BIOLOGICAL SURVEY OF THE NIMPKISH RIVER SYSTEM - 1957

DEPARTMENT OF FISHERIES, CANADA

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TABLE OF CONTENTS:

FIGURES

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1 INTRODUCTION

The Nimpkish River System, located seventy miles north of Sayward on Vancouver Island (Fig. 1 - Site Map), supports runs of all five species of the commercially important Pacific salmon. This fishery is considered second in value only to that of the Fraser in the southern half of the Province. The system also has a hydro-electric potential, having a drainage area of 768 square miles, which is the second largest watershed on Vancouver Island.

A. History

The hydro-electric potential of the system was first recognized in 1928 when a logging company, Canadian Forest Products Ltd., applied for a water licence with the view of establishing power facilities to operate a proposed pulp mill near the mouth of the river. On receipt of the licence, the company carried out a preliminary investigation, but the project did not proceed beyond that stage. The original licence was due to lapse in 1965.

In 1956, the Nimpkish system was referred to in the expansion program of the B. C. Power Commission. The interest in this system was heightened by the fact that the Commission had recently completed definite plans to develop the Kokish River, located ten miles east of the Nimpkish (Fig. 2). The Commission felt that both projects should be considered simultaneously as construction costs would be minimized by installation of a transmission line from Campbell River to the Kokish River suitable to carry the output of both developments.

In June of 1957, the Power Commission informed the Department of Fisheries of their plans to conduct preliminary field surveys in the Nimpkish area, with the purpose of locating suitable dam and powerhouse sites.

B. Proposed Hydroelectric Development

The proposed hydroelectric development includes plans for a rock-fill storage dam approximately 150 feet high, situated one-half mile upstream from tidal influence. A dam of this size would contain a live storage of 507,000 acre-feet, and would have maximum-minimum reservoir elevations of 200 and 169 feet respectively, providing a gross head of 192 to 161 feet. The normal elevation of Nimpkish Lake is 65 feet. The approximate flood-line of this reservoir is shown in Fig. 2.

Power would be supplied by two 40,000 Horsepower Francis Units with a normal discharge of 2500 c.f.s. per unit. The invert for these units would be established 100 feet below the minimum reservoir level. Facilities for the protection and maintenance of the salmon runs have also been considered in the Power Commission's preliminary plans.

C. Biological Surveys

On receipt of the Power Commission's definite intentions to investigate the hydroelectric potential of the Nimpkish Valley, the Department of Fisheries immediately planned two biological surveys of the system, one of which was carried out during the summer, and the other in the fall and early winter of 1957.

The purpose of the survey conducted during July and August was to assess the over-all biological productivity of the system, to assess the known spawning areas, and to survey further areas which were not known to accommodate spawning salmon.

The fall survey, designed from the information obtained during the summer, was conducted to complement the present information on the distribution, timing, and magnitude of the salmon runs. Both surveys were planned and conducted with special reference to the fisheries problems which would arise as a result of hydroelectric developments.

The work of the survey parties was greatly facilitated by the cooperation of Canadian Forest Products Ltd., which maintains five logging camps interconnected by road and railway throughout the Nimpkish valley. Transportation and accommodation were provided to the Fisheries personnel in the area whenever required.

11 METHOD

The biological survey of the Nimpkish system was divided into two sections: (a) the Limnological Survey, which consisted of the study of the general topography, productivity, available and potential spawning grounds and rearing areas of the lakes and rivers; and (b) the Spawning Ground Survey, during which the timing, distribution, and magnitude of the salmon runs to the system were studied.

To facilitate study, the system was topographically subdivided into the following seven sections (Fig. 3):

Section 1 - Nimpkish River - from Nimpkish Lake to Broughton Straits.

11 - Nimpkish Lake and Atluck - Hustan - Anutz Lakes system.

111 - Upper Nimpkish or Klaanch River from the junction of the Davie River to Nimpkish Lake.

1V - Woss Lake and River to the junction of the Woss and Klaanch Rivers.

V - Davie River system, composed of Schoen Lake, Klaklakama Lakes, and the Davie River to its junction with the Klaanch River.

VI - The Klaanch River from its headwaters to the junction of the Davie River.

V11 - The Sebalhall River system, composed of Vernon Lake and the Sebalhall River to its junction with the Klaanch River.

Each of the above sectionswas assessed individually, the lakes by boat, and the streams on foot or by rubber boat.

A. Limnological Survey

1. Lakes:

The lakes of the system were assessed for the following characteristics:

(1) General morphometry.

(2) TDS (Total dissolved solids) - water samples were taken and analysed in the laboratory during the winter.

(3) Plankton - Total vertical and surface tows were made in at least one station on each lake.

(4) Transparencies - by Secchi disc.

(5) Temperatures - vertical series recorded by bathythermograph or reversing thermometer.

(6) Depth contours, by echo sounder, of the three major lakes; the others by handline.

(7) Native fish populations - sampled by a gill-net gang of 1", 2", and 3" stretched-mesh sizes. A total length of 100 yards of net was used. The fish were sampled for species, sex, length, age, stomach content.

2. Streams:

Small streams entering the lakes were surveyed on foot to the extent of their accessibility to migrating fish or to the extent of gravel suitable to spawning salmon. These streams were inspected as potential spawning grounds and obstructions were noted and mapped.

All major rivers entering and leaving the lakes of the system were surveyed for the same characteristics, but by rubber boat.

B. Spawning Grounds Survey

Spawning grounds surveys were conducted during September, October, and November. Lakes were examined periodically by boat and aircraft, small streams on foot, and major tributaries and main-stem streams by rubber boat. Species present, numbers of each species present, and duration of spawning were recorded for each of the seven areas. In cases where extensive spawning occurred, e.g. Woss Lake and River, each major area was subdivided into smaller, more easily surveyed sections.

111 RESULTS

A. Limnological Survey

1. General Morphology

(a) Lakes:

The lake basins of the Nimpkish River system may be classified broadly in three general categories: (a) oligotrophic - those lakes set in narrow, deep valleys bordered by steep mountains, (b) intermediate - those lakes set in broader valleys bordered by mountains of lesser height and steepness, and (c) eutrophic - those lakes set in wide-open valleys bordered by low hills and swamp areas. Table 1 gives the total length, average width, and general distribution of the lakes in the above categories.

TABLE 1. GENERAL MORPHOMETRY OF THE NIMPKISH RIVER SYSTEM LAKES

Oligotrophic			Intermediate			Eutrophic		
Lake	Total Length (Miles)	Average Width (Miles)	Lake	Total Length (Miles)	Average Width (Miles)	Lake	Total Length (Miles)	Average Width (Miles)
Woss	9.19	.68	Vernon	4.25	.75	Anutz	.98	.50
Schoen	3.20	.33	Hustan	1.78	.37	Upper Klaklakama	1.17	.37
Nimpkish	13.69	1.13				Lower Klaklakama	2.53	.33

The five lakes of the "oligotrophic" and "intermediate" classifications have an extremely small percentage of their total areas in depths of less than fifty feet. Their shorelines are generally steep to precipitous with extremely narrow shelving areas. Schoen and Woss Lakes both have one large area of relatively shallow water; Schoen, a 3/4-mile stretch midway along the western shore having a width of 100 yards to a depth of 10 feet (Fig. 4); Woss, a fairly wide band of water 50 feet deep or less on both sides of the northern four miles of the lake (Fig. 5).

The three lakes with typically eutrophic basin shape (Anutz, Upper Klaklakama, Lower Klaklakama) are less than 100 feet deep, and shelve gradually to their greatest depths. Their bottom composition is generally mud with good weed and algal growths in the zone of light penetration, and the shoreline shallows have heavy growths of reeds and lily pads.

(b) Streams Tributary to Lakes:

All major streams entering the surveyed lakes were assessed for obstructions, available, and potentially available spawning grounds.

1. Nimpkish Lake streams - Although there are many small streams entering the lake, only two appear suitable for spawning salmon; Willow Creek, with an accessible area of 3/4 of a mile, and Anutz River, completely accessible. Both have extensive areas of fine to medium gravel and appear to be affected little by erosion.

2. Anutz Lake streams - Atluck Creek, flowing into the lake at the head end, is unobstructed for one mile. At this point the stream is obstructed by a 6 to 10 ft. perpendicular fall. Immediately above this the river passes through a sheer limestone-cut canyon in which there is a series of falls which also appear to be impassable to salmon (Fig. 6). There is a series of three log jams in the lower three hundred yards of the stream which, although

presently passable, should be removed. The entire length of unobstructed river appears suitable for salmon spawning.

3. Woss Lake streams - Six of the many small streams entering Woss Lake were considered accessible to spawning salmon. Three of these, glacial creeks at the head of the lake, have fairly extensive areas of suitable gravel, while the remaining three have small scattered areas of available gravel (Fig. 7, A to F inclusive).

4. Klaklakama Lakes streams - Good gravel areas exist in the stream joining the two lakes. A few small log jams are present, but serve to stabilize the river rather than to obstruct it. The stream flowing out of Lower Klaklakama Lake into the Davie River also has a good gravel bottom throughout its length.

5. Schoen Lake streams - Two small creeks at the head end of the lake are accessible for short distances. Fair to medium gravel is present, and good numbers of salmon, especially coho, could be accommodated.

6. Vernon Lake streams - Airport Creek, entering on the eastern shore, and the Upper Sebalhall River, entering at the head of the lake, are the two streams accessible to salmon in this section. The

Upper Sebalhall, in particular, has a very large area of available gravel. The east fork is obstructed 300 yards upstream by a 25 ft. fall, but the west fork has suitable gravel for 3/4 of a mile.

(c) Mainstem Rivers:

The main rivers of the system were surveyed by rubber boat. Large areas of suitable gravel were found especially in the extreme upper reaches of the Klaanch (Upper Nimpkish). Coho fry were observed in good numbers, but the gravel does not appear to be utilized to its full potential.

The Davie River, from Schoen Lake to its junction with Klaklakama Creek, has many good areas of suitable gravel. Log jams which could be obstructions at certain water levels, were noted in several places. From the entrance of Klaklakama Creek to the junction of the Klaanch (Upper Nimpkish) the Davie is an extremely fast, rough river with virtually no suitable spawning areas.

The Klaanch from nine miles upstream of Karmutsen Falls to three miles below, is extremely fast and bouldery with no extensive spawning areas. A secondary obstruction, approximately seven miles upstream from Karmutsen, is impassable under high water conditions.

The Woss River, which enters the Klaanch three miles downstream from Karmutsen Falls, has fair to good spawning gravel throughout its five-mile length. It is a very stable river which suffers little from erosion and has no obstructions.

The Klaanch, from the Woss junction to Nimpkish Lake, is a fast, bouldery river with few areas of suitable gravel, and no obstructions.

Nimpkish River, from Nimpkish Lake to Broughton Strait, is a large fairly deep river with a few areas of fairly large gravel which could support good populations of salmon.

2. Total Dissolved Solids

Quart samples of the surface water were taken at the limnological stations of each of the lakes surveyed. These samples were analysed for total dissolved solids in the laboratories of the B. C. Game Commission.

As a general rule, it is considered that a reading of 40 parts per million is typical for lakes of the coast and insular mountains. For lakes of the southern interior plateau a reading of 200 parts per million is considered typical. (Northcote and Larkin, 1956) Table II lists the TDS readings for the lakes of this system. When compared with 40 ppm. it is evident that most of this water is somewhat less productive than average.

TABLE 11. TOTAL DISSOLVED SOLIDS OF THE LAKES OF THE NIMPKISH SYSTEM.

Lakes	TDS (ppm)
Anutz	48
Hustan	42
Woss (Inlet)	33
Schoen	32
Nimpkish	32
Woss (Outlet)	31
Vernon	29
Upper Klaklakama	22
Lower Klaklakama	18

3. Plankton

Plankton samples, taken from all lakes surveyed by a Wisconsin-type plankton net, were obtained in two manners: (a) a three minute surface tow, and (b) a total vertical haul. All samples so obtained proved to be too small to evaluate quantitatively by the normally used "settled-volume" method. However, a microscopic examination of the samples was made to obtain a qualitative analysis (Table 111). It has been shown (Northcote and Larkin, 1956) that in general the lakes of higher "TDS" contained larger quantities of, and more species of plankton.

4. Transparencies

The depth of light penetration was obtained from

TABLE 111. QUALITATIVE ANALYSIS OF PLANKTON SAMPLES

LAKE	DATE	COPEPODA	RONFERA	BLUE-GREEN ALGAE	GREEN ALGAE	DIATOMS
ANUTZ	AUG. 9/57	DAPHNIA DIAPTOMUS CYCLOPS LIMNOCALANUS	PRESENT	COELOSPHAERIUM MICROCYSTIS	CLADOPHORA RICHTERIELLA MICROSPORA SPIROGYRA	ASTERIONELLA TABELLARIA SYNEDRA
HUSTAN	AUG. 12/57	LIMNOCALANUS DIAPTOMUS	-	PHORMIDIUM	CLADOPHORA RICHTERIELLA	ASTERIONELLA STEPHANODISCUS
SCHOEN	JULY 23/57	CANTHOCAMPTUS CYCLOPS DAPHNIA DIAPTOMUS LIMNOCALANUS	-	MICROCYSTIS	CLADOPHORA SPIROGYRA	-
WOSS	JULY 14/57	SAMPLES BADLY DETERIORATED	PRESENT	MICROCYSTIS	CLADOPHORA	ASTERIONELLA
NIMPKISH	AUG. 8/57	CANTHOCAMPTUS DAPHNIA EUBRANCHIPUS CYCLOPS	SYNCHAETA	COELOSPHAERIUM SPIROGYRA	CLADOPHORA RICHTERIELLA	STEPHANODISCUS TABELLARIA
VERNON	JULY 30/57	DAPHNIA LIMNOCALANUS	-	MICROCYSTIS	CLADOPHORA SPIROGYRA DICTYOSPHAERIUM CHAETOPHORA	-
UPPER KLAKLAKAMA	JULY 27/57	DAPHNIA DIAPTOMUS LIMNOCALANUS CANTHOCAMPTUS	PHILODINA	MICROCYSTIS TETRASPORA	CLADOPHORA	SYNEDRA
LOWER KLAKLAKAMA	AUG. 1/57	DAPHNIA LIMNOCALANUS DIAPTOMUS EUBRANCHIPUS	PHILODINA	PRESENT UNIDENTIFIED	CLADOPHORA	PRESENT UNIDENTIFIED

each lake by a Secchi disc. Readings could not always be taken under similar light and wind conditions, but despite some cloudy weather light penetration was relatively high in all lakes (Table IV). These results are consistent with the very light plankton catches, and may be considered typical for relatively unproductive lakes.

TABLE 1V. DEPTH OF LIGHT PENETRATION IN NIMPKISH LAKES

Lake	Depth in Feet (Meters)		
	Out of Sight at	In Sight at	Mean
Anutz	31.16 (9.5)	26.24 (8)	28.7
Hustan	39.36 (12)	36.08 (11)	37.72
Schoen	41.0 (12.5)	37.72 (11.5)	39.36
Nimpkish	22.96 (7.0)	21.32 (6.5)	22.14
Vernon	42.64 (13)	41.0 (12.5)	41.82
Upper Klaklakama	22.96 (7)	19.68 (6.0)	21.32
Lower Klaklakama	21.32 (6.5)	19.68 (6.0)	20.5

5. Temperatures

Depth-temperature series were taken on all accessible lakes by bathythermograph. On those lakes inaccessible by railway or road, temperature series were taken by reversing thermometer.

It was found that typical thermal stratification, or at least some indication of thermal stratification, existed at the time the lakes were studied. Bathythermograph slides are on file.

6. Soundings

The three main lakes of the system, namely Nimpkish, Woss, and Vernon, along with the smaller Anutz Lake which adjoins Nimpkish Lake, were sounded by echo sounder. From the sounding contour maps (Figs. 5, 8, and 9), it can be seen that each of the three large lakes is extremely deep and has a fast "drop-off". A relatively small percentage of their areas is in shoal water, i.e. they have typical oligotrophic basins.

7. Gillnet Catches

A gang of gillnets of varying mesh sizes was set in each lake surveyed to sample the native fish populations. Sizes of net used were 25 yards of 1" mesh 8 feet deep, 25 yards of 2" mesh 8 feet deep and 50 yards of 3" mesh 6 feet deep. The nets were set at right angles to the shore in locations thought to be most productive, with the fine meshed net anchored to shore. The 3" net was sunk and anchored, while the 1" and the majority of the 2" were usually floating. Sets were of approximately twenty-four hours duration.

From Table V, it can be seen that all lakes of the Nimpkish system support good populations of coastal cutthroat trout (*Salmo clarki*). These gillnet catches are supported by angling results of the same period.

TABLE V. GILLNET CATCHES IN THE LAKES OF THE NIMPKISH RIVER SYSTEM

Total Catches for all Mesh Sizes								
Lake	Date	Cutthroat	Dolly Varden	Sculpins	Stickleback	Sockeye	Kokanee	Coho
Woss Lake	July 14	4	5	1	-	-	-	-
	July 15	3	-	-	-	-	-	-
	July 16	-	4	-	-	1	2	-
	July 17	7	-	-	-	-	1	-
Schoen Lake	July 23*	4	-	-	-	-	-	-
	July 24	15	-	-	-	-	-	-
Lower Klaklakama	Aug. 2	14	-	3	-	-	-	2
Vernon	July 30	3	-	2	-	-	-	-
Nimpkish	Aug. 8	3	3	1	8	-	-	-
Anutz	Aug. 9	4	-	1	1	1	-	-
Hustan	Aug. 12	9	-	4	-	-	19	-

* No. 2 net only.

The cutthroat taken in all lakes had a range of from 11.0 cm. to 46 cm., and a mean length of 30.61 cm. The size distribution for each lake is recorded in Table VI, and the length-frequency distribution of the cutthroat of all the lakes is shown in Fig. 10.

Dolly Varden (Salvelinus malma) were found in Woss and Nimpkish Lakes only. Several were caught in the gillnets, but only one was taken by angling, and that one was in Woss Lake.

Small populations of sculpins (Cottus asper, C. cognatus) and sticklebacks (Gasterosteus aculeatus) were found to be present in most lakes. No other coarse fish were caught or observed.

Although one or more species of Pacific salmon is common to all lakes surveyed except Hustan, only four specimens of salmon were taken in the gillnets. Single specimens of adult sockeye (Oncorhynchus nerka) were caught in Anutz and Woss Lakes. Kokanee or "landlocked" sockeye salmon were taken from Woss and Hustan Lakes (Table VI).

It is interesting to note that Hustan Lake has a large population of small kokanee (Table VI) which proved to be four year old fish (as were the larger specimens caught in Woss Lake). Hustan Lake is not utilized by anadromous sockeye due to several impassable log jams and two falls in a sheer limestone-cut canyon

TABLE V1. SIZE DISTRIBUTION OF FISH NATIVE TO THE LAKES OF THE NIMPKISH RIVER SYSTEM

Lake	Species	Number of Fish in Sample	Range (in cm.)	Mean Length (in cm.)
All Lakes	Cutthroat	97	11.00 - 46.00	30.61
Nimpkish	Cutthroat	3	11.00 - 30.00	18.30
Anutz	Cutthroat	4	16.5 - 28.5	24.63
Hustan	Cutthroat	9	23.00 - 34.00	28.89
Vernon	Cutthroat	7	25.0 - 33.0	28.4
Lower Klaklakama	Cutthroat	23	18.0 - 44.0	31.02
Schoen	Cutthroat	19	27.0 - 35.5	31.34
Woss	Cutthroat	32	15.0 - 46.0	32.80
Hustan	Kokanee	19	12.5 - 14.0	13.30
Woss	Kokanee	3	24.0 - 25.0	24.30
Woss	Dolly Varden	10	36.5 - 45.0	40.10
Nimpkish	Dolly Varden	3	12.0 - 39.5	21.80

on Atluck Creek (Fig. 6).

Two coho (Oncorhynchus kisutch) were caught in the gillnet on Lower Klaklakama Lake on August 2nd. One, taken in the 1" net, was a smolt, while the other, caught in the 3" net, was a three year old male, having a salt-water growth of two years. Migrant coho have not previously been reported in the upper reaches of the Nimpkish System before early September.

B. Spawning Grounds Survey

1. Distribution and Relative Abundance

A survey was made throughout October and November in an effort to determine timing, distribution, and magnitude of the salmon runs to this system. Estimates of the total populations utilizing the Nimpkish system, submitted yearly by Fisheries Inspectors, are summarized in Table VII.

TABLE VII. INSPECTORS' ESTIMATES 1949-56 NIMPKISH ESCAPEMENT

Year	Sockeye	Chums	Springs	Coho	Pinks
1949	>100,000	>100,000	2- 5,000	10-20,000	5-10,000
1950	>100,000	>100,000	5-10,000	5-10,000	10-20,000
1951	>100,000	50-100,000	10-20,000	10-20,000	5-10,000
1952	>100,000	>100,000	10-20,000	10-20,000	10-20,000
1953	>100,000	50-100,000	10-20,000	10-20,000	2- 5,000
1954	50-100,000	20- 50,000	10-20,000	5-10,000	2- 5,000
1955	50-100,000	50-100,000	10-20,000	10-20,000	1- 2,000
1956	50-100,000	20- 50,000	5-10,000	10-20,000	2- 5,000

The 1957 survey, being of a preliminary nature, was concerned with making a visual assessment of the magnitude of these runs, and consequently more accurate biological methods of obtaining population estimates were not used. For this reason all population figures reported must be considered minimum. The system was surveyed on the same basis as the limnological study, and the same physical divisions were used (Fig. 3).

(a) Section 1 - Nimpkish River - from Nimpkish Lake to Broughton Strait.

This section of the system (Fig. 11) supports the entire run of chum salmon, some springs, and is thought to support the majority of the pinks. It is also, of course, the migratory route of all sockeye and coho, the majority of springs, and a few pinks.

(1) Pinks - One trip was made by rubber boat on September 20, and no fish were observed spawning in the river at that time. One school of pinks, estimated at 500-1000 fish, was observed in estuarial water. The next float trip was made on October 21, and again no spawning pinks were seen in the river. However, three pink carcasses were observed near the mouth of a small stream three hundred yards above the outlet of Nimpkish Lake (See Fig. 11). Pinks have been reported in Willow Creek (Fig. 1) during previous years, but several inspections revealed no spawning fish or signs of previous spawning.

(2) Springs - A small number of springs were observed to spawn among the chums (Fig. 11). Counts and *point estimates were made on each

*point estimate - i.e., where the concentration of fish was so great as to prohibit actual counting, estimates were made.

float trip, and are summarized in Table V111. The spring run was considered light this year by local residents, and the usually heavy sports fishery at the mouth reportedly failed to materialize.

TABLE V111. COUNTS AND POINT ESTIMATES OF SPRINGS AND CHUMS IN THE NIMPKISH RIVER

Date	Springs								Total	
	Section 1		Section 11		Section 111		Section 1V		Live	Dead
	Live	Dead	Live	Dead	Live	Dead	Live	Dead		
Oct.21	175	0	250	0	100	0	0	0	525	0
Oct.25	200	0	200	0	100	0	0	0	500	0
Nov. 7	0	0	0	0	0	0	0	0	0	0
Nov.18	0	0	0	0	0	0	0	1	0	1
Nov.22	3	0	0	0	0	0	0	0	3	0
	Chums									
Oct.21	900	0	1850	0	725	0	200	0	3675	0
Oct.25	1600	0	2600	0	1000	0	300	0	5400	0
Nov. 7	8	0	5	0	0	0	200	0	213	0
Nov.18	22	0	725	0	50	0	0	2	797	2
Nov.22	8	0	723	0	1050	5	0	0	1781	5

(3) Chums - During the period of the survey an estimated 10,000 chums spawned in the lower river. From November 25, when the survey ended, to January 10, a further 20,000 fish were estimated to have spawned in the same relative areas (Fig. 11). Counts, and point estimates, where heavy

concentrations of fish made actual counting impractical, were carried out on each float trip (Table VIII). Very few dead chums were seen. This was expected since in a river of this size dead and weakened fish either float downstream and are lost in the salt water or are lost in the numerous deep pools. The Inspectors reported fair numbers of dead spawned-out chums in the estuary late in December.

(b) Section 11 (a) - Nimpkish Lake - No spawning salmon of any species were seen in the lake except at the head end, where approximately 30 sockeye spawned on a bar near the mouth of Anutz River.

All streams flowing into the lake were examined, but only one (other than the Anutz and Klaanch Rivers) was considered to have suitable grounds. This one, Willow Creek, also had no spawning salmon this year, although both pinks and sockeye have been reported in previous years.

(c) Section 11 (b) - Anutz River, Anutz Lake, Atluck Creek - This system was found to support a fair number of sockeye, some coho, and a few springs. The distribution of each is given in Fig. 6, and Table IX (a) shows the counts and point estimates made during each inspection.

TABLE IX (a). COUNTS AND POINT ESTIMATES OF SPAWNING SALMON ANUTZ-ATLUCK SYSTEM

Date	Sockeye							
	Anutz River		Anutz Lake		Atluck Creek		Total	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead
Sept.23	0	0	0	0	400	0	400	0
Oct. 17	565	4	300	0	750	4	1615	8
Oct. 22	580	0	300	0	950	16	1830	16
Oct. 27	0	17	N.C.	7	N.C.	N.C.	N.C.	24
Oct. 31	84	35	N.C.	8	75	0	159	43
Nov. 5	100	76	N.C.	4	15	9	115	89
Nov. 6	55	73	N.C.	N.C.	N.C.	N.C.	55	73
Nov. 14	6	56	1	14	1	0	8	70

Date	Springs Anutz Lake	Coho Anutz Lake	Coho Atluck Creek	Total Coho Live	Total Coho Dead
Sept.23	0		50	50	0
Oct. 17	20	N.C.	-	-	-
Oct. 22	40	230	90	320	0

From the counts obtained in Anutz River and Atluck Creek, it is possible to obtain population estimates. A life-span of 16 days on the actual spawning grounds is considered average for spawning sockeye. Table IX (b) shows the method of calculation and the total estimated numbers of sockeye in Anutz River and Atluck Creek. The point estimate recorded on Anutz Lake (Table IX (a)) must be considered minimum, as only a portion of the spawning fish could be observed due to visibility limits.

TABLE 1X (b). ESTIMATES OF SOCKEYE IN ANUTZ RIVER AND ATLUCK CREEK

Date	Actual Count	Accumulation	Cum. Total
		Anutz River	
Oct. 17	569	569	569
22	580	580 - (11/16 x 565)	
		580 - 388 = 192	761
31	84	84 - (7/16 x 580)	
		- 99 = 0	761
Nov. 5	100	100	861
		Atluck Creek	
Sept.23	400	400	400
Oct. 17	754	754	1154
22	950	950 - (11/16 x 750)	
		- 517 = 433	1587
	Total		2448
	Total in Anutz Lake		300
	Grand Total		2748

Thus a total minimum estimate for the system is 2748 sockeye.

From October 27 until the end of the survey, heavy rainfall and consequent flooding conditions made counting impossible on Atluck Creek (N.C. =

no count) and extremely difficult elsewhere.

(d) Section 111 - The section consists of the Klaanch, or Upper Nimpkish River, from its entrance into Nimpkish Lake south to its junction with the Davie River. A small amount of mainstem spawning occurred between Karmutsen Falls and slightly below the Woss River junction. An estimated 1000 sockeye utilized this portion of the river (See Fig. 12).

(e) Section lV - Woss Lake and River. This section was found to be the main sockeye spawning area of the system. During one point of the migration period, the concentration of sockeye in the vicinity of the Woss-Klaanch junction was estimated at 50,000 fish.

A small number of coho, and the majority of spring salmon also spawn either in Woss River (springs) or in Woss Lake (springs and coho). Table X (a) shows the sockeye counts and point estimates on Woss Lake, Table X (b) shows the same on Woss River, and Table X (c) shows spring salmon counts on Woss Lake and River. Figure 7 shows the distribution of spawning on Woss Lake, and Figure 12 shows the same on Woss River, plus the mainstem spawning in the Klaanch River. The numbers (Fig. 7) indicate the maximum counts and point estimates of sockeye for each section.

TABLE X(A) COUNTS AND POINT ESTIMATES OF SOCKEYE SPAWNING IN WOSS LAKE

DATE	SECTION 1		SECTION 2		SECTION 3		SECTION 4		SECTION 5		SECTION 6		SECTION 7		SECTION 8		SECTION 9		SECTION 10		SECTION 11		SECTION 12		SECTION 13		SECTION 14		SECTION 15		TOTALS	
	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD	LIVE	DEAD
OCT. 24	N.C.		N.C.		N.C.		N.C.		600	15	4000	52	2464	31	150	2	200	0	500	0	N.C.		N.C.		N.C.		N.C.		N.C.		7914	100
OCT. 28	3500	0	400	0	525	2	250	5	350	7	3700	29	2150	49	675	8	238	5	750	0	600	11	220	5	769	5	530	4	300	3	14957	133
OCT. 31	3000	0	450	4	600	6	N.C.		N.C.		N.C.		N.C.		N.C.		N.C.		N.C.		N.C.		N.C.		N.C.		N.C.		1100	5	5150	15
NOV. 4	3500	0	1000	0	309	37	19	6	92	24	730	31	2496	168	714	63	N.C.		N.C.		N.C.		300	18	789	82	1081	143	1050	36	12080	608
NOV. 14	2500	50	2	69	139	204	100	50	298	576	1200	800	532	795	316	189	191	202	300	84	150	39	N.C.		N.C.		N.C.		508	468	6236	3526
NOV. 25	1500	600	15	186	66	340	23	85	200	600	784	895	473	1163	120	93	80	157	121	63	N.C.		N.C.		75	500	N.C.		478	533	3935	5215

TABLE X (b). COUNTS AND POINT ESTIMATES OF SOCKEYE SPAWNING IN WOSS RIVER

Date	Section 1		Section 2		Section 3		Section 4		Totals	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
Oct. 31	862	0	889	4	228	0	6500	26	8479	30
Nov. 17	4800	4500	2150	2700	4300	6500	600	5200	11850	18900
Nov. 24	6500	9200	1100	3500	1500	7100	800	9500	9900	29300

TABLE X (c). COUNTS AND POINT ESTIMATES OF SPRINGS SPAWNING IN WOSS LAKE AND RIVER

WOSS RIVER

Date	Section 1		Section 2		Section 3		Section 4		Totals	
	Live	Dead	Live	Dead	Live	Dead	Live	Dead	Live	Dead
Oct. 31	191	0	147	0	23	0	25	0	386	0
Nov. 17	425	7	13	5	1	4	160	17	599	33
Nov. 24	80	27	1	9	0	21	0	2	81	59

WOSS LAKE

Date	Section 1		Section 2		Section 3			Totals	
	Live	Dead	Live	Dead	Live	Dead		Live	Dead
Oct. 28	200	-	30	-	25	-		255	0
Oct. 31	175	-	35	-	0	-		210	0
Nov. 4	300	-	0	-	3	-		303	0
Nov. 16	0	-	0	-	0	-		0	0

Summation of the numbers of sockeye in each section of the lake shows a total observed escapement of 18,018. This must be considered a minimum figure as observation was limited by visibility. In certain places where unusually good visibility occurred, sockeye were observed spawning in depths of 25 feet. In other lakes where beach spawning occurs and where known numbers have entered the lake it has been found that only 10 percent of the fish are observable on spawning ground surveys. The calculated estimate of sockeye spawning in Woss River is presented in Table XI. This total, 24,884, plus the total from the lake, gives a minimum total escapement to the Woss System of 43,002 sockeye.

TABLE X1. CALCULATED SOCKEYE POPULATION OF WOSS RIVER

Date	Section 1		Section 11		Section 111		Section 1V	
	Actual Count	Cumu-lative Total	Actual Count	Cumu-lative Total	Actual Count	Cumu-lative Total	Actual Count	Cumu-lative Total
Oct.31	862	862	893	893	228	228	6526	6526
Nov.17	4800	5662	2150	3043	4300	4528	600	7126
Nov.24	6500	9762*	1100	3068	1500	4528	800	7526
GRAND TOTAL = 24,884								

*Calculated as in Table IX (a).

Approximately 200 coho were found spawning in the three glacial streams at the south end of Woss Lake (Fig. 7 - A, B, C).

(f) Section V - Davie River System. The Davie River, accessible to both sockeye and coho, had some mainstem coho spawning in the upper reaches (See Figs. 13 & 4). Sockeye have been reported in Schoen Lake (Fig. 4) in previous years, but none were observed in 1957. A medium seeding of coho was found in the two small streams at the head of Schoen Lake.

A small number of sockeye, and a considerably larger number of coho, were found to spawn in the small stream connecting Upper and Lower Klaklakama Lakes. The outlet stream leading into Davie River also supported a good number of coho (Fig. 13).

(g) Section V1 - Upper Klaanch River. This section of the river, from the Davie River junction to the headwaters (Fig. 3) supports the largest portion of the coho run. 13,000 of an estimated 16,000 escapement (1957) were found to spawn throughout this area (Fig. 14). The amount of gravel available for spawning is such that it is possible to accommodate many times this number of adult fish.

(h) Section V11 - Sebalhall System. Composed of the Sebalhall River and Vernon Lake, this system supports a small number of coho and has been known to have a light population of sockeye. Sockeye were not observed in 1957, but some coho were found in the Sebalhall River below Vernon Lake, and in Airport Creek on Vernon Lake (See Fig. 14). A few coho were seen in shallow water along the gravel beaches of the eastern shore (Fig. 14) but it could not be ascertained whether spawning occurred at those sites.

Despite its relatively unlimited area of good gravel, the Upper Sebalhall River (flowing into Vernon Lake) had no fish at the time of survey and showed no evidence of previous spawning.

2. Timing of Migration and Spawning Periods

Information on the timing of the migration and spawning periods of all species of salmon was obtained during both phases of the program. Each species is dealt with individually as follows:

(a) Sockeye - Migration of adult sockeye into the Nimpkish River usually begins around the 1st of June, peaks in the third week, and ends in the first week of July.

The first migrants appear at Karmutsen Falls in the first week of July. During 1957 a peak concentration below the falls occurred on July 23, held until July 26, and then dropped off rapidly. In August, a repetition of this rapid build-up re-occurred, with the peak considerably larger than that of July, occurring on August 21. From

August until the second week in October, the start of spawning in the Woss system, the fish matured in the deep pools of the main Klaanch between the Woss junction and Karmutsen Falls. The peak of spawning occurred during the period of October 28 to November 4 in Woss Lake, and the majority had ceased by November 25. On Woss River, the peak occurred around November 17, and was dropping off, but could not be considered ended, by November 24.

Sockeye were found maturing on the spawning grounds of the Atluck system on September 23. Spawning started shortly after, the peak occurred between October 17 and 22, and ended by November 5.

No data is available for the timing of sockeye spawning in the area upstream from Karmutsen Falls. However, spawning on Klaklakama Creek had finished by November 20, when 38 carcasses, but no live fish, were found.

(b) Chums - All chums were found to spawn in the Lower Nimpkish River no more than five miles from the estuary. The movement into the river occurred less than two weeks before the spawning period. Spawning commenced in the second week of October and peaked between October 21 and 25. The end of this part of the run occurred in the first week of November. A gradual build-up occurred again, starting around November 7 and peaking around November 22. Fish continued to enter the river and spawn until the first week of January.

(c) Coho - Coho entered the river late in August, and the peak of their migration occurred at Karmutsen Falls during the last week of September. Spawning fish were seen throughout the entire system above Karmutsen Falls on November 20, which was considered to be fairly close to the peak.

(d) Springs - The main run of springs entered the river in September, and spawned in the Woss system at the same time as the sockeye. A later run entered the system early in October, spawned below Nimpkish Lake along with the chums late in October, and was finished by early November.

(e) Pinks - Very few pinks were observed in the system in 1957. A school of migrating pinks was observed on September 20 in the estuary of Nimpkish River, and one carcass was found on October 23 at the exit of Nimpkish Lake. No pinks were found during their spawning period anywhere in the system.

3. Karmutsen Falls Fishway Counts

During the peak period of sockeye concentration at Karmutsen Falls in July, an attempt was made to assess the efficiency of the fishway and to obtain some information on the numbers of sockeye entering the upper system, by counting at the exit of the fishway. Counts were of twenty minute duration interrupted by ten minute rest periods.

It was observed at all times that the fish did not appear to be excessively active at the falls. Very few "jumpers" were seen. However, relatively high water levels may have allowed numbers of fish to surmount the falls without jumping.

Relatively few sockeye were found to utilize the fishway. On July 25, 26, 27, and 28 a total of 195 sockeye, during a period of 16 hours and 40 minutes actual counting, were observed through the fishway. Further counts on August 7, 22, 23, and 28 totalling 5 hours actual observation passed 20 sockeye.

During this entire period a fluctuating population of sockeye was present in the pools immediately downstream from the falls. From July 25 to 28 an estimated 10,000 to 15,000 fish were concentrated in that area, with lesser numbers as time progressed.

The number of jumping fish observed in the large pool upstream from the falls indicated the presence of a considerably larger number of sockeye than could be accounted for by fishway counts. From this it is evident that a certain number of fish must succeed in jumping, or swimming over the falls. Some of these fish were traced to Klaklakama Lakes; the remainder could have reached Schoen and Vernon Lakes and spawned at an earlier or later date than that of inspection; a number could have spawned in the main Davie River, or more likely, in the main Klaanch River. If the latter occurred, it is quite conceivable that a good number of fish could have been missed, the available spawning areas being so large.

IV DISCUSSION

In addition to its primary purpose of obtaining information on the general productivity of the Nimpkish system, the limnological survey was also designed to determine the approximate areas in which salmon could spawn. The success of the fall spawning grounds survey depended to a high degree on the information thus obtained. While the limnological results indicate that the lakes of the system are relatively unproductive, it has been observed for many years (Table VIII) that large runs of salmon are successfully supported.

The spawning ground survey conducted in 1957 served mainly to establish the timing and distribution of the various salmon runs. It was also successful in obtaining information on the relative abundance of the different species in 1957. However, the figures in Tables VIII to X indicate to some degree the large numbers of salmon, especially sockeye, which utilize the system. It should be pointed out that past experience from similar surveys checked against fishway counts and fence counts show that figures such as these are absolute minimum estimates. In some cases where lake spawning sockeye have been estimated by this type of survey, then checked against accurate fence or fishway counts, the survey estimates in some cases have been only 10 percent of the actual numbers. A tagging program would vastly increase the accuracy of these estimates.

Thus, summing the calculated estimates for the Anutz-Atluck system, the Woss system, the main Klaanch, and the Davie River (Klaklakama Lakes) system, results in a total minimum escapement of approximately 46,800 sockeye in 1957. Similarly, minimum estimates of the other species present were as follows: chums, 30,000; coho, 16,000; springs, 2500; pinks, 500-1000. This visual method of population estimation has serious disadvantages when lake spawning sockeye are concerned. In this case though the minimum estimate is 46,800 it is probable that 100,000 and conceivable that 200,000 sockeye used this system this year.

Results of observations at Karmutsen Falls fishway indicate that despite the tremendous concentration of sockeye below the falls and the resultant assumption that the falls "block" migration, relatively few sockeye ascend to the upper reaches of the system.

Although the fishway is utilized by some sockeye, observations indicate that the area immediately downstream from the falls and extending to a point two miles downstream from the Woss-Klaanch junction is the area in which the majority of the sockeye mature before entering the spawning grounds of Woss Lake and River.

Supporting evidence is found in the 1951 tagging results in which fish tagged at Karmutsen Falls were recovered in Woss River. In 1957, although an estimated 1000 sockeye spawned in the main Klaanch below the falls, no abnormal number of dead unspawned fish was discovered (as was reported in 1951). The fishway, however, is an efficient aid to the coho run, the major portion of which spawns above Karmutsen Falls.

V SUMMARY

A. Limnological Survey

1. The lakes of the Nimpkish River system, from the study of their general characteristics and productivity, appear to be typical coastal lakes, and as such are capable of supporting populations of resident fish (notably trout) as well as anadromous salmon.
2. The many miles of streams and rivers were found to have large areas of suitable gravel available for spawning salmon.
3. The lakes may be considered suitable areas for the rearing of those salmon whose life cycles include a period of fresh-water existence.

B. Spawning Survey

1. Populations of all five species of Pacific salmon were found to utilize the spawning grounds of the

Nimpkish system. The runs of sockeye, churns, and coho are of major commercial importance, while springs and pinks contribute to a lesser degree.

2. Spawning occurs throughout the length of the system with the major areas being Woss Lake, which supports the majority of sockeye and springs, and the Nimpkish River (Nimpkish Lake to Broughton Strait) which supports all chums, some springs and is thought to accommodate the majority of pinks.
3. The Upper Nimpkish, (Klaanch) above Karmutsen Falls, supports the majority of the coho as well as a few sockeye.
4. The spawning grounds of the system above Karmutsen Falls have a capacity far exceeding the numbers of fish at present utilizing them.
5. Karmutsen Falls is the present natural limit of migration of the major body of sockeye.

VI RECOMMENDATIONS

This survey report, through description of the salmon runs and their environment has demonstrated the serious problems that will be created by the proposed hydroelectric development. It is important that further studies be commenced to provide solutions to these problems.

A tagging program should be carried out to improve population estimates of all species and especially sockeye.

This program will also refine much of the other information contained in this report.

A study of the role of Nimpkish Lake as a rearing area should be carried out. The first stage of this program would be a measure of the number of young salmon migrants entering and leaving the lake.

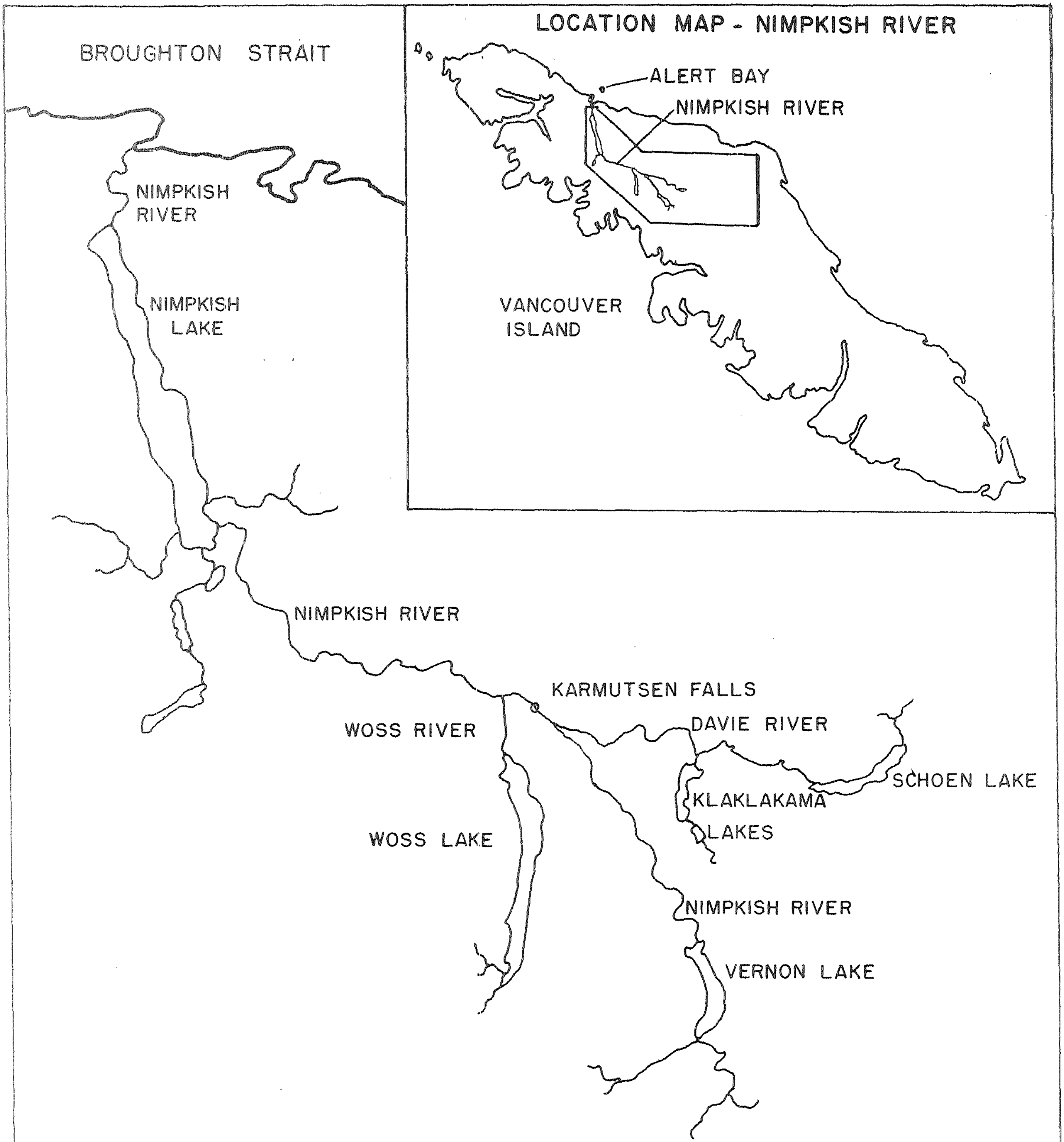
The timing of the downstream migrations of all species along with sizes and ages of migrants should be established before the power development is started.

The proposed flood line of the reservoir should be inspected with a view to its anticipated effect on spawning grounds.

The possibility of rehabilitating the system above Karmutsen Falls should be considered since the fishway at the falls has removed the only major obstruction to the four lakes and many miles of available spawning and rearing areas.

Department of Fisheries, Canada
Vancouver, B. C.

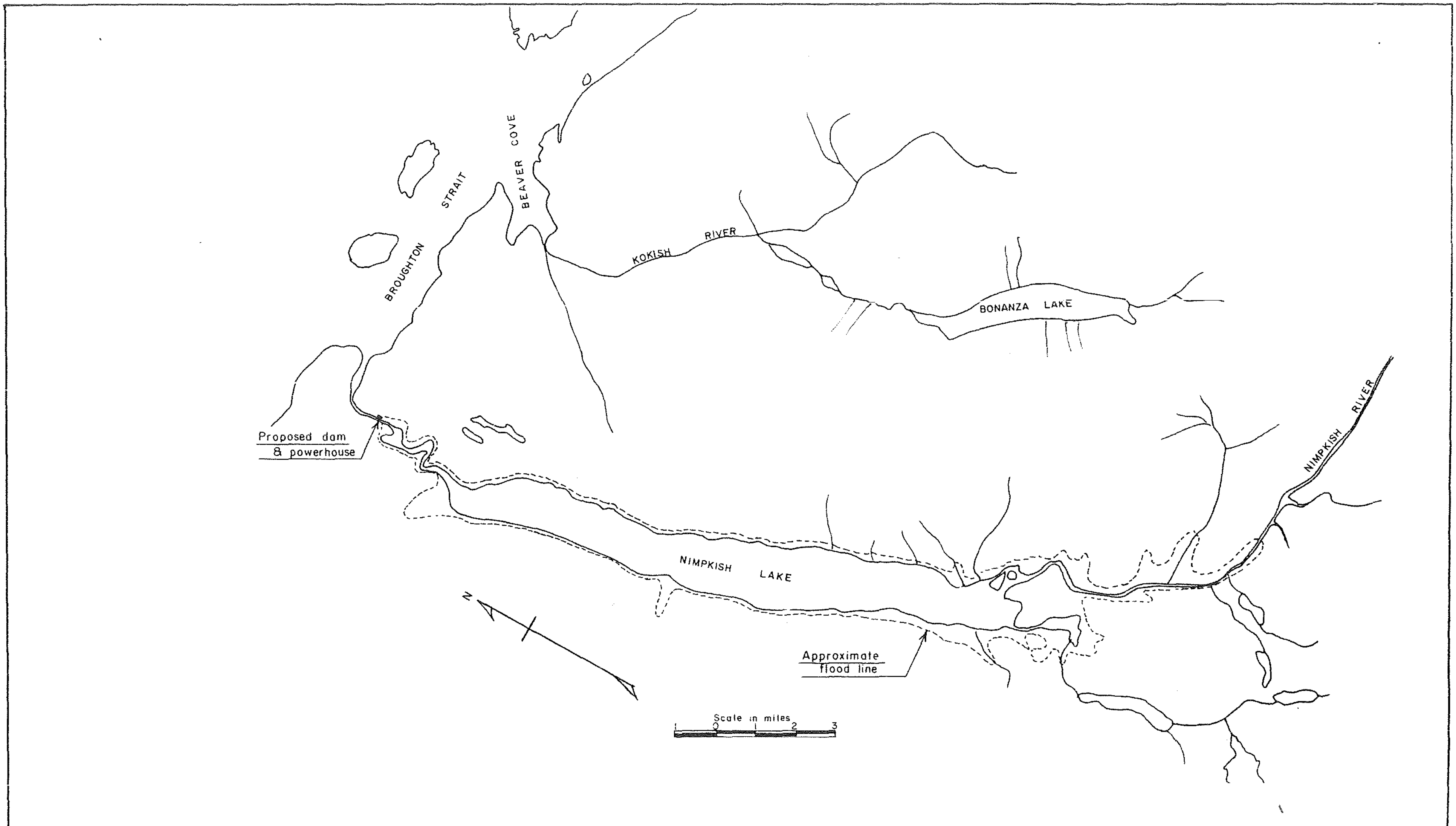
March 1, 1958.



NIMPKISH RIVER SYSTEM

SCALE: I INCH EQUALS 8·27 MILES

Figure I



NIMPKISH RIVER DEVELOPMENT
SHOWING
APPROXIMATE FLOOD LINE

Figure 2

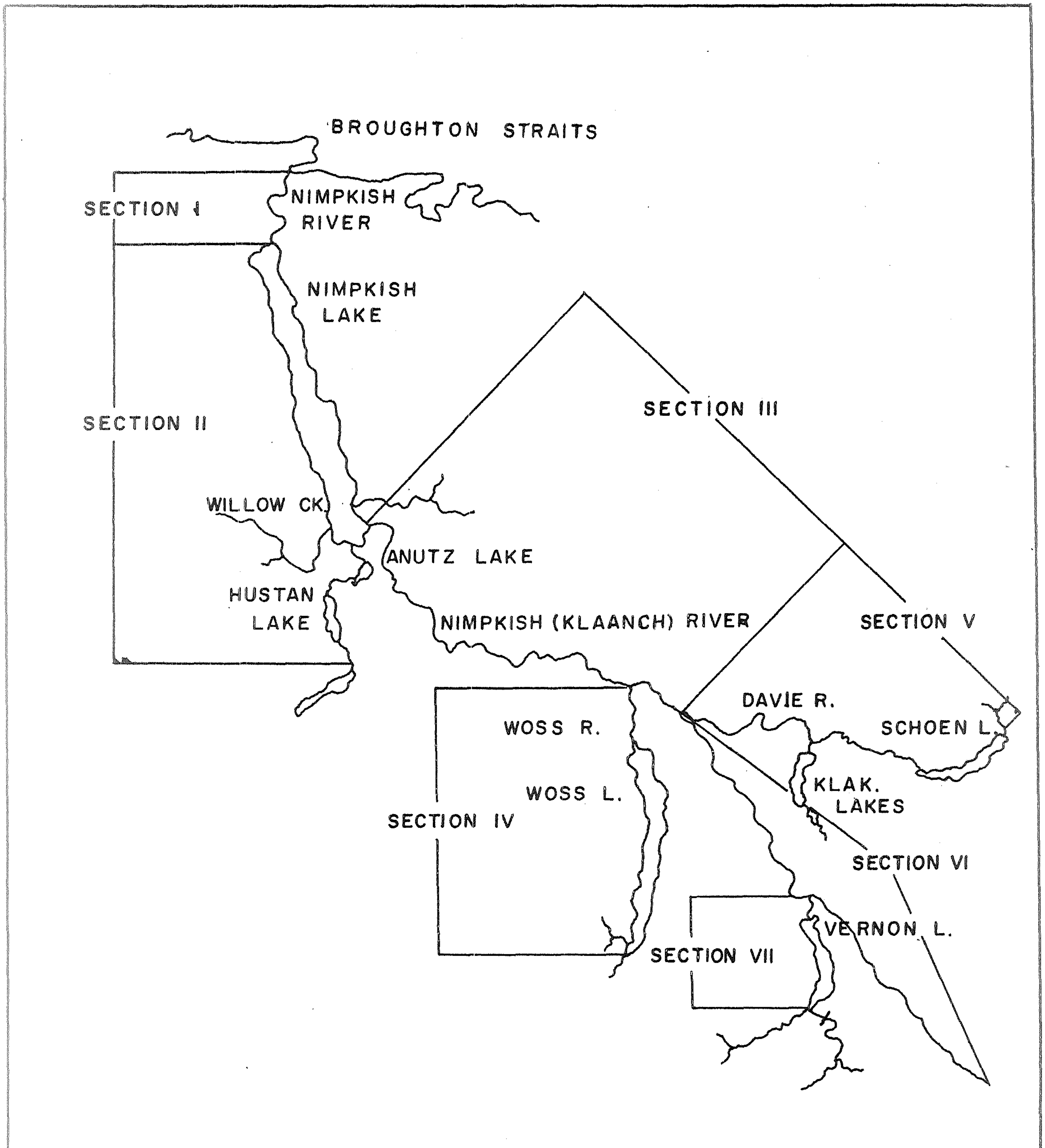
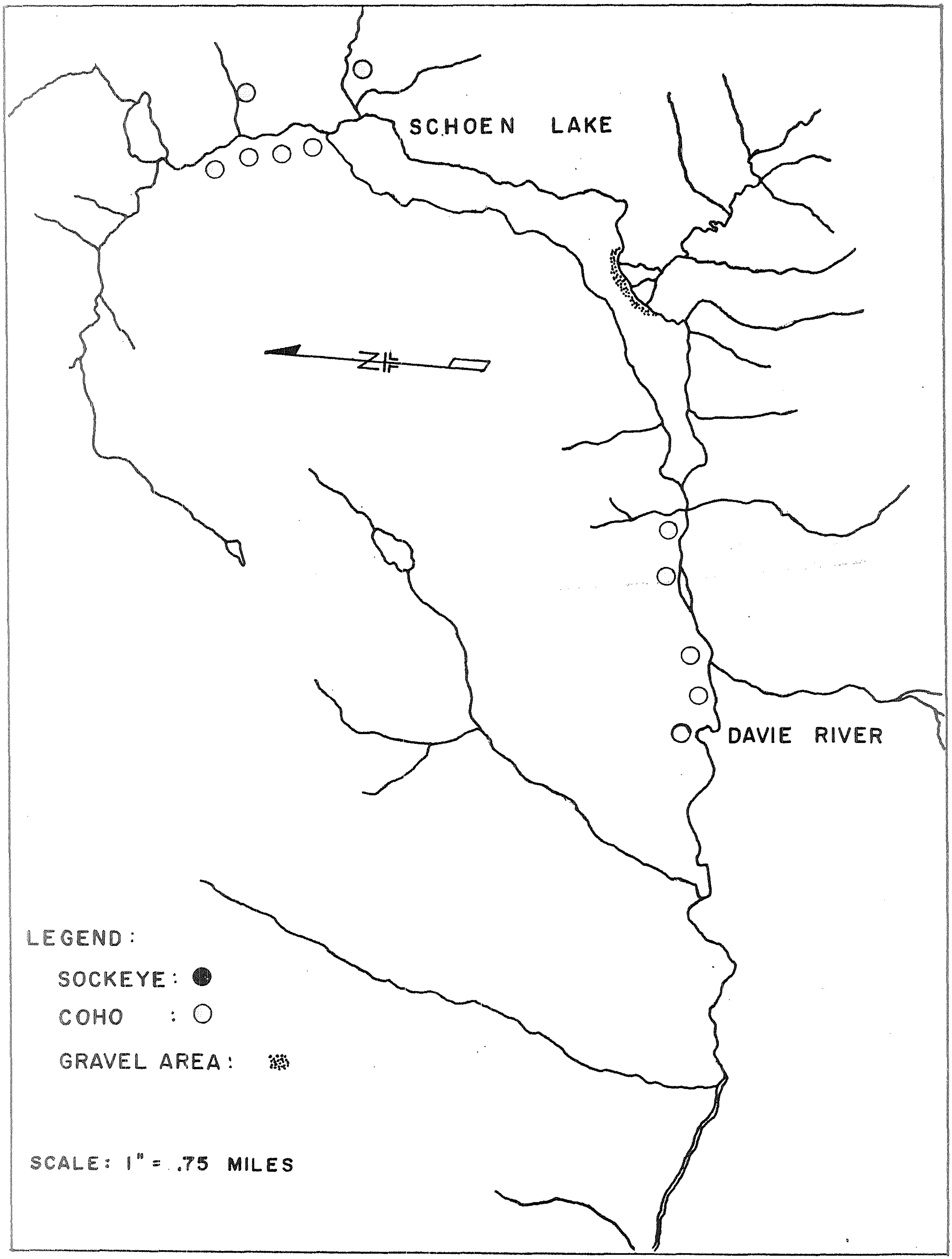


Figure 3

The Topographical Division of the Nimpkish River System into sections for Biological Survey.

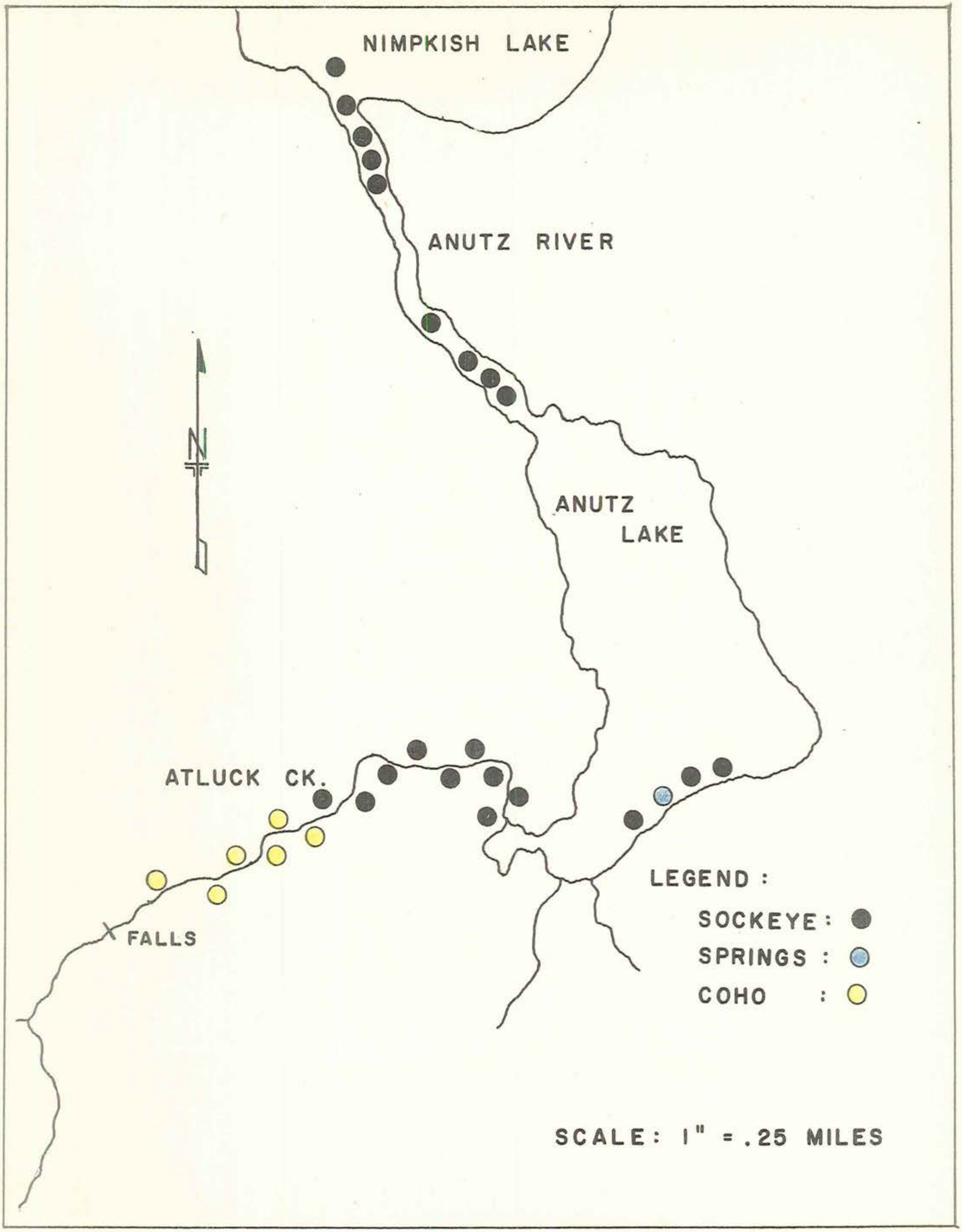


Section V(b) – Distribution of Spawning Salmon in the Davie River and Schoen Lake

Figure 4

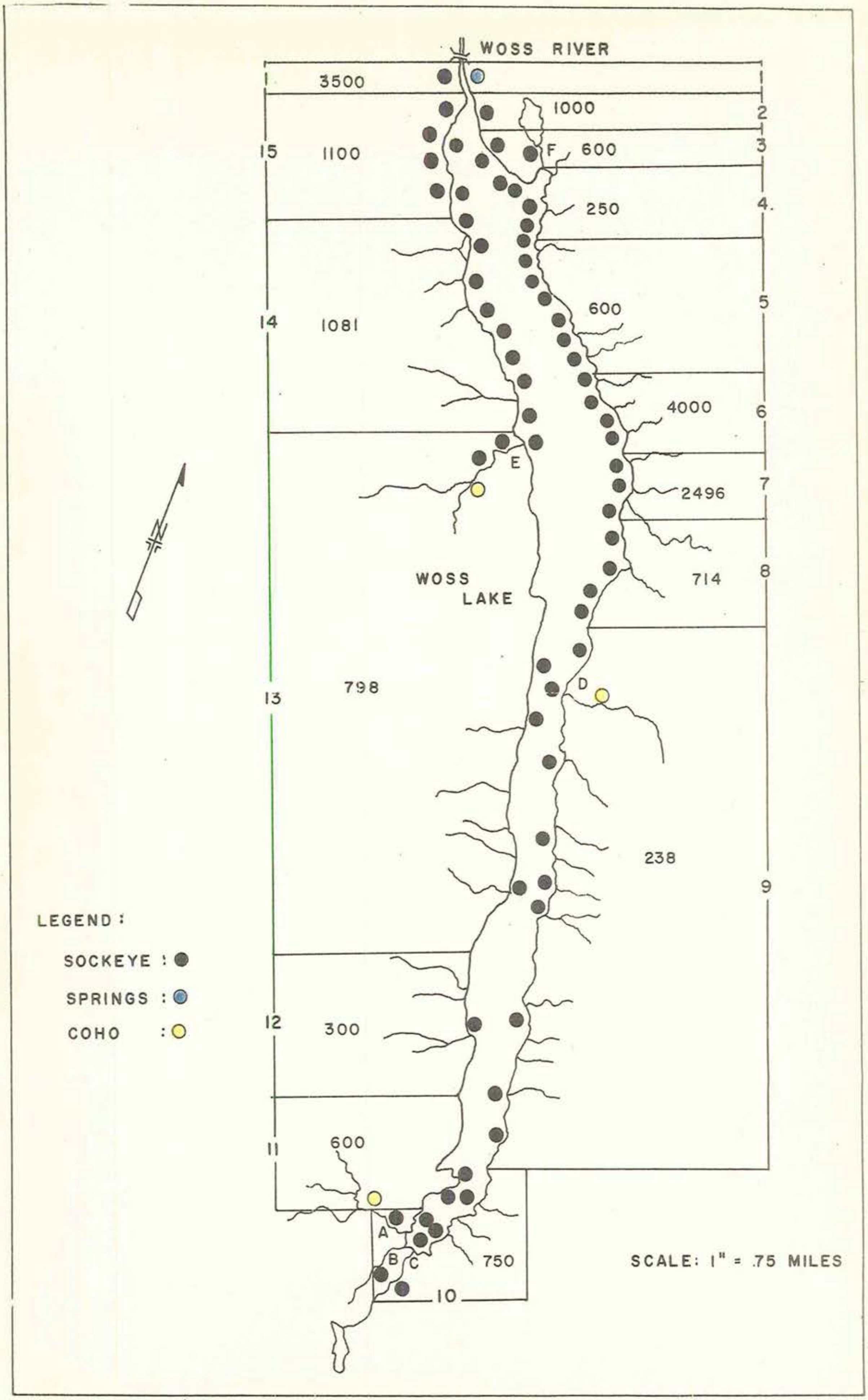
100
200
300
400
500
N
500
400
300
200
100
WOSS LAKE
DEPTH CONTOUR MAP
DEPTH CONTOURS IN FEET
Scale :- 1 : 50,000

Figure 5



Section II(b) - Distribution of Spawning Salmon in the Anutz-Atluck River System.

Figure 6



Section IV (b) - Distribution of Salmon Spawning in Woss Lake

Figure 7

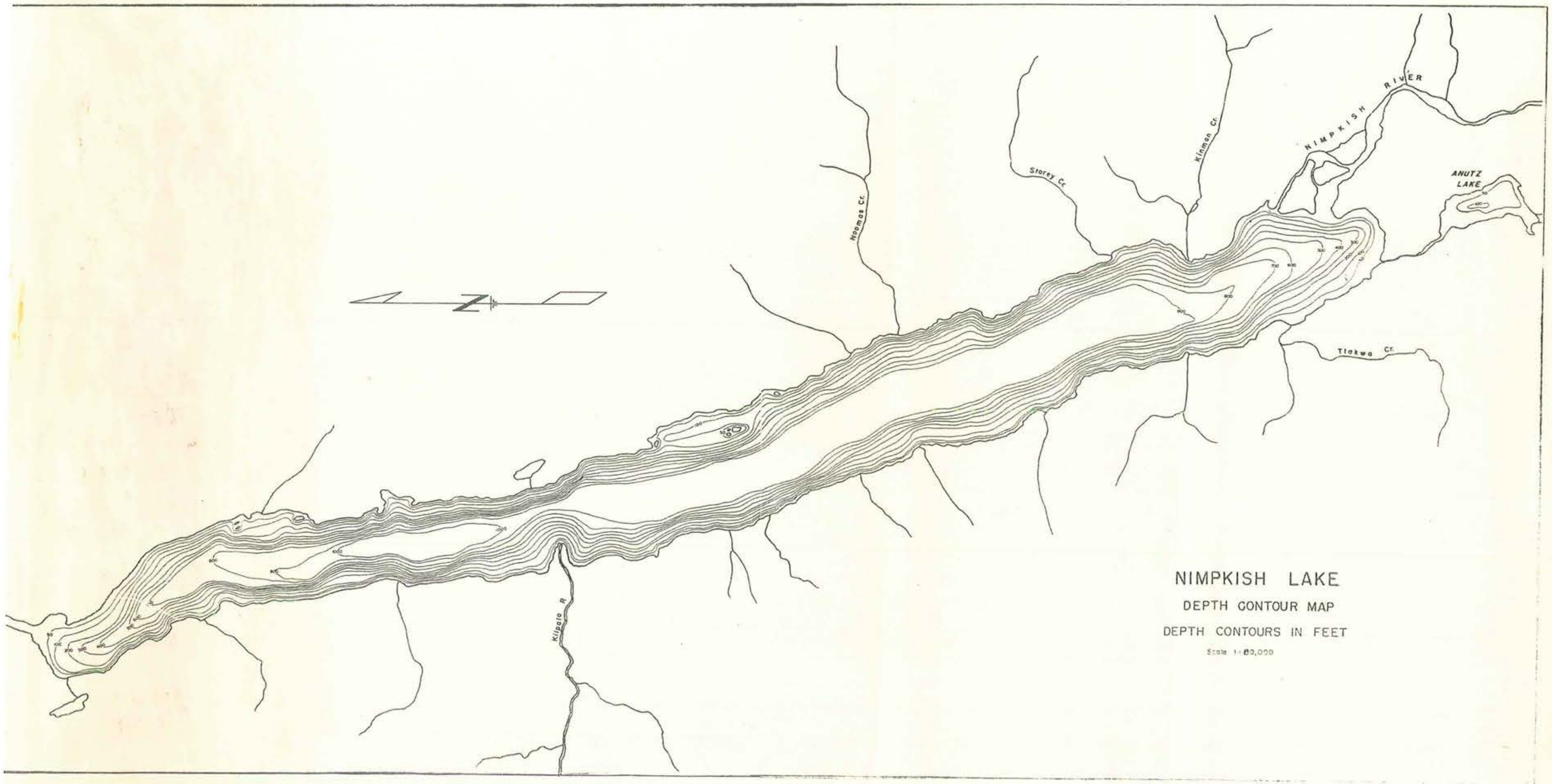

NIMPKISH RIVER
ANUTZ LAKE
Kinman Cr.
Storey Cr.
Noomas Cr.
Tlakwa Cr.
Kilpala R.
NIMPKISH LAKE
DEPTH CONTOUR MAP
DEPTH CONTOURS IN FEET

Figure 8

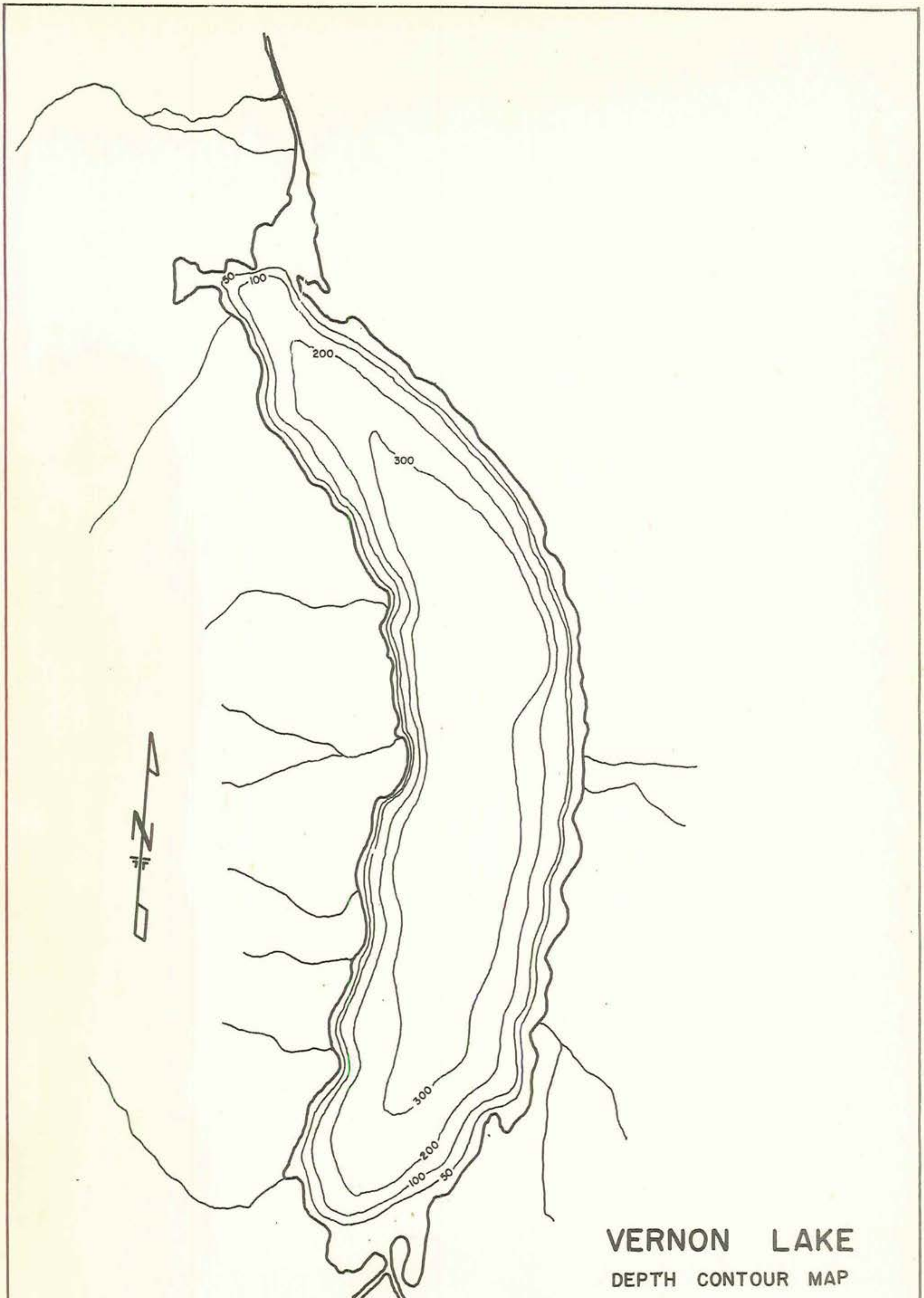
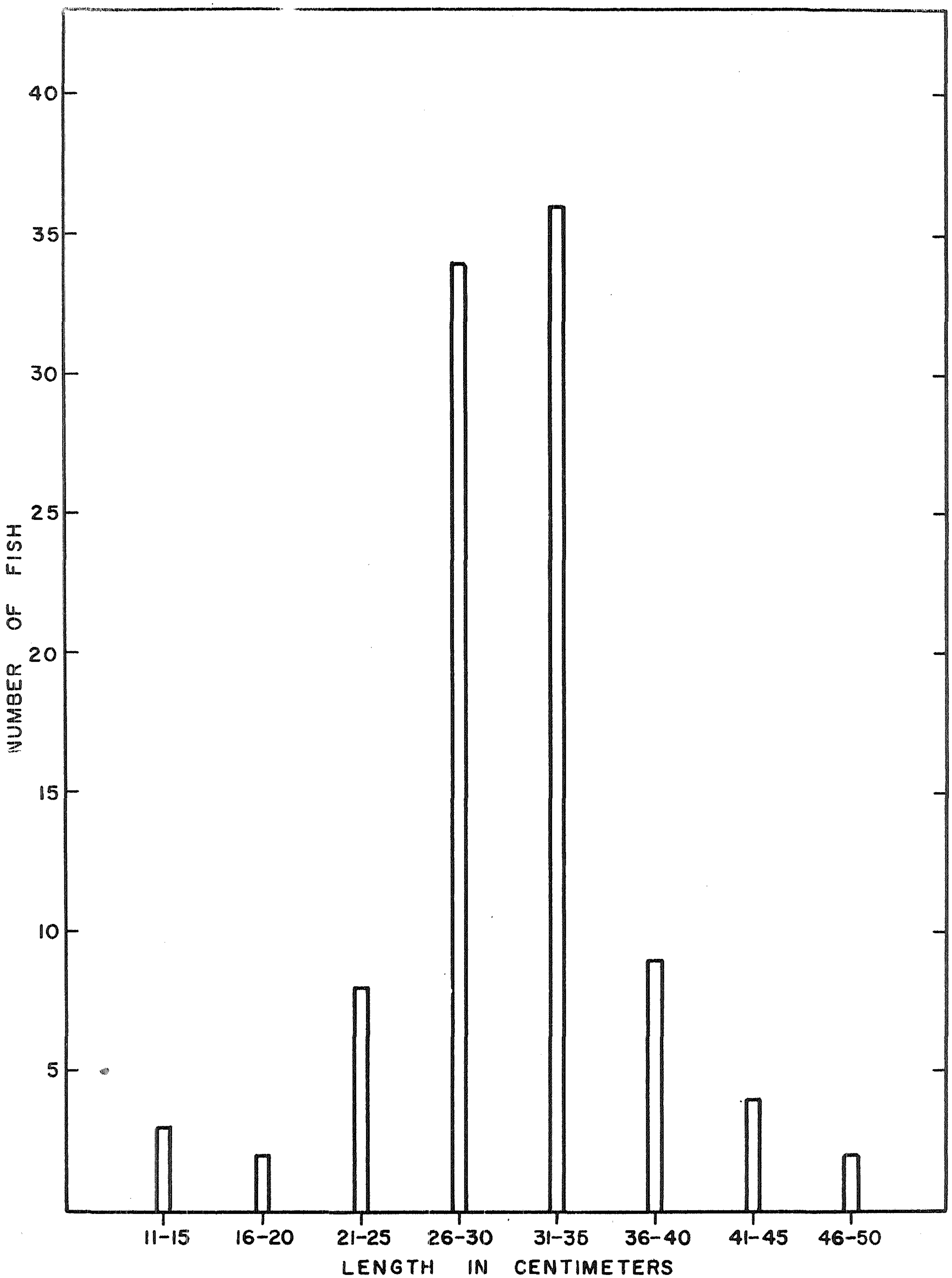
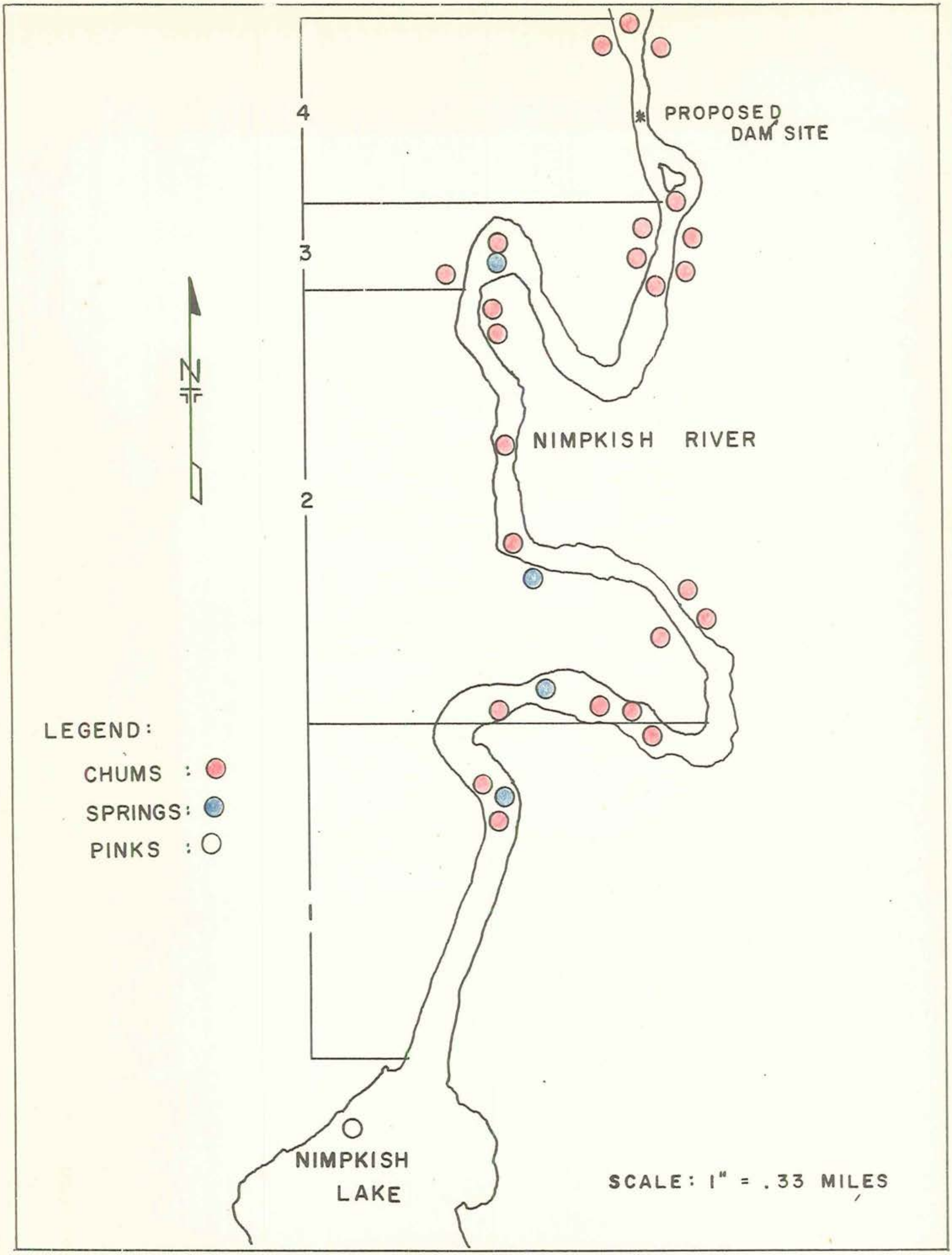

50
100
200
300
300
200
100
50
N
VERNON LAKE
DEPTH CONTOUR MAP
DEPTH CONTOURS IN FEET
Scale:– 1" = 2000'

Figure 9

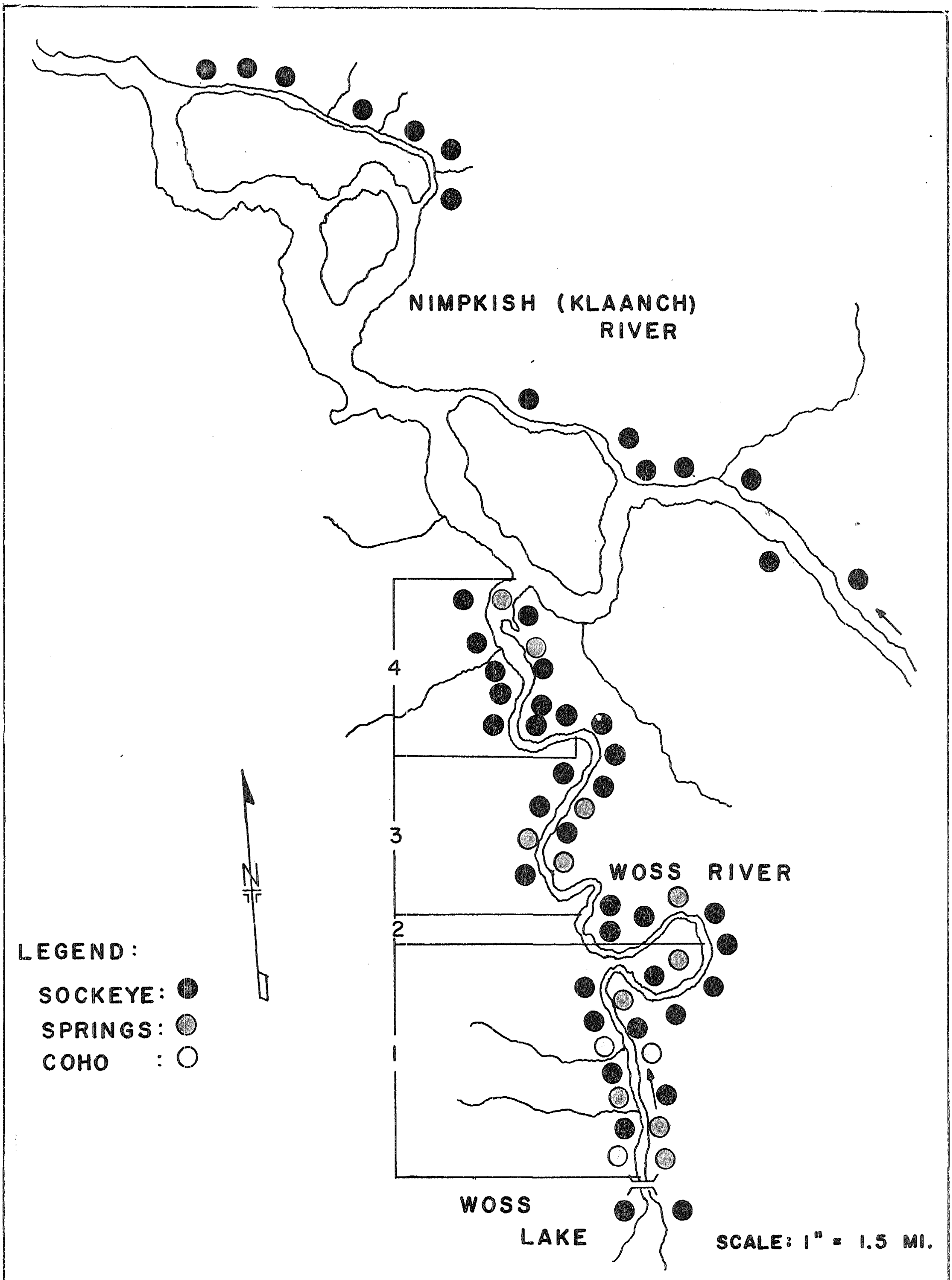


The Length-Frequency Distribution of Cutthroat Trout sampled in all lakes of the Nimpkish River System.

Figure 10

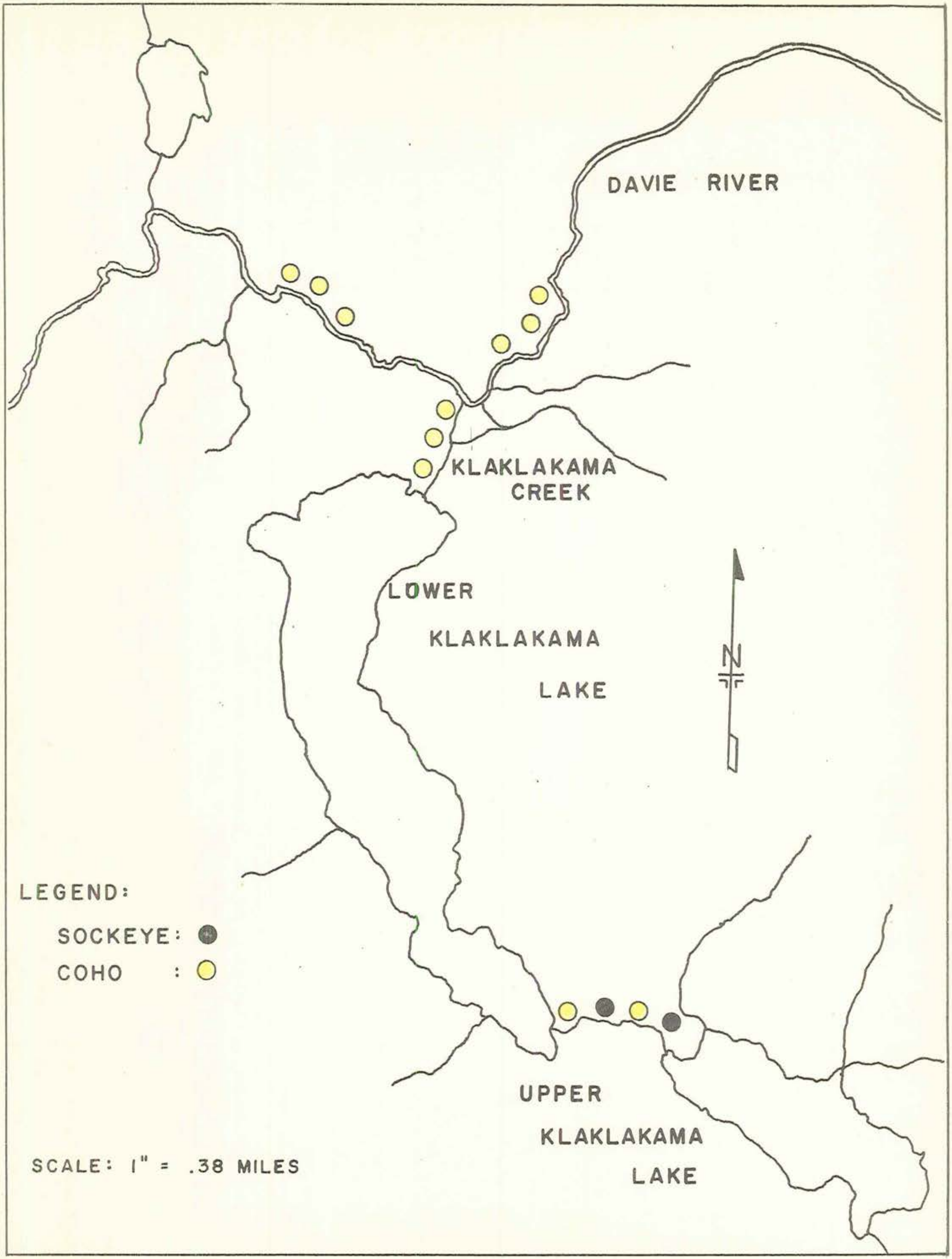


Section I - Distribution of Spawning Salmon in the Nimpkish River. Figure 11



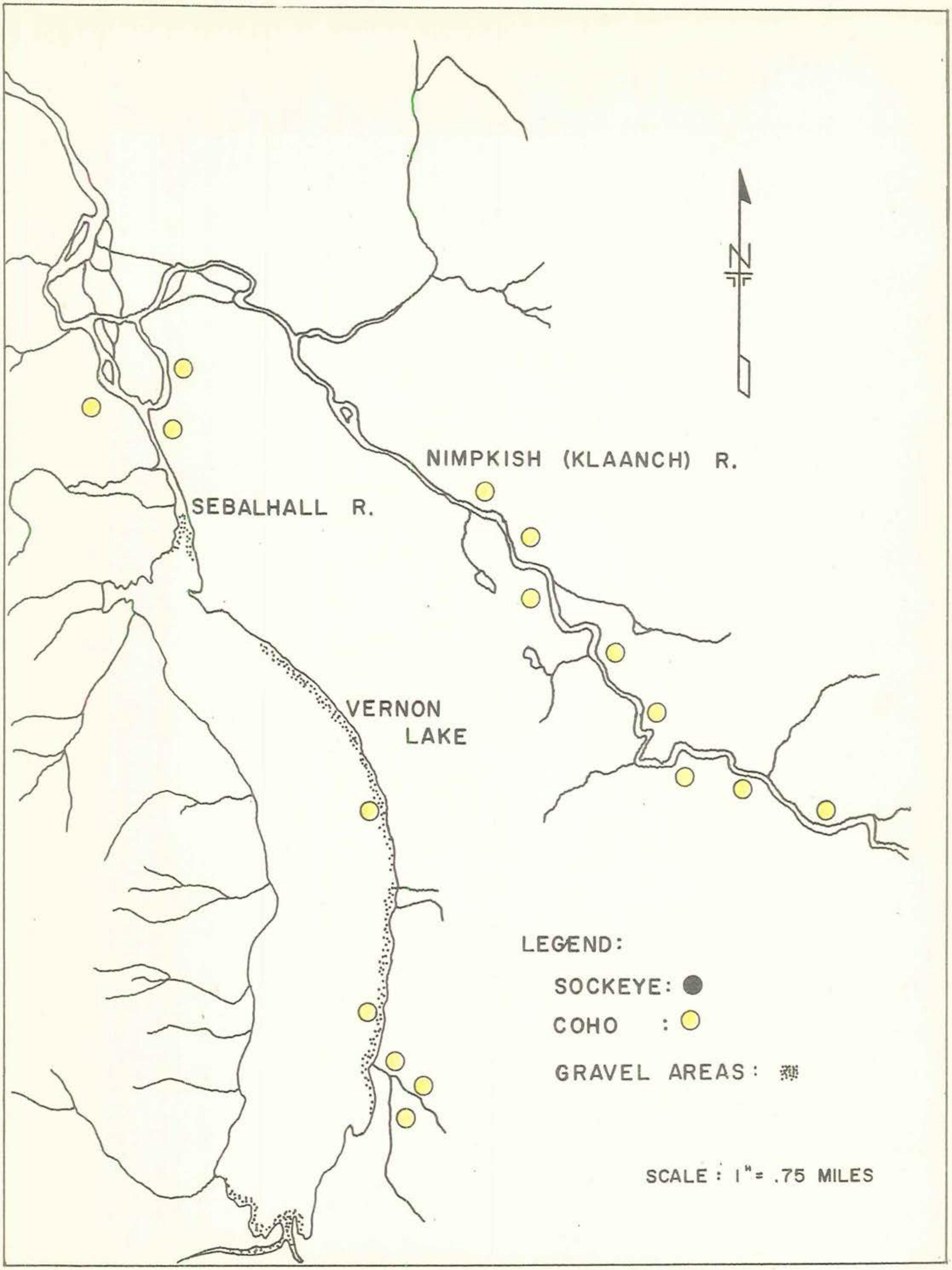
Section III and IV(a) - Distribution of Spawning Salmon in the Klaanich and Woss Rivers

Figure 12



Section V(a) – Distribution of Spawning Salmon in the Davie River and Klaklakama Lakes

Figure 13



Section VII – Distribution of Spawning Salmon in the Sebalhall River, the Klaanch River and Vernon Lake

Figure 14