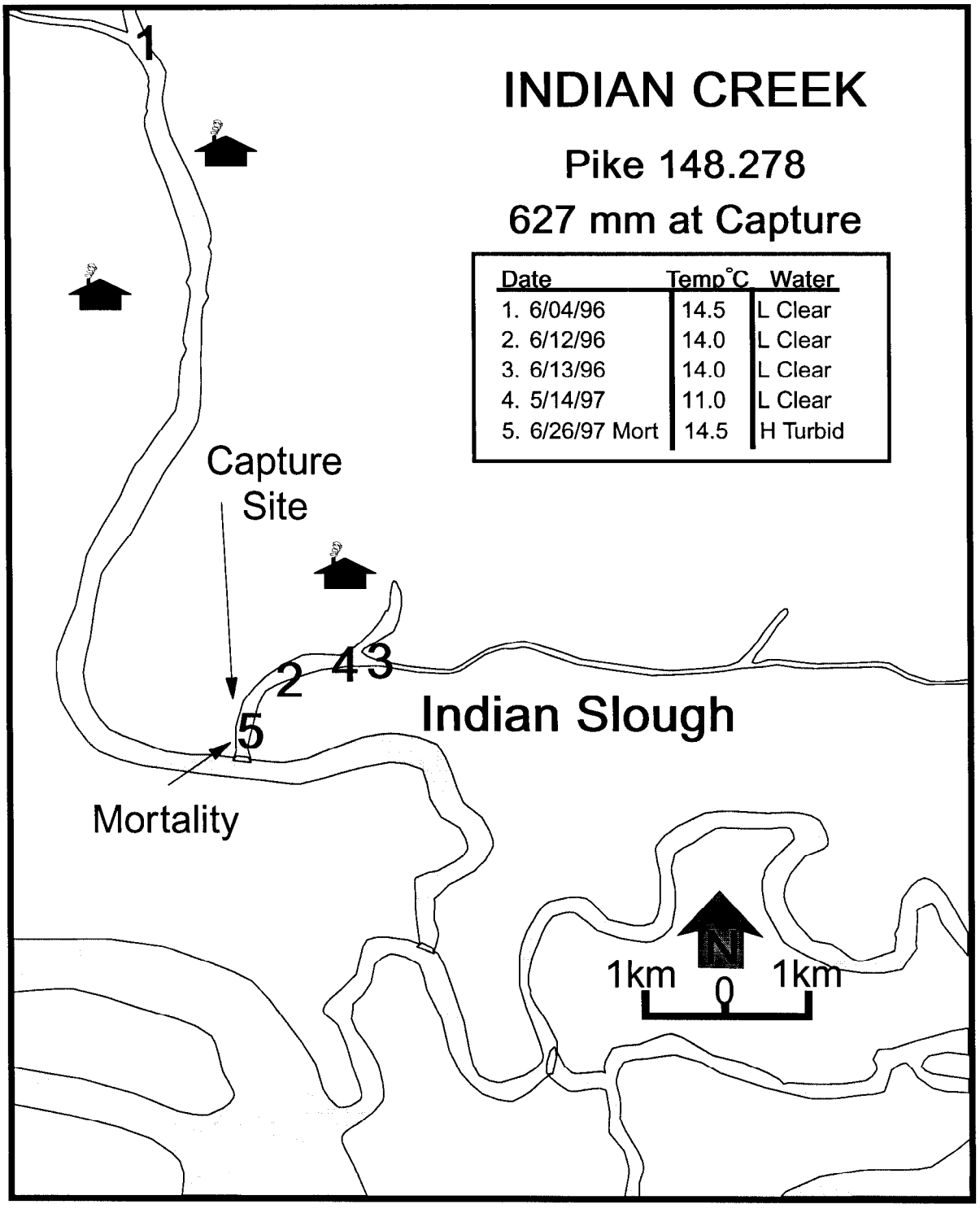
Appendix B8.-Movements of northern pike number 148.682 in Moose Creek, June 1996-June 1997.



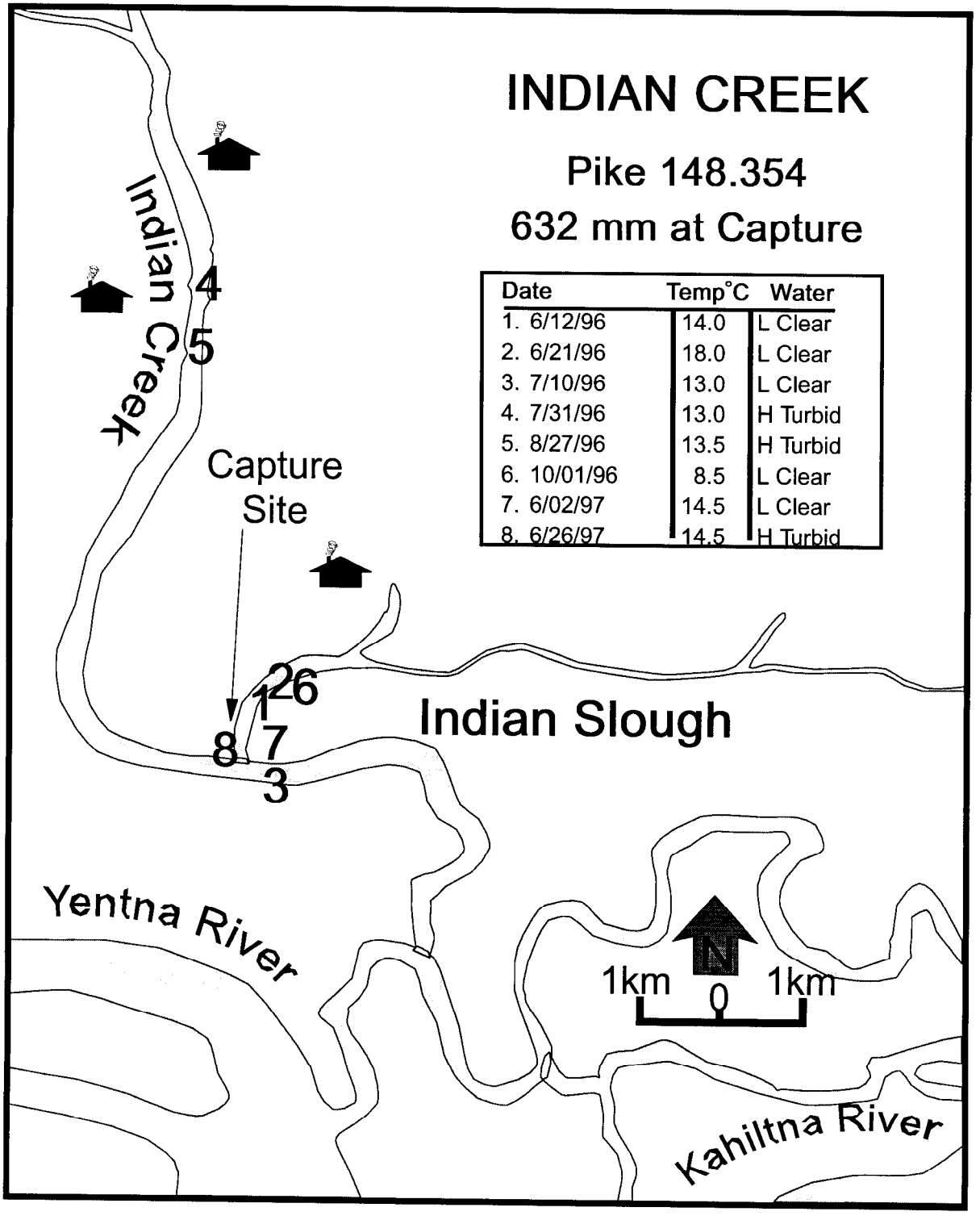
Appendix B9.-Movements of northern pike number 148.861 in Moose Creek, June 1996-June 1997.



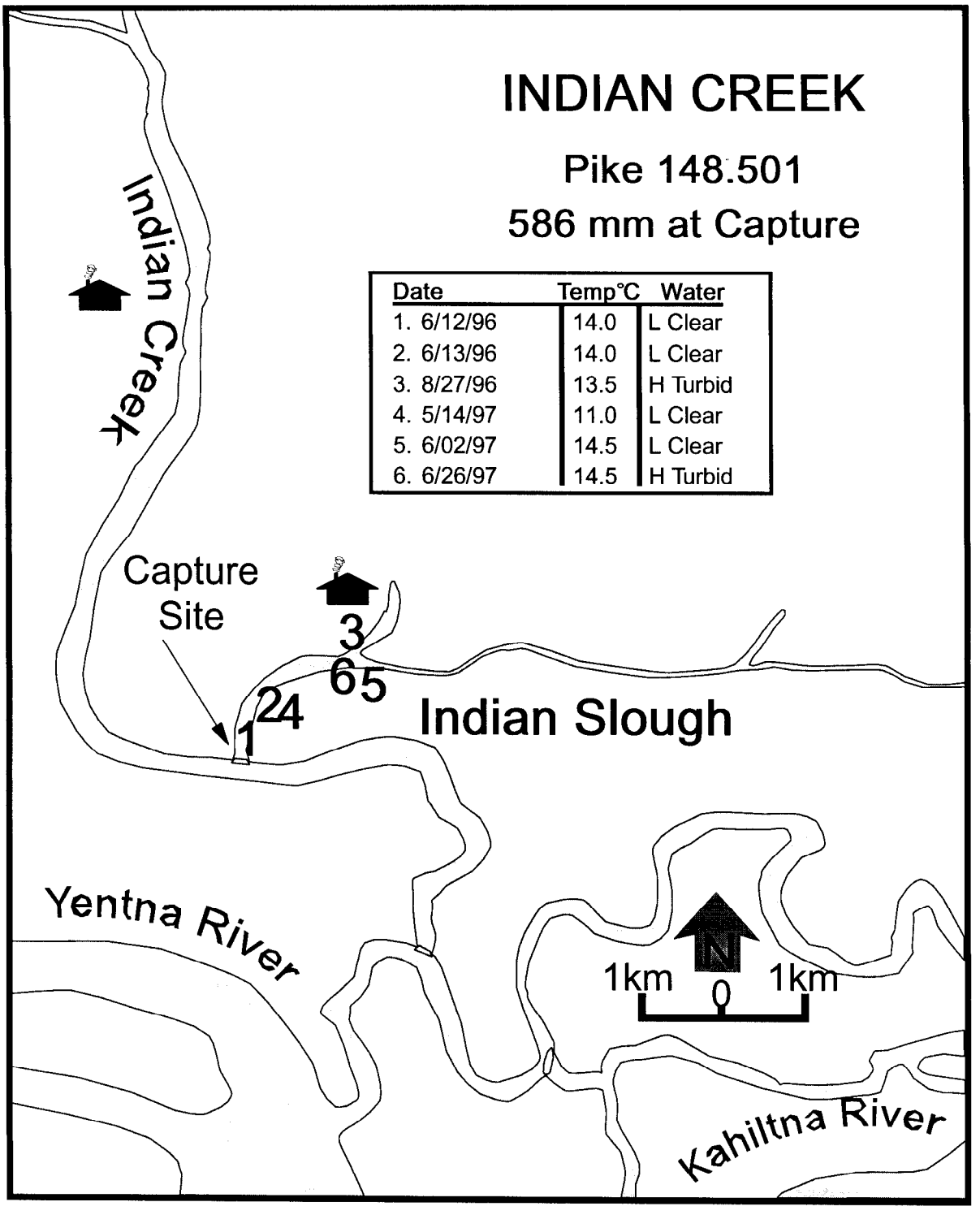
Appendix B10.-Movements of northern pike number 148.142 in Indian Creek, June 1996-June 1997.



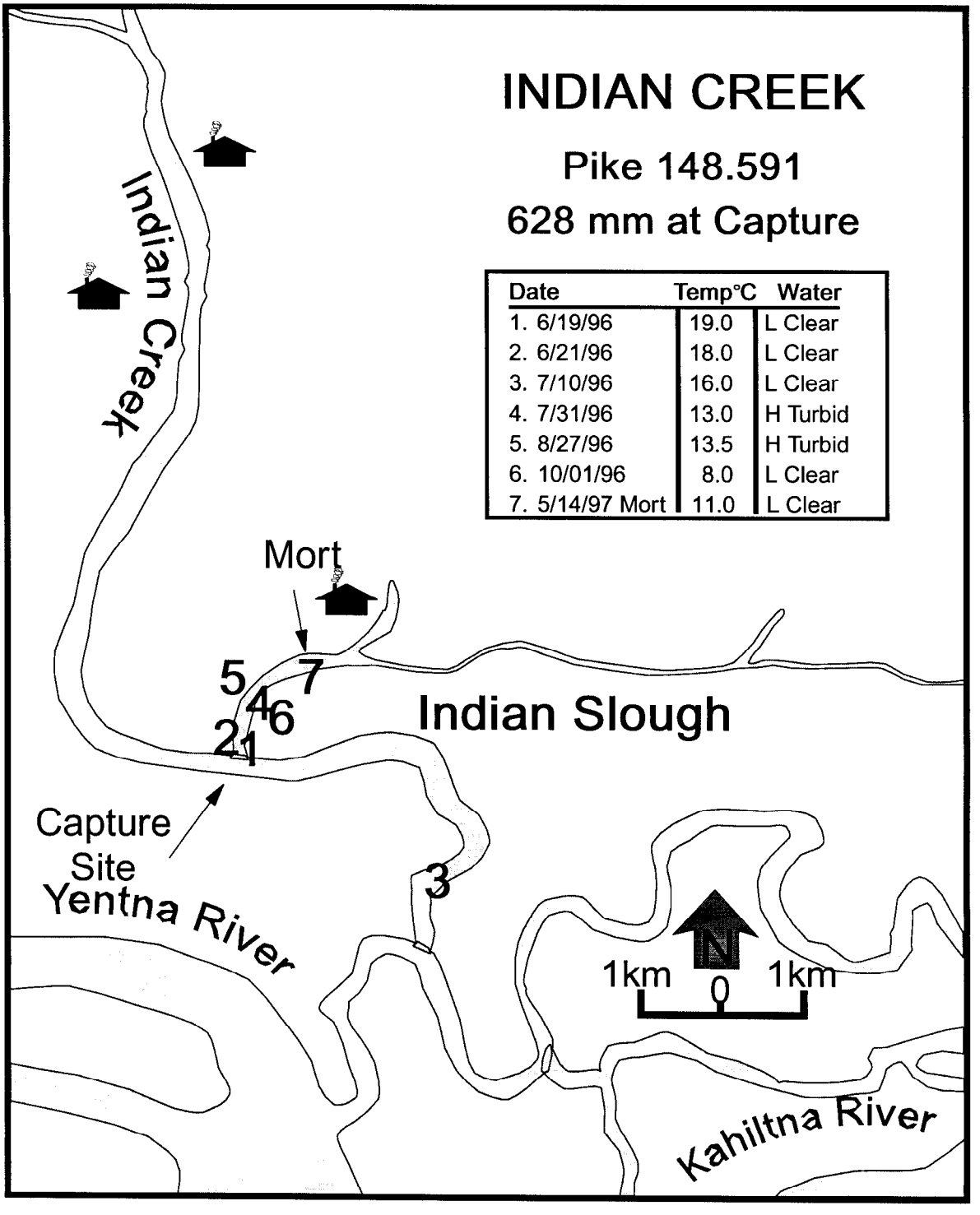
Appendix B11.-Movements of northern pike number 148.278 in Indian Creek, June 1996-June 1997.



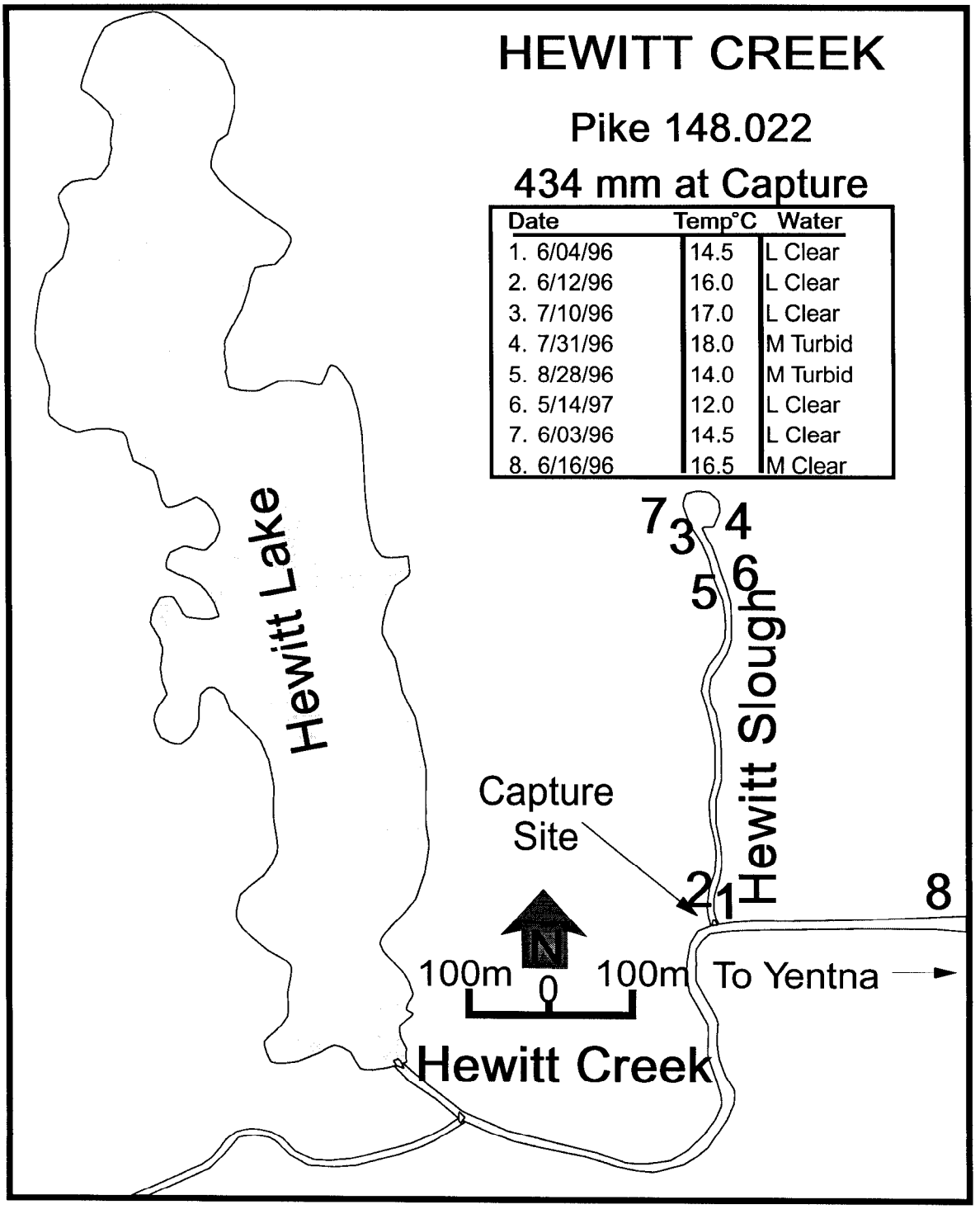
Appendix B12.-Movements of northern pike number 148.354 in Indian Creek, June 1996-June 1997.



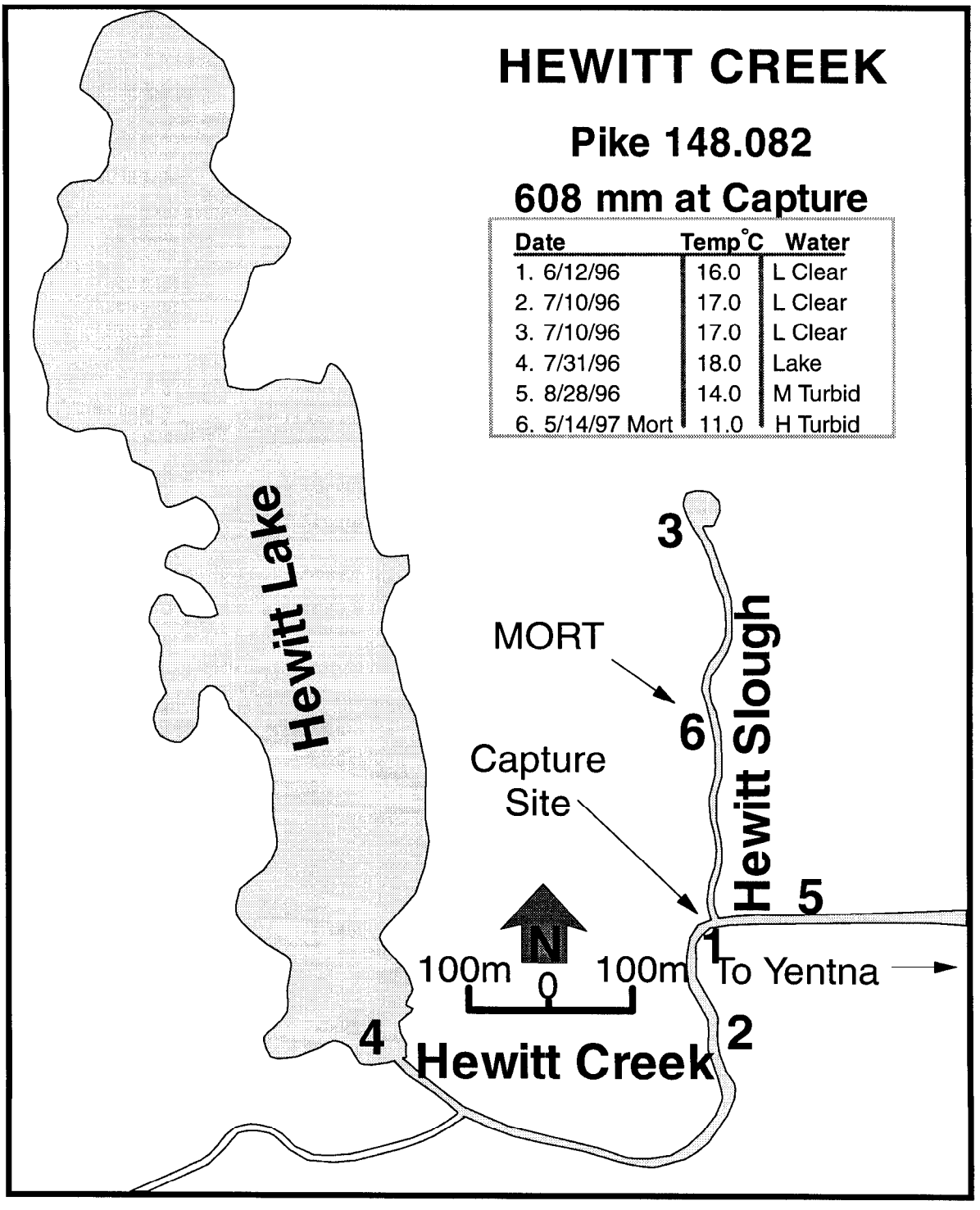
Appendix B13.-Movements of northern pike number 148.501 in Indian Creek, June 1996-June 1997.



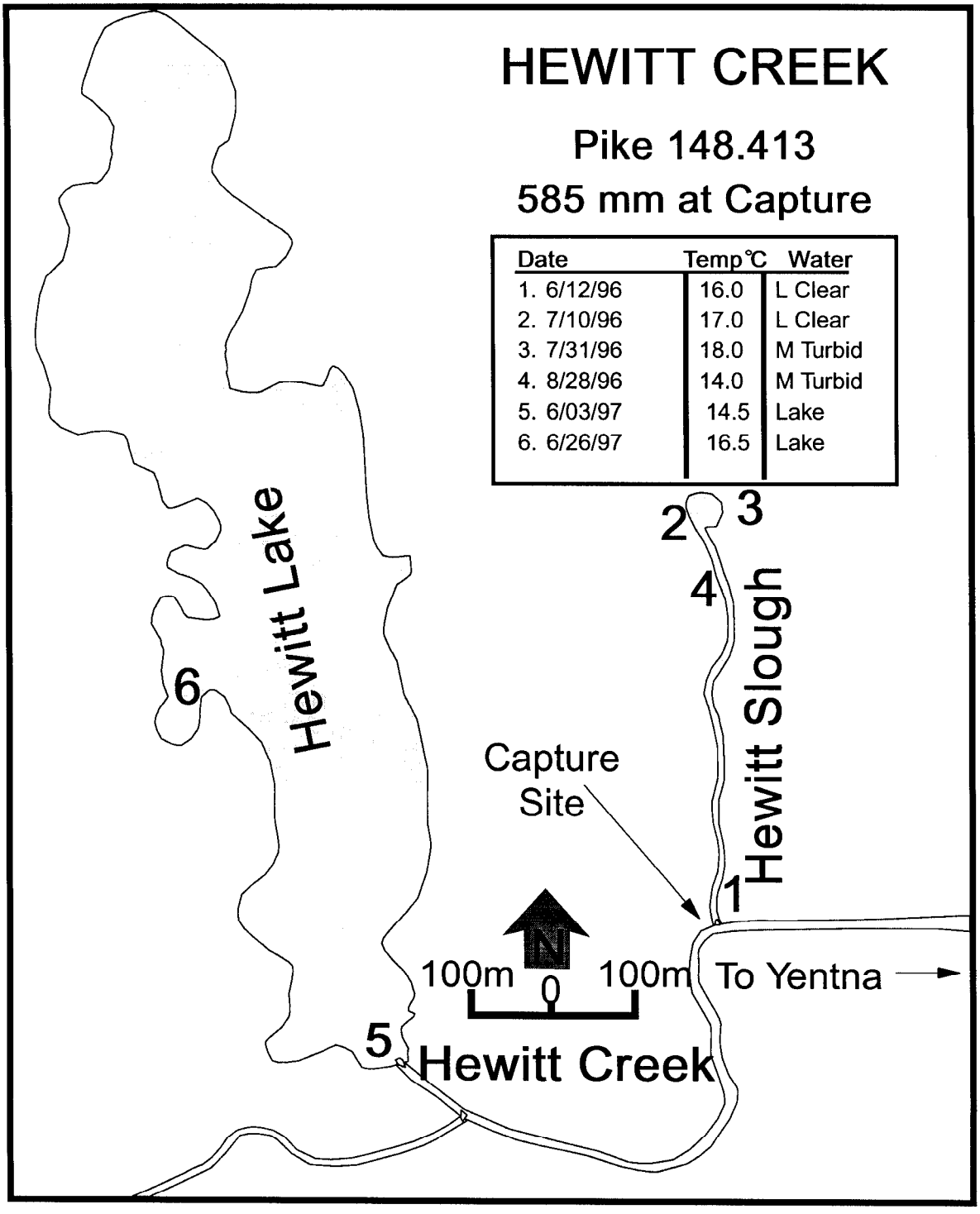
Appendix B14.-Movements of northern pike number 148.591 in Indian Creek, June 1996-June 1997.



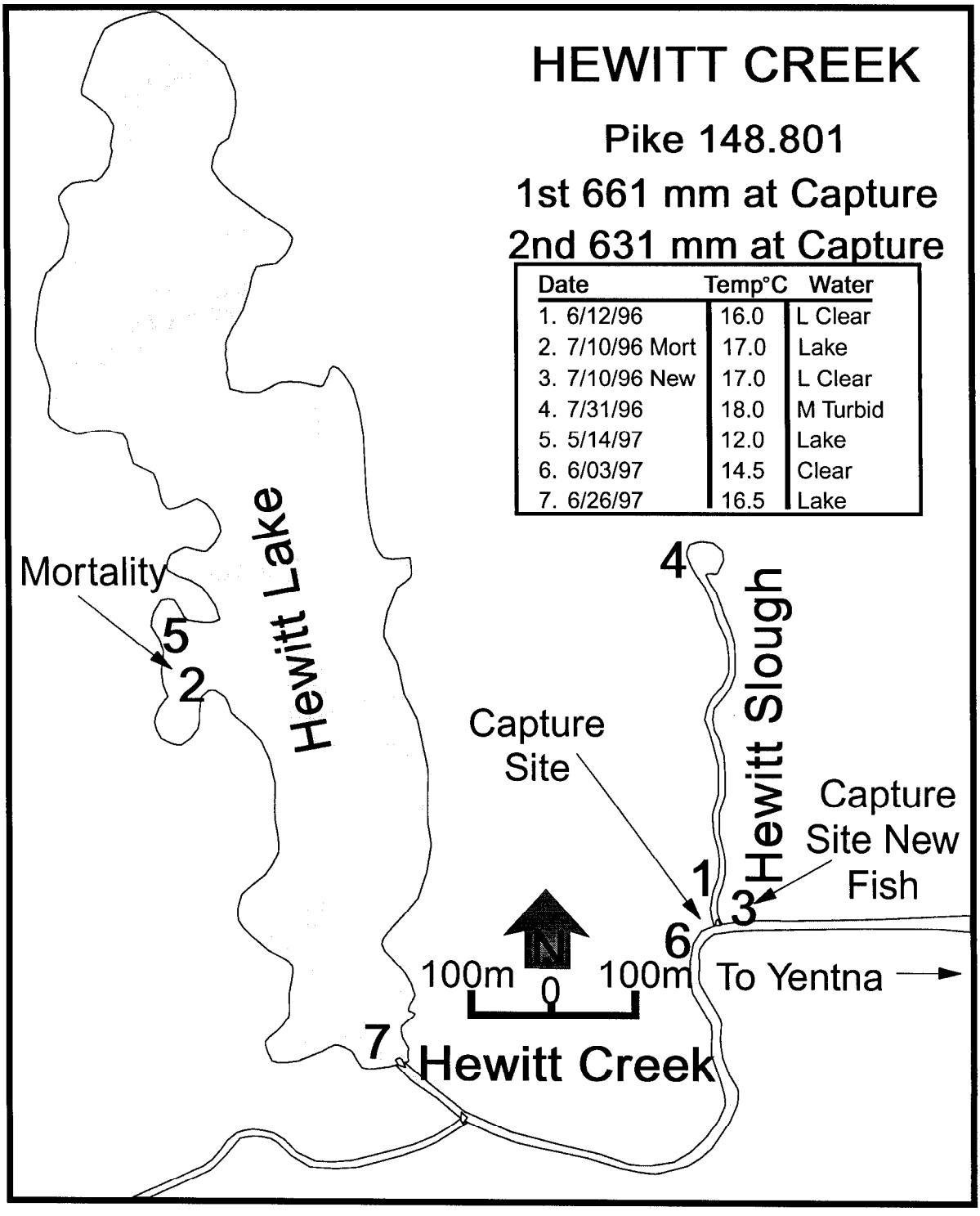
Appendix B15.-Movements of northern pike number 148.022 in Hewitt Creek, June 1996-June 1997.



Appendix B16.-Movements of northern pike number 148.082 in Hewitt Creek, June 1996-June 1997.



Appendix B17.-Movements of northern pike number 148.413 in Hewitt Creek, June 1996-June 1997.



Appendix B18.-Movements of northern pike number 148.801 in Hewitt Creek, June 1996-June 1997.

APPENDIX C. CONFIRMED AND REPORTED NORTHERN PIKE WATERS IN THE NORTHERN COOK INLET MANAGEMENT AREA

Appendix C1.-Confirmed and reported northern pike waters in the Northern Cook Inlet Management Area.

Susitna River Drainage Lakes

Alexander Creek

1. Alexander Lake
2. Sucker Lake
3. Trail Lake
4. Rabbit Lake

Lower Susitna

1. Flathorn Lake
2. Figure 8 Lake
3. No Name (NW of Fig 8 L.)

Mid Susitna

1. Witsoe Lake
2. Witsol Lake
3. Lockwood Lake
4. Lady Slipper
5. Unnamed
6. Unnamed
7. Unnamed
8. Vern Lake
9. Ding Dong

Yentna River

1. Whiskey Lake
2. Bulchitna Lake
3. Fish Creek Lake 1
4. Fish Creek Lake 2
5. Fish Creek Lake 3
6. Fish Creek Lake 4
7. Donkey Lake
8. Hewitt Lake
9. No Name (Big Bend)
10. Chelatna Lake
11. Cabin L. (Big Bend)
13. Pear L. (U Skwentna)
14. Stickleback Lake

Skwentna River

1. Eight Mile Lake
2. Seven Mile Lake
3. No Name (Herk Strip)
4. One Stone Lake

Deshka River

1. Parker Lake
2. Trapper Lake
3. No Name Lake
4. Ambler Lake
5. Rocky Lake
6. Neil Lake
7. Kroto Lake

Upper Susitna

1. Kashwitna Lake*
2. Caswell Lake*
3. Fish Lake*
4. Sawmill Lake*
5. Swan Lake

Nancy Lake Area

1. Redshirt Lake
2. Lynx Lake
3. Cow Lake
4. Little Chicken
5. South Rolly Lake
6. North Rolly Lake
7. Tanaina Lake
8. Milo Lake
9. Frazer Lake
10. Little Frazer Lake
11. James Lake
12. Owl Lake
13. Char Lake
14. Ardaw Lake
15. Phoebe Lake
16. Chicken Lake
17. Echo Pond #1
18. Echo Pond #2
19. Echo Pond #3
20. Candle Stick Lake
21. Bains Pond #1
22. Bains Pond #2
23. Bains Pond #3

Susitna Tributaries

Deshka River

1. Fish Creek (Flathorn)
2. Fish Creek (Kroto)
3. Lake Creek
4. Fish Lake Creek
5. Alexander Creek
6. Trapper Creek
7. Sucker Creek
8. Montana Creek
9. Rolly Creek
10. Moose Creek
11. Bottle Creek
12. Hewitt Creek
13. Donkey Creek
14. Indian Creek (Yentna)
15. Indian (Chulitna)*
16. Rabideux Creek
17. Fish Lake Creek
18. Kutna Creek (Yentna)
19. Shell Creek
20. Eightmile Creek
21. Caswell Creek
22. Witsoe Creek
23. Trapper (Talkeetna)*
24. Talachulitna Creek*
25. Johnson Creek
26. Otter Creek
27. Unnamed (Low Su)
28. Sunshine Creek*
29. Anderson Creek*
30. Wiggel Creek*
31. Birch Creek*
32. Yentna River
33. Skwentna River
34. Chulitna River*
35. Little Susitna River*
36. Tokositna

Knik Arm Drainages

1. Little Susitna*
2. Swan Lake*
2. Jim Lake*
4. Knik River
5. Big Lake*
6. Fish Creek*
7. Horseshoe Lake

West Cook Inlet

1. Chuit River
2. Chuit Lake
3. Threemile Creek
3. Chuit Lake
4. Threemile Lake

Anchorage Lakes

1. Sand Lake
2. Delong Lake
3. Lower Fire Lake
4. Upper Fire Lake*
5. Mink Creek
6. Fire Creek

Mat-Su Valley Lakes

1. Crystal Lake*
2. Blodgett Lake*

* Reported but not confirmed northern pike populations

APPENDIX D. WATER TEMPERATURE IN CREEK AND SLOUGH, TIME, DATE, LOCATION AND WATER CONDITION AT RELOCATION OF RADIO TAGGED FISH BY TAGGING LOCATION, RADIO FREQUENCY, AND LENGTH

Appendix D1.-Water temperature in creek (Area B) and slough (Area A), time, date, and water condition at relocation of radio tagged fish by tagging location, radio frequency, and length.

Location	Radio Freq	Tag	Length	Water Temp (^{0}C) in Slough	Water Temp (^{0}C) in Creek	Time	Date	Recapture Location	Recap Lat Long	Water Condition
Hewitt	148.022	7001	434	16.5	14.5	8:00	6/4/96	Mouth of Slough	N61^{0}59.454 W151^{0}21.087'	Low Clear
Hewitt	148.022	7001		18.5	16.0	18:00	6/12/96	Mouth of Slough	N61^{0}59.454 W151^{0}21.090'	Low Clear
Hewitt	148.022	7001		19.0	17.0	18:00	7/10/96	Slough in pond	N61^{0}59.466 W151^{0}21.041'	Low Clear
Hewitt	148.023	7001		22.0	18.0	16:00	7/31/96	Slough in Pond	N61^{0}59.511 W151^{0}21.087'	H Turbid
Hewitt	148.023	7001		16.5	14.0	13:00	8/28/96	Slough in Pond	N61^{0}59.457 W151^{0}21.087'	Mod Clear
Hewitt	148.023	7001		15.0	12.0	9:00	5/14/97	Slough in Pond		Low Clear
Hewitt	148.023	7001		17.5	14.5	10:30	6/3/97	Slough in Pond		Low Clear
Hewitt	148.023	7001		18.5	16.5	9:00	6/26/97	mouth of Hewitt Creek (Yentna River)		H Turbid
Hewitt	148.082	7007	608	18.0	16.0	18:00	6/12/96	Mouth of Slough	N61^{0}59.454 W151^{0}21.090'	Low Clear
Hewitt	148.082	7007		20.0	17.0		7/10/96	300 m Downstream of Slough	N61^{0}59.250 W151^{0}19762'	Low Clear
Hewitt	148.082	7007		19.0	17.0	19:00	7/10/96	Slough in Pond	N61^{0}59.466 W151^{0}21.041'	Low Clear
Hewitt	148.082	7007		21.0	18.0	16:00	7/31/96	Near Lake Outlet in Lake	N61^{0}59.358 W151^{0}21.057'	H Turbid
Hewitt	148.082	7007		15.0	14.0	13:00	8/28/96	500 m downstream of slough	N61^{0}59.453 W151^{0}20.906'	Mod Clear
Hewitt	148.082	7007	MORT	13.5	12.0	9:00	5/14/97	Mid slough		Low Clear
Hewitt	148.413	7006	585	18.0	16.0	18:00	6/12/96	Mouth of Slough	N61^{0}59.454 W151^{0}21.090'	Low Clear
Hewitt	148.413	7006		19.0	17.0		7/10/96	Pond at end of Slough		Low Clear
Hewitt	148.413	7006		22.0	18.0	16:00	7/31/96	Slough in Pond	N61^{0}59.511 W151^{0}21.087'	H Turbid
Hewitt	148.413	7006		16.0	14.0	13:00	8/28/96	Confluence of Pond and Creek	N61^{0}59.332 W151^{0}21.169'	Mod Clear
Hewitt	148.413	7006		15.0	12.0	9:00	5/14/97	Not Found		Low Clear
Hewitt	148.413	7006		16.5	14.5	10:30	6/3/97	Lake Outlet		Lake
Hewitt	148.413	7006		20.0	16.5	9:00	6/26/97	Lake Pike Bay		Lake
Hewitt	148.801	7008	661	18.5	16.0	18:00	6/12/96	Mouth of Slough	N61^{0}59.454 W151^{0}21.090'	Low Clear
Hewitt	148.801	7008	MORT				Mortality	2nd Bay in Lake		Low Clear
Hewitt	148.801	7008	631	New Fish	New Fish	19:00	7/10/96	Mouth of Slough	N61^{0}59.454 W151^{0}21.090'	Low Clear
Hewitt	148.801	7008		17.0	18.0	16:00	7/31/96	Slough in Pond	N61^{0}59.511 W151^{0}21.087'	M Turbid
Hewitt	148.801	7008		16.0	14.0	14:00	8/28/96	Not Found		Mod Clear
Hewitt	148.801	7008		14.0	12.0	9:00	5/14/97	Pike Bay Lake		Low Clear
Hewitt	148.801	7008		17.0	14.5	10:30	6/3/97	Mouth of Slough		Clear
Hewitt	148.801	7008		18.5	16.5	9:00	6/26/97	Lake Outlet		Low Clear
Indian	148.142	7004	675	16.5	14.0	12:00	6/12/96	Mile .25 of Slough	N61^{0}52.287' W150^{0}46.803'	Low Clear
Indian	148.142	7004		16.0	14.0	8:00	6/13/96	.25 Mile Up Creek Above Slough	N61^{0}52.233' W150^{0}47.043'	Low Clear
Indian	148.142	7004		18.0	18.0	14:00	6/21/96	On Creek 3/4 of a mile upstream of Slough	N61^{0}52.233' W150^{0}47.043'	Low Clear
Indian	148.142	7004		18.0	16.0	18:00	7/10/96	No Contact		Low Clear
Indian	148.142	7004		15.5	13.5	10:00	8/27/96	Above Last Cabin 1 Mile	N61^{0}53.223' W150^{0}47.992'	H Turbid
Indian	148.142	7004		9.0	8.0	10:00	10/1/96	No Contact		Low Clear

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Location	Radio Freq	Tag	Length	Water Temp (°C) in Slough	Water Temp (°C) in Creek	Time	Date	Recapture Location	Recap Lat Long	Water Condition
Indian	148.142	7004		13.0	11.0	12:00	5/14/97	No Contact		Low Clear
Indian	148.142	7004		16.5	14.5	13:00	6/2/97	No Contact		Low Clear
Indian	148.142	7004		17.0	14.5	13:00	6/26/97	No Contact		H Turbid
Indian	148.143	7004		14.0	13.0	20:00	7/31/96	200 yds Upstream of Last Cabin on Left	N61°53.194' W150°47.945'	H Turbid
Indian	148.278	7002	627	15.5	14.5	13:41	6/4/96	4 Mile Up Creek	N61°53.194' W150°47.945'	Low Clear
Indian	148.278	7002		16.5	14.0	12:00	6/12/96	Mile .50 of Slough	N61°52.287' W150°46.803'	Low Clear
Indian	148.278	7002		16.0	14.0	8:00	6/13/96	1 Mile Up Slough	N61°52.371' W150°46.689'	Low Clear
Indian	148.278	7002		22.0	18.0	14:00	6/21/96	No Contact		Low Clear
Indian	148.278	7002		20.0	16.0	18:00	7/10/96	No Contact		Low Clear
Indian	148.278	7002		14.0	13.0	20:00	7/31/96	No Contact		H Turbid
Indian	148.278	7002		14.5	13.5	10:00	8/27/96	No Contact		H Turbid
Indian	148.278	7002		14.0	11.0	12:00	5/14/97	Upstream By Rocks	N61°52.371' W150°46.689'	Low Clear
Indian	148.278	7002		17.5	14.5	13:00	6/2/97	No Contact		Low Clear
Indian	148.278	7002	MORT	17.5	14.5	13:00	6/26/97	100 Meters Up Slough From Confluence	N61052.319' W150046.548'	H Turbid
Indian	148.354	7003	632	17.0	14.0	12:00	6/12/96	Mile .25 of Slough	N61°52.287' W150°46.803'	Low Clear
Indian	148.354	7003		16.0	14.0	8:00	6/13/96	No Contact	N61°52.563' W150°47.707'	Low Clear
Indian	148.354	7003		22.0	18.0	14:00	6/21/96	Mid Slough	N61°52.371' W150°46.689'	Low Clear
Indian	148.354	7003		17.5	16.0	18:00	7/10/96	50 yd Below Slough/Indian Conf	N61°52.200' W150°46.724'	Low Clear
Indian	148.354	7003		14.5	13.0	20:00	7/31/96	Across From Lodge	N61°52.719' W150°47.667'	H Turbid
Indian	148.354	7003		15.5	13.5	10:00	8/27/96	Guide Cabin	N61°52.803' W150°47.623'	H Turbid
Indian	148.354	7003		9.0	8.0	10:00	10/1/96	Mid Slough	N61°52.287' W150°46.803'	Low Clear
Indian	148.354	7003		13.0	11.0	12:00	5/14/97	No Contact		Low Clear
Indian	148.354	7003		16.0	14.0	13:00	6/2/97	100 m Up Slough From Confluence	N61°52.319' W150°46.548'	Low Clear
Indian	148.354	7003		17.0	14.0	13:00	6/26/97	100 m Up Slough From Confluence	N61°52.319' W150°46.548'	H Turbid
Indian	148.501	7005		19.5	16.0	18:00	7/10/96	No Contact		Low Clear
Indian	148.501	7005		16.5	13.0	20:00	7/31/96	No Contact		H Turbid
Indian	148.503	7005	586	16.0	14.0	12:00	6/12/96	Mouth of Slough	N61°52.303 W150°46.687'	Low Clear
Indian	148.503	7005		15.0	14.0	8:00	6/13/96	60 m Upstream of Capture Site	N61°52.303 W150°46.687'	Low Clear
Indian	148.503	7005		18.0	18.0	14:00	6/21/96	No Contact		Low Clear
Indian	148.503	7005		13.5	13.5	10:00	8/27/96	Up by Cabin Slough	N61°52.450' W150°46.136'	H Turbid
Indian	148.503	7005		8.0	8.0	10:00	10/1/96	no contact		Low Clear
Indian	148.503	7005		13.5	11.0	12:00	5/14/97	Upstream 200 m Slough	N61°52.287' W150°46.803'	Low Clear
Indian	148.503	7005		17.5	14.5	13:00	6/2/97	I Mile up Slough Near Rocks	N61°52.371' W150°46.689'	Low Clear
Indian	148.503	7005		17.5	14.5	13:00	6/26/97	I Mile up Slough Near Rocks	N61°52.371' W150°46.689'	H Turbid
Indian	148.591	7020	628	21.5	19.0	12:00	6/19/96	Mouth of Slough	N61°52.306' W150°46.835'	Low Clear

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Location	Radio Freq	Tag	Length	Water Temp (^{O}C) in Slough	Water Temp (^{O}C) in Creek	Time	Date	Recapture Location	Recap Lat Long	Water Condition
Indian	148.591	7020		20.0	18.0	14:00	6/21/96	Near Mouth Of Slough	N61^{0}52.303' W150^{0}46.687'	Low Clear
Indian	148.591	7020		19.0	16.0	18:00	7/10/96	100 m upstream of Indian Yentna Con	N61^{0}52.188' W150^{0}46.735'	Low Clear
Indian	148.592	7020		16.5	13.5	10:00	8/27/96	100 m Upstream of slough	N61^{0}52.289' W150^{0}46.582'	H Turbid
Indian	148.592	7020		9.4	8.0	10:00	10/1/96	100 m Upstream of slough	N61^{0}52.319' W150^{0}46.548'	Low Clear
Indian	148.592	7020	MORT	13.2	11.0	12:00	5/14/97	Upstream 300 m Slough	N61^{0}52.287' W150046.803'	Low Clear
Indian	148.593	7020		15.0	13.0	20:00	7/31/96	100 m Up Slough From Confluence	N61^{0}52.319' W150^{0}46.548'	H Turbid
Moose	148.233	7025	569	17.5	15.0	9:00	6/19/96	Mouth of Slough	N61^{0}47.977 W150^{0}41.708'	Low Clear
Moose	148.233	7025		17.0	15.0	10:30	6/21/96	50 m Upstream Slough Conf	N61^{0}48.015' W150^{0}41.726'	Low Clear
Moose	148.233	7025		18.0	16.0	10:30	7/10/96	Wide Portion of Slough 60 m From Confluence	N61^{0}48.202' W150^{0}41.488'	Low Clear
Moose	148.233	7025		19.0	18.0	10:30	8/1/96	No Contact		Turbid
Moose	148.233	7025	MORT	17.0	15.0	12:00	8/23/96	Lake Head of Creek		Low Clear
Moose	148.233	7063	623	17.0	15.0	13:00	8/23/96	Mouth of Slough	N61^{0}47.997' W150^{0}41.772'	Low Clear
Moose	148.861	7064	591	18.0	15.0	13:00	8/23/96	Mouth of Slough	N61^{0}47.997' W150^{0}41.772'	Low Clear
Moose	148.474	7065	592	18.0	15.0	13:00	8/23/96	Mouth of Slough	N61^{0}47.997' W150^{0}41.772'	Low Clear
Moose	148.251	7067	546	18.0	15.0	13:00	8/23/96	Mouth of Slough	N61^{0}47.997' W150^{0}41.772'	Low Clear
Moose	148.682	7068	560	18.0	15.0	13:00	8/23/96	Mouth of Slough	N61^{0}47.997' W150^{0}41.772'	Low Clear
Moose	148.233	7063		15.0	13.0	12:00	8/27/96	First Bend in Slough	N61^{0}48.044' W150^{0}41.572'	Low Clear
Moose	148.861	7064		16.0	13.0	13:00	8/27/96	First Bend in Slough	N61^{0}48.044' W150^{0}41.572'	Low Clear
Moose	148.474	7065		16.0	13.0	14:00	8/27/96	End of Slough	N61^{0}48.202' W150^{0}41.488'	Low Clear
Moose	148.251	7067		15.5	13.0	15:00	8/27/96	End of Slough	N61^{0}48.202' W150^{0}41.488'	Low Clear
Moose	148.682	7068		16.0	13.0	16:00	8/27/96	In Creek Upper Drainage left of Cabin	N61^{0}48.900' W150^{0}42.308'	Low Clear
Moose	148.233	7063		6.5	6.0	11:30	10/4/96			
Moose	148.861	7064		7.0	6.0	11:30	10/4/96	Mouth of Slough	N61^{0}47.997' W150^{0}41.772'	Low Clear
Moose	148.474	7065		7.0	6.0	11:30	10/4/96	Not found		Low Clear
Moose	148.251	7067		7.0	6.0	11:30	10/4/96	Mainstem of Creek Below Mouth		Low Clear
Moose	148.682	7068		7.0	6.0	11:30	10/4/96	Mouth of Slough	N61^{0}47.997' W150^{0}41.772'	Low Clear
Moose	148.861	7064		1.0	1.0	13:00	12/20/96	Not found		Low Clear
Moose	148.474	7065		1.0	1.0	13:00	12/20/96	In Creek Between Slough and Cabin	N61^{0}48.015' W150^{0}41.726'	Low Clear
Moose	148.251	7067		1.0	1.0	13:00	12/20/96	Not found		Low Clear
Moose	148.233	7063		1.0	1.0	13:00	12/20/96	In Creek Between Slough and Cabin	N61^{0}48.015' W150^{0}41.726'	Low Clear
Moose	148.682	7068		7.0	6.0	13:00	12/20/96	Not found		Low Clear
Moose	148.233	7063		12.5	11.0	10:00	5/14/97	Mid Slough	N61^{0}48.108' W150^{0}41.520'	Low Clear
Moose	148.861	7064		13.0	11.0	10:00	5/14/97	Mouth of Slough	N61^{0}47.997' W150^{0}41.772'	Low Clear
Moose	148.474	7065		13.0	11.0	10:00	5/14/97	Mid Slough	N61^{0}48.108' W150^{0}41.520'	Low Clear
Moose	148.251	7067		13.0	11.0	10:00	5/14/97	First Bend of Slough	N61^{0}48.044' W150^{0}41.572'	Low Clear

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Location	Radio Freq	Tag	Length	Water Temp (^{O}C) in Slough	Water Temp (^{O}C) in Creek	Time	Date	Recapture Location	Recap Lat Long	Water Condition
Moose	148.682	7068		13.0	11.0	10:00	5/14/97	Not found		Low Clear
Moose	148.233	7063		15.0	13.0	10:00	6/2/97	Mid Slough	N61^{0}48.108' W150^{0}41.520'	Clear
Moose	148.861	7064		15.0	13.0	10:00	6/2/97	First Bend of Slough	N61^{0}48.044' W150^{0}41.572'	Clear
Moose	148.474	7065		15.0	13.0	10:00	6/2/97	Mid Slough	N61^{0}48.108' W150^{0}41.520'	Clear
Moose	148.251	7067		15.0	13.0	10:00	6/2/97	First Bend of Slough	N61^{0}48.044' W150^{0}41.572'	Clear
Moose	148.682	7068		15.0	13.0	10:00	6/2/97	Mid Slough	N61^{0}48.108' W150^{0}41.520'	Clear
Moose	148.233	7063		17.5	15.5	15:00	6/26/97	Not found		High Muddy
Moose	148.861	7064		18.5	15.5	15:00	6/26/97	Wide portion of slough 60 m from confluence	N61^{0}48.202' W150^{0}41.488'	High Muddy
Moose	148.474	7065		18.0	15.5	15:00	6/26/97	First Bend of Slough	N61^{0}48.044' W150^{0}41.572'	High Muddy
Moose	148.251	7067		18.5	15.5	15:00	6/26/97	Wide portion of slough 60 m from confluence	N61^{0}48.202' W150^{0}41.488'	High Muddy
Moose	148.682	7068		18.0	15.5	15:00	6/26/97	In Creek upper Drainage left of cabin	N61^{0}48.900' W150^{0}42.308'	High Muddy
Witsoe	148.113	7047	497	23.0	19.0	16:00	7/2/96	Mouth of Slough	N61^{0}39.000 W150^{0}27.516'	Low Clear
Witsoe	148.113	7047		16.0	13.5	15:00	8/1/96	Mid Lake	N61^{0}39.390 W150^{0}28.429'	High Clear
Witsoe	148.113	7047		12.0	11.0	11:00	9/3/96	Lake inlet near stream	N61^{0}39.291 W150^{0}27.862'	Low Clear
Witsoe	148.113	7047		1.5	1.5	15:00	12/26/97	Mid Lake	N61^{0}39.000 W150^{0}27.516'	Low Clear
Witsoe	148.113	7047		1.5	1.5	15:00	2/7/97	Lower 1/3 of lake by Bear Slough		
Witsoe	148.173	7043	525	23.0	19.0	16:00	7/2/96	Mid Lake	N61^{0}39.000 W150^{0}27.516'	Low Clear
Witsoe	148.173	7043		17.0	13.5	15:00	8/1/96	Lake inlet near stream	N61^{0}39.291 W150^{0}27.862'	High clear
Witsoe	148.173	7043		16.0	11.0	9:00	9/3/96	Mid Lake	N61^{0}39.000 W150^{0}27.516'	Low Clear
Witsoe	148.173	7043		1.0	1.0	13:00	12/26/97	End of Slough	Upper 1/3 of Lake	Low Clear
Witsoe	148.173	7043		13.0	11.0	14:00	5/30/97	Mid Lake	N61^{0}39.000 W150^{0}27.516'	Low Clear
Witsoe	148.173	7043		17.5	15.0	10:00	6/27/97	Near Inlet Creek	N61^{0}38.994 W150^{0}27.623'	Low Clear
Witsoe	148.262	7048	535	23.0	19.0	16:00	7/2/96	Mouth of Slough	N61^{0}39.000 W150^{0}27.516'	Low Clear
Witsoe	148.262	7048		15.0	13.5	15:00	8/1/96	lower 1/3 of lake by Bear Slough	N61^{0}39.101 W150^{0}27.828'	High clear
Witsoe	148.262	7048		14.0	11.0	12:00	9/3/96	Mouth of Slough	N61^{0}39.000 W150^{0}27.516'	Low Clear
Witsoe	148.262	7048		1.0	1.0	16:00	12/26/97	Mid Lake	N61^{0}39.000 W150^{0}27.516'	Low Clear
Witsoe	148.262	7048		15.0	11.0	14:00	5/30/97	Mid Lake	N61^{0}39.000 W150^{0}27.516'	Low Clear
Witsoe	148.262	7048		19.0	15.0	12:00	6/27/97	Mid Lake	N61^{0}39.110 W150^{0}27.830'	Low Clear
Witsoe	148.562	7044	597	23.5	19.0	16:00	7/2/96	Mid Lake	N61^{0}39.000 W150^{0}27.516'	Low Clear
Witsoe	148.562	7044		17.0	13.5	15:00	8/1/96	Upper 1/3 of Lake	N61^{0}39.201 W150^{0}27.799'	High clear
Witsoe	148.562	7044		13.0	11.0	10:00	9/3/96	Lake inlet near stream	N61^{0}39.291 W150^{0}27.862'	Low Clear
Witsoe	148.562	7044		1.0	1.0	14:00	12/26/97	End of Slough	Upper 1/3 of Lake	Low Clear
Witsoe	148.562	7044		15.0	11.0	14:00	5/30/97	1 Mile up Fish Cr		Low Clear
Witsoe	148.562	7044		18.5	15.0	11:00	6/27/97	Outlet to Kroto	N61^{0}27.932 W150^{0}27.830'	Low Clear
Witsoe	148.562	7048		18.5	15.0	12:30	6/27/97	Mid Lake	N61^{0}39.329' W150^{0}27.870'	Low Clear

APPENDIX E. LENGTH, SEX AND STOMACH CONTENT OF NORTHERN PIKE SAMPLED FROM THE SUSITNA RIVER DRAINAGE DURING 1996 AND 1997

Appendix E1.-Length, sex, and stomach content of northern pike sampled from the Susitna River drainage during 1996 and 1997.

Location	Fork Length	Sex	Stomach Content[a]
Hewitt	420	F	12RS
Hewitt	430	F	2RS,6SS
Hewitt	462	F	E
Hewitt	470	F	12SS
Hewitt	472	F	28RS
Hewitt	488	F	3SS
Hewitt	512	F	6RS, 3SS
Hewitt	518	F	3SS
Hewitt	524	F	WF
Hewitt	530	F	WF
Hewitt	563	F	E
Hewitt	570	F	WF
Hewitt	580	F	6SS
Hewitt	590	F	E
Hewitt	592	F	E
Hewitt	595	F	14SS
Hewitt	610	F	E
Hewitt	633	F	6SS
Hewitt	635	F	E
Hewitt	672	F	WF
Hewitt	691	F	WF
Hewitt	692	F	WF
Hewitt	730	F	E
Hewitt	733	F	WF
Hewitt	782	F	E
Hewitt	791	F	WF
Hewitt	821	F	WF,NP
Hewitt	338	M	26RS
Hewitt	342	M	12RS
Hewitt	392	M	4RS(B)
Hewitt	403	M	14RS
Hewitt	412	M	E
Hewitt	413	M	6SS
Hewitt	419	M	2SS
Hewitt	450	M	7RS
Hewitt	467	M	3RS
Hewitt	473	M	E
Hewitt	481	M	18RS
Hewitt	488	M	7RS
Hewitt	494	M	14RS
Hewitt	502	M	7RS
Hewitt	521	M	E
Hewitt	522	M	3SS(B)
Hewitt	540	M	12SS

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Location	Fork Length	Sex	Stomach Content[a]
Hewitt	562	M	E
Hewitt	570	M	E
Hewitt	573	M	10SS
Hewitt	593	M	E
Hewitt	603	M	WF
Hewitt	624	M	E
Hewitt	626	M	1SS
Hewitt	640	M	E
Hewitt	670	M	WF, 3SS(B)
Hewitt	682	M	4SS
Hewitt	708	M	E
Hewitt	340		RS2
Hewitt	452		RS3SS1
Hewitt	460		SS2
Hewitt	468		SS1,RS3
Hewitt	476		SS2,RS1
Hewitt	488		SS2
Hewitt	493		E
Hewitt	502		WF
Hewitt	505		SS1, RS3
Hewitt	508		FRS3
Hewitt	516		E
Hewitt	518		RS1
Hewitt	523		E
Hewitt	531		RS2SS1
Hewitt	538		E
Hewitt	541		SS1
Hewitt	548		SS1,IH
Hewitt	548		SS1
Hewitt	558		RS3SS1
Hewitt	574		SS3,RS1
Hewitt	580		RT1,RS1
Hewitt	595		RS2
Hewitt	709		SS1,WF1
Hewitt	439	F	MOUSE
Hewitt	455	F	5RS
Hewitt	462	F	E
Hewitt	475	F	E
Hewitt	504	F	3RS,3SS
Hewitt	520	F	E
Hewitt	521	F	7RS
Hewitt	521	F	7RS,5SS
Hewitt	528	F	E
Hewitt	567	F	3SS,2RS

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Appendix E1.-Page 3 of 9.

Location	Fork Length	Sex	Stomach Content[a]
Hewitt	567	F	E
Hewitt	574	F	10SS
Hewitt	601	F	5SS
Hewitt	604	F	E
Hewitt	613	F	3RS
Hewitt	640	F	3RS,2SS(B)
Hewitt	653	F	4SS
Hewitt	683	F	E
Hewitt	700	F	E
Hewitt	705	F	E
Hewitt	711	F	E
Hewitt	722	F	E
Hewitt	731	F	E
Hewitt	733	F	E
Hewitt	735	F	E
Hewitt	736	F	4RS
Hewitt	738	F	E
Hewitt	766	F	E
Hewitt	785	F	E
Hewitt	795	F	E
Hewitt	810	F	E
Hewitt	813	F	E
Hewitt	381	M	E
Hewitt	415	M	9SS
Hewitt	422	M	SS
Hewitt	426	M	E
Hewitt	453	M	5SS
Hewitt	495	M	MOUSE
Hewitt	537	M	4SS
Hewitt	542	M	3SS,PS
Hewitt	542	M	1RS
Hewitt	543	M	7RS
Hewitt	573	M	4RS,LP
Hewitt	598	M	LP
Hewitt	630	M	E
Hewitt	642	M	E
Hewitt	662	M	E
Hewitt	663	M	2SS
Hewitt	675	M	6RS
Hewitt	735	M	E
Hewitt	760	M	E
Hewitt	792	M	E
Hewitt	812	M	9RS
Hewitt	942	M	WF

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Appendix E1.-Page 4 of 9.

Location	Fork Length	Sex	Stomach Content[a]
Indian	427	F	E
Indian	447	F	5SS
Indian	454	F	2SS,RT
Indian	462	F	E
Indian	492	F	SS,KS,SB
Indian	512	F	E
Indian	523	F	E
Indian	540	F	4SS
Indian	540	F	7SS
Indian	545	F	RT,2SS
Indian	548	F	5SS
Indian	553	F	2SS
Indian	571	F	E
Indian	580	F	3SS,7SB
Indian	582	F	MOUSE
Indian	583	F	SS,4SB
Indian	587	F	2SS,5SB
Indian	614	F	5SS(B)
Indian	632	F	E
Indian	634	F	WF
Indian	643	F	WF
Indian	670	F	E
Indian	680	F	WF
Indian	683	F	2SS
Indian	705	F	WF
Indian	710	F	WF
Indian	711	F	E
Indian	711	F	SB,LNS
Indian	726	F	WF,NP
Indian	728	F	E
Indian	749	F	MOUSE
Indian	782	F	E
Indian	350	M	13SS
Indian	390	M	6SS
Indian	401	M	WF, 2SB
Indian	418	M	WF,SS
Indian	440	M	4KS
Indian	442	M	E
Indian	442	M	E
Indian	443	M	11SS
Indian	453	M	8SS
Indian	472	M	4SS, RT
Indian	482	M	4RS(B)
Indian	492	M	3SS,SB

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Appendix E1.-Page 5 of 9.

Location	Fork Length	Sex	Stomach Content[a]
Indian	492	M	E
Indian	505	M	30PS
Indian	508	M	E
Indian	511	M	2SB
Indian	512	M	3SS,SB
Indian	516	M	RT
Indian	518	M	2SS
Indian	518	M	2KS,2SS
Indian	520	M	10SB
Indian	523	M	20SS
Indian	546	M	E
Indian	569	M	WF,1SS, RT
Indian	572	M	2SS
Indian	575	M	NP
Indian	593	M	E
Indian	602	M	E
Indian	613	M	5SS
Indian	613	M	E
Indian	614	M	MOUSE
Indian	635	M	E
Indian	640	M	E
Indian	642	M	E
Indian	652	M	3SS(B)
Indian	653	M	E
Indian	660	M	4SS
Indian	662	M	E
Indian	665	M	E
Indian	665	M	WF
Indian	667	M	E
Indian	675	M	3SS,LP
Indian	675	M	E
Indian	682	M	WF,2SS
Indian	682	M	E
Indian	684	M	NP
Indian	693	M	RT
Indian	705	M	NP
Indian	812	M	WF
Indian	397		E
Indian	408		BB,SS
Indian	412		E
Indian	433		2SS
Indian	444		BB
Indian	444		BB,SS
Indian	462		E

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Location	Fork Length	Sex	Stomach Content[a]
Indian	480		E
Indian	513		BB,RT
Indian	540		9SB
Moose	230	F	E
Moose	275	F	E
Moose	315	F	4RS(B)
Moose	319	F	2RS
Moose	408	F	2SS, SCL
Moose	420	F	2RS
Moose	460	F	9SS
Moose	467	F	E
Moose	478	F	7SS,WF
Moose	480	F	4RS,1LP
Moose	489	F	RT
Moose	508	F	E
Moose	510	F	6SS
Moose	510	F	SS
Moose	515	F	E
Moose	521	F	6SB,2SS
Moose	543	F	KS,RT
Moose	555	F	RT
Moose	563	F	E
Moose	564	F	E
Moose	567	F	4KS,4SS
Moose	572	F	3SB
Moose	576	F	3RS,32SS
Moose	597	F	RT
Moose	601	F	WF,SS
Moose	602	F	WF,BB
Moose	612	F	6SS(B)
Moose	615	F	E
Moose	621	F	6SS, SCUL
Moose	622	F	E
Moose	622	F	RT
Moose	623	F	E
Moose	623	F	11SS,1RS
Moose	629	F	E
Moose	630	F	NP
Moose	631	F	NP
Moose	637	F	E
Moose	642	F	E
Moose	644	F	2SB
Moose	653	F	E
Moose	675	F	E

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Location	Fork Length	Sex	Stomach Content[a]
Moose	682	F	E
Moose	722	F	3SS
Moose	222	M	3KS
Moose	265	M	2RS
Moose	275	M	E
Moose	305	M	E
Moose	315	M	2RS,1SS
Moose	320	M	E
Moose	390	M	16SS
Moose	395	M	4CS
Moose	398	M	E
Moose	402	M	E
Moose	405	M	SS
Moose	405	M	6SS
Moose	410	M	E
Moose	418	M	5RS
Moose	422	M	E
Moose	423	M	2SS
Moose	423	M	11SS
Moose	423	M	4SS
Moose	424	M	SS
Moose	428	M	E
Moose	429	M	5SS
Moose	433	M	5LE
Moose	433	M	7SS,WF
Moose	443	M	E
Moose	444	M	E
Moose	448	M	2SS,3LE
Moose	452	M	3SS
Moose	460	M	3SS,LE
Moose	462	M	E
Moose	472	M	SS
Moose	472	M	9SS
Moose	473	M	3SS
Moose	474	M	3SS
Moose	482	M	E
Moose	483	M	SS
Moose	483	M	6SS
Moose	486	M	2SS
Moose	492	M	E
Moose	493	M	E
Moose	498	M	4SS,WF
Moose	510	M	7SS,WF
Moose	510	M	SM

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Appendix E1.-Page 8 of 9.

Location	Fork Length	Sex	Stomach Content[a]
Moose	512	M	E
Moose	521	M	E
Moose	522	M	6RS
Moose	525	M	5SS
Moose	528	M	2KS,3SS
Moose	530	M	5RS
Moose	540	M	15RS,LP
Moose	540	M	2SS
Moose	543	M	3SS,2SB
Moose	548	M	E
Moose	551	M	4KS,3SS
Moose	554	M	9SS
Moose	555	M	E
Moose	561	M	E
Moose	563	M	E
Moose	566	M	E
Moose	573	M	E
Moose	588	M	E
Moose	593	M	2SS
Moose	593	M	3RS
Moose	595	M	E
Moose	601	M	E
Moose	602	M	5SS(B)
Moose	610	M	WF
Moose	614	M	E
Moose	621	M	7SS,WF
Moose	622	M	E
Moose	624	M	RT
Moose	647	M	E
Moose	653	M	E
Moose	658	M	E
Moose	673	M	E
Moose	685	M	E
Moose	804	M	WF
Moose	456		RT,2SS
Moose	492		2WF
Moose	547		4SS
Moose	612		3SS(B)
Whitsoe	458	F	12SS,3SB
Whitsoe	508	F	4SS(B)
Whitsoe	521	F	E
Whitsoe	541	F	E
Whitsoe	543	F	E
Whitsoe	545	F	LP

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Appendix E1.-Page 9 of 9.

Location	Fork Length	Sex	Stomach Content[a]
Whitsoe	552	F	6SS, LP
Whitsoe	557	F	19SS, 2LP
Whitsoe	558	F	5SS,LP
Whitsoe	567	F	WF
Whitsoe	575	F	LP
Whitsoe	575	F	E
Whitsoe	597	F	4SS
Whitsoe	602	F	E
Whitsoe	608	F	9SS
Whitsoe	615	F	WF,2SS(B)
Whitsoe	638	F	E
Whitsoe	649	F	10SS
Whitsoe	658	F	16SS
Whitsoe	665	F	3SS(B)
Whitsoe	304	M	E
Whitsoe	360	M	12SS
Whitsoe	405	M	6SS
Whitsoe	406	M	14SS, RS2
Whitsoe	408	M	15SS, 3RS
Whitsoe	409	M	9SS, RS
Whitsoe	413	M	E
Whitsoe	415	M	6SS
Whitsoe	419	M	2RS
Whitsoe	421	M	E
Whitsoe	423	M	2SS
Whitsoe	464	M	8SS
Whitsoe	467	M	5SS(B)
Whitsoe	486	M	12SS,3SB
Whitsoe	492	M	6SS
Whitsoe	493	M	WF
Whitsoe	545	M	13SS, LP
Whitsoe	622	M	8SS, LP
Whitsoe	642	M	E
Whitsoe	645	M	E
Whitsoe	653	M	15SS,3RS
Whitsoe	653	M	5SS,2RS
Whitsoe	LOW WATER		E

[a] RS = SS = Coho, Sockeye, KS = King, CS = Chum and PS = Pink salmon, RT = Rainbow trout, WF = Whitefish species, LNS = Longnose sucker, SCUL = Sculpin, BB = Burbot, LP = Lamprey, SB = Stickleback, NP = Northern Pike, AG = Arctic Grayling, E = Empty, SM = Smelt, I = Invertebrate