Volume 20 Study G-I-R

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

INVENTORY OF HIGH QUALITY RECREATIONAL FISHING WATERS IN SOUTHEAST ALASKA

by

Artwin E. Schmidt

ALASKA DEPARTMENT OF FISH AND GAME
Ronald O. Skoog, Commissioner

SPORT FISH DIVISION
Rupert E. Andrews, Director

STUDY NO. G-I INVENTORY AND CATALOGING

Job No. G-I-R Inventory of High-Quality Recreational Fishing Waters in Southeast Alaska

By: Artwin E. Schmidt

(G-I-R Cont.)

RESEARCH PROJECT SEGMENT

State: ALASKA Name: Sport Fish Investigations of Alaska

Project No.: F-9-11

Study No.: G-I Study Title: INVENTORY & CATALOGING

Job No.: G-I-R Job Title: Inventory of High-Quality Recreational Fishing Waters in Southeast Alaska

Period Covered: July 1, 1978 to June 30, 1979

ABSTRACT

Limnological investigations and recreational analyses were conducted on seven lakes in an attempt to further quantify the relationship of physical, chemical, and biological characteristics to fish production. Intensive limnological and fishery investigations were conducted on four lakes (Gar, Red, Rezanof, and Salmon Bay), while the other three lakes (Big Bay, Kvoustof, and Lower Kvoustof) were only sampled once during the summer. Recreational analyses were conducted on all systems.

Analyses of physical and chemical parameters indicate Red Lake has the highest potential fish yield, 2.41 kilograms per hectare, of lakes studied to date in Southeast Alaska. Salmon Bay Lake was considerably lower, 0.86 kilograms per hectare, and Lonieof and Rezanof are the lowest studied to date, 0.25 and 0.17, respectively. Specific conductance was high in Red Lake, 93 micromhos, and very low in Lonieof, 5 micromhos, and Rezanof, 3 micromhos.

Red Lake and Salmon Bay Lake are anadromous and both have fish populations of rainbow/steelhead, *Salmo gairdneri* Richardson, and cutthroat trout, *S. clarki* Richardson; Dolly Varden, *Salvelinus malma* (Walbaum); and coho, *Oncorhynchus kisutch* (Walbaum), and sockeye salmon, *O. nerka* (Walbaum). Condition factors of resident cutthroat trout from Red Lake and Salmon Bay Lake were 1.00 and 0.98, respectively. Cutthroat trout from Big Bay Lake, a nonanadromous, muskeg lake, had a mean condition factor of 0.85.

Rezanof, Kvoustof, and Lonieof lakes are a chain of nonanadromous lakes which have rainbow trout as the only fish species. Mean condition factors of rainbow trout were nearly the same from Rezanof Lake (1.06) and Lonieof Lake (1.08). Condition factor of rainbow trout from Kvoustof Lake was 1.22.

Cutthroat trout stomach analyses from Red Lake and Salmon Bay Lake showed a high dependence of cutthroat trout on salmon fry; threespine stickleback, *Gasterosteus aculeatus* Linnaeus; and beetles. Food of the cutthroat trout from Big Bay Lake, a landlocked system, was primarily midges.

The diversity of food organisms found in rainbow trout stomachs indicates they are eating whatever is available. The most frequently eaten items were mayflies, caddis flies, midges, and black flies. Zooplankton apparently was little utilized.

BACKGROUND

Limnological investigations have been conducted in several lakes in Southeast Alaska (Schmidt, 1974; Schmidt and Robards, 1975; Schmidt, 1976, 1977, 1978). One continuing objective of this project is to determine the relationship of physical, chemical, and biological characteristics to fish production.

The Alaska Department of Fish and Game, Sport Fish Division, has long attempted to obtain additional protection for high-quality fishing waters. In 1972 the Alaska Department of Fish and Game made an official request to the forest supervisor of the Tongass National Forest to give special consideration to identified high-quality watersheds.

This investigation was conducted to further quantify the recreational value and productivity of five lake systems. Selected lakes were Red Lake and Salmon Bay Lake on Prince of Wales Island and Rezanof Lake, Lonieof Lake, and Big Bay Lake on Baranof Island (Fig.1).

Table 1 lists common and scientific names of fish encountered.

RECOMMENDATIONS

Measures should be taken to insure no logging or other development impacts Red Lake and Salmon Lake or their inlet and outlet streams.

OBJECTIVES

1. To determine the relationship of physical, chemical, and biological characteristics of selected lakes to fish production.

2. To identify and protect from undesirable development high-quality recreational fishing waters in Southeast Alaska.

3. To determine the recreational fishing potential of Red and Salmon Bays, and Gar, and Big Bay lakes.

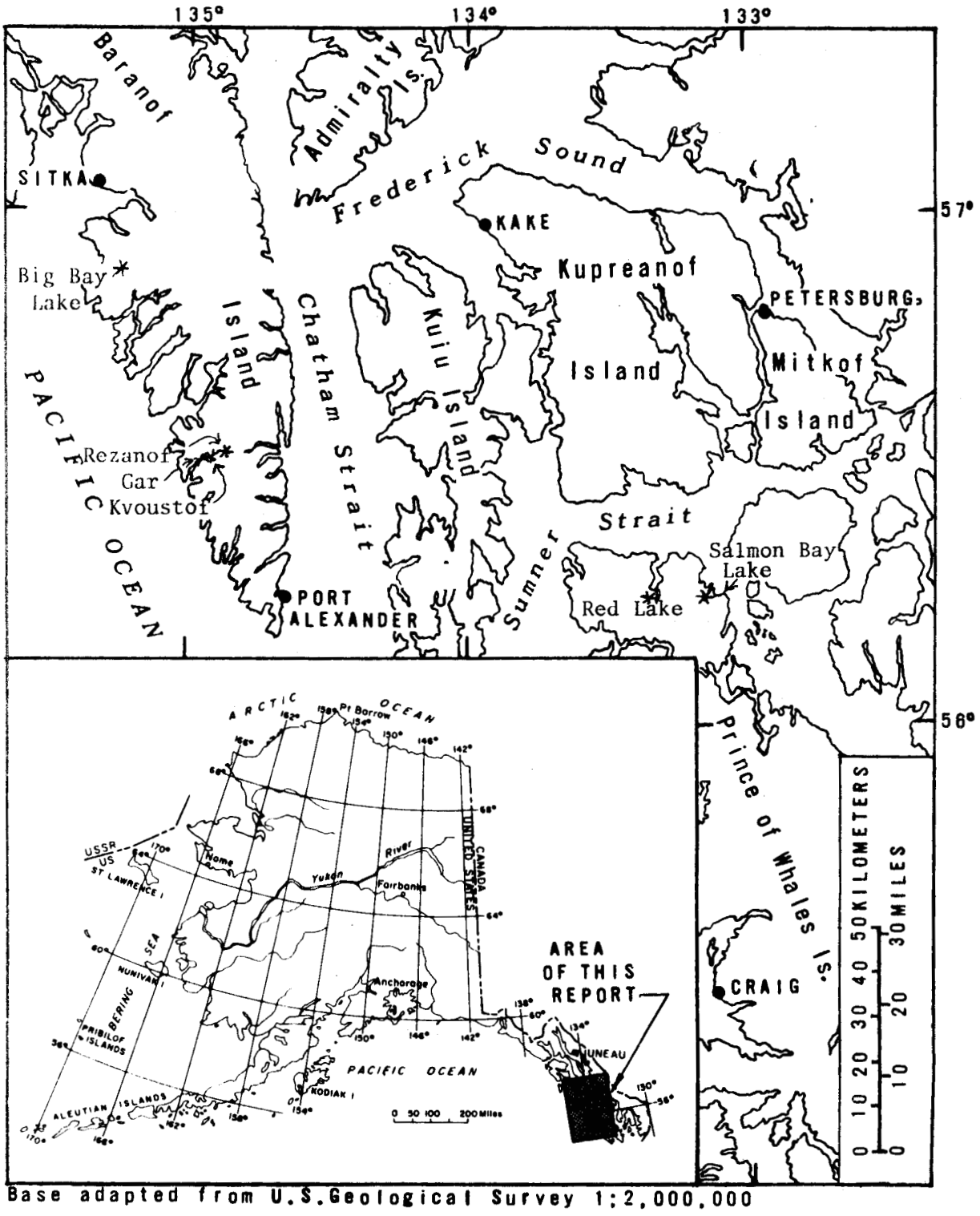

Fig. 1. Location of six lakes studied in 1978.

Table 1. List of common and scientific names.

Common Name	Scientific Name and Author
Dolly Varden	*Salvelinus malma* (Walbaum)
Cutthroat Trout	*Salmo clarki* Richardson
Coho Salmon	*Oncorhynchus kisutch* (Walbaum)
Sockeye Salmon	*Oncorhynchus nerka* (Walbaum)
Pink Salmon	*Oncorhynchus gorbuscha* (Walbaum)
Chum Salmon	*Oncorhynchus keta* (Walbaum)
Rainbow Trout	*Salmo gairdneri* Richardson
Steelhead Trout	*Salmo gairdneri* Richardson
Threespine stickleback	*Gasterosteus aculeatus* Linnaeus

TECHNIQUES USED

Relationship of Limnological Characteristics to Fish Production

Limnological relationships existing in seven lakes were investigated. Four of the lakes (Red, Salmon Bay, Rezanof, and Lonieof) were sampled intensively every third week, while the other three lakes (Big Bay, Kvoustof, and Lower Kvoustof) were only sampled once during the summer.

Sampling stations were established at approximately the deepest portion of each lake. Vertical profiles of temperature and specific conductance were recorded at each station. Water samples for comprehensive chemical analyses were collected and preserved at each station. Field chemical analyses, including alkalinity titrations, were conducted according to Standard Methods (1971). Comprehensive chemical determinations on preserved samples were conducted by the contractual firm of Dames and Moore using atomonic absorption and gas chromatographic analysis.

Bathymetric maps were prepared for each lake. A recording fathometer was used to record depth contours on transects crossing each lake. The depth contours were transferred to bathymetric maps, and morphometric data were calculated from these maps.

Zooplankton were collected every 3 weeks by making duplicate vertical tows from the lake bottom with each of two nets. Nets used were 0.5 m diameter and 3 m long. Straining cloth of the No. 153 Nitex net had aperture of 153 microns and 45% open area. Plankton were identified and counted. Dry and ash weight of plankton were determined gravimetrically. Efficiency of nets was not accounted for in calculations. Thermal profiles and Secchi disc readings were taken in conjunction with plankton tows.

Stream drift organisms were collected by placing two nets in the main inlet. Nets used were 30.5 cm square, 91.4 mm long, made with Nitex with pore size of 280 microns and 45% open area. Benthos were preserved and later identified and enumerated in the laboratory.

Bottom fauna were collected by dredging with an Ekman 152.4-mm dredge. Bottom samples were washed through three screens, the finest having 28 meshes per inch. Organisms were preserved in 70% ethyl alcohol or frozen until laboratory analysis.

Rearing and spawning areas of inlet and outlet streams were mapped. Adult and juvenile fish were collected by hook and line, gill nets, and fry traps. Age, growth, and food habits of fish in the lakes were determined from fish collected throughout the study period.

Evaluation of High-Quality Recreational Fishing Waters

The recreational potential of each of the lakes was evaluated. Information evaluated included present and future recreational opportunity and importance, proximity to other recreational areas, uniqueness of the area, ability of the system to support a viable fishery, accessibility, and aesthetics.

FINDINGS

Relationship of Limnological Characteristics to Fish Production

Morphometry:

The depth, size, and shape of lakes strongly influence physical and chemical conditions which prevail in them. Since physical and chemical parameters limit species composition and abundance of organisms, it is essential to study the morphometric features of lakes. Bathymetric maps of Big Bay Lake (Fig. 2), Lonieof Lake (Fig. 3), Lower Kvoustof Lake (Fig. 4), Red Lake (Fig. 5), Rezanof Lake (Fig. 6), and Salmon Bay Lake (Fig. 7) were prepared from sounding data. Morphometric data for Lonieof, Lower Kvoustof, Red, Rezanof, and Salmon Bay lakes are presented in Tables 2 through 6.

Physical and Chemical Considerations:

Observations of temperature, Secchi disc visibility, pH, conductivity, alkalinity, and hardness were made on lakes during the survey period. Locations of sampling stations on Big Bay, Kvoustof, Lonieof, Red, Rezanof, and Salmon Bay lakes are shown in Figs. 8 through 13. Thermal data from Big Bay, Lonieof, Red, Rezanof, and Salmon Bay lakes are presented in Table 7. Alkalinity, conductivity, hardness, pH, and Secchi disc visibility from lakes studied are presented in Table 8. Water quality analyses for all lakes studied in 1978 are presented in Table 9.

The morphoedaphic index (Ryder, 1964; 1965) is an empirically-derived formula that was described initially as a convenient method of rapidly calculating potential fish yields from unexploited north-temperate lakes. Since its inception, the constraints on the use of the morphoedaphic index (MEI) have been relaxed, as it has been applied to sets of lakes other than those for which it was originally devised. Various investigators have clarified our understanding of the MEI (e.g., Jenkins, 1967; Regier et al., 1971; Henderson et al., 1973) and have extended the application of this index to other climatic systems.

The MEI for all lakes studied so far in Southeast Alaska is presented in Table 10. Red Lake has the highest MEI and potential yield of all lakes studied to date, while Lonieof and Rezanof lakes have the lowest.

Plankton:

Zooplankton populations were monitored throughout the summer at Lonieof Lake (Table 11), Red Lake (Table 12), Rezanof Lake (Table 13), and Salmon Bay Lake (Table 14). A list of zooplankton species identified from these lakes is presented in Table 15. Plankton composition and density from Big Bay Lake (Table 16) and Kvoustof Lake and Lower Kvoustof Lake (Table 17) were sampled only once during the summer.

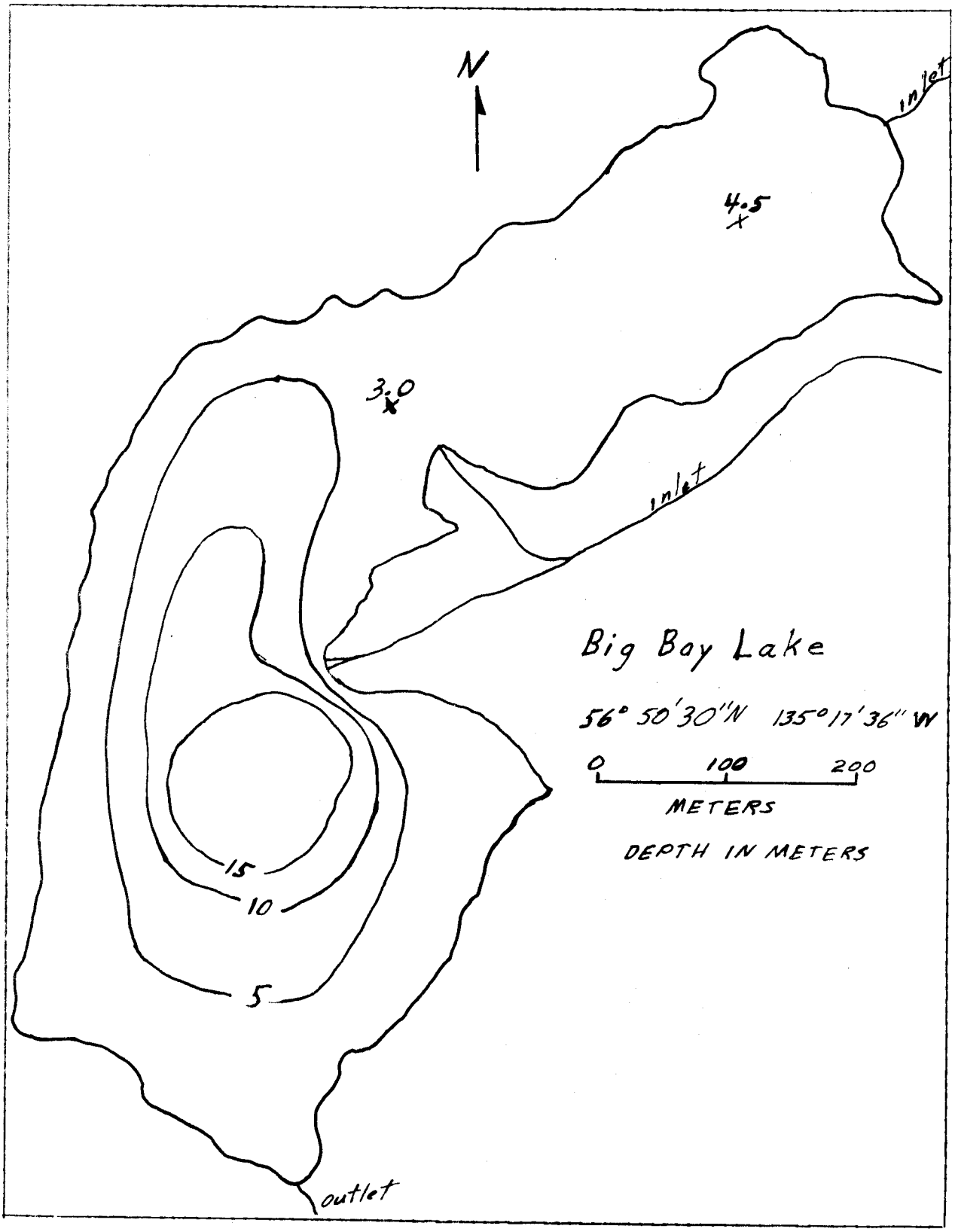

Fig. 2. Bathymetric map of Big Bay Lake.

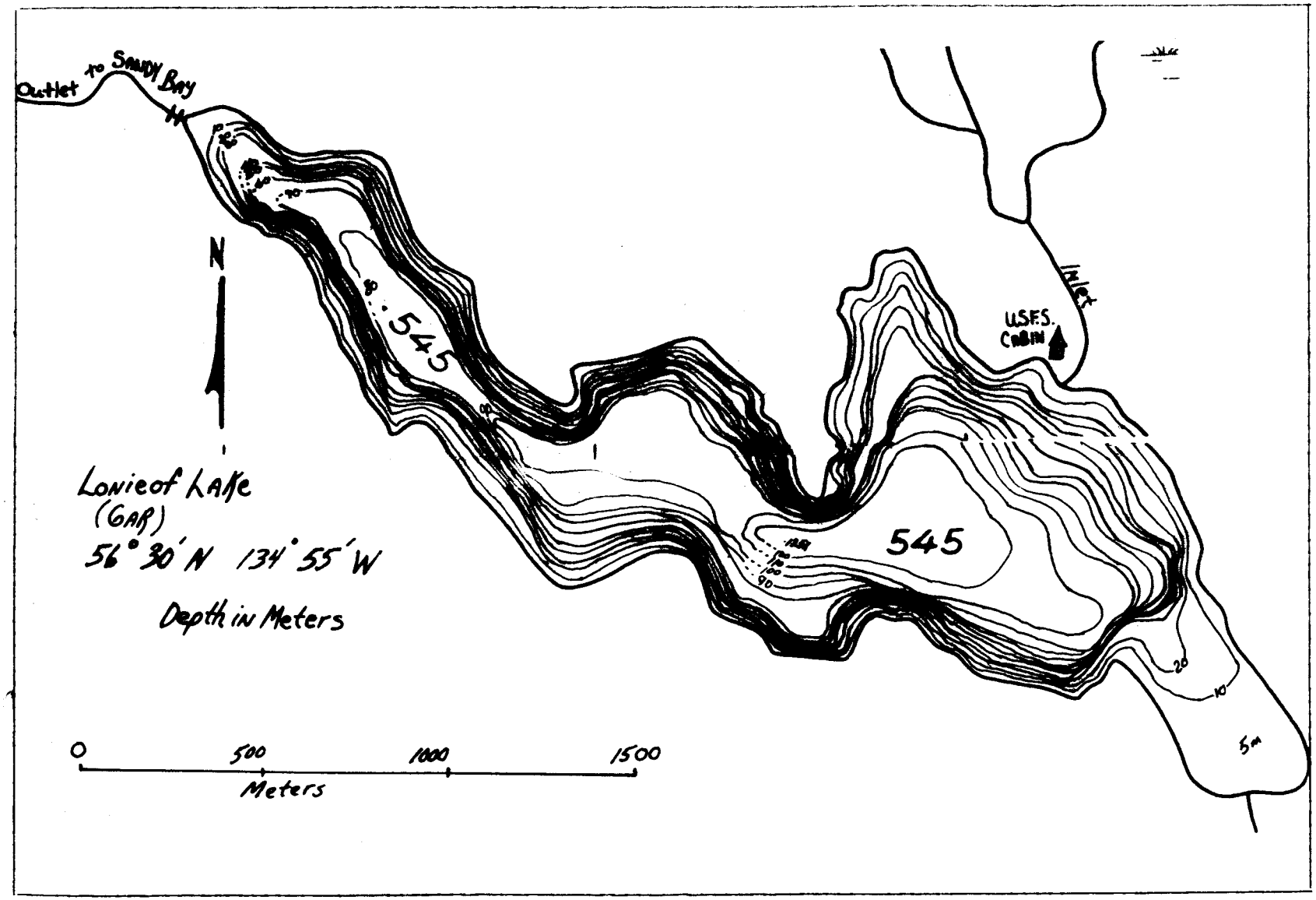

Fig. 3. Bathymetric map of Lonieof Lake.

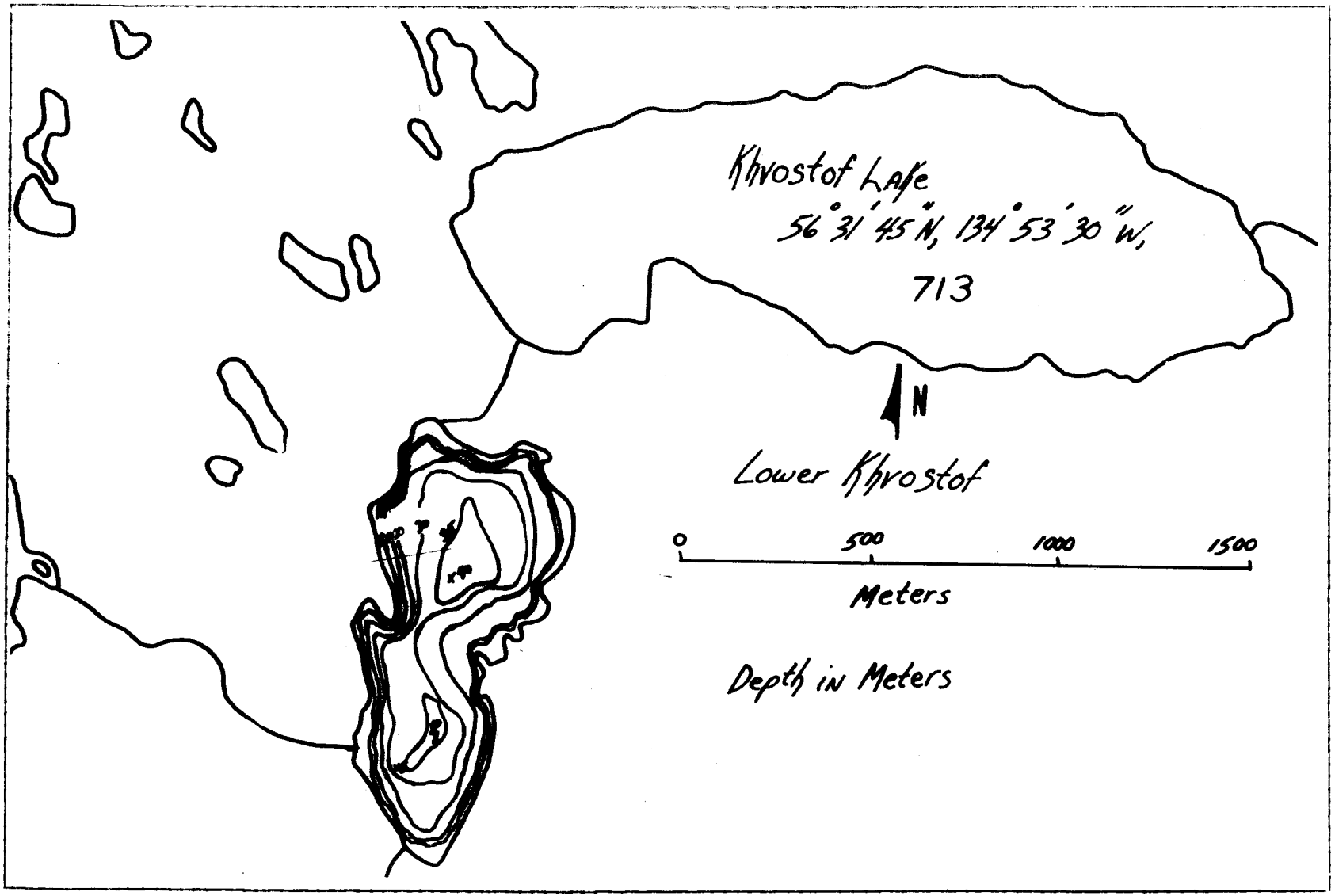

Fig. 4. Bathymetric map of Lower Kvoustof Lake.

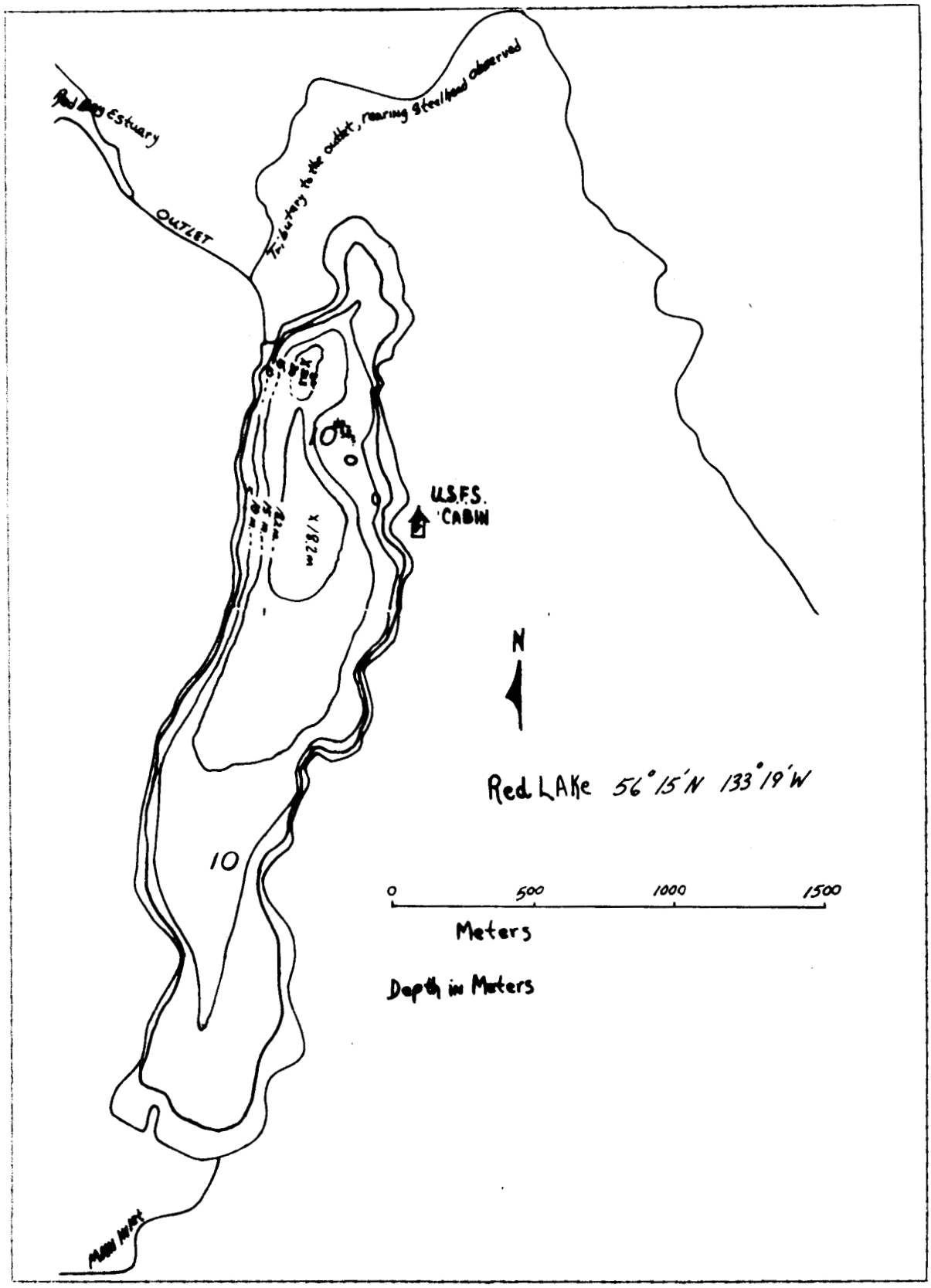

Fig. 5. Bathymetric map of Red Lake.

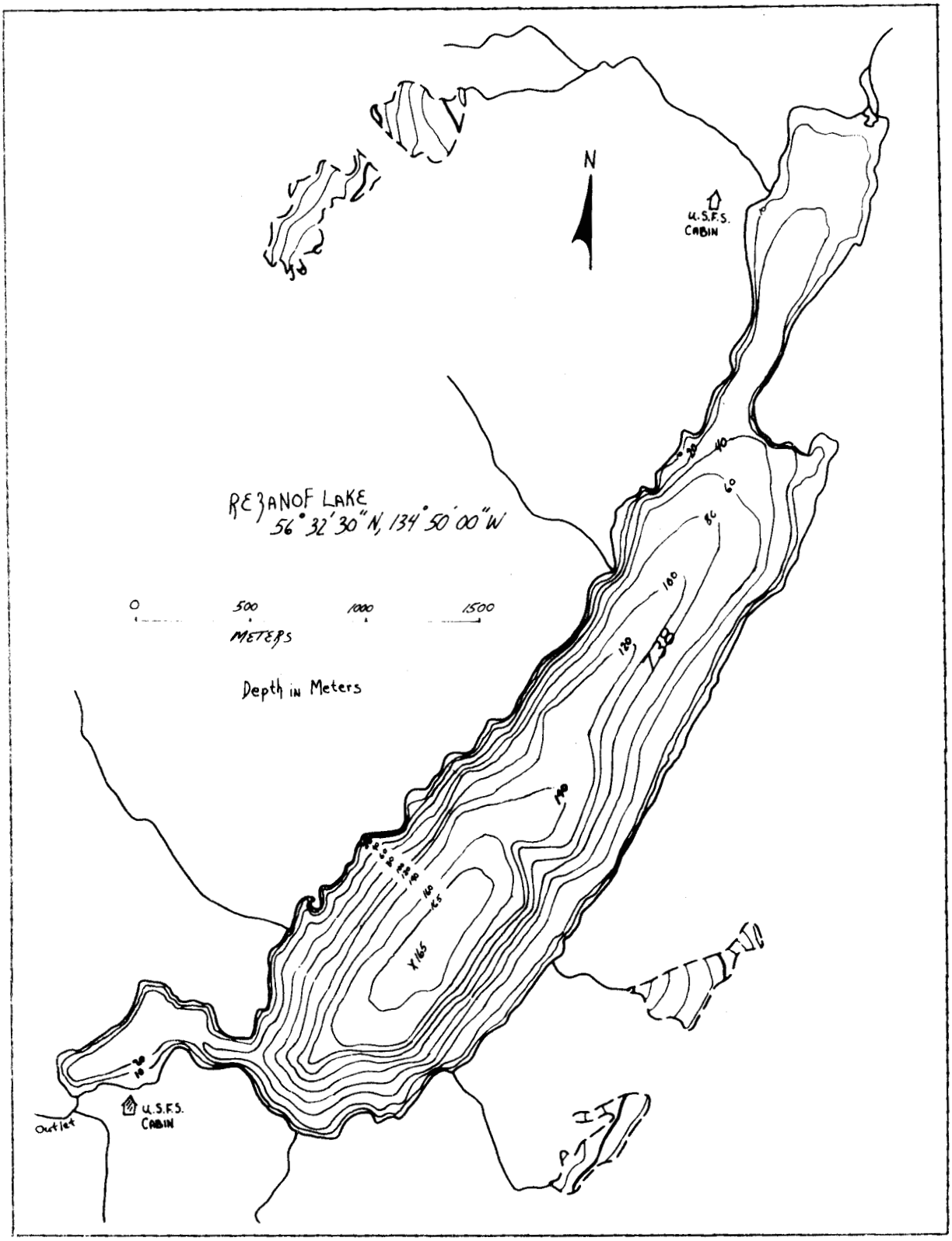

Fig. 6. Bathymetric map of Rezanof Lake.

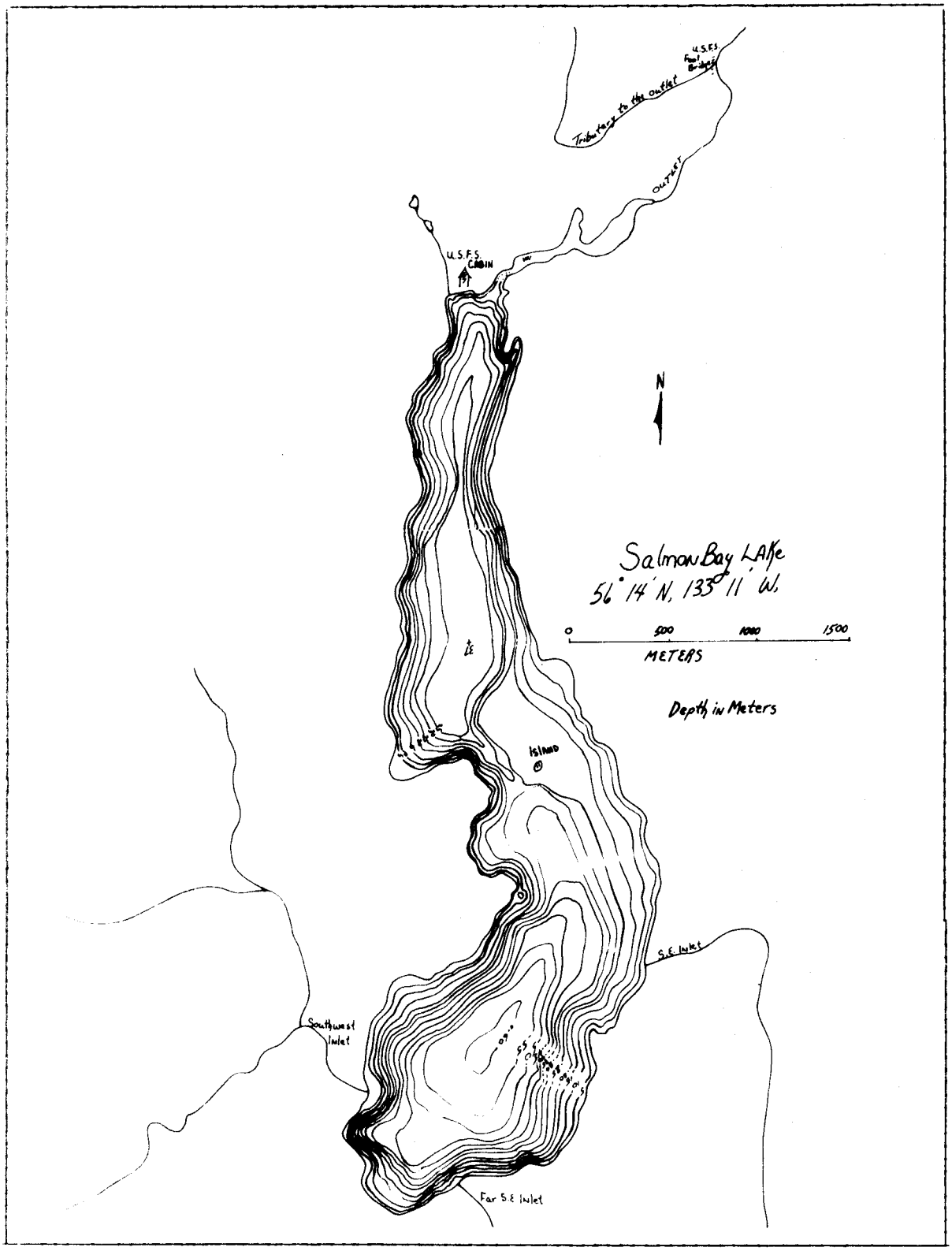

Fig. 7. Bathymetric map of Salmon Bay Lake.

Table 2. Morphometry of Lonieof Lake.

Water Area 178.9 ha or 1,788,602 m acres

Area by Depth Zone

Depth Zone (m)	Area (m^2)	Percent of Total Area
0- 10	268,629	15.0
10- 20	183,621	10.3
20- 30	132,615	7.4
30- 40	125,815	7.0
40- 50	88,409	4.9
50- 60	129,214	7.2
60- 70	115,614	6.5
70- 80	57,806	3.2
80- 90	156,418	8.7
90-100	95,211	5.3
100-110	200,623	11.2
110-120	112,212	6.3
120+	122,414	6.8

Water Volume

Cubic Meters 98,589,096

Acre Feet 79,917

Volume by Depth Zone

Depth Zone (m)	Volume (m^3)	Percent of Total Volume
0- 10	16,524,659	16.8
10- 20	7,014,323	7.1
20- 30	12,694,661	12.9
30- 40	11,402,499	11.6
40- 50	10,334,013	10.5
50- 60	9,241,519	9.4
60- 70	8,017,961	8.1
70- 80	7,155,864	7.2
80- 90	6,069,872	6.2
90-100	4,820,703	4.9
100-110	3,298,128	3.3
110-120	1,755,047	1.8
120-125	259,847	0.3

Maximum Depth = 125 m Mean Depth = 55.1 m

Shoreline Length = 9,377.1 m Shoreline Development = 2.0

Table 3. Morphometry of Lower Kvoustof Lake.

Water Area 41.8 ha or 103.3 acres

Area by Depth Zone

Depth Zone (m)	Area (m^2)	Percent of Total Area
0-10	680,073	68.3
10-20	72,089	7.2
20-30	97,250	9.8
30-35	122,754	12.3
35-45	13,262	1.3
45+	10,201	1.0

Water Volume

Cubic Meters 8,916,896.2

Acre Feet 7,228.1

Volume by Depth Zone

Depth Zone (m)	Volume (m^3)	Percent of Total Volume
0-10	3,656,982	41.0
10-20	2,787,335	31.3
20-30	1,927,869	21.6
30-35	380,419	4.3
35-45	163,781	1.8
45+	510	0

Maximum Depth = 50 m

Mean Depth = 21.3 m

Shoreline Length = 3,219.6 m

Shoreline Development = 1.4

Table 4. Morphometry of Red Lake.

Water Area 165.9 ha or 409.9 acres

Area by Depth Zone

Depth Zone (m)	Area (m^2)	Percent of Total Area
0- 5	296,513	17.9
5-10	516,178	31.1
10-15	357,040	21.5
15-20	475,985	28.7
20+	13,670	0.8

Water Volume

Cubic Meters 17,320,834.1

Acre Feet 14,040.4

Volume by Depth Zone

Depth Zone (m)	Volume (m^3)	Percent of Total Volume
0- 5	7,543,497	43.6
5-10	5,472,972	31.6
10-15	3,300,393	19.0
15-20	975,230	5.6
20+	28,743	0.1

Maximum Depth = 21.3 m Mean Depth = 10.4 m

Shoreline Length = 8,008.8 m Shoreline Development = 1.75

Table 5. Morphometry of Rezanof Lake.

Water Area 354 ha or 874.3 acres

Area by Depth Zone

Depth Zone (m)	Area (m^2)	Percent of Total Area
0- 20	734,483	21.6
20- 40	634,511	18.7
40- 60	389,684	11.5
60- 80	401,925	11.8
80-100	342,759	10.0
100-120	248,908	7.3
120-140	265,230	7.8
140-160	199,942	5.9
165	179,540	5.3

Water Volume

Cubic Meters 252,181,312.6

Acre Feet 204,420.5

Volume by Depth Zone

Depth Zone (m)	Volume (m^3)	Percent of Total Volume
0- 20	63,308,951	25.1
20- 40	49,625,793	19.7
40- 60	39,455,042	15.6
60- 80	31,517,610	12.5
80-100	27,583,900	10.9
100-120	18,182,771	7.2
120-140	13,007,824	5.1
140-160	8,366,530	3.3
160-165	1,132,893	0.4

Maximum Depth = 165 m Mean Depth = 71.2 m

Shoreline Length = 13,079.6 m Shoreline Development = 1.9

Table 6. Morphometry of Salmon Bay Lake.

Water Area 388.4 ha or 959.4 acres

Area by Depth Zone

Depth Zone (m)	Area (m^2)	Percent of Total Area
0- 5	287,673	7.7
5-10	340,718	9.0
10-15	426,408	11.3
15-20	491,695	13.0
20-25	332,557	8.9
25-30	373,362	10.0
30-35	402,604	10.7
35-40	466,533	12.4
40-45	171,379	4.6
45-50	181,580	4.9
50-55	144,856	3.9
55-60	142,816	3.8

Water Volume

Cubic Meters 103,932,021

Acre Feet 84,248

Volume by Depth Zone

Depth Zone (m)	Volume (m^3)	Percent of Total Volume
0- 5	18,699,192	18.0
5-10	17,125,762	16.4
10-15	15,202,546	14.7
15-20	12,900,215	12.4
20-25	10,848,496	10.4
25-30	9,078,313	8.7
30-35	7,130,688	6.9
35-40	4,456,970	4.3
40-45	3,377,710	3.2
45-50	2,490,552	2.4
50-55	1,675,190	1.7
55-60	946,386	0.9

Maximum Depth = 60 m Mean Depth = 26.7 m

Shoreline Length = 15,091.9 m Shoreline Development = 2.1

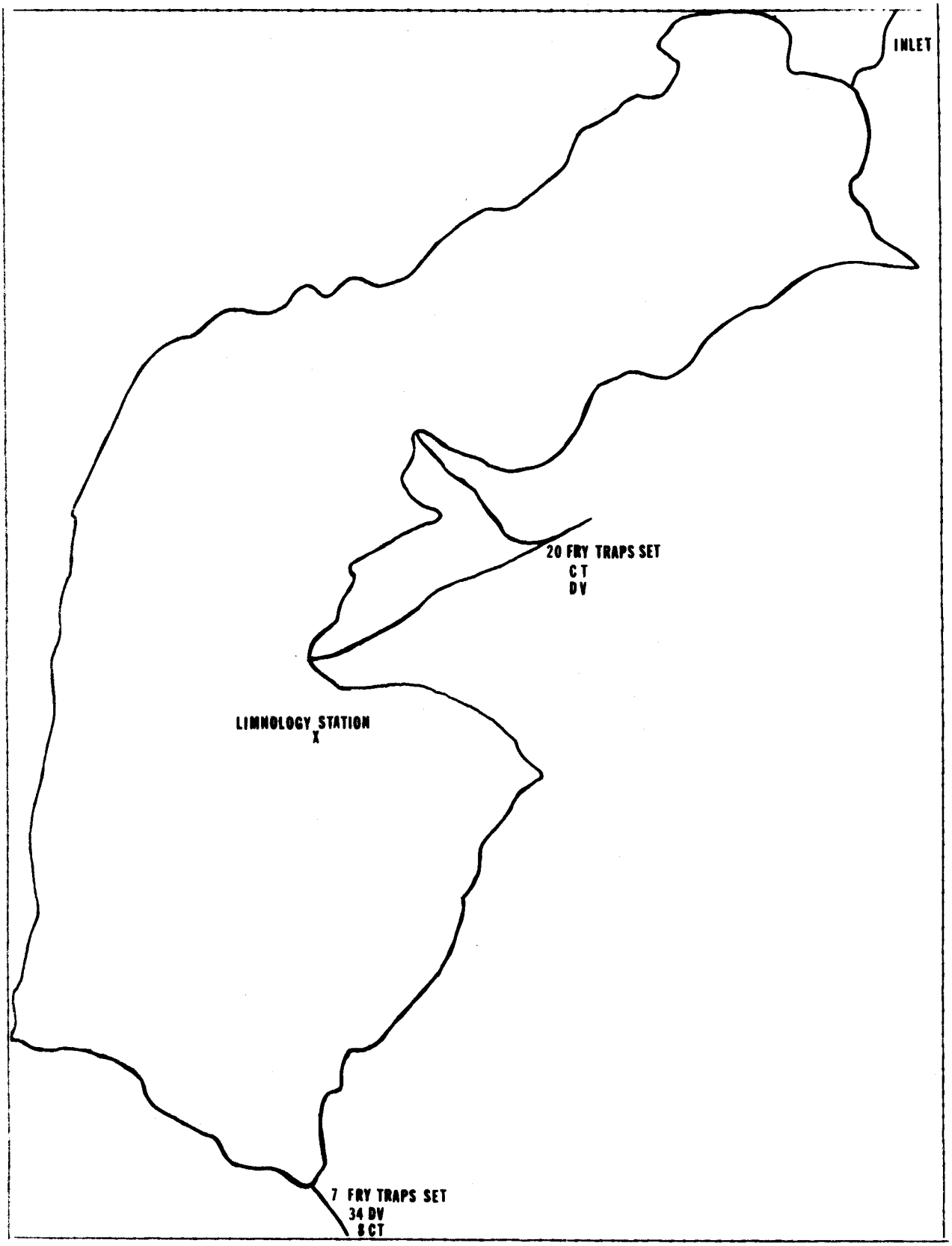

Fig. 8. Map showing location of sampling stations, Big Bay Lake, 1978.

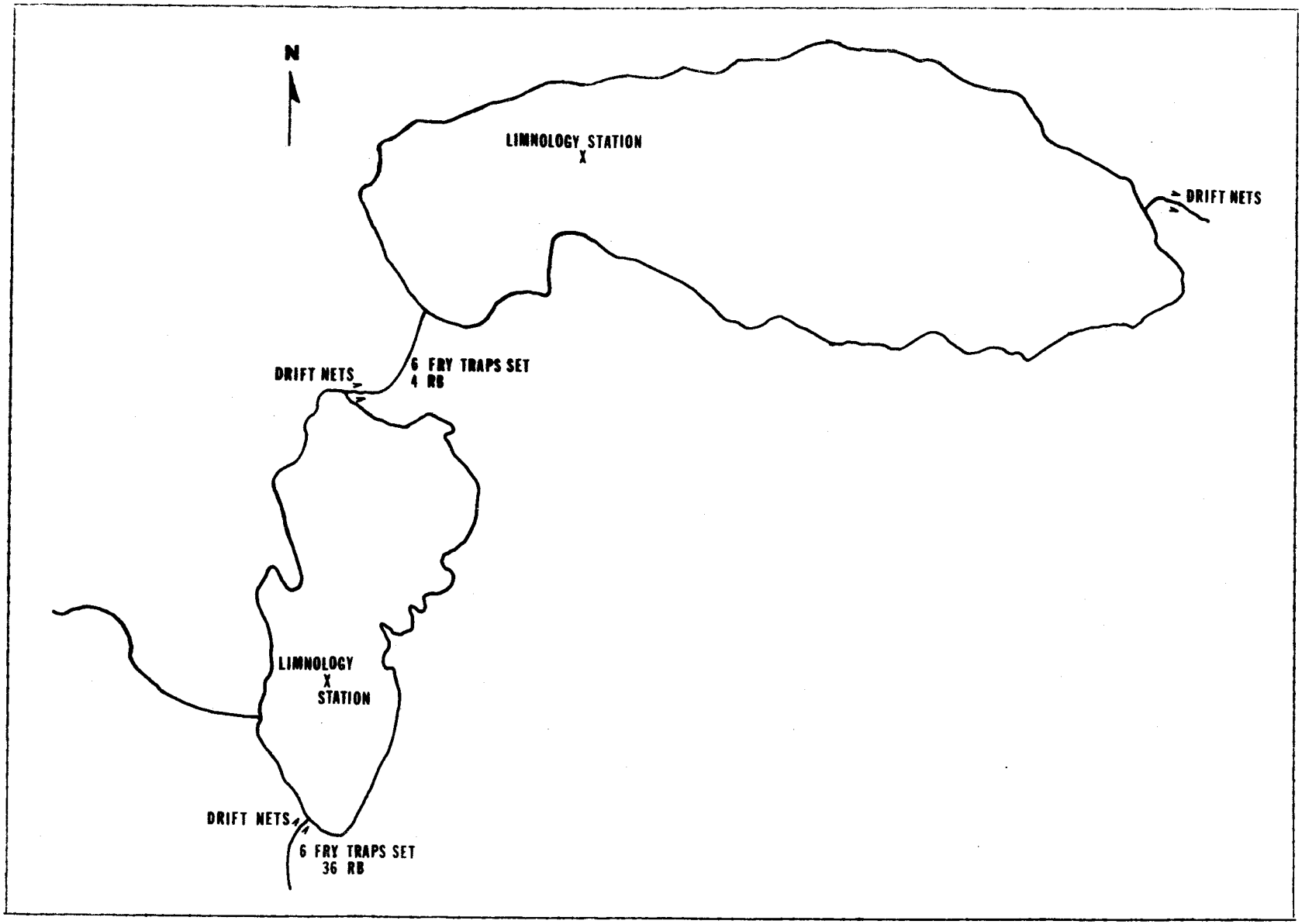

Fig. 9. Map showing location of sampling stations, Kvoustof Lake, 1978.

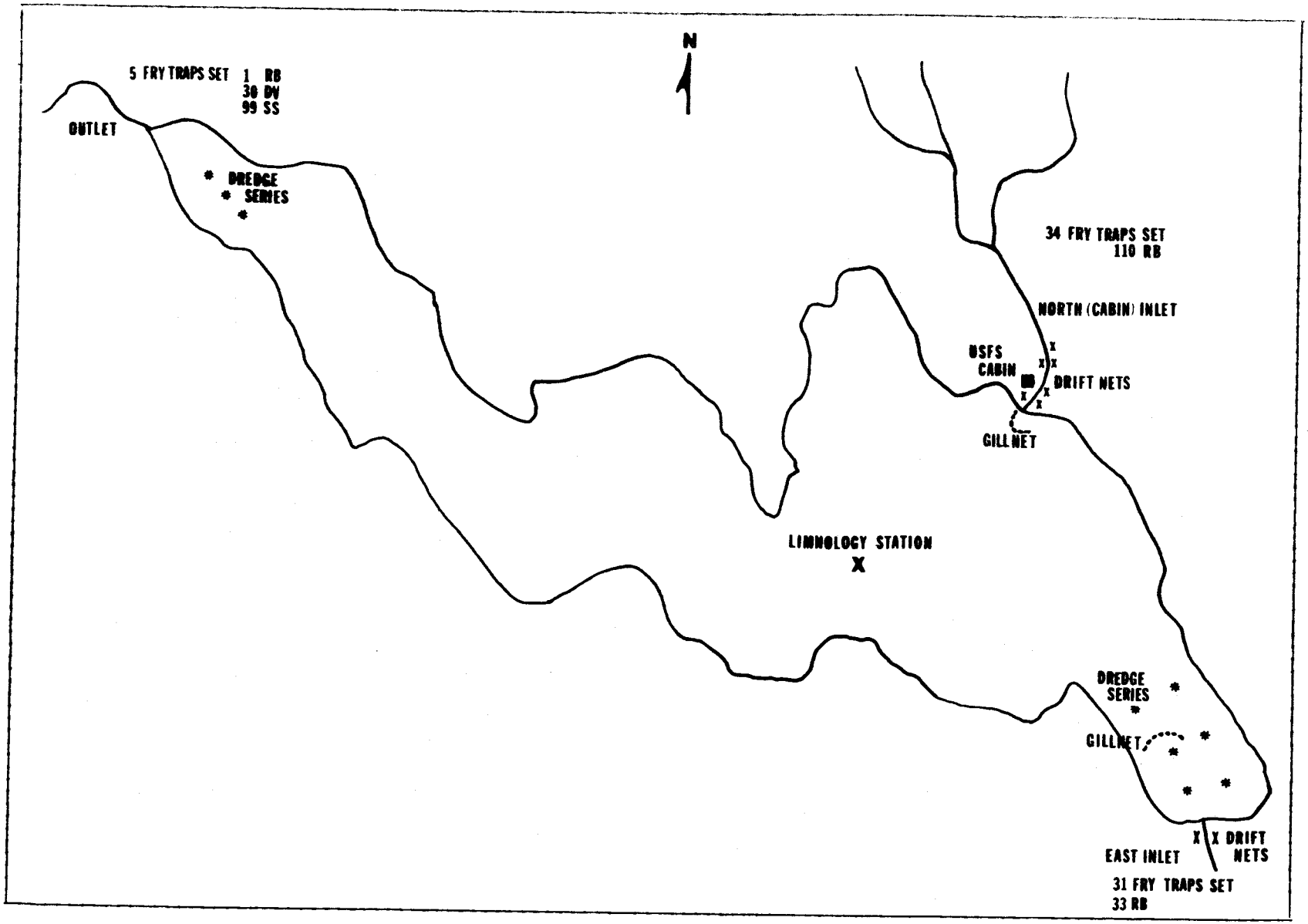

Fig. 10. Map showing location of sampling stations, Lonieof Lake, 1978.

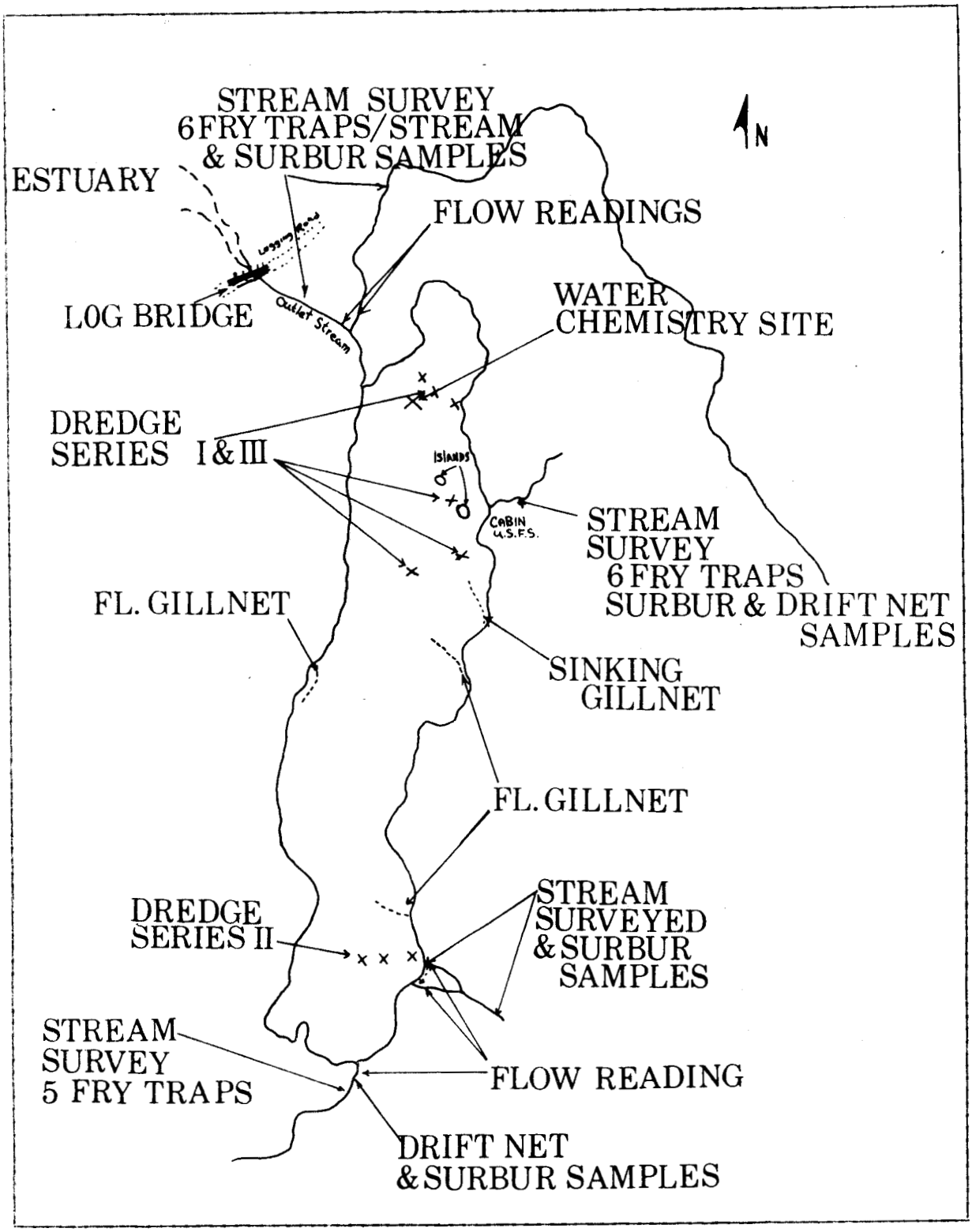

Fig. 11. Map showing location of sampling stations, Red Lake, 1978.

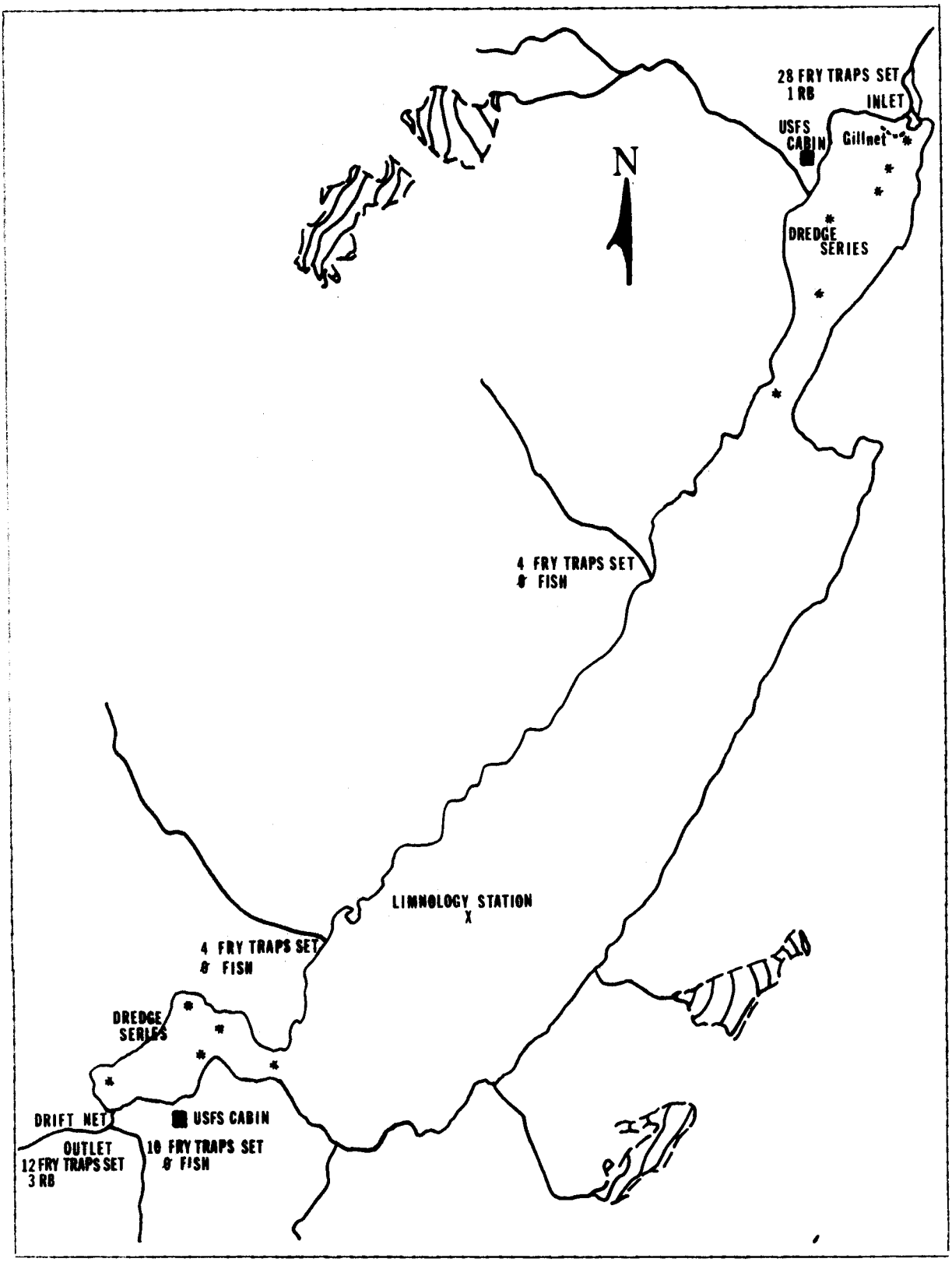

Fig. 12. Map showing location of sampling stations, Rezanof Lake, 1978.

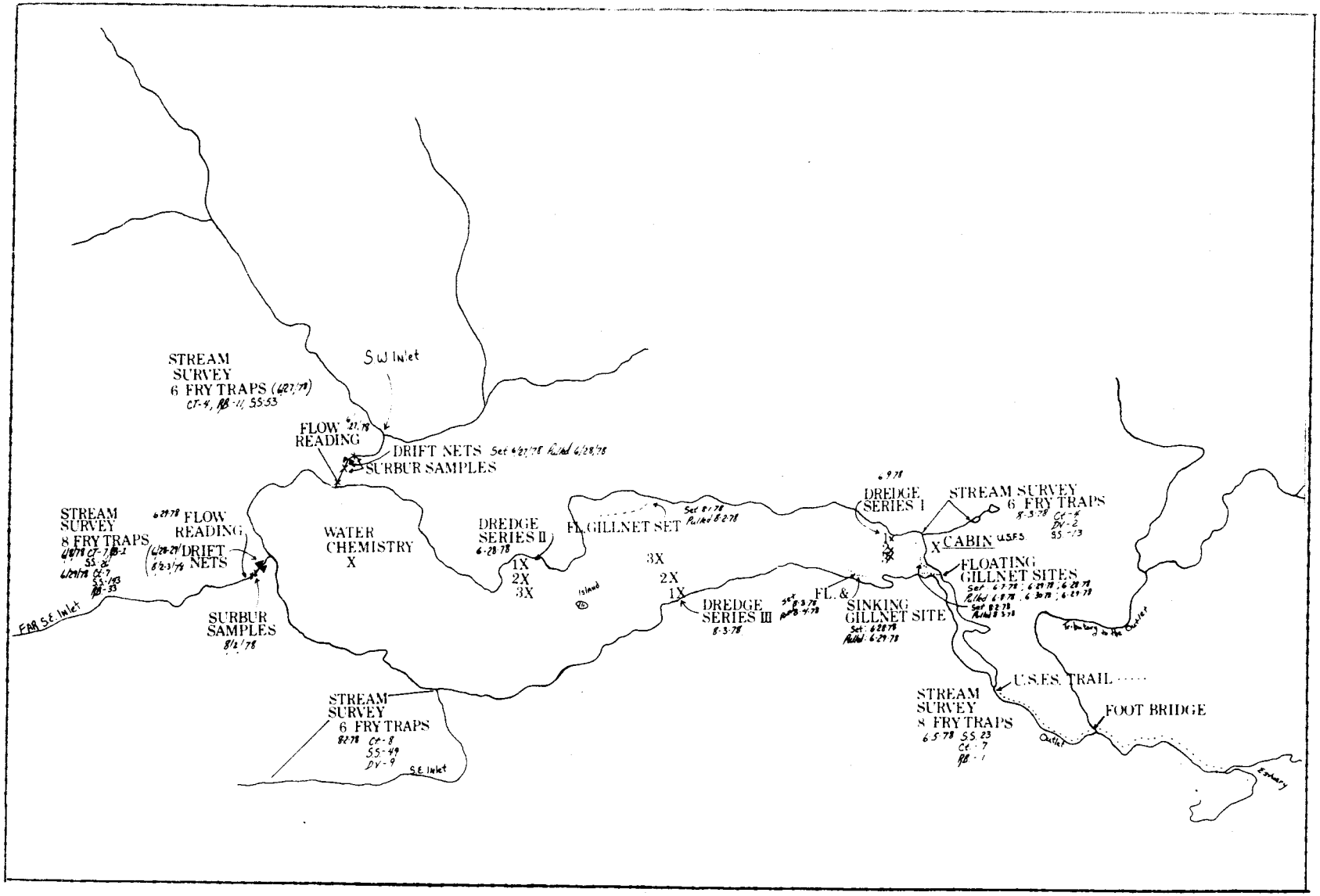

Fig. 13. Map showing location of sampling stations, Salmon Bay Lake, 1978.

Table 7. Thermal data (°C) from lakes studied, 1978.

	Big Bay		Lonieof				Red				
Depth (m)	June 26	Nov. 9	July 3	July 18	Aug. 14	Nov. 9	June 13	July 16	July 27	Aug. 16	Nov. 9
Surface	10.6	2.5	10.0	12.2	13.6	6.2	17.2	16.9	17.0	17.0	6.2
1	10.3			12.0	13.6	6.2	17.0	16.8		16.9	6.2
2	9.7			11.5	13.5	6.2	16.5	15.9		16.7	6.2
3	9.7	3.0		11.2	13.5	6.2	15.0	15.7		16.2	6.2
4	9.1		10.0	11.0	13.5	6.2	12.9	15.2		16.0	6.2
5	9.0	3.7		10.9	13.5	6.2	11.3	15.1		15.8	6.2
6	8.9			10.7	13.5	6.2	10.0	13.0		14.8	6.2
7	8.8			10.5	13.4	6.2	9.3	12.0		13.1	6.2
8	8.7			10.5	13.4	6.2	9.0	10.9		11.4	6.1
9	8.7			10.5	13.0	6.2	8.6	9.8		10.8	6.0
10	8.6	4.0		10.4	12.8	6.2	8.3	9.1		10.3	6.0
11	8.5			10.2	12.7	6.2	8.0	9.0		9.8	6.0
12	8.0			10.0	11.7	6.2	7.6	8.9		9.1	5.9
13	7.4			10.0	11.2	6.2	7.5	8.8		8.2	5.9
14	7.1			10.0	10.8	6.2	7.0	7.8		7.7	5.9
15				9.8	10.5	6.2	7.0	6.1		7.0	
16				9.6	9.9	6.2					
17				9.5	9.7	6.2					
18				9.3	9.6	6.2					
19				9.0	9.4	6.2					
20				8.9	9.0	6.2					
25				7.0	6.6						
30				6.1	5.9						
35				5.8	5.6						
40				5.5	5.4						
45					5.1						
50					5.0						
60											
70											
80											
90											

Table 7. (Cont.) Thermal data (°C) from lakes studied, 1978.

	Rezanof				Salmon Bay			
Depth (m)	June 7	July 14	Aug. 1	Nov. 9	June 6	June 28	Aug. 1	Nov. 9
Surface	7.0	10.0	13.0	5.5	17.5	15.9	19.2	
1	6.5	9.6	13.0	5.5	17.0	15.2	18.1	6.5
2	6.5	9.6	13.0	5.5	15.5	15.1	17.3	6.5
3	6.3	9.5	12.9	5.5	15.1	15.0	16.4	6.5
4	6.1	9.5	12.4	5.5	11.7	15.0	16.0	6.5
5	6.0	9.5	12.0	5.5	10.0	14.9	14.9	6.5
6	5.8	9.5	11.9	5.5	9.5	13.1	13.6	6.5
7	5.6	9.4	11.6	5.5	9.5	10.3	11.2	6.5
8	5.6	9.0	11.5	5.5	8.5	9.2	9.0	6.5
9	5.5	9.0	11.0	5.5	8.0	8.2	8.0	6.5
10	5.4	8.8	10.8	5.5	7.9	7.7	7.7	6.5
11		8.6	10.6	5.5	7.0	7.2	7.1	6.5
12		8.6	10.5	5.5	6.0	7.0	6.9	6.5
13		8.6	10.1	5.5	6.0	6.8	6.6	6.5
14		8.5	9.4	5.5	6.0	6.4	6.2	6.5
15	5.0	8.4	9.0	5.5	5.5	6.0	6.2	6.5
16		8.4	8.5	5.5				
17		8.0	8.4	5.5				
18		8.0	8.2	5.5				
19		7.5	8.0	5.5				
20	4.7	7.4	7.6	5.5				
25	4.5	6.2	6.6	5.5				
30	4.3	5.5	5.9	5.5				
35		5.2	5.5	5.5				
40	4.0	4.9	5.0	5.5				
45		4.6	4.5	5.5				
50	4.0	4.4	4.5	5.5				
60				5.5				
70				5.4				
80				4.5				
90				4.0				

Table 8. Alkalinity, conductivity, hardness, pH, and Secchi disc visibility of lakes studied, 1978.

Lake	Alkalinity (mg/l)	Conductivity (μ mhos)	Hardness (mg/l)	pH	Secchi Disc (m)
Baranof	4.3	ND*	4.0	ND*	ND*
Big Bay	4.0	8-10	6.0	5.5-5.8	5.5
Lonieof	4.4	4- 5	3.0	6.5-7.2	12.5-14.0
Red	40.0	92-94	52.0	7.4	9.8
Rezanof	3.8	3	6.0	6.5-8.1	13.0-15.0
Salmon Bay	14.0	29-30	18.0	6.5-6.6	3.5- 5.6
Tumakof	4.0	8- 9	3.0	5.2-7.0	

*Not determined

Table 9. Water quality analyses (mg/l) from lakes studied, November 9, 1978.

Parameter	Baranof	Big Bay	Lonieof	Red	Rezanof	Salmon Bay	Tumakof
Aluminum	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Boron	1.20	2.00	< 1.00	< 1.00	< 1.00	2.00	1.80
Calcium	0.31	0.40	0.12	0.18	0.10	14.20	19.00
Iron	0.08	0.08	0.08	0.08	0.08	0.21	< 0.05
Magnesium	0.22	0.14	0.38	0.19	0.34	4.13	0.40
Manganese	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Molybdenum	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40	< 0.40
Potassium	0.16	0.26	0.20	0.14	0.26	32.50	0.16
Sodium	7.20	0.85	3.10	10.50	6.60	39.40	2.52
Chloride	5.20	2.20	8.50	3.80	7.00	102.60	8.50
Fluoride	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.20	0.20
Nitrate, as N	0.10	< 0.10	< 0.10	< 0.10	0.10	0.20	< 0.10
Nitrite, as N	0.11	0.12	< 0.13	< 0.10	0.12	0.17	0.22
Orthophosphate, as P	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Silica	2.00	2.50	2.50	2.20	3.50	3.50	2.50
Sulfate	< 1.00	< 1.00	< 1.00	< 1.00	< 1.00	13.40	< 1.00

Table 10. Morphoedaphic Index of 22 lakes in Southeast Alaska.

Lake	Specific Conductance (μ mhos)	Residue Dissolved Calculated Sum (mg/1)	Surface Area (ha)	$\bar{x}$ Depth (m)	MEI*	Potential Yield** (kg/ha)
Red	93	65***	166	10.4	6.25	2.41
Finger	28	20***	347	10.7	1.87	1.32
Tammy	25	18***	134	10.0	1.80	1.30
Green	39	22	70	12.3	1.79	1.29
Klawak	39	24	1,177	17.7	1.36	1.13
Auke	28	20	46	19.0	1.05	0.99
Virginia	18	13***	258	13.0	1.00	0.97
Manzanita	60	42***	625	49.0	0.86	0.89
Salmon Bay	30	21***	388	26.7	0.79	0.86
Heckman	17	14	163	19.7	0.71	0.81
Spurt	16	14	107	22.2	0.63	0.77
Karta	26	16	508	27.6	0.58	0.74
De Boer	13	13	51	23.0	0.56	0.72
Wilson	51	36***	468	54.0	0.67	0.69
Ella	47	33***	710	70.0	0.47	0.66
Patching	17	14	207	30.2	0.46	0.66
Blue	33	22	538	52.0	0.42	0.63
Turner	15	10***	1,270	30.0	0.33	0.55
Osprey	20	14	109	60.0	0.23	0.46
Swan	20	16	208	91.4	0.18	0.41
Lonieof	5	4***	179	55.1	0.07	0.25
Rezanof	3	2***	354	71.2	0.03	0.17

*MEI = Morphoedaphic Index = $\frac{\text{Total Dissolved Solids (TDS)}}{\text{Mean Depth } (\bar{z})}$ (Ryder, 1965)

**Ryder (1965) described the equation $y \sim 2\sqrt{x}$ where y = yield in pounds per acre and mean depth ($\bar{z}$) was in feet. The metric expression (Ryder et al., 1974) is therefore $y \sim 0.966\sqrt{x}$ where yield is fish yield as kg/ha and x = MEI.

***Calculated as 0.70 x specific conductance in micromhos.

Table 11. Plankton composition, density (organisms per square meter), and weight (milligrams per square meter) as collected with No. 153 Nitex plankton nets, Lonieof Lake, 1978.

Date	June 28	July 18	August 9	September 18
Depth of Tow (m)	100	100	100	100
Mesh Size	153	153	153	153
Copepoda				
Calanoida				
Diaptomus sp.	3,054	12,980	3,563	509
Cyclopoida				
Cyclops sp.	14,506	51,154	37,411	18,833
Epischura sp.		54,463	38,175	28,504
Nauplii		7,635	4,581	3,308
Cladocera				
Daphnia sp.		5,853	7,890	13,234
Eubosmina sp.		3,054	7,126	11,707
Holopedium sp.		15,524	7,380	5,344
Dry Weight		696.8	515.1	456.6
Organic Weight		650.5	369.5	375.7
Ash Weight		46.3	145.6	80.9

Table 12. Plankton composition, density (organisms per square meter), and weight (milligrams per square meter) as collected with No. 153 Nitex plankton nets, Red Lake, 1978.

Date	June 13	July 11	July 27	August 16	August 28	October 7
Depth of Tow (m)	17	16	16	15	14	16
Mesh Size	153	153	153	153	153	153
Copepoda						
Cyclopoida	1,781	509	1,018	2,545	3,563	1,527
Nauplii	764	509	1,527	1,527	509	1,018
Cladocera						
Bosmina sp.	431,632	316,089	626,070	472,861	421,961	206,145
Daphnia sp.	53,445	8,653	48,355	53,700	47,846	140,484
Dry Weight	450.0	541.6	329.8	297.8	258.1	280.0
Organic Weight	420.9	499.3	295.7	265.2	230.6	252.0
Ash Weight	29.0	42.2	34.1	32.6	27.5	28.0

Table 13. Plankton composition, density (organisms per square meter), and weight (milligrams per square meter) as collected with No. 153 Nitex plankton nets, Rezanof Lake, 1978.

Date	June 8	July 12	August 1	September 18
Depth of Tow (m)	100	100	100	100
Mesh Size	153	153	153	153
Copepoda				
Calanoida				
Diaptomus sp.	50,157	92,129	100,018	40,974
Nauplii	14,822	509	10,180	
Cyclopoida				
Cyclops sp.	12,175	16,797	49,628	44,538
Nauplii	10,322	12,980	41,229	12,470
Cladocera				
Daphnia sp.	794	764	2,036	5,344
Eubosmina sp.	27,659	16,288	41,738	
Holopedium sp.			10,943	101,800
Dry Weight	456.1	1,149.8	1,373.8	545.6
Organic Weight	412.8	1,088.7	1,305.6	493.7
Ash Weight	43.3	61.1	68.2	51.9

Table 14. Plankton composition, density (organisms per square meter), and weight (milligrams per square meter) as collected with No. 153 Nitex plankton nets, Salmon Bay Lake, 1978.

Date	June 6	June 28	July 14	August 1	August 28	October 7
Depth of Tow (m)	51	50	50	50	50	50
Mesh Size	153	153	153	153	153	153
Copepoda						
Cyclopoida						
Cyclops sp.	129,948	266,716	144,760	222,433	236,176	24,864
Nauplii	1,069	2,850	10,231		2,290	763
Epischura sp.	4,581	3,258	5,955	54,972	77,114	18,578
Nauplii			2,749	8,398		
Cladocera						
Daphnia spp.	3,512	12,012	5,497	5,344	5,854	3,308
Bosmina sp. and *Eubosmina* sp.	25,959	62,912	34,358	56,499	29,268	201,310
Dry Weight	372.1	354.8	419.9	1,373.8	622.0	544.1
Organic Weight	350.7	320.2	388.4	1,305.6	594.0	501.3
Ash Weight	21.4	34.6	31.5	68.2	28.0	42.8

Table 15. List of zooplankton species identified by lake, 1978.

Lonieof Lake	Red Lake
Cyclops vernalis	Cyclops bicuspidatus thomasi
Diaptomus kenai	Macrocyclops albidus
Epischura nevadensis	Bosmina longirosteris
Daphnia longiremis	Daphnia longiremis
Eubosmina longispina	Asplanchna
Holopedium gibberum	Filinia
Collotheca	Keratella (cochlearis group)
Conochilus	Kellicottia longispina
Ploesoma	Ploesoma
Kellicottia longispina	Synchaeta
	Polyarthra
Rezanof Lake	**Salmon Bay Lake**
Diaptomus kenai	Cyclops bicuspidatus thomasi
Cyclops vernalis	Epischura nevadensis
Daphnia longiremis	Daphnia longiremis
Eubosmina longispina	Daphnia middendorphiana
Holopedium gibberum	Holopedium gibberum
	Eubosmina longispina
	Bosmina longirostris

Table 16. Plankton composition and density (organisms per square meter) as collected with No. 153 Nitex plankton nets, Big Bay Lake, 1978.

Date	June 20
Depth of Tow (m)	14
Mesh Size	153
Copepoda	
Calanoida	
Diaptomus franciscanus	1,018
Cyclopoida	
Cyclops capillatus	1,018
Cladocera	
Eubosmina longispina	41,906
Holopedium gibberum	68,038

Table 17. Plankton composition, density (organims per square meter), and weight (milligrams per square meter) as collected with No. 153 Nitex plankton nets, Kvoustof and Lower Kvoustof lakes, 1978.

Date	June 13	July 25
Depth of Tow (m)	100	40
Mesh Size	153	153
Copepoda		
Calanoida		
Diaptomus kenai	63,966	28,249
Nauplii	6,449	
Cyclopoida		
Cyclops vernalis	12,893	18,935
Nauplii	29,013	19,851
Cladocera		
Daphnia longiremis	341	2,443
Eubosmina longispina	3,904	10,231
Holopedium gibberum	341	
Dry Weight	577.7	489.6
Organic Weight	553.3	467.7
Ash Weight	24.4	21.9

Although a standing crop of plankton does not measure production, net plankton samples may show some distinction between oligotrophic and eutrophic lakes. Rawson (1953) stated that the standing crop of No. 20 net plankton measured by total vertical hauls exhibits this distinction in western Canada. He gives this range as 10 to 40 kg/ha dry weight for alpine and large oligotrophic lakes, while mesotrophic and moderately eutrophic lakes have up to 100 kg/ha.

The standing crop of No. 10 net plankton was calculated using an assumed net efficiency of 25%. The organic weight of the three or four heaviest plankton samples collected throughout the summer was averaged for each lake. Average standing crop (organic weight in kg/ha) of No. 10 net plankton was Lonieof Lake, 18.6; Red Lake, 14.8; Rezanof Lake, 33.0; and Salmon Bay Lake, 27.9. This shows all lakes to be in the oligotrophic category.

Bottom Fauna:

Bottom fauna collected by dredging and screening benthic material are identified and enumerated in Table 18. Analysis of stream drift organisms from Red and Salmon Bay lakes (Table 19) and Kvoustof, Lonieof, and Rezanof lakes (Table 20) shows a wide diversity of species.

Fish (Lake Inlet and Outlet Areas and Fry Trap Results):

Big Bay Lake. Big Bay Lake is fed by one major inlet which enters from the mountains to the east. This muskeg inlet had a flow of 2.5 cubic feet per second (cfs) when measured on June 26. The lower 3.2 km of this inlet were mapped (Fig. 14).

The outlet from Big Bay Lake to Lower Big Bay Lake (Fig. 15) was mapped and fry trapped. A 24-m falls just below Big Bay Lake blocks anadromous fish passage. Rearing Dolly Varden, cutthroat trout, and coho salmon are abundant downstream from the falls. The outlet below Lower Big Bay Lake was mapped and fry trapped for about 400 m (Fig. 15).

Twenty fry traps set in the main inlet to Big Bay Lake captured 84 Dolly Varden and 30 cutthroat trout. Twenty traps set in a minor, unmapped inlet to the lake captured 67 Dolly Varden and 30 cutthroat trout. Sixteen fry traps set in the lake outlet stream below the barrier falls captured 186 Dolly Varden, 65 coho salmon, and 40 cutthroat trout.

Rezanof, Kvoustof, and Lonieof Lakes. Fig. 16 shows the relative position of Rezanof, Kvoustof, Lower Kvoustof, and Lonieof lakes. The main inlet to Rezanof Lake (Fig. 17) had a flow of 103 cfs on June 13. Three other minor inlets were not mapped. The outlet from Rezanof Lake (Fig. 18) flows about 450 m to Kvoustof Lake.

Fifty-eight fry traps were set in the inlets and outlet from Rezanof Lake with a resultant catch of three rearing rainbow trout.

The stream between Kvoustof and Lower Kvoustof lakes (Fig. 18) is about 18 m wide and has several cascades and falls. Twelve fry traps set

Table 18. Identification and enumeration (organisms/m^2) of benthic organisms from lakes studied, 1978.

Lake	Big Bay	Kvoustof	Lonieof	Red	Rezanof	Salmon Bay
Depth Range (m)	0.5-15.0	8.0-98.0	3.0-59.0	1.5-18.0	8.0-40.0	1.5-36.0
Number of Samples	3	9	7	12	16	9
Aranea						4.8
Turbellaria	57.4					
Planaridae					2.7	
Oligochaeta	516.7	43.1	166.1	46.6	247.6	23.9
Hirudinea	14.3					4.8
Pelecypoda				7.2		
Sphaeriidae	215.3	19.4	190.7	122.0	204.5	
Gastropoda				10.8		4.8
Crangonyx sp.			30.8	21.5	2.7	
Gyralus sp.	14.3	2.1	12.3	50.2		
Cladocera	86.1					
Chyrsomellidae					2.7	4.8
Nematocera						4.8
Odonata				3.6		
Diptera					2.7	
Ceratopogoninae	14.3				2.7	
Chironomidae				10.8	2.7	
Chironomini	143.5	4.3	166.1	549.0	667.4	172.2
Tanytarsini					13.4	
Macropelopiini	28.7					9.6
Podonomini			18.4			
Diamisini		8.6	30.8	25.1	18.8	
Orthocladini		88.3	12.3		18.8	4.8
Protanypini					2.7	
Enallagma sp.				3.6		
Oxytrema sp.						19.1

Table 19. Identification and enumeration of stream drift organisms from inlets to Red Lake and Salmon Bay Lake, 1978.

Lake	Red	Salmon Bay		Red	Salmon Bay
Date	June 14-Aug. 15	June 9-Aug. 3		June 14-Aug. 15	June 9-Aug. 3
Number of Samples	8	10		8	10
Oligochaeta		3	Coleoptera		
Gordius sp.	4	1	Narpus sp.		1
Colembola			Agabetes sp.	2	
Isotomidae	1		Staphylinidae		1
Ephemoptera	1		Dytiscidae	1	
Ameletus sp.	14		Curiulionidae		1
A. suffusus	26	15	Cerambicidae		1
Baetis sp.	2	3	Byrrhidae		1
B. bicaudatus	23	14	Amphizoidae		1
B. tricaudatus	18	17	Ceratopogonidae	1	3
Cinygmula sp.	5	2	Chironomidae	2	5
Epeorus sg. Iron sp.	2	1	Chironomini	34	5
E. longimanus	2		Tanytarsini	3	
E. albertae	4		Macropelopiini		3
Ephemerella sp.	1		Pentaneurini	4	2
E. grandis	1		Diamesini	9	
E. sg. Serratella sp.	8		Corynoneurini	66	7
E. tibialis	12	15	Orthocladiini	60	69
Paraleptophlebia sp.	4		Tanypodini	4	
P. debilis		4	Tipulidae		1
Centroptilum sp.		1	Dicranota sp.	1	
Plecoptera			Hexatoma sp.		1
Alloperla sp.	2	1	Prosimulium sp.	1	
Capnia sp.	1		Simulium sp.	6	32
Leuctra sp.		1	Empididae	1	2
Nemoura sg. Zapada sp.	3	2	Sciaridae	2	1
Trichoptera			Anthomyiidae	1	
Psychoglypha sp.	45	2	Ichneumonidae	2	1
Limnephilus sp.	1		Acari	19	7
Onocosmoecus sp.	2	1	Araneae	1	1
Glossosoma sp.		1	Ostracoda	4	
Lepidostoma sp.	8	1	Salmonidae		3
Cercopidae		1	Copepoda	1	
			Buffo boreas	1	

Table 20. Identification and enumeration of stream drift organisms from inlets to Lonieof, Kvoustof, and Rezanof lakes, 1978.

Lake	Lonieof	Kvoustof	Rezanof		Lonieof	Kvoustof	Rezanof
Date	June 25-Aug. 10	June 14-July 25	June 6-Aug. 3		June 25-Aug. 10	June 14-July 25	June 6-Aug. 3
Number of Samples	10	6	8		10	6	8
Collembola		9		Dytiscidae			
Planariidae	20	48	11	Bidessus sp.	1		
Ephemeroptera	2	2	1	Ceratopogininae			15
Ameletus sp.	2		3	Culicidae			2
A. suffusus			1	Anaopheles sp.			1
Baetis sp.	2	1		Chironomidae	26	7	51
B. bicaudatus	17	38	1,172	Chironomini	2	7	
B. tricaudatus			12	Tanytarsini	29	3	3
Cinygmula sp.	3	1	6	Macropelopiini	1	1	2
Epeorus sg. Iron sp.	1			Pentaneurini	2		
E. albertae	4	1	3	Podonomini	2		
E. longimanus	4			Prodiamesini			2
E. deceptivus			3	Diamesini	15	8	764
Ephemerella sp.	2	1		Corynoneurini	1	5	
E. grandis	1			Orthocladiini	11	9	202
Paraleptophlebia sp.	4			Boreochlini			2
P. memoralis	18			Tipulidae	1	2	1
Rithrogena sp.	1			Antocha sp.			1
Heptageniidae	2		1	Dicranota sp.	2	1	46
Plecoptera			1	Dixa sp.			11
Perlodidae	1			Molophilus sp.			1
Alloperla sp.	10	8	20	Simuliidae	4	7	2
Paraperla sp.			1	Prosimulium sp.	127	1	8
Capnia sp.		8	1	Simulium sp.	18	1	
Isogenus sp.	1			Empididae	4	2	2
Perlomyia sp.		3	9	Rhagionidae			5
Leuctrinae		1		Syrphidae			1
Leuctra sp.			2	Cecidomyidae			1
Leuctra sg. Paraleuctra sp.		1	3	Phoridae			3
Nemoura sp.	1		1	Bibionidae	1		2
N. sg. Zapada sp.		1	13	Diptera		1	
Limnephilidae	2		3	Lepidoptera		1	
Psychoglypha sp.	4		5	Ichneumonidae	1	1	
Onocosmoecus sp.	1			Proctotrupoidea			1
Chyranda sp.		4	4	Entomobryidae			2
Hydropsychidae	2			Chalcidoidea			6
Rhyacophila sp.	7		6	Mymaridae			1
R. acropedes	1			Acari	13	5	30
R. grandis	1			Araneae			1
R. hyalinata			1	Sphaeriidae	2	1	
R. narvae			1	Sminthuridae	1		
R. tucula	1	3	2	Copepoda	350	1,097	
R. verrula		1		Cladocera	787	473	
Coleoptera				Ostracoda	2	1	
Staphylinidae	1	1	5	Amphipoda	27		
Amphizoidae			1	Crangonyx sp.	1		
Cantharidae	2	3		Arcynopteryx sg. Megarcys sp.		5	
Scaphidiidae	3		2	Sciaridae		2	
Chrysomelidae		1		Thysanura			9
Curculionidae	1			Oxytrema sp.			7
Carabidae	1		1	Cicadellidae			1
				Aphidae			1

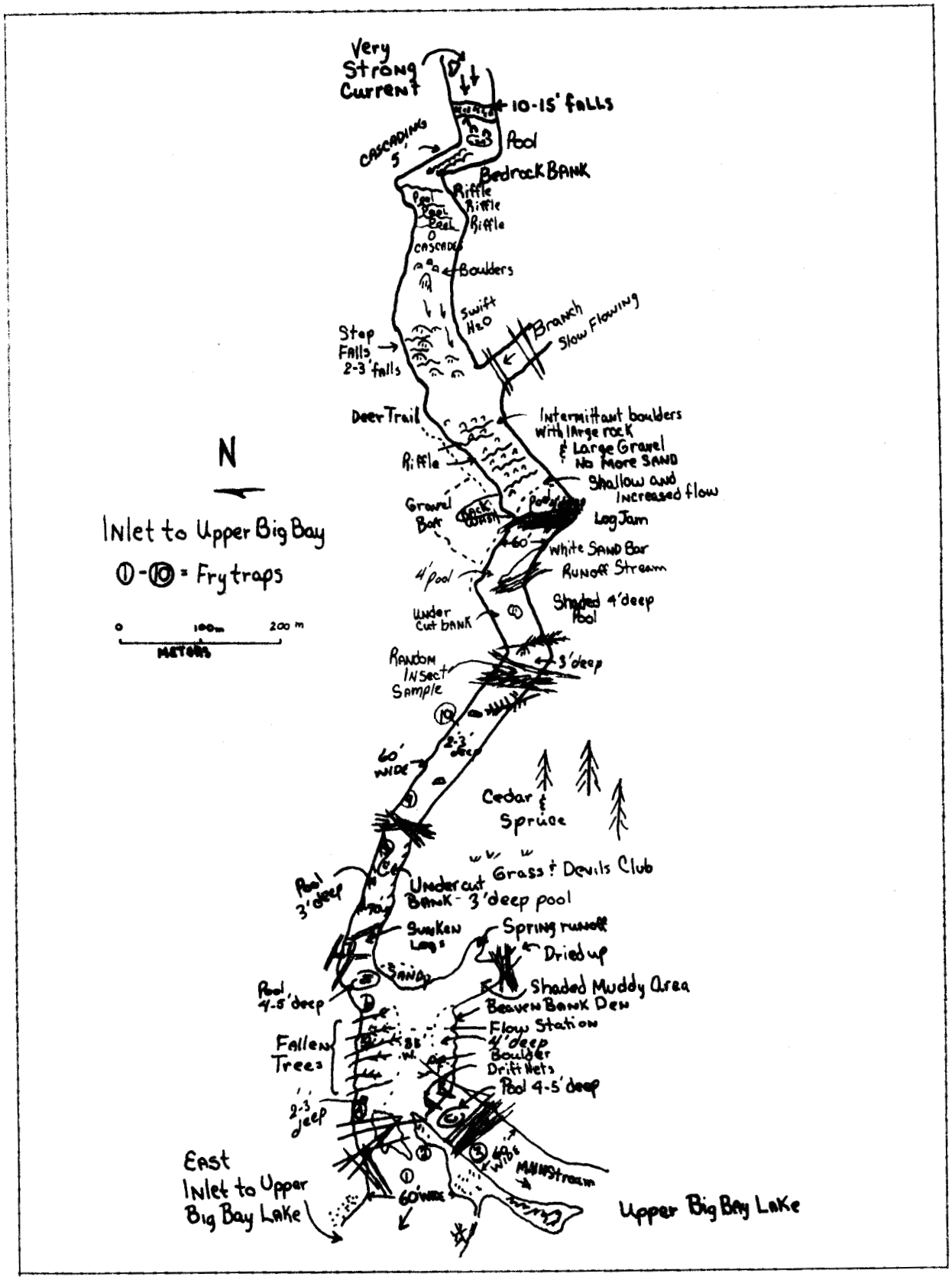

Fig. 14. Map showing inlet to Big Bay Lake.

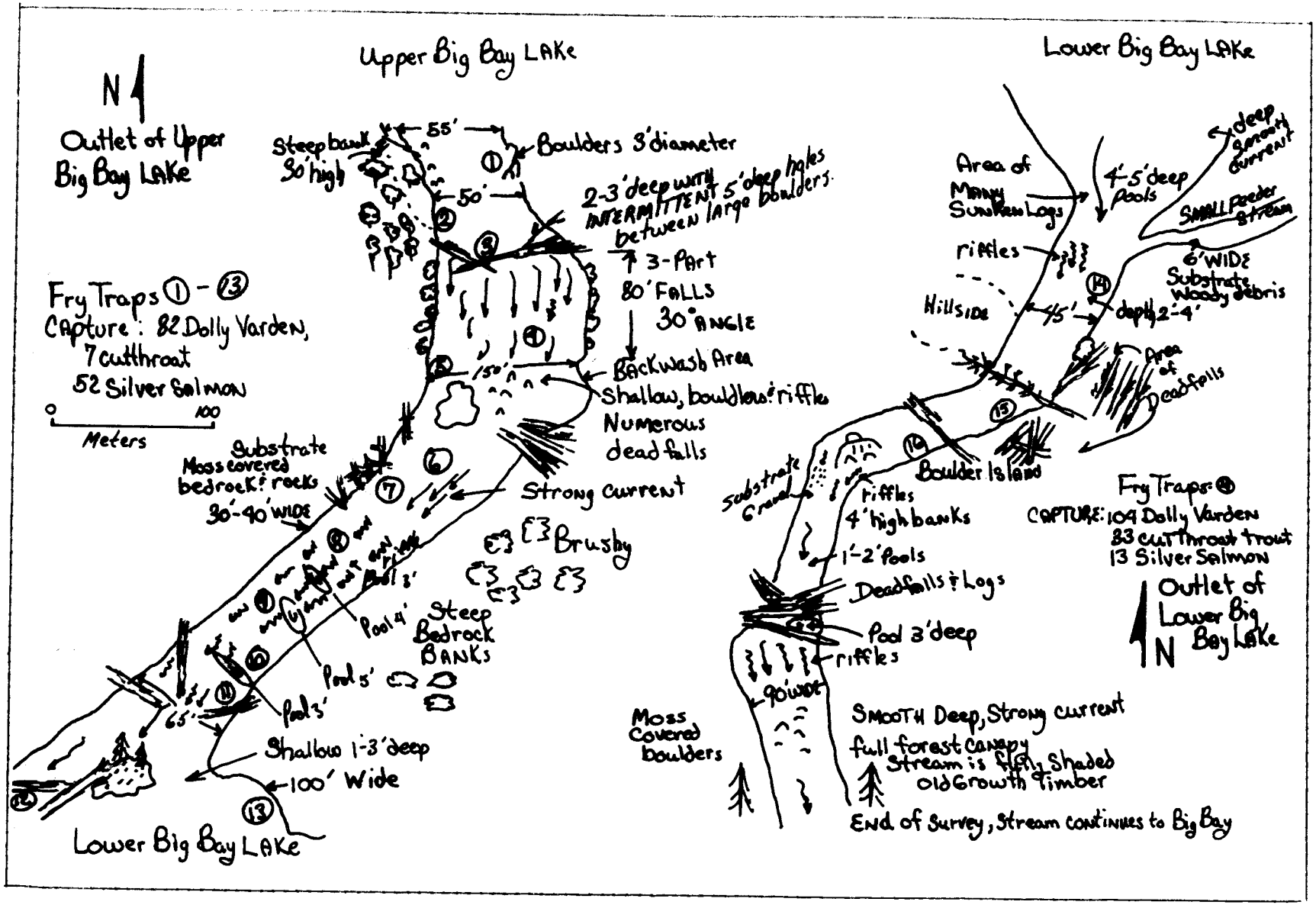

Fig. 15. Map showing outlets of Big Bay Lake and Lower Big Bay Lake.

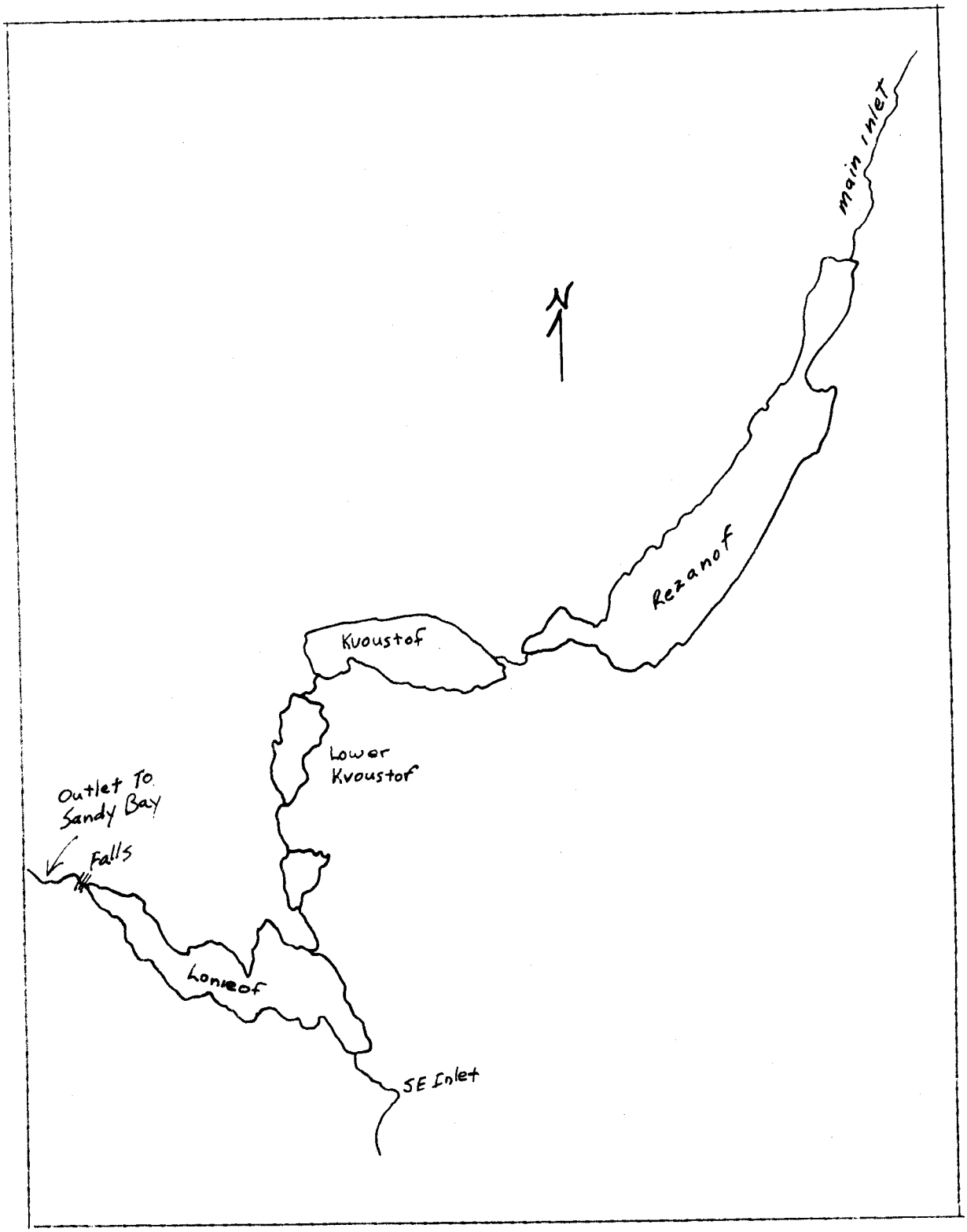

Fig. 16. Relative position of Rezanof, Kvoustof, Lower Kvoustof, and Lonieof lakes.

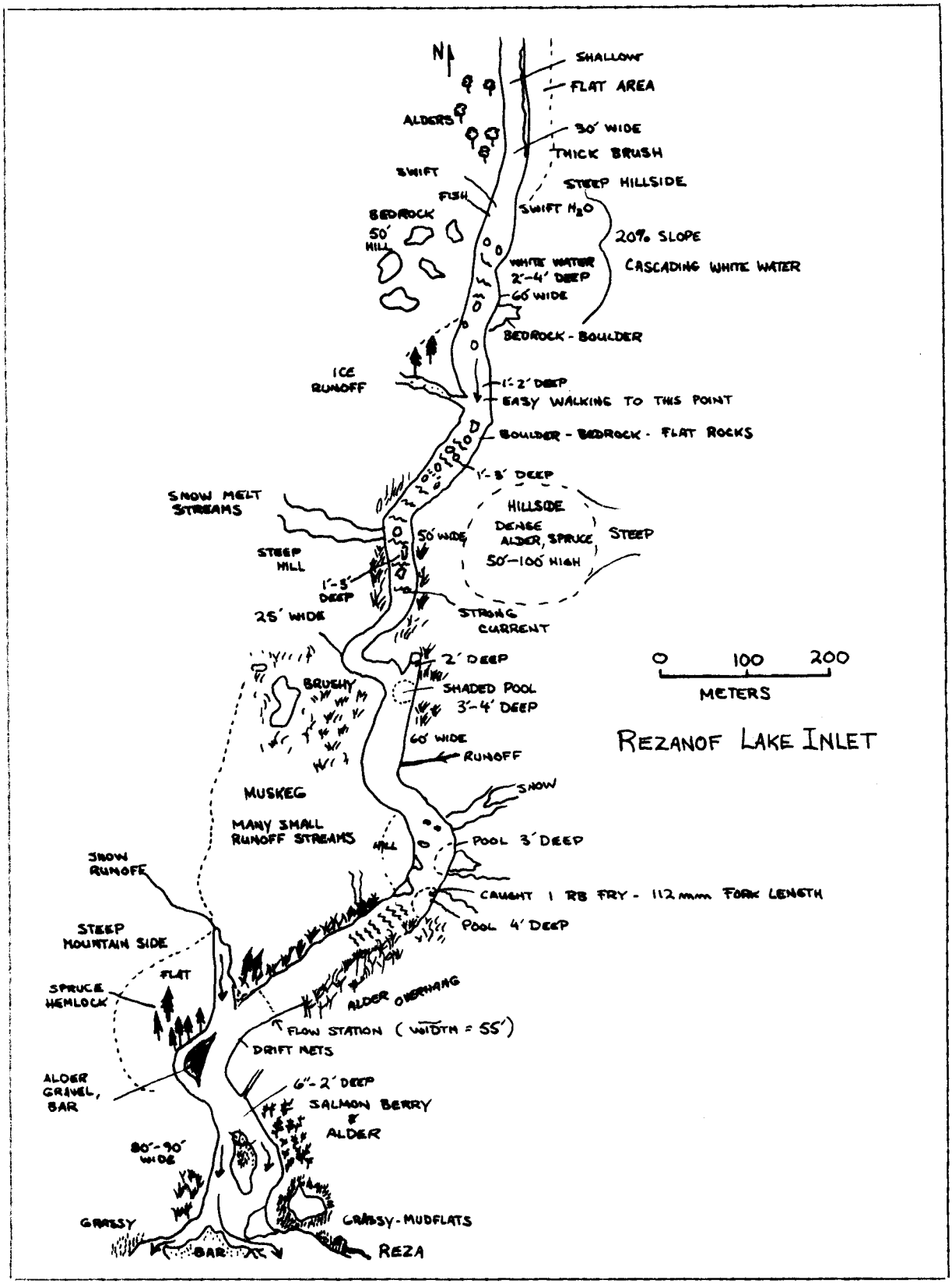

Fig. 17. Map showing main inlet to Rezanof Lake.

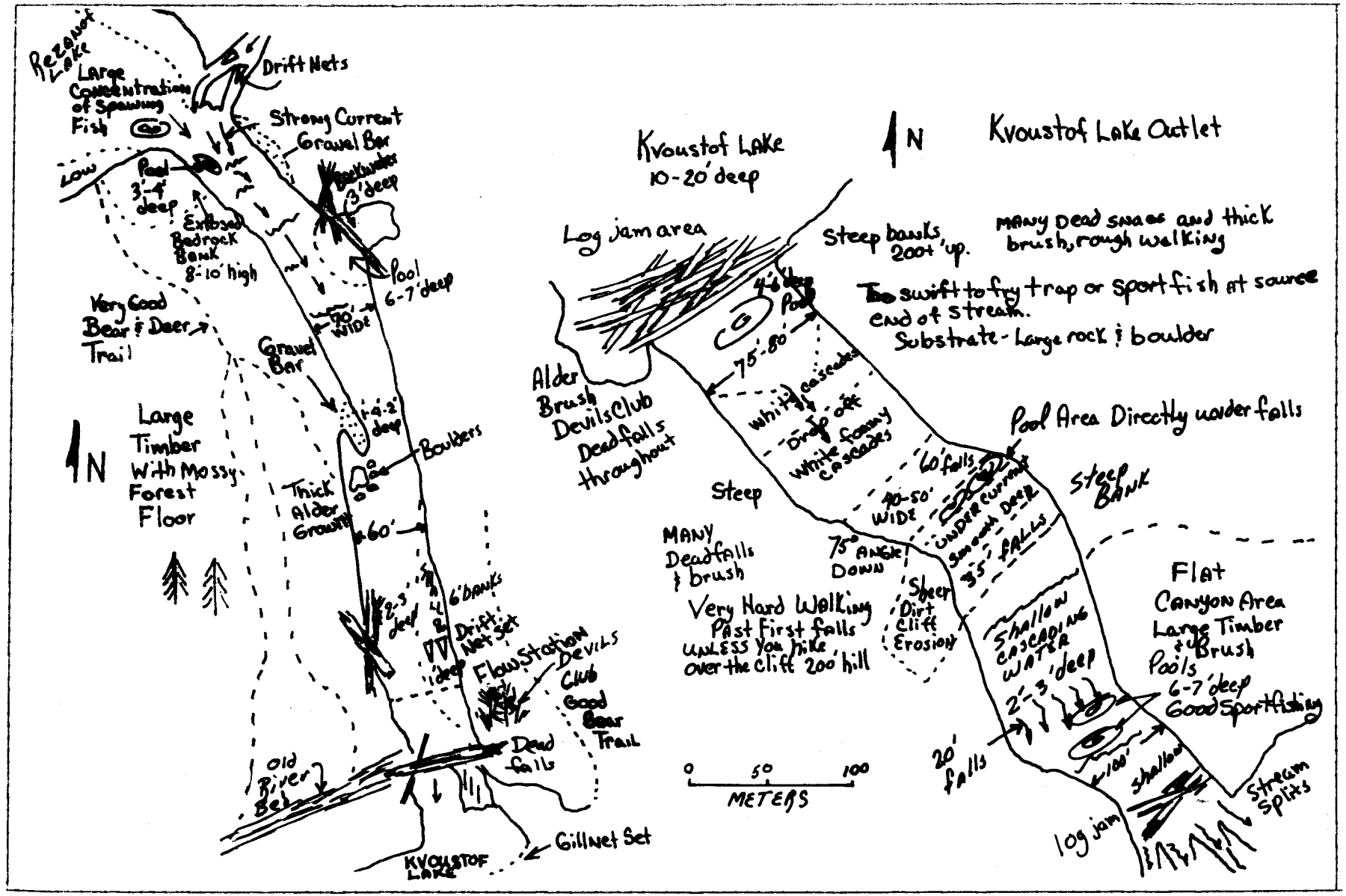

Fig. 18. Map showing outlets from Rezanof and Kvoustof lakes.

in this stream and the outlet from Lower Kvoustof Lake captured 42 rearing rainbow trout.

Fig. 19 shows the southeast inlet to Lonieof Lake. Thirty-one fry traps on this inlet captured 33 rearing rainbow trout. Thirty-four fry traps set on the main inlet from Lower Kvoustof Lake captured 110 rainbow trout.

Red Lake. The main inlet to Red Lake (Fig. 20) is characterized by abundant deadfalls, 1-4 m pools, and channel of 2-6 m wide. This is an important spawning and rearing stream. A small inlet near the U.S. Forest Service cabin (Fig. 21) was fry trapped and mapped. Two minor inlets on the southeast end of the lake (Fig. 22) showed rearing potential. Five fry traps set in the main inlet captured 7 coho salmon and 1 Dolly Varden. Six fry traps set in the cabin inlet captured 23 coho salmon, 7 Dolly Varden, and 5 cutthroat and 1 rainbow trout.

The outlet from Red Lake to Red Bay (Fig. 23) is an important rearing area for coho salmon and rainbow trout. Seven fry traps captured 75 coho salmon and 5 rainbow trout. The outlet stream has one main tributary which enters from the northeast (Fig. 24). This tributary is very important for steelhead trout spawning and rearing. Six fry traps set in this tributary captured 66 coho salmon, 28 rainbow trout, and 7 Dolly Varden.

Salmon Bay Lake. The southwest inlet to Salmon Bay Lake (Fig. 25) and the far southeast inlet (Fig. 26) provide the major stream spawning and rearing areas. These inlets were mapped during very low flow periods, so no flow readings were taken. Six fry traps set in the southwest inlet captured 53 coho salmon and 11 rainbow and 4 cutthroat trout. Eight fry traps set in the far southeast inlet captured 169 coho salmon and 34 rainbow and 14 cutthroat trout. The third major inlet is the southeast inlet (Fig. 27). Six fry traps set in this inlet captured 49 coho salmon, 9 Dolly Varden, and 8 cutthroat trout.

A small inlet (Fig. 28) enters the lake near the U.S. Forest Service cabin. This stream originates from a series of beaver dams. Six fry traps set in this stream captured 13 coho salmon, 4 cutthroat trout, and 2 Dolly Varden.

The main outlet from Salmon Bay Lake (Fig. 29) provides excellent fishing areas. This stream and its main tributary (unmapped) provide excellent spawning and rearing areas. Eight fry traps set in the outlet captured 23 coho salmon and 7 cutthroat and 1 rainbow trout.

Age, Length-Weight, and Condition Factors of fish:

Age and length-weight information from cutthroat and rainbow trout are presented in Tables 21 and 22. Length-weight correlations for cutthroat and rainbow trout are presented in Figs. 30 and 31.

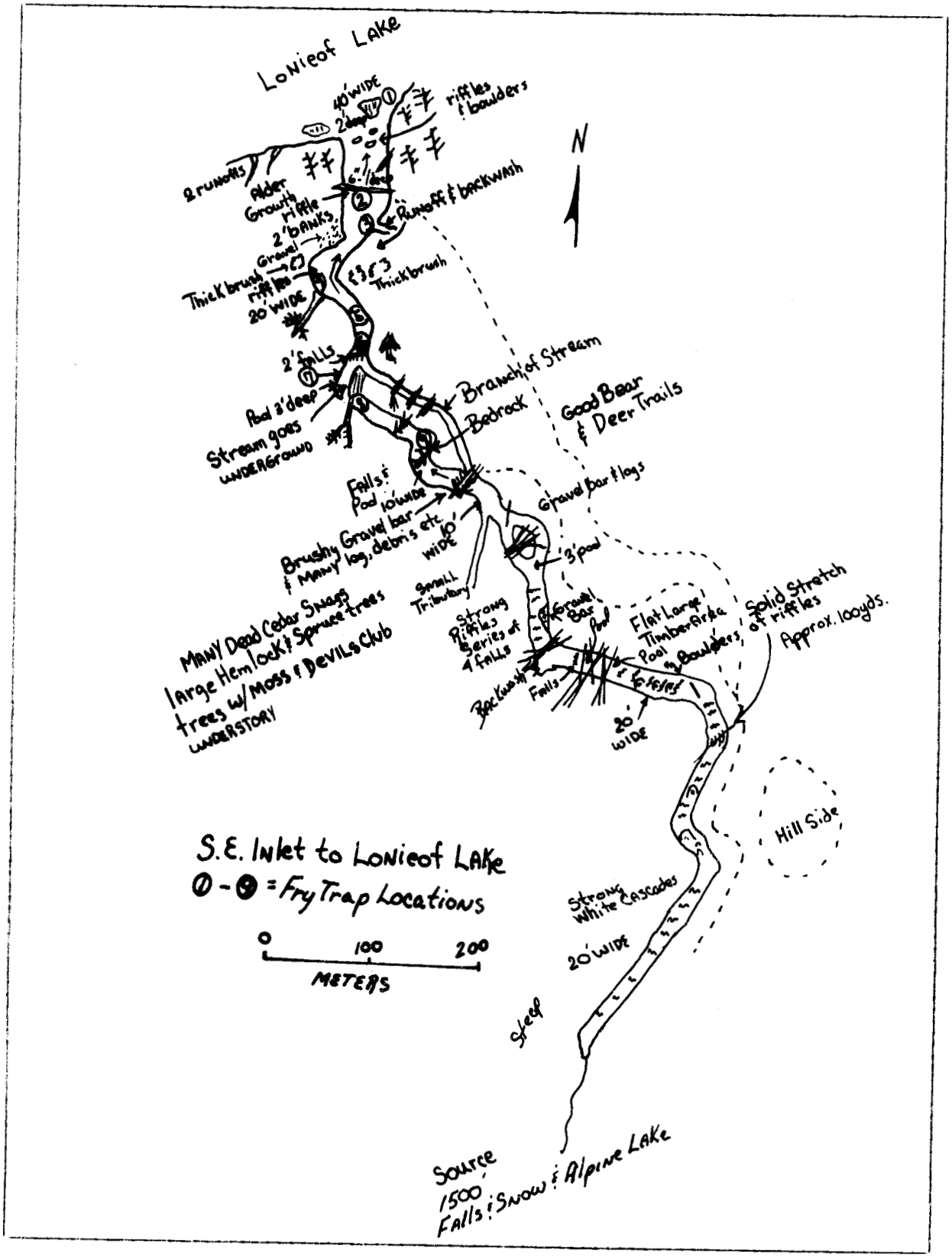

Fig. 19. Map showing southeast inlet to Lonieof Lake.

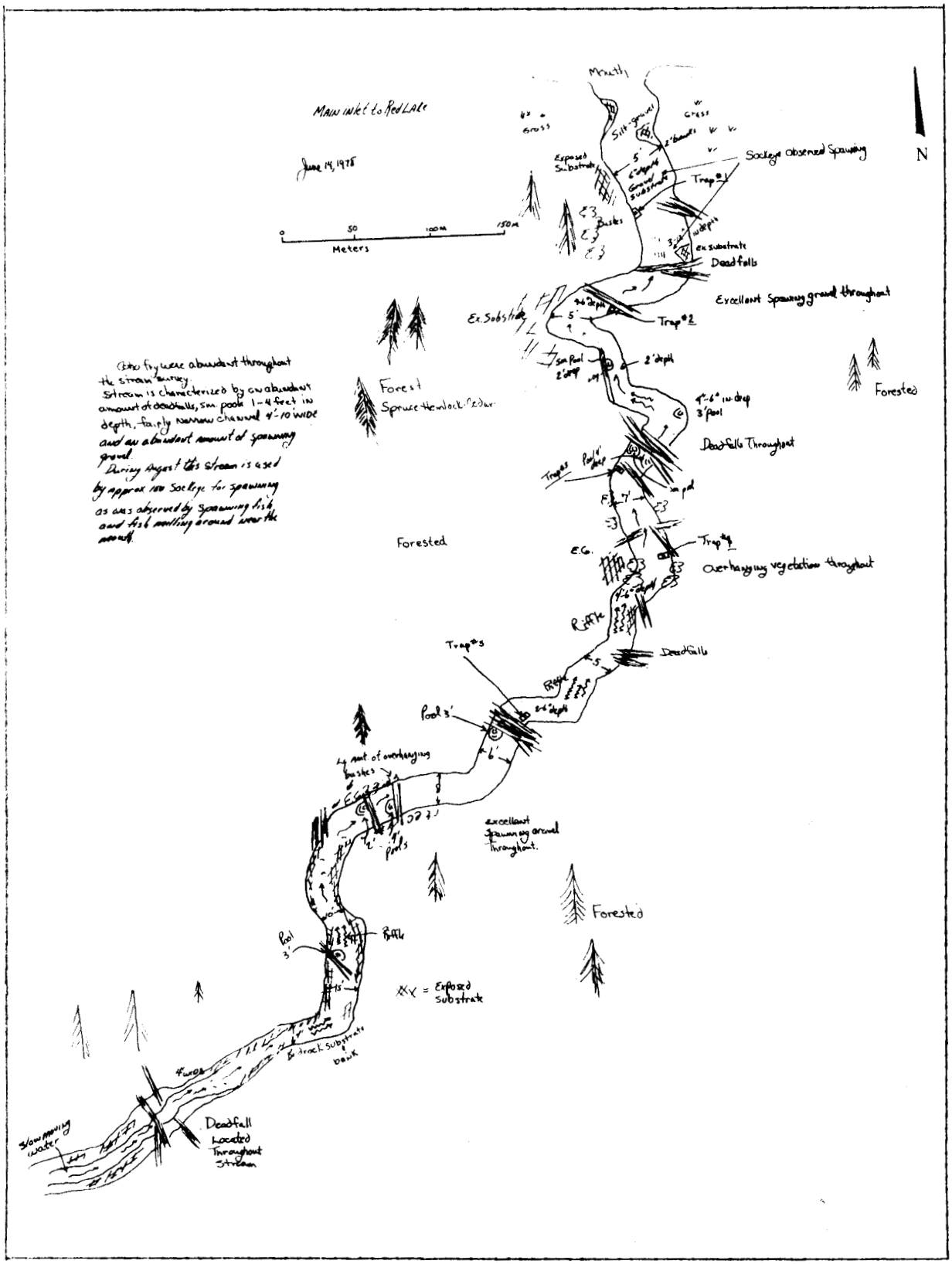

Fig. 20. Map showing main inlet to Red Lake.

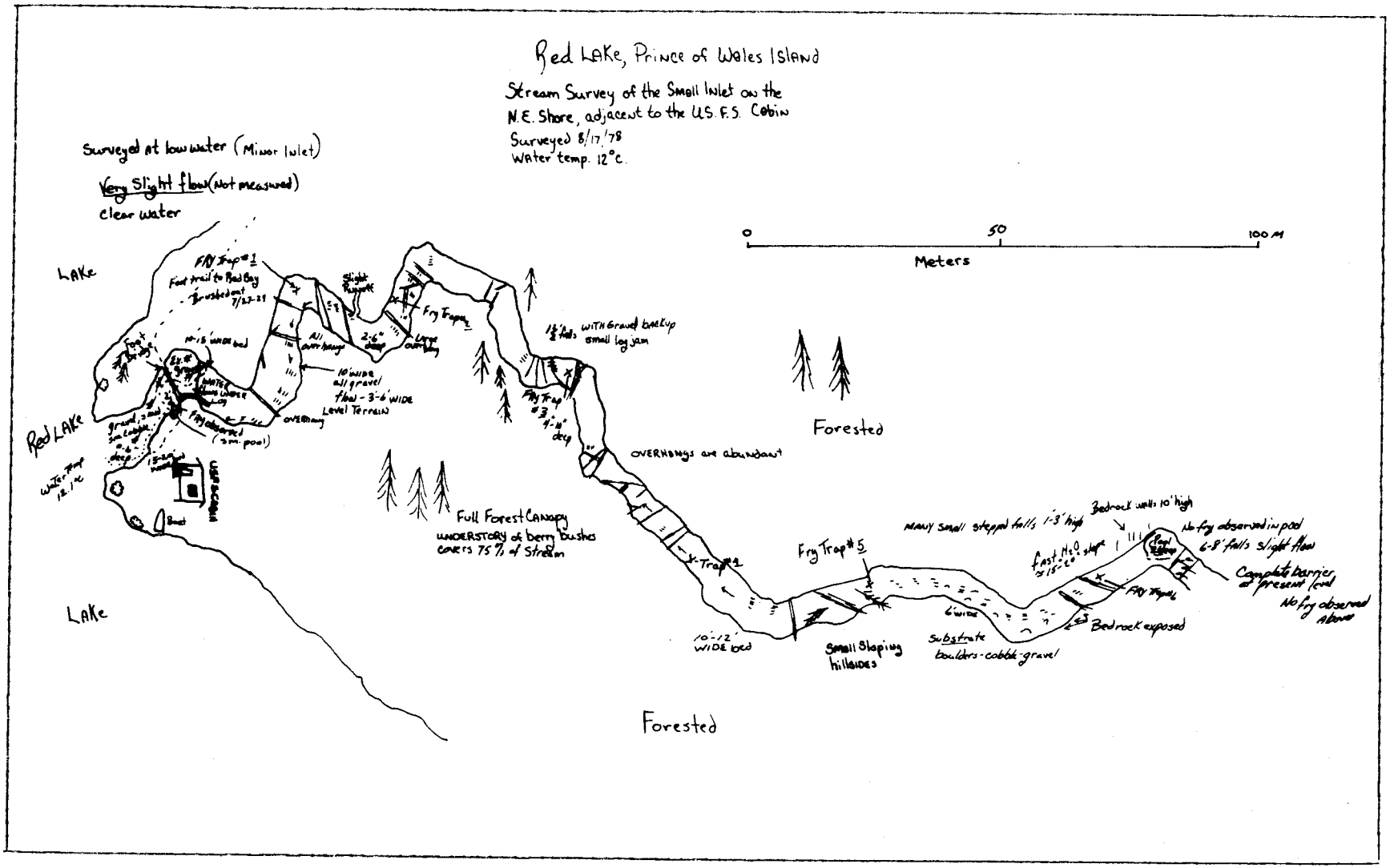

Fig. 21. Map showing "cabin inlet" at Red Lake.

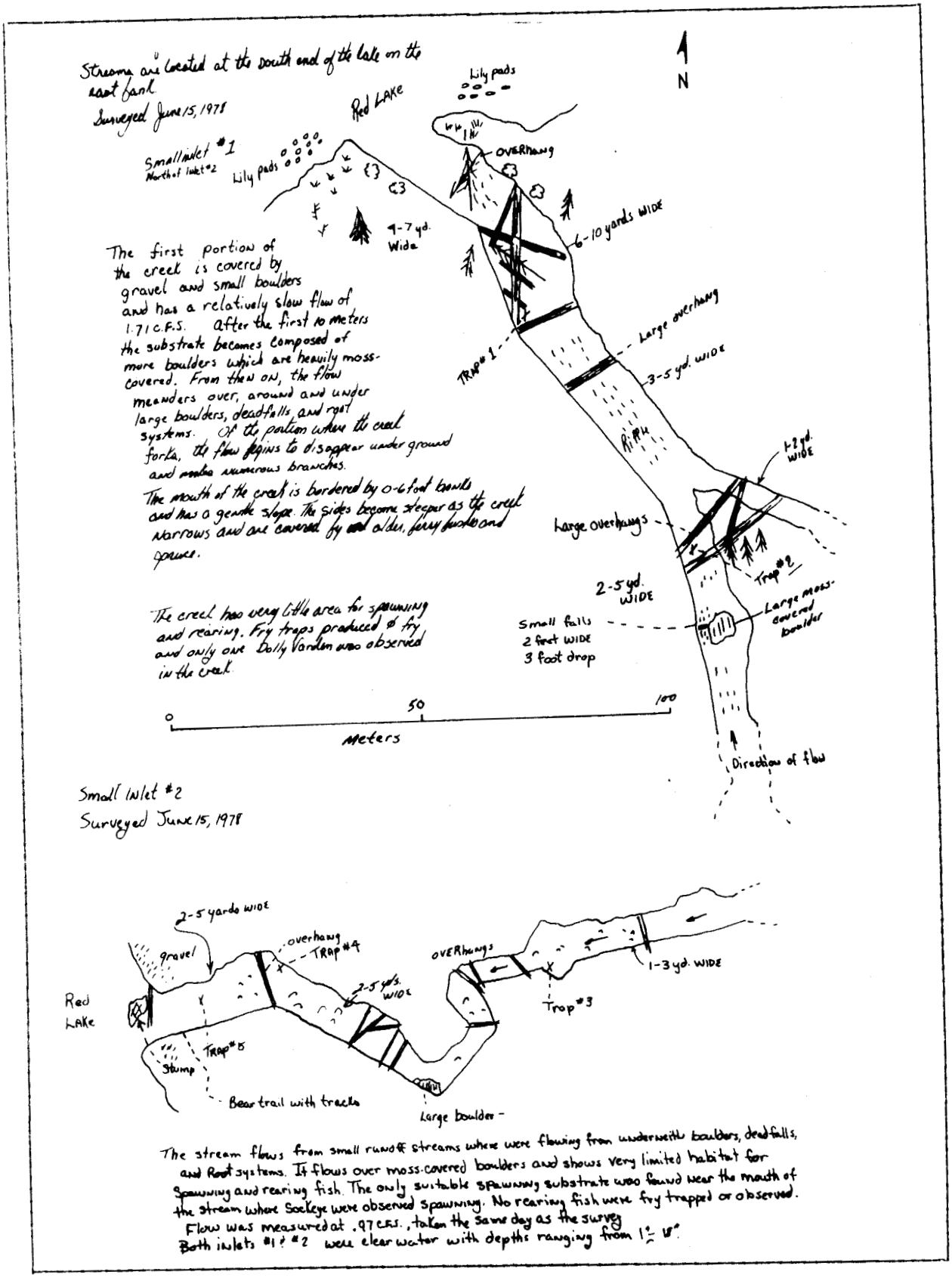

Fig. 22. Map showing minor inlets to Red Lake.

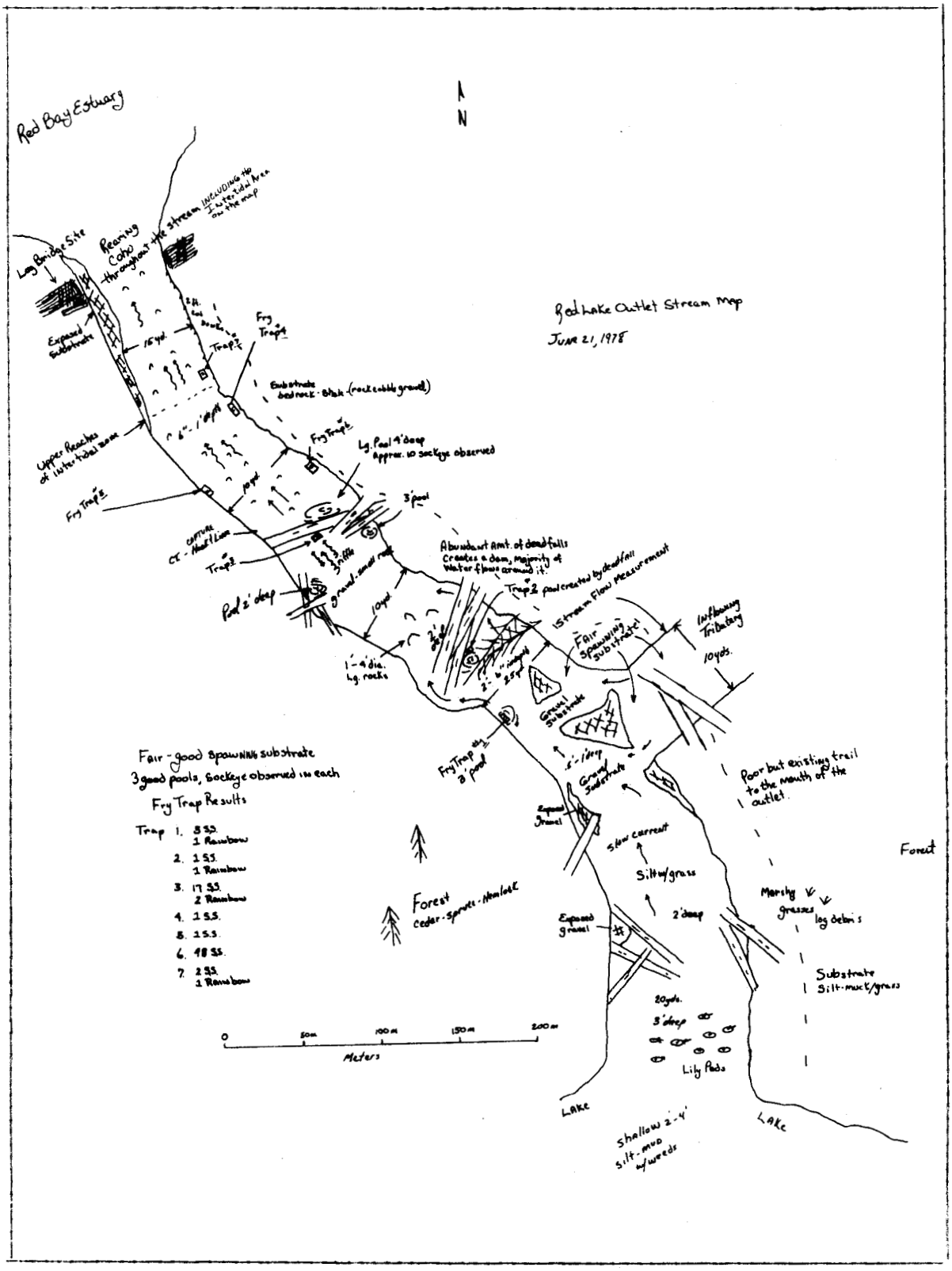

Fig. 23. Map showing outlet from Red Lake to Red Bay.

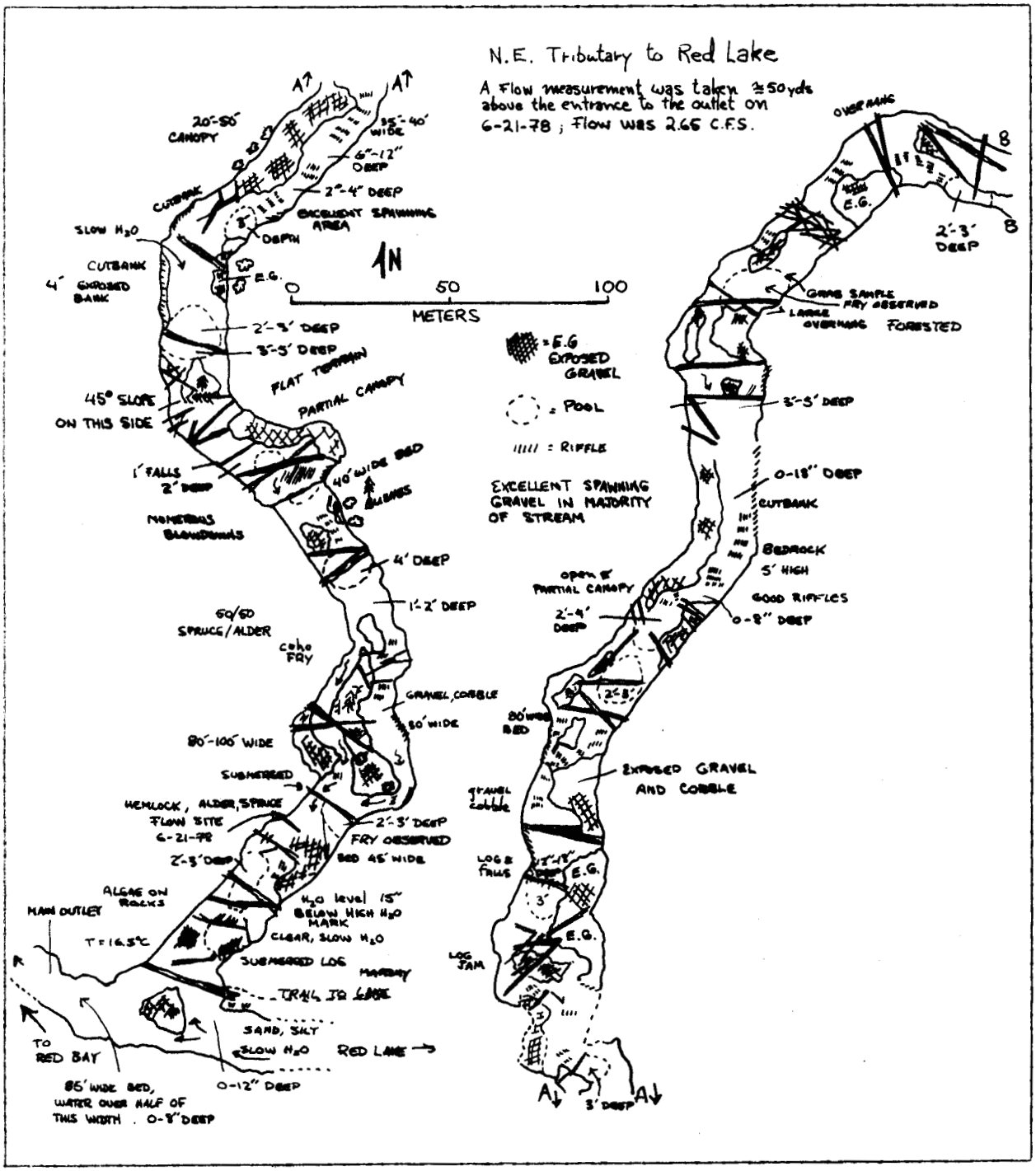

Fig. 24. Map showing tributary to outlet from Red Lake.

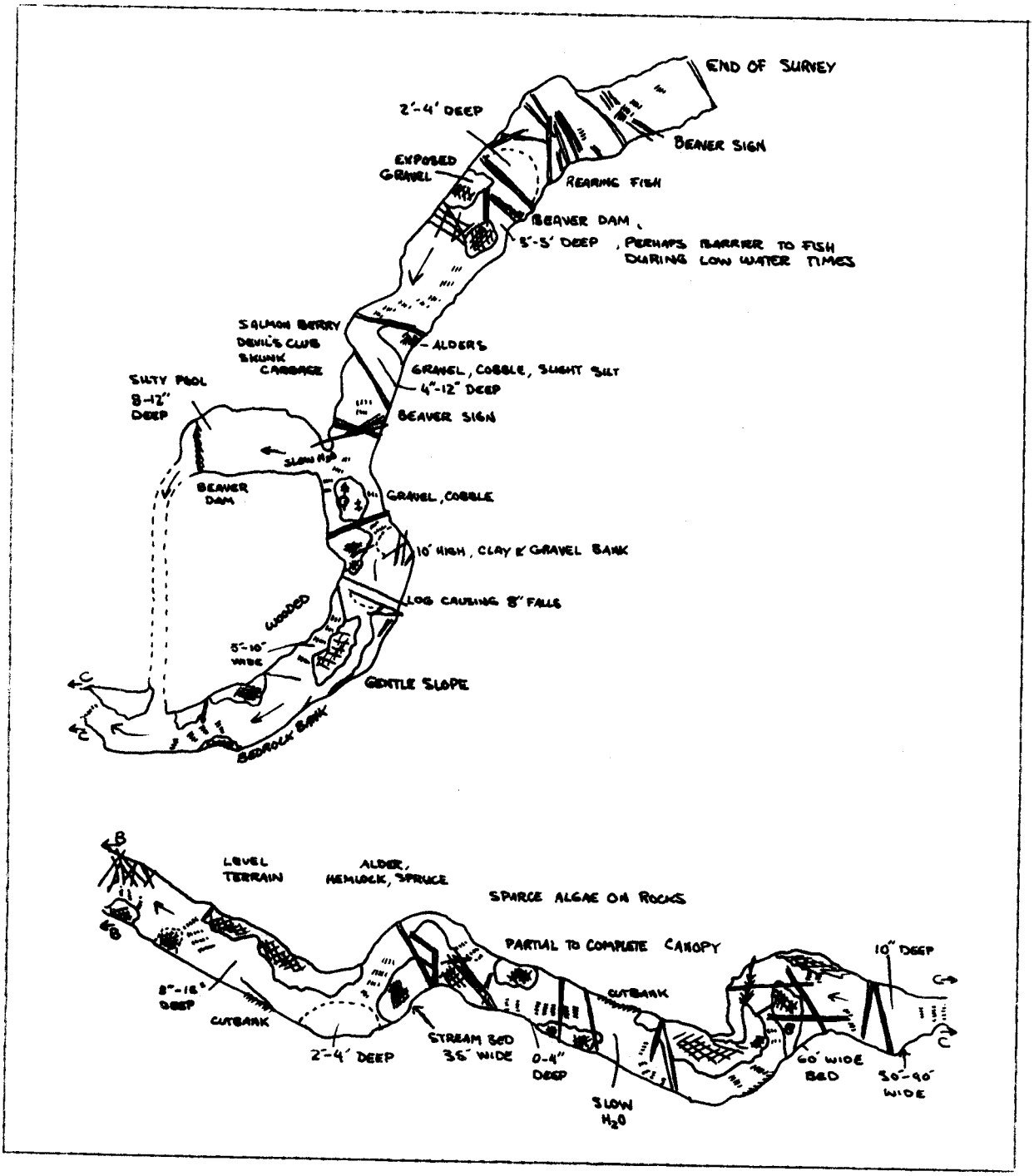

Fig. 24. (Cont.) Map showing tributary to outlet from Red Lake.

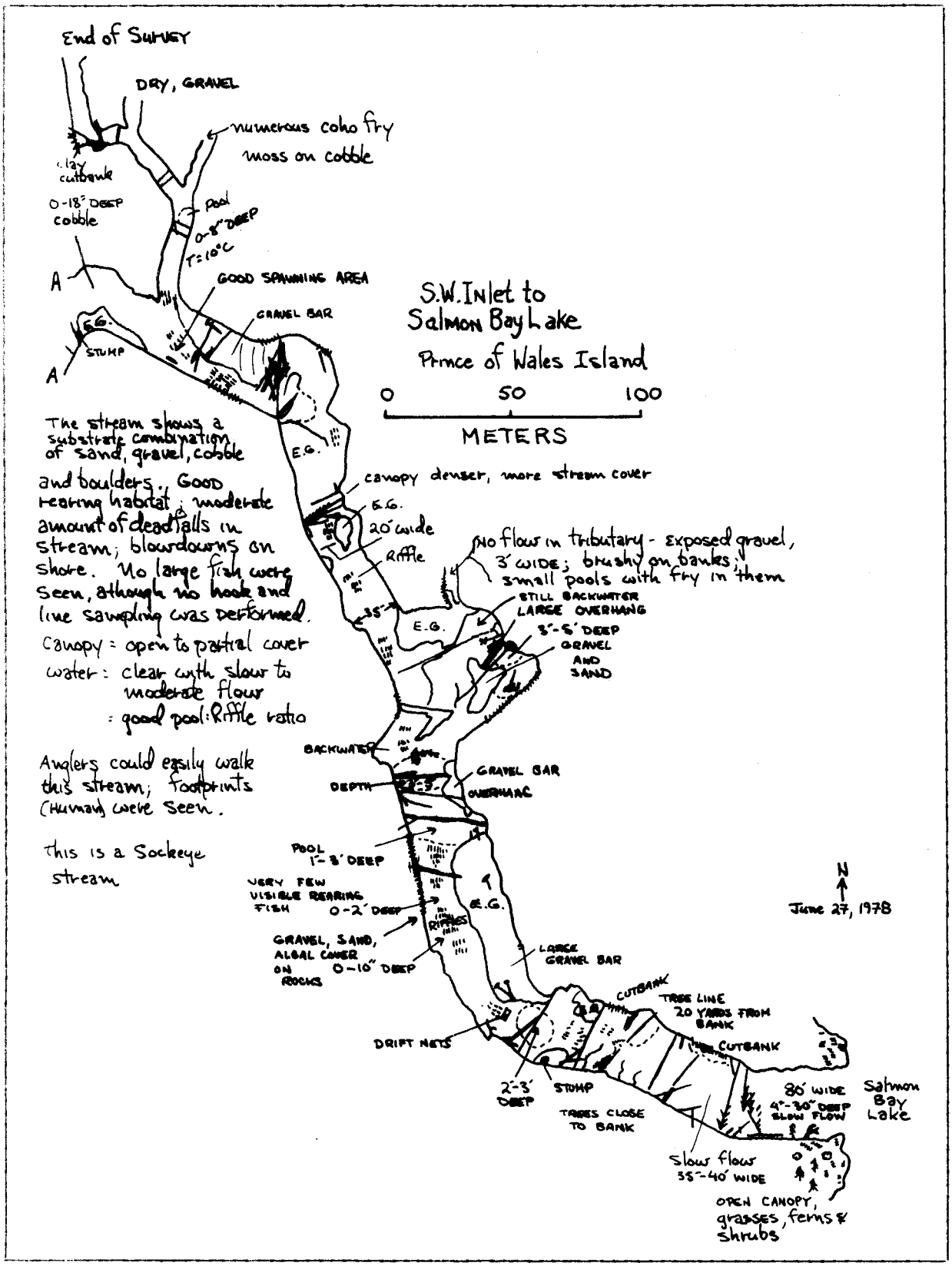

Fig. 25. Map showing southwest inlet to Salmon Bay Lake.

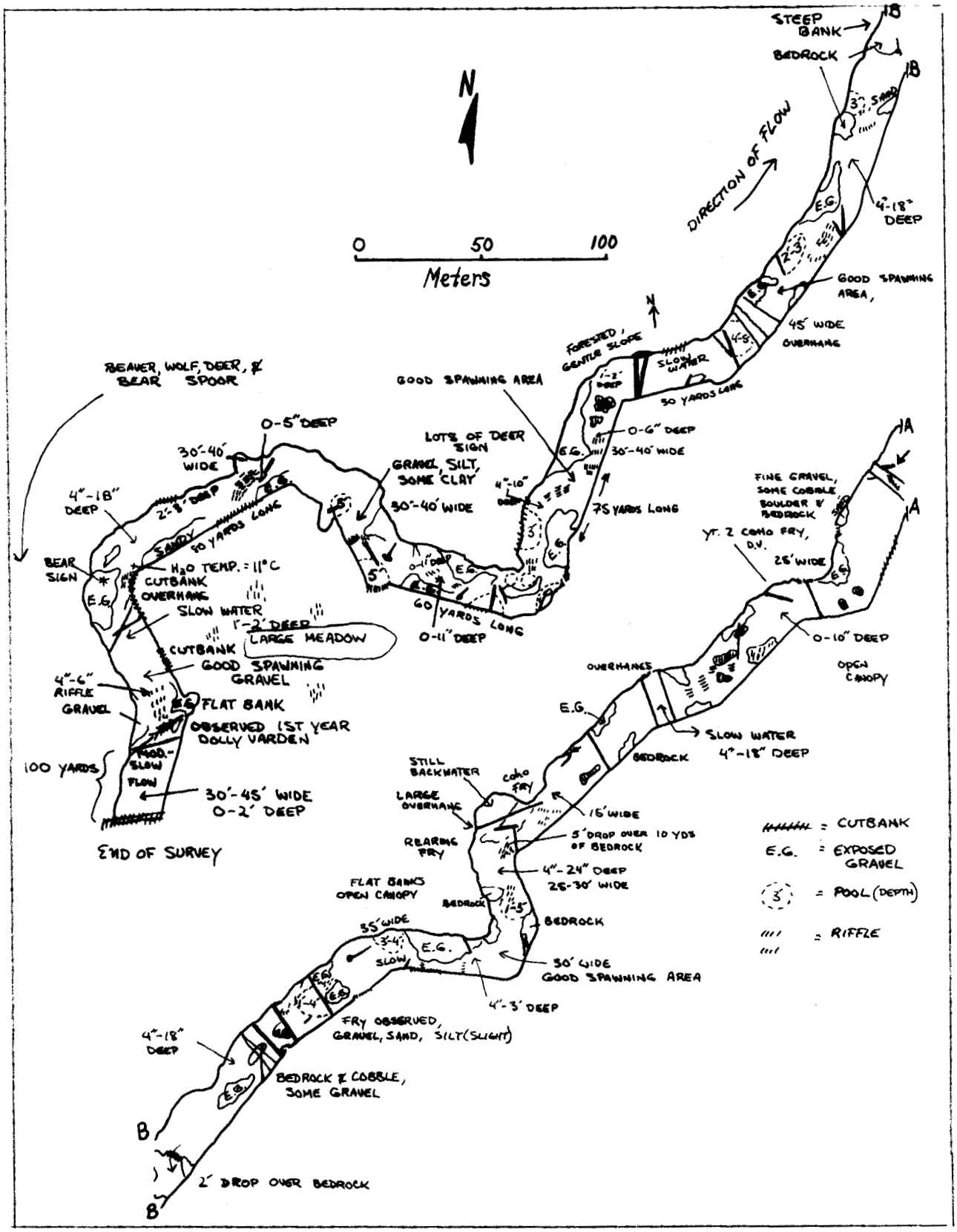

Fig. 25. (Cont.) Map showing southwest inlet to Salmon Bay Lake.

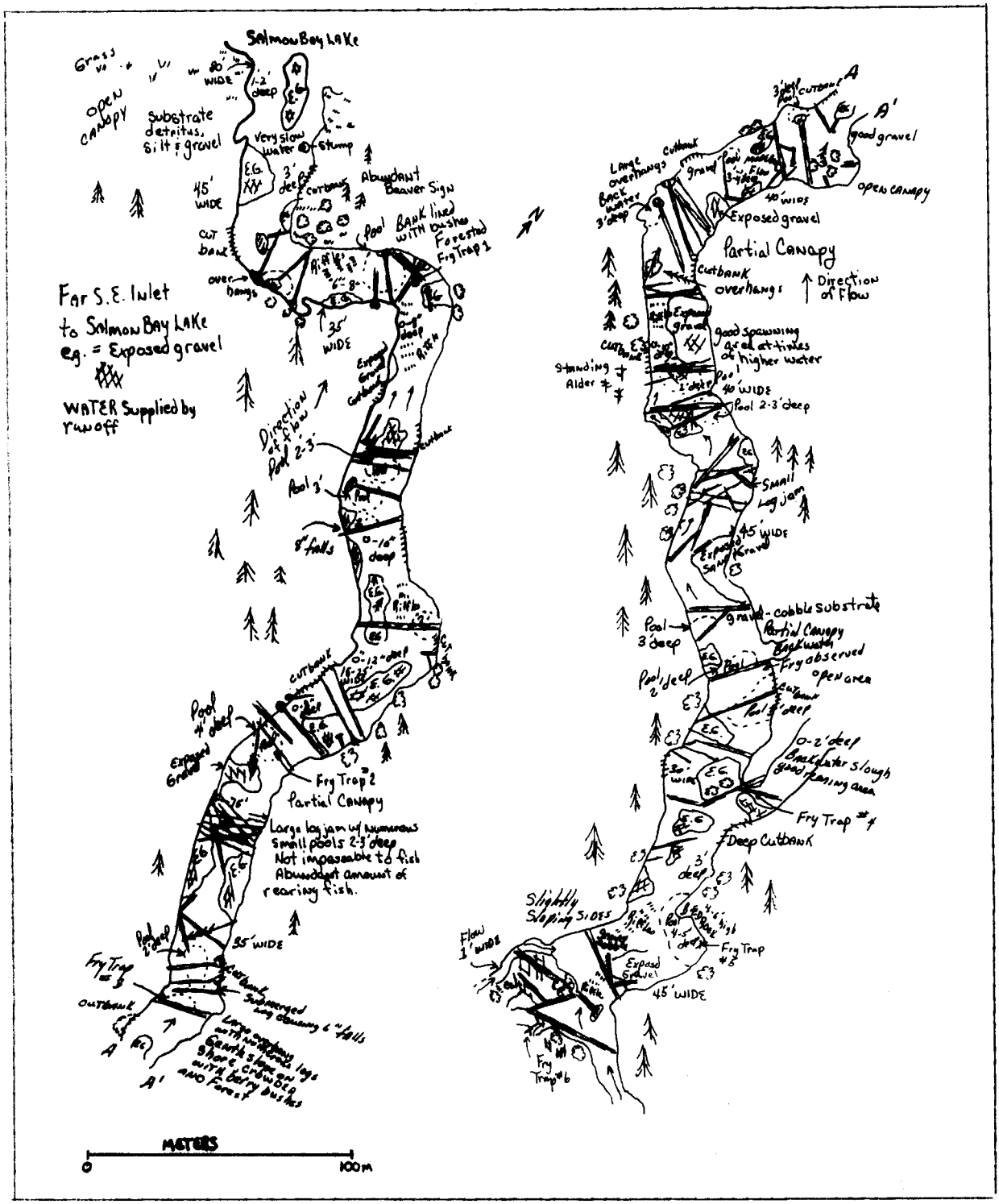

Fig. 26. Map showing far southeast inlet to Salmon Bay Lake.

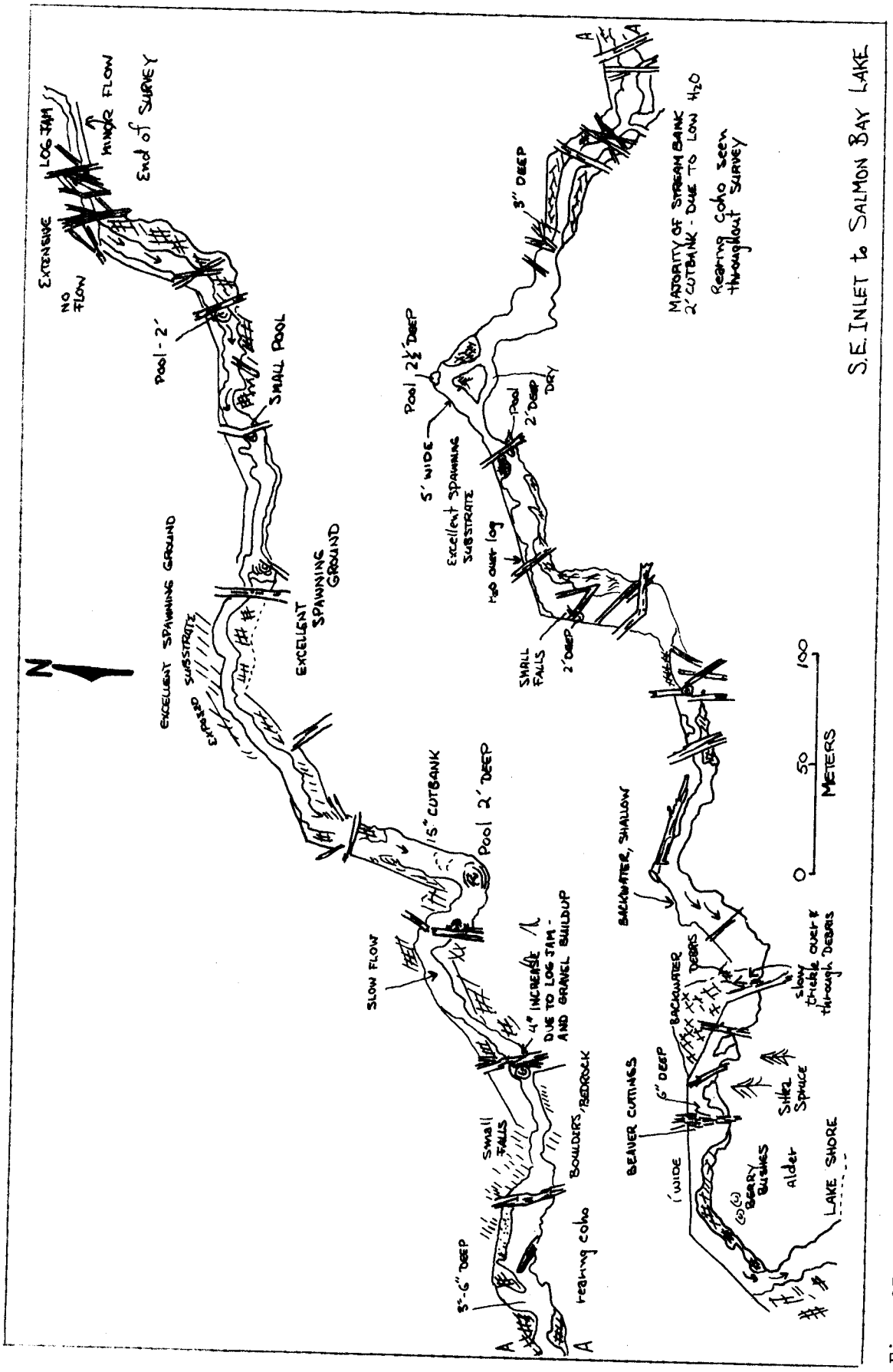

Fig. 27. Map showing southeast inlet to Salmon Bay Lake.

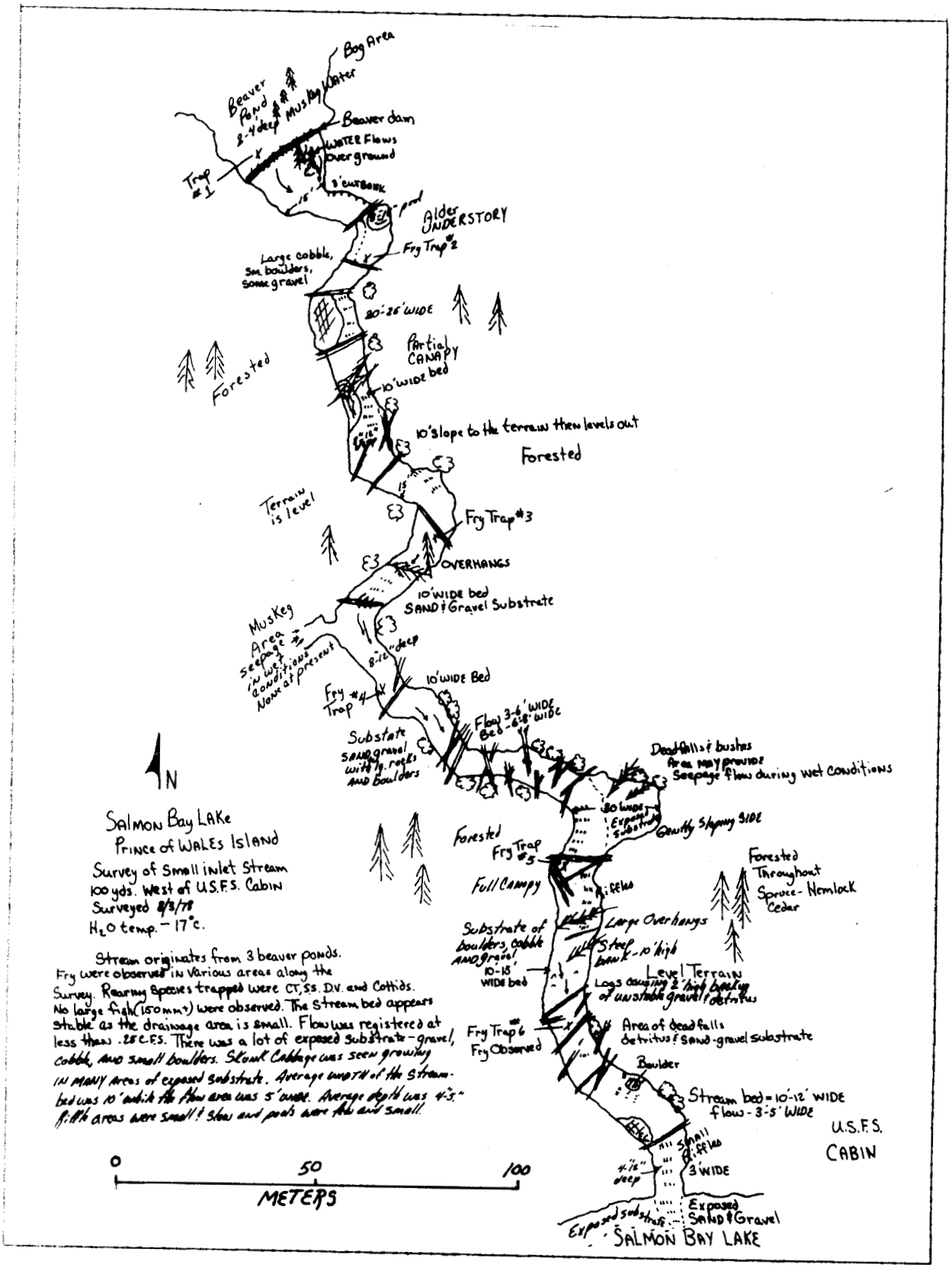

Fig. 28. Map showing "cabin inlet" to Salmon Bay Lake.

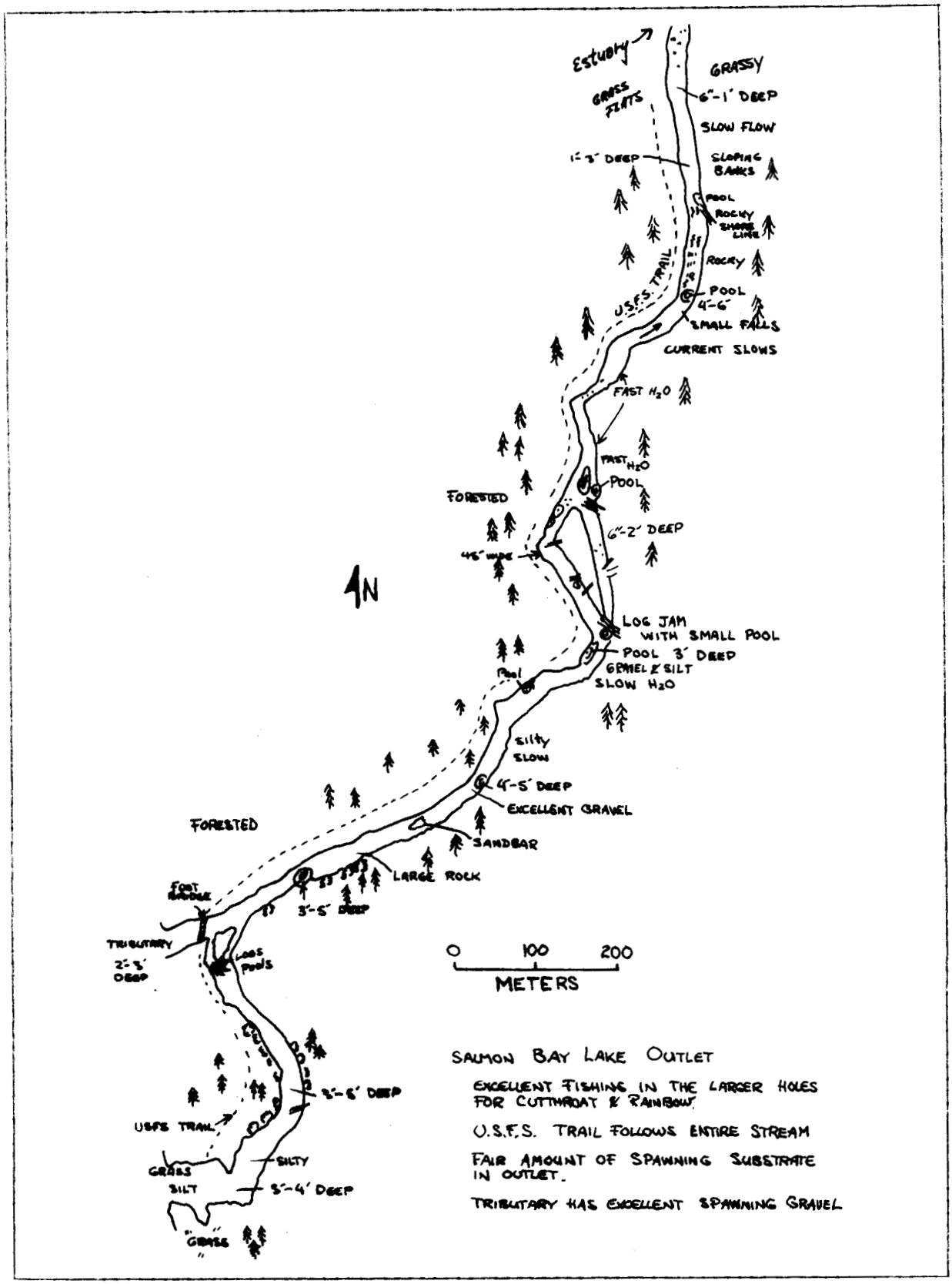

Fig. 29. Map showing outlet from Salmon Bay Lake.

Table 21. Mean length and weight of cutthroat trout by age class, Big Bay, Red, and Salmon Bay lakes, 1978.

Age	Number	$\bar{x}$ Length*	Range	Standard Deviation	$\bar{x}$ Weight**	Range	Standard Deviation
				Big Bay Lake			
3	2	156	140-173	23.0	42	40- 43	2.0
4	3	164	156-171	8.0	41	36- 44	4.0
5	6	222	174-284	42.0	105	50-187	53.0
6	3	290	272-300	15.0	220	182-250	35.0
7	5	316	280-345	23.0	252	169-306	51.0
8	9	317	280-345	26.0	254	184-315	49.0
9	1	297			240		
10	2	360	311-410	70.0	315	192-439	174.0
				Red Lake			
5	1	270			197		
6	6	264	244-282	15.9	198	150-297	58.0
7	7	280	243-316	27.0	230	136-286	61.0
8	2	297	282-312	21.0	248	214-281	47.0
9	2	304	312-395	12.0	242	239-245	4.2
				Salmon Bay Lake			
3	2	121	117-125	6.0	20	18- 21	2.0
4	5	179	138-240	38.0	61	26-130	40.0
5	21	248	120-297	39.0	164	17-265	61.0
6	16	279	216-343	35.0	222	90-380	84.0
7	9	274	242-332	25.0	210	137-344	65.0
8	4	298	255-372	53.0	239	154-396	109.0
9	2	320	293-347	38.0	334	279-388	77.0

* Length in mm
** Weight in gms

Table 22. Mean Length and weight of rainbow trout by age class, Kvoustof, Lonieof, Red, and Rezanof lakes, 1978.

Age	Number	$\bar{x}$ Length*	Range	Standard Deviation	$\bar{x}$ Weight**	Range	Standard Deviation
				Kvoustof Lake			
3	1	172			54		
4	23	191	154-230	31.0	91	56- 160	33.0
5	14	215	185-283	29.0	122	76- 271	49.0
6	1	435			675		
7	2	227	200-255	39.0	152	104- 200	68.0
8	1	245			182		
9	3	282	203-412	113.0	276	98- 561	249.0
				Lonieof Lake			
1	8	123	95-140	14.9	23	11- 40	9.1
2	5	151	133-184	23.8	42	29- 63	16.7
3	17	175	114-247	35.9	64	18- 158	39.4
4	12	214	142-355	53.4	123	29- 144	109.7
5	4	313	262-450	105.7	361	56- 848	325.0
8	1	389			534		
				Rezanof Lake			
4	6	238	169-286	54.3	162	50- 293	99.0
5	11	254	166-328	49.4	198	48- 378	104.0
8	2	386	315-457	100.0	685	356-1,014	465.0
9	2	464	392-535	101.0	1,178	664-1,692	726.0
11	1	465			942		
12	2	574	567-573	2.1	1,786	1,770-1,803	23.3
				Red Lake			
2	3	112	106-116	5.1	18	15- 18	2.9
3	1	112			16		
8	1	262			187		

* Length in mm
** Weight in gms

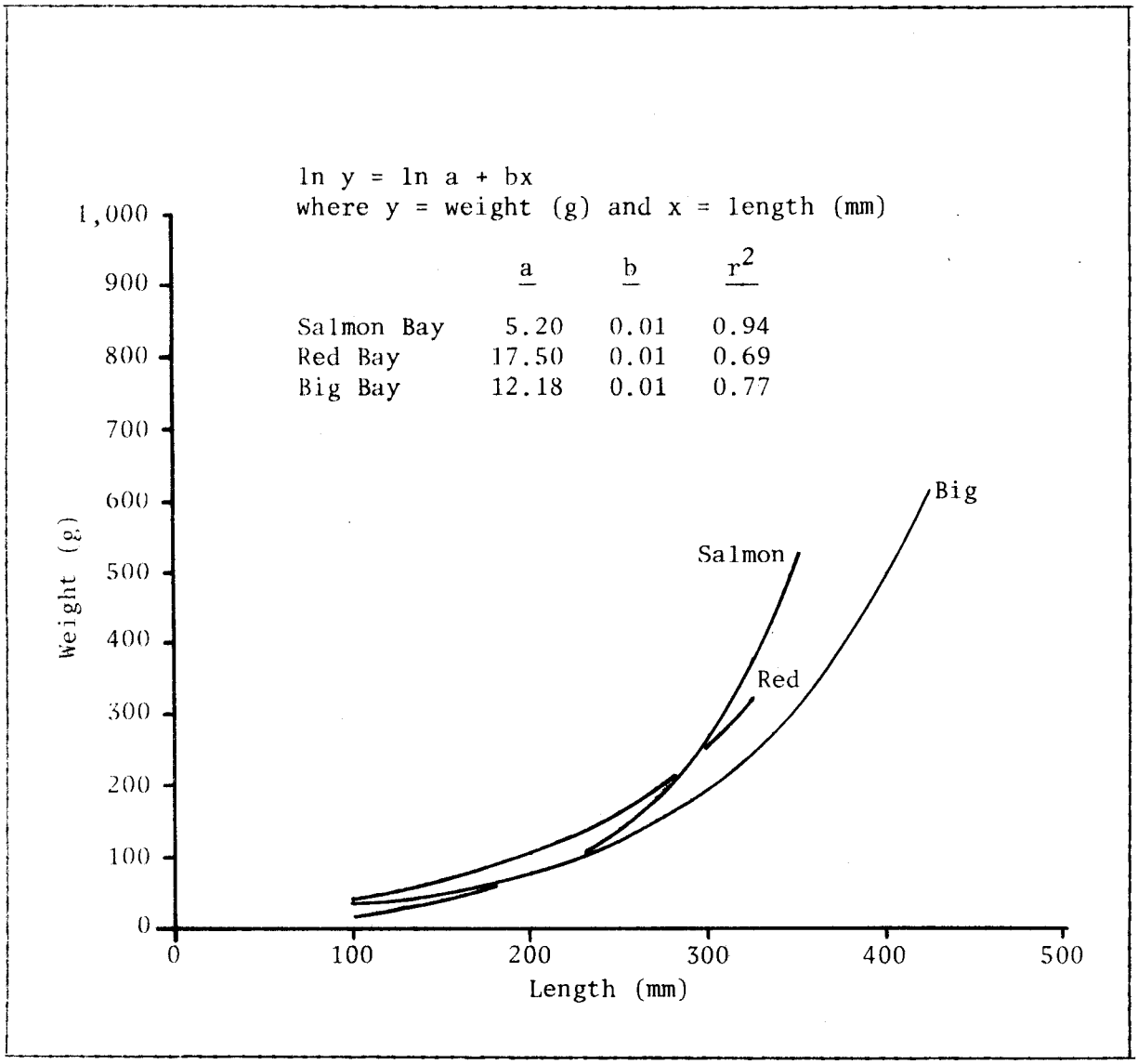

Fig. 30. Length-weight relationships of cutthroat trout from Big Bay, Red, and Salmon Bay lakes, 1978.

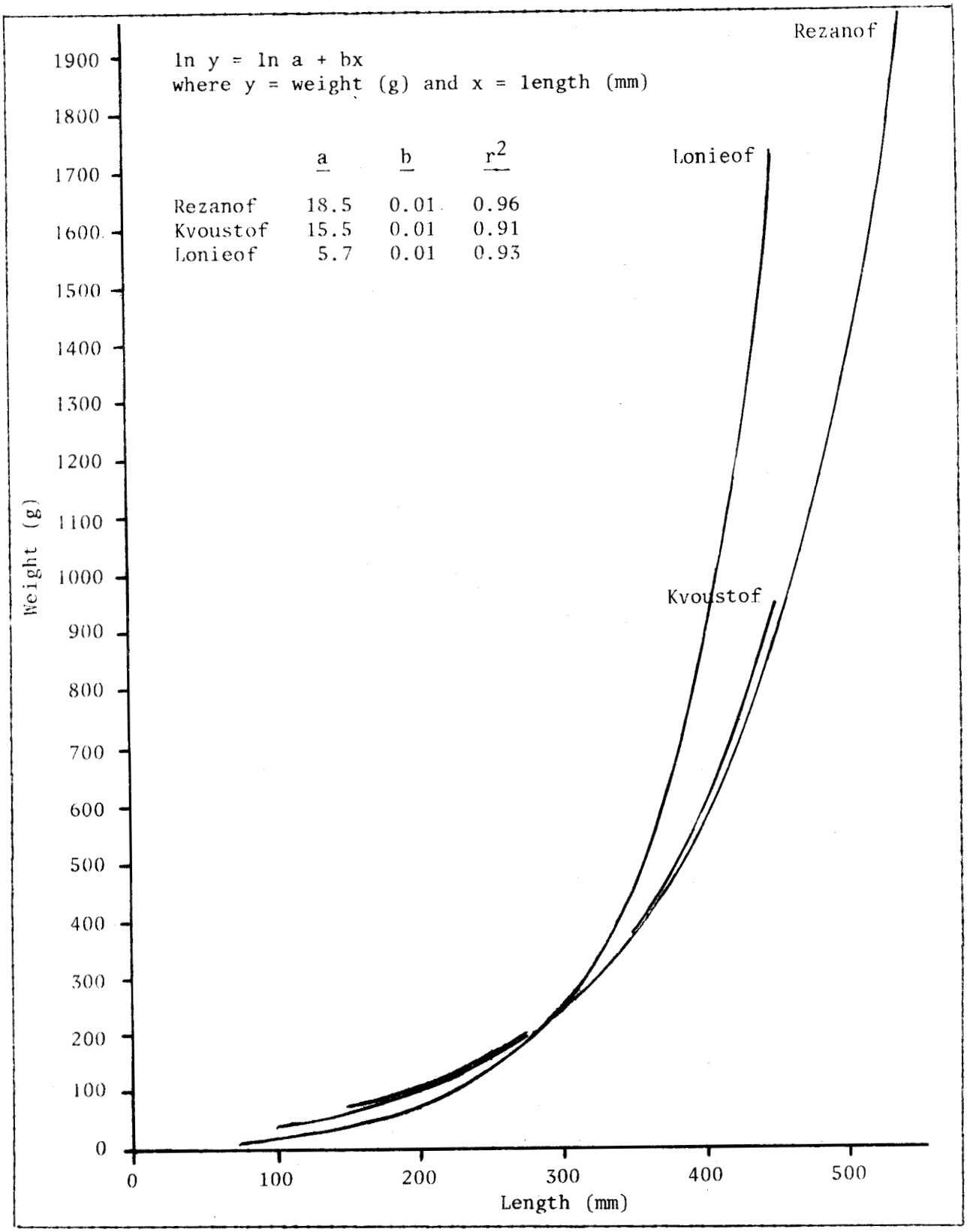

Fig. 31. Length-weight relationship of rainbow trout from Kvoustof, Lonieof, and Rezanof lakes, 1978.

Condition factors of all fish examined are summarized in Table 23. Mean condition factors of rainbow trout were nearly the same for Rezanof Lake (1.06) and Lonieof Lake (1.08). Condition factor of rainbow trout from Kvoustof Lake was 1.22.

Condition factors of cutthroat trout from the anadromous lakes (Salmon Bay and Red) were 0.98 and 1.00, respectively. Cutthroat trout from Big Bay Lake, a nonanadromous, muskeg system, had mean condition factor of 0.85.

Food Habits:

Stomach contents of rainbow trout from Rezanof, Kvoustof, and Lonieof lakes were examined and enumerated in Table 24. Stomach contents data of cutthroat trout from Red and Salmon Bay lakes on Prince of Wales Island and Big Bay Lake on Baranof Island are presented in Tables 25 and 26.

The diversity of food organisms found in rainbow trout stomachs indicates they are eating whatever is available. The most frequently eaten items were mayflies, caddis flies, midges, and black flies. Zooplankton apparently was little utilized.

Cutthroat trout stomach analyses from Red Lake and Salmon Bay Lake showed a high dependence on salmon fry, threespine stickleback, and beetles. Food of the cutthroat trout from Big Bay Lake, a landlocked system, was primarily midges.

Evaluation of High-Quality Recreational Fishing Waters

Big Bay Lake, Baranof Island:

Big Bay Lake (56°50' N, 135°17' W) is located on Baranof Island 22.4 km south of Sitka. It is at elevation of 63.7 m and has a maximum depth of 15 m. The lake is the last of a chain of three lakes about 5 km upstream of Big Bay. The lake is small but accessible by floatplane. There are no facilities but a boat is not needed. The lake shore itself is easily walked; the moist ground, however, makes it necessary to wear waterproof footwear. Much of the shore is poor for camping, but a large gravel bar and timber stand on the northwest corner is adequate.

The terrain around the lake is low and rolling with muskeg-type ground covered with scrub yellow cedar trees. An old burn at the outlet end gives it a bald appearance. At the east side there is old-growth timber along beaver sloughs; further to the northeast there are muskegs which lead to steep alpine fields.

Fishing at Upper Big Bay Lake is excellent for cutthroat trout and Dolly Varden. Pan-size cutthroat trout can be caught with nearly every cast during the daylight hours and Dolly Varden during the evening. The best fishing is found at the northwest end of the lake near a gravel bar. All of the fish at the lake are landlocked because of a 25-m barrier

Table 23. Condition factors (K)* of cutthroat and rainbow trout and Dolly Varden from lakes studied, 1978.

Lake and Species	Number	Condition Factor (K)* x	Range	Standard Deviation
Big Bay,				
Cutthroat Trout	32	0.85	0.64-1.45	0.15
Lonieof,				
Rainbow Trout	47	1.08	0.81-1.55	0.16
Kvoustof,				
Rainbow Trout	47	1.22	0.63-1.75	0.17
Red Bay,				
Cutthroat Trout	17	1.00	0.91-1.32	0.11
Rainbow Trout	4	1.23	1.04-1.76	0.30
Dolly Varden	6	1.02	0.83-1.15	0.15
Rezanof,				
Rainbow Trout	24	1.06	0.93-1.20	0.06
Salmon Bay,				
Cutthroat Trout	59	0.98	0.77-1.60	0.14

*$K = \frac{100 \times \text{Weight (gm)}}{\text{Fork Length (cm)}^3}$

Table 24. Stomach contents of rainbow trout, Rezanof, Kvoustof, and Lonieof lakes, 1978

	Rezanof		Kvoustof		Lonieof	
	Sample Size - 11		Sample Size - 20		Sample Size - 36	
	Number Present	Percent Occurrence	Number Present	Percent Occurrence	Number Present	Percent Occurrence
Oligochaeta	1	.09	5	.25	13	.11
Ephemoptera			66	.60	56	.44
Ameletus sp.	9	.09	1	.05		
Baetis sp.	16	.18	19	.25		
B. bicaudatus	5	.09	11	.40	1	.03
Cinygmula sp.			1	.05	1	.03
Heptageniidae					7	.06
Emphemerella sp.			18	.30	5	.08
E. grandis					1	.03
Paraleptophlebia sp.					2	.06
Arcynopteryx megarcys			11	.15	18	.11
Plecoptera	3	.18	22	.50	15	.14
Alloperla sp.	4	.36	22	.35		
Perlodidae			5	.15		
Perlomyia sp.	2	.18				
Capnia sp.			8	.10		
Isogenus sp.	1	.09				
Leuctrinae sp.			1	.05		
Leuctra sg. Paraleuctra sp.	2	.09	19	.15		
Nemouridae	2	.09				
N. sg. Zapada sp.	51	.09	1	.05		
Bibionidae	1	.09	2	.05	1	.03
Trichoptera	1	.09	91	.60	102	.50
Limnephilidae			11	.35	11	.14
Grensia praeterita					1	.03
Psychologlypha sp.			5	.10	2	.03
Rhyacophilidae			1	.05		
Manophylax sp.			1	.05		
Phoridae					1	.03
Homoptera			2	.05	6	.06
Rhyacophila sp.			24	.25	96	.17
R. acropedes			10	.25	1	.03
R. verrula			4	.15		
R. tucula					1	.03
Parapsyhe sp.					1	.03
Philopotamide			3	.05		
Coleoptera	3	.09	4	.15	5	.14
Elateridae	1	.09	18	.05	7	.11
Cryptophagidae					1	.03
Staphylinidae			10	.20	1	.06
Hydraenidae					2	.06

Table 24. (Cont.) Stomach contents of rainbow trout, Rezanof, Kvoustof, and Lonieof lakes, 1978.

	Rezanof		Kvoustof		Lonieof	
	Sample Size - 11		Sample Size - 20		Sample Size - 36	
	Number Present	Percent Occurrence	Number Present	Percent Occurrence	Number Present	Percent Occurrence
Cantheridae			5	.15	1	.03
Miridae			1	.05	1	.03
Hydropsychidae			1	.05	29	.14
Nematocera			30	.45	42	.28
Chironomidae			146	.70	156	.42
Chironomini			17	.35	32	.08
Tanytarsini			6	.15	133	.44
Macropelopiini			802	.15		
Pentaneurini			2	.05	9	.08
Diamesini			13	.25	5	.06
Orthocladiini			50	.55	20	.19
Diptera			10	.10		
Tipulidae			3	.15	7	.03
Antocha sp.			3	.15		
Dicranota sp.	2	.18				
Monophilus sp.	1	.09				
Simulidae			100	.55	40	.31
Prosimulium sp.			34	.35	127	.28
Simulium sp.			36	.45	17	.14
Empididae			73	.25	20	.44
Trichocera sp.			1	.05		
Chloropidae					1	.03
Proctotrupoidea			1	.05	1	.03
Pamphilidae	1	.09				
Chloropidae			1	.05		
Acari	1	.09	8	.20		
Araneae			4	.20		
Oxytrema sp.			1	.05		
Gyralus sp.			11	.20	4	.03
Cragonyx sp.	1	.09			443	.28
Cerapogonidae			2	.10		
Nematoda			1	.05	55	.08
Cladocera					1	.03
Lepidoptera			1	.05		
Copepoda					270	.03
Psilidae			1	.05		
Mymaridae					1	.03
Insecta			2	.05		
Hemerobiidae			1	.05		
Sminthuridae					1	.03
Ostracoda			1	.05		
Scolytidae			1	.05		

Table 25. Stomach contents of cutthroat trout, Salmon Bay and Red lakes, 1978.

	Salmon Bay Sample Size - 40		Red Sample Size - 12	
	Number Present	Percent Occurrence	Number Present	Percent Occurrence
Gordius sp.	1	.03		
Ephemoptera	20	.03		
Ameletus suffusus	1	.03		
Baetis sp.	1	.03		
Geometridae	1	.03		
Lepidoptera	1	.03		
Trichoptera	13	.05	2	.08
Limnephilidae	8	.05	2	.17
Psychoglypha sp.	13	.03		
Hemiptera	1	.03		
Curculionidae	4	.11		
Brentidae	1	.03		
Coleoptera	5	.08		
Elateridae	93	.58	24	.42
Chrysomelidae	38	.30	11	.25
Staphylinidae	22	.31	5	.17
Cantheridae			11	.17
Ceratopogonidae			1	.08
Agabus sp.			10	.08
Chironomidae	9	.08	21	.33
Chironomini			1	.08
Tanytarsini			3	.08
Diptera	4	.05	2	.08
Tipulidae	16	.30	4	.08
Caribidae	3	.05		
Simulium sp.	8	.03		
Empididae	1	.03	37	.17
Mycetophilidae			1	.08
Bibionidae	173	.38	6	.08
Aradidae	1	.05		
Ichneumonidae	3	.05		
Anobiidae	8	.08		
Acari	1	.03		
Araneae	1	.03		
Syrphidae	1	.03		
Salmonidae	53	.35	12	.58
Salmonid eggs	3	.03		
Gasterosteus aculeatus	26	.33	7	.33
Nematoda			8	.08
Gyraulus sp.			5	.08
Saldidae	2	.05		
Proctotrupoidea	1	.03		
Cerambycidae	1	.03		
Ecunemidae	1	.03		
Scolytidae	3	.05		
Coenomyiidae	3	.05		
Coenagrionidae	1	.03		
Engallagama carunculatum	2	.05		

Table 26. Stomach contents of cutthroat trout, Big Bay Lake, 1978.

	Sample Size - 26	
	Number Present	Percent Occurrence
Ephemoptera	3	.08
Ameletus sp.	4	.04
Siphlonuridae	4	.15
Plecoptera	1	.04
Leuctra sg. Paraleuctra sp.	1	.04
Nemoura sp.	1	.04
Mystacides sp.	1	.04
Trichoptera	15	.46
Limnephilidae	8	.15
Psychoglypha sp.	83	.54
Limnephilus sp.	285	.38
Discomoecus sp.	1	.04
Cladocera	9	.08
Homoptera	1	.04
Rhyacophila sp.	1	.04
Coxidae	2	.08
Gerris sp.	3	.08
Coleoptera	1	.04
Elateridae	1	.04
Hydrovatus sp.	10	.23
Staphylinidae	5	.12
Nematocera	6	.15
Chrysomelidae	1	.04
Cantheridae	5	.15
Chironomidae	70	.58
Chironomini	17	.38
Tanytarsini	29	.27
Pentaneurini	17	.12
Podonomini	1	.04
Diamesini	2	.08
Corynoneurini	3	.04
Orthocladiini	10	.19
Podonomidae	4	.08
Tipulidae	2	.08
Empididae	191	.38
Sciaridae	1	.04
Braconidae	1	.04
Sphaeriidae	2	.04
Osteichthyes	1	.04
Aesna sp.	1	.04
Crangonyx sp.	13	.27
Ceratopogonidae	16	.31
Tenthredinidae	1	.04
Gammaridae	1	.04
Anisoptera	2	.08
Planorbidae	8	.04

falls at the outlet stream. The lake has two inlets, each with a good population of cutthroat trout and Dolly Varden fry.

The wildlife at the lake is unique. There are beaver inhabiting the lake and streambanks.

From Upper Big Bay Lake you can walk to two lower lakes and then from there to salt water to Big Bay. From salt water to the first two lakes there are coho salmon and cutthroat trout runs. Local rumor has it that steelhead trout also are present.

Actual use of Upper Big Bay Lake is light. The surrounding burn area to the southwest and the outlet stream are utilized by a few walk-in fishermen and deer hunters.

Rezanof Lake, Baranof Island:

Rezanof Lake (55°33' N, 134°50' W) is a long (about 6 km), narrow lake 11 km southeast of Whale Bay. Elevation is 225 m above sea level and maximum depth is 170.7 m. This is the first of a series of four main lakes draining to Sandy Bay.

Facilities at the lake include two U.S. Forest Service panabode-type cabins. One is a four-person cabin and the other is a two-person cabin. Each cabin is equipped with a good wood stove. There are two 3.6-m skiffs at the larger Rezanof cabin. Due to the long length of the lake an outboard should be taken.

Access to the lake is by floatplane. Flight time from Sitka is 25 minutes. The sides of the lake are bordered by steep, snow-covered mountains. The main inlet is a river flowing through muskeg flats with thick alder and berry brush. The inlet end of the lake offers some beach walking on the north shore; and if hip boots are used, stream walking can be fairly easy for about 2.4 km upstream at the northeast inlet. Several landslides border the inlet.

At the outlet stream on the north shore there is a very good bear trail leading to Kvoustof Lake, which takes only 5-10 minutes to walk.

Rainbow trout which were stocked from Sashin Lake in 1938 are the only fish in the lake. Fishing history denotes an excellent sport fishery with rainbow trout ranging up to 635 mm long and upwards to 2.2 kg in weight. Due to the cold water runoff into Rezanof Lake, fishing is usually erratic with most of the trout being caught in late May and early June during the spawning run. Some stream fishing may be possible if salmon eggs or artificial flies are used in deep pools of the main inlet and outlet streams.

The other wildlife at Rezanof Lake is as erratic as its fish; yet seasonally you can view many shore birds, waterfowl, songbirds, blacktail deer, bear, mink, mice, hawks, and eagles. The landscape of the lake is equally varied from spruce forests next to muskeg fields of

wildflowers to solid rock and snow cliffs towering 900 m straight up from the lake's surface.

Kvoustof Lake, Baranof Island:

Kvoustof Lake (56°32' N, 134°54' W) is 2.4 km long with maximum depth of over 100 m. Access is by floatplane from Sitka. There are no cabins or skiffs at Kvoustof. A person staying at nearby Rezanof Lake cabin (the outlet cabin) could use waders to cross the shallow outlet, then proceed to Kvoustof via the old-growth timber trail. At the end of the trail there is a large sand and gravel bar ideal for a campsite and within walking distance of the inlet stream where there are rainbow trout and clean drinking water. This eastern shoreline can also be easily fished and walked because of an old, dried-up streambed.

The terrain around Kvoustof is spruce and yellow cedar covered hillsides which are not too steep on the north shore to attempt walking. On the south side, however, the shoreline is more abrupt and too steep for walking. At the northwest corner of Kvoustof Lake the terrain is even lower, and it may be possible to hike to nearby ponds or even Plotnikof Lake. At the outlet there are very steep banks; walking is very rough but can be done for 150 m downstream to a 25-m falls. This outlet stream then leads onto Lower Kvoustof Lake.

There is no previous fishing history except for fishermen wandering from Rezanof Lake. The fishing is poor, but some rainbow trout can be caught at the inlet in early summer.

The deer and bear sign was quite abundant at Kvoustof Lake, especially at the eastern sand bar. Also many songbirds and waterfowl are seasonally present. Deer hunters staying at Rezanof sometimes walk the hillsides nearby in August and September.

It may be possible for experienced canoeists or raft users to float to Kvoustof from Rezanof Lake, which is only about 0.4 km. The stream's velocity and depth are not dangerous but rocks must be avoided. Another way would be to portage a canoe along the trail (between Rezanof and Kvoustof). It is advisable to have some sort of watercraft because most of the lake is inaccessible without floating along the shoreline.

Lower Kvoustof Lake, Baranof Island:

Access to Lower Kvoustof Lake (56°31' N, 134°55' W) is by way of floatplane from Sitka (30 minutes), but poor weather conditions and the small lake basin sometimes make it difficult for planes taking off. Lower Kvoustof is almost completely inaccessible by foot because of a lack of shoal area and lack of a trail system. There are no cabin or boat facilities at the lake.

Most of the lake's surrounding terrain is spruce, yellow cedar, hemlock, and lodgepole pine covered hillsides with numerous muskeg runoff areas and old-growth timber stands. On the northeast shore there is a landslide

leading up to alpine meadows 460 m high. The north inlet end is a flat basin of old-growth yellow cedar and hemlock where the inlet stream branches into four sections. This flat area is ideal for tent campsites, with well-drained ground and pure drinking water nearby. At the outlet end of the lake the streambanks are steep and brushy, but there is a deer trail that leads all the way from Lower Kvoustof to a no-name lake about 0.4 km away.

Fishing history (in the non-name lake?) is nonexistent because of the lack of knowledge about this particular lake. The lake itself offers is rather poor fishing. Rainbow trout may be taken at the lake and outlet stream junction. The streams, however, are excellent fishing; and in the north inlet about 180 m upstream beneath a 6-m falls are some nice pan-size rainbow trout. The outlet stream also offers excellent rainbow fishing with many deep pools along the banks.

Lonieof Lake, Baranof Island:

Lonieof (Gar) Lake (56°30' N, 134°55' W) is located 32 km northwest of Port Alexander on Baranof Island. This is the lower lake of the Rezanof Lake chain and drains to Sandy Bay.

Lonieof Lake has a two-person capacity cabin at the northeast shore of the lake next to the main inlet. It has a very good wood stove. There is no boat at the lake, so a canoe or raft should be taken because of the poor trails.

There are four main deer trails which can be used for hiking, all of which are very poor because of vegetation, steep slopes, and deadfalls. The best of the trails is the one directly behind the Lonieof Lake cabin which follows the inlet all the way to an upper (no-name) lake. The second trail starts on the east side of the cabin inlet and is worn into the north shore of the lake but is very steep going. This trail goes all the way to the east inlet where it joins a third trail that is relatively flat but congested with deadfalls. The fourth trail is at the outlet stream and can only be reached by boat. The trail goes along cliffs and finally ends up at the 60+-m barrier falls. From the falls you can walk to Sandy Bay without a trail.

Historically Lonieof has a reputation of good rainbow trout fishing. At the two inlets rainbow trout fishing is very good if salmon eggs are used. The best fishing seems to be at the source of the north inlet. The deeper pools in the east inlet also produce some rainbow trout. In the outlet stream at its junction with Lonieof Lake you can catch a few pan-size rainbow trout. Below the barrier falls there are Dolly Varden and coho salmon runs.

Deer hunting seems to be another popular use of Lonieof Lake because of the abundant deer herd along the lake during the fall months and the large muskeg meadows nearby.

Wildlife at Lonieof are seasonally abundant. In the summer blacktail deer, brown bear, various nesting songbirds and waterfowl, red squirrels, otter, and eagles are commonly seen.

Red Lake, Prince of Wales Island:

Red Lake (56°15' N, 133°19' W) is located on the southeast end of Prince of Wales Island. Lake area is 166 ha, and maximum depth is 21 m.

The facilities on the lake include a small 2.4-m by 3-m cabin which contains a set of bunks, table, and bench. It has an old wood stove which provides plenty of heat, and the U.S. Forest Service has provided firewood. The mice also enjoy the cabin. The cabin is adjacent to a small stream so fresh water is available.

There were at times two different skiffs available. One is a large 4.3-m aluminum John boat and the other a 3.6-m aluminum skiff. On one trip to the lake both skiffs were missing but were later found near the outlet, apparently having been used by local loggers.

The Y.C.C. this year built a trail from the estuary up along the outlet stream, around the north end of the lake, and to the cabin. On last inspection the trail was in pretty rough shape but was usable which made walking the outlet a little easier. The trail was begun by the loggers in the area who also built the bridge over the mouth of the outlet. On more than one occasion we observed loggers fishing in this stream (snagging sockeye salmon). There was a logging camp nearby and a logging road crossed over the outlet, so Red Lake and its outlet proved to be one of their recreational areas.

Access to the area is by floatplane from Petersburg or Ketchikan or by boat to Red Bay and a short hike up the outlet. Anyone interested in staying on the lake is advised to get reservations to use the cabin.

Red Lake is surrounded by 152-m mountains which are covered with Sitka spruce, hemlock, and cedar. The shoreline is steep in quite a few areas with cliffs of rock approximately 6-8 m high. The lake also has an abundant amount of deadfalls from trees that have blown down or fallen from the lake shore.

Red Lake has rainbow/steelhead and cutthroat trout, Dolly Varden, and coho and sockeye salmon for the sport fisherman. The period of June to early July is good for resident cutthroat trout. After mid-July cutthroat trout fishing drops, but anadromous Dolly Varden and salmon enter the system.

The outlet has a few pools that usually hold some cutthroat trout and Dolly Varden. Sockeye salmon in-migrating to spawn were constantly seen holding in these before moving into the lake. Sockeye salmon were also observed spawning off of all the inlets into the lake. Steelhead trout are known to use the outlet and the lake for spawning and rearing sites.

A person staying at Red Lake would have to consider angling as a chief source of entertainment. The only area not heavily forested and mountainous is the main inlet on the south shore and the outlet. Both provide a mile or two of possible hiking, but only the outlet area has any type of trail. Hiking up the main inlet would entail walking in the stream on occasion.

The only potential improvements to the system include a new cabin and improving the trail to the cabin from the outlet.

The apparent wildlife in the area consists mainly of loons, geese, mallards, and an abundant number of beaver. Bear and deer sign were found near the main inlet but none were sighted. Eagles were fairly abundant in the outlet.

Salmon Bay Lake, Prince of Wales Island:

Salmon Bay Lake (56°15' N, 133°12' W) is located at the north end of Prince of Wales Island at the head of Salmon Bay. Lake area is 388 ha, and maximum depth is 60 m. Water is fairly clear throughout the lake, but the outlet area has a muskeg color in the proximity of lily pad concentrations. Access to the lake is via floatplane or by boat to Salmon Bay and trail to the cabin. Facilities on the lake include a panabode cabin with oil stove and 4.3-m aluminum skiff. The cabin is in good shape and has four bunks. The cabin is located on the north shore near a small stream with a large sand beach. The skiff has several patches covering bullet holes but still leaks. The U.S. Forest Service maintains a trail along the outlet stream from the cabin to Salmon Bay.

The lake is surrounded by mountains averaging about 170 m in elevation that are covered by cedar, hemlock, and spruce. Towards the south bowl of the lake are some larger mountains which add to the scenic beauty of the lake.

Fish species found in the Salmon Bay Lake and outlet stream include: rainbow/steelhead and cutthroat trout; Dolly Varden; and pink, chum, coho, and sockeye salmon. The outlet stream is the best fishing area. Cutthroat trout were the only fish caught in the lake during July and August.

The lake is a nice area for the person that wants a pleasant stay in the woods away from "civilization," but civilization is apparent even on Salmon Bay Lake with logging taking place only about 1.7 km northeast of the lake's north shore. During the summer months the sound of "toots" and "whistles" from logging machinery is constantly heard.

The wildlife in the area consists mainly of beavers, loons, mergansers, and some deer, black bear, and wolves.

LITERATURE CITED

Henderson, H. F., R. A. Ryder, and A. W. Kudhongania 1973. Assessing fishery potentials of lakes and reservoirs. J. Fish Res. Bd. Can. 30:2000-2009.

Jenkins, R. M. 1967. The influence of some environmental factors on standing crop and harvest of fishes in U.S. reservoirs. Pages 298-321 In Proc. Res. Fish. Symp. Southern Div. Am. Fish. Soc.

Rawson, D. S. 1953. The standing crop of net plankton in lakes. J. Fish Res. Bd. Can. 10(5):237-244.

Regier, H. A., A. J. Cordone, and R. A. Ryder. 1971. Total fish landings from fresh waters as a function of limnological variables, with special reference to lakes of east-central Africa. FAO Fish Stock Assess. Work. Pap. No. 3. 13 p.

Ryder, R. A. 1964. Chemical characteristics of Ontario lakes with reference to a method for estimating fish production. Ont. Dept. Lands For. Sect. Rep. (Fish.) No. 38. 75 p.

_____. 1965. A method for estimating the potential fish production of north-temperate lakes. Trans. Am. Fish. Soc. 94:214-218.

Ryder, R. A., S. R. Kerr, K. H. Loftus, and H. A. Regier. 1974. The morphoedaphic index, a fish yield estimator--review and evaluation. J. Fish Res. Board Can. 31:663-688.

Schmidt, A. E. 1974. Inventory and cataloging of the sport fish and sport fish waters in Southeast Alaska. Alaska Dept. of Fish and Game. Fed. Aid in Fish Rest., Annu. Rep. of Prog., 1973-1974, Proj. F-9-6, 15(G-I-A). 125 pp.

_____. 1976. Inventory and cataloging of the sport fish and sport fish waters in Southeast Alaska. Alaska Dept. of Fish and Game. Fed. Aid in Fish Rest., Annu. Rep. of Performance, 1975-1976, Proj. F-9-8, 17(G-I-R). 48 pp.

_____. 1977. Inventory and cataloging of the sport fish and sport fish waters in Southeast Alaska. Alaska Dept. of Fish and Game. Fed. Aid in Fish Rest., Annu. Rep. of Performance, 1976-1977, Proj. F-9-9, 18(G-I-R). 60 pp.

_____. 1978. Inventory and cataloging of the sport fish and sport fish waters in Southeast Alaska. Alaska Dept. of Fish and Game. Fed. Aid in Fish Rest., Annu. Rep. of Performance, 1977-1978, Proj. F-9-10, 19(G-I-R). 64 pp.

Schmidt, A. E. and F. S. Robards, 1975. Inventory and cataloging of the sport fish and sport fish waters in Southeast Alaska. Alaska Dept. of Fish and Game. Fed. Aid in Fish Rest., Annu. Rep. of Performance, 1974-1975, Proj. F-9-7, 16(G-I-A). 111 pp.

Prepared by:

Artwin E. Schmidt
Fishery Biologist

Approved by:

Rupert E. Andrews, Director
Sport Fish Division

Mark C. Warner, Ph.D.
Sport Fish Research Chief