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Trawl Catch Statistics from Seven Sockeye Rearing Lakes of the Fraser River Drainage Basin: 1986 - 1991

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ABSTRACT

Mueller, C. W., H. J. Enzenhofer, and J. M. B. Hume. 1991. Trawl catch statistics from seven sockeye rearing lakes of the Fraser River drainage basin: 1986 - 1991. Can. Data Rep. Fish. Aquat. Sci. 864: 87 p.

Over a 6 year period we collected pelagic fish stock information using mid-water trawls from seven sockeye rearing lakes of the Fraser River drainage basin. The seven lakes are Fraser, Chilko, Pitt, Harrison, Cultus, E. Barriere and N. Barriere. After at least one month in formalin, each sample was measured and weighed. Summary statistics were calculated and length frequencies were plotted by survey and species. The results are presented in tables and graphs. The data show some evidence of density dependent growth in Chilko Lake.

RÉSUMÉ

Mueller, C. W., H. J. Enzenhofer, and J. M. B. Hume. 1991. Trawl catch statistics from seven sockeye rearing lakes of the Fraser River drainage basin: 1986 - 1991. Can. Data Rep. Fish. Aquat. Sci. 864: 87 p.

Au cours d'une période de 6 ans, nous avons recueilli de l'information sur des stocks de poissons pélagiques par des prélèvements au chalut flottant dans sept lacs d'élevage du saumon rouge du bassin hydrographique du Fraser, soit les lacs Fraser, Chilko, Pitt, Harrison, Cultus, E. Barriere et N. Barriere. Après avoir laissé les échantillons au moins un mois dans le formol, nous avons mesuré et pesé chacun d'entre eux. Pour chaque relevé et chaque espèce, nous avons établi des statistiques sommaires et tracé la courbe de fréquence des longueurs. Les résultats sont présentés sous forme de tableaux et de graphiques. L'analyse des données révèle des signes indiquant que la croissance dépend de la densité dans le lac Chilko.

INTRODUCTION

The Fraser River drainage basin is one of the world's major salmonid systems and is the world's largest single river producer of sockeye salmon (*Oncorhynchus nerka*) (Northcote and Larkin 1989). Within this watershed there are 16 nursery lakes for juvenile sockeye: Takla, Trembleur, Stuart, Francois, Fraser, Quesnel, Chilko, Adams, Shuswap, Seton, Anderson, Lillooet, Pitt, Harrison, Cultus, and N. Barriere (Fig. 1).

From 1986 to 1991, staff of the Department of Fisheries and Oceans periodically collected hydroacoustic density estimates and mid-water trawl samples from nine of these lakes. The lakes surveyed were: Fraser (1989), Chilko (1986, 87, 88, 89, 90), Pitt (1989, 90, 91), Harrison (1986, 87), Cultus (1987, 89, 90), and N. Barriere (1988). E. Barriere, Quesnel and Shuswap lakes were also surveyed. Results of the E. Barriere surveys are reported in this report. Results of the Quesnel Lake surveys were reported in Enzenhofer, Mueller and Hume (1991). Results of the Shuswap Lake surveys are as yet unreported.

The samples collected during this period will contribute toward determining the carrying capacity of these and other comparable interior lakes. Along with other data these results will be also used for examining in-lake factors (i.e. food supply) which may contribute to cyclic dominance, and will be used in evaluating the effectiveness of various enhancement activities under consideration. These include spawning channels, lake fertilization, and increased escapement through experimental management of the fishery.

METHODS

Each study lake was divided into trawl sample areas which contained 2 or 3 randomly selected hydroacoustic transects perpendicular to shore (i.e. Fig. 2). These areas and transects remained the same for each survey. Methods used to estimate fish densities using acoustic and trawl results are described in Nunnalee (1973) and in Burzcynski and Johnson (1986). Trawl samples were captured using a 3 m by 7 m midwater trawl capable of fishing to 64 m at the middle of the mouth opening. The trawl net is described in Enzenhofer and Hume (1989). The depth and duration of the trawl were determined by visually estimating density from the acoustic echogram. Normally only one tow per area done but if the echogram showed that the fish were stratified into layers then a trawl was done through each layer.

Each catch was anaesthetized in a 1% solution of 2-phenoxyethanol to prevent them from regurgitating their stomach contents and then preserved in 10% formalin. Each trawl catch was labelled and a trawl log waskept recording survey, tow, area, date, time, duration of trawl, depth, and weather. The total catch from each trawl was preserved.

The catch was left for at least one month to stabilize fish size before measuring (Rogers 1964). Fish were weighed to 0.01 g using a Mettler PN 1210 electronic balance and measured to the nearest mm. Scales and the anterior portion of the stomach were removed from a maximum of 20 sockeye fry per trawl for aging and diet analysis. Each fish was numbered consecutively to reference the stomach and scale information to fish size and to aid in error checking.

Raw data were entered into a Lotus 123 spreadsheet for statistical analysis. Each survey was entered as a separate file and was organized for analysis by tow, area and species. Sockeye were divided into age 1, age 1 and age 2+. These categories were determined from the scale aging analysis, length frequency distributions, and somewhat arbitrarily by time of year based on fry emergence. Age 0 are fry from the current year's emergence and have not been in the lake over the winter. Age 1 are from the previous year's emergence and have been in the lake over 1 winter. Age 2+ are determined to have been in the lake for at least 2 winters and may also include older kokanee (landlocked *O. nerka*).

After numbers were entered, length frequencies were plotted by survey number and species. All sockeye were plotted and where abundance exceeded 20/survey, stickleback (*Gasterosteus aculeatus*) and smelt (*Spirinchus thaleichthys*) were also plotted. Summary statistics (n, maximum, minimum, mean, standard deviation and variance) were calculated for length and weight by survey number and species and then by tow number and species.

RESULTS

In the five years, 35 surveys and 103 tows were carried out. A total of 1850 sockeye (1670 age 0, 148 age 1, 32 age 2+), 3288 smelt, 1639 stickleback, 26 sculpin (*Cottus asper*), 1 cyprinidae and 8 others were sampled. The results are presented in a tow log summarizing the catch and conditions of capture; a table summarizing the data by survey; a table summarizing the data by individual trawl; and a length frequency graph for each survey.

ACKNOWLEDGEMENTS

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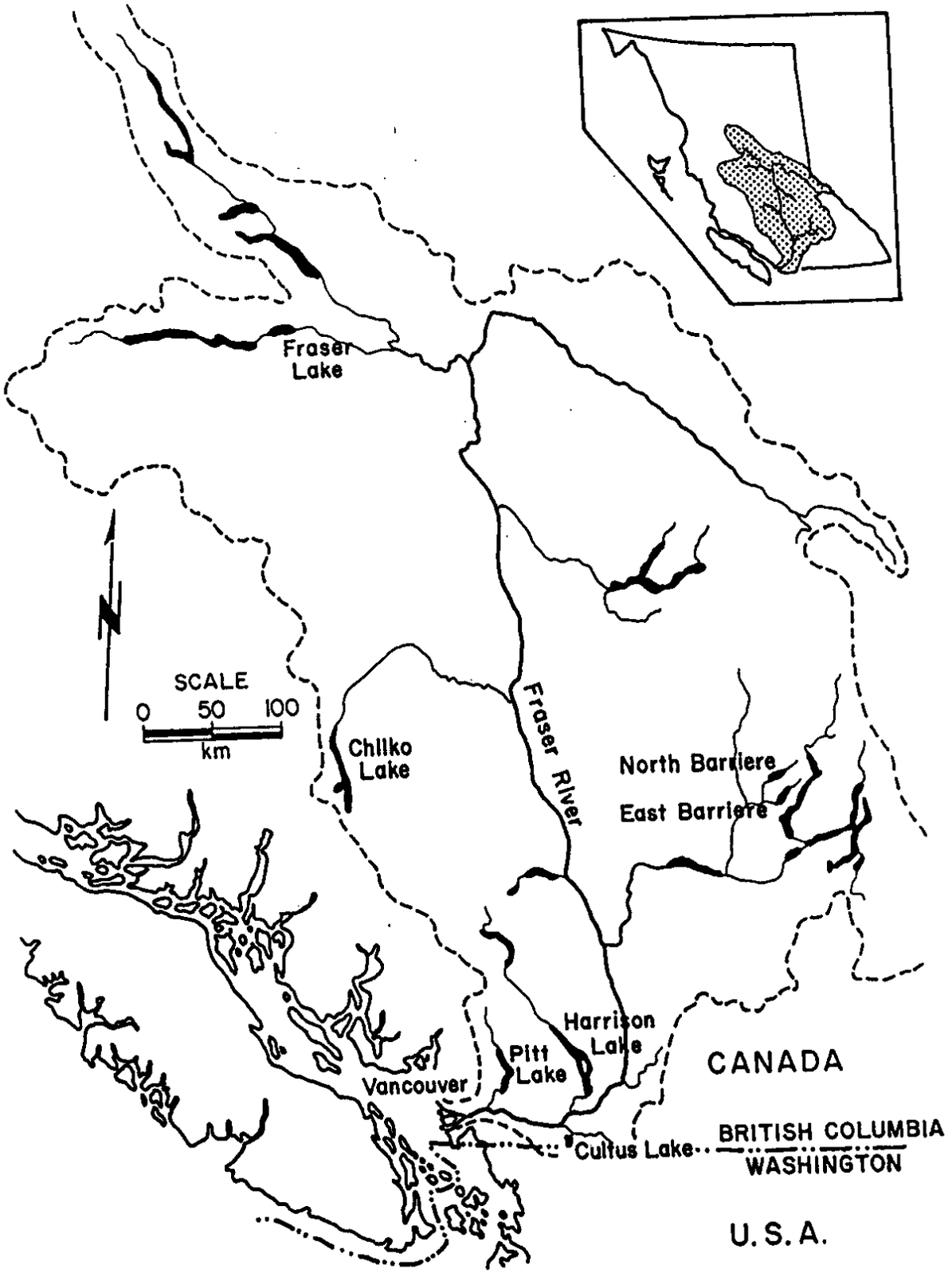


Fig. 1. Map of the Fraser River drainage basin showing lakes surveyed.

TABLE 1. Code number explanation for tow summary.

SKY:	LIGHT:	WIND:
0 - NO OBSERVATION	0 - NO OBSERVATION	0 - NO WIND
1 - 10% CLOUD COVER	1 - DAYLIGHT	1 - NE
2 - 50% CLOUD COVER	2 - TWILIGHT	2 - EAST
3 - > 50% CLOUD COVER	3 - DARK	3 - SE
4 - FOG OR HAZE	4 - MODERATE MOONLIGHT	4 - SOUTH
5 - INTERMITTENT RAIN	5 - BRIGHT MOONLIGHT	5 - SW
6 - CONTINUOUS RAIN		6 - WEST
7 - SNOW, RAIN OR BOTH		7 - NW
8 - HAIL		8 - NORTH
9 - THUNDERSTORM		9 - NO OBSERV

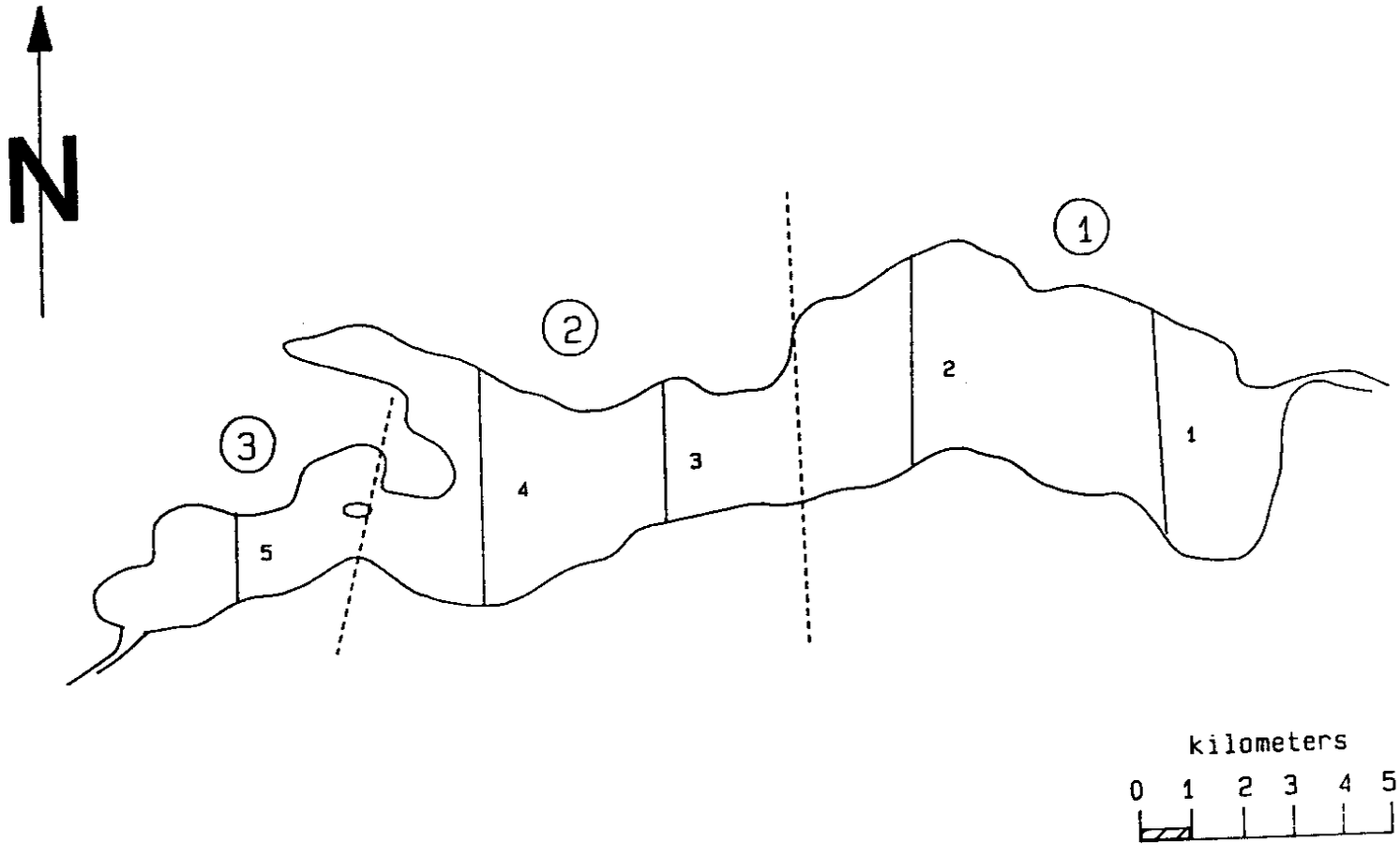


Fig. 2. Map of Fraser Lake showing areas and transects.

Table 2a - Tow summary for Fraser Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
8915	SEP 28/89	890032	2	21:10	10	11	1	4			91 AGE 0

Table 2b - Trawl statistics for Fraser Lake

	TRAWL				CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 8915																
2	SEP 28/89	890032	11	10	AGE 0	91	73.09	87	55	7.96	63.38	4.62	8.07	1.88	1.54	2.38

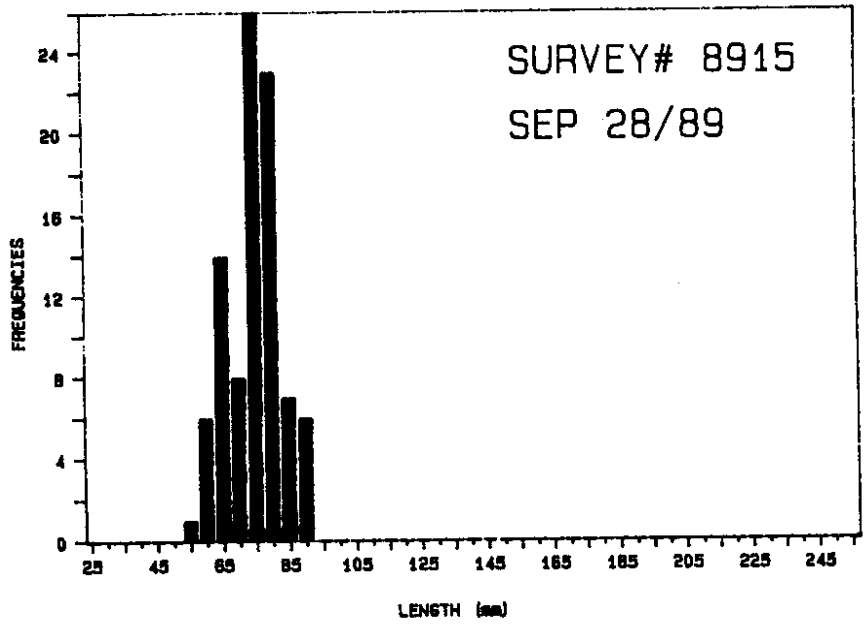


Fig. 3. O. Nerka length frequencies in Fraser Lake.

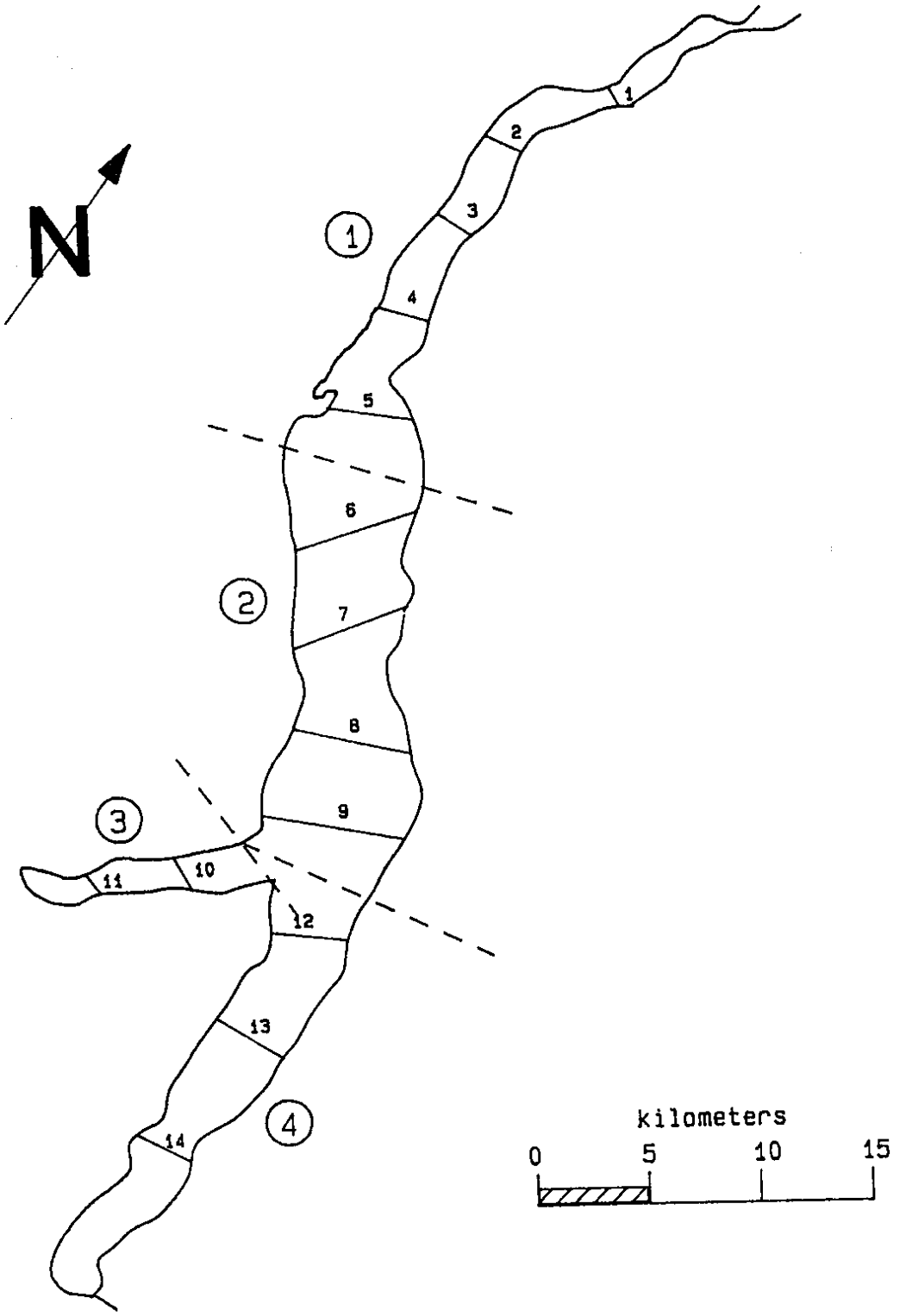


Fig. 4. Map of Chilko Lake showing areas and transects.

Table 3a - Tow summary for Chilko Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
8603	AUG 21/86	860012	1	10:30	30	5	2	1	0	14.5	NONE
	AUG 21/86	860013	1	14:00	20	6	2	1	0	16.5	NONE
	AUG 21/86	860014	4	21:16	30	3	1	4	0	13.0	5 AGE 0
											4 AGE 1
	AUG 21/86	860015	3	23:41	20	3	1	4	0	13.0	1 AGE 0
	AUG 22/86	860016	2	01:54	30	5	1	4	0	14.0	5 AGE 0
	AUG 22/86	860018	1	21:10	15	10	3	3	4	15.0	21 AGE 0
											2 AGE 1
	AUG 22/86	860019	1	22:15	30	13	3	3	4	13.5	32 AGE 0
											4 AGE 1
8701	JUL 14/87	870001	1	22:13	20	2	1	4	0		4 AGE 0
	JUL 14/87	870002	1	22:53	30	2	1	4	0		11 AGE 0
	JUL 15/87	870004	1	01:00	30	2	3	3	8		28 AGE 0
	JUL 15/87	870005	1	02:00	30	20	3	3	8		18 AGE 0
8704	AUG 15/87	870026	3	00:15	20	20	1	4	3		82 AGE 0
	AUG 15/87	870027	1	22:00	20	19	1	4	3		55 AGE 0
8705	OCT 7/87	870028	3	23:25	20	19	1	4			NONE
8809	SEP 17/88	880037	1	19:55	30	SURFACE	1	4			47 AGE 0
	SEP 17/88	880038	1	21:10	15	15	1	4			5 AGE 0
	SEP 17/88	880039	1	23:41	30	SURFACE	1	4	5		19 AGE 0
	SEP 18/88	880040	1	00:45	30	15	1	4			18 AGE 0
	SEP 18/88	880041	2	02:50	20	SURFACE	1	4	5		11 AGE 0
	SEP 18/88	880042	2	03:20	20	10	2	1			21 AGE 0
	SEP 19/88	880043	1	17:30	30	SURFACE	2	1			NONE
	SEP 19/88	880044	1	18:15	30	13	2	1			NONE
	SEP 19/88	880045	1	19:50	20	SURFACE	2	1			9 AGE 0
	SEP 19/88	880046	1	20:30	20	16	2	1			6 AGE 0
8916	OCT 1/89	890033	4	20:30	30	25	1	4			27 AGE 0
	OCT 2/89	890034	3	00:10	5	25	1	4			6 AGE 0
	OCT 2/89	890035	1	20:13	20	11	1	4			30 AGE 0
9021	SEP 16/90	900058	1	20:40	30	25	1	3	S		15 AGE 0

Table 3b - Trawl statistics by survey for Chilko Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
8603	AUG 21-22/86	AGE 0	164	47.45	57	34	4.25	18.10	1.09	1.99	0.43	0.28	0.08
		AGE 1	10	83.50	102	62	11.53	132.85	6.70	12.54	2.28	2.77	7.67
		CYPRINID	1	19.00	19	19	0.00	0.00	0.20	0.20	0.20	0.00	0.00
8701	JUL 14-15/87	AGE 0	61	37.43	47	30	3.47	12.05	0.55	1.02	0.24	0.15	0.02
8704	AUG 15/87	AGE 0	437	50.82	68	35	5.52	30.47	1.54	3.53	0.58	0.49	0.24
8705	OCT 7/87	NONE											
8809	SEP 17-19/88	AGE 0	236	60.54	75	39	5.54	30.66	2.54	21.60	0.93	1.41	1.99
8916	OCT 1-2/89	AGE 0	63	70.46	89	38	7.84	61.42	4.04	7.58	2.02	1.29	1.65
9021	SEP 16/90	AGE 0	15	76.33	88	66	5.87	34.49	5.26	8.31	3.06	1.54	2.37

Table 3c - Trawl statistics by tow for Chilko Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 8603																
1	AUG 21/86	860012	5	30	NONE											
1	AUG 21/86	860013	6	20	NONE											
4	AUG 21/86	860014	3	30	AGE 0	5	45.20	53	39	6.40	40.96	1.02	1.63	0.58	0.47	0.22
					AGE 1	4	92.50	102	80	8.05	64.75	8.80	12.54	6.21	2.39	5.70
3	AUG 21/86	860015	3	20	AGE 0	1	46.00	46	46	0.00	0.00	1.06	1.06	1.06	0.00	0.00
2	AUG 22/86	860016	5	30	AGE 0	5	50.20	53	47	2.14	4.56	1.29	1.49	1.01	0.19	0.04
1	AUG 22/86	860018	10	15	AGE 0	121	47.13	56	34	4.20	17.64	1.05	1.66	0.44	0.26	0.07
					AGE 1	2	65.00	68	62	3.00	9.00	2.60	2.92	2.28	0.32	0.10
1	AUG 22/86	860019	13	30	AGE 0	32	48.59	57	36	3.90	15.24	1.20	1.99	0.43	0.29	0.08
					AGE 1	4	83.75	88	79	3.27	10.69	6.66	7.88	5.76	0.78	0.61
SURVEY # 8701																
1	JUL 14/87	870001	2	20	AGE 0	4	33.25	34	32	0.83	0.69	0.38	0.41	0.32	0.04	0.00
1	JUL 14/87	870002	2	30	AGE 0	11	38.91	46	32	3.94	15.54	0.61	1.02	0.35	0.19	0.04
1	JUL 15/87	870004	2	30	AGE 0	28	38.54	47	34	2.91	8.46	0.60	0.84	0.44	0.12	0.01
1	JUL 15/87	870005	20	30	AGE 0	18	35.72	40	30	2.82	7.98	0.47	0.61	0.24	0.10	0.00
SURVEY # 8704																
3	AUG 15/87	870026	20	20	AGE 0	182	55.03	68	39	4.12	16.94	1.93	3.53	0.58	0.42	0.18
1	AUG 15/87	870027	19	20	AGE 0	255	47.81	61	35	4.29	18.41	1.26	2.47	0.62	0.32	0.10
SURVEY # 8705																
3	OCT 7/87	870028	19	20	NONE											

Table 3c - Trawl statistics by tow for Chilko Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 8809																
1	SEP 17/88	880037	SURFACE	30	AGE 0	47	60.38	72	54	3.52	12.36	2.39	4.06	1.68	0.47	0.22
1	SEP 17/88	880038	15	15	AGE 0	5	59.80	73	47	8.35	69.76	2.44	4.04	1.13	0.95	0.90
1	SEP 17/88	880039	SURFACE	30	AGE 0	19	59.32	71	51	5.34	28.53	2.29	3.60	1.57	0.61	0.38
1	SEP 18/88	880040	15	30	AGE 0	18	57.11	70	50	5.61	31.43	1.95	3.60	1.07	0.77	0.60
2	SEP 18/88	880041	SURFACE	20	AGE 0	11	63.18	71	45	6.78	45.97	2.96	3.83	2.27	0.48	0.23
2	SEP 18/88	880042	10	20	AGE 0	121	61.08	75	45	5.42	29.41	2.52	4.63	0.93	0.66	0.44
1	SEP 19/88	880043	SURFACE	30	NONE											
1	SEP 19/88	880044	13	30	NONE											
1	SEP 19/88	880045	SURFACE	20	AGE 0	9	61.89	70	51	5.13	26.32	2.71	4.10	1.96	0.63	0.40
1	SEP 19/88	880046	16	20	AGE 0	6	58.83	66	39	9.19	84.47	2.47	3.42	1.07	0.78	0.61
SURVEY # 8916																
4	OCT 1/89	890033	25	30	AGE 0	27	76.15	89	60	5.23	27.39	5.14	7.58	2.35	1.05	1.10
3	OCT 2/89	890034	25	5	AGE 0	6	71.00	74	69	1.83	3.33	3.45	4.08	2.90	0.39	0.15
1	OCT 2/89	890035	11	20	AGE 0	30	65.23	77	38	6.87	47.18	3.16	5.18	2.02	0.72	0.51
SURVEY # 9021																
1	SEP 16/90	900058	25	30	AGE 0	15	76.33	88	66	5.87	34.49	5.26	8.31	3.06	1.54	2.37

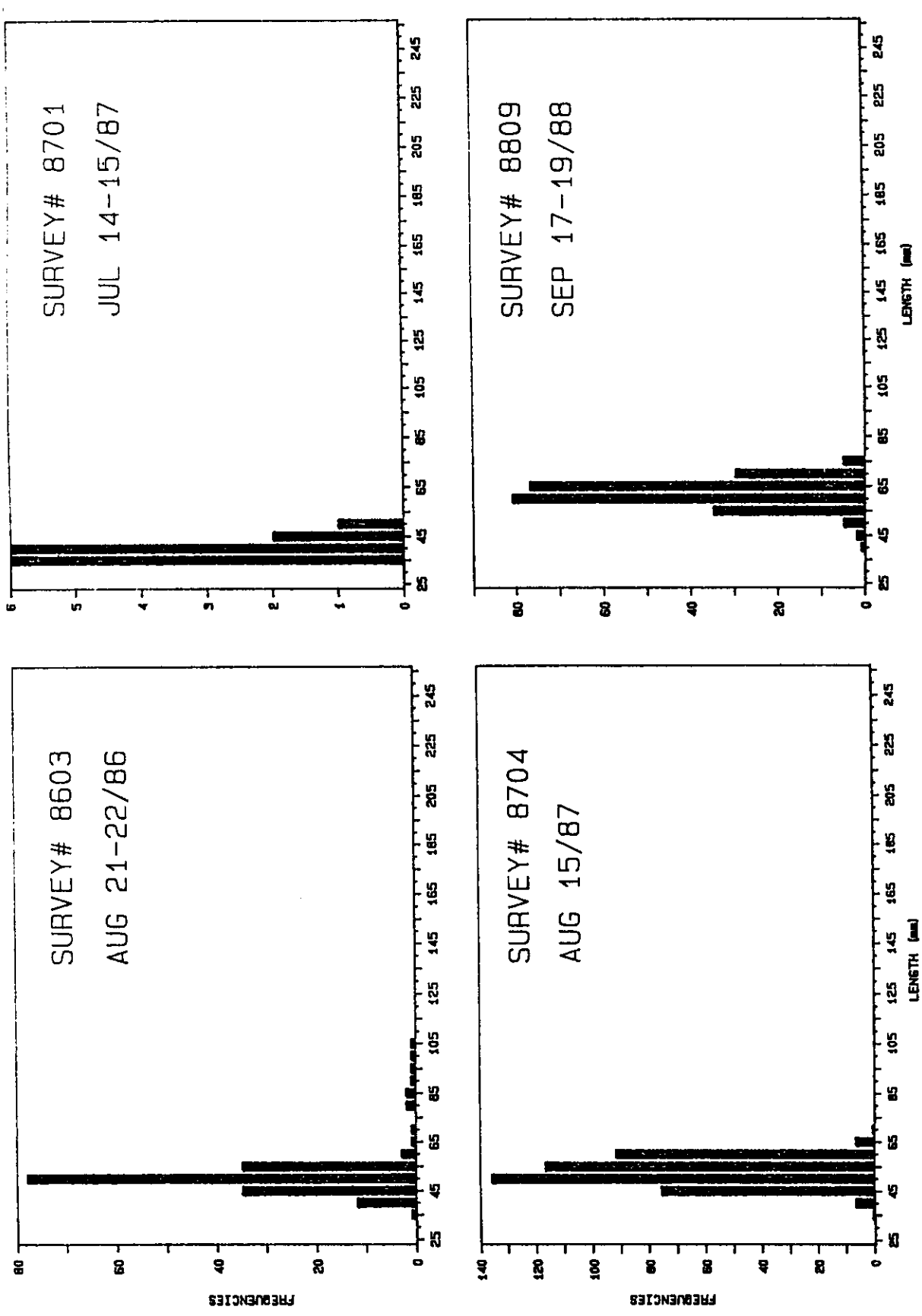
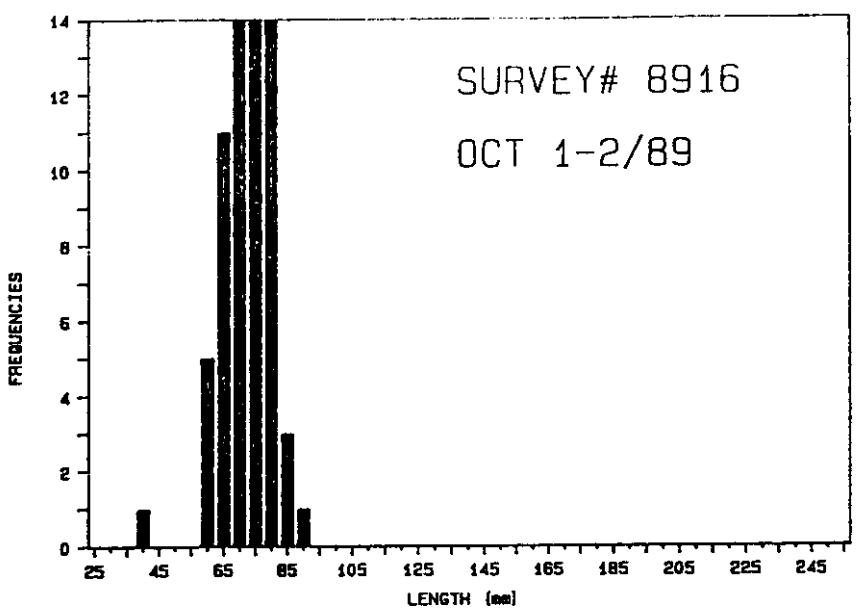


Fig. 5. Sockeye (O. nerka) length frequencies in Chilko Lake.



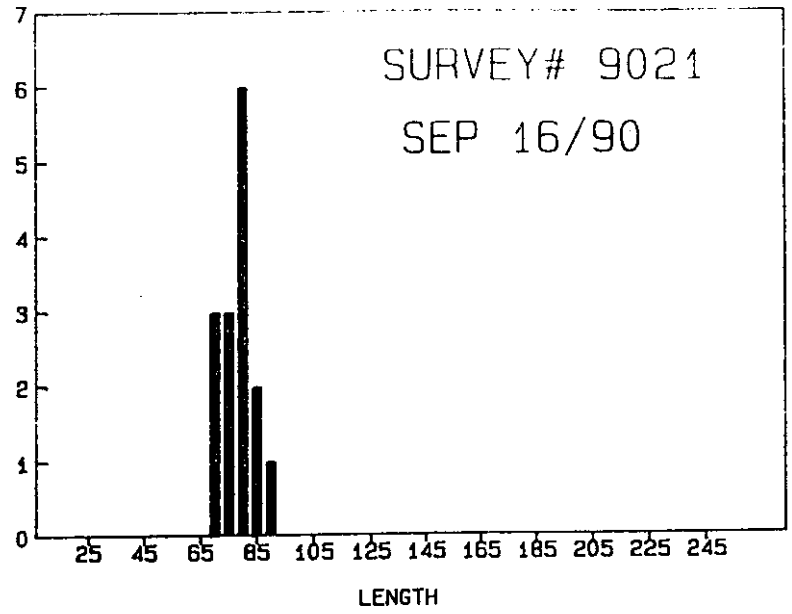


Fig. 5. Continued.

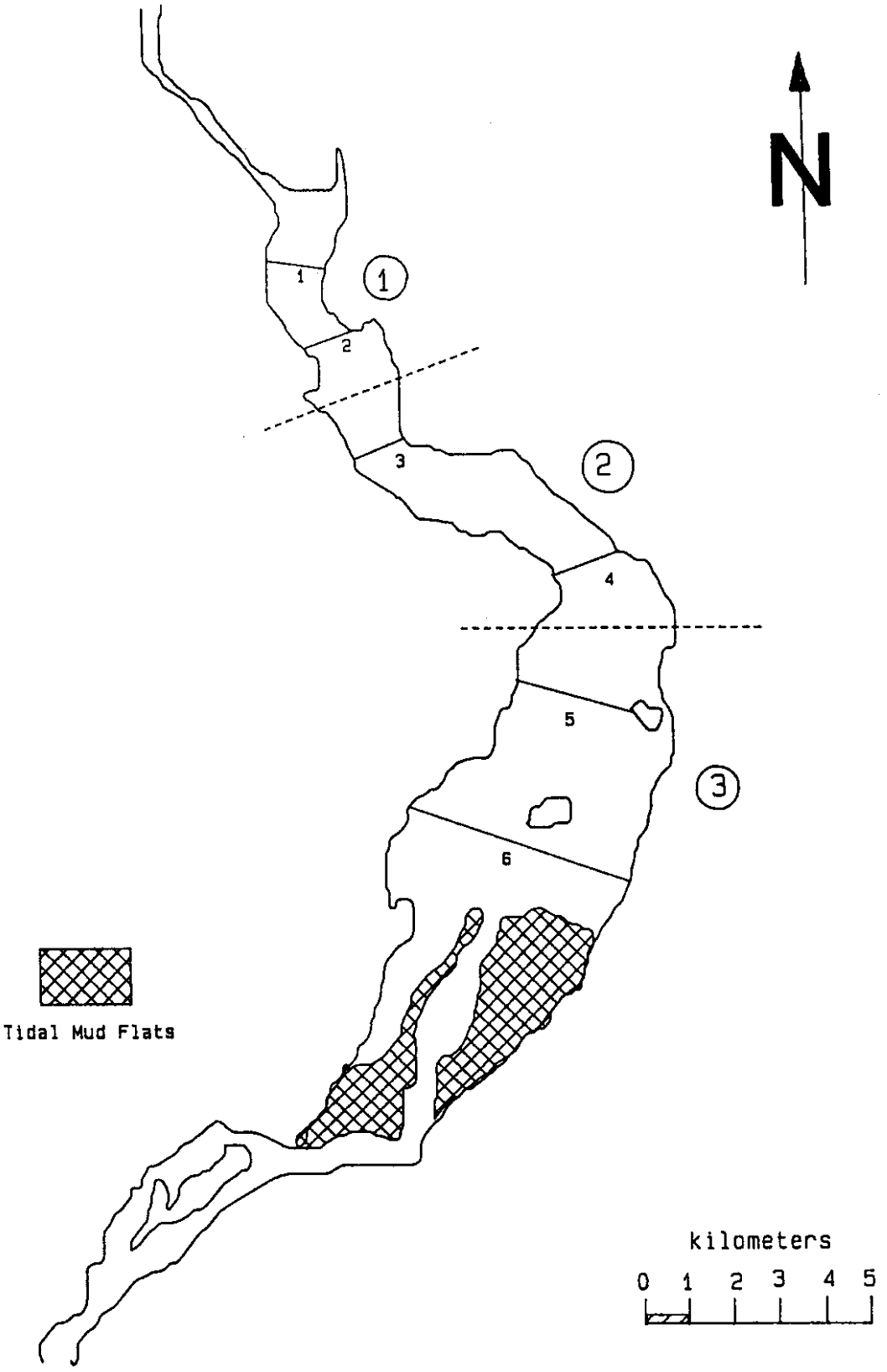


Fig. 6. Map of Pitt Lake showing areas and transects.

Table 4a - Tow summary for Pitt Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
8910	JUL 25/89	890017	1	22:00	10	11	1	4	0		51 AGE 0 83 SMELT
	JUL 26/89	890018	2	22:00	5	11	1	4	0		42 SMELT 60 STICKLEBACK
	JUL 26/89	890019	3	22:45	5	11	1	4	0		18 AGE 0 1 SCULPIN 9 SMELT 4 STICKLEBACK
8921	NOV 21/89	890048	3	21:30	15	11	1	3			26 SMELT 92 STICKLEBACK
	NOV 21/89	890049	3	22:05	20	39	1	3			11 AGE 0 4 SMELT 13 STICKLEBACK
	NOV 21/89	890050	2	23:44	10	18	1	3			2 AGE 0 1 SMELT 105 STICKLEBACK
	NOV 22/89	890051	2	00:11	10	18	1	3			2 AGE 0 1 SMELT 71 STICKLEBACK
	NOV 22/89	890052	1	01:50	15	11	1	3			35 SMELT 144 STICKLEBACK
9002	MAR 6/90	900003	1	19:54	15	11	2	3			7 STICKLEBACK 50 SMELT
	MAR 6/90	900004	2	21:27	30	53	2	3			2 STICKLEBACK 4 SMELT
	MAR 6/90	900005	2	22:00	30	32	2	3			8 STICKLEBACK 18 SMELT
	MAR 7/90	900006	3	20:00	40	53	2	3			15 AGE 1 3 STICKLEBACK 103 SMELT
	MAR 7/90	900007	3	20:45	30	11	2	3			47 STICKLEBACK 12 SMELT
9006	APR 24/90	900012	1	20:40	20	18	3	3			5 SMELT
	APR 24/90	900013	1	21:27	30	53	3	3			11 SMELT
	APR 24/90	900014	2	23:11	30	11	6	3			4 STICKLEBACK 1 SMELT
9010	MAY 24/90	900017	1	21:25	15	11	5	3			3 SMELT
	MAY 24/90	900018	1	21:54	15	11	5	3			208 SMELT
	MAY 24/90	900019	2	22:46	10	11	5	3			1 AGE 1 244 SMELT 1 SCULPIN
9012	JUN 6/90	900021	1	22:23	10	11	3	3	0		82 SMELT
	JUN 6/90	900022	2	23:45	10	11	3	3	NW		153 SMELT
	JUN 7/90	900023	3	02:00	10	11	3	3	NW		1 STICLKEBACK 3 SMELT

Table 4a - Tow summary for Pitt Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
9018	AUG 8/90	900032	1	21:36	10	18	1	3	0		12 AGE 0 1 STICKLEBACK 67 SMELT
	AUG 8/90	900033	2	22:50	10	11	1	3	0		8 AGE 0 22 STICKLEBACK 137 SMELT
	AUG 9/90	900034	3	00:35	10	11	1	3	0		8 AGE 0 302 STICKLEBACK 17 SMELT 2 SCULPIN
9101	FEB 6/91	910001	1	19:02	20	7					4 STICKLEBACK 30 SMELT

Table 4b - Trawl statistics by survey for Pitt Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
8910	JUL 25-26/89	AGE 0	69	69.35	87	47	5.96	35.56	4.21	7.65	1.29	1.07	1.15
		SCULPIN	1	52.00	52	52	0.00	0.00	0.76	0.76	0.76	0.00	0.00
		SMELT	134	59.53	135	32	21.30	453.77	2.34	19.66	0.44	3.82	14.58
		STICKLEBACK	64	43.63	54	26	3.95	15.58	1.09	1.97	0.22	0.27	0.07
8921	NOV 21-22/89	AGE 0	15	86.80	112	79	7.45	55.49	8.02	19.00	3.79	3.21	10.31
		SMELT	67	52.16	125	34	12.16	147.93	1.27	13.82	0.16	1.65	2.73
		STICKLEBACK	425	41.03	55	7	7.07	50.03	0.86	1.80	0.17	0.40	0.16
9002	MAR 6-7/90	AGE 1	15	81.60	88	73	4.81	23.17	6.85	9.18	4.47	1.25	1.55
		STICKLEBACK	67	44.12	60	30	6.19	38.34	0.85	1.44	0.19	0.31	0.10
		SMELT	187	61.00	152	35	18.02	324.55	2.41	31.04	0.15	3.85	14.81
9006	APR 24/90	STICKLEBACK	4	37.00	47	33	5.79	33.50	0.55	1.07	0.33	0.31	0.09
		SMELT	17	58.71	74	45	7.83	61.38	1.44	2.79	0.53	0.62	0.39
9010	MAY 24/90	SMELT	555	54.50	135	22	15.24	232.20	1.51	21.64	0.08	2.32	5.40
		AGE 1	1	83.00	83	83	0.00	0.00	6.94	6.94	6.94	0.00	0.00
		SCULPIN	1	28.00	28	28	0.00	0.00	2.02	2.02	2.02	0.00	0.00
9012	JUN 6-7/90	SMELT	238	56.55	110	19	12.60	158.87	1.60	10.37	0.09	1.43	2.03
		STICKLEBACK	1	47.00	47	47	0.00	0.00	1.17	1.17	1.17	0.00	0.00
9018	AUG 8-9/90	AGE 0	28	81.75	102	64	8.79	77.26	7.32	13.69	2.60	2.68	7.21
		STICKLEBACK	325	25.54	55	18	5.03	25.28	0.27	1.90	0.10	0.18	0.03
		SMELT	221	49.14	147	18	21.70	470.96	1.50	26.55	0.08	2.82	7.95
		SCULPIN	2	76.00	97	55	21.00	441.00	7.86	13.89	1.82	6.04	36.42
9101	FEB 6/91 [1]	STICKLEBACK	4	33.75	36	31	2.28	5.19	0.42	0.55	0.31	0.10	0.01
		SMELT	30	62.10	106	33	18.75	351.49	1.45	3.67	0.19	1.45	1.12

[1] Smelt length calculated on N = 30 and smelt weight calculated on N = 20.

Table 4c - Trawl statistics by tow for Pitt Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 8910																
1	JUL 25/89	890017	11	10	AGE 0	51	70.43	87	57	5.65	31.89	4.41	7.65	2.58	1.08	1.16
					SMELT	83	62.01	135	42	24.13	582.20	2.75	19.66	0.44	4.45	19.82
2	JUL 26/89	890018	11	5	SMELT	42	55.24	120	32	13.66	186.51	1.57	14.14	0.46	2.07	4.29
					STICKLEBACK	60	43.57	54	26	4.03	16.28	1.08	1.97	0.22	0.27	0.07
3	JUL 26/89	890019	11	5	AGE 0	18	66.28	73	47	5.76	33.20	3.63	4.93	1.29	0.83	0.69
					SCULPIN	1	52.00	52	52	0.00	0.00	0.76	0.76	0.76	0.00	0.00
					SMELT	9	56.67	110	47	19.12	365.56	2.14	11.00	0.69	3.15	9.91
					STICKLEBACK	4	44.50	47	42	2.06	4.25	1.19	1.37	0.93	0.17	0.03
SURVEY # 8921																
3	NOV 21/89	890048	11	15	SMELT	26	50.50	78	34	10.81	116.79	1.13	3.46	0.16	0.77	0.60
					STICKLEBACK	92	37.37	52	27	6.40	40.93	0.65	1.80	0.19	0.36	0.13
3	NOV 21/89	890049	39	20	AGE 0	11	85.36	91	79	3.62	13.14	7.60	9.28	6.03	1.04	1.07
					SMELT	4	52.50	57	48	3.35	11.25	1.08	1.32	0.74	0.22	0.05
					STICKLEBACK	13	39.62	49	31	5.34	28.54	0.76	1.44	0.35	0.30	0.09
2	NOV 21/89	890050	18	10	AGE 0	2	98.00	112	84	14.00	196.00	13.11	19.00	7.23	5.89	34.63
					SMELT	1	54.00	54	54	0.00	0.00	1.23	1.23	1.23	0.00	0.00
					STICKLEBACK	105	41.61	54	7	7.02	49.32	0.89	1.74	0.18	0.37	0.14
2	NOV 22/89	890051	18	10	AGE 0	2	83.50	84	83	0.50	0.25	5.23	6.67	3.79	1.44	2.07
					SMELT	1	46.00	46	46	0.00	0.00	0.32	0.32	0.32	0.00	0.00
					STICKLEBACK	71	42.06	52	19	7.28	53.04	0.96	1.75	0.23	0.42	0.18
1	NOV 22/89	890052	11	15	SMELT	35	53.49	125	36	13.79	190.14	1.43	13.82	0.18	2.17	4.70
					STICKLEBACK	144	42.58	55	27	6.70	44.92	0.92	1.70	0.17	0.39	0.15
SURVEY # 9002																
1	MAR 6/90	900003	11	15	STICKLEBACK	7	43.57	50	32	7.19	51.67	0.88	1.41	0.19	0.42	0.17
					SMELT	50	60.78	112	38	14.42	207.85	2.21	11.46	0.30	2.20	4.85
2	MAR 6/90	900004	53	30	STICKLEBACK	2	50.00	60	40	10.00	100.00	0.92	1.24	0.60	0.32	0.10
					SMELT	4	66.25	114	45	27.99	783.19	4.12	13.74	0.73	5.56	30.89
2	MAR 6/90	900005	32	30	STICKLEBACK	8	44.25	57	31	8.00	63.94	0.81	1.25	0.28	0.31	0.10
					SMELT	18	67.28	129	35	35.44	1255.65	5.32	21.42	0.22	7.74	59.84

Table 4c - Trawl statistics by tow for Pitt Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
3	MAR 7/90	900006	53	40	AGE 1	15	81.60	88	73	4.81	23.17	6.85	9.18	4.47	1.25	1.55
					STICKLEBACK	3	38.00	38	38	0.00	0.00	0.51	0.53	0.50	0.01	0.00
					SMELT	103	59.07	152	40	13.28	176.32	1.87	31.04	0.15	3.11	0.90
3	MAR 7/90	900007	11	30	STICKLEBACK	47	44.32	58	30	5.28	27.88	0.87	1.44	0.25	0.29	0.08
					SMELT	12	67.33	120	38	19.82	392.89	2.97	13.15	0.29	3.32	11.01
SURVEY # 9006																
1	APR 24/90	900012	18	20	SMELT	5	57.60	68	51	5.75	33.04	1.43	2.42	0.87	0.52	0.27
1	APR 24/90	900013	53	30	SMELT	11	60.45	74	53	7.69	59.16	1.53	2.79	1.06	0.63	0.39
2	APR 24/90	900014	11	30	STICKLEBACK	4	37.00	47	33	5.79	33.50	0.55	1.07	0.33	0.31	0.09
					SMELT	1	45.00	45	45	0.00	0.00	0.53	0.53	0.53	0.00	0.00
SURVEY # 9010																
1	MAY 24/90	900017	11	15	SMELT	3	68.67	85	54	12.71	161.56	2.85	5.37	1.12	1.82	3.33
1	MAY 24/90	900018	11	15	SMELT	308	54.10	135	22	16.03	256.96	1.56	19.67	0.16	2.32	5.37
2	MAY 24/90	900019	11	10	AGE 1	1	83.00	83	83	0.00	0.00	6.94	6.94	6.94	0.00	0.00
					SMELT	244	54.82	134	22	14.11	199.03	1.42	21.64	0.08	2.33	5.43
					SCULPIN	1	58.00	58	58	0.00	0.00	2.02	2.02	2.02	0.00	0.00
SURVEY # 9012																
1	JUN 6/90	900021	11	10	SMELT	82	61.40	110	25	15.70	246.53	2.21	10.37	0.09	2.02	4.08
2	JUN 6/90	900022	11	10	SMELT	153	53.97	110	19	9.78	95.64	1.28	8.72	0.09	0.82	0.67
3	JUN 7/90	900023	11	10	STICKLEBACK	1	47.00	47	47	0.00	0.00	1.17	1.17	1.17	0.00	0.00
					SMELT	3	55.67	58	54	1.70	2.89	1.09	1.26	1.00	0.12	0.01

Table 4c - Trawl statistics by tow for Pitt Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9018																
1	AUG 8/90	900032	18	10	AGE 0	12	84.33	102	74	8.38	70.22	8.35	13.69	5.44	2.65	7.03
					STICKLEBACK	1	20.00	20	20	0.00	0.00	0.16	0.16	0.16	0.00	0.00
					SMELT	67	34.60	135	18	21.76	473.46	0.94	18.50	0.08	3.05	9.32
2	AUG 8/90	900033	11	10	AGE 0	8	79.25	95	64	8.09	65.44	6.18	10.97	2.60	2.41	5.81
					STICKLEBACK	22	28.68	55	19	11.09	122.94	0.38	1.90	0.10	0.48	0.23
					SMELT	137	55.17	108	20	14.45	208.86	1.48	11.15	0.08	1.35	1.82
3	AUG 9/90	900034	11	10	AGE 0	8	80.38	93	66	9.03	81.48	6.90	11.49	3.92	2.41	5.79
					STICKLEBACK	302	25.32	51	18	4.17	17.38	0.26	1.50	0.13	0.13	0.02
					SMELT	17	57.94	147	22	37.01	1369.47	3.97	26.55	0.10	6.68	44.57
					SCULPIN	2	76.00	97	55	21.00	441.00	7.86	13.89	1.82	6.04	36.42
SURVEY # 9101																
1	FEB 6/91	910001	7	20	STICKLEBACK	4	33.75	36	31	2.28	5.19	0.42	0.55	0.31	0.10	0.01
				[1]	SMELT	30	62.10	106	33	18.75	351.49	1.45	3.67	0.19	1.45	1.12

[1] Smelt length calculated on N = 30 and smelt weight calculated on N = 20.

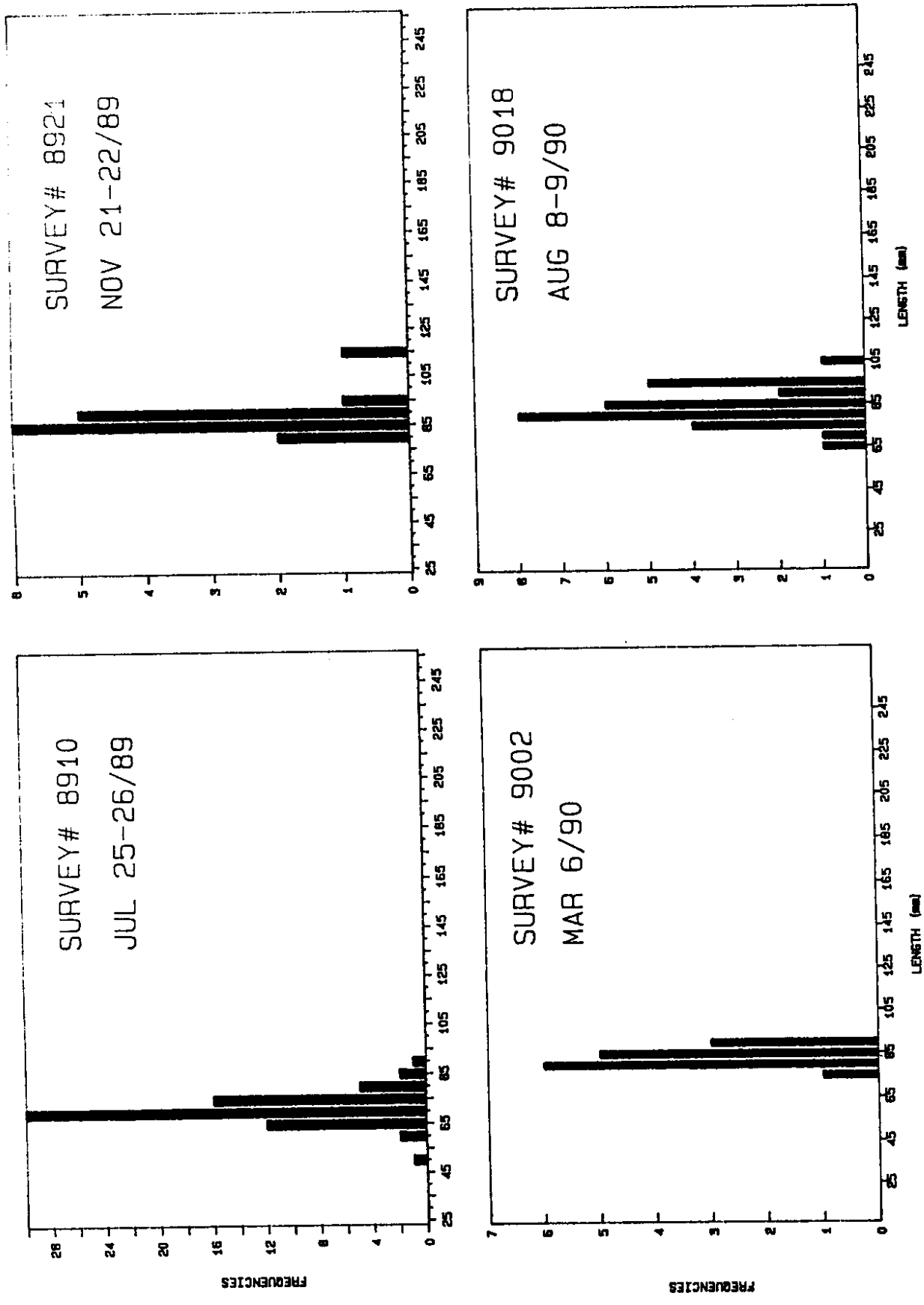


Fig. 7a. Sockeye (O. nerka) length frequencies in Pitt Lake.

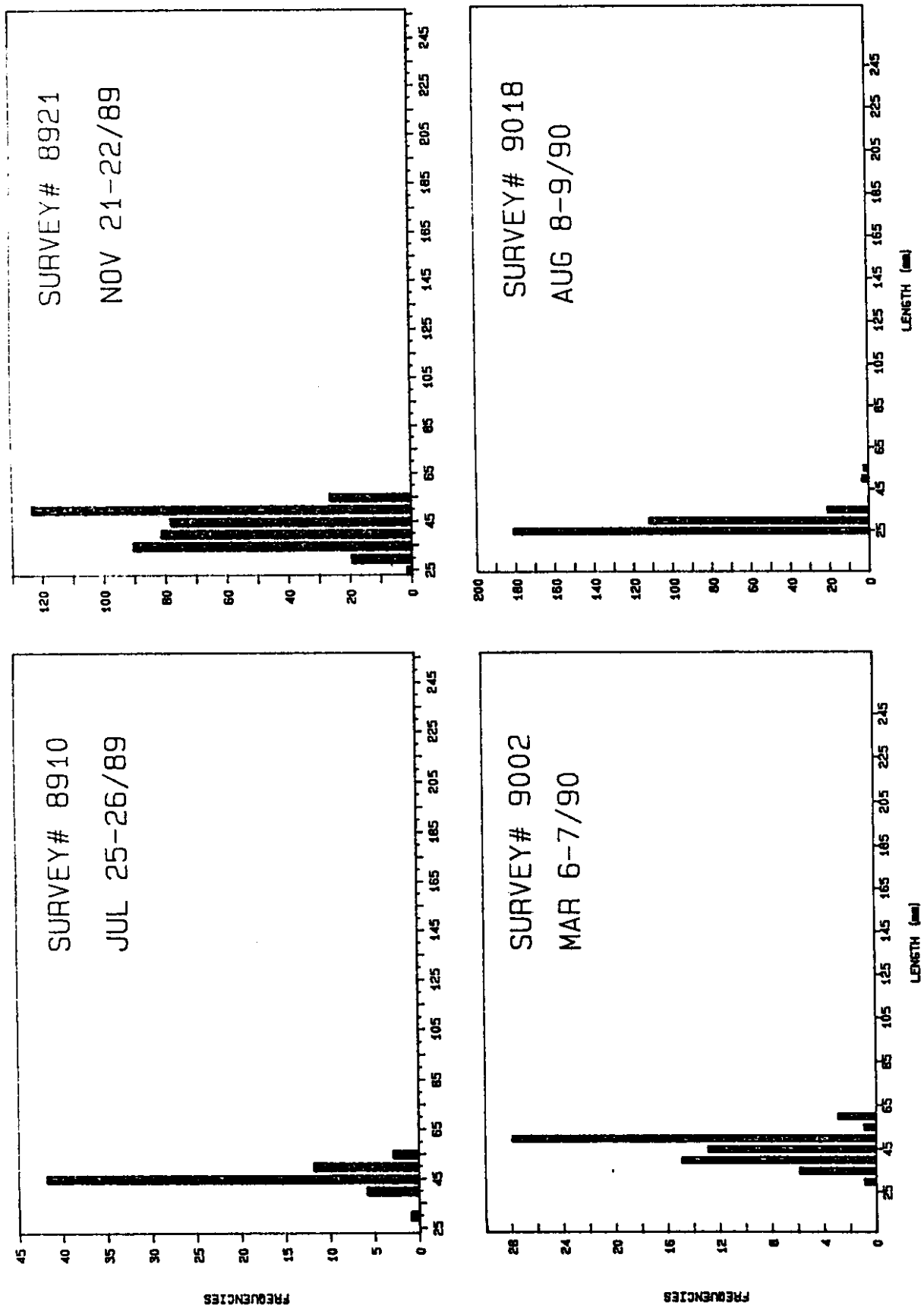


Fig. 7B. Stickleback (Gasterosteus Aculeatus) Length Frequencies in Pitt Lake.

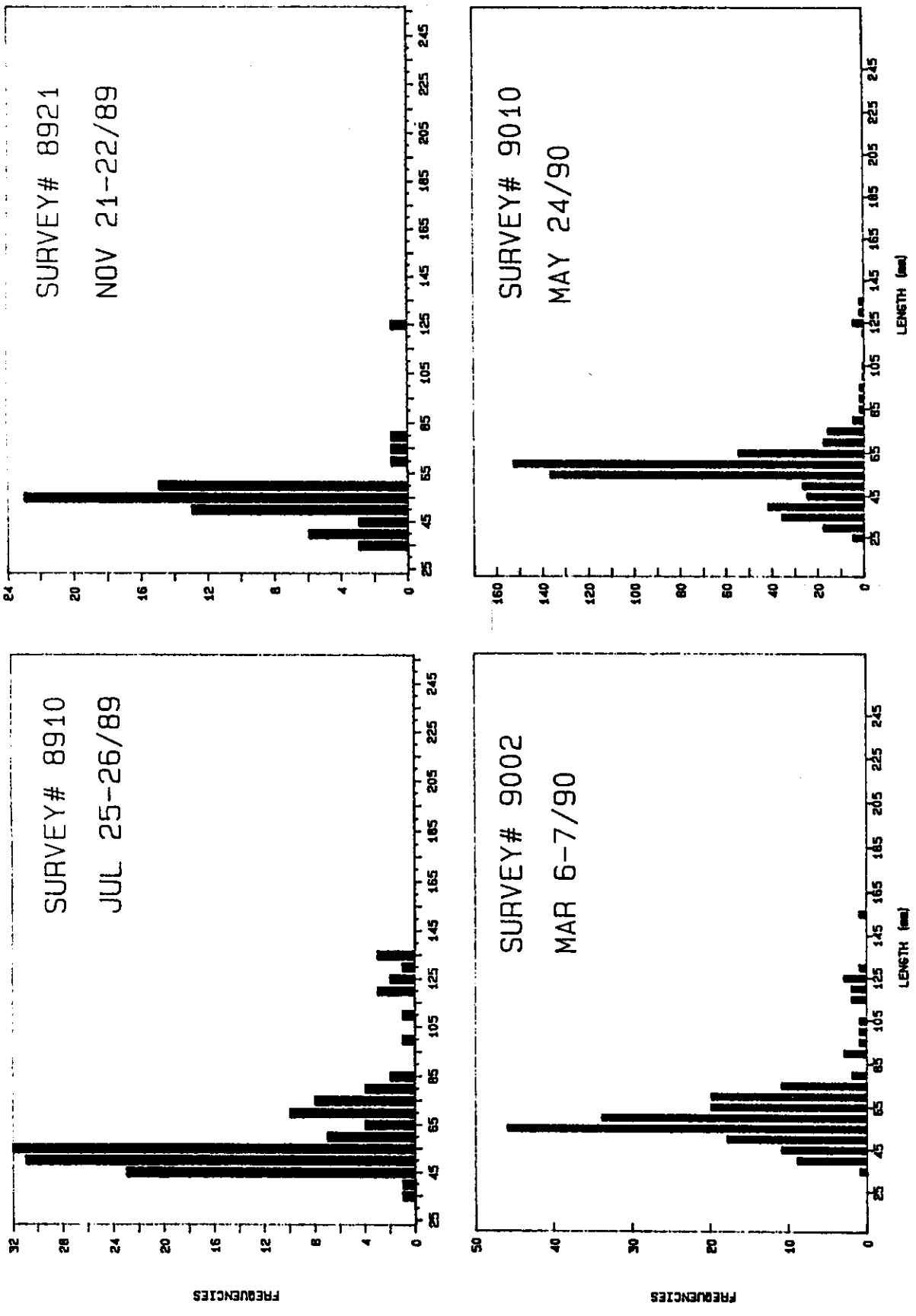
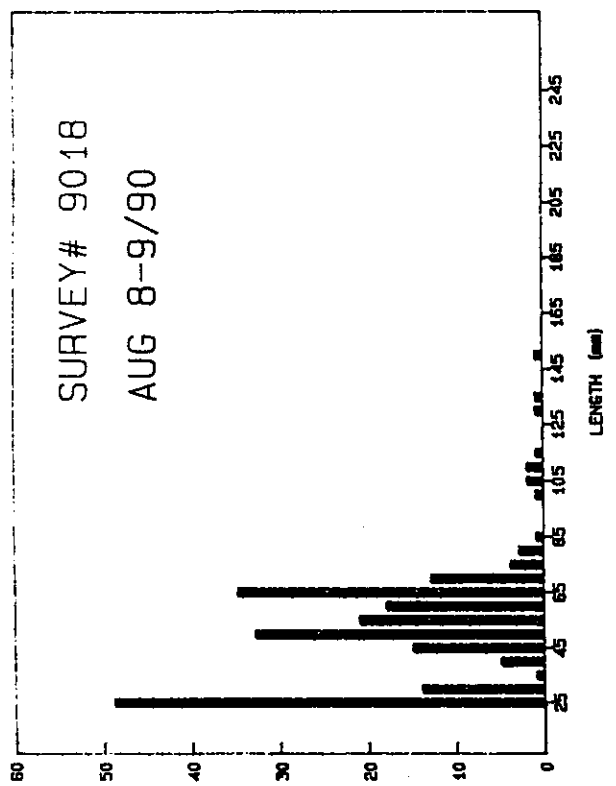
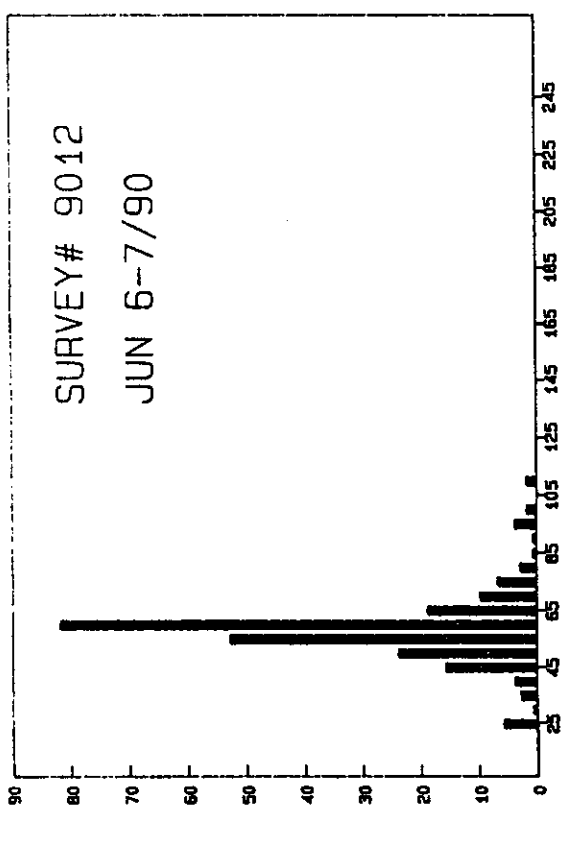


Fig. 7C. Smelt (Spirinchus thaleichthys) length frequencies in Pitt Lake.





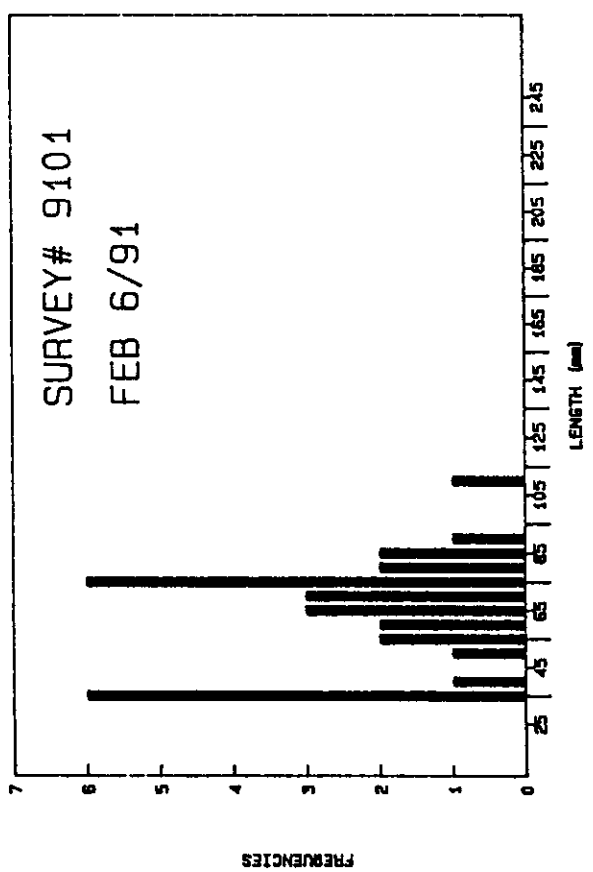


Fig. 7C. Continued

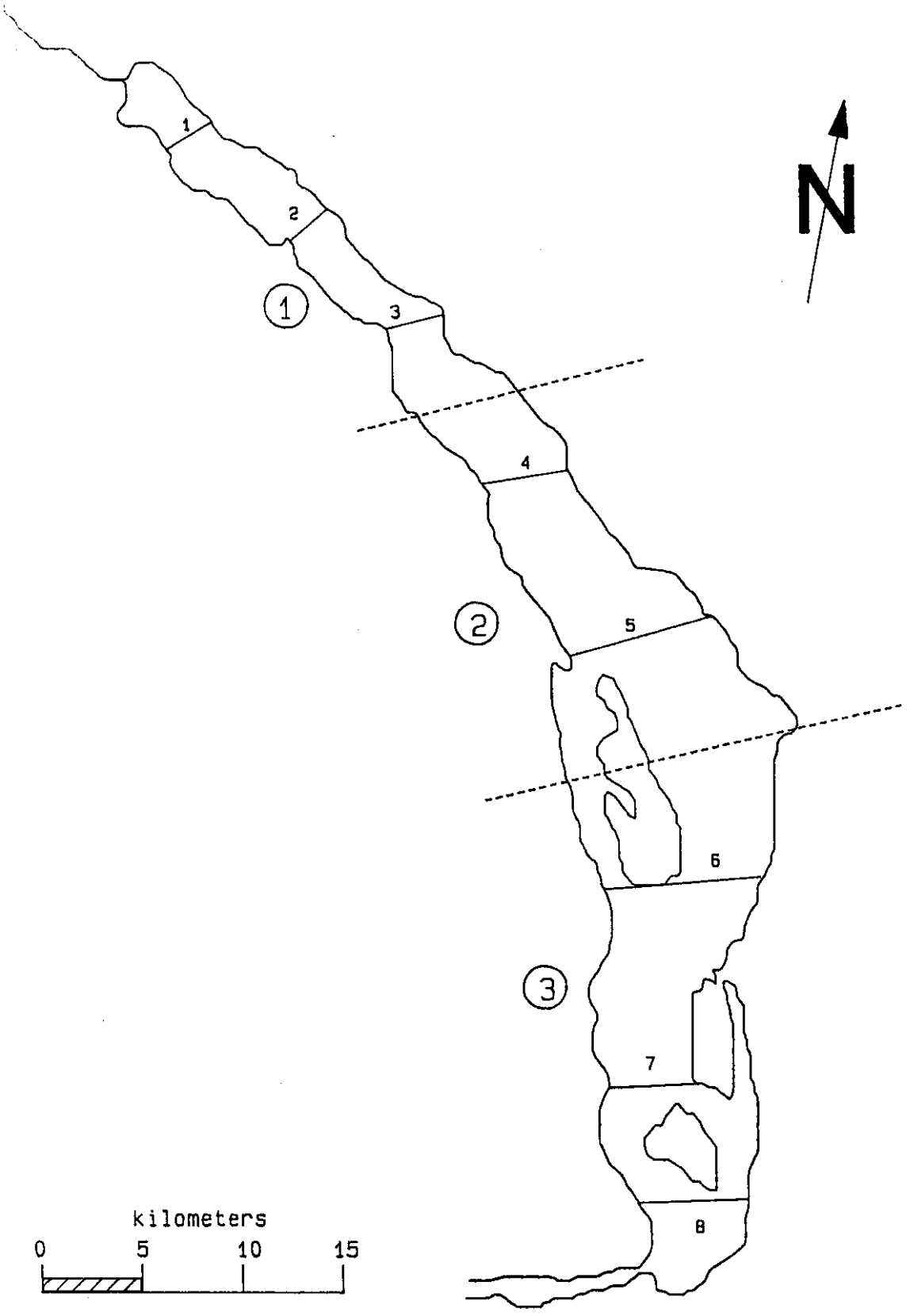


Fig. 8. Map of Harrison Lake showing areas and transects.

Table 5a - Tow summary for Harrison Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
8601	JUL 7/86	860001	1	23:30	5	25		1	3 0	11.5	1 AGE 0
											1 OTHER
											39 SMELT
	JUL 7/86	860002	1	23:35	6	13		1	3 0	11.5	135 SMELT
	JUL 8/86	860003	2	00:30	5	13		1	3 0	16.0	36 SMELT
	JUL 8/86	860004	2	01:00	5	7		1	3 0	16.0	23 SMELT
	JUL 8/86	860005	3	01:35	10	7		1	3 0		10 SMELT
											2 STICKLEBACK
8605	SEP 16/86	860026	3	20:00	5	19		3	4 0	16.0	49 SMELT
											332 STICKLEBACK
	SEP 16/86	860027	3	22:10	20	36		3	4 0	16.0	1 AGE 0
											36 SMELT
											144 STICKLEBACK
8608	NOV 6/86	860045	1	20:56	10	31		3	3 0		193 SMELT
8609	NOV 13/86	860046	2	17:30	10	36		3	3 0	10.0	12 SMELT
											5 STICKLEBACK
	NOV 13/86	860047	3	19:30	15	36		3	3 0	10.0	197 SMELT
											4 STICKLEBACK
8610	DEC 16/86	860048	3	00:22	15	55		2	4 0	8.0	344 SMELT
											11 STICKLEBACK
	DEC 16/86	860049	3	01:00	15	28		2	4 0	8.0	69 SMELT
											30 STICKLEBACK
	DEC 16/86	860050	3	01:20	10	40		2	4 0	8.0	318 SMELT
											13 STICKLEBACK
8708	NOV 16/87	870044	1	21:45	5	35		1	3		63 SMELT
	NOV 16/87	870045	1	21:50	9	15		1	3		407 SMELT
	NOV 16/87	870046	3	23:45	10	45		1	3 7		1 AGE 0
											49 SMELT
											9 STICKLEBACK
	NOV 17/87	870047	3	00:15	10	15		1	3 7		33 SMELT
											2 STICKLEBACK
8710	NOV 23/87	870051	3	17:49	10	60		3	3 0		5 AGE 0
											28 SMELT
	NOV 23/87	870052	3	18:25	10	60		3	3 0		1 AGE 0
											25 SMELT
	NOV 23/87	870053	3	19:00	10	48		3	3 0		12 SMELT
											1 STICKLEBACK

Table 5a - Tow summary for Harrison Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
8710	NOV 23/87	870054	3	19:20	10	48		3	3 0		1 AGE 0 68 SMELT 2 STICKLEBACK
	NOV 23/87	870055	3	20:00	10	37		3	3 0		1 AGE 0 66 SMELT 1 STICKLEBACK
	NOV 23/87	870056	3	20:30	10	37		3	3 0		1 AGE 0 23 SMELT 1 STICKLEBACK

Table 5b - Trawl statistics by survey for Harrison Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
8601	JUL 7-8/86	AGE 0	1	49.00	49	49	0.00	0.00	1.34	1.34	1.34	0.00	0.00
		OTHER	1	170.00	170	170	0.00	0.00	54.86	54.86	54.86	0.00	0.00
		SMELT	243	45.42	126	23	14.11	199.11	0.86	15.12	0.01	1.08	1.17
		STICKLEBACK	2	52.00	56	48	4.00	16.00	1.41	1.89	0.93	0.48	0.23
8605	SEP 16/86	AGE 0	1	83.00	83	83	0.00	0.00	7.96	7.96	7.96	0.00	0.00
		STICKLEBACK	476	39.70	440	28	19.02	361.66	0.70	2.39	0.22	0.31	0.09
		SMELT	85	43.91	331	28	33.28	1107.66	0.51	6.33	0.07	0.80	0.64
8608	NOV 6/86	SMELT	193	43.60	112	29	11.40	130.02	0.68	11.69	0.09	1.05	1.11
8609	NOV 13/86	SMELT	209	40.64	65	31	6.92	47.88	0.49	2.13	0.13	0.42	0.17
		STICKLEBACK	9	44.00	57	33	6.99	48.89	0.97	1.90	0.37	0.49	0.24
8610	DEC 16/86	SMELT	731	41.35	72	30	6.35	40.35	0.49	2.78	0.13	0.36	0.13
		STICKLEBACK	54	43.46	56	23	6.77	45.84	0.87	1.97	0.11	0.42	0.17
8708	NOV 16-17/87	AGE 0	1	73.00	73	73	0.00	0.00	5.35	5.35	5.35	0.00	0.00
		SMELT	552	54.51	136	28	8.34	69.58	1.25	21.98	0.13	1.36	1.86
		STICKLEBACK	11	48.00	57	34	6.77	45.82	1.15	1.83	0.37	0.45	0.20
8710	NOV 23/87	AGE 0	9	72.44	81	53	8.38	70.25	4.76	6.45	1.33	1.48	2.18
		SMELT	222	52.83	75	32	5.47	29.87	1.18	4.66	0.20	0.45	0.20
		STICKLEBACK	5	45.60	57	26	12.09	146.24	1.14	1.82	0.19	0.64	0.41

Table 5c - Trawl statistics by tow for Harrison Lake

TRAWL							LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH(m)	DURATION	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 8601																
1	JUL 7/86	860001	25	5	AGE 0	1	49.00	49	49	0.00	0.00	1.34	1.34	1.34	0.00	0.00
					OTHER	1	170.00	170	170	0.00	0.00	54.86	54.86	54.86	0.00	0.00
					SMELT	39	43.74	61	23	13.29	176.70	0.73	1.70	0.02	0.58	0.34
1	JUL 7/86	860002	13	6	SMELT	135	48.73	126	23	12.83	164.73	1.02	15.12	0.03	1.32	1.73
2	JUL 8/86	860003	13	5	SMELT	36	35.22	67	23	14.34	205.56	0.45	2.11	0.01	0.65	0.42
2	JUL 8/86	860004	7	5	SMELT	23	40.48	62	23	14.09	198.51	0.60	1.88	0.01	0.59	0.34
3	JUL 8/86	860005	7	10	SMELT	10	55.40	63	43	6.33	40.04	1.24	2.03	0.53	0.44	0.19
					STICKLEBACK	2	52.00	56	48	4.00	16.00	1.41	1.89	0.93	0.48	0.23
SURVEY # 8605																
3	SEP 16/86	860026	19	5	SMELT	49	44.14	331	28	42.19	1779.84	0.34	1.75	0.07	0.37	0.14
					STICKLEBACK	332	39.28	60	28	4.94	24.39	0.71	2.31	0.22	0.31	0.10
3	SEP 16/86	860027	36	20	AGE 0	1	83.00	83	83	0.00	0.00	7.96	7.96	7.96	0.00	0.00
					SMELT	36	43.58	95	32	13.88	192.58	0.73	6.33	0.11	1.11	1.22
					STICKLEBACK	144	40.67	440	28	33.73	1137.87	0.68	2.39	0.24	0.29	0.08
SURVEY # 8608																
1	NOV 6/86	860045	31	10	SMELT	193	43.60	112	29	11.40	130.02	0.68	11.69	0.09	1.05	1.11
SURVEY # 8609																
2	NOV 13/86	860046	36	10	SMELT	12	52.33	65	39	8.58	73.56	1.20	2.12	0.33	0.59	0.35
					STICKLEBACK	5	45.60	57	36	7.06	49.84	1.05	1.90	0.42	0.51	0.26
3	NOV 13/86	860047	36	15	SMELT	197	39.92	61	31	6.12	37.47	0.45	2.13	0.13	0.36	0.13
					STICKLEBACK	4	42.00	48	33	6.36	40.50	0.87	1.44	0.37	0.43	0.19
SURVEY # 8610																
3	DEC 16/86	860048	55	15	SMELT	344	41.37	69	31	6.46	41.72	0.50	2.78	0.13	0.36	0.13

Table 5c - Trawl statistics by tow for Harrison Lake

AREA	DATE	TRAWL TOW	DEPTH(m)	DURATION	SPECIES	N	LENGTH (mm) MEAN	MAX	MIN	S.D.	VAR	WEIGHT (g) MEAN	MAX	MIN	S.D.	VAR
					STICKLEBACK	11	44.36	49	37	3.72	13.87	0.87	1.19	0.39	0.25	0.06
3	DEC 16/86	860049	28	15	SMELT	69	41.23	72	33	7.62	58.06	0.58	2.49	0.23	0.46	0.21
					STICKLEBACK	30	43.07	56	23	6.78	45.93	0.84	1.83	0.11	0.40	0.16
3	DEC 16/86	860050	40	10	SMELT	318	41.36	68	30	5.92	35.02	0.46	2.28	0.13	0.34	0.11
					STICKLEBACK	13	43.62	55	27	8.46	71.62	0.94	1.97	0.19	0.54	0.29
SURVEY # 8708																
1	NOV 16/87	870044	35	5	SMELT	63	52.75	106	47	7.56	57.17	1.11	2.60	0.70	0.26	0.07
1	NOV 16/87	870045	15	9	SMELT	407	54.59	136	28	8.14	66.31	1.24	21.98	0.13	1.38	1.90
3	NOV 16/87	870046	45	10	AGE 0	1	73.00	73	73	0.00	0.00	5.35	5.35	5.35	0.00	0.00
					SMELT	49	53.71	122	34	10.79	116.45	1.45	16.54	0.27	2.20	4.84
					STICKLEBACK	9	49.00	57	39	5.52	30.44	1.19	1.83	0.63	0.40	0.16
3	NOV 17/87	870047	15	10	SMELT	33	58.03	73	48	6.69	44.70	1.36	2.53	0.69	0.46	0.21
					STICKLEBACK	2	43.50	53	34	9.50	90.25	0.96	1.56	0.37	0.60	0.35
SURVEY # 8710																
3	NOV 23/87	870051	60	10	AGE 0	5	74.80	81	67	4.66	21.76	5.32	6.45	4.14	0.75	0.56
					SMELT	28	52.50	61	48	2.65	7.04	1.07	1.56	0.79	0.17	0.03
3	NOV 23/87	870052	60	10	AGE 0	1	78.00	78	78	0.00	0.00	5.71	5.71	5.71	0.00	0.00
					SMELT	25	53.96	68	40	5.96	35.48	1.31	2.39	0.47	0.45	0.20
3	NOV 23/87	870053	48	10	SMELT	12	52.42	67	49	4.59	21.08	1.17	2.32	0.89	0.37	0.14
					STICKLEBACK	1	26.00	26	26	0.00	0.00	0.19	0.19	0.19	0.00	0.00
3	NOV 23/87	870054	48	10	AGE 0	1	80.00	80	80	0.00	0.00	5.73	5.73	5.73	0.00	0.00
					SMELT	68	52.49	73	32	6.25	39.01	1.14	4.66	0.20	0.54	0.29
					STICKLEBACK	2	47.00	57	37	10.00	100.00	1.23	1.82	0.64	0.59	0.35
3	NOV 23/87	870055	37	10	AGE 0	1	53.00	53	53	0.00	0.00	1.33	1.33	1.33	0.00	0.00
					SMELT	66	52.73	75	32	5.74	32.96	1.20	3.76	0.23	0.44	0.20
					STICKLEBACK	1	53.00	53	53	0.00	0.00	1.25	1.25	1.25	0.00	0.00
3	NOV 23/87	870056	37	10	AGE 0	1	67.00	67	67	0.00	0.00	3.46	3.46	3.46	0.00	0.00
					SMELT	23	53.57	69	48	4.21	17.72	1.23	2.59	0.76	0.36	0.13
					STICKLEBACK	1	55.00	55	55	0.00	0.00	1.79	1.79	1.79	0.00	0.00

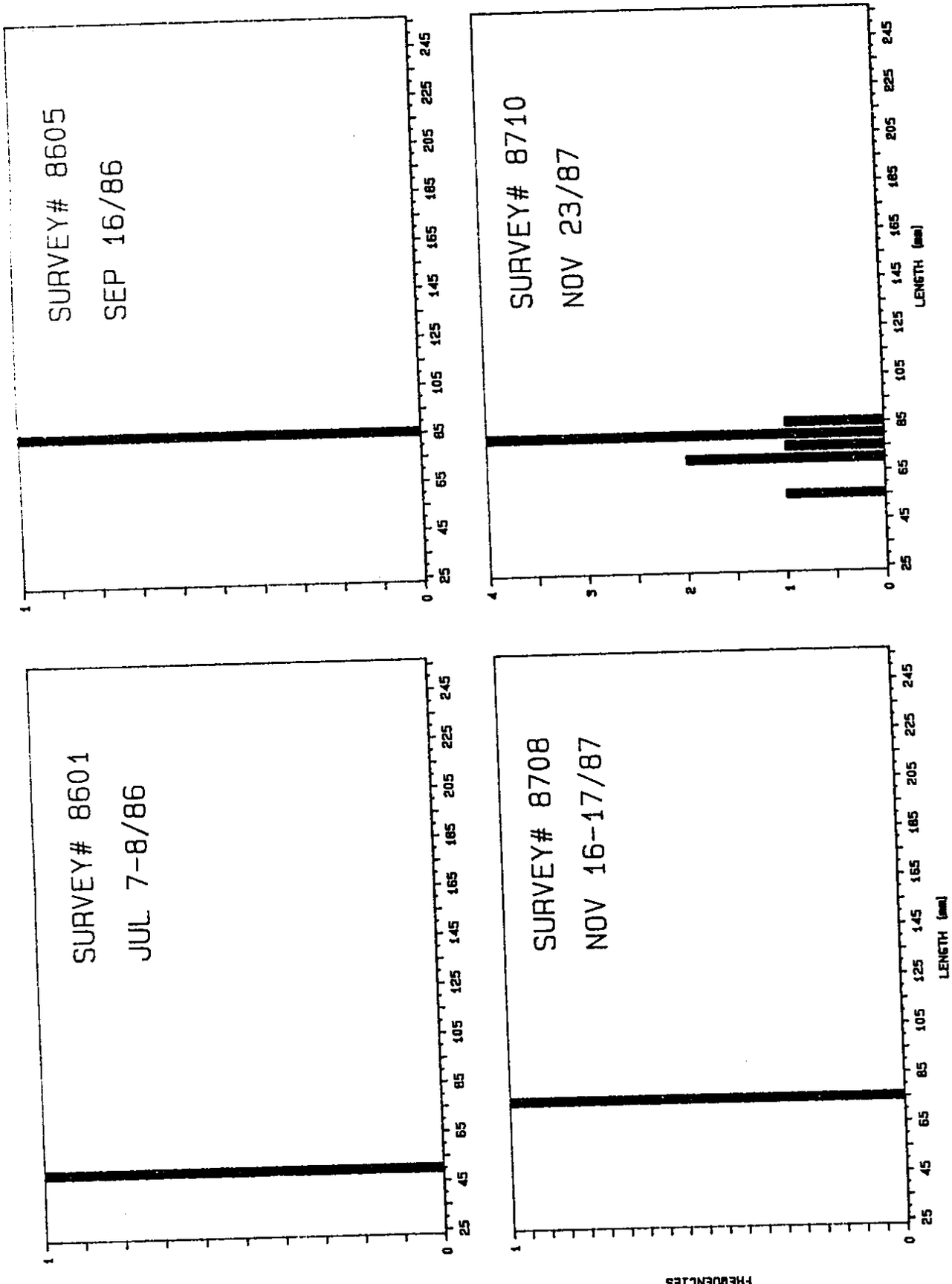


Fig. 9a. Sockeye (O. nerka) length frequencies in Harrison Lake.

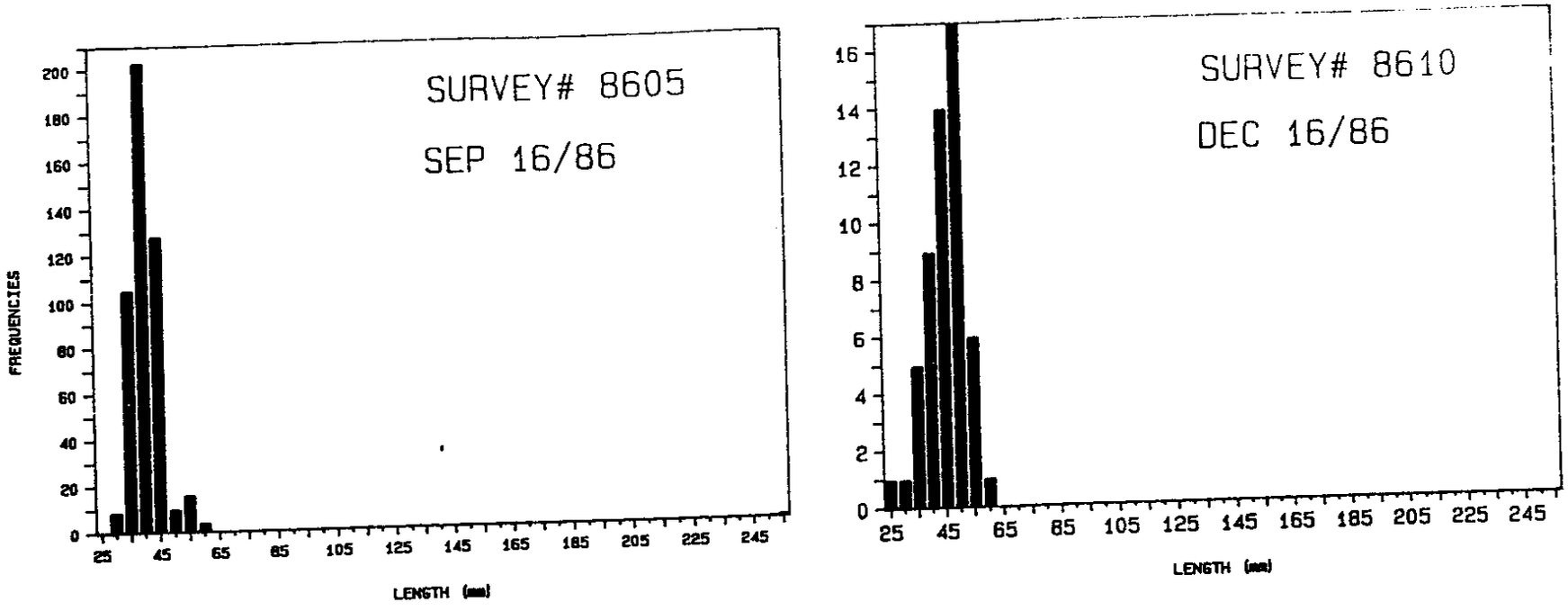


Fig. 9b. Stickleback (Gasterosteus Aculeatus) Length Frequencies in Harrison Lake.

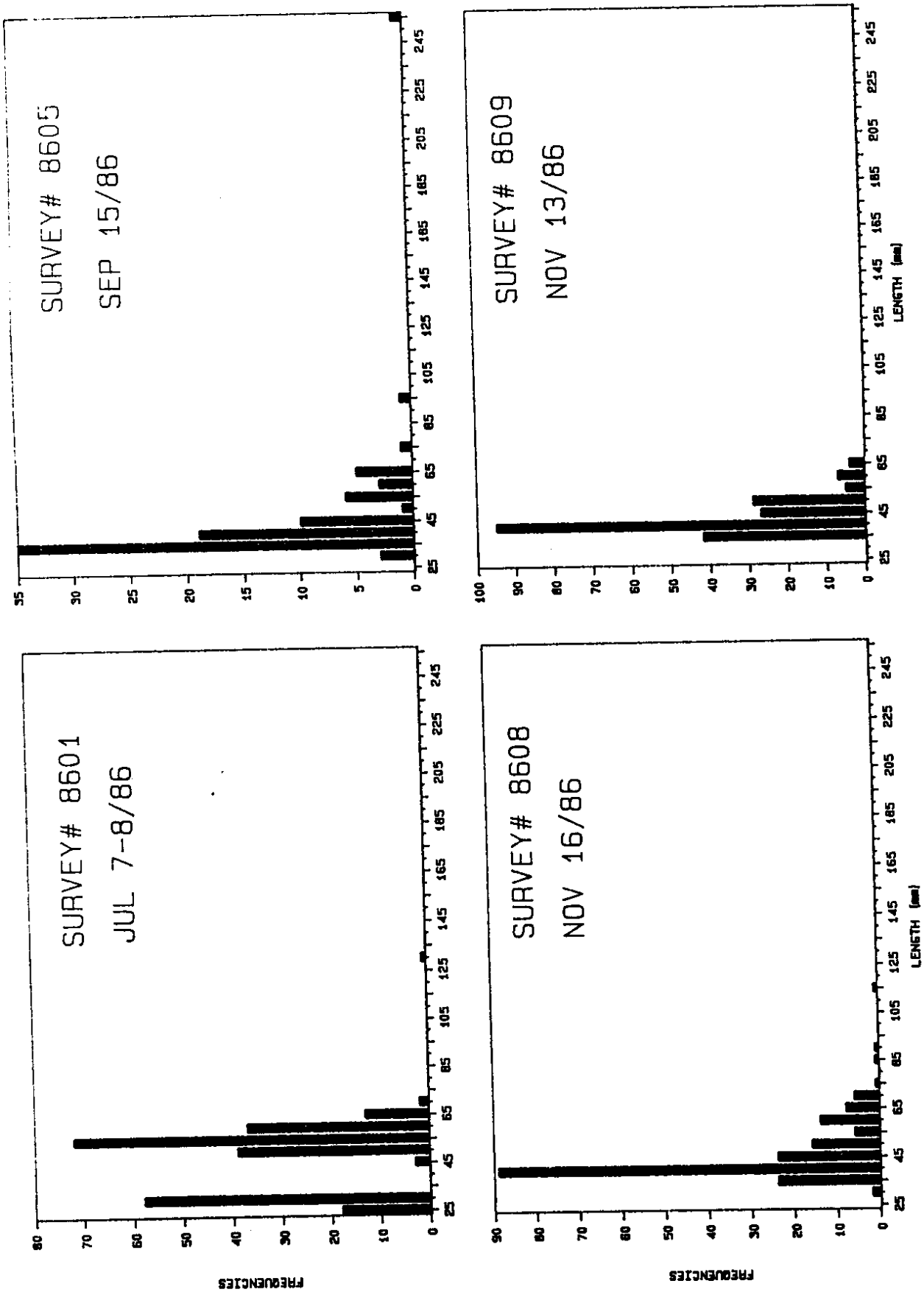


Fig. 9c. Smelt (Spirinchus thaleichthys) length frequencies in Harrison Lake.

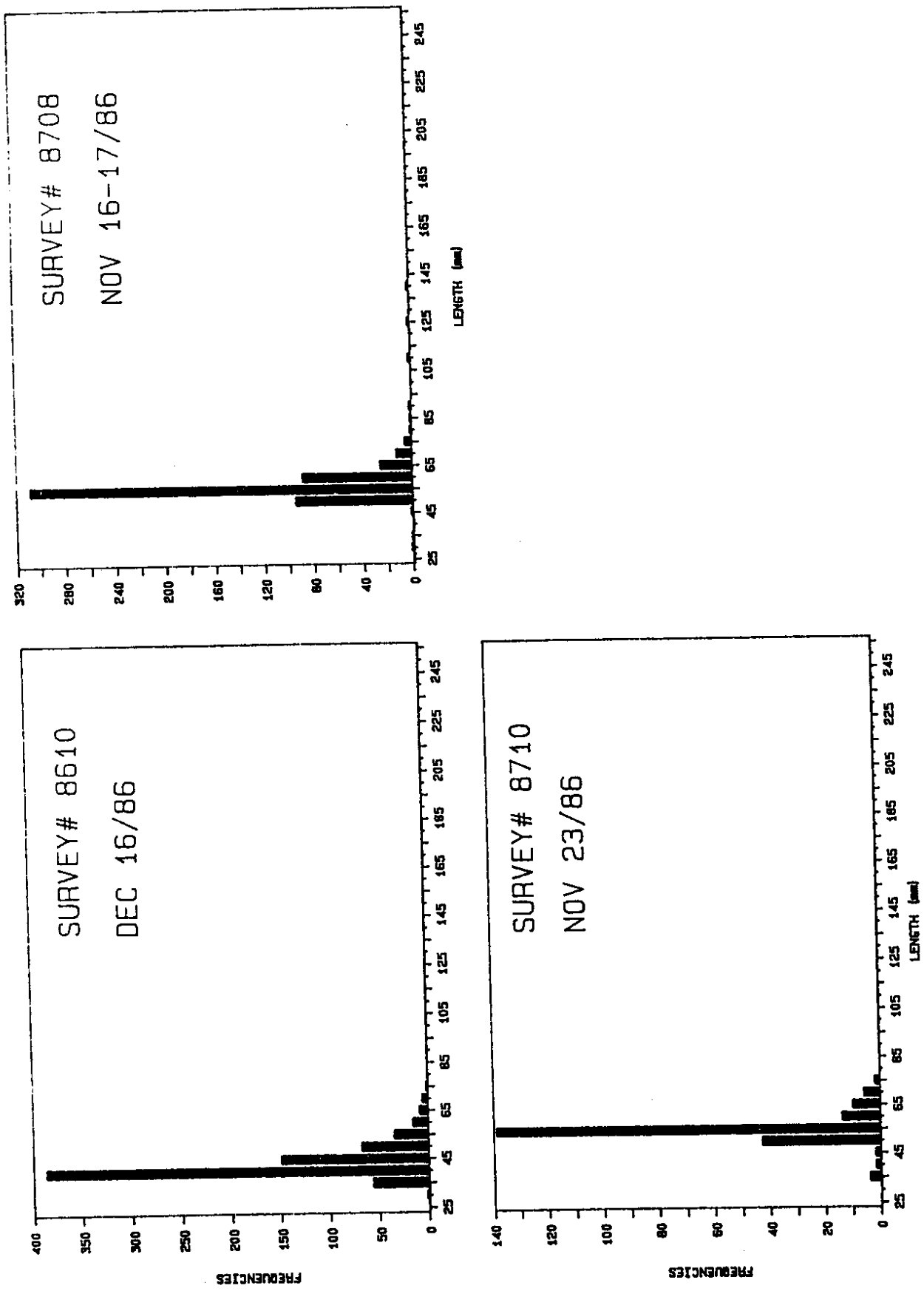


Fig. 9c. Continued.

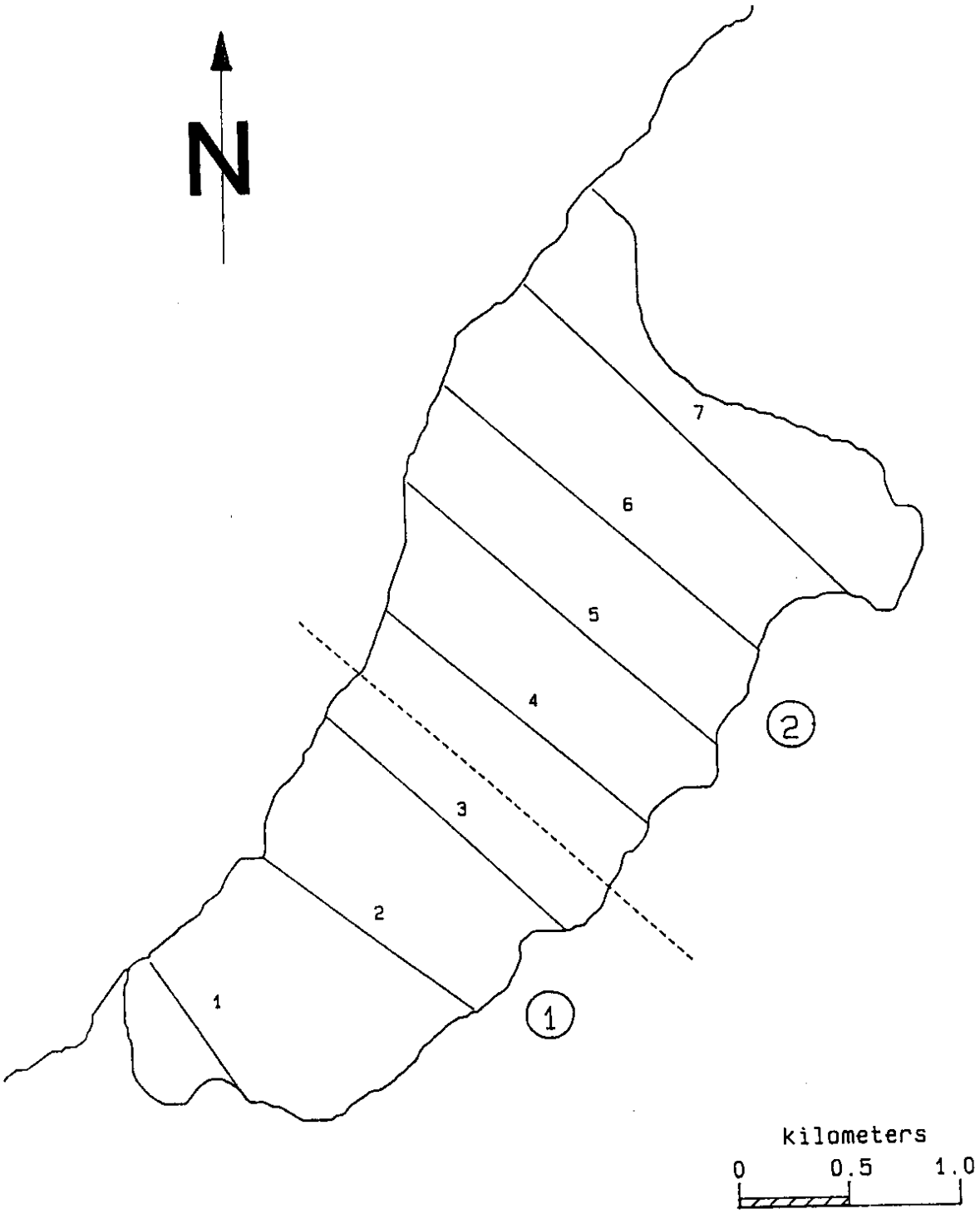


Fig. 10. Map of Cultus Lake showing areas and transects.

Table 6a - Tow summary for Cultus Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
8709	NOV 17/87	870048	2	19:35	2	31	1	3	0		21 AGE 0 1 OTHER 2 SCULPIN 2 STICKLEBACK
	NOV 17/87	870049	1	20:25	10	15	1	3	0		2 AGE 0 1 OTHER
	NOV 17/87	870050	1	21:05	20	15	1	3	0		8 AGE 0 1 OTHER
8902	MAY 1/89	890002	1	23:20	30	11	3	3	0		39 AGE 1 3 SCULPIN 1 STICKLEBACK
8904	MAY 29/89	890005	2	24:00	30	25	2	3	0		12 AGE 1 1 AGE 2+ 1 SCULPIN
	MAY 30/89	890006	1	00:35	30	11	2	3	0		10 AGE 0 12 AGE 1
8905	JUN 6/89	890007	1	00:30	30	18	1	4	0		5 AGE 0 6 AGE 1
8907	JUN 22/89	890012	1	00:20	30	11	2	3	0		NONE
	JUN 22/89	890013	1	01:05	30	18	2	3	0		29 AGE 0 8 AGE 1
8911	AUG 3/89	890020	1	00:00	15	20	3	3	0		15 AGE 0 1 STICKLEBACK
8913	SEP 19/89	890025	1	22:50	10	32	2	4			66 AGE 0 2 SCULPIN
8919	OCT 30/89	890043	1	20:52	10	32					11 AGE 0 2 STICKLEBACK
8922	NOV 27/89	890053	1	20:00	5	25	1	3			26 AGE 0 1 SCULPIN 13 STICKLEBACK
	NOV 27/89	890054	1	20:15	5	11	1	3			3 AGE 0 1 AGE 1 1 OTHER 94 STICKLEBACK
9001	MAR 5/90	900001		22:35	15	25	1	3			12 AGE 1 2 AGE 2+ 21 STICKLEBACK 1 OTHER
	MAR 5/90	900002		23:00	15	11	1	3			10 AGE 1 2 AGE 2+ 60 STICKLEBACK
9005	APR 9/90	900011		21:56	30	25	3	4			2 AGE 1

Table 6a - Tow summary for Cultus Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
9007	MAY 2/90	900015		23:06	45	18	4	3			6 AGE 1
											2 STICKLEBACK
9009	MAY 22/90	900016		23:25	30	18	5	3			1 AGE 1
9011	JUN 4/90	900020		23:42	40	11	3	3			236 AGE 0
											2 AGE 1
											1 AGE 2+
											5 SCULPIN
9015	JUL 3/90	900025		00:30	20	18	3	3	0		1 AGE 1
											1 SCULPIN
	JUL 3/90	900026		01:30	20	18	1	3	0		1 AGE 0
											1 AGE 1
9017	AUG 7/90	900030	1	23:49	15	25	1	4	0		5 AGE 0
	AUG 8/90	900031	1	00:30	15	25	1	4	0		36 AGE 0
											1 AGE 1
											1 CYPRINID
											7 SCULPIN

Table 6b - Trawl statistics by survey for Cultus Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
8709	NOV 17/87	AGE 0	31	72.16	85	59	6.24	38.91	4.21	7.00	2.28	1.12	1.26
		OTHER	3	53.00	66	39	11.05	122.00	2.20	4.08	0.74	1.40	1.95
		SCULPIN	2	39.00	50	28	11.00	121.00	0.73	1.20	0.26	0.47	0.22
		STICKLEBACK	2	50.50	56	45	5.50	30.25	1.51	1.88	1.14	0.37	0.14
8902	MAY 1/89	AGE 1	39	65.05	102	43	11.11	123.43	2.95	9.72	0.93	1.55	2.41
		SCULPIN	3	42.00	45	40	2.16	4.67	0.73	0.85	0.56	0.12	0.02
		STICKLEBACK	1	44.00	44	44	0.00	0.00	0.91	0.91	0.91	0.00	0.00
8904	MAY 29-30/89	AGE 0	10	30.80	34	28	1.78	3.16	0.31	0.36	0.26	0.04	0.00
		AGE 1	24	62.13	75	49	7.30	53.36	2.70	4.77	0.16	1.11	1.23
		AGE 2+	1	168.00	168	168	0.00	0.00	59.04	59.04	59.04	0.00	0.00
		SCULPIN	1	33.00	33	33	0.00	0.00	0.66	0.66	0.66	0.00	0.00
8905	JUN 6/89	AGE 0	5	33.80	35	32	1.17	1.36	0.47	0.55	0.35	0.07	0.00
		AGE 1	6	65.67	71	62	2.81	7.89	3.13	4.23	2.44	0.57	0.32
8907	JUN 22/89	AGE 0	29	35.62	41	30	2.85	8.10	0.53	0.80	0.32	0.13	0.02
		AGE 1	8	76.13	91	65	9.74	94.86	3.84	6.85	0.61	2.04	4.15
8911	AUG 3/89	AGE 0	15	53.67	64	41	5.58	31.16	1.84	3.28	0.79	0.65	0.42
		STICKLEBACK	1	46.00	46	46	0.00	0.00	1.11	1.11	1.11	0.00	0.00
8913	SEP 19/89	AGE 0	66	65.32	80	51	6.71	45.04	3.09	5.45	1.51	1.01	1.02
		SCULPIN	2	38.00	42	34	4.00	16.00	0.69	0.92	0.47	0.22	0.05
8919	OCT 30/89	AGE 0	11	69.36	82	54	8.21	67.32	3.88	6.11	1.45	1.42	2.01
		STICKLEBACK	2	46.00	47	45	1.00	1.00	0.92	0.99	0.85	0.07	0.00

Table 6b - Trawl statistics by survey for Cultus Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
8922	NOV 27/89	AGE 0	30	70.31	91	47	9.37	87.80	4.34	7.93	1.17	1.52	2.32
		AGE 1	1	135.00	135	135	0.00	0.00	25.06	25.06	25.06	0.00	0.00
		OTHER	1	75.00	75	75	0.00	0.00	5.38	5.38	5.38	0.00	0.00
		SCULPIN	1	40.00	40	40	0.00	0.00	0.56	0.56	0.56	0.00	0.00
		STICKLEBACK	107	44.02	56	32	5.69	32.39	0.94	1.86	0.21	0.34	0.12
9001	MAR 5/90	AGE 1	22	79.73	95	67	7.45	55.56	5.42	8.81	3.07	1.41	1.99
		AGE 2+	4	130.00	147	113	14.71	216.50	24.61	34.08	15.13	8.85	78.34
		STICKLEBACK	81	44.73	53	29	4.77	22.72	0.82	1.37	0.18	0.26	0.07
		OTHER	1	132.00	132	132	0.00	0.00	28.00	28.00	28.00	0.00	0.00
9005	APR 9/90	AGE 1	2	86.50	91	82	4.50	20.25	5.81	6.65	4.97	0.84	0.71
9007	MAY 2/90	AGE 1	6	76.67	88	63	9.18	84.22	4.84	7.29	2.31	1.71	2.94
		STICKLEBACK	2	35.00	35	35	0.00	0.00	0.47	0.48	0.46	0.01	0.00
9009	MAY 22/90	AGE 1	1	95.00	95	95	0.00	0.00	10.06	10.06	10.06	0.00	0.00
9011	JUN 4/90	AGE 0	236	28.56	37	15	4.21	17.73	0.25	0.65	0.06	0.11	0.01
		AGE 1	2	74.50	78	71	3.50	12.25	4.63	5.25	4.00	0.63	0.39
		AGE 2+	1	137.00	137	137	0.00	0.00	32.38	32.38	32.38	0.00	0.00
		SCULPIN	5	36.20	49	26	8.01	64.16	0.40	0.66	0.21	0.15	0.02
9015	JUL 3/90	AGE 0	1	32.00	32	32	0.00	0.00	0.36	0.36	0.36	0.00	0.00
		AGE 1	2	66.00	89	43	23.00	529.00	5.35	9.87	0.82	4.52	20.48
		SCULPIN	1	52.00	52	52	0.00	0.00	0.87	0.87	0.87	0.00	0.00
9017	AUG 7-8/90	AGE 0	41	50.00	68	27	7.34	53.90	1.55	3.60	0.22	0.64	0.41
		AGE 1	1	83.00	83	83	0.00	0.00	6.64	6.64	6.64	0.00	0.00
		CYPRINID	1	14.00	14	14	0.00	0.00	0.07	0.07	0.07	0.00	0.00
		SCULPIN	7	16.57	19	14	1.68	2.82	0.10	0.14	0.07	0.02	0.00

Table 6c - Trawl statistics by tow for Cultus Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 8709																
2	NOV 17/87	870048	31	2	AGE 0	21	71.86	85	59	6.82	46.50	4.33	7.00	2.28	1.27	1.60
					OTHER	1	39.00	39	39	0.00	0.00	0.74	0.74	0.74	0.00	0.00
					SCULPIN	2	39.00	50	28	11.00	121.00	0.73	1.20	0.26	0.47	0.22
					STICKLEBACK	2	50.50	56	45	5.50	30.25	1.51	1.88	1.14	0.37	0.14
1	NOV 17/87	870049	15	10	AGE 0	2	76.50	78	75	1.50	2.25	4.14	4.41	3.86	0.28	0.08
					OTHER	1	54.00	54	54	0.00	0.00	1.78	1.78	1.78	0.00	0.00
1	NOV 17/87	870050	15	20	AGE 0	8	71.88	77	64	4.81	23.11	3.91	4.79	2.58	0.73	0.53
					OTHER	1	66.00	66	66	0.00	0.00	4.08	4.08	4.08	0.00	0.00
SURVEY # 8902																
1	MAY 1/89	890002	11	30	AGE 1	39	65.05	102	43	11.11	123.43	2.95	9.72	0.93	1.55	2.41
					SCULPIN	3	42.00	45	40	2.16	4.67	0.73	0.85	0.56	0.12	0.02
					STICKLEBACK	1	44.00	44	44	0.00	0.00	0.91	0.91	0.91	0.00	0.00
SURVEY # 8904																
2	MAY 29/89	890005	25	30	AGE 1	12	62.92	75	53	7.27	52.91	2.87	4.77	1.70	1.00	0.99
					AGE 2+	1	168.00	168	168	0.00	0.00	59.04	59.04	59.04	0.00	0.00
					SCULPIN	1	33.00	33	33	0.00	0.00	0.66	0.66	0.66	0.00	0.00
1	MAY 30/89	890006	11	30	AGE 0	10	30.80	34	28	1.78	3.16	0.31	0.36	0.26	0.04	0.00
					AGE 1	12	61.33	75	49	7.25	52.56	2.53	4.67	0.16	1.19	1.41
SURVEY # 8905																
1	JUN 6/89	890007	18	30	AGE 0	5	33.80	35	32	1.17	1.36	0.47	0.55	0.35	0.07	0.00
					AGE 1	6	65.67	71	62	2.81	7.89	3.13	4.23	2.44	0.57	0.32

Table 6c - Trawl statistics by tow for Cultus Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 8907																
1	JUN 22/89	890012	11	30	NONE											
1	JUN 22/89	890013	18	30	AGE 0	29	35.62	41	30	2.85	8.10	0.53	0.80	0.32	0.13	0.02
					AGE 1	8	76.13	91	65	9.74	94.86	3.84	6.85	0.61	2.04	4.15
SURVEY # 8911																
1	AUG 3/89	890020	20	15	AGE 0	15	53.67	64	41	5.58	31.16	1.84	3.28	0.79	0.65	0.42
					STICKLEBACK	1	46.00	46	46	0.00	0.00	1.11	1.11	1.11	0.00	0.00
SURVEY # 8913																
1	SEP 19/89	890025	32	10	AGE 0	66	65.32	80	51	6.71	45.04	3.09	5.45	1.51	1.01	1.02
					SCULPIN	2	38.00	42	34	4.00	16.00	0.69	0.92	0.47	0.22	0.05
SURVEY # 8919																
1	OCT 30/89	890043	32	10	AGE 0	11	69.36	82	54	8.21	67.32	3.88	6.11	1.45	1.42	2.01
					STICKLEBACK	2	46.00	47	45	1.00	1.00	0.92	0.99	0.85	0.07	0.00
SURVEY # 8922																
1	NOV 27/89	890053	25	5	AGE 0	26	69.50	85	47	8.96	80.33	4.21	6.75	1.17	1.44	2.07
					SCULPIN	1	40.00	40	40	0.00	0.00	0.56	0.56	0.56	0.00	0.00
					STICKLEBACK	13	41.69	48	32	5.69	32.37	0.72	1.11	0.21	0.29	0.08
1	NOV 27/89	890054	11	5	AGE 0	3	77.33	91	68	9.88	97.56	5.44	7.93	4.05	1.76	3.11
					AGE 1	1	135.00	135	135	0.00	0.00	25.06	25.06	25.06	0.00	0.00
					OTHER	1	75.00	75	75	0.00	0.00	5.38	5.38	5.38	0.00	0.00
					STICKLEBACK	94	44.34	56	32	5.62	31.54	0.97	1.86	0.29	0.34	0.11

Table 6c - Trawl statistics by tow for Cultus Lake

AREA	DATE	TRAWL TOW	DEPTH (m)	DURATION (min)	CATCH SPECIES	N	LENGTH (mm) MEAN	MAX	MIN	S.D.	VAR	WEIGHT (g) MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9001																
		900001	25	15	AGE 1	12	79.50	90	67	6.71	45.08	5.14	7.00	3.80	1.02	1.03
					AGE 2+	2	132.50	147	118	14.50	210.25	25.26	34.08	16.44	8.82	77.79
					STICKLEBACK	21	45.14	52	32	4.72	22.31	0.83	1.16	0.20	0.26	0.07
					OTHER	1	132.00	132	132	0.00	0.00	28.00	28.00	28.00	0.00	0.00
		900002	11	15	AGE 1	10	80.00	95	68	8.25	68.00	5.75	8.81	3.07	1.71	2.93
					AGE 2+	2	127.50	142	113	14.50	210.25	23.97	32.80	15.13	8.83	78.06
					STICKLEBACK	60	44.58	53	29	4.77	22.78	0.81	1.37	0.18	0.25	0.06
SURVEY # 9005																
		900011	25	30	AGE 1	2	86.50	91	82	4.50	20.25	5.81	6.65	4.97	0.84	0.71
SURVEY # 9007																
		900015	18	45	AGE 1	6	76.67	88	63	9.18	84.22	4.84	7.29	2.31	1.71	2.94
					STICKLEBACK	2	35.00	35	35	0.00	0.00	0.47	0.48	0.46	0.01	0.00
SURVEY # 9009																
		900016	18	30	AGE 1	1	95.00	95	95	0.00	0.00	10.06	10.06	10.06	0.00	0.00
SURVEY # 9011																
		900020	11	40	AGE 0	236	28.56	37	15	4.21	17.73	0.25	0.65	0.06	0.11	0.01
					AGE 1	2	74.50	78	71	3.50	12.25	4.63	5.25	4.00	0.63	0.39
					AGE 2+	1	137.00	137	137	0.00	0.00	32.38	32.38	32.38	0.00	0.00
					SCULPIN	5	36.20	49	26	8.01	64.16	0.40	0.66	0.21	0.15	0.02

Table 6c - Trawl statistics by tow for Cultus Lake

AREA	DATE	TRAWL TOW	DEPTH (m)	DURATION (min)	CATCH SPECIES	N	LENGTH (mm) MEAN	MAX	MIN	S.D.	VAR	WEIGHT (g) MEAN	MAX	MIN	S.D.	VAR
SURVEY # 9015																
		900025	18	20	AGE 1	1	89.00	89	89	0.00	0.00	9.87	9.87	9.87	0.00	0.00
					SCULPIN	1	52.00	52	52	0.00	0.00	0.87	0.87	0.87	0.00	0.00
		900026	18	20	AGE 0	1	32.00	32	32	0.00	0.00	0.36	0.36	0.36	0.00	0.00
					AGE 1	1	43.00	43	43	0.00	0.00	0.82	0.82	0.82	0.00	0.00
SURVEY # 9017																
		900030	25	15	AGE 0	5	51.00	60	45	5.18	26.80	1.65	2.60	1.18	0.52	0.27
		900031	25	15	AGE 0	36	49.86	68	27	7.58	57.51	1.54	3.60	0.22	0.65	0.42
					AGE 1	1	83.00	83	83	0.00	0.00	6.64	6.64	6.64	0.00	0.00
					CYPRINID	1	14.00	14	14	0.00	0.00	0.07	0.07	0.07	0.00	0.00
					SCULPIN	7	16.57	19	14	1.68	2.82	0.10	0.14	0.07	0.02	0.00

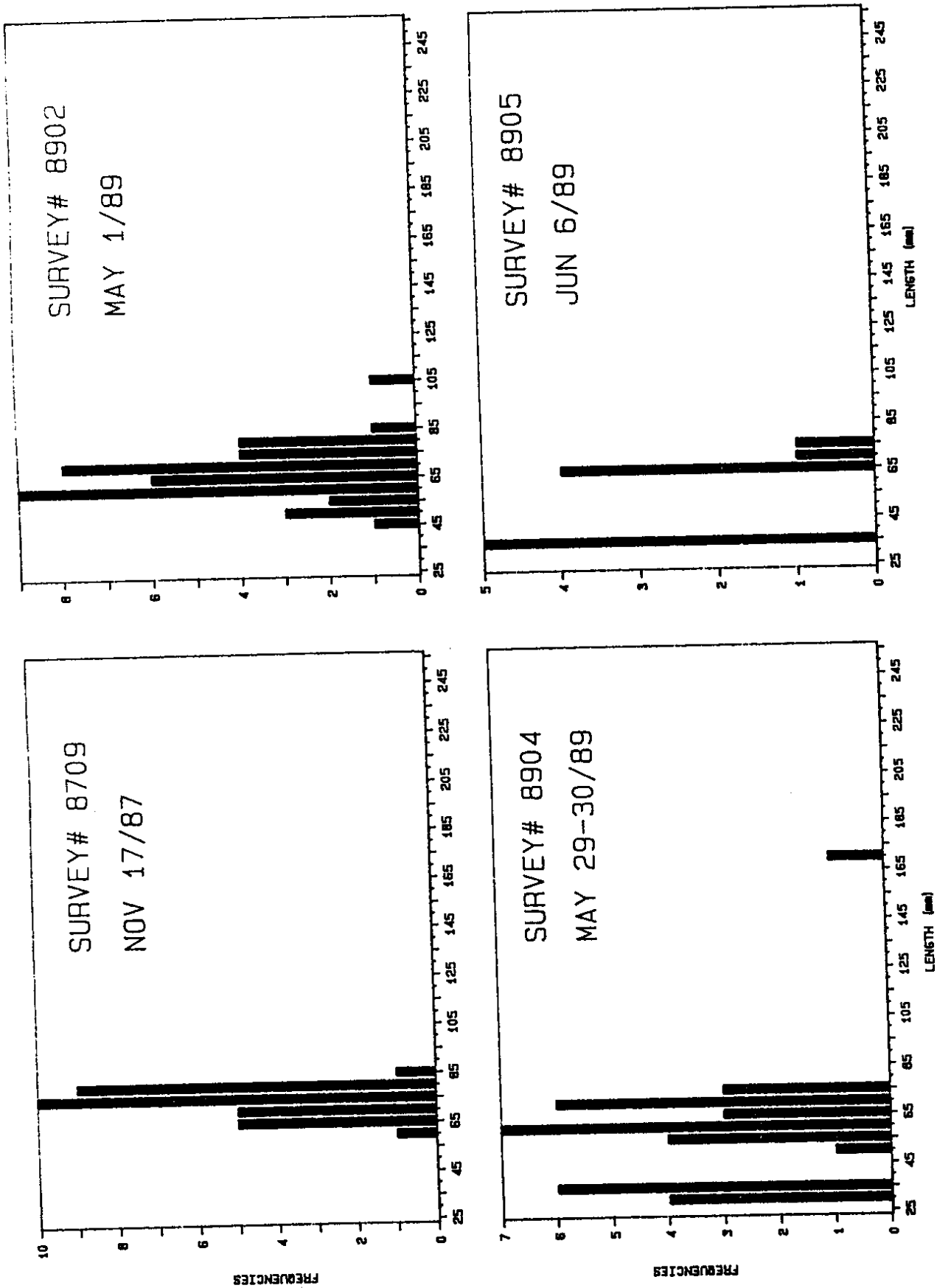


Fig. 11a. Sockeye (O. nerka) length frequencies in Cultus Lake.

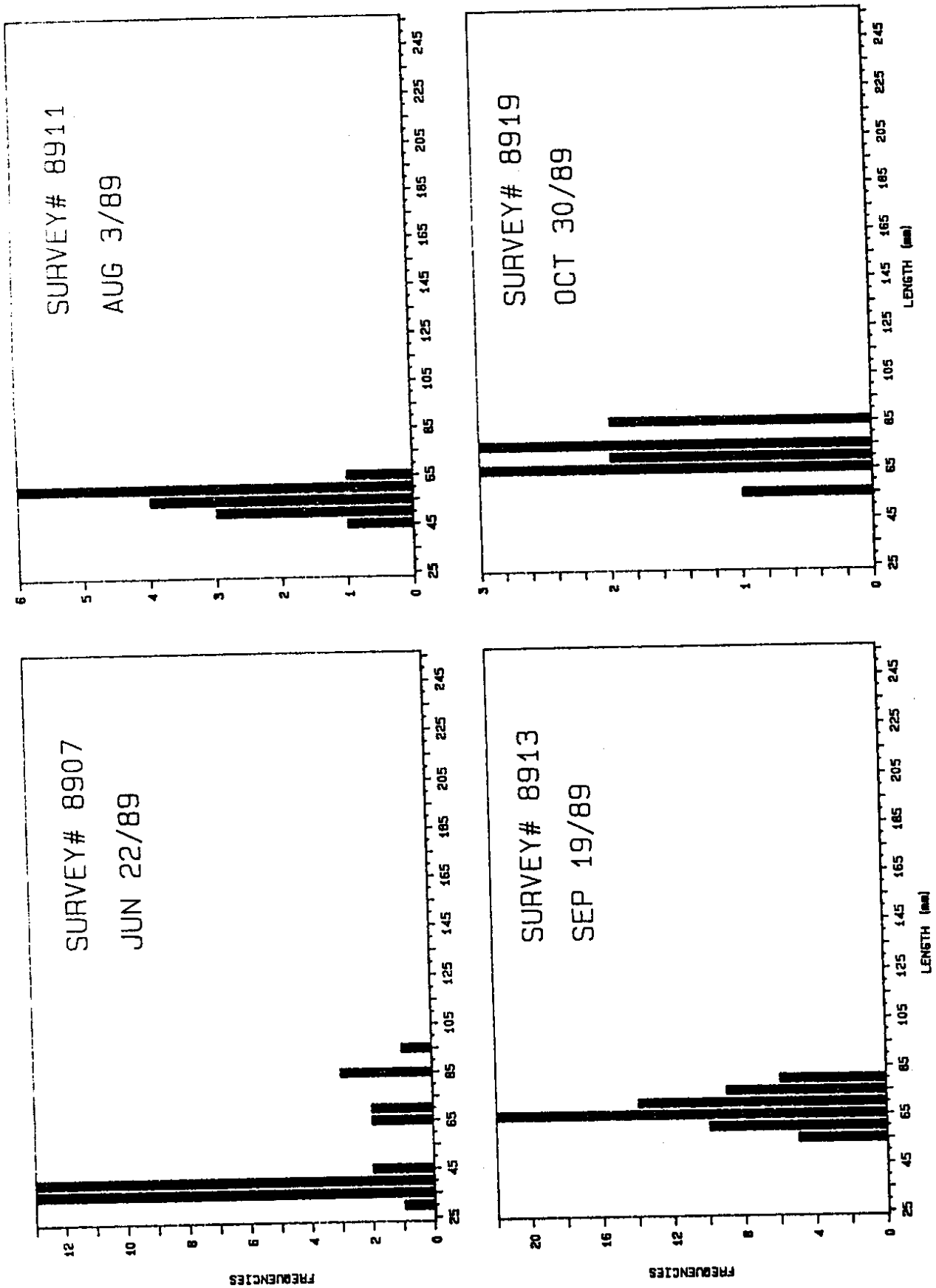


Fig. 11a. Continued.

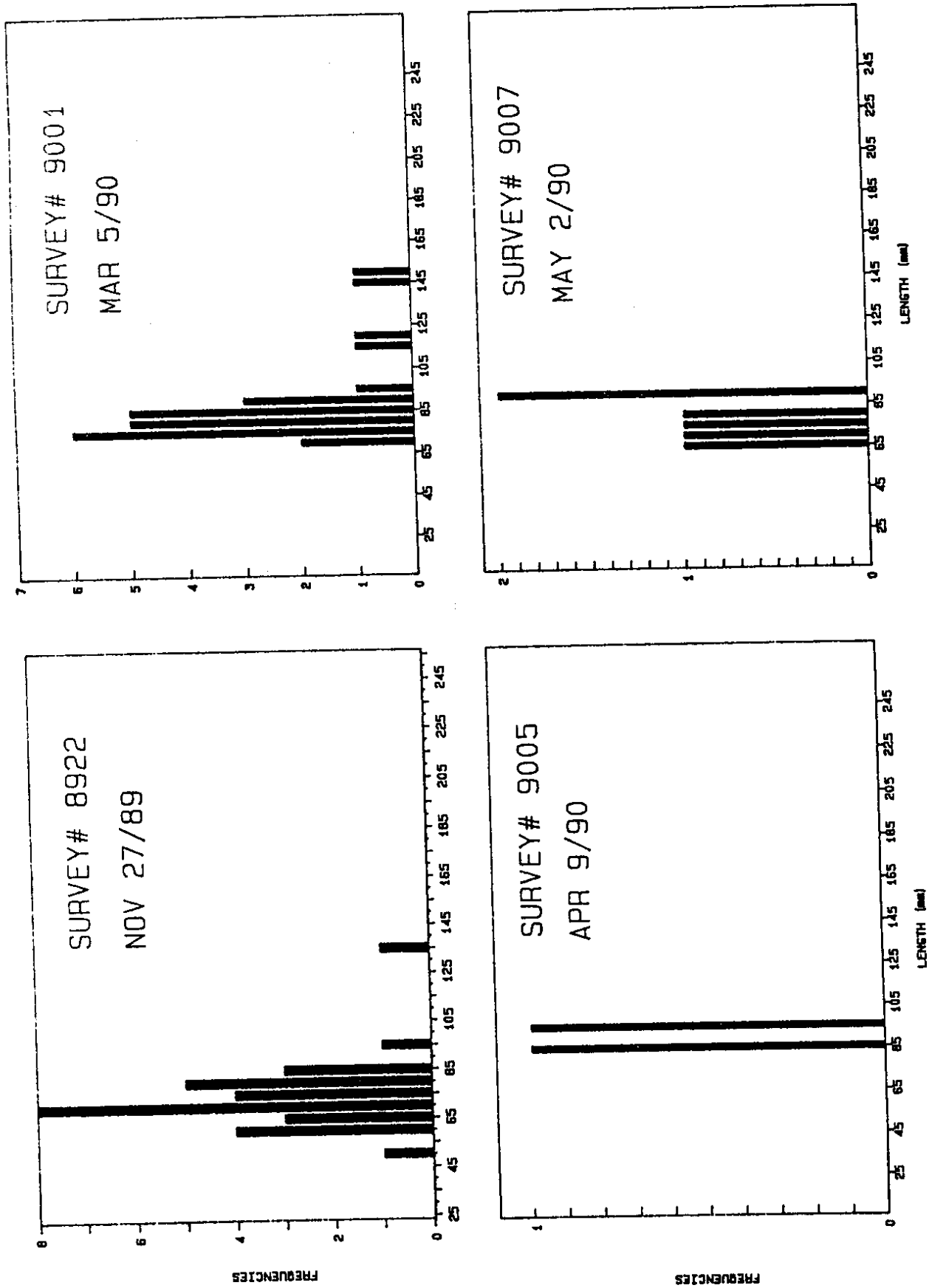


Fig. 11a. Continued.

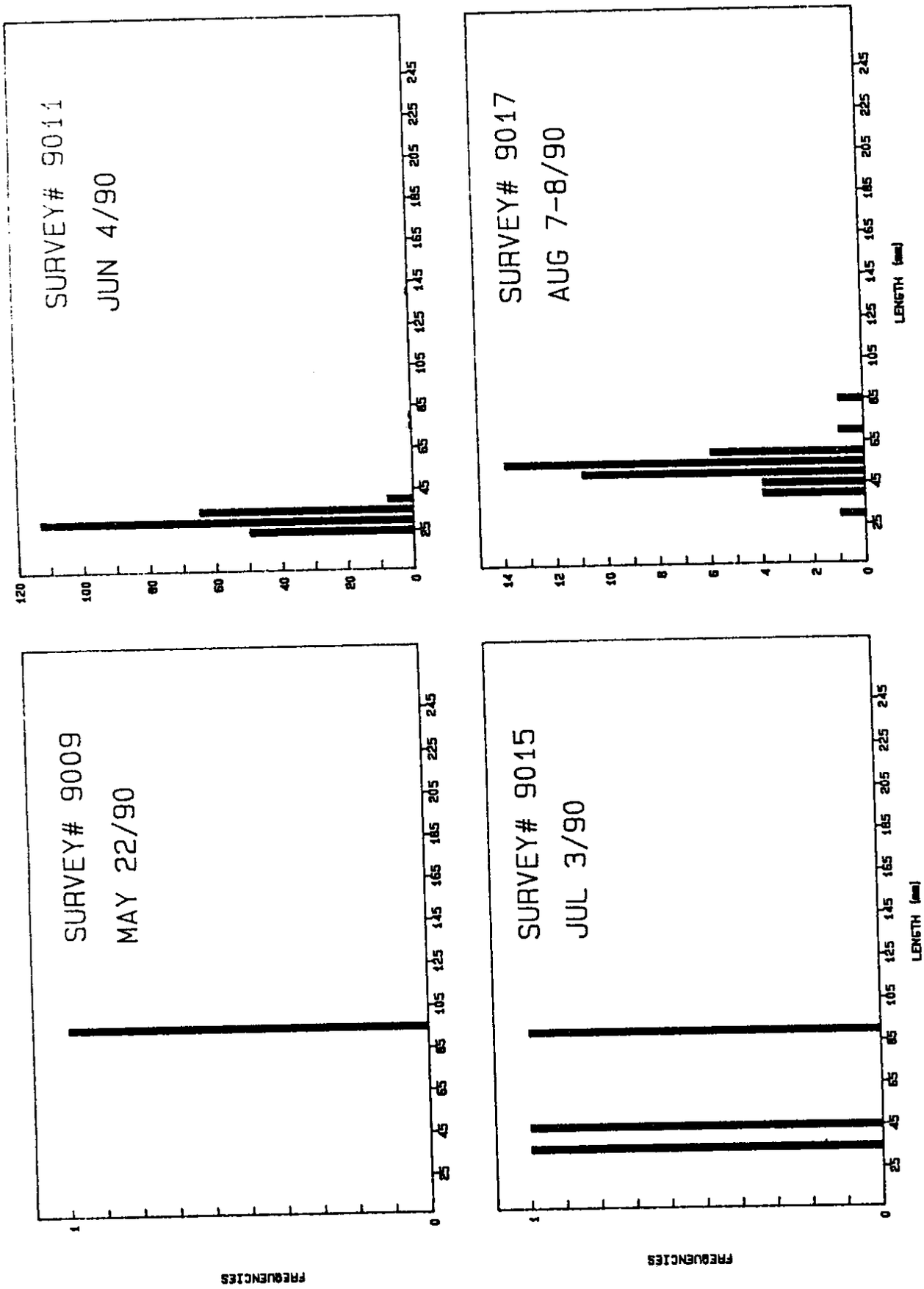


Fig. 11a. Continued.

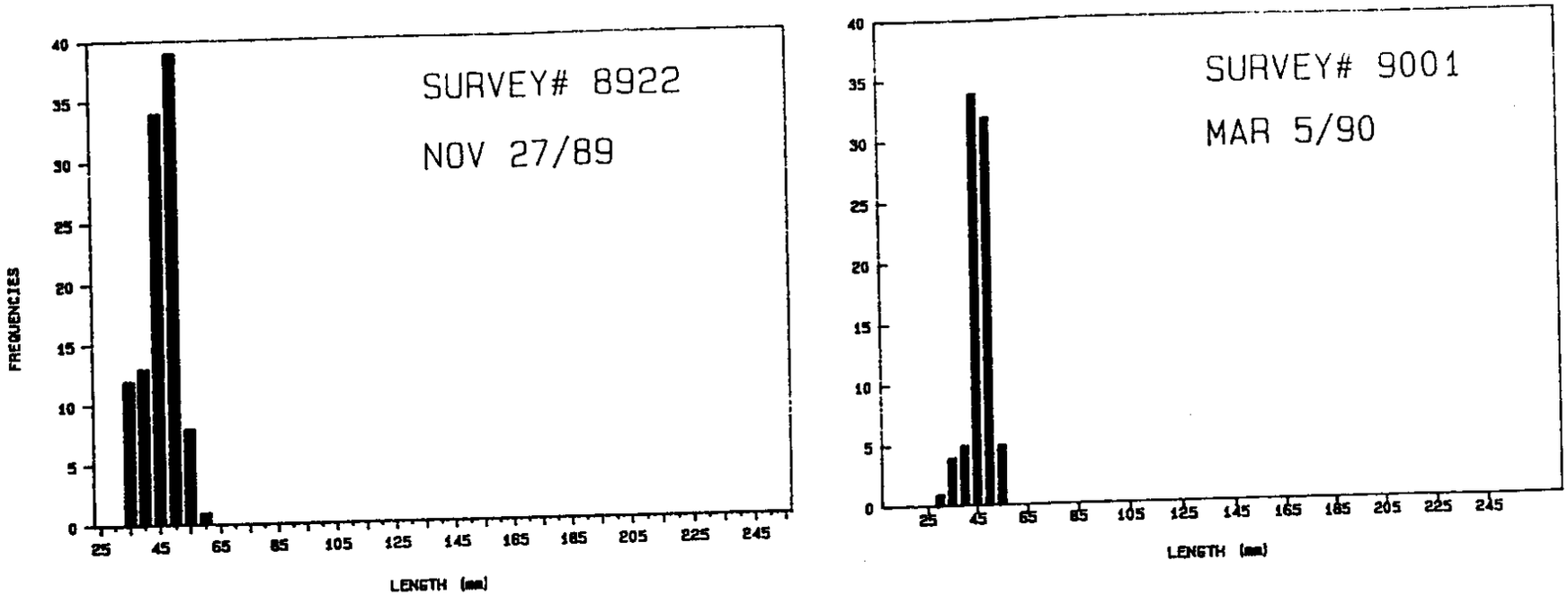


Fig. 11b. Stickleback (Gasterosteus Aculeatus) Length Frequencies in Cultus Lake.

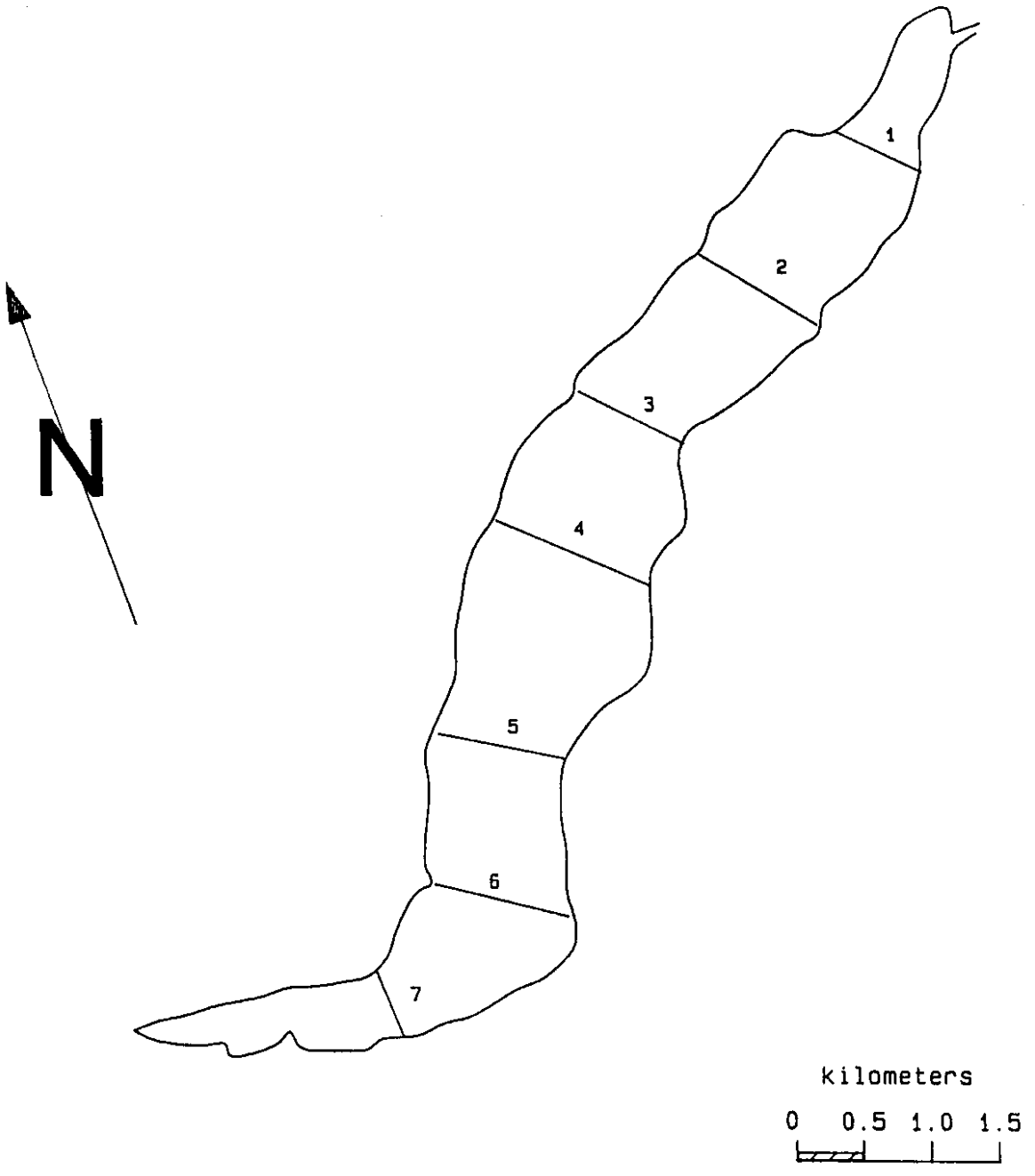


Fig. 12. Map of East Barriere Lake showing transects.

Table 7a - Tow summary for E. Barriere Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	TIME min.	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
8806	AUG 13/88	880031		22:47	50	16-26-30	1	3			18 AGE 0 2 AGE 1 23 AGE 2+ 2 OTHER
8811	OCT 13/88	880053		22:00	40	35-27-20	2	3			8 AGE 0 5 AGE 1 3 AGE 2+

Table 7b - Trawl statistics for E. Barriere Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 8806																
	AUG 13/88	880031	16-26-30	50	AGE 0	18	52.06	62	41	5.08	25.83	1.51	2.16	1.00	0.38	0.14
					AGE 1	2	98.00	110	86	12.00	144.00	7.71	9.43	5.99	1.72	2.96
					AGE 2+	23	187.26	298	110	33.17	1100.28	72.92	144.90	9.67	26.91	724.38
					OTHER	2	48.50	53	44	4.50	20.25	1.55	1.93	1.17	0.38	0.14
SURVEY # 8811																
	OCT 13/88	880053	35-27-20	40	AGE 0	8	58.13	67	54	4.20	17.61	2.03	3.24	1.57	0.54	0.30
					AGE 1	5	61.80	63	60	1.17	1.36	2.56	2.77	2.32	0.16	0.02
					AGE 2+	3	180.00	180	180	0.00	0.00					

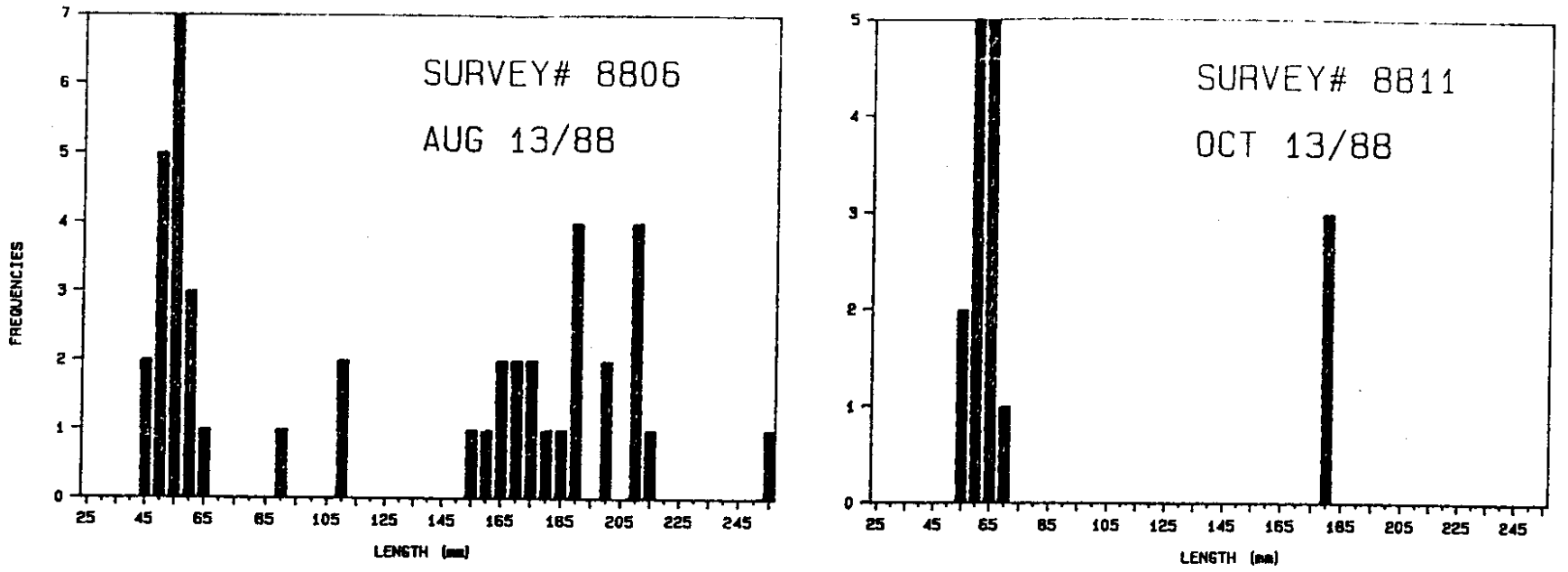


Fig. 13. Sockeye (O. nerka) length frequencies in E. Barriere Lake.

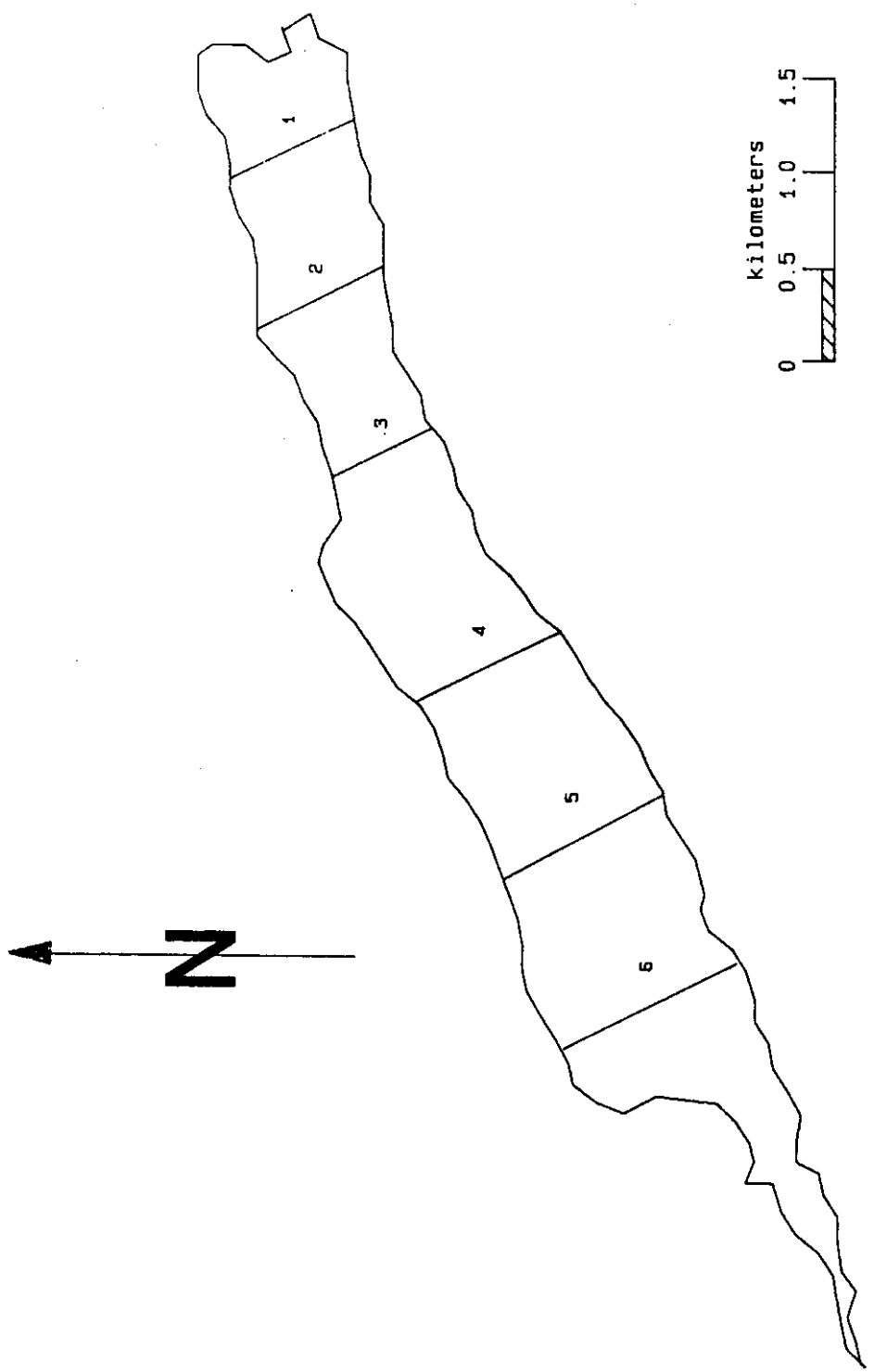


Fig. 14. Map of North Barriere Lake showing transects.

Table 8a - Tow summary for N. Barriere Lake

SURVEY #	SAMPLE DATE	TOW	AREA	SAMPLE TIME	DURATION (min)	DEPTH (m)	SKY CODE	LIGHT CODE	WIND DIR	SURFACE TEMP (C)	CATCH
8807	AUG 14/88	880032	1	21:00	15	15		2	3		229 AGE 0 1 OTHER
		880033	2	22.46	5	15		2	3		135 AGE 0 1 AGE 2+
8812	OCT 14/88	880054		20:30	15	15		2	3		118 AGE 0 1 AGE 1 1 AGE 2+

Table 8b - Trawl statistics by survey for N. Barriere Lake

SURVEY#	DATES	CATCH		LENGTH (mm)					WEIGHT (g)				
		SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
8807	AUG 14/88	AGE 0	364	55.33	74	35	6.23	38.81	1.94	4.45	0.47	0.62	0.38
		AGE 2+	1	115.00	115	115	0.00	0.00	12.58	12.58	12.58	0.00	0.00
		OTHER	1	57.00	57	57	0.00	0.00	2.54	2.54	2.54	0.00	0.00
8812	OCT 14/88	AGE 0	118	63.48	85	38	9.30	86.45	2.90	6.89	0.53	1.30	1.69
		AGE 1	1	146.00	146	146	0.00	0.00	37.59	37.59	37.59	0.00	0.00
		AGE 2+	1	208.00	208	208	0.00	0.00	109.69	109.69	109.69	0.00	0.00

Table 8c - Trawl statistics by tow for N. Barriere Lake

TRAWL					CATCH		LENGTH (mm)					WEIGHT (g)				
AREA	DATE	TOW	DEPTH (m)	DURATION (min)	SPECIES	N	MEAN	MAX	MIN	S.D.	VAR	MEAN	MAX	MIN	S.D.	VAR
SURVEY # 8807																
1	AUG 14/88	880032	15	15	AGE 0	229	54.61	72	35	6.25	39.08	1.84	4.45	0.47	0.58	0.34
					OTHER	1	57.00	57	57	0.00	0.00	2.54	2.54	2.54	0.00	0.00
2	AUG 14/88	880033	15	5	AGE 0	135	56.54	74	37	6.00	36.03	2.12	4.45	0.56	0.63	0.40
					AGE 2+	1	115.00	115	115	0.00	0.00	12.58	12.58	12.58	0.00	0.00
SURVEY # 8812																
	OCT 14/88	880054	15	15	AGE 0	118	63.48	85	38	9.30	86.45	2.90	6.89	0.53	1.30	1.69
					AGE 1	1	146.00	146	146	0.00	0.00	37.59	37.59	37.59	0.00	0.00
					AGE 2+	1	208.00	208	208	0.00	0.00	109.69	109.69	109.69	0.00	0.00

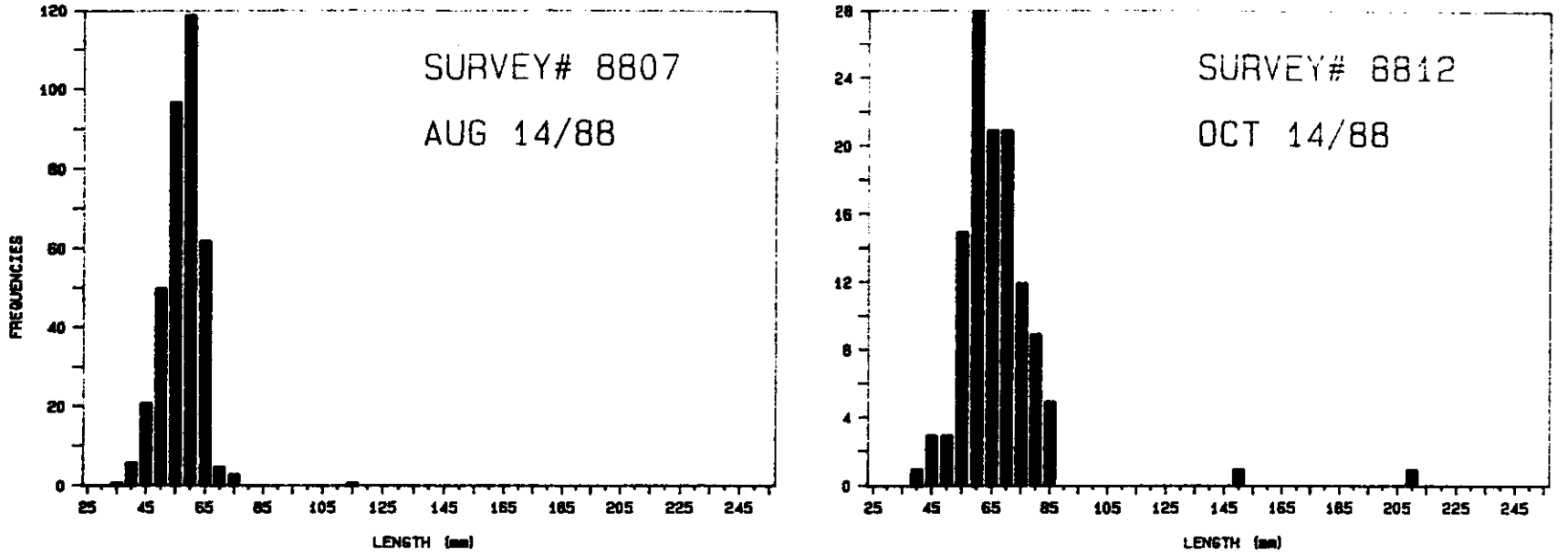


Fig. 15. Sockeye (O. nerka) length frequencies in N. Barriere Lake.