

FISHERY DATA SERIES NO. 63

EVALUATION OF ENHANCEMENT EFFORTS FOR  
SPORT FISHERIES FOR RAINBOW TROUT AND ARCTIC CHAR  
IN BIG LAKE, ALASKA, 1987<sup>1</sup>

By

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## ABSTRACT

Morphological surveys were performed on five lakes in the Big Lake drainage during July and August, 1987. Data from these surveys were used to construct bathymetric maps of each lake. In addition, biological surveys were conducted on each of the five lakes. Rainbow trout *Salmo gairdneri*, but no Arctic char *Salvelinus alpinus*, were captured in Beaverhouse, Blodgett, Lalen, Lynda, and Visnaw lakes, all of which drain into Big Lake via Meadow Creek. Gill and fyke nets and hoop traps fished in the seven basins of Big Lake between May and October 1987 captured 12 species of fish including 747 rainbow trout ranging in size from 69 millimeters to 486 millimeters and 410 Arctic char ranging in fork length from 122 millimeters to 660 millimeters. Fyke nets fished in Meadow and Fish Creeks between April and June 1987 captured four species of fish including 135 rainbow trout and two Arctic char.

A stratified random creel survey was conducted at Big Lake for 2 to 12 days each month during the ice-covered season (winter fishery) from December 1986 through April 1987 and for 5 to 17 days each month during the open-water season (summer fishery) from May through October 1987. Rainbow trout catch and harvest rates ranged from 0 fish/hour to 0.09 and 0.03 fish/hour, respectively, during the winter fishery and from 0.02 and 0.01 fish/hour, respectively, to 0.16 and 0.14 fish/hour, respectively, during the summer fishery. Catch and harvest rates for Arctic char ranged from 0.05 and 0.02 fish/hour, respectively, to 0.58 and 0.31 fish/hour, respectively, during the winter fishery and from 0 fish/hour to 0.63 and 0.21 fish/hour, respectively, during the summer fishery.

Biological and creel data obtained from this study were compared to historical biological and creel data. These comparisons indicate that rainbow trout abundance in the Big Lake drainage has decreased from historical levels whereas Arctic char abundance has remained relatively stable.

KEY WORDS: Southcentral Alaska, Matanuska-Susitna Valley, Big Lake, net sampling, creel survey, rainbow trout, *Salmo gairdneri*, Arctic char, *Salvelinus alpinus*, bathymetry.

## INTRODUCTION

Big Lake is located in the Matanuska-Susitna Valley of southcentral Alaska (Figure 1). Meadow Creek, the principal tributary of Big Lake, drains an extensive watershed that includes over 30 lakes and ponds located north and east of the lake. Minor drainages also enter from the west through Flat and Mirror (Mud) lakes. Fish Creek, the outlet of Big Lake, flows approximately 23 km into the Knik Arm of northern Cook Inlet.

The large number of private residences and easy public access along the lake have contributed to the growth and popularity of a recreational fishery in Big Lake. Currently, there are 934 lake front lots that currently support in excess of 500 private lake front cabins and residences, two state waysides, a private commercial campground, two boat marinas, and at least seven lounge and restaurant establishments including three motel/lodges.

During 1952, the U.S. Fish and Wildlife Service conducted studies of fishing pressure on Big Lake. These studies indicated that 10.9% of all sport fishing on the Alaska mainland south of the Alaska Range occurred on Big Lake (Allin 1956). During the period 1977 to 1986, fishing effort on Big Lake has averaged approximately 13,100 angler-days annually (Mills 1979-1987) which represents over 7% of all freshwater fishing effort in the Matanuska-Susitna Valley. Big Lake is perhaps the largest producer of non-anadromous Dolly Varden/Arctic char<sup>1</sup> *Salvelinus* sp. in Alaska, has the largest ice-fishery for Arctic char, and in 1986 had the fourth largest single system harvest of Arctic char statewide. Big Lake also had the highest reported single system harvest of native rainbow trout *Salmo gairdneri* in 1986. The lake is also the site of an Alaska Department of Fish and Game (ADF&G) hatchery. In 1987, this hatchery released 11,867,000 sockeye salmon *Oncorhynchus nerka* fry and 2,362,000 coho salmon *Oncorhynchus kisutch* fingerling and smolt into the Big Lake drainage.

Pronounced reductions in catch rate and harvest for both rainbow trout and Arctic char during 1983 and 1984 (Table 1) provided the impetus for this investigation. Although both rainbow trout and Arctic char harvest and catch per unit of effort (CPUE) have shown improvement since 1985, the development of management strategies and regulatory measures to achieve optimum sustained recreational yield for these species remains a goal. A three phase investigation was proposed to achieve this goal:

1. Assessment of the baseline biological characteristics of rainbow trout and Arctic char populations and angler use patterns;
2. Characterization of spawning, rearing, and harvest areas used by rainbow trout and Arctic char; and,

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<sup>1</sup> Gill raker and pyloric caeca counts (Appendix Table 1) indicate that these fish are Arctic char *Salvelinus alpinus* rather than Dolly Varden char *Salvelinus malma*, but are reported as Dolly Varden/Arctic char in Mills (1979-1986).

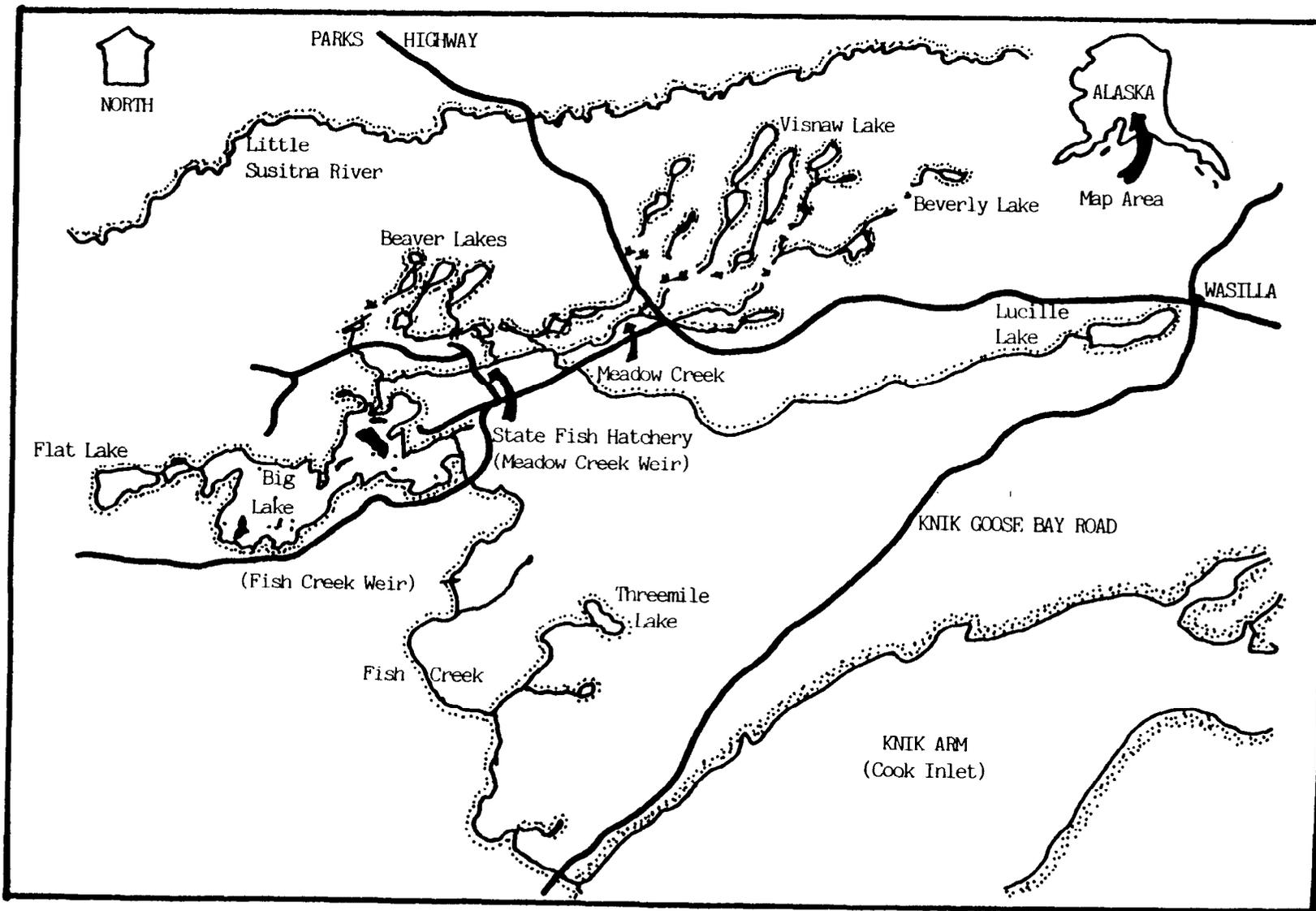


Figure 1. Study area of the Matanuska-Susitna Valley.

Table 1. Sport effort, harvest, and catch per unit effort (CPUE) for rainbow trout, Arctic char, and juvenile coho salmon at Big Lake, 1977-1986<sup>1</sup>.

Year	Effort (angler- days)	Rainbow Trout		Arctic Char <sup>2</sup>		Coho Salmon <sup>3</sup>		Composition		
		Harvest	CPUE	Harvest	CPUE	Harvest	CPUE	RT	: Char	: SS
1977	11,869	3,906	0.329	5618	0.417	721	0.061	38%	: 55%	: 7%
1978	9,865	4,845	0.491	5433	0.551	226	0.023	46%	: 52%	: 2%
1979	8,300	2,882	0.347	4682	0.564	145	0.017	37%	: 61%	: 2%
1980	12,195	5,398	0.443	8179	0.671	189	0.016	39%	: 60%	: 1%
1981	14,568	9,810	0.673	8364	0.574	651	0.045	52%	: 44%	: 4%
1982	15,371	9,369	0.610	9233	0.601	324	0.021	49%	: 49%	: 2%
1983	15,989	4,102	0.257	6567	0.411	462	0.029	37%	: 59%	: 4%
1984	12,196	4,938	0.405	4664	0.382	1384	0.113	45%	: 42%	: 13%
1985	16,299	6,953	0.427	8252	0.506	703	0.043	44%	: 52%	: 4%
1986	14,559	5,105	0.351	7406	0.509	618	0.042	39%	: 56%	: 5%
Average	13,121	5,731	0.433	6,840	0.521	542	0.041	44%	: 52%	: 4%

<sup>1</sup> Source: Mills (1979-1987).

<sup>2</sup> Includes fish reported as Arctic Char, Dolly Varden, and lake trout; no lake trout have been recorded by Fish and Game personnel.

<sup>3</sup> Coho salmon juveniles are recorded as landlocked salmon in the Statewide Harvest Survey.

3. Development of appropriate management strategies through regulatory measures and/or supplemental production<sup>2</sup>.

The objective of this report is to present results of the second year of this investigation.

## METHODS

The study design for the project during 1986-1987 had three major components: (1) fish sampling, (2) creel survey of the sport fishery, and (3) lake surveys.

### Big Lake Fish Sampling

Locations in each of the seven basins of Big Lake (Figure 2) were randomly selected for fish sampling during May through October 1987. Gill and fyke nets and hoop traps were investigated as to their effectiveness at capturing rainbow trout and char in Big Lake to determine which capture techniques could best delineate the spatial distribution by length and/or age class of these species. Gill nets were 36.6 m (120.0 ft) by 1.8 m (6.0 ft) variable mesh monofilament composed of six square mesh sizes: 1.3 cm (0.5 in); 1.6 cm (0.6 in); 1.9 cm (0.8 in); 2.5 cm (1.0 in); 3.8 cm (1.5 in); and 5.1 cm (2.0 in) each in a 6.1 m (20.0 ft) panel. Fyke nets were 2.7 m (9.0 ft) in length by 76.2 cm (30.0 in) in diameter and included two 0.9 m (3.0 ft) by 6.1 m (20.0 ft) wings (two square aluminum frames and six steel or aluminum hoops supported the entrance and body of the fyke net). Internal throats, body, and wings were of 0.5 cm (0.2 in) square mesh knotless nylon. Hoop traps were 2.7 m (9.0 ft) in length, with seven fiberglass hoops tapering from 76.2 cm (30.0 in) to 55.9 cm (22.0 in) in diameter at the cod end; the two internal throats and body are of 2.3 cm (0.9 in) square mesh nylon.

In each basin, six potential littoral zone fyke net sampling sites, and up to 18 potential gill net sampling sites were identified: six sites from the shoreline; six sites from 6.1 m (20.0 ft) to 12.2 m (40.0 ft) deep or to the bottom; and in basins 4 and 6, six sites from 12.2 m (40.0 ft) to the bottom. Hoop traps were set at the deepest locations in each basin.

Once each month from May through October 1987, one to two fyke nets, one to three gill nets, and two to three hoop traps were set overnight in randomly selected locations in a basin. The basin to be sampled each fishing day was randomly selected without replacement until all basins were selected. Fish captured by gill net were enumerated by species, measured for fork length to the nearest millimeter, and an otolith was removed from each rainbow trout and Arctic char that was dead or not expected to live if released. Fish captured by fyke net and hoop trap were placed in a tub oxygenated with a portable 7.5 kg (20 lb) oxygen bottle and anesthetized with equal parts of MS-222 and

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<sup>2</sup> Rainbow trout of Big Lake origin provide fish for Alaska's landlocked lake stocking program.

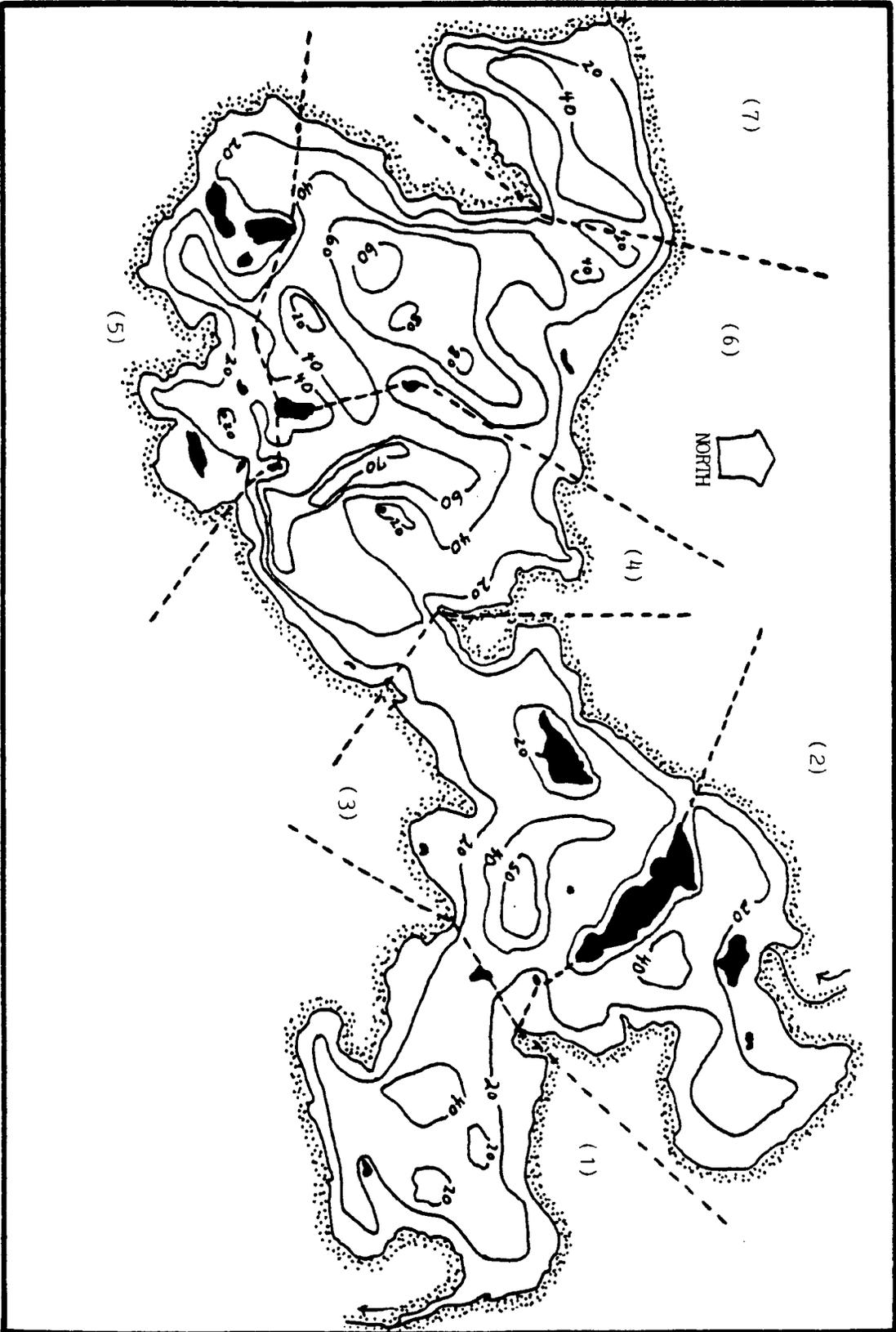


Figure 2. Big Lake contour map partitioned to indicate the seven sampling basins.

Quinate. Anesthetized fish were enumerated by species and rainbow trout and Arctic char were measured for fork length to the nearest millimeter and released.

### Creel Surveys

A roving creel survey was conducted on Big Lake from 6 December 1986 through 11 October 1987<sup>3</sup>. The objectives of the survey were to obtain catch (fish caught) and harvest (fish kept) rate data for and biological samples from rainbow trout and Arctic char harvested by recreational anglers. The survey was not designed to obtain estimates of angler effort or total catch and harvest; therefore only angler interviews were conducted. Interviews were conducted each month during two consecutive weekends and two or three randomly selected weekdays during the intervening week. Sampling was conducted for 7 hours each day during daylight hours. Twelve days were surveyed in December 1986, 17 days in May 1987, and from 2 to 7 days in each of the other months.

The location fished by each interviewed angler was recorded by basin, using the basins defined for the net sampling (Figure 2). Each interviewed angler was asked to provide information regarding: (1) the number of hours fished by basin; (2) the number and species of fish harvested by lake basin; and, (3) their preference for taking rainbow trout, Arctic char, other species, or no preference. Survey personnel also measured harvested rainbow trout and Arctic char for fork length to the nearest millimeter and, with the angler's permission, collected the head of each rainbow trout and Arctic char for aging by otolith. Fish heads were labeled and frozen for aging at a later date.

Harvest rate for species  $i$  was computed as:

$$\hat{H}_i = C_i/E \quad (1)$$

where:

$C_i$  = the total number of fish of species  $i$  kept by interviewed anglers,  
and

$E$  = the total number of hours of effort by interviewed anglers.

Omitting the finite population correction factor, the variance of  $\hat{H}_i$  was approximated as (Jessen 1978):

$$V(\hat{H}_i) = (\hat{H}_i)^2 [s_C^2/\bar{C}_i^2 + s_E^2/\bar{E}^2 - (2r_i s_C s_E / \bar{C}_i \bar{E})], \quad (2)$$

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<sup>3</sup> Creel survey data for December 1986 through February 1987 was reported by Havens (1987) but is included in this report as a portion of the winter (ice covered) fishing season.

where:

$\bar{C}_i$  = the mean harvest of species i by interviewed anglers,

$\bar{E}$  = the mean effort (in hours) by anglers interviewed during the run period of species i,

$s^2_C$  = the two-stage variance estimate for the mean harvest of species i

$s^2_E$  = the two-stage variance estimate for the mean effort, and

$r_i$  = the correlation coefficient between harvest of species i and effort for individual anglers.

Variances of mean effort and harvest were estimated using a two-stage formula (Von Geldern and Tomlinson 1973). Days were considered the first stage sample units and anglers interviewed during a day as the second-stage sample units. Variance was estimated as:

$$V(\bar{X}) = [1-(d/D)]s^2_B/d + [(\sum_{j=1}^D s^2_j/m_j)]/(dD) \quad (3)$$

where:

$\bar{X}$  = mean effort ( $\bar{E}$ ) or mean harvest ( $\bar{C}$ ) of species i,

d = number of days sampled,

D = number of days possible to sample,

$s^2_B$  = the between-day variance for  $\bar{X}$ ,

$s^2_j$  = the sample variance of  $\bar{X}_j$ , the mean effort or harvest of species i by anglers interviewed on day j, and

$m_j$  = the number of anglers interviewed on day j.

Between-day variance ( $s^2_B$ ) was estimated by:

$$s^2_B = [ \sum_{j=1}^D (\bar{X}_j - \bar{X})^2 ] / (d-1).$$

Catch rate for species i was estimated identically to harvest rate except that mean catch (fish kept plus those released) and its variance were substituted for mean harvest and its variance.

Length distributions for each species in the winter sport harvest were compared to those for each species in the summer harvest using chi-square tests. Length frequencies of each species caught during net and trap sampling were also compared using chi-square tests to length frequencies of each species taken in the sport harvest.

#### Other Lake Surveys and Fish Sampling

Physical, chemical, and biological data were collected from Beaverhouse, Blodgett, Lalen, Lynda, and Visnaw lakes during July and August of 1987 using techniques described by Andrews et al. (1971). Physical contour mapping of each lake was accomplished using a boat-mounted fathometer. An aerial photograph (with a given scale or with a scale determined by on-ground point-to-point measurement) was used in conjunction with the fathometer chart record to map contour lines in 1.5 m (5.0 ft) increments to the 6.1 m (20.0 ft) depth and 3.1 m (10.0 ft) increments, thereafter. Shoreline length, surface area, volume, and mean depths were calculated from the contoured map using formulae presented in Hutchinson (1975).

A water sample was collected at the 0.9 m (3.0 ft) depth over the deepest portion of each lake by use of a Kemmerer water sampler. Each sample was analyzed for pH, alkalinity, and hardness using a Hach Test Kit Model AL-36DT; and for specific conductance using a Cole-Parmer digital conductivity meter.

Fish were collected from each lake by use of gill nets, fyke nets, and minnow traps set overnight. At least one gill and fyke net and five minnow traps were set in all lakes surveyed. Minnow traps were semi-collapsible and 44.4 cm (17.5 in) length with 0.3 cm (0.1 in) square wire mesh painted green and brown and baited with salmon eggs. All fish were enumerated by capture gear and species. All rainbow trout were measured for fork length to the nearest millimeter, and catch rates were computed for each species by gear type.

## RESULTS

### Fish Population Studies

Six lakes in the Big Lake and Meadow Creek drainages were sampled with fyke nets and gill nets between 5 May and 23 October 1987. In addition, selected areas in Meadow and Fish creeks were sampled with fyke nets between 16 April and 5 June 1987. In all, 13 species of fish were captured including rainbow trout, Arctic char, coho salmon, sockeye salmon, round whitefish *Prosopium cylindraceum*, burbot *Lota lota*, longnose sucker *Catostomus catostomus*, slimy sculpin *Cottus cognatus* and prickly sculpin *Cottus asper*, threespine stickleback *Gasterosteus aculeatus*, ninespine stickleback *Pungitius pungitius*, and Arctic lamprey *Lampetra japonica*.

Stickleback and juvenile coho salmon dominated the catches in fyke nets in all lakes, except Lalen and Visnaw lakes where no juvenile coho salmon were captured (Tables 2 and 3). Rainbow trout comprised only minor portions of catches of all gear types in all lakes. Arctic char were captured only in Big

Table 2. Catch and effort by gear type during surveys of Beaverhouse, Blodgett, Lalen, Lynda, and Visnaw lakes, 24 July through 4 August 1987.

Lake	Sample Date	Surface Area (ha)	Capture Method <sup>1</sup>	Number of Traps	Number of Hours	Number of Fish Captured			
						Rainbow Trout	Coho Salmon	Long nose Sucker	Three spine Stickleback <sup>2</sup>
Beaverhouse	07/30/87	13.4	MT	10	223.7	0	0	0	595
			FN	1	22.5	0	6	0	100
			GN	2	22.3	2	16	0	0
TOTALS:						2	22	0	695
Blodgett	07/31/87	23.3	MT	12	229.8	0	592	0	696
			FN	1	19.3	9	48	7	175
			GN	2	38.0	12	11	0	0
TOTALS:						21	651	7	871
Lalen	07/24/87	37.2	MT	12	275.0	0	0	0	543
			FN	1	24.0	2	0	0	100
			GN	2	35.7	28	0	0	0
TOTALS:						30	0	0	643
Lynda	08/04/87	4.5	MT	10	224.0	8	171	1	235
			FN	1	21.8	74	112	42	200
			GN	1	21.0	5	6	11	0
TOTALS:						87	289	54	435
Visnaw	07/28/87	52.9	MT	15	356.8	0	0	0	621
			FN	1	24.0	3	0	0	50
			GN	3	71.3	25	0	0	0
TOTALS:						28	0	0	671

<sup>1</sup> MT = Minnow Trap, FN = Fyke Net, GN = Gillnet

<sup>2</sup> The majority of stickleback captured were threespine stickleback, although a few ninespine stickleback were identified.

Table 3. Catch and effort by gear type and by basin and period during samples in Big Lake, May through October, 1987.

Basin	Capture		Trap Hours	Number Captured										
	Method <sup>1</sup>	Period <sup>2</sup>		Rain-	Arc-	Coho Salmon <sup>3</sup>		Sockeye Salmon <sup>3</sup>		Bur-	Long-	Round	Slimy	3-Spine
				bow	tic	Juvenile	Adult	Juvenile	Adult	bot	nose	White-	Sculpin <sup>4</sup>	Stickle-
1-7	FN	1	161.25	77	0	2,078	0	444	0	0	99	0	42	550
1-7	FN	2	308.25	120	0	2,614	0	309	0	0	295	0	221	4,595
1-7	FN	3	157.00	30	0	3,965	0	402	0	0	167	0	120	3,025
1-7	FN	4	315.50	123	0	4,794	0	83	26	0	145	0	252	29,400
1-7	FN	5	310.00	145	0	6,334	0	299	129	0	38	0	476	42,200
1-7	FN	6	306.50	139	0	3,010	1	2	10	3	28	0	159	1,090
1	FN	1-6	214.50	181	0	2,261	0	37	8	1	145	0	330	2,085
2	FN	1-6	215.25	124	0	3,592	0	23	67	0	121	0	160	10,005
3	FN	1-6	230.25	102	0	3,049	1	475	42	0	63	0	143	8,250
4	FN	1-6	224.00	87	0	3,431	0	87	16	0	147	0	153	13,205
5	FN	1-6	219.75	40	0	2,377	0	484	5	1	117	0	152	11,085
6	FN	1-6	229.50	48	0	4,688	0	127	12	0	55	0	180	12,305
7	FN	1-6	225.25	52	0	3,397	0	306	15	1	124	0	152	23,925
1-7	GN	1	421.75	20	124	227	0	631	0	8	203	23	0	0
1-7	GN	2	246.00	0	57	1	0	4	0	1	3	7	0	0
1-7	GN	3	314.00	16	43	50	0	48	1	3	69	23	0	0
1-7	GN <sup>5</sup>	4	133.75	0	0	0	0	1	0	0	0	0	0	0
1-7	GN <sup>5</sup>	5	153.50	0	3	1	0	6	5	0	0	0	0	0
1-7	GN	6	345.75	69	153	264	0	23	256	7	79	10	0	0
1	GN	1-6	177.50	6	39	23	0	6	6	3	46	6	0	0
2	GN	1-6	193.50	37	53	85	0	2	7	1	81	8	0	0
3	GN	1-6	254.00	21	85	72	0	23	70	1	82	11	0	0
4	GN	1-6	267.50	25	61	170	0	35	119	7	35	11	0	0
5	GN	1-6	201.75	5	37	62	0	71	17	1	50	6	0	0
6	GN	1-6	277.25	2	47	107	0	13	23	6	31	10	0	0
7	GN	1-6	243.25	9	58	24	0	563	20	0	29	11	0	0
1-7	HT	1	481.00	0	5	0	0	0	0	4	1	0	0	0
1-7	HT	2	479.00	0	6	1	0	0	0	2	0	0	0	0
1-7	HT	3	494.75	0	8	1	0	0	0	4	1	0	0	0
1-7	HT	4	489.25	0	2	0	0	0	0	0	0	0	0	0
1-7	HT	5	480.00	0	3	8	0	0	0	5	1	0	0	0
1-7	HT	6	780.75	8	6	172	0	0	0	13	3	0	0	0
1	HT	1-6	438.75	0	2	17	0	0	0	3	2	0	0	0
2	HT	1-6	475.50	3	10	61	0	0	0	5	1	0	0	0
3	HT	1-6	473.75	1	4	14	0	0	0	5	1	0	0	0

-Continued-



Lake. Combined fyke and gill net and hoop trap catches of rainbow trout in Big Lake, by basin, ranged from 48 fish in basin 5 near the center of Big Lake to 187 fish in basin 1 which is closest to the Fish Creek outlet. Arctic char catches were small in all cases and ranged from 41 fish in basin 1 to 89 fish in basin 3.

Fyke nets fished in Fish and Meadow Creeks captured 135 rainbow trout; 76 rainbow trout were passed through the ADF&G smolt weir on Fish Creek. Two Arctic char were captured by fyke net in Meadow Creek (Table 4). Rainbow trout taken in gillnets were larger than those taken in fyke nets in all lakes sampled (Tables 5 and 6). In Big Lake, the mean size of rainbow trout captured in gill nets was 239 mm, in fyke nets 165 mm, and in hoop traps 300 mm (Table 6). Arctic char taken in gill nets averaged 349 mm, and in hoop traps 411 mm (Table 6). There were no pronounced differences in length or weight between the sexes for either species (Table 7).

### Sport Fishery

Creel surveys conducted at Big Lake during the winter (ice-covered) season, December 1986 through April 1987, showed progressively declining catch rates by month for Arctic char (Table 8 and Figure 3). In contrast, catch rates for rainbow trout declined through early February and increased through April. Harvest rates for both rainbow trout and Arctic char remained low from February through April. Creel surveys during the summer (ice-free) season, May through October 1987, showed declining catch and harvest rates for Arctic char through September, followed by dramatic increases in October. Catch and harvest rates for rainbow trout were variable through the summer with the lowest rates occurring in July. Catch and harvest rates for coho salmon followed trends similar to those for Arctic char throughout the entire creel survey.

Most of the coho salmon harvested in the sport fishery fall within a relatively narrow range of lengths (Figure 4 and Table 9). Length frequencies of coho salmon harvested in the winter and summer fisheries were not significantly different ( $P > 0.05$ ). Conversely, the distribution of lengths for rainbow trout and Arctic char harvested by the sport fishery was relatively wide; the length frequencies for rainbow trout were not significantly different ( $P > 0.05$ ) between the winter and summer fishing seasons. Length frequencies of Arctic char harvested in the winter and summer fisheries were significantly different ( $P < 0.05$ ).

Length frequencies for net and trap caught rainbow trout and Arctic char during the May through October samples (Figure 5) were significantly different ( $P < 0.05$ ) from the length compositions in the sport harvest. Net and trap sampling for coho salmon caught mostly pre-recruits to the fishery; the length compositions were significantly different ( $P < 0.05$ ) from the sport harvest.

Otoliths were collected from 193 rainbow trout and 506 Arctic char taken in sample nets or harvested in the Big Lake sport fishery. Most of the sampled rainbow trout were age 5, with the oldest rainbow trout examined being age 12. Most of the Arctic char sampled were age 3, with the oldest Arctic char examined being age 11 (Table 10).

Table 4. Summary of length (mm) and CPUE data for rainbow trout (RT) and Arctic char (AC) captured at the Fish Creek wier and by fyke net in Fish and Meadow Creeks between 16 April and 17 June, 1987.

Location	Sample Period	Capture Method <sup>1</sup>	Hours Fished	Species	Number Caught	Catch/Net Hour	Length		
							Mean	Std Err	Range
Fish Creek	4/16-4/22	FN	9.0	RT	0				
	4/23-4/29	FN	33.5	RT	0				
	4/30-5/06	FN	81.5	RT	6	.07	306	44.2	153 - 410
	5/07-5/13	FN	127.0	RT	28	0.22	243	16.9	154 - 422
		WEIR	48.0	RT	23	0.48	242	16.2	158 - 438
	5/14-5/20	FN	43.0	RT	0				
		WEIR	168.0	RT	23	0.14	281	12.9	206 - 397
	5/21-5/27	FN	45.3	RT	3	.07	219	21.9	176 - 248
		WEIR	168.0	RT	7	.04	285	29.4	176 - 450
	5/28-6/03	WEIR	168.0	RT	15	.09	249	13.6	193 - 388
	6/04-6/10	WEIR	168.0	RT	5	.03	230	19.3	188 - 298
	6/11-6/17	WEIR	168.0	RT	3	.02	282	47.6	214 - 374
	Sub-total	FN	339.0	RT	37	0.11	251	15.0	153 - 422
		WEIR	888.0	RT	76	.09	259	7.9	158 - 450
	Total	1,227.0	RT	113	.09	257	7.2	153 - 450	
Meadow Creek	5/07-5/13	FN	47.0	RT	20	0.43	221	7.6	164 - 280
				AC	1	.02	186		
	5/14-5/20	FN	145.3	RT	62	0.43	228	7.8	140 - 365
	5/21-5/27	FN	67.0	RT	12	0.12	217	9.3	166 - 203
	5/28-6/03	FN	25.8	RT	3	0.12	271	78.9	181 - 428
	6/04-6/05	FN	24.5	RT	1	.04	214		
				AC	1	.04	482		
	Total			309.6	RT	98	0.32	227	5.7
AC					2	.01	334	148.0	186 - 482

<sup>1</sup> Capture Method:

FN = Fyke nets were fished on Fish Creek at the Big Lake outlet and on Meadow Creek from 1 to 4 km upstream from the Big Lake inlet.

WEIR = ADF&G, FRED Division smolt weir located 1.6 km downstream on Fish Creek from the Big Lake outlet. The weir was operable on 11 May 1987 and was removed on 21 June 1987.

Table 5. Summary of length (mm) and CPUE data for rainbow trout (RT) captured during surveys of Beaverhouse, Blodgett, Lalen, Lynda, and Visnaw lakes, 24 July through 4 August, 1987.

Lake	Sample Date	Species	Capture Method <sup>1</sup>	Number Caught	Catch/Net Hour	Number Measured	Length		
							Mean	Std Err	Range
Beaverhouse	07/30/87	RT	FN	0					
			GN	2	0.09	2	330	52.0	278 - 382
Blodgett	07/31/87	RT	FN	9	0.47	9	155	10.3	98 - 201
			GN	12	0.32	12	297	27.7	138 - 432
Lalen	07/24/87	RT	MT	2	0.08	2	144	16.5	127 - 160
			GN	28	1.09	28	269	13.7	172 - 460
Lynda	08/04/87	RT	FN	74	3.40	9	159	14.2	101 - 226
			GN	5	0.23	5	315	51.0	202 - 478
Visnaw	08/05/87	RT	FN	3	0.13	3	251	4.7	242 - 257
			GN	25	0.35	25	323	14.9	240 - 605

<sup>1</sup> FN = Fyke Net; GN = Gillnet; MT = Minnow Trap

Table 6. Summary of length (mm) and CPUE by basin for rainbow trout and Arctic char in Big Lake, May through October 1987.

Basin	Species	Capture Method <sup>1</sup>	Number Caught	Catch		Length			
				/Net Hour	Std Err	Mean	Std Err	Range	
1	Rainbow Trout	FN	181	0.844	0.1047	157	3.0	80 - 320	
		GN	6	0.034	0.0142	291	52.4	165 - 452	
		HT	0						
	Arctic Char	FN	0						
		GN	39	0.220	0.0744	354	20.6	168 - 623	
		HT	2	0.004	0.0026	340	92.0	248 - 432	
	2	Rainbow Trout	FN	124	0.576	0.1688	151	3.9	86 - 432
			GN	37	0.191	0.0984	255	12.9	130 - 483
			HT	3	0.006	0.0043	263	53.5	209 - 370
Arctic Char		FN	0						
		GN	53	0.274	0.1074	356	15.1	167 - 525	
		HT	10	0.021	0.0092	388	31.4	240 - 501	
3		Rainbow Trout	FN	102	0.443	0.1676	188	5.7	93 - 459
			GN	21	0.083	0.0486	186	16.4	113 - 390
			HT	1	0.002	0.0015	200		
	Arctic Char	FN	0						
		GN	85	0.335	0.1152	326	11.9	165 - 577	
		HT	4	0.008	0.0059	368	61.6	226 - 497	
	4	Rainbow Trout	FN	87	0.388	0.0783	152	5.4	69 - 427
			GN	25	0.093	0.0486	203	10.9	136 - 378
			HT	0					
Arctic Char		FN	0						
		GN	61	0.228	0.0483	354	15.8	122 - 627	
		HT	3	0.007	0.0049	469	87.5	329 - 630	
5		Rainbow Trout	FN	40	0.182	0.0601	165	6.1	99 - 275
			GN	5	0.025	0.0115	278	33.8	194 - 371
			HT	3	0.007	0.0045	343	72.6	251 - 486
	Arctic Char	FN	0						
		GN	37	0.183	0.0530	352	21.0	170 - 585	
		HT	6	0.013	0.0092	459	25.3	293 - 553	

-Continued-

Table 6. Summary of length (mm) and CPUE by basin for rainbow trout and Arctic char in Big Lake, May through October 1987 (continued).

Basin	Species	Capture Method <sup>1</sup>	Number Caught	Catch		Length		
				/Net Hour	Std Err	Mean	Std Err	Range
6	Rainbow Trout	FN	48	0.209	0.0474	189	9.9	96 - 412
		GN	2	0.007	0.0030	363	116.2	246 - 480
		HT	1	0.002	0.0013	386		
	Arctic Char	FN	0					
		GN	47	0.170	0.0616	391	18.7	155 - 640
		HT	1	0.002	0.0023	305		
7	Rainbow Trout	FN	52	0.231	0.0595	185	6.5	110 - 352
		GN	9	0.037	0.0294	311	32.5	193 - 438
		HT	0					
	Arctic Char	FN	0					
		GN	58	0.238	0.0899	328	18.1	156 - 660
		HT	4	0.009	0.0024	477	25.8	358 - 496
TOTALS:								
	Rainbow Trout	FN	634	0.407	0.0512	165	2.0	69 - 459
		GN	105	0.065	0.0171	239	8.7	113 - 483
		HT	8	0.003	0.0009	300	36.8	200 - 486
	Arctic Char	FN	0					
		GN	380	0.235	0.0294	349	6.3	122 - 660
		HT	30	0.009	0.0023	411	18.5	226 - 630

<sup>1</sup> FN = Fyke net; GN = Gill net; HT = Hoop trap

Table 7. Comparison of length (mm) and weight (g) by sex for rainbow trout and Arctic char captured by gill nets, 13 October through 23 October, 1987.

Species	Sex	Number Examined <sup>1</sup>	Length			Weight		
			Mean	Std Err	Range	Mean	Std Err	Range
Rainbow Trout	Female	17	234	26.2	130 - 480	265	86.2	24 - 1190
	Male	20	234	17.2	140 - 458	227	70.3	32 - 1367
	Total	37	234	15.0	130 - 480	245	54.2	24 - 1367
Arctic Char	Female	55	362	12.8	133 - 535	553	54.9	20 - 1634
	Male	43	371	17.5	115 - 585	646	84.6	16 - 2216
	Total	98	366	10.5	115 - 585	594	48.2	16 - 2216

<sup>1</sup> Only gill-netted rainbow trout and Arctic char unable to be released alive were retained for samples of weight and sex.

Table 8. Sport catch and harvest rates for rainbow trout, Arctic char, and coho salmon, Big Lake, 6 December 1986 through 11 October 1987.

Sample Period	N <sup>1</sup>	n <sup>2</sup>	Inter views	Rainbow Trout				Arctic Char				Coho Salmon			
				Catch Rate	St. Error	Harvest Rate	St. Error	Catch Rate	St. Error	Harvest Rate	St. Error	Catch Rate	St. Error	Harvest Rate	St. Error
Winter															
12/06/86-12/21/86	16	12	195	0.048	0.015	0.022	0.006	0.581	0.093	0.305	0.055	0.246	0.039	0.067	0.022
01/03/87-01/11/87	9	6	124	0.035	0.012	0.028	0.010	0.418	0.089	0.244	0.058	0.220	0.073	0.119	0.042
01/31/87-02/08/87	9	7	237	0		0		0.259	0.033	0.207	0.027	0.087	0.019	0.067	0.016
02/28/87-03/08/87	9	7	202	0.002	0.007	0.002	0.007	0.170	0.074	0.120	0.032	0.057	0.018	0.023	0.014
03/21/87-03/29/87	9	7	219	0.011	0.005	0		0.162	0.031	0.108	0.027	0.086	0.025	0.027	0.011
04/11/87-04/12/87	2	2	20	0.090	0.052	0		0.045	0.020	0.023	0.013	0.023	0.015	0.023	0.015
Summer															
05/15/87-05/31/87	10	17	209	0.159	0.064	0.047	0.012	0.101	0.027	0.090	0.025	0.033	0.011	0.006	0.002
06/06/87-06/14/87	9	6	120	0.139	0.060	0.139	0.060	0.070	0.026	0.063	0.024	0.063	0.025	0.007	0.009
06/27/87-07/05/87	9	5	139	0.140	0.034	0.070	0.016	0.047	0.018	0.033	0.019	0.056	0.025	0.009	0.005
07/11/87-07/19/87	9	5	153	0.022	0.012	0.011	0.004	0.011	0.004	0.011	0.004	0.004	0.002	0.004	0.002
08/01/87-08/09/87	9	5	100	0.089	0.049	0.071	0.047	0		0		0.167	0.059	0.132	0.059
09/05/87-09/13/87	9	6	96	0.159	0.066	0.079	0.045	0.006	0.003	0		0.006	0.003	0	
10/03/87-10/11/87	9	5	160	0.122	0.031	0.067	0.021	0.632	0.316	0.212	0.043	0.662	0.215	0.148	0.059

<sup>1</sup> N = Number of days possible.

<sup>2</sup> n = Number of days sampled.

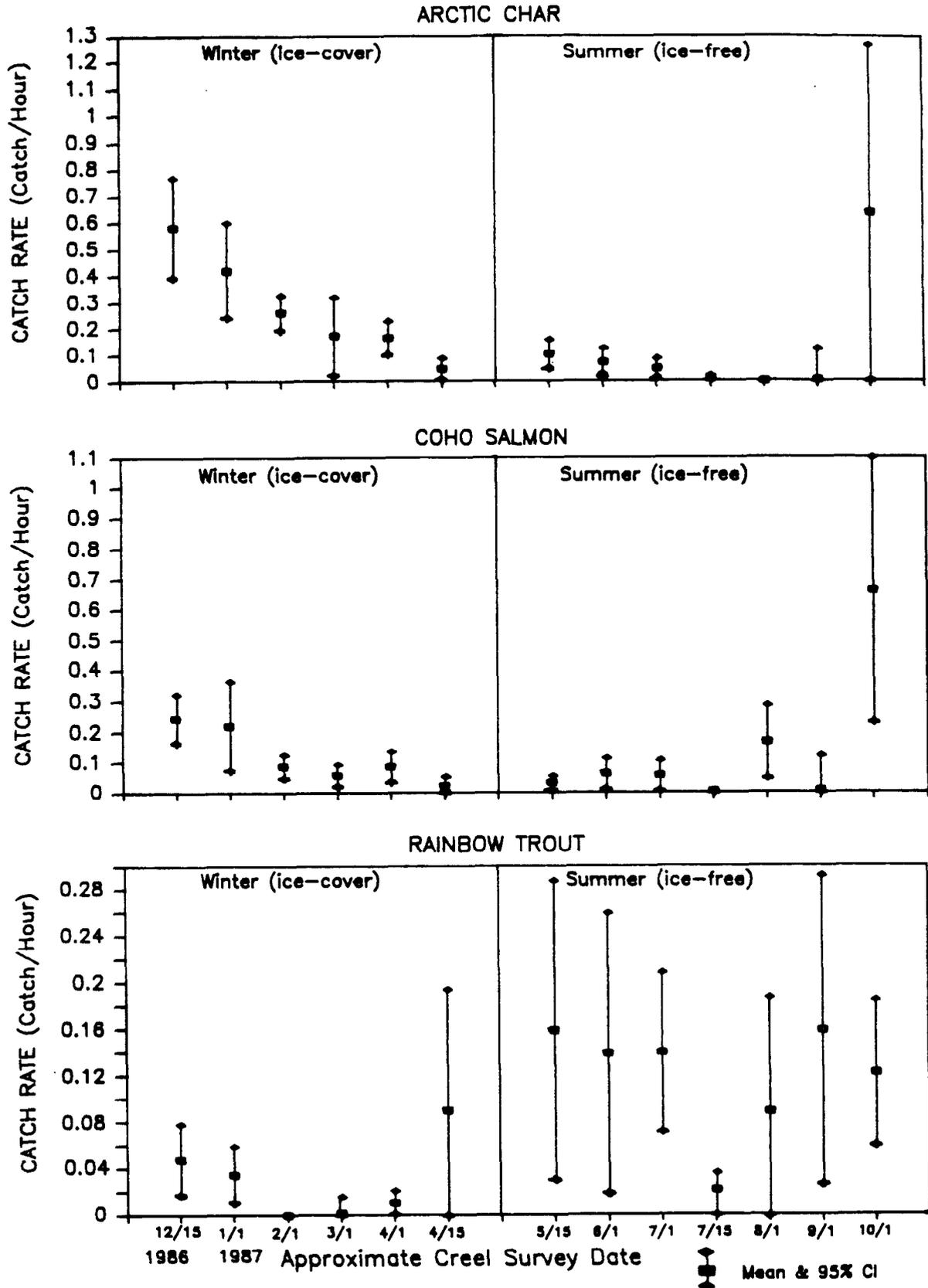


Figure 3. Sport catch rates during the winter and summer fisheries by species and sample date, Big Lake, 1986-1987.

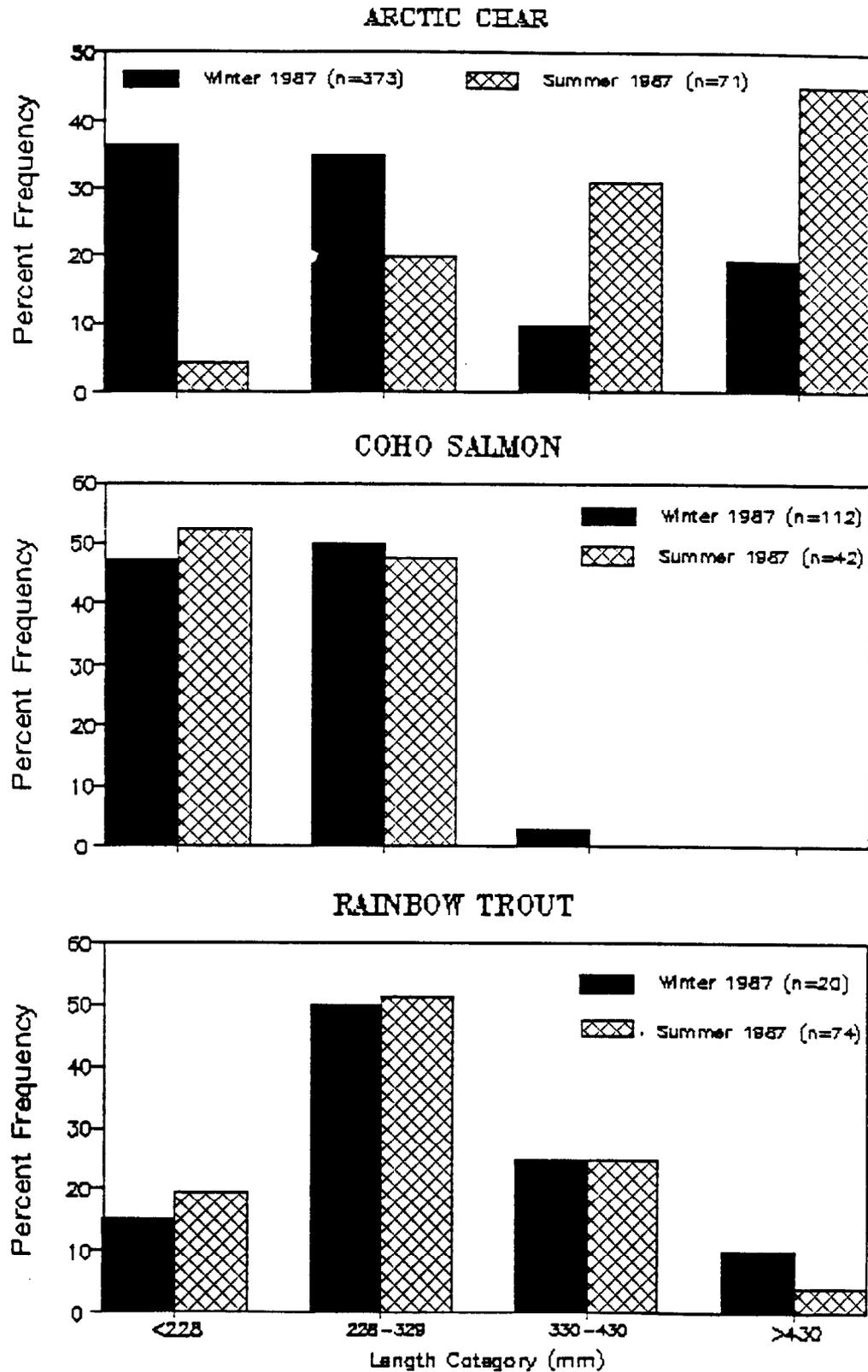


Figure 4. Comparison of length distributions for rainbow trout, Arctic char, and coho salmon between the winter and summer sport fisheries, Big Lake, 1986-1987.

Table 9. Mean lengths and length ranges for rainbow trout, Arctic char, and juvenile coho salmon harvested during the Big Lake creel survey, 6 December 1986 through 11 October 1987.

Period	Rainbow Trout					Arctic Char				Coho Salmon			
	Number		Mean	St.	Range	Mean	St.	Range	Mean	St.	Range		
	of	Number	(mm)	Error	(mm)	Number	(mm)	Error	(mm)	Number	(mm)	Error	(mm)
Winter (ice-cover)													
12/06/86-12/21/86	196	10	273	19.0	200-405	121	271	8.1	170-600	34	228	9.4	117-315
01/03/87-01/11/87	134	9	347	31.5	225-465	53	270	10.8	162-485	36	203	6.3	130-295
01/31/87-02/08/87	238	0				115	303	11.8	148-670	42	197	7.4	125-322
02/28/87-03/08/87	202	1	340			41	374	23.2	135-670	10	186	17.0	108-295
03/21/87-03/29/87	219	0				42	406	18.1	208-570	8	201	18.1	173-260
04/11/87-04/12/87	20	0				1	464			1	100		
Summer (ice-free)													
05/15/87-05/31/87	209	15	257	21.7	108-380	26	444	19.0	213-557	2	123	5.5	117-128
06/06/87-06/29/87	183	22	299	16.1	152-505	10	391	31.0	202-557	3	107	6.7	101-114
07/03/87-07/19/87	244	11	280	17.1	208-383	6	522	11.5	491-572	2	227	21.0	206-248
08/01/87-08/09/87	118	8	287	26.5	207-408	0				13	177	10.2	100-267
09/05/87-09/13/87	98	5	267	52.3	211-340	0				0			
10/03/87-10/11/87	168	13	348	16.2	286-439	29	372	16.7	266-600	22	236	17.5	210-298
Sub-total (winter):	1,009	20	310	18.5	200-465	373	308	6.2	135-670	131	205	4.3	100-322
Sub-total (Summer):	1,020	74	293	8.7	108-505	71	414	12.0	202-600	42	203	7.6	100-298
Totals:	2,029	94	296	7.9	108-505	454	318	6.2	135-670	173	205	3.7	100-322

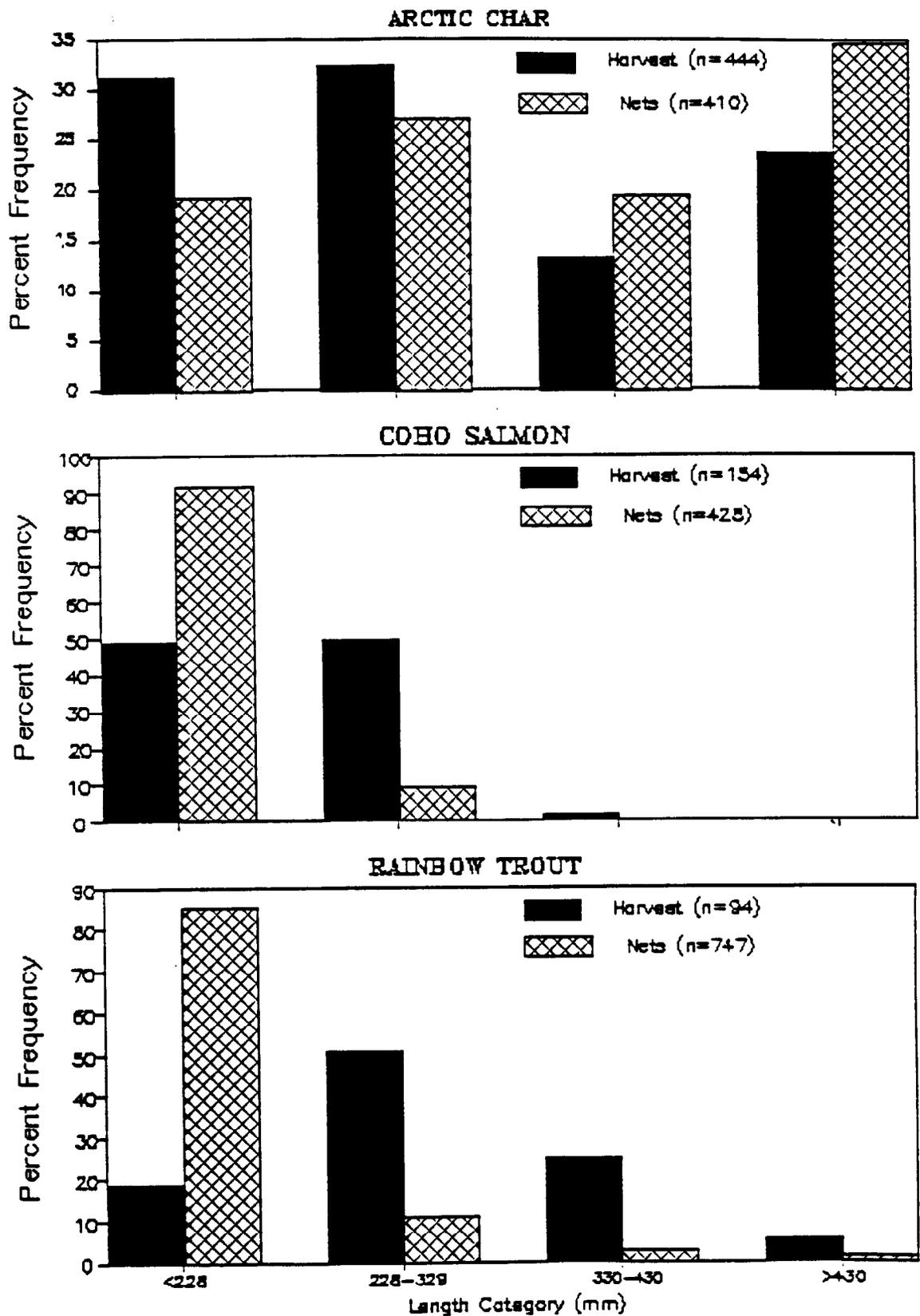


Figure 5. Comparison of length distributions for rainbow trout, Arctic char, and coho salmon captured in nets and traps between May and October 1987 and sport caught between December, 1986 and October, 1987.

Table 10. Summary of length (mm) by age class (otoliths) for rainbow trout and Arctic char samples collected from Big Lake, December 1986 through October 1987.

Species	Age Class	Number Examined	Length		
			Mean	Std Err	Range
Rainbow Trout	1	0			
	2	1	108		
	3	8	143	8.1	113 - 182
	4	24	176	5.6	130 - 221
	5	50	219	5.1	150 - 319
	6	45	264	5.6	140 - 371
	7	27	306	7.7	225 - 395
	8	23	368	7.8	291 - 460
	9	12	419	8.0	380 - 465
	10	2	407	16.6	383 - 430
	11	0			
	12	1	480		
Arctic Char	1	4	132	7.8	115 - 156
	2	23	178	4.7	144 - 251
	3	142	229	3.0	156 - 325
	4	101	293	3.6	203 - 370
	5	69	347	6.1	258 - 455
	6	47	420	7.2	302 - 515
	7	43	477	3.7	424 - 530
	8	46	506	3.3	445 - 565
	9	19	525	6.1	470 - 570
	10	10	577	14.7	520 - 670
	11	2	602	15.9	579 - 624

## Lake Surveys

Bathymetric maps of Big, Beaverhouse, Blodgett, Lalen, Lynda, and Visnaw Lakes are presented in Figure 2 and Appendix Figures 1-5. Physical and water chemistry data collected from these lakes are summarized in Appendix Tables 4 and 5, respectively.

## DISCUSSION

Historical weir records (Ward 1974) and sampling conducted during 1986 and 1987 indicate that resident rainbow trout are found throughout the Big Lake drainage. In contrast, Arctic char appear to complete their entire life cycle in interconnected Big, Mirror, and Flat Lakes and do not use either Fish or Meadow Creeks to any great extent for spawning or rearing.

Havens (1987) reported that harvest rates of rainbow trout in Big Lake from the 1986-1987 winter ice-fishery had declined compared to historical levels in the 1955, 1960, and 1966 winter ice-fisheries whereas harvest rates for Arctic char were less than those measured during 1955 and 1960 but similar to the 1966 survey.

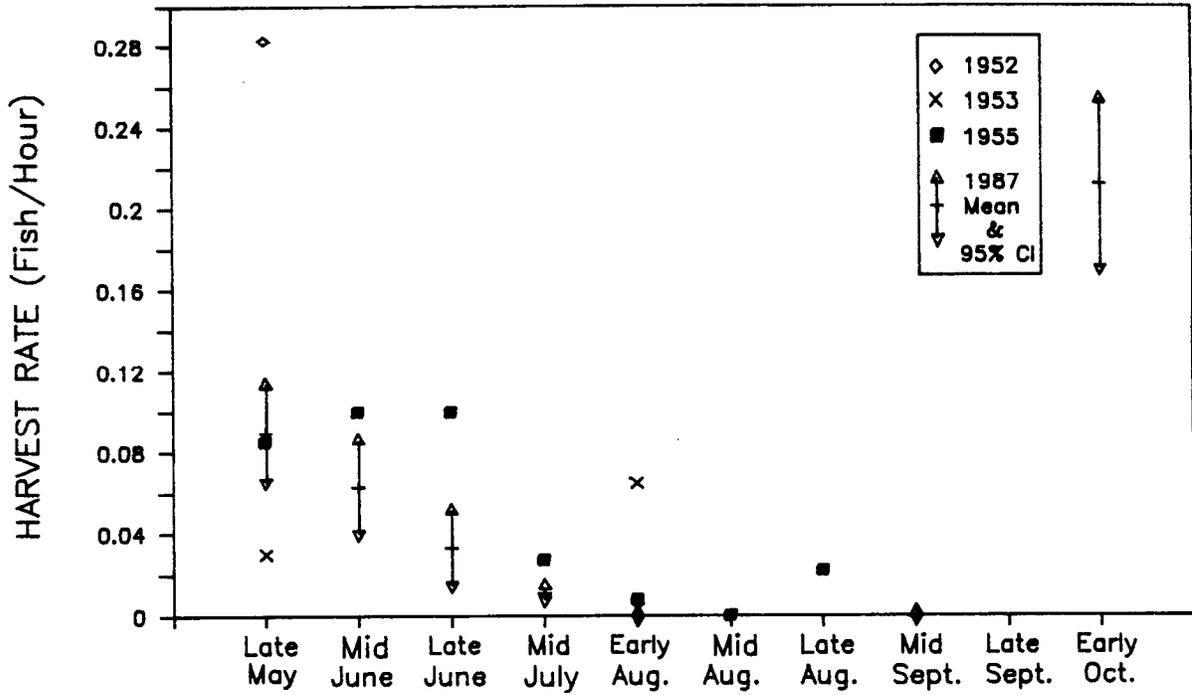
Few differences were observed in the harvest rates of Big Lake rainbow trout between the 1955 and 1987 summer fisheries, although these harvest rates were lower than harvest rates from comparable census periods during May and July 1952 and 1953 (Figure 6). Harvest rates of rainbow trout from the May and July 1952 fishery (Allin, 1953) at Big Lake were 0.21 fish/hour and 0.35 fish/hour, respectively, and harvest rates from the May and July 1953 fishery (Allin, 1956) were 0.19 fish/hour and 0.20 fish/hour, respectively. Harvest rates of rainbow trout from the 1955 summer fishery (Allin, 1956) at Big Lake ranged from 0.03 fish/hour to 0.15 fish/hour while rainbow trout harvest rates from the 1987 fishery ranged from 0.01 fish/hour to 0.14 fish/hour.

Harvest rates of Arctic char from the 1987 summer fishery at Big Lake do not show a consistent relationship to historical levels in 1952, 1953, and 1955 (Figure 6). Harvest rates of Arctic char from the May and July 1952 fishery at Big Lake were 0.28 fish/hour and 0.01 fish/hour, respectively, while harvest rates from the May and July 1953 fishery were 0.03 fish/hour and 0.07 fish/hour, respectively. Harvest rates of Arctic char from the 1955 summer fishery ranged from 0 to 0.10 fish/hour, whereas those from the 1987 fishery ranged from 0 to 0.21 fish/hour.

Length compositions of the 1987 sport harvest of rainbow trout (Figure 7) were not significantly different ( $P > 0.05$ ) from those of the 1955 sport harvest. In contrast, length compositions of Arctic char in the 1987 sport harvest were significantly different ( $P < 0.05$ ) from those of the 1955 sport harvest. For Arctic char, the most recent harvest was comprised of a higher fraction of larger fish than the 1955 harvest (Figure 7).

Harvest estimates reported by Mills (Table 1) for the period 1977 through 1986 indicate average harvest compositions of 44% rainbow trout, 52% Arctic char, and 4% coho salmon. In contrast, results of the creel survey conducted in Big

## ARCTIC CHAR



## RAINBOW TROUT

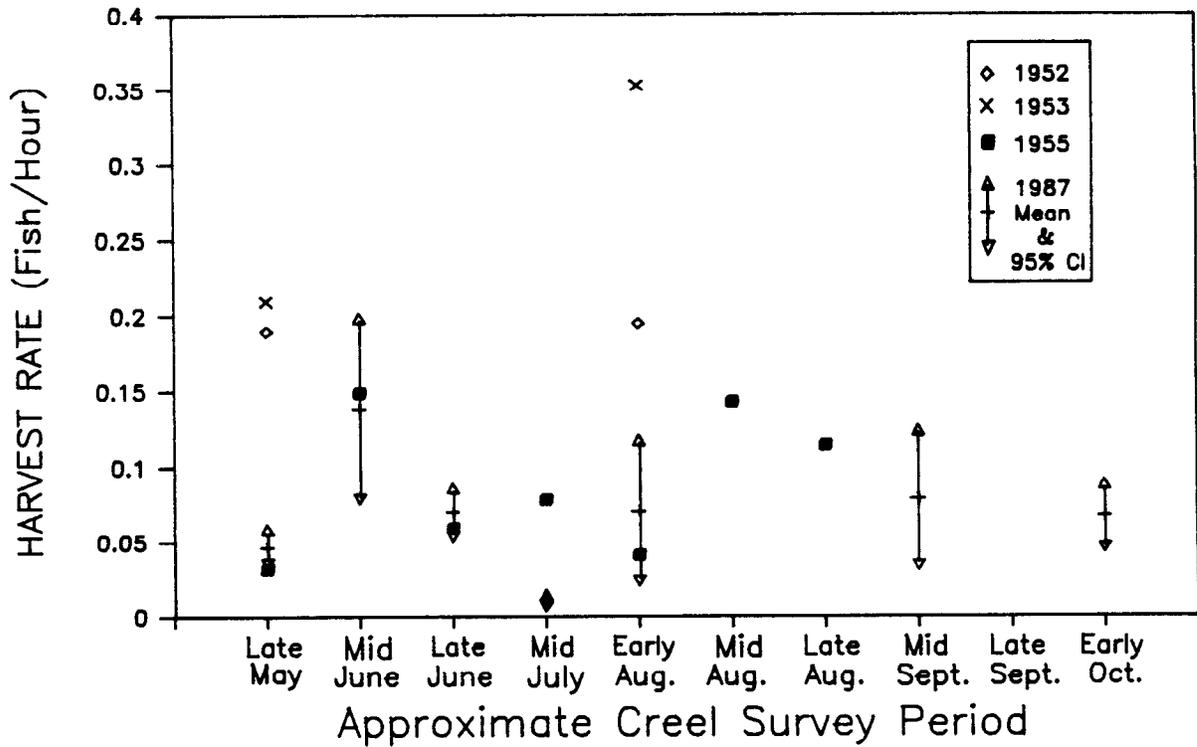
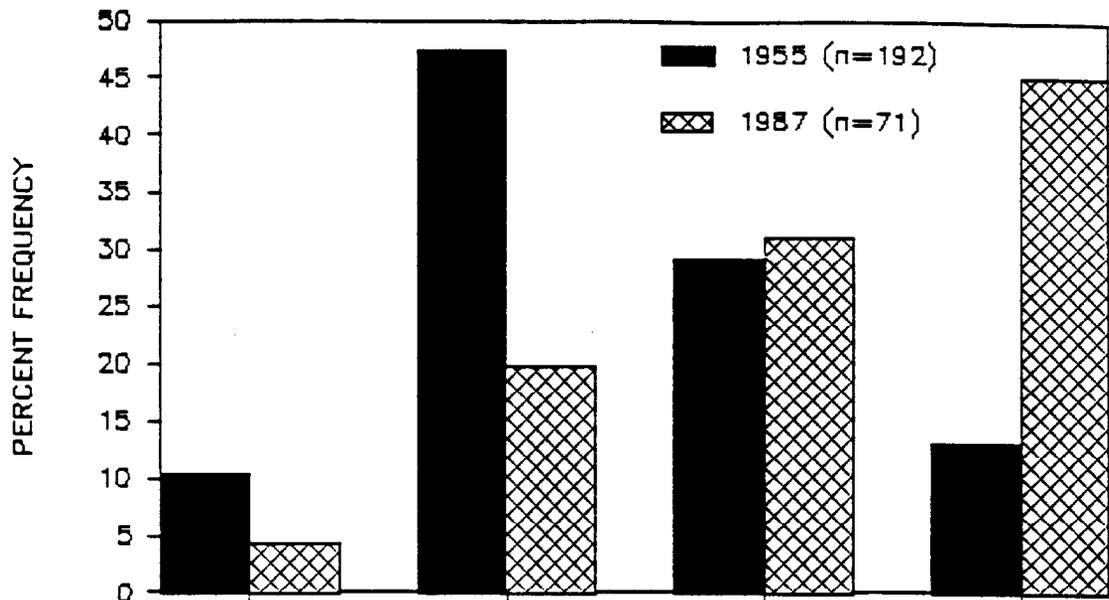


Figure 6. Comparison of sport harvest rates for rainbow trout and Arctic char between summer fisheries at Big Lake in 1952, 1953, 1955, and 1957.

## ARCTIC CHAR



## RAINBOW TROUT

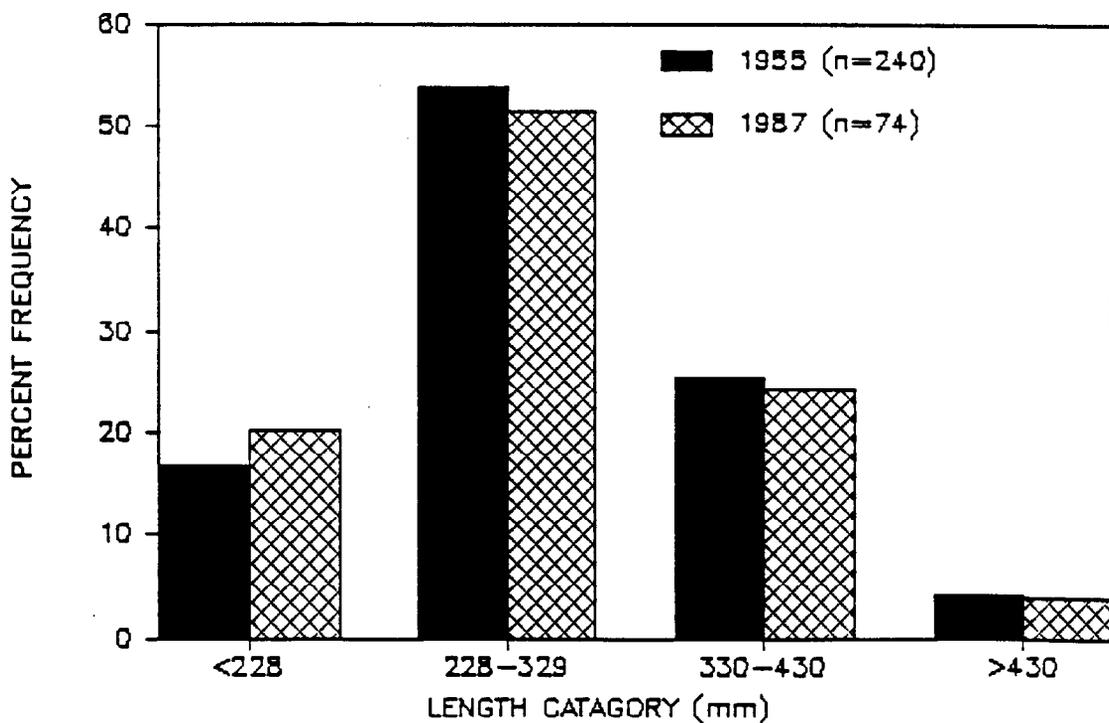


Figure 7. Comparison of length distributions for rainbow trout and Arctic char between summer fisheries at Big Lake in 1955 and 1987.

Lake during 1986 and 1987 indicate that coho salmon comprised 23% of the harvest, Arctic char 63%, and rainbow trout only 13% (Table 11). Personnel collecting angler interview data during the 1986-1987 Big Lake creel survey reported numerous occasions where anglers stated they had harvested rainbow trout but the fish were identified by creel clerks as coho salmon. If anglers responding to Mills' harvest survey have mistakenly reported harvests of juvenile salmon as rainbow trout, the 1977-1986 Big Lake rainbow trout harvest estimates reported by Mills may be too high.

In total, comparisons with historical harvest rates, rainbow trout test gill net catch rates (Havens, 1987), and juvenile rainbow trout abundance (Havens, 1987) point towards a decline in the number of rainbow trout in the Big Lake drainage. In contrast, there is little evidence that numbers of Arctic char have declined from historical levels.

### Recommendations

1. The numbers of harvestable size rainbow trout in Big Lake should be estimated. This will be accomplished in 1988 through a mark/recapture estimate. The initial mark will consist of a release of 24,000 marked catchable rainbow trout of Big Lake origin.
2. The Big Lake creel survey should be continued through the entire 1988 open-water period and the 1988-1989 ice-fishing season to determine the harvest rate of stocked rainbow trout versus native rainbow trout.
3. The stocking of rainbow trout fingerlings of Big Lake origin initiated in 1987 should be continued.

### ACKNOWLEDGEMENTS

To Larry Engel, Palmer Sport Fish Area Management Biologist, for his many suggestions regarding sampling schemes and data interpretation; Terrence Bradley and Stan Walker for their innovation and persistence in sample collection and their timely data summation during the fish population sampling; and Carol Kerkvliet for her perseverance at creel survey data collection and summation.

Table 11. Sport catch and harvest for rainbow trout, Arctic char, and juvenile coho salmon during the Big Lake creel survey, 6 December 1986 through 11 October 1987.

Period	Number of anglers Interviewed	Rainbow Trout		Arctic Char		Coho Salmon		Harvest Composition		
		Catch	Harvest	Catch	Harvest	Catch	Harvest	RT	AC	SS
Winter (ice-cover)										
12/06/86-12/21/86	196	22	10	270	143	110	36	5%	76%	19%
01/03/87-01/11/87	134	11	8	134	90	63	32	6%	69%	25%
01/31/87-02/08/87	238	0	0	152	122	52	40	0%	75%	25%
02/28/87-03/08/87	202	1	1	69	52	30	10	2%	82%	16%
03/21/87-03/29/87	219	4	0	63	39	33	10	0%	80%	20%
04/11/87-04/12/87	20	4	0	2	1	1	1	0%	50%	50%
Summer (ice-free)										
05/15/87-05/31/87	209	53	16	36	32	11	1	33%	65%	2%
06/06/87-06/29/87	183	25	25	13	9	16	4	66%	24%	10%
07/03/87-07/19/87	244	24	12	8	8	10	3	52%	35%	13%
08/01/87-08/09/87	118	10	8	0	0	20	15	35%	0%	65%
09/05/87-09/13/87	98	25	13	1	0	1	0	100%	0%	0%
10/03/87-10/11/87	168	45	27	226	75	226	57	17%	47%	36%
Sub-total (Winter):	1,009	42	19	690	447	289	129	3%	75%	22%
Sub-total (Summer):	1,020	182	101	284	124	284	80	33%	41%	26%
Totals:	2,029	224	120	974	571	573	209	13%	63%	23%

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## APPENDICES

Appendix Table 1. Comparison of length (mm), weight (g), number of pyloric caeca, and total gill rakers between Arctic char captured in nets and harvested by sport anglers at Big Lake, and Dolly Varden char captured in nets at Eklutna Lake, 1987.

Location and Species <sup>1</sup>	Number Examined <sup>2</sup>	Length			Weight			Pyloric Caeca			Total Gill Rakers <sup>3</sup>		
		Mean	S.E.	Range	Mean	S.E.	Range	Mean	S.E.	Range	Mean	S.E.	Range
BL (AC)	168	347	9.4	144-600	592	45.3	20-2,570	46	0.4	35-57			
	73	342	14.0	168-579	560	64.8	42-2,385	47	0.5	36-57	25	0.2	19-28
EL (DV)	28	201	21.4	64-468	195	63.2	2-1,250	22	0.7	16-32	18	0.3	16-23

<sup>1</sup> BL (AC) = Big Lake (Arctic char); EL (DV) = Eklutna Lake (Dolly Varden char).

<sup>2</sup> The 73 Arctic char are that portion of the total 168 Arctic char for which gill rakers were counted.

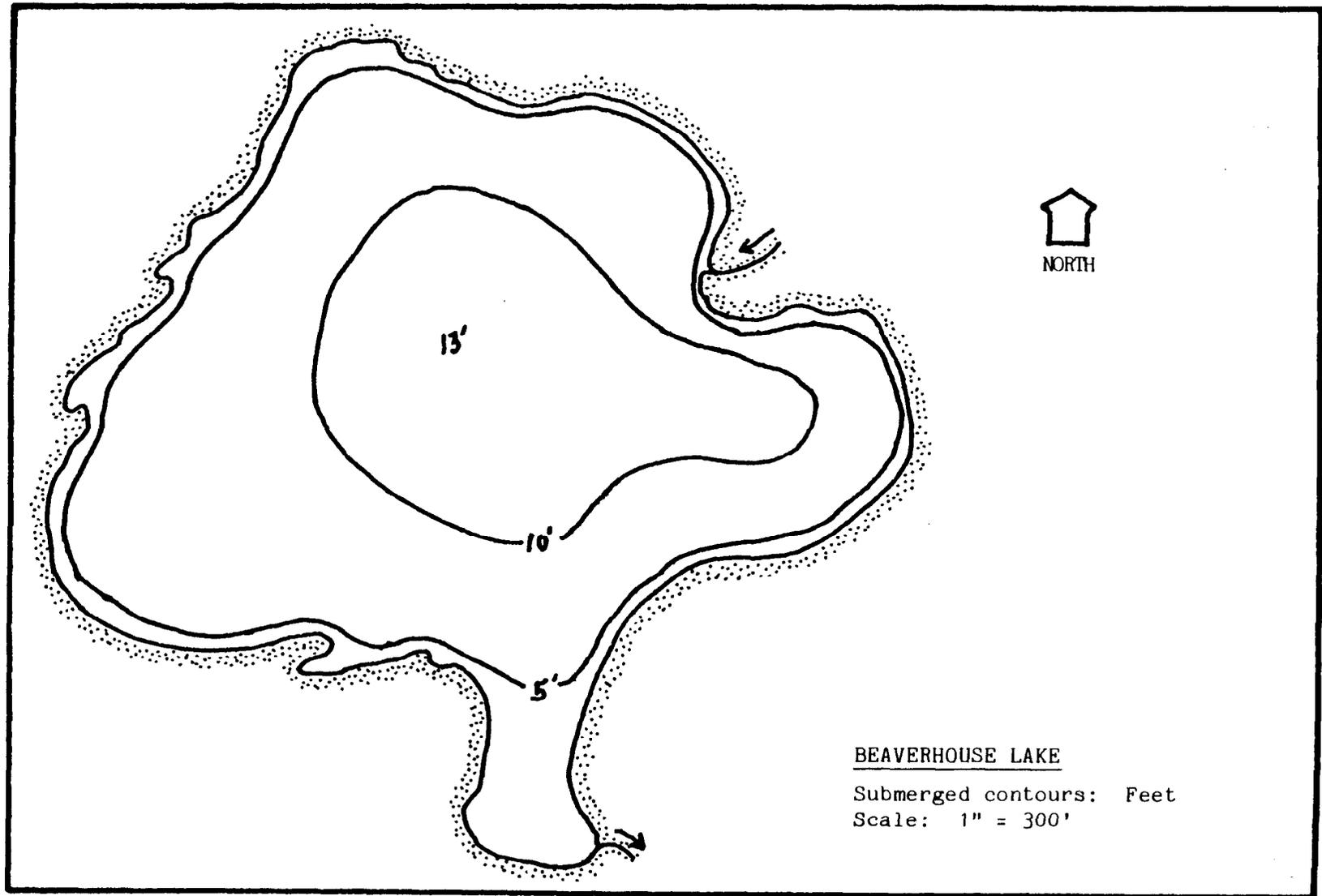
<sup>3</sup> Total gill raker count is the sum of gill rakers on lower and upper arch.

Appendix Table 2. Physical data collected during surveys of Beaverhouse, Blodgett, Lalen, Lynda, and Visnaw Lakes, 24 July through 4 August 1987.

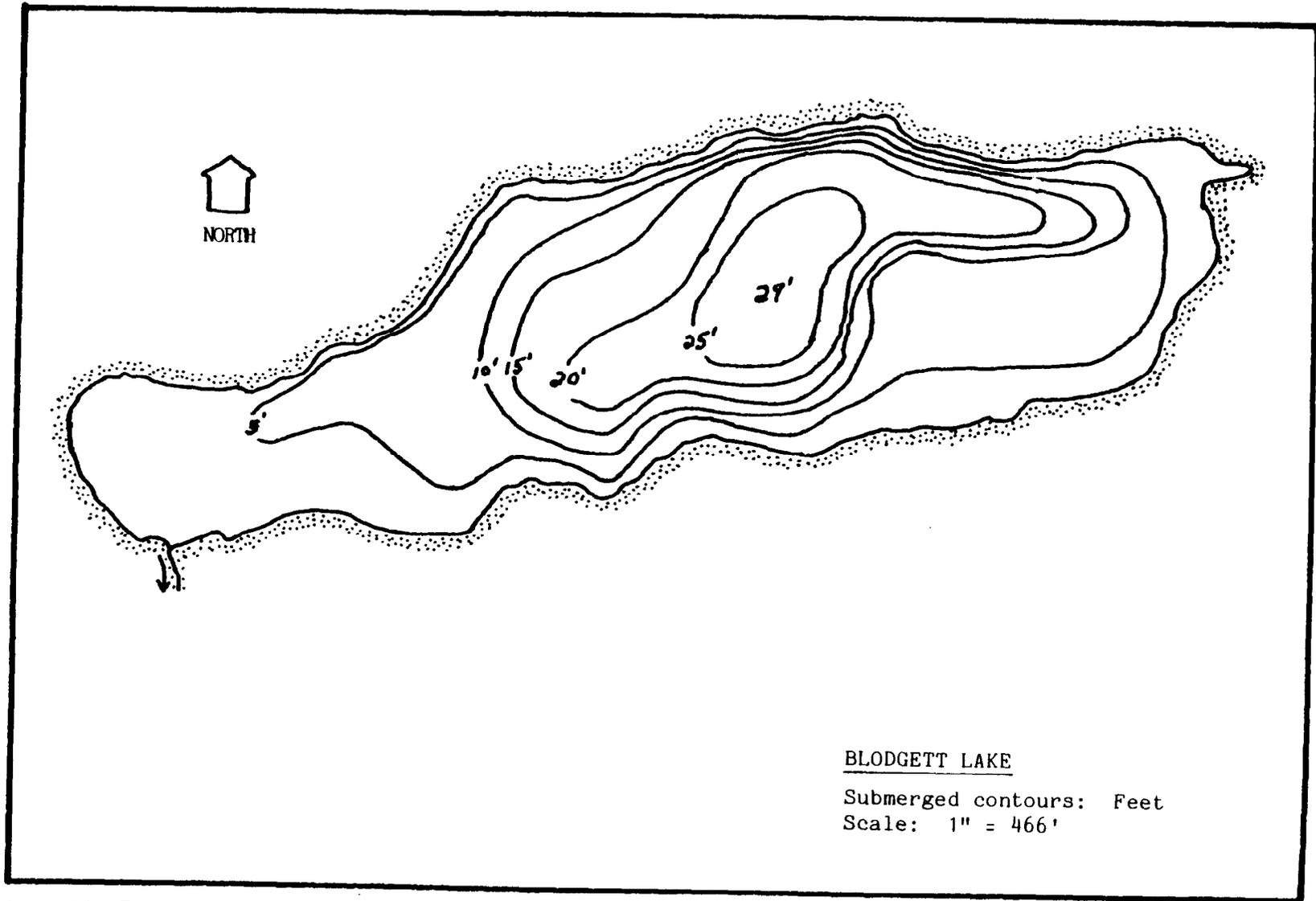
Lake	Sample Date	Location		Surface Area (ha)	Maximum Depth (m)	Mean Depth (m)	Shoreline Distance (km)	Surface Elevation (m)
		Latitude,	Longitude					
Beaverhouse	07/30/87	61 34'25"N,	149 51'40"W	13.4	4.0	2.3	1.8	53.3
Blodgett	07/31/87	61 34'37"N,	149 40'00"W	23.3	8.8	3.3	2.6	76.2
Lalen	07/24/87	61 36'22"N,	149 40'50"W	37.2	4.0	1.7	2.4	91.4
Lynda	08/04/87	61 34'15"N,	149 50'00"W	4.5	6.1	3.5	1.0	53.3
Visnaw	07/28/87	61 34'10"N,	149 40'40"W	52.9	5.2	1.5	3.7	91.4

Appendix Table 3. Water chemistry data collected during surveys of Lynda, Beaverhouse, Blodgett, Lalen, and Visnaw Lakes, 1987.

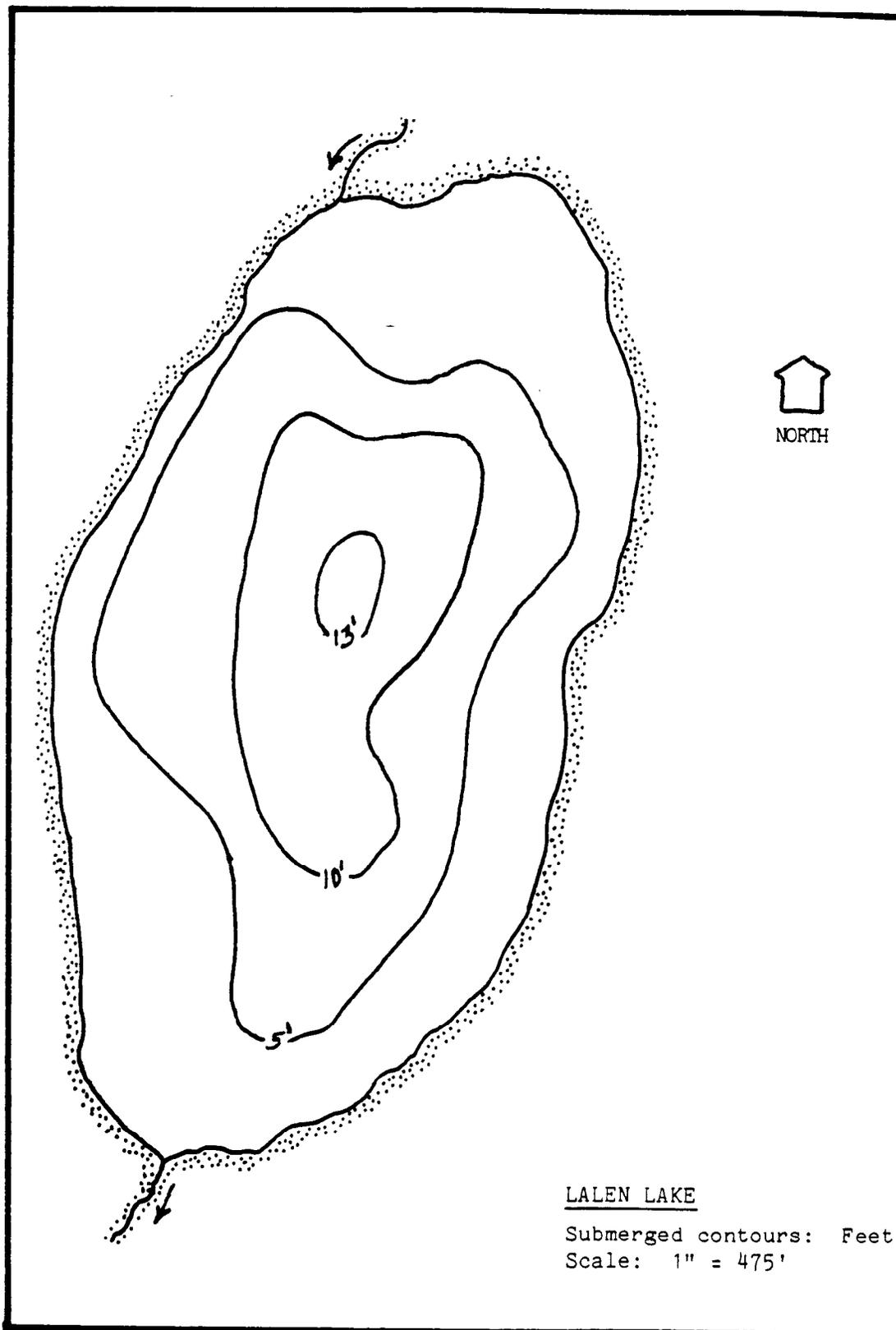
Lake	Sample		Alkalinity (mg/l)	Conductivity (micromhos)	Hardness (mg/l)	pH (units)
	Sample Date	Depth (m)				
Beaverhouse	07/30/87	1	28	54	42	7.2
Blodgett	07/31/87	1	102	143	112	7.8
Lalen	07/24/87	1	35	53	31	7.2
Lynda	08/04/87	1	37	86	51	7.7
Visnaw	07/28/87	1	34	39	40	7.4



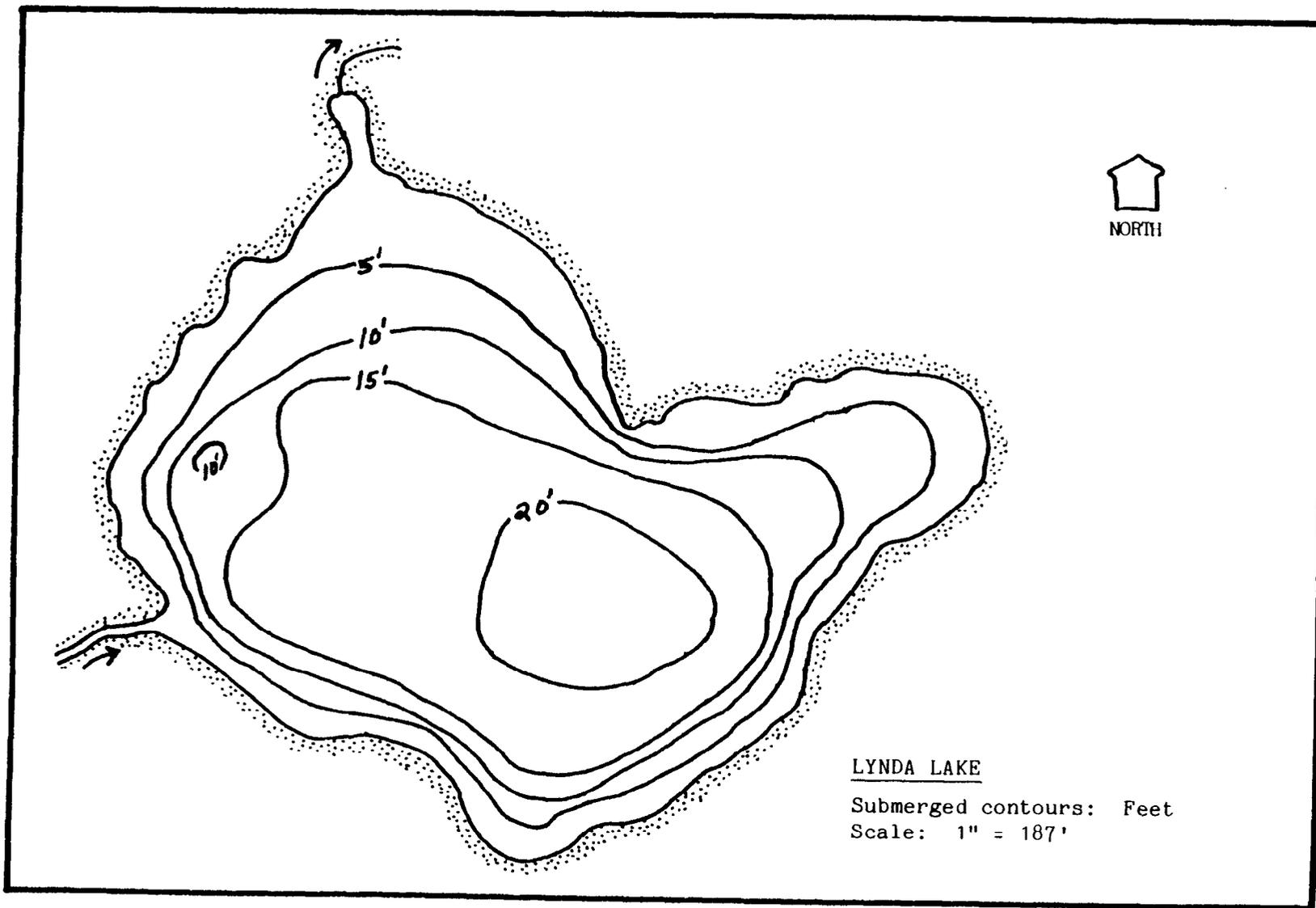
Appendix Figure 1. Beaverhouse Lake contour map.



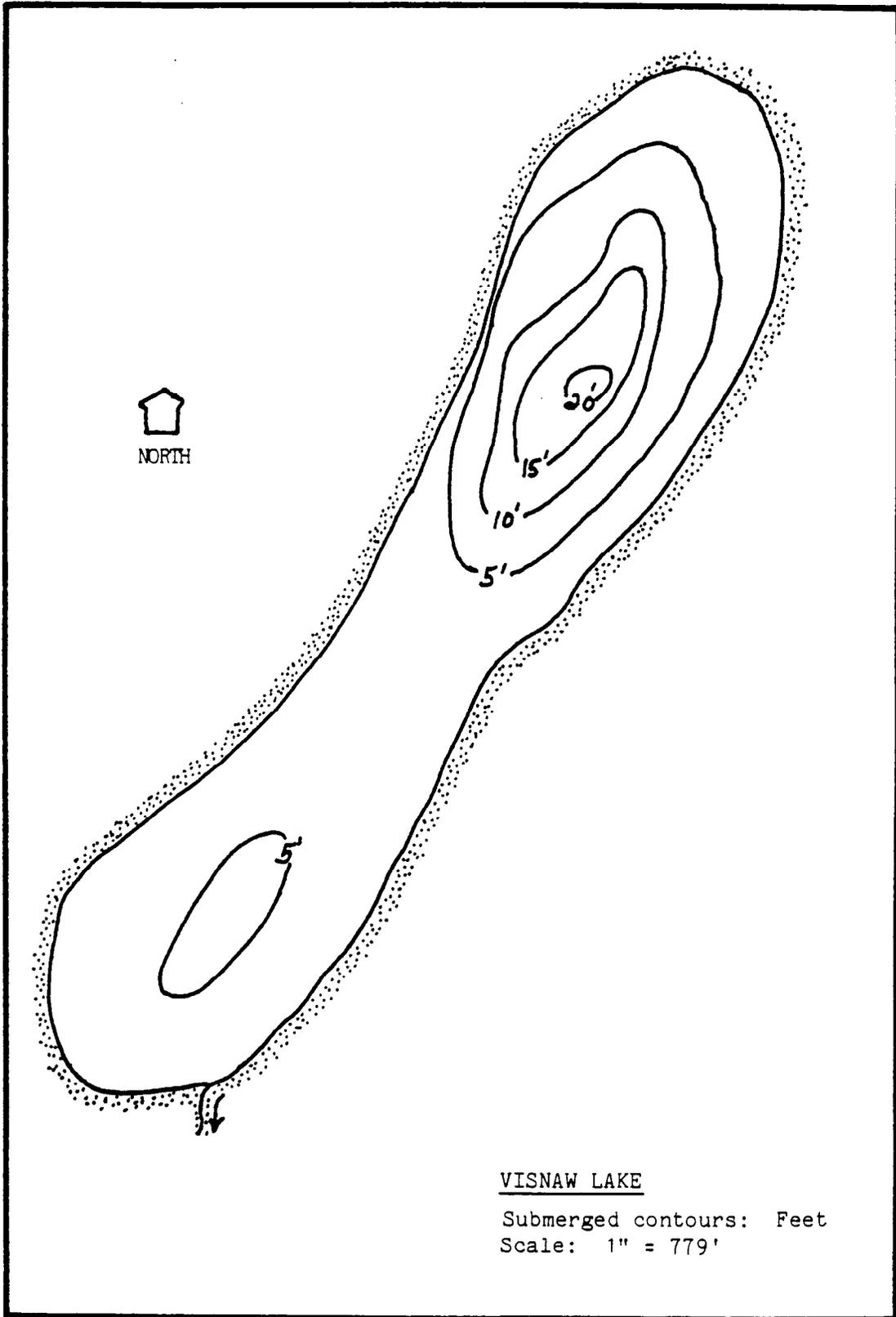
Appendix Figure 2. Blodgett Lake contour map.



Appendix Figure 3. Lalen Lake contour map.



Appendix Figure 4. Lynda Lake contour map.



Appendix Figure 5. Visnaw Lake contour map.