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NORTHERN PIKE IN THE VICINITY OF THE YUKON
RIVER HAUL ROAD CROSSING, 1988¹

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ABSTRACT

A total of 1,827 northern pike *Esox lucius* were sampled and tagged from six streams located in the vicinity of the Yukon Haul Road Bridge: Dall River (964), Little Dall River (276), Old Lost Creek (437), Ray River (55), Hess Creek (78), and miscellaneous Yukon River locations (17) from 6 June until 24 August 1988. Northern pike were sampled for length, age and sex, and all fish longer than 250 mm in fork length were tagged with numbered external Floy anchor tags to provide information on age, sex and size composition of sampled stocks and to determine population abundance of the Dall River stock after subsequent recapture in 1989. Ages 5 through 9 were most frequent in all streams sampled and the oldest individuals encountered were an estimated 17 (Hess Creek) and 14 (Dall River) years of age. Age composition of northern pike in the Little Dall River is skewed toward the younger age classes in comparison with samples from the Dall River and Old Lost Creek. Female northern pike are more abundant in the larger size classes than males. Size at age information from the sampled stocks indicates that the growth rate of northern pike in the Dall River is faster than in the other stocks measured in this study, and faster than in all other stocks measured to date in interior Alaska.

A partial angler survey in the Dall River contacted 58 individuals, and it is estimated that 76 northern pike were harvested by these fishermen. An expanded harvest estimate for the entire season is not available.

Recaptures in 1988 of tagged northern pike in streams other than the ones in which they were originally tagged indicates that northern pike move both into and out of the Dall River, and it is unlikely that the population can be considered geographically closed.

KEY WORDS: northern pike, *Esox lucius*, mark-recapture, age, sex and size composition, growth, Relative Stock Density, Dalton Highway, Yukon Haul Road.

INTRODUCTION

Northern pike *Esox lucius* are the second-most sought after fish species in interior Alaska (Holmes 1987). The annual sport harvest of northern pike in Alaska has averaged about 17,000 fish between 1977 and 1987, with a high proportion (about 87%) of the statewide harvest taken in interior Alaska (Mills 1988). The annual sport harvest of northern pike from the area of the south slope of the Brooks Range, of which the Yukon Flats are a part, averaged 466 fish between 1977 and 1983, but the estimated annual harvest increased to 2,250 fish between 1984 and 1987 (Mills 1979-1988).

Completion of the North Slope Haul Road (also called the Dalton Highway) and the Yukon River Bridge with its small boat launching ramp in 1973 provided easy access for urban recreational fishermen to the middle Yukon River and its tributaries, including the vast wetlands of the western Yukon Flats. Pressure on local fish resources, especially those closest to the bridge, has increased because of the influx of new users, although the extent and intensity of new use has not been measured. The primary sport fisheries in the area are for northern pike, sheefish *Stenodus leucichthys*, and Arctic grayling *Thymallus arcticus* in tributaries and sloughs of the Yukon River and in nearby lakes.

Residents of Stevens Village petitioned the Alaska Department of Fish and Game (ADFG) and the Alaska Board of Fisheries (ABOF) in 1987 to reduce or eliminate the sport fishery taking place in the Dall River. The Dall River is utilized by local subsistence fishermen, and it is also the stream most frequently visited by sport fishermen entering the area via the Haul Road. Stevens Village residents have alleged that non-local sport fishermen have damaged private property on the Lower Dall River and have depleted stocks of northern pike in streams near the Dalton Highway Bridge. Limited responses from the statewide harvest surveys in 1979, 1984, 1985, and 1986 indicate that the sport harvest of northern pike from the Dall River has ranged from zero (1979) to as high as 1,750 (1984) (Mills pers. comm.)¹.

Sumida (1988) reports that 730 northern pike were harvested for subsistence by residents of Stevens Village in 1984. The proportion of the subsistence harvest which is taken from the Dall River is not known, although it is clear that the Dall River drainage is used frequently for subsistence activities.

In December 1987, the ABOF placed a daily bag and possession limit of five northern pike (only one longer than 30 inches) in the area of the Yukon River and its tributaries from the mouth of the Tanana River upstream to and including the Hodzana River drainage. Prior to this action, there had been no bag limit for northern pike in the area. The Board of Fisheries action should slow the growth of the sport fishery until stock assessment can be carried out. An identical bag limit regulation was enacted for the Tanana River drainage where conservation concerns have emerged for this species in several locations.

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The primary study goal of this project is to determine whether the estimated annual harvest of northern pike from the Dall River is sustainable. Populations were surveyed within the Dall River and adjacent watersheds (Figure 1) to estimate abundance, age, and size of northern pike in the Dall River and nearby streams to provide a basis for determining sustainable yields and to define the composition of the local stocks. An abundance estimate of northern pike in the Dall River will not be available until the second sampling event occurs in 1989.

Study Objectives

The study was scheduled for two-years duration with analysis of stock definition and abundance scheduled for the second year (1989). Project objectives for the 1988 field season were to:

1. capture, tag, and release in healthy condition a total of 1,050 northern pike of fork length greater than 250 mm in the Dall River to provide a sufficient number of marked individuals in the population to conduct a population estimate in 1989;
2. capture, tag and release in healthy condition a total of 1,600 northern pike of fork length greater than 250 mm in watersheds adjacent to the Dall River to test the hypothesis that the Dall River population is geographically closed²;
3. estimate the sex and age compositions of the population(s) of northern pike in and outside the Dall River;
4. estimate the mean length of northern pike in the population(s) in and outside the Dall River and in the subsistence and sport harvest; and,
5. estimate the parameters in age-length relationship for the population of northern pike in the Dall River.

Because there is little information on the number of fishermen in this area, data from fishermen interviews in 1988 will be used to test the feasibility of a harvest survey, and of obtaining accurate and precise estimates on the demography, preferences, and harvest rates of fishermen.

Study Area

The Yukon River and its tributaries in the vicinity of the Dalton Highway (Figure 1) include an area which encompasses the drainages of Hess Creek, Ray River, Little Dall River, Dall River, Alfred Creek, and Old Lost Creek.

Hess Creek enters the Yukon River from the east at 65° 40'N, 149° 49'W approximately 48 km downstream from the Dalton Highway bridge. Current velocity is slow in the lower reaches, becoming swifter approximately 3 km

² A population has been arbitrarily defined as geographically closed if no more than 5% of its population is composed of new immigrants.

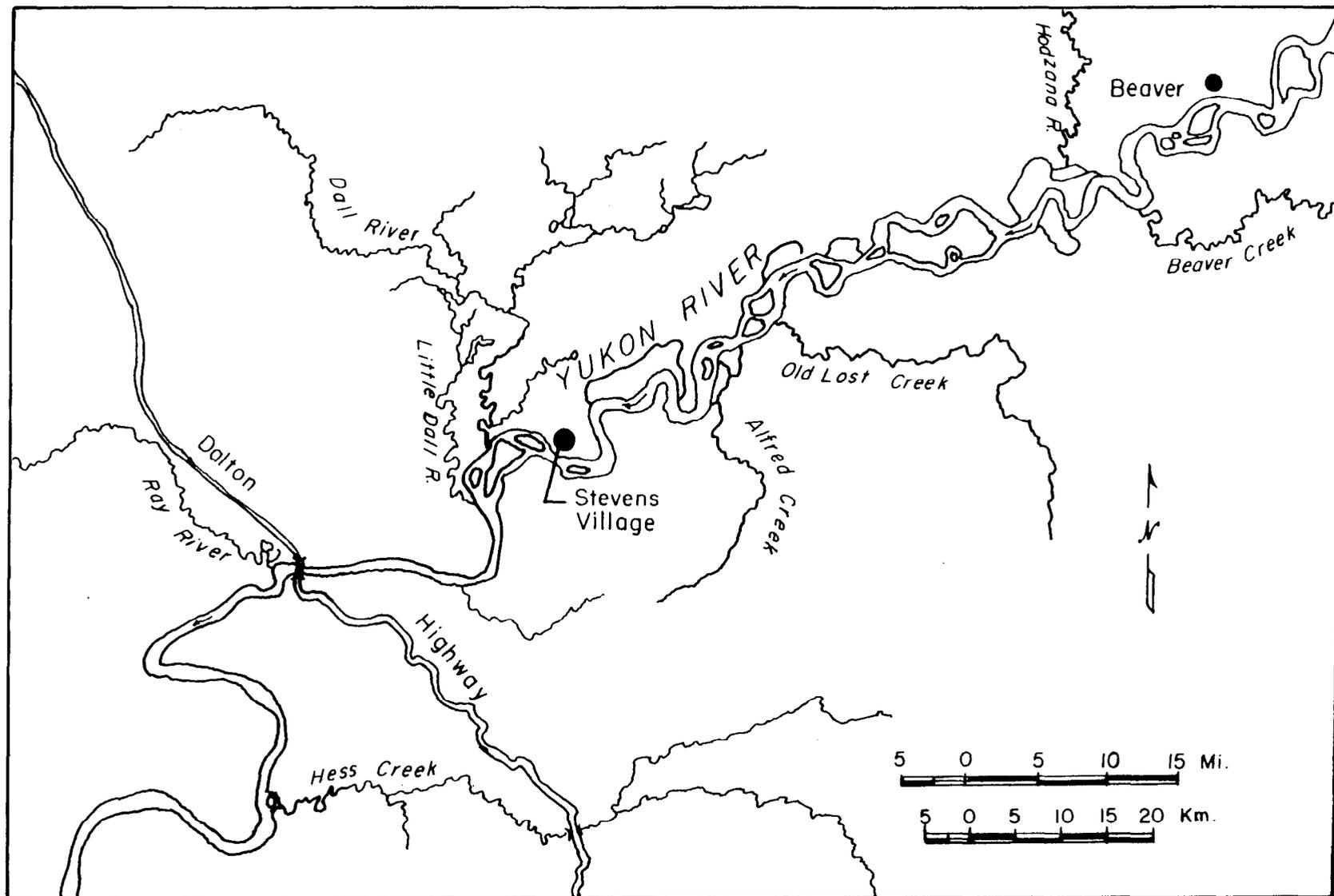


Figure 1. Yukon River drainage from Beaver to Hess Creek.

upstream from the mouth, where gravel bars and riffles begin to emerge. Good habitat for northern pike is limited to the lower 2 to 3 km of the stream.

The Ray River enters the Yukon River from the north at 65° 53'N, 149° 48'W., approximately 4 km downstream from the Dalton Highway Bridge. The stream is slow moving in the lower reaches with two large sloughs near the mouth. Approximately 4 km upstream, the river becomes shallow. Navigability as well as the best northern pike habitat, is generally restricted to below this point.

The Little Dall River enters the Yukon River from the west at 65° 56'N, 149° 17'W, approximately 33 km upstream from the Dalton Highway Bridge. It is a slow, meandering stream throughout its drainage in the Yukon Flats, and drains the area between the Dall River and the Fort Hamlin Hills. The drainage has interconnections with the Dall River approximately 70 km upstream from the mouth via two channels. The cross drainage allows exchange of water between the two systems and the potential for interchange of fish populations. Many lakes connect to the Little Dall River, and the drainage provides extensive habitat for whitefish, ciscoes, and northern pike. A log jam completely blocks the stream to boat travel approximately 26 km upstream, and no sampling was conducted above that point.

The Dall River enters the Yukon River from the north at 66° 00' 30"N, 149° 15'W, approximately 40 km upstream from the Dalton Highway Bridge. It is the largest river sampled in this study and drains an extensive area of the western Yukon Flats between the Little Dall River on the west and the Hodzana River on the east. Its drainage includes Datkokan Creek, Pat Creek and The Forks as well as many lakes. The Dall River provides extensive habitat for northern pike and whitefish. A log jam, located approximately 18 km upstream is a barrier to boat traffic on the river (Figure 2). This barrier was overcome on several occasions and sampling was carried out as far upstream as Geese Lake on The Forks. Another, much larger, log jam was observed from the air approximately 4 km upstream of The Forks on the mainstem of the Dall River.

Old Lost Creek enters the Yukon from the east at 66°08'N, 148° 35'W, approximately 101 km upstream from the Dalton Highway Bridge. It is a slow stream draining a series of lakes between the Yukon River and hills to the south and provides excellent habitat for northern pike and whitefish.

Land Status

Land surrounding the mouth of Hess Creek has received an interim conveyance to private ownership from the Bureau of Land Management. From approximately 5 km upstream of the mouth of Hess Creek, lands surrounding the creek have been selected by the state of Alaska. The status of lands surrounding the mouth of Ray River is more complicated. With the exception of the downstream corner of the mouth of the river, the majority of the land in the immediate area on both sides of the Yukon River have been state-selected. Some individual and village selections have been made just upstream of the mouth, however. As of this writing, no special landowner restrictions have been announced on any of the selected or conveyed parcels near the mouths of the two streams.

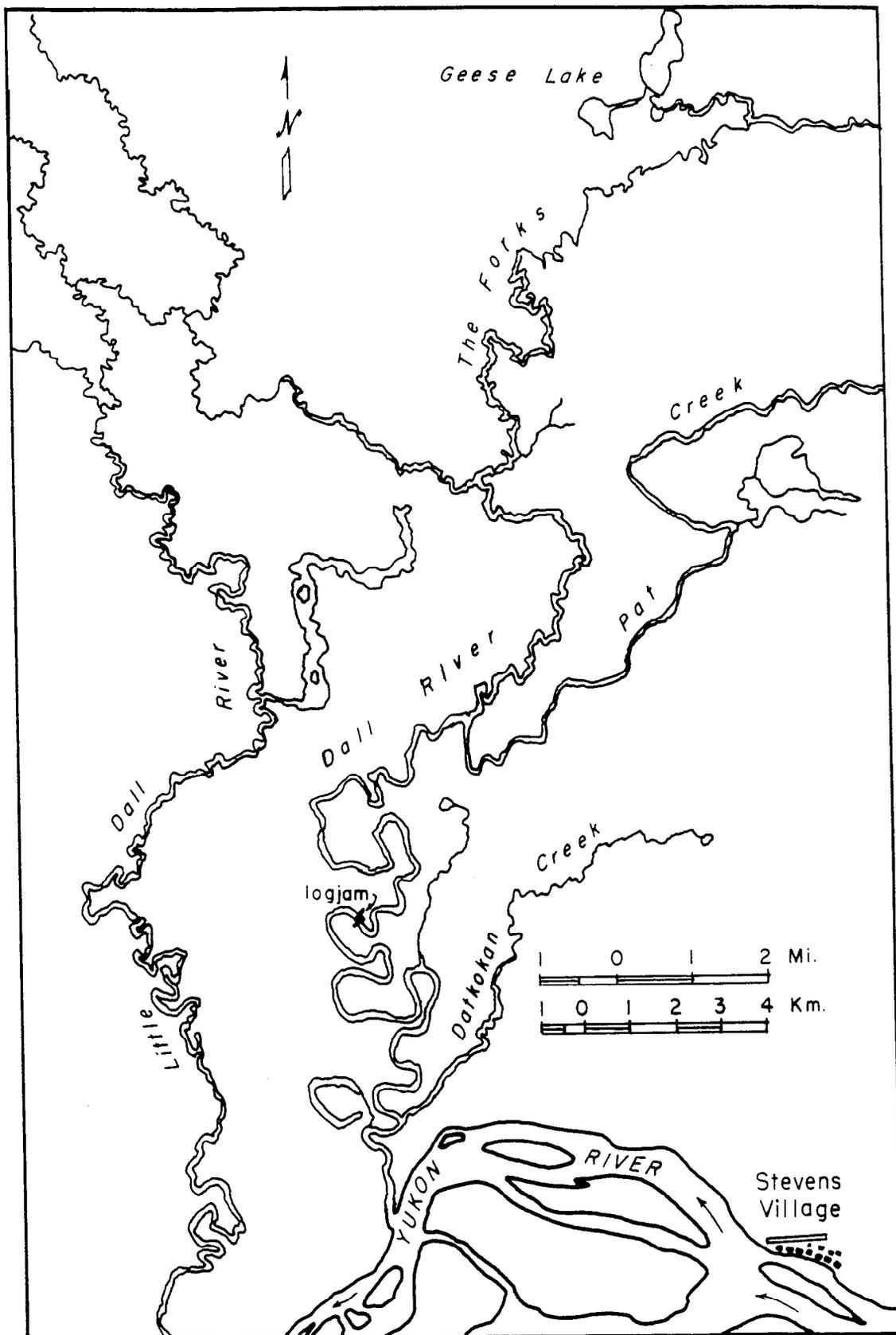


Figure 2. Lower portions of the Dall River and Little Dall River drainages, western Yukon Flats.

A large fraction of the land within the Little Dall and Dall River drainages have been selected for transfer to native corporation ownership, both by the regional Doyon Corporation, as well as by Dinyee, the local Stevens Village corporation. In addition, several land allotments have been conveyed to individuals, many of which are located along the Dall and Little Dall Rivers. Many larger land blocks, townships, have been conveyed to corporate ownership. An inexact portrayal of the larger land selections and ownership status is presented in Appendix Figure 1. The distinction between selected and conveyed lands is important since selected lands are still considered public domain, while the conveyed lands are privately owned and may be subject to common landowner restrictions.

Almost the entire area surrounding Old Lost Creek has received interim conveyance to the regional native corporation.

MATERIALS AND METHODS

Fish Capture

Sampling occurred in tributaries that flow into three sections of the Yukon River: (1) between the Tanana and the Dall Rivers, (2) the Dall River and tributaries, and (3) between the Dall and Hodzana Rivers. In the first section, northern pike in the Little Dall River, Ray River, and Hess Creek were captured. Fish in the Dall River were sampled in the second section. In the third section, sampling occurred in Old Lost Creek.

Floating and sinking variable mesh gill nets were the primary gear used to capture northern pike throughout the study area. Other capture methods included hook and line, baited and unbaited trap nets, and electrofishing.

Gill nets were of two types:

- 1) Floating five panel, 38 m (125 ft) long with 7.6 m (25 ft) panels of 25 mm (1.0 in), 38 mm (1.5 in), 51 mm (2.0 in), 64 mm (2.5 in), and 76 mm (3.0 in) bar mesh multifilament netting.
- 2) Sinking and floating six panel, 46 m (150 ft) long with 7.6 m panels of 25, 38, 51, 25, 38, and 51 mm bar mesh multifilament netting.

Trap nets were of either the hoop trap or fyke configuration. Hoop traps were used predominantly in the study and consisted of a trap 1 m (3 ft) in diameter by 4 m (12 ft) long with 25 mm square mesh nylon netting on seven fiberglass hoops and with finger-style throats on second and fourth hoops. Attached leads and wings were of various lengths up to 10 m and depths up to 1.3 m (4 ft) with mesh sizes of from 25 mm to 64 mm.

Field work commenced on 6 June and continued through 24 August during which time a crew of three to four persons was present for six, 10 day periods in the study area. Streams in the study area were accessed with both a 4.9 m and a 5.5 m flat-bottom river skiff equipped with outboard motors.

General procedures during each 10-day sample period were to first install up to 12 trap nets throughout the area to be sampled. Traps were sometimes baited if fished singly without leads, and unbaited if used with net leads. Several double trap sets were made, consisting of two traps back to back near shore, with mouths oriented up- and downstream respectively. Leads were installed from each mouth hoop towards midstream to guide fish moving along shore to the trap mouths. Many of the traps were set singly, nearshore, without leads and with or without bait. Traps once set were usually kept at the same fishing location for the duration of the sampling period.

Following installation of traps, a number of gill nets were set in the area to be sampled. Two sets of gill nets were monitored by either two persons per boat, or in the case of a three person crew, two persons in one boat and a single person in another. The amount of gill net gear fished at any one time depended upon catch rates. During extremely slow sampling periods, with catch rates less than one fish per net hour, up to six nets were fished by each boat, and as few as a single net was fished per boat during periods of high catch rates (> 10 fish/net hour). Because of the limited size of the waterways fished during the study, gill nets were usually tied off on shore, shortening the length of net actually fished 25% to 50% of the total net length. Gill nets were set from shore perpendicular to the current direction, generally in shallow (less than 2 m) water. Current velocity of all sampling locations was less than 0.5 m/sec. Gill nets were fished from six to 13 hours each sampling day. Nets were checked every 30 minutes to one hour to minimize net-induced sampling mortality. Traps were checked once every 12 hours. Size of gill net mesh was not recorded for each pike captured.

Northern pike were tagged with individually-numbered Floy FD-68 anchor tags placed near the insertion of the interneural rays of the dorsal fin. The left pectoral fin was partially removed from fish caught in the first study section, the right pectoral from fish caught in the second section, and the left pelvic fin from fish caught in the third section.

Set and lift times were recorded for each trap net and gill net. Locations of each trap net and gill net were sequentially numbered and recorded on maps. A separate map was used for each day.

Boat-mounted electroshocking techniques, using pulsed DC impulses were attempted on several occasions.

Age, Sex, and Length

After removal from gill nets, each northern pike was measured to the nearest millimeter of fork length (FL), and examined for evidence of external sex characteristics according to methods described by Casselman (1974). Weight was not measured in this study.

Scales for determination of age were removed from each live fish, and scales, vertebrae (cervical), and cleithra were taken from each dead fish. All mortalities were dissected to verify sex and maturity by examination of the gonads. All length, sex and tag data were recorded on standard tagging length

mark sense forms. Scales were stored in coin envelopes and later removed, cleaned, and mounted (two per fish) on gum cards. Gum cards were used to make scale impressions on 20 mil acetate using a Carver press at 137,895 kPa (20,000 psi) heated to 93°C for 30 seconds. Individual fish ages were estimated from examining the scale impressions on a 3M Consultant Microfische reader and counting annular growth checks. Age of each fish was estimated in two separate trials by the same reader on different days. Estimated age in the second trial was assumed to be more accurate than estimated age in the first trial.

Data Analysis

Age and sex composition was evaluated in each of the five streams sampled in the study area. Data were not stratified by time period. The percent age composition and associated variances were estimated as multinomial proportions using the following formulas (Cochran 1977):

$$(1) \hat{p}_i = \frac{n_i}{n};$$

$$(2) V[\hat{p}_i] = \frac{\hat{p}_i(1-\hat{p}_i)}{n-1};$$

where:

\hat{p}_i = the proportion of age i in the sample;

n_i = the number of fish of age i in the sample; and,

n = the number in the sample.

Age distribution of combined sexes by stock was examined using the Chi square test. The three stocks examined for similiarity in age distribution were Dall River, Old Lost Creek, and Ray/Hess/Little Dall Rivers.

Mean length-at-age was calculated as the arithmetic mean for male and female northern pike. The mean length of northern pike sampled by sex in each of the sampled streams was estimated. Variances and standard errors for mean lengths were also calculated using standard normal procedures. Length distribution of combined sexes by stream was compared using the Chi square test.

Minimum length categories for Relative Stock Density (RSD) were defined after review of Gabelhouse (1984). The RSD estimates were calculated as the percent of all northern pike 300 mm FL and longer within a defined category.

Growth characteristics by stock were estimated with length-at-age data. The von Bertalanffy growth model (Ricker 1975) was chosen to calculate absolute

growth at ages 1 through 14 years. Model parameters were the theoretical maximum length (L_{∞}), the Brody growth coefficient (K), and the theoretical length at age 0 (t_0). These parameters were fitted by nonlinear regression with the Marquardt compromise (Marquardt 1963). The range of parameter values chosen for iteration by the model were L_{∞} : 400 to 1,200 mm by 200 mm increments; K: 0 to 0.4 by 0.1 increments; and t_0 : -2.0 to 2.0 mm by 0.5 mm increments.

Dall River Abundance Estimate

To generate a population estimate in 1989, a two-year, two sampling experiment was initiated in 1988. This experiment was Chapman's (1951) modification of the Petersen estimate. Since no prior information on the abundance of northern pike in the Dall River existed, an approximate estimate (N_0) was calculated. The number of fish which must be tagged in 1988, and the number of fish which must be inspected in 1989 was calculated using N_0 .

Harvest information was used to calculate N_0 . Limited experience with stocks of northern pike in the Tanana River drainage has shown that annual yields of 16% percent from a stable population are sustainable based on estimates of abundance and harvest of northern pike from Volkmar Lake (Mills 1987; Peckham 1986; Peckham and Bernard 1987). The estimate of harvest of northern pike in subsistence and in sport fisheries on the Dall River in 1984 was 2,480 (Mills pers. comm.³; Sumida pers. comm.⁴). Assuming that this level of harvest would be a maximum sustainable yield and that productivity of this population is similar to that of stocks so far studied, approximately 15,500 northern pike should be present in the Dall River population.

At this abundance, 800 fish must be marked and released in 1988. Since mortality would reduce the number of tags in the population over a year's time, the sample size was increased to 1,050 for the sampling event in 1988 by assuming a 75% annual rate of survival.

Geographic Closure of the Dall River Northern Pike Population

To test the hypothesis that the population of northern pike in the Dall River is geographically closed, the probability of a fish tagged outside of the Dall River, migrating to the Dall River and being caught there was calculated. If the abundance of fish in the Dall River is 15,500 and if 800 of these fish are sampled in 1989 (about 5%), the probability of a fish tagged outside of the Dall River, migrating to the Dall River and being caught there is 0.0025. Therefore for a 95% chance of finding at least one immigrant in the Dall River under these conditions, m fish must be tagged, such that $\alpha = (1 - 0.0025)^m$. The solution is 1,200 fish; this number was adjusted to 1,600 after consideration of a 75% rate of annual survival.

³ Mills, M. J. 1989. Personal communication. Alaska Department of Fish and Game, 333 Raspberry Rd., Anchorage, AK.

⁴ Sumida, V. A. 1988. Personal communication. Alaska Department of Fish and Game, 565 University Ave., Fairbanks, AK.

For a 95% chance of finding at least one immigrant in the Dall River, x fish in the river must be inspected, such that:

$$(3) \alpha = \left[1 - \frac{x(0.05)}{15,500} \right]^s$$

where s is the number of fish tagged in 1988 which are still alive in 1989 after an annual mortality rate of 75%.

Creel Survey

The following information was recorded during each angler interview:

- 1) Date and time of day;
- 2) Location (coded to individual stream or section of stream);
- 3) Number of fishermen in party;
- 4) Time spent fishing (hours, completed fishing, still fishing);
- 5) Number of fish by species kept and released;
- 6) Demography (sex, adult or youth, resident or non-resident, local or non-local, civilian or military, guided or unguided); and,
- 7) Gear (type of gear, type of boat, number of hooks, length of net, mesh size).

Data from interviews were entered onto standard mark-sense forms.

RESULTS

Sampling and Tagging

A total of 1,827 northern pike were sampled and tagged in six streams: Dall River (964), Little Dall River (276), Old Lost Creek (437), Ray River (55), Hess Creek (78) and miscellaneous Yukon River (17) from 6 June until 24 August, 1988. Distribution of sampling effort by time period (Table 1) indicates that sampling was most intense in the Dall River, where northern pike were sampled during every time block available.

The majority, 1,330 (73%) of the fish were captured by gill net, while hoop-traps accounted for 385 (21%), hook and line 108 (6%), fyke-trap and electroshock methods accounted for two fish (< 1%) each. Electroshocking techniques were, for the most part, unsuccessful in this study.

Two burbot were captured and tagged during the study. Both were taken at the confluence of the Dall River and the Yukon River with hoop traps.

Immediate sampling mortality in 1988 totalled 64 northern pike, 4.0% of all northern pike sampled during the study. All mortalities occurred in gill net gear.

Table 1. Yukon River northern pike tagging summary by time block, 1988.

Location	6-15 June	20-29 June	5-13 July	18-27 July	2-10 August	16-24 August	Total
Dall River	70	162	190	2	134	406	964
L. Dall River			276				276
Old Lost Creek				437			437
Ray River					55		55
Hess Creek					78		78
Misc. Yukon Rivers				16		1	17
Total	70	162	466	455	267	407	1,827

Age, Sex, and Length

A total of 1,747 northern pike were aged and sexed from all sampling locations. The total sample included 897 males and 850 females. The oldest fish sampled were a 17 year old male from Hess Creek and 14 year old females from Dall River and Old Lost Creek. There is no apparent dominance of females in samples of the older (more than 11 years) fish from any of the sampled streams (Table 2). For males, 7 year old fish were most prevalent in all streams with the exception of Little Dall River and Ray River where age 4 and age 6 fish, respectively, were more frequent in samples. Ages 5 through 9 inclusive, comprised 81% of the males sampled in the Dall River, 60% of Little Dall River, 82% of Old Lost Creek, 82% of Ray River and 55% of males sampled in Hess Creek.

The same comparison for female northern pike indicates that 77% of Dall River, 66% of Little Dall River, 74% of Old Lost Creek, 82% of Ray River, and 79% of the Hess Creek samples were of ages 5 through 9. For combined sexes, 79% of Dall River, 64% of Little Dall River, 57% of Old Lost Creek, 65% of Ray River, and 65% of Hess Creek samples were of those age classes.

Age distribution of combined sexes for each stream sampled illustrates that age composition of northern pike in the Little Dall River is skewed toward the younger age classes in comparison with samples taken from the Dall River and Old Lost Creek (Figure 3).

Estimated age distributions of combined sexes significantly differed among northern pike stocks in Old Lost Creek, Ray/Hess/Little Dall and Dall Rivers (Chi-square = 228.9, df = 20, P < 0.001).

For all sites sampled, Dall River northern pike were the largest, for ages 3 through 10 (Table 2). Of the remaining sampled stocks, sample sizes from Ray River and Hess Creek are too small to permit a meaningful conclusion to be drawn, and between Old Lost Creek and Little Dall River samples, Old Lost Creek northern pike are most frequently larger at ages 3 through 10. Length frequency distribution (Table 3, Figure 4) indicates that the average size of northern pike in the Dall River and Old Lost Creek is larger and the distribution more normal than in the Little Dall River, Hess Creek and Ray River samples. Northern pike sampled from the Little Dall River were smaller in average fork length than those sampled from the Dall River and Old Lost Creek.

Length distribution by sex for the Dall River and Ray/Hess/Little Dall Rivers upstream and downstream categories indicates smaller-sized fish were present in the "downstream" category compared to the other river systems examined (Figure 5).

The RSD estimates (Table 4) using the method of Gabelhouse (1984) indicates that a higher proportion of the Dall River and Old Lost Creek northern pike samples are in the "preferred" size range in contrast to downstream stocks where the sampled fish were predominantly in the "quality" and "stock" size categories.

Table 2. Age and length (mm) of northern pike sampled from streams near the Yukon River Haul Road Bridge, June - August 1988.

Age	Males			Females			Combined ¹		
	Sample Size	Length		Sample Size	Length		Sample Size	Length	
		mean	SE		mean	SE		mean	SE
<u>Dall River</u>									
1	0	---	---	0	---	---	1	301	---
2	1	461	---	1	460	---	4	404	29
3	7	550	19	13	534	12	20	540	10
4	36	568	10	39	580	9	78	572	7
5	83	612	6	50	618	9	134	613	5
6	80	650	9	74	668	8	155	659	6
7	101	661	6	101	679	8	203	670	5
8	67	692	9	69	728	9	136	710	6
9	58	697	8	50	735	12	108	715	7
10	27	727	12	25	768	20	53	760	12
11	8	736	19	14	745	25	22	742	17
12	8	774	23	8	861	36	16	817	27
13	4	709	30	1	960	---	4	770	62
14	1	715	---	3	851	26	4	817	33
15	0	---	---	0	---	---	0	---	---
16	0	---	---	0	---	---	0	---	---
17	0	---	---	0	---	---	0	---	---
Total	481	647	---	448	683	---	938	669	---
<u>Little Dall River</u>									
1	1	266	---	1	347	---	5	310	14
2	3	443	39	1	455	---	5	418	39
3	13	480	10	12	486	17	25	483	9
4	29	500	9	32	500	8	61	500	6
5	24	541	9	35	544	13	59	543	9
6	19	559	17	24	571	13	43	566	10
7	15	578	12	22	600	15	37	591	10
8	10	648	22	16	668	20	26	660	15
9	3	714	27	4	660	19	7	683	19
10	0	---	---	4	632	16	4	632	16
11	1	791	---	1	791	---	2	827	56
12	0	---	---	0	---	---	0	---	---
13	0	---	---	0	---	---	0	---	---
14	0	---	---	0	---	---	0	---	---
15	0	---	---	0	---	---	0	---	---
16	0	---	---	0	---	---	0	---	---
17	0	---	---	0	---	---	0	---	---
Total	118	543	---	152	561	---	274	550	---

- continued -

Table 2. Age and length (mm) of northern pike sampled from streams near the Yukon River Haul Road Bridge, June - August 1988 (continued).

Age	Males			Females			Combined ¹		
	Sample Size	Length		Sample Size	Length		Sample Size	Length	
		mean	SE		mean	SE		mean	SE
<u>Old Lost Creek</u>									
1	0	---	---	0	---	---	0	---	---
2	0	---	---	0	---	---	1	300	---
3	1	315	---	2	428	4	5	398	23
4	3	534	53	6	509	34	9	517	24
5	19	555	11	19	576	29	38	565	10
6	30	602	9	24	598	25	54	600	7
7	56	618	7	36	613	23	92	616	6
8	50	635	8	30	672	26	80	649	7
9	42	662	7	25	721	26	67	684	8
10	24	695	14	20	700	28	44	697	12
11	12	729	18	10	776	36	22	750	20
12	2	795	126	9	799	10	11	798	19
13	2	900	27	0	-	---	2	900	27
14	0	---	---	1	800	---	1	800	---
15	0	---	---	0	---	---	0	---	---
16	0	---	---	0	---	---	0	---	---
17	0	---	---	0	---	---	0	---	---
Total	241	637	---	182	655	---	426	643	---
<u>Ray River</u>									
1	0	---	---	1	325	---	0	---	---
3	0	-	---	1	337	---	1	325	---
4	3	497	35	6	512	17	1	337	---
5	2	530	82	5	567	10	10	509	14
6	6	568	16	3	568	21	7	556	20
7	4	494	36	7	619	30	9	568	12
8	0	---	---	3	590	17	11	610	23
9	0	---	---	3	764	61	3	590	17
10	2	747	89	3	643	80	3	764	61
11	0	---	---	2	833	103	5	685	58
12	0	---	---	0	---	---	2	833	103
13	0	---	---	0	---	---	0	---	---
14	0	---	---	0	---	---	0	---	---
15	0	---	---	0	---	---	0	---	---
16	0	---	---	0	---	---	0	---	---
17	0	---	---	0	---	---	0	---	---
Total	17	555	---	34	596	---	52	589	---

- continued -

Table 2. Age and length (mm) of northern pike sampled from streams near the Yukon River Haul Road Bridge, June - August 1988 (continued).

Age	Males			Females			Combined ¹		
	Sample Size	Length		Sample Size	Length		Sample Size	Length	
		mean	SE		mean	SE		mean	SE
<u>Hess Creek</u>									
1	0	---	---	0	---	---	1	285	---
2	3	534	17	0	---	---	3	534	17
3	0	---	---	1	404	---	1	404	---
4	6	472	29	4	459	28	10	467	20
5	8	513	21	4	531	18	12	519	15
6	3	552	54	6	522	43	10	507	38
7	8	589	21	9	589	32	17	589	19
8	1	582	---	6	604	11	8	560	42
9	2	671	4	1	775	---	3	699	28
10	2	675	19	1	790	-	3	713	14
11	3	786	12	2	754	4	5	773	10
12	1	710	---	0	---	---	1	710	---
13	1	707	---	0	---	---	1	707	---
14	1	838	---	0	---	---	1	838	---
15	0	---	---	0	---	---	0	---	---
16	0	---	---	0	---	---	0	---	---
17	1	930	---	0	---	---	0	---	---
Total	40	593	---	34	573	---	77	572	---

¹ Includes fish of unknown sex.

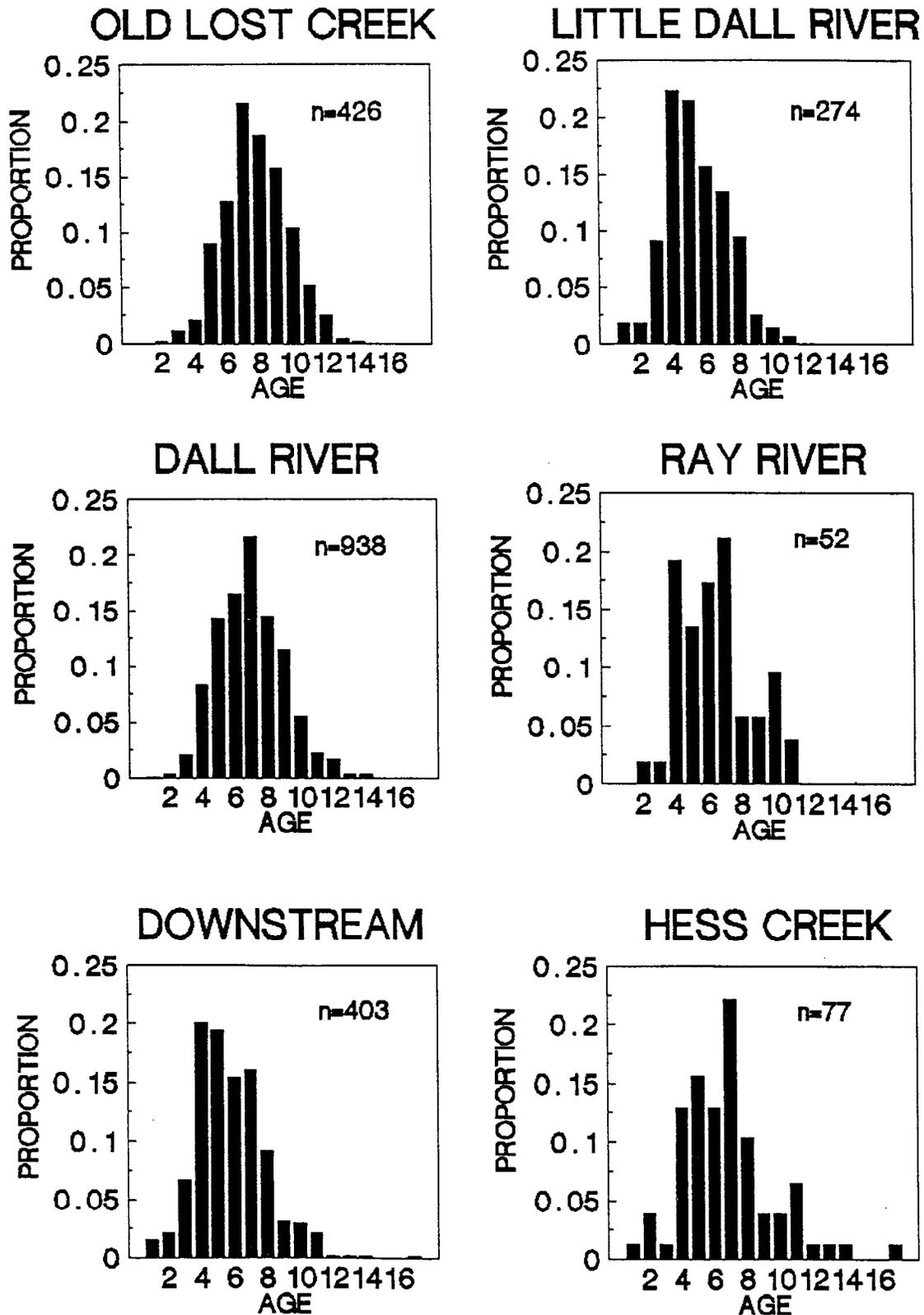


Figure 3. Age proportions of northern pike captured in 1988 from streams in the vicinity of the Yukon River Haul Road Bridge. Downstream category includes Hess Creek, Ray River, and Little Dall River combined.

Table 3. Length distribution by sex of northern pike sampled in Yukon River tributaries, 1988.

Fork Length Range (mm)	Dall River			L. Dall R.			O. Lost Cr.			Ray River			Hess Cr.		
	M	F	All ¹	M	F	All ¹	M	F	All ¹	M	F	All ¹	M	F	All ¹
275-299	0	0	0	1	0	2	0	0	0	0	0	0	0	0	4
300-324	0	0	1	0	0	3	1	0	2	0	0	0	0	0	0
325-349	0	0	1	0	1	1	0	0	0	0	2	2	0	1	1
350-374	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
375-399	1	0	3	2	1	3	0	0	1	0	0	0	0	1	1
400-424	1	0	1	2	3	5	0	1	1	0	0	0	3	2	5
425-449	1	3	4	7	9	16	0	3	4	2	1	4	1	0	1
450-474	4	3	7	7	10	17	2	2	5	0	2	2	3	1	4
475-499	5	3	8	16	20	36	3	1	4	1	3	4	1	3	4
500-524	5	10	15	18	12	30	7	8	15	2	0	2	3	3	6
525-549	15	20	36	16	19	35	13	11	24	0	5	5	4	4	8
550-574	36	18	55	15	13	28	18	17	35	3	7	11	5	3	8
575-599	42	28	71	11	19	30	28	18	46	3	3	6	5	1	6
600-624	56	36	93	8	9	17	36	14	50	2	3	5	1	6	7
625-649	62	52	115	3	14	17	42	21	63	0	1	1	1	3	4
650-674	70	49	119	6	8	14	31	20	51	3	0	3	3	0	3
675-699	50	47	97	1	5	6	26	14	40	0	3	3	3	0	3
700-724	43	54	97	1	4	5	15	10	25	0	0	0	2	2	4
725-749	42	29	71	2	0	2	6	12	18	0	3	3	0	0	0
750-774	26	23	49	0	3	3	7	10	17	0	2	2	1	3	4
775-799	14	22	37	1	4	5	4	6	10	0	0	0	1	1	2
800-824	10	21	31	1	0	1	3	6	9	0	0	0	1	0	1
825-849	7	6	13	0	0	0	1	7	8	1	0	1	1	0	1
850-874	3	8	11	1	0	1	2	2	4	0	0	0	0	0	0
875-899	1	10	11	0	0	0	0	2	2	0	1	1	0	0	0
900-924	1	6	7	0	0	0	1	1	2	0	0	0	0	0	0
925-949	0	3	3	0	0	0	1	0	1	0	1	1	1	0	1
950-974	1	3	4	0	0	0	0	0	0	0	0	0	0	0	0
975-999	0	1	1	0	0	0	0	1	1	0	0	0	0	0	0
100-1024	0	2	2	0	0	0	0	0	0	0	0	0	0	0	0
Total	496	457	964	119	154	277	247	187	438	17	37	56	40	34	78

¹ Includes fish of unknown sex.

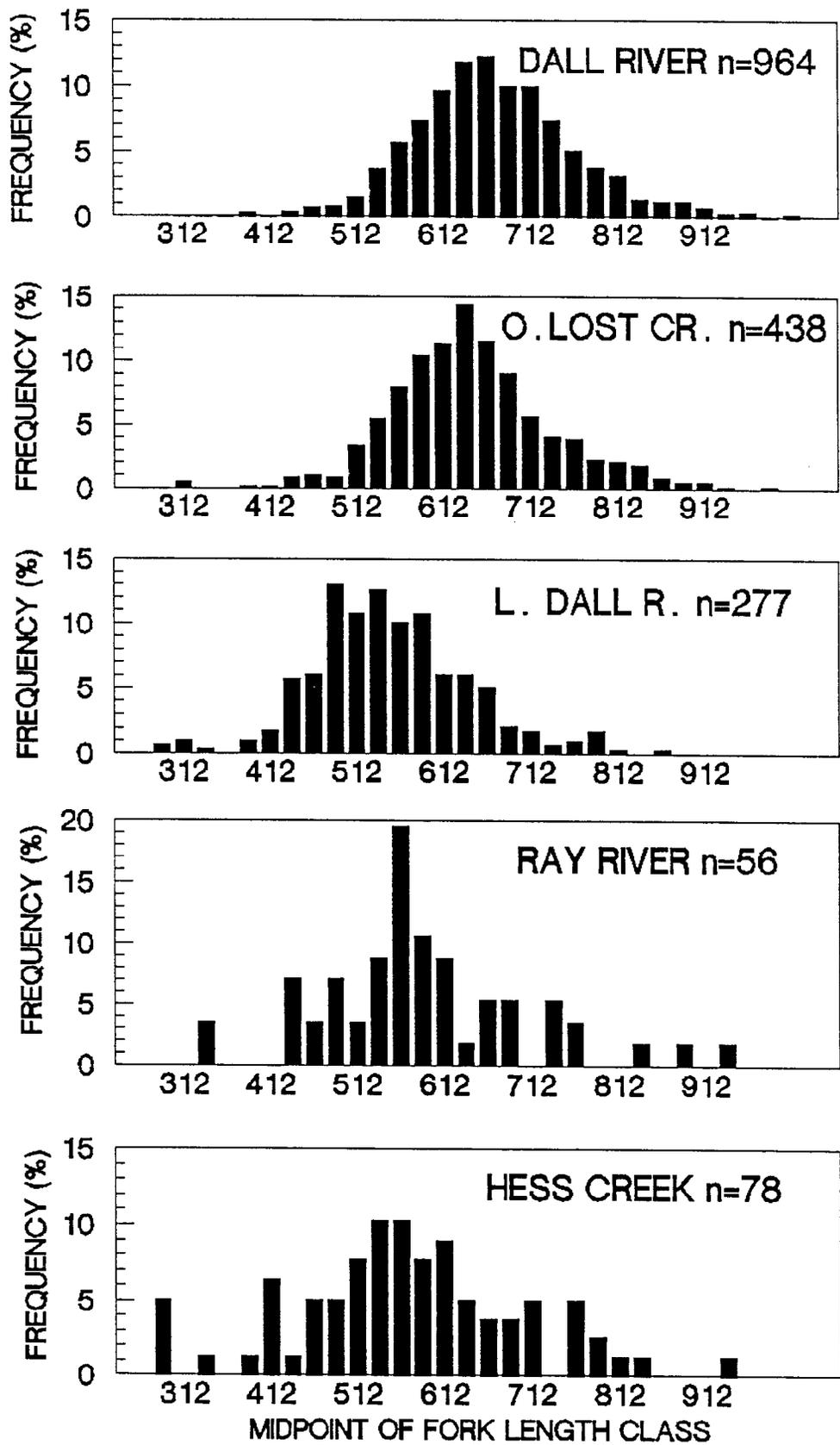


Figure 4. Frequency distribution by fork length of northern pike captured in 1988 in streams in the vicinity of the Yukon River Haul Road Bridge.

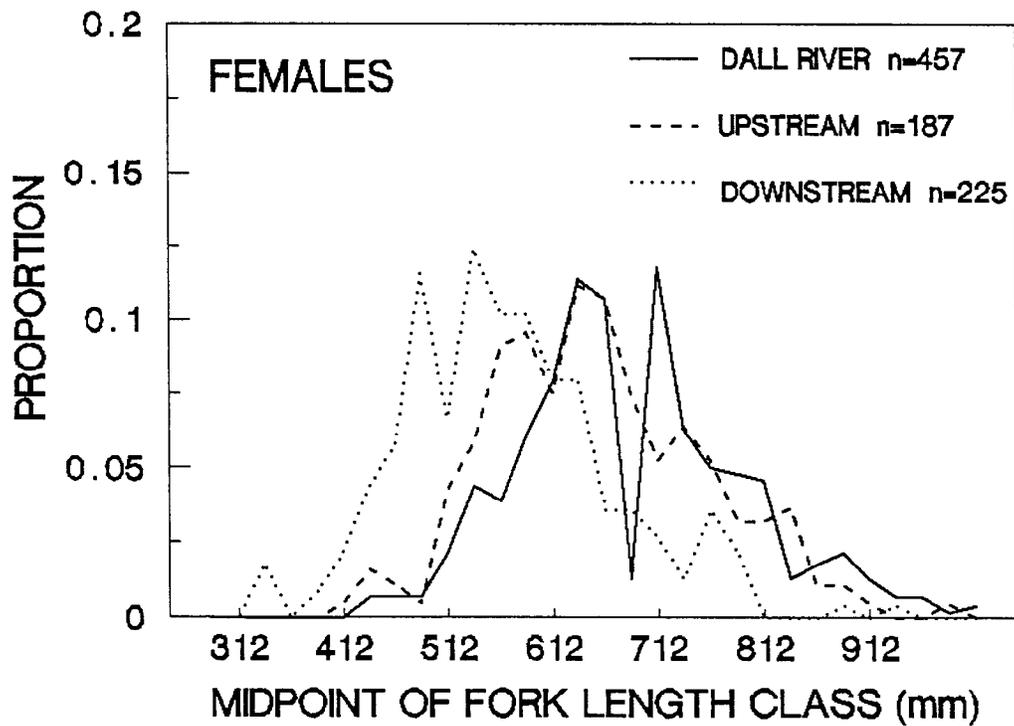
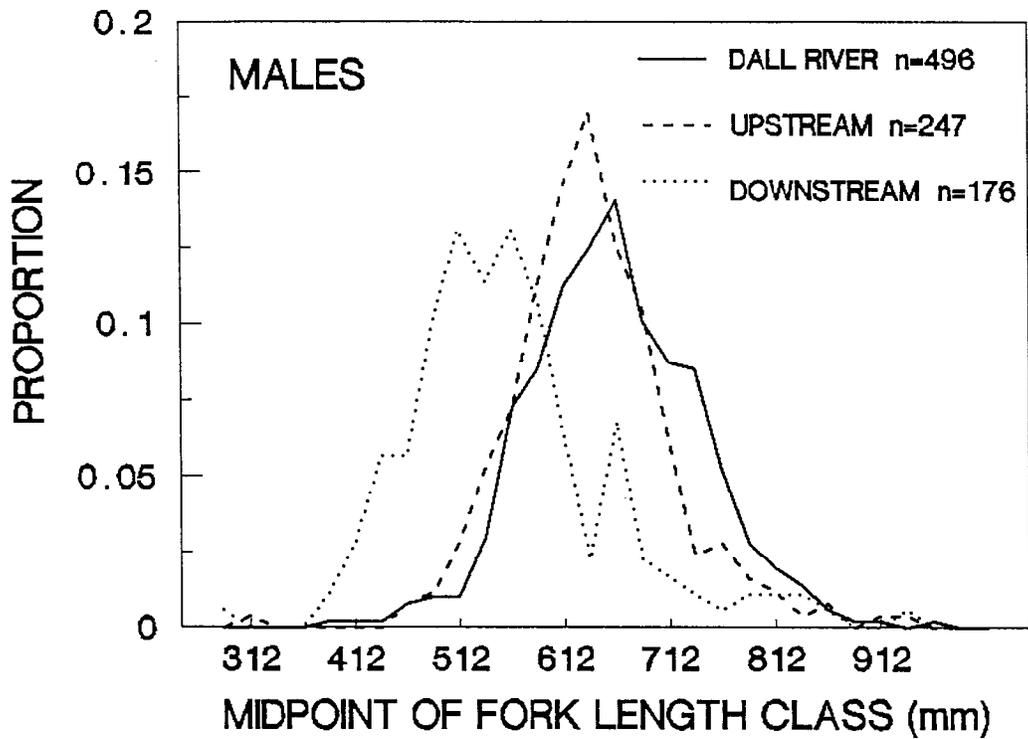


Figure 5. Fork length proportions by sex of northern pike in the vicinity of the Haul Road Bridge, 1988. Upstream category includes only Old Lost Creek. Downstream category includes Little Dall River, Ray River, and Hess Creek.

Table 4. Length categorization of northern pike sampled in Yukon River tributaries, 1988.

Category	Gabelhouse ¹ Length Range (mm)		Dall R. n % Sample ²		(Upstream) Old Lost Cr. n % Sample		L. Dall R. n % Sample		Ray River n % Sample		Hess Creek n % Sample		Downstream ³ Combined n % Sample	
	Stock	300 to	524	41	4.0	32	7.0	111	40.4	14	25.0	22	29.7	147
Quality	525 to	654	394	41.0	228	52.0	130	47.3	29	51.8	33	44.6	192	47.4
Preferred	655 to	859	493	51.0	170	39.0	33	12.0	11	19.6	18	24.3	62	15.3
Memorable	860 to	1,079	36	4.0	8	2.0	1	0.4	2	3.6	1	1.4	4	1.0
Trophy	>1,079		0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total			964	100.0	438	100.0	275	100.1	56	100.0	74	100.0	405	100.0

¹ Categories taken from Gabelhouse (1984).

² Same as Relative Stock Density, (Gabelhouse 1984).

³ Downstream includes Little Dall River, Ray River and Hess Creek.

Length distributions of combined sexes significantly differed among northern pike stocks in the Dall River and Old Lost Creek (Chi-square = 29.4, df = 3, P < 0.001) and the Dall River and Ray/Hess/Little Dall Rivers (Chi-square = 359.7, df = 3, P < 0.001).

Parameter estimates for the von Bertalanffy growth equation were generated for males and females in the Dall River. Estimates for Old Lost Creek were discarded due to failure of iterations to converge. The non-convergence of iterations is probably due to poor representation of age classes at the small end of the length-frequency distribution. Other stocks for which data are available from the Haul Road study had too few samples to attempt the analysis.

Theoretical maximum length for males and females in the Dall River was 790 mm (SE = 37) and 1,082 mm (SE = 193), respectively. The Brody growth coefficient for males and females was 0.19 (SE = 0.05) and 0.08 (SE = 0.04), respectively. The relationship between L_{∞} and K appeared to be inverse. Theoretical age at length zero for males and females was -3.04 years (SE = 1.44) and -5.54 years (SE = 2.27), respectively. A graphic comparison of age versus length at age among males and females shows slightly greater growth in females for ages 12 to 14 years (Figure 6). Five-year old northern pike from the Little Dall River averaged 541 and 544 mm for males and females, respectively. There is a wide dispersion of lengths per estimated age class for both males and females (Figure 6).

Dall River Abundance Estimate

A total of 964 northern pike were tagged in the Dall River in 1988. This is within 10% of the objective (1,050), and should provide an adequate population of marked individuals so that the abundance estimate will be within, or close to the bounds set by the objective criteria if the actual population size is at or below 15,500 northern pike. Of the 964 fish tagged in 1988, 723 are estimated to survive to 1989 after discounting for 75% annual rate of survival. Therefore, in 1989, 875 fish must be examined for tags.

Geographic Closure of the Dall River Northern Pike Population

A total of 863 northern pike were tagged outside of the Dall River in 1988. This is about half the desired number (1,600). Assuming a 75% annual survival rate, 647 should still be alive in 1989. Thus, the parameter s in equation 3 is defined as 647 fish. Using equation 3 to test the hypothesis at the 95% level, 1,425 northern pike must be inspected for tags in the Dall River in 1989.

A total of 12 tag recoveries were made from northern pike that were tagged in one drainage and recaptured in another drainage in 1988 (Table 5). All but two of the recoveries were made from fish that were originally tagged in the Dall River, while two of the recoveries were from fish tagged in the Little Dall River and recaptured in the Dall River. A total of eight recoveries have been reported by Stevens Village residents who fished in Jackson Slough, a Yukon River Slough, 3 km upstream of Stevens Village. All of the returned tags from this slough were originally placed on northern pike in the Dall

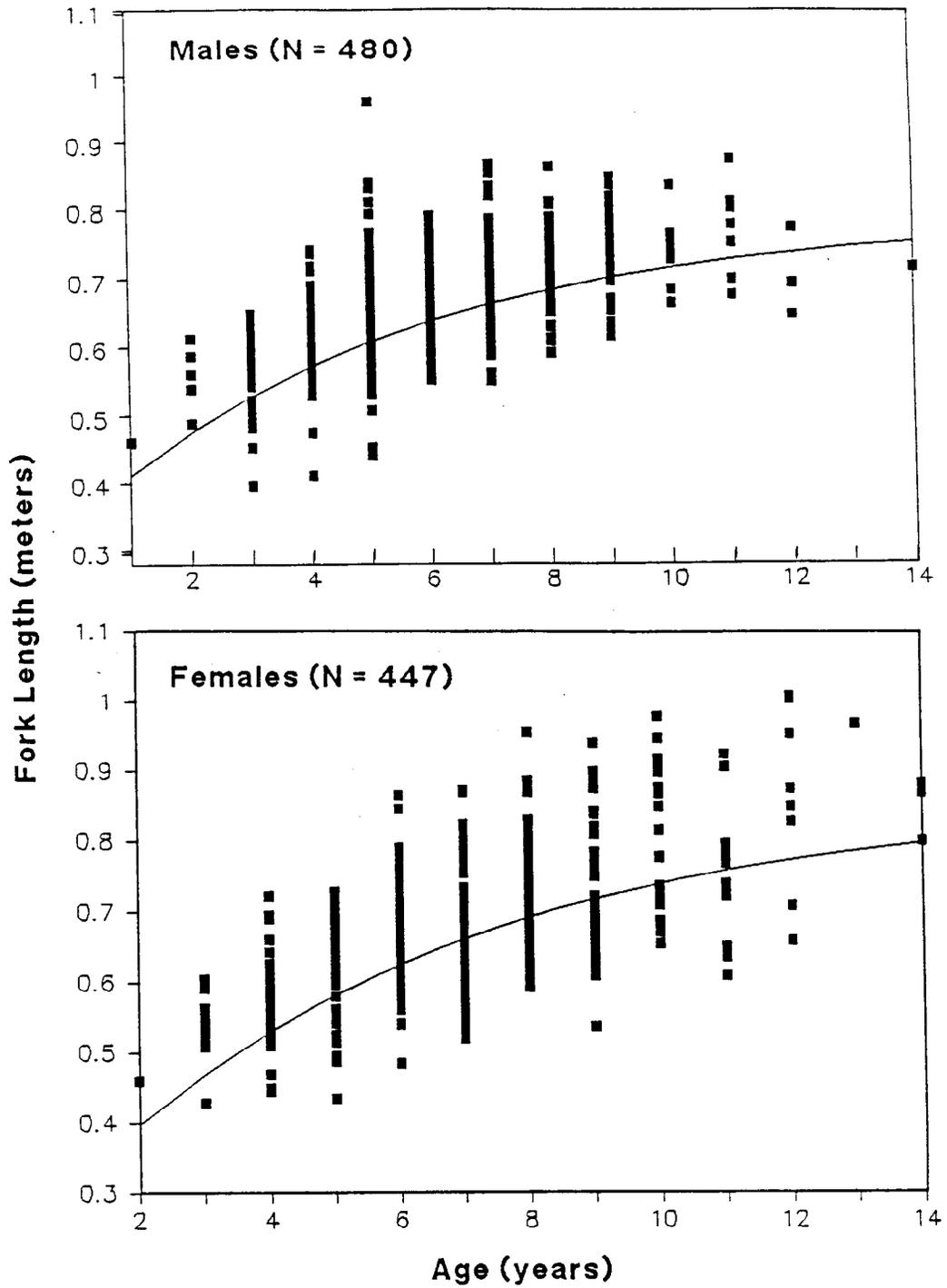


Figure 6. Growth curves of male and female northern pike from the Dall River, 1988.

Table 5. Recaptures of northern pike in 1988 outside streams of original tag application.

Tag Number	Tagging Location	Date Tagged	Recovery Location	Recovery Date ¹
93153	L. Dall R.	7/09/88	Dall River	08/21/88
93251	L. Dall R.	7/12/88	Dall River	08/23/88
94063	Dall River	7/11/88	Hess Creek	08/06/88
94695	Dall River	8/18/88	L. Dall R.	09/02/88
94014	Dall River	6/27/88	Jackson Sl.	09/--/88
94299	Dall River	6/24/88	Jackson Sl.	09/--/88
94498	Dall River	8/08/88	Jackson Sl.	09/--/88
94530	Dall River	8/10/88	Jackson Sl.	09/--/88
94760	Dall River	8/20/88	Jackson Sl.	09/--/88
94865	Dall River	8/22/88	Jackson Sl.	09/--/88
94893	Dall River	8/22/88	Jackson Sl.	09/--/88
94894	Dall River	8/22/88	Jackson Sl.	11/--/88

¹ Dashes indicate day of capture unknown.

River. Single tag recoveries were made by the study crew of fish originally tagged in the Dall River and recovered in the Little Dall River and Hess Creek.

Creel Survey

Only scattered interviews were conducted with anglers in locations other than the Dall River. Therefore no attempt was made to summarize interview data from stream locations outside of the Dall River. A total of 58 anglers were interviewed in the Dall River in 1988. The interviewed anglers reported keeping 76 northern pike from a total catch of 174 fish in 255 hours of fishing (Table 6). Lengths were obtained from 23 northern pike harvested in the sport fishery on the Dall River. The mean length of females was 768 mm (n = 11, range = 611 to 965 mm, SE = 116.8 mm) and for males was 696 mm (n = 12, range = 606 to 810 mm, SE = 64.2 mm).

By regulation, the Dall River is closed to subsistence fishing for northern pike from 10 June to 10 September (5AAC 01.225). Since the field data collection for this study was conducted from 6 June until 24 August, no data were obtained for the subsistence harvest.

DISCUSSION

Age, Sex, and Length

Results from the studies of northern pike in 1988 in the Dall River and other streams within the study area are comparable to the four other populations in interior Alaska from which data are available: T Lake (Clark 1988), Volkmar Lake (Clark and Gregory 1988), George Lake (Clark et al., 1988) and Minto Flats (Holmes and Burkholder 1988). In general the other cited studies have shown that sex ratios are skewed in favor of female fish in larger and older northern pike. The sex ratio of larger northern pike (> 750 mm) favors female fish for all Haul Road stocks measured except for Hess Creek where only a very small sample size was available in that size range. However, when the same comparison is made based upon age, it is not evident that sex ratios are skewed to favor older females. It seems probable that imprecise age determination could account for the observed discrepancy.

Growth of northern pike in the Dall River is faster than in other stocks measured to date in Alaska. Five-year old males from the Dall River averaged 612 mm in length, compared to 555, 560, 496, 505, and 448 mm for Old Lost Creek, Minto Flats, George Lake, Volkmar Lake, and T Lake, respectively. Similarly, five-year old females from the Dall River averaged 618 mm in length compared to 576, 587, 531, 541, and 527 mm for Old Lost Creek, Minto Flats, George Lake, Volkmar Lake, and T Lake, respectively. It is particularly noteworthy that the interior Alaska lake stocks of northern pike that have been examined to date all grow considerably slower than most stocks with access to major river systems, where prey species are presumably more abundant (Clark 1988; Clark et al. 1988; Clark and Gregory 1988; Peckham and Bernard 1987; Holmes and Burkholder 1988). However, growth rates of northern pike

Table 6. Dall River angler surveys, 1988.

Date	No. of Anglers	Hours Fished	Northern Pike		Total Hours	CPUE	
			Caught	Kept		Caught	Kept
09 Jun	3	2.9	0	0	8.7	0.00	0.00
22 Jun	2	0.2	0	0	0.3	0.00	0.00
23 Jun	2	3.0	0	0	6.0	0.00	0.00
25 Jun	2	3.0	0	0	6.0	0.00	0.00
25 Jun	2	5.0	0	0	10.0	0.00	0.00
26 Jun	2	4.5	0	0	9.0	0.00	0.00
02 Jul	2	7.5	0	0	15.0	0.00	0.00
10 Jul	4	7.5	7	7	30.0	0.23	0.23
12 Jul	2	4.5	9	9	9.0	1.00	1.00
21 Jul	6	2.0	7	7	12.0	0.58	0.58
24 Jul	2	5.0	7	7	10.0	0.70	0.70
31 Jul	2	5.0	0	0	10.0	0.00	0.00
31 Jul	1	6.0	5	0	6.0	0.83	0.00
06 Aug	4	5.5	5	5	22.0	0.23	0.23
06 Aug	4	5.5	5	5	22.0	0.23	0.23
20 Aug	3	9.0	38	9	27.0	1.41	0.33
20 Aug	4	6.0	40	15	24.0	1.67	0.63
20 Aug	2	3.0	10	2	6.0	1.67	0.33
21 Aug	4	2.0	20	4	8.0	2.50	0.50
21 Aug	2	5.5	21	6	11.0	1.91	0.55
21 Aug	3	1.0	0	0	3.0	0.00	0.00
Total	58	93.6	174	76	255.0	12.96	5.31
Mean		4.46				0.62	0.25

measured from the Little Dall River were more similar to those observed in interior Alaska lake populations.

Parameters of the von Bertalanffy growth equation for several interior Alaska stocks have been compared by Pearse and Timmons (1989). Those stocks are compared with values obtained from Dall River in Table 7. Theoretical maximum length was greatest for female northern pike from the Dall River and least for T Lake, while for males, the greatest theoretical length was obtained in George Lake and least in Volkmar Lake. The Brody growth coefficient (K) was greatest for female northern pike in T Lake and least in the Dall River, while for males it was greatest in Volkmar Lake and least in George Lake (Table 7).

Comparisons of parameters with other interior Alaska northern pike populations suggest that the parameter values for L_{∞} and K obtained are within the observed range of values reported from other interior Alaska northern pike stocks. Values for t_0 however, for Dall River northern pike, fall outside the range of reported values.

Dall River Abundance Estimate

The abundance estimate is dependent on the accuracy of northern pike harvest estimates in the Dall River. Harvest estimates of northern pike from the Dall River in 1984 are based upon Sumida's (1988) estimate of the 1984 subsistence harvest for the community of Stevens Village, and from responses to Mills (1985) statewide sport fish harvest survey. The subsistence harvest (Sumida 1988) was estimated at 730 northern pike for 1984. While the accuracy of the estimate is not in question because of the intensive nature of the study conducted, and the large proportion of households surveyed, the proportion of the harvest taken from the Dall River is not known. It is clear from Sumida (1988) that northern pike are taken on a year-around basis by local residents, using various gear types and from many different locations on the main Yukon River as well as on local tributaries and sloughs such as the Dall River. It is reasonable to assume that a significant proportion of the harvest was taken from the Dall River, but certainly not all the fish harvested were Dall River stocks. The accuracy of the harvest estimate of 1,750 northern pike from the sport fishery (Mills 1985) may be questioned on the basis that in no other year in which responses were received from this fishery was the harvest estimate of this magnitude, and also the sample size of responses is very low, tending to increase error. However, for the purpose of experimental design, we assumed a maximum harvest estimate to determine whether such harvests could be within the range of sustained yield using 16% exploitation as a maximum rate.

If the actual abundance of northern pike in the Dall River is larger than the estimate of 15,500, the objective criteria for the abundance estimate will not be met. However, in such a case it will be evident that the harvest from this population is sustainable.

Geographic Closure of the Dall River Northern Pike Population

The null hypothesis of equal mixing among drainages can be rejected, and geographic closure of the Dall River is assumed at the 95% level of

Table 7. Parameter estimates for the von Bertalanffy growth equation for northern pike in Volkmar¹, George², and T Lakes³ and the Dall River by sex.

Sex	L_{∞}	SE L_{∞}	K	t_0
<u>Volkmar Lake</u>				
Females	1,079	52	0.12	-0.56
Males	741	19	0.25	0.48
<u>George Lake</u>				
Females	1,030	97	0.13	-1.00
Males	971	242	0.09	-2.94
<u>T Lake</u>				
Females	965	94	0.15	0.11
Males	887	170	0.14	-0.20
<u>Dall River</u>				
Females	1,082	193	0.08	-5.54
Males	790	37	0.19	-3.04

¹ Pearse and Timmons 1989.

² Clark et al. 1988.

³ Clark 1988.

confidence, if 1,425 northern pike are without tags from other drainages. The first 875 fish of those 1,425 will be used for the abundance estimate. Sampling after 875 fish have been examined will be discontinued if at least one tagged immigrant from another area is recovered in the Dall River. In view of the two recaptures recorded in 1988 of northern pike tagged outside the Dall River and recovered in the Dall River, it seems likely that more such recaptures will occur in 1989, and that the population will not be considered closed.

Creel Survey

Survey results in 1988 were incomplete and insufficient to allow precise quantification of harvest rates and total catch. Priority objectives to tag, age, and measure northern pike for abundance and population age, sex and size status took precedence over creel survey activity, although the attempt was made to interview all anglers encountered in the course of the study. One of the key failures of the study to properly conduct a creel survey was due to the fact that many of the weekend periods were not monitored because of crew scheduling commitments. While the harvest results in 1988 are inconclusive, it is apparent that a properly designed creel survey would be feasible to determine the sport fishing harvest in the Dall River. To be successful, the study would need to devote far more effort to only those objectives. For the time being, it will be necessary to rely upon the statewide creel census results (Mills 1979-1988) to provide approximate harvest values for northern pike in the study area.

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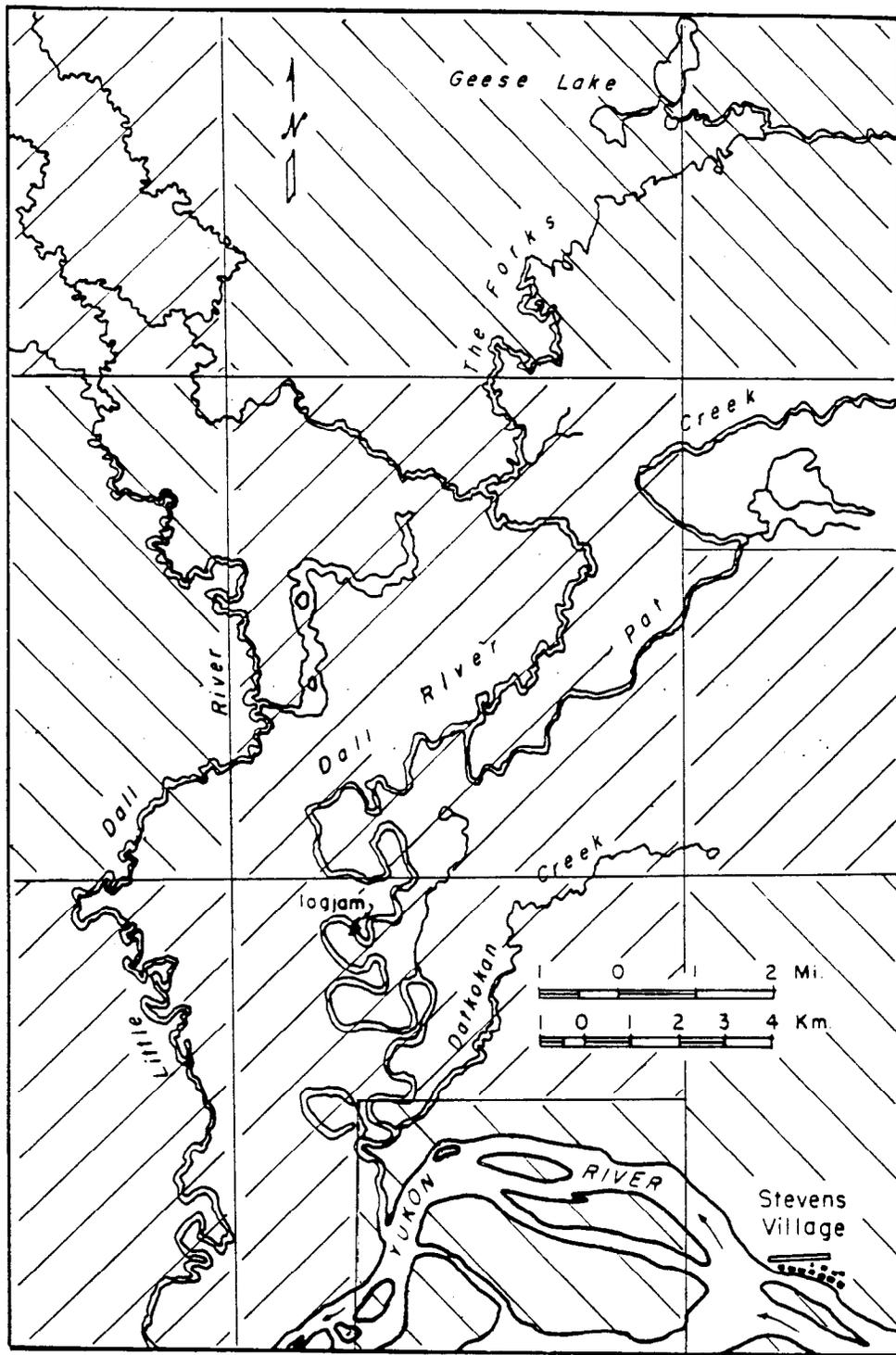
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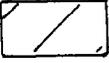
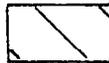
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APPENDIX



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 Regional or village corporation selected lands
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 Regional or village corporation conveyed lands (interim conveyance)
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 Public lands (refuge)

Appendix Figure 1. Status of 1988 land ownership in townships near the Dall River. Individual allotments are not shown. Township borders are approximated.

