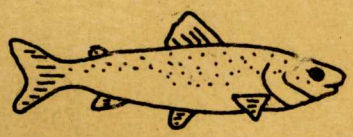
ENVIRONMENT CANADA

FISHERIES SERVICE

PROGRESS REPORT NO. 100

THE LIMNOLOGY AND SPORT FISH POPULATIONS OF SELECTED AVALON PENINSULA LAKES



BY

R.J. WISEMAN

RESOURCE DEVELOPMENT BRANCH
NEWFOUNDLAND REGION
ST. JOHN'S

The Limnology and Sport Fish Populations of Selected Avalon Peninsula Lakes

by

R. J. Wiseman

Resource Development Branch
Department of the Environment
Fisheries Service
St. John's, Newfoundland
1973

TABLE OF CONTENTS

ACKNOWLEDGEMENTS

Project Technician, W. G. Whelan, deserves special recognition for his technical advice and planning and supervision of field work and in the often tedious calculations of field data.

The field assistance of W. J. Bruce and B. Ebsary, summer students; and D. P. Riche and J. Jones, biological assistants, is also much appreciated.

Appreciation is extended to A. Jamieson, Technician, Laboratory Services Unit, Water Resource Group, who supervised and interpreted much of the water quality analysis.

The author acknowledges the interest and guidance of R. E. Cutting, Acting Branch, Chief, throughout the planning phase, field operations, data analysis and interpretation, and preparation of the report.

I. INTRODUCTION

The purpose of this study is to inventory the existing recreational fishery resource in the lakes of the Avalon Peninsula and to estimate the potential of these lakes for future sport fishing development. This report deals only with the inventory of existing fishery resources in representative Avalon Peninsula lakes; it considers the limnology of these lakes in terms of morphometric, edaphic, and biotic characteristics, all of which have a bearing on lake productivity; it also considers the structure and parameters of the existing sport fish populations inhabiting these lakes. In addition, information on present lake use, both recreational and industrial, are included where appropriate. A report on suggested future development of lake sport fisheries, with the lakes ranked in terms of their potential for future development, is forthcoming under separate cover.

The problem of "overfishing" of sport fish stocks has become a reality in this Province in recent years. This problem is particularly evident in lakes and ponds on the Avalon Peninsula more specifically near the Metropolitan area of St. John's. Increased resource accessibility, human population growth, affluence, and increased leisure time have been the major causes of "overfishing" of recreational fish stocks in this area.

We, as sport fisheries managers, must immediately formulate and implement sound and efficient management and development techniques to ensure the effective management and development of the recreational fishery resource for the present and future demands. However, a prerequisite to any effective management and development scheme is the possession of an inventory of existing resources.

This present study is a portion of a detailed long-term study program initiated by the Resource Development Branch in late 1967 designed to evaluate the present status of the recreational fishery in heavily-fished lakes and ponds near the St. John's Metropolitan Area. The objectives of this study program were to define annual production rate, harvest rate, and angling pressure for several representative Metro-Area lakes (See the Limnology, Ecology and Sport Fishery of Thomas Pond: A Multi-Use Reservoir; and The Limnology, Ecology, and Sport Fishery of Paddy's Pond: A Heavily Fished Lake near Metropolitan St. John's, Newfoundland; Progress Reports 73 and 83, Resource Development Branch, St. John's), to inventory the overall resource in these lakes, and to provide sound management and development plans for this resource.

II. METHODS AND MATERIALS

A total of sixteen lakes ranging in size from approximately 120 acres to 1270 acres were studied as part of this survey. Generally, all lakes surveyed were located relatively close to the Trans Canada Highway (Figure 1).

A. LIMNOLOGY

Information on the physical and biotic characteristics of the drainage areas was obtained from aerial photographs and topographical maps of the Canadian Mines and Technical Surveys series.

Depth and volume information were obtained for each lake by using a Ferrograph "Offshore 500" depth recorder on an outrigger-type transducer arm attached to the gunwhale of either a 13'3" or 16'7" Boston Whaler boat, or a 14 foot aluminum boat. Other parameters were determined by methods recommended by Welch (1948) and are calculated directly from topographical maps.

Data on the chemical limnology of the lakes were obtained from surface water analysis. Water analysis was carried out by both the Inland Waters Directorate, Water Management Service, Department of the Environment, Moncton, N.B. and by the Laboratory Services Unit of the Water Resource Group, Resource Development Branch, St. John's.

B. FISH POPULATIONS

Information on the fish populations of the lakes studied was collected by gill-netting and/or live-trapping. Gill-netting generally consisted of fishing one or more gangs of multifilament nylon gill nets, each composed of three nets with stretched-mesh size 1½", 2", and 3", overnight. Each net measured 50 yards in length and was six feet deep. The gangs were invariably set with the 1½-inch net tied to the shore. In instances where collections of small salmonid fishes such as arctic char or landlocked smelt were required, small mesh monofilament gill nets were used. A standard gang of these gill nets was composed of three nets with stretched-mesh size ½", 3/4", and 1", each net measured 50 feet in length and was 8 feet deep. Live trapping consisted of one or more lake-trap nets of 3/4" knitted nylon stretched-mesh tended from a 13'3" or 16'7" Boston Whaler boat. Information on the size and age composition of sport fish populations inhabiting each lake was obtained by measuring, to the nearest millimeter, the fork length of each fish captured, and by taking a small sample of scales from each of these fish. The age of the individual fish was obtained by viewing these scales, mounted wet in a Petri dish, using a Bausch and Lomb microprojector. The scale image was projected onto a sheet of white paper and an outline of each scale with its focus and annuli was traced on the paper.

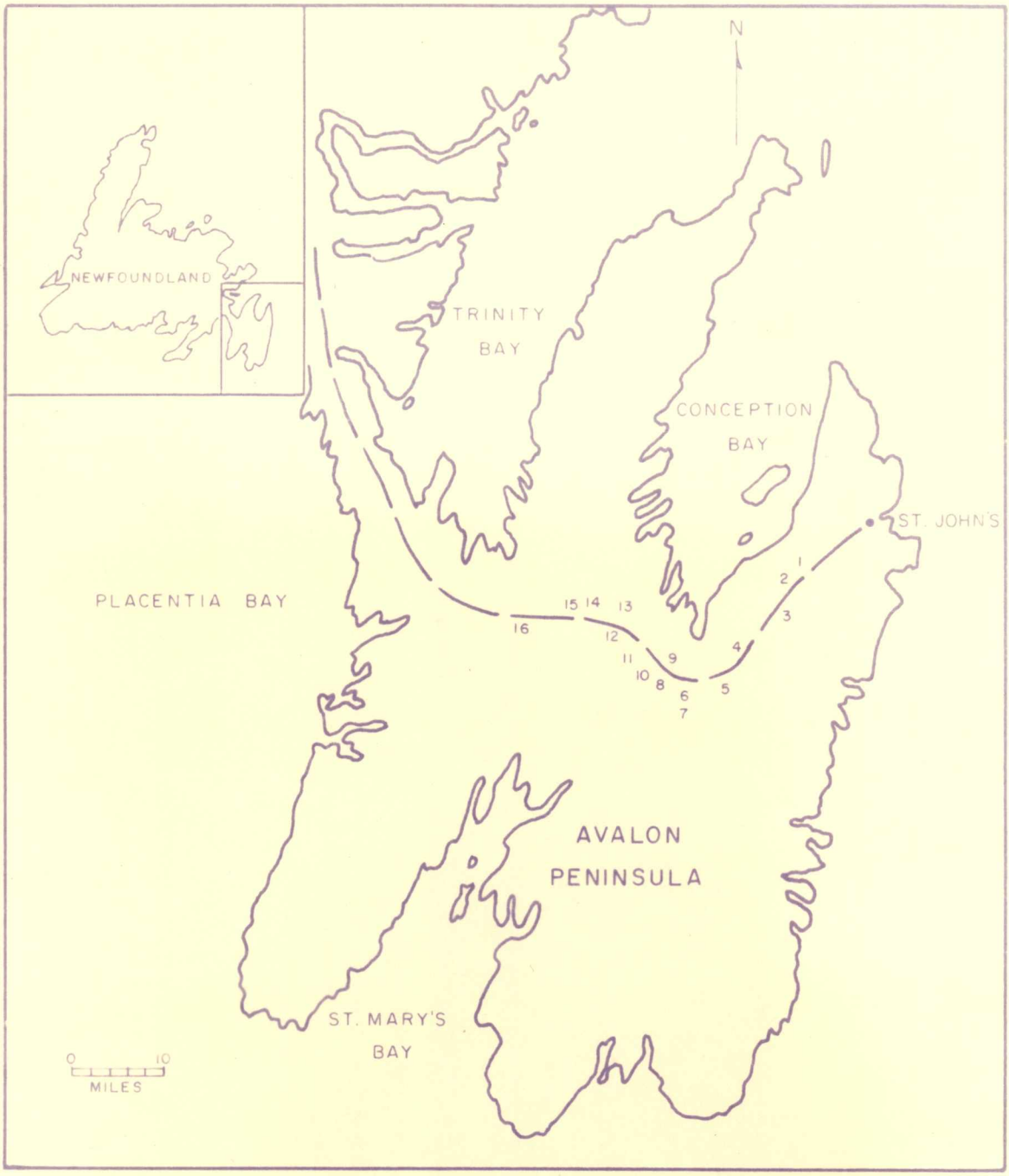


FIGURE 1. LOCATION OF THE 16 AVALON PENINSULA LAKES SURVEYED (1. GULL POND; 2. LOON AND LITTLE SOLDIERS PONDS; 3. SOLDIERS POND; 4. FINNIES POND, 5. FIVE MILE POND WEST; 6. BIG TRIANGLE POND; 7. SOUTHERN PEAK POND; 8. SOUTHWEST POND; 9. HARBOUR MAIN POND; 10. NINE ISLAND POND SOUTH; 11. MIDDLE GULL POND; 12. COLLIERS BIG POND; 13. NINE ISLAND POND; 14. GRAND POND; 15. SNOWS POND; 16. GOOSE POND.)

Growth data were obtained by using the method of back-calculation. The Monastyrsky method of back-calculation was chosen for fish of the Genus Salvelinus, while the Lee method was found to be most suitable for the Genus Salmo.

The study of the food habits of the sport fishes was carried out using a simple qualitative analysis. Of all the fish captured during the gill net and/or live-trap operations, only a small sub-sample was sacrificed for food analysis. The entire stomach from the lower esophagus to the pyloric sphincter was removed and cut open. The invertebrate food organisms present, if any, were simply classified as planktonic or benthic and terrestrial. Fish and any unusual vertebrate food items were identified more specifically.

III. RESULTS AND DISCUSSIONS

The nature of this report is basically an inventory of the present recreational fishery resource of Avalon Peninsula lakes and for this reason the results of the study are presented as simple and straightforward as possible and discussions are kept to a minimum. A more detailed analysis of the data with discussion and consideration of future management and development plans will form the basis of a later report.

In this present report we shall consider the limnology and ecology of each of the sixteen lakes, separately. We will be looking at the physical and chemical limnology and how each affects the productivity of the lake. We shall then examine the nature of the fish populations in the lake. We will be attempting to answer such questions as: What fish species are present? What is the species composition? What is the age and size composition of the sport fish populations? What creel limit should be applied on each lake? How fast are the fish growing in each lake? Are they growing faster or slower than other populations? What do the fish eat and how important is food supply to growth rate and longevity?

GULL POND

A. Limnology

1. Location

Gull Pond is situated at 47°27' North Latitude and 52°59' West Longitude. It lies approximately 15 miles south-west of the city of St. John's along the Foxtrap Access Road, approximately 1 mile north of the Trans Canada Highway. Gull Pond has an elevation of approximately 475 feet.

2. Uses

a. Industrial. At the present time the waters of Gull Pond have no industrial use.

b. Recreational. At present there is a light to moderate fishing pressure for resident salmonid species. In addition to angling other recreational uses include swimming, picnicing, and a limited amount of boating. The lake is only occasionally used for camping and waterfowl hunting. There is no summer cabin development on this lake.

3. Characteristics of the Drainage Area

Gull Pond empties directly into Conception Bay via Steadywater Brook. The drainage area of the lake occupies 0.9 square miles. Of the total drainage area, 0.2 square miles are in standing water. Only one tiny drainage system contributes its drainage to Gull Pond.

The drainage area lies at an altitude ranging from approximately 475 to 725 feet above sea level. The terrain ranges from mostly barren land to some climax forest of fir, tamarack, and spruce. There is a limited amount of farm land within the drainage area.

The area lies in a region of Precambrian plutonic rocks. The drainage basin contains Hadrynian granodiorite, quartz monzonite, granite, and quartz diorite of the Holyrood plutonic series (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemistry Environment

a. Morphometry. A bathymetric map of Gull Pond is presented in Figure 1, the morphometric parameters are given in Table I. As is the case throughout this report, parameters are given in both the English and metric systems in accordance with international limnological practice.

Table I. Morphometry of Gull Pond

Area, including islands (acres) 144.6 (ha.) 58.5	Area, excluding islands (acres) 140.3 (ha.) 56.8
Maximum length (mi.) 0.8 (km.) 1.3	Maximum effective length (mi.) 0.6 (km.) 1.0
Maximum width (mi.) 0.5 (km.) 0.7	Maximum effective width (mi.) 0.5 (km.) 0.7
Mean width (mi.) 0.3 (km.) 0.4	Volume (cu. ft.) 8.58×10^7 (cu. m.) 2.43×10^6
Maximum depth (ft.) 49.0 (m.) 14.9	Mean depth (ft.) 14.0 (m.) 4.3
Mean depth-maximum depth ratio 0.29	Volume development 0.87
Perimeter, including islands (mi.) 3.0 (km.) 4.8	Perimeter, excluding islands (mi.) 2.4 (km.) 3.9
Shore development, including islands 1.80	Shore development, excluding islands 1.47

Direction of Major Axes NE-SW

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	1,694,900	38.8	27.7
5-10	1,169,600	26.9	19.2
10-15	890,800	20.5	14.6
15-20	654,300	15.0	10.7
20-25	479,600	11.0	7.8
25-30	531,000	12.2	8.7
30-35	383,300	8.8	6.3
35-40	179,000	4.1	2.9
40-45	89,700	2.1	1.5
Over 45	38,300	0.9	0.6
TOTAL	6.11×10^6	140.3	

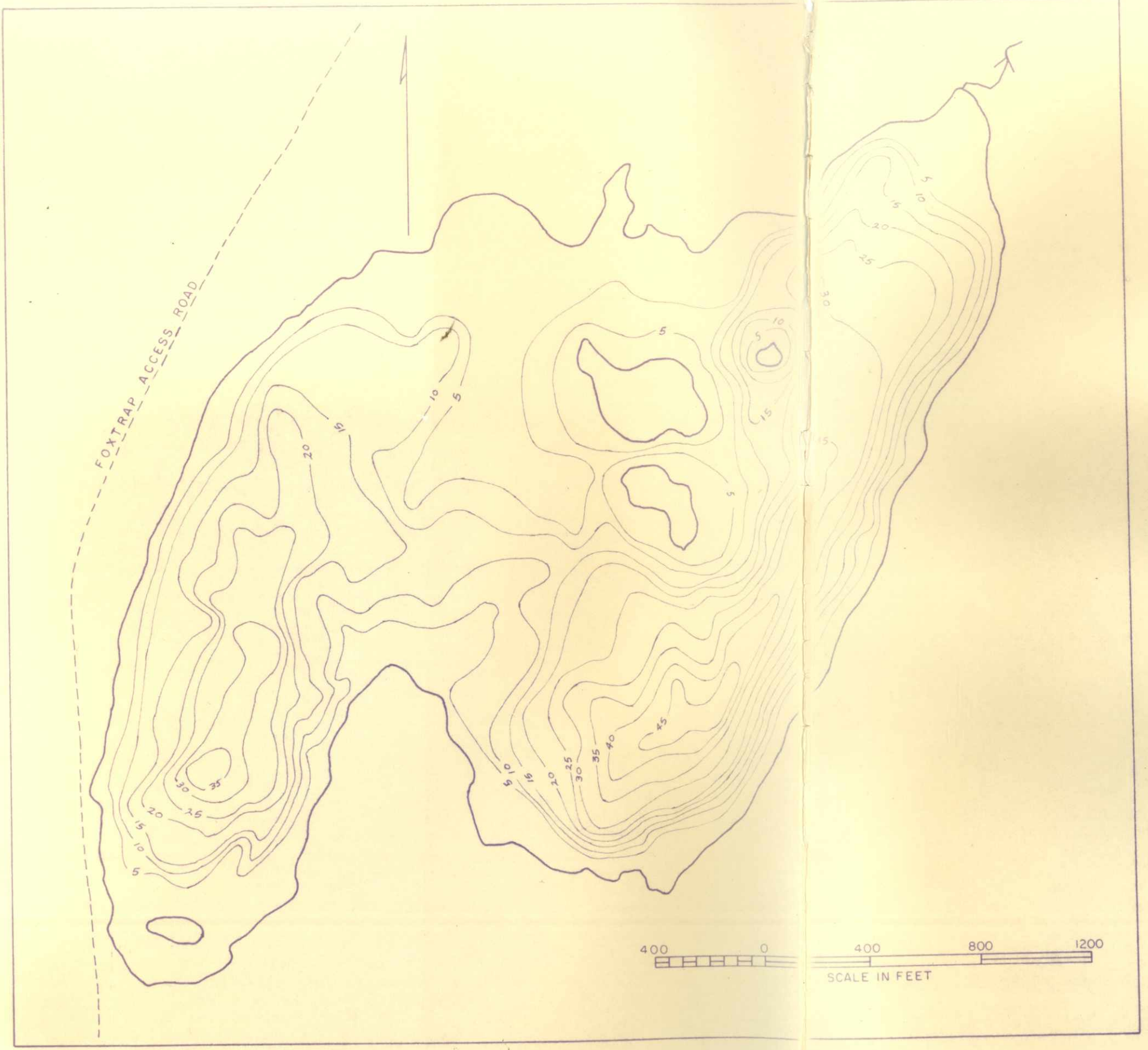


FIGURE 1. BATHYMETRIC MAP OF GULL POND

Gull Pond is fairly regular in shape (shore development index = 1.80) and its shores are moderately sloped. The mean depth of the lake is 14 feet and the maximum depth is 49 feet. Approximately 72 percent of the lake area is included in the 0-20 feet range of depth. Gull Pond would appear, then, to be a fairly productive lake in terms of its morphometry.

b. Surface Water Chemistry. Analysis of the surface water of Gull Pond, as well as all other lakes surveyed, was carried out by both the Inland Waters Directorate, Department of the Environment, Moncton, N.B. and by the Laboratory Services Unit of the Water Resource Group. Most parameters were determined by both agencies and mean values were calculated. Analyses of surface water appear in Table II.

Table II. Analysis of surface water of Gull Pond (samples collected August, 1971)

	Range	Mean
pH	6.3 - 6.5	6.4
Alkalinity as $CaCO_3$	2.0 - 3.1 ppm.	2.9 ppm.
Total hardness as $CaCO_3$	5.0 - 7.8 ppm	6.4 ppm.
Sp. conductance, micromhos at 25°C	37.1 - 50.6	44.1
Total dissolved solids	33.7 - 43.5 ppm	38.8 ppm.
Colour (Hazen Units)	-	5.0
Turbidity (Units)	0.62 - 0.96	0.78
Total Organic Carbon	3.0 - 6.4 ppm.	4.1 ppm.
Calcium (Ca)	1.5 - 1.8	1.7 ppm.
Magnesium (Mg)	0.7 - 0.8 ppm.	0.8 ppm.
Sodium (Na)	3.5 - 5.9 ppm.	5.1 ppm.
Potassium (K)	0.4 - 0.6 ppm.	0.5 ppm.
Sulphate (SO_4)	2.9 - 3.5 ppm	3.2 ppm.
Chloride (Cl)	10.0 - 10.1 ppm	10.0 ppm.
Phosphate (PO_4) total	0.05 - 0.24 ppm.	0.12 ppm.
dissolved	0.05 - 0.12 ppm.	0.08 ppm.
Nitrate (NO_3)	0.058 - 0.080 ppm.	0.071 ppm.
Silica (SiO_2)	1.4 - 1.5 ppm.	1.5 ppm.
Sum of constituents	25.2 - 26.5 ppm	26.0 ppm.

Gull Pond, like all lakes on the Avalon Peninsula, has very soft water. However, the waters of Gull Pond are the hardest of those studied during this present survey. Available information suggests Avalon Peninsula lakes have an agerage T.D.S. value of approximately 30 ppm., the waters of Gull Pond have a mean T.D.S. value of 38.8 ppm. The concentration of such nutrients as calcium, phosphate, and nitrate is appreciably greater in Gull Pond water than in most Avalon Peninsula lakes investigated.

c. Morphoedaphic Index and Lake Productivity. The mineral content or the amount of dissolved nutrients in lake water is of great importance in determining the amount of fish a lake can produce or yield. The specific conductance at 25°C of Gull Pond water ranged from 37.1 to 50.6 micromhos depending on sampling station. Specific conductance values were converted to a more significant limnological parameter, total dissolved solids (T.D.S.). T.D.S. values ranged from 33.7 to 43.5 with a mean value of 38.8 ppm. By dividing the T.D.S. of a lake by its mean depth we arrive at a morphoedaphic index (Ryder, 1965). This morphoedaphic index provides a means of estimating potential fish productions in north-temperate lakes. Gull Pond has a morphoedaphic index of 2.77, which means Gull Pond has an estimated annual fish production (yield) of 3.33 pounds per acre per year, or 466 pounds per year. A creel limit or maximum sustained yield for Gull Pond then is suggested to be 466 pounds of sport fish per year. Of all the Avalon Peninsula lakes investigated to date, potential annual production ranges from approximately 2 to 4 pounds per acre per year.

B. Fish Species Present

Only three fish species inhabit Gull Pond and its drainage system. Two of the species are of sport value and include the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815, and the brown trout Salmo trutta (Linnaeus) 1758. Brook trout are by far the dominant species in terms of numbers; the lake contains relatively few brown trout. The brook trout is a native species, while the brown trout is an exotic species introduced into the Conception Bay rivers beginning in 1886. The American eel, Anguilla rostrata (Le Sueur) 1817, is also a resident of Gull Pond, however the magnitude of the population is unknown.

C. Age and Size Composition of the Sport Species

1. Brook Trout

The oldest and largest brook trout observed during the survey on Gull Pond was VI^{+} years of age with a fork length of 31.6 centimeters.

The age-length distribution of 102 brook trout sampled at Gull Pond during July to August, 1971, is given in Table III.

2. Brown Trout

A brown trout 54.0 cm. fork length and X^{+} years of age holds the known longevity and size record at Gull Pond.

The lengths and ages of 3 brown trout taken from the lake during the sampling period are presented in Table IV. Unfortunately a large sample of brown trout could not be obtained because of the relatively low number of this species in Gull Pond.

Table III. Age-length distribution of brook trout taken in gill nets and live-traps during July - August, 1971, in Gull Pond.

Fork length (cm.) (Class mark)	Age-Class					Total
	II+	III+	IV+	V+	VI+	
14.55	8(100.0)	-	-	-	-	8(7.8)
16.55	37(75.5)	12(24.5)	-	-	-	49(48.0)
18.55	8(72.7)	3(27.3)	-	-	-	11(10.9)
20.55	-	3(60.0)	2(40.0)	-	-	5(4.9)
22.55	-	1(12.5)	7(98.5)	-	-	8(7.8)
24.55	-	-	15(100.0)	-	-	15(14.7)
26.55	-	-	2(66.6)	1(33.4)	-	3(2.9)
28.55	-	-	-	2(100.0)	-	2(2.0)
30.55	-	-	-	-	-	-
32.55	-	-	-	-	1(100.00)	1(1.0)
TOTAL	53	19	26	3	1	102

Table IV. Age and size of 3 brown trout taken in Gull Pond during July - August, 1971

Fork length (cm.)	Age
28.9	4^+
33.6	6^+
54.0	10^+

D. Growth Rates of the Sport Species

The growth rates of brook trout and brown trout were determined

through the method back-calculation.

1. Brook Trout

The Monastyrsky method of back-calculation has been found to be suitable for fish of the Genus Salvelinus (Wiseman, 1970), and was chosen to calculate the growth of Gull Pond brook trout.

From paired observations of fish length and scale length, a log-log regression was calculated and is as follows:

$$\text{Log } L_f = 0.9280 \text{ Log } L_s + 0.8558$$

$$\text{or} \quad L_f = 7.174 \, L_s^{0.9280}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table V.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Gull Pond brook trout

Annulus	I	II	III	IV	V	VI
Scale length (x43)	0.91	1.73	2.42	3.27	3.75	4.40
Fish fork length (cm.)	6.6	11.9	16.3	21.5	24.5	28.4
Fish fork length (in.)	2.1	4.7	6.4	8.5	9.6	11.2

Generally, the growth of Gull Pond brook trout is somewhat faster during the first four years of life than the mean growth rate of fish from other Avalon Peninsula lakes (Wiseman, 1972). The rate of growth in succeeding years, however, is somewhat slower.

2. Brown Trout

The Lee method of back-calculation has proven in the past to be the most suitable for the Genus Salmo (Wiseman, 1971), and was chosen to determine the growth rate of Gull Pond brown trout.

From paired observations of fish length and scale length, a least squares regression was calculated and is as follows:

$$L_f = 3.95 \, L_s + 0.25$$

The average scale lengths for each year of life and the

corresponding calculated fish lengths are given in Table VI.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Gull Pond brown trout.

Annulus	I	II	III	IV	V	VI	VII	VIII	IX	X
Scale length (x43)	1.33	2.65	4.23	6.18	7.60	9.07	10.10	10.40	11.90	13.00
Fish fork length (cm.)	5.5	10.7	17.0	24.7	30.3	36.1	40.2	43.3	47.3	51.6
Fish fork length (in.)	2.2	4.2	6.7	9.7	11.9	14.2	15.8	17.1	18.6	20.3

The growth rate of Gull Pond brown trout over three years of age is considerably faster than the mean growth rate of brown trout of this age from other Avalon Peninsula lakes (Wiseman, 1972). The growth rate of the younger fish in Gull Pond is, however, somewhat slower than average.

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 89 brook trout taken in Gull Pond during the period July - August, 1971, is given in Table VII. Generally, it appears that Gull Pond brook trout are totally insectivorous.

Table VII. The food habits of Gull Pond brook trout expressed as frequency of occurrence (percentages in parentheses).

Fork length (cm.) (Class mark)	Stomach contents	
	Empty	Benthic and/or Terrestrial Invertebrates
15.55	22	23 (100.0)
19.55	6	9 (100.0)
23.55	13	10 (100.0)
27.55	2	3 (100.0)
31.55	1	-
Total	44	45

2. Brown Trout

Only 3 brown trout were captured for food studies at Gull Pond and the analysis of the stomach contents is given in Table VIII. It would appear that brown trout in Gull Pond are insectivorous, at least at the smaller sizes.

Table VIII. The food habits of Gull Pond brown trout expressed as frequency of occurrence (percentages in parentheses).

Fork length (cm.) (Class mark)	Stomach Contents	
	Empty	Benthic and/or Terrestrial Invertebrates
28.9	-	1 (100.0)
33.6	-	1 (100.0)
54.0	1	-
Total	1	2

LOON AND LITTLE SOLDIERS PONDS

A. Limnology

1. Location

Loon and Little Soldiers Ponds are, in fact, only the two basins of one lake. The lake is situated at 47° 26' North Latitude and 53°00' West Longitude. It lies approximately 17 miles south-west of the city of St. John's along the Trans Canada Highway. Loon and Little Soldiers Ponds have an elevation of approximately 425 feet.

2. Uses

a. Industrial. At the present time the waters of Loon and Little Soldiers Ponds have no industrial use.

b. Recreational. Loon and Little Soldiers Ponds presently experience light to moderate sport fishing pressure for resident salmonid species. In addition to angling, the lake has few other recreational uses except very light boating, swimming, picnicing, and camping. There is no summer cabin development on this lake presently.

3. Characteristics of the Drainage Area

Loon and Little Soldiers Ponds empty into Conception Bay via Black Mountain Pond and the Lower Gullies River. The drainage area of the ponds occupies 2.5 square miles. Historically, Loon and Little Soldiers Ponds had a considerably larger drainage area. Prior to the early 1930's, Loon and Little Soldiers Ponds received the outflow from Soldiers Pond. In the early 1930's, the Newfoundland Light and Power Company constructed a diversion dam at the outlet of Soldiers Pond and diverted the waters into the Seal Cove River drainage where they now contribute toward the generation of electricity at the Seal Cove Hydroelectric Station. Of the present total drainage area, 0.5 square miles are in standing water. Three minor drainage systems and one major system contribute their drainage to Loon and Little Soldiers Ponds.

The drainage area lies at an altitude ranging from approximately 425 to 725 feet above sea level. The terrain ranges from climax forest of fir, tamarack, and spruce, to barren land. The drainage area is about equally divided between forest and barren land.

The area lies in a region of Precambrian plutonic rocks. The drainage basin contains Hadryrian granodiorite, quartz monzonite, granite, and quartz diorite of the Holyrood plutonic series (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Loon and Little Soldiers Ponds is presented in Figure 1, the morphometric parameters are given in both the English and metric systems in Table I.

Table I. Morphometry of Loon and Little Soldiers Ponds

Area, including islands (acres) 167.5 (ha.) 67.8	Area, excluding islands (acres) 167.1 (ha.) 67.7
Maximum length (mi.) 0.9 (km.) 1.5	Maximum effective length (mi.) 0.9 (km.) 1.5
Maximum width (mi.) 0.5 (km.) 0.8	Maximum effective width (mi.) 0.5 (km.) 0.8
Mean width (mi.) 0.3 (km.) 0.5	Volume (cu. ft.) 1.03×10^8 (cu. m.) 2.92×10^6
Maximum depth (ft.) 72.0 (m.) 22.0	Mean depth (ft.) 14.2 (m.) 4.3

Table I. (Cont'd).

Mean depth-maximum depth ratio 0.20 Volume development 0.60
Perimeter, including islands (mi.) 4.4 Perimeters, excluding islands (mi.) 4.2
(km.) 7.1 (km.) 6.8

Shore development, including islands 2.43 Shore development, excluding islands 2.34

Direction of Major Axes N-S

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	2,462,400	56.6	33.8
5-10	1,329,900	30.5	18.3
10-15	1,093,400	25.1	15.0
15-20	504,900	11.6	6.9
20-25	492,700	11.3	6.8
25-30	364,200	8.4	5.0
30-35	345,400	7.9	4.9
35-40	204,700	4.7	2.8
40-45	159,900	3.7	2.2
45-50	95,800	2.2	1.3
50-55	83,200	1.9	1.1
55-60	51,000	1.2	0.7
60-65	44,900	1.0	0.6
65-70	25,700	0.6	0.4
over 70	19,200	0.4	0.3
TOTAL	7.28×10^6	167.1	

FIGURE 1. BATHYMETRIC MAP OF LITTLE SOLDIERS & LOON PONDS

The Loon and Little Soldiers Ponds complex is fairly irregular in shape (shore development index = 2.43) and its shores are moderately to heavily sloped. The mean depth of the lake is 14.2 feet and the maximum depth is 72 feet. Approximately 74 percent of the lake area is included in the 0-20 feet range of depth. This lake would appear, then, to be a moderately productive environment in terms of morphometry.

b. Surface Water Chemistry. The analysis of the surface water of Loon and Little Soldiers Ponds appears in Table II. The lake appears to be mildly dystrophic as evidenced by the slightly acidic, moderately stained, lightly mineralized waters with a moderate organic carbon content. It appears then that the relatively favourable morphometry of the lake in terms of productivity is overshadowed by the unfavourable water chemistry thus resulting in an overall low lake productivity.

c. Morphoedaphic Index and Lake Productivity. The amount of dissolved nutrients, or specific conductance at 25° C, ranges from 23.0 to 39.2 micromhos depending on sampling station. Converting the specific conductance values to T.D.S. values, we find the waters of Loon and Little Soldiers Ponds range from 23.6 to 25.3 ppm, with a mean of 26.0 ppm. This mineral content is slightly lower than the average for Avalon Peninsula lakes, which is approximately 30 ppm. By dividing the T.D.S. of the lake water by the mean depth of the lake we arrive at a morphoedaphic index of 1.83 for Loon and Little Soldiers Ponds. The potential fish production of a lake is calculated by the approximation:

$$P = 2\sqrt{X}$$

where P = Production

X = Morphoedaphic Index

Using this equation we find that Loon and Little Soldiers Ponds have an estimated fish production of 2.71 pounds per acre per year, or 453 pounds per year. Since Avalon Peninsula lakes investigated to date range in production from approximately 2-4 pounds per acre per year, Loon and Little Soldiers Ponds are light to moderately productive.

B. Fish Species Present

Only three fish species inhabit Loon and Little Soldiers Ponds and their drainage systems. Two of the species are of recreational value and include the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815, and the landlocked Atlantic salmon (ouananiche), Salmo salar Linnaeus 1758. Both are native salmonid species. Brook trout are by far the dominant sport species in the lake both in terms of size and numbers. The American eel, Anguilla rostrata (Le Sueur) 1817, is also a resident of the lake, however, little is known of its population characteristics.

Table II. Analysis of surface water of Loon and Little Soldiers Ponds (samples collected July, 1971)

	Range	Mean
Alkalinity as $CaCO_3$	2.0 - 3.0 ppm	2.7 ppm
Total hardness as $CaCO_3$	2.0 - 5.6 ppm	4.4 ppm
pH	6.2 - 6.3	6.3
Color (Hazen units)	30 - 40	-
Total organic carbon	3.5 - 5.0 ppm	4.0 ppm
Turbidity (units)	0.81 - 0.91	0.86
Sp. conductance, micromhos at 25°C	23.0 - 39.2	31.2
Total dissolved solids	23.6 - 35.2 ppm	26.0 ppm
Calcium (Ca)	1.1 - 1.4 ppm	1.2 ppm
Magnesium (Mg)	-	0.5 ppm
Sodium (Na)	4.2 - 4.5 ppm	4.4 ppm
Potassium (K)	-	0.3 ppm
Sulphate (SO_4)	2.4 - 3.5 ppm	2.9 ppm
Chloride (Cl)	6.9 - 7.2 ppm	7.0 ppm
Phosphate (PO_4) Total	0.05 - 0.07 ppm	0.06 ppm
Dissolved	-	0.05 ppm
Bicarbonate (HCO_3)	-	3.3 ppm
Nitrate (NO_3)	-	<0.005 ppm
Silica (SiO_2)	1.7 - 1.8 ppm	1.7 ppm
Sum of constituents	19.4 - 20.2 ppm	19.7 ppm

C. Age and Size Composition of the Sport Species

1. Brook Trout

A brook trout 37.2 cm fork length and VI+ years of age holds the known longevity and size record at Loon and Little Soliders Ponds.

The age-length distribution of 111 brook trout sampled at Loon and Little Soldiers Ponds during July, 1971, is given in Table III.

Table III. Age-length distribution of brook trout taken in gill nets and live-traps during July, 1971, in Loon and Little Soldiers Ponds

Fork length (cm.) (Class mark)	Age-Class					Total
	II	III	IV	V	VI	
10.55	3(100.0)	-	-	-	-	3(2.7)
12.55	8(100.0)	-	-	-	-	8(7.2)
14.55	2(50.0)	2(50.0)	-	-	-	4(3.6)
16.55	-	19(82.6)	4(17.4)	-	-	23(20.7)
18.55	-	14(51.9)	13(48.1)	-	-	27(24.3)
20.55	-	-	16(94.1)	1(5.9)	-	17(15.3)
22.55	-	-	8(53.3)	7(46.7)	-	15(13.5)
24.55	-	-	1(12.5)	7(87.5)	-	8(7.2)
26.55	-	-	-	1(100.0)	-	1(0.9)
28.55	-	-	-	1(100.0)	-	1(0.9)
30.55	-	-	-	1(100.0)	-	1(0.9)
32.55	-	-	-	-	1(100.0)	1(0.9)
34.55	-	-	-	-	1(100.0)	1(0.9)
36.55	-	-	-	-	1(100.0)	1(0.9)
TOTAL	13	35	42	18	3	111

2. Ouananiche

The oldest and largest ouananiche observed during the survey on Loon and Little Soldiers Ponds was V+ years of age with a fork length of 16.5 centimeters.

The age-length distribution of 134 ouananiche sampled at this lake during July, 1971, is given in Table IV.

Table IV. Age-length distribution of ouananiche taken in live-traps during July, 1971, in Loon and Little Soldiers Ponds

Fork length (cm.) (Class mark)	Age-Class					Total
	I+	II+	III+	IV+	V+	
6.55	1(100.0)	-	-	-	-	1(0.7)
8.55	-	43(100.0)	-	-	-	43(32.1)
10.55	-	16(55.2)	13(44.8)	-	-	29(21.6)
12.55	-	12(26.1)	22(47.8)	12(26.1)	-	46(34.3)
14.55	-	-	6(42.9)	7(50.0)	1(7.1)	14(10.4)
16.55	-	-	-	-	1(100.0)	1(0.7)
TOTAL	1	71	41	19	2	134

D. Growth Rates of the Sport Species

The growth rates of brook trout and ouananiche were determined through the method of back-calculation.

1. Brook Trout

The Monastyrsky method of back-calculation in which a log-log regression is calculated from paired observations of fish length and scale length was used for this species.

The regression equation for fish length and scale length is as follows:

$$\text{Log } L_f = 0.9582 \text{ Log } L_s + 0.8736$$

$$\text{or} \quad L_f = 7.474 \, L_s^{0.9582}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table V.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Loon and Little Soldiers Ponds brook trout

Annulus	I	II	III	IV	V	VI
Scale length (x43)	0.78	1.39	2.00	2.58	3.30	4.57
Fish fork length (cm.)	5.9	10.2	14.5	18.5	23.5	32.0
Fish fork length (in.)	2.3	4.0	5.7	7.3	9.3	12.6

Generally, the growth rate of brook trout in Loon and Little Soldiers Ponds is slightly slower than the mean rate of fish from other Avalon Peninsula lakes.

2. Ouananiche

The Lee method of back-calculation has proven in earlier studies to be the most suitable for ouananiche (Wiseman, 1971), and was chosen to determine the growth rate of this species in Loon and Little Soldiers Ponds.

From paired observations of fish length and scale length, a least squares regression was calculated and is as follows:

$$L_f = 3.67\ L_s + 1.03$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Loon and Little Soldiers Ponds ouananiche

Annulus	I	II	III	IV	V
Scale length (x43)	0.86	1.64	2.62	3.35	3.80
Fish fork length (cm.)	4.2	7.1	10.7	13.3	15.0
Fish fork length (in.)	1.7	2.8	4.2	5.2	5.9

The growth rate of ouananiche in Loon and Little Soldiers Pond is considerably slower than the mean growth rate of ouananiche from other Avalon Peninsula lakes (Wiseman, 1972).

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 76 brook trout taken in Loon and Little Soldiers Ponds during July, 1971, is given in Table VII. Generally, brook trout in this lake are insectivorous, except for some of the smaller individuals which utilize zooplankton as food, and some of the larger individuals which may occasionally prey upon small ouananiche.

Table VII. The food habits of Loon and Little Soldiers Ponds brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Zooplankton	Benthic and/or Terrestrial Invertebrates	*Fish
11.55	1	-	2(100.0)	-
15.55	5	2(22.2)	7(77.8)	-
19.55	8	-	25(100.0)	-
23.55	4	2(12.5)	14(87.5)	-
27.55	-	-	2(100.0)	-
31.55	1	-	1(100.0)	-
35.55	1	-	-	1(100.0)
Total	20	4	51	1

*Ouananiche

2. Ouananiche

A total of 81 ouananiche were captured for food studies at Loon and Little Soldiers Ponds, and the analysis of the stomach contents is given in Table VIII. It would appear that ouananiche in this lake are

mostly zooplankton feeders at the smaller sizes while the larger individuals rely heavily on benthic and terrestrial invertebrates as food organisms.

Table VIII. The food habits of Loon and Little Soldiers Ponds ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents		
	Empty	Zooplankton	Benthic and/or Terrestrial Invertebrates
7.55	6	12(75.0)	4(25.0)
11.55	10	13(38.2)	21(61.8)
15.55	3	3(25.0)	9(75.0)
Total	19	28	34

SOLDIERS POND

A. Limnology

1. Location

Soldiers Pond is situated at 47°25' North Latitude and 52° 59' West Longitude. It lies approximately 18 miles south-west of the city of St. John's along the Trans Canada Highway. Soldiers Pond has an elevation of approximately 525 feet.

2. Uses

a. Industrial. The waters of Soldiers Pond are impounded and form a hydroelectric reservoir. In the early 1930's the Newfoundland Light and Power Company constructed a diversion dam at the outlet of Soldiers Pond and diverted the waters into the Seal Cove River drainage via a diversion channel into Round Pond. Since that time, the waters of Soldiers Pond have contributed toward the generation of electricity at the Seal Cove power station.

b. Recreational. Presently, Soldiers Pond experiences light to moderate fishing pressure on its resident salmonid species. Besides angling, the lake has few other recreational uses except some waterfowl hunting, and very light boating, swimming, picnicing, and camping.

Considerable ptarmigan hunting is carried on in proximity to Soldiers Pond. There is no summer cabin development on the lake presently.

3. Characteristics of the Drainage Area

Soldiers Pond empties into Conception Bay via Round Pond, Kellys Pond, Seal Cove Rocky Pond, Gull Pond East, White Hill Pond, Seal Cove Pond, and the Seal Cove River. The drainage area of the lake occupies 4.7 square miles. Of the total drainage area of Soldiers Pond, 0.9 square miles are in standing water. Five minor drainage systems and one major system contribute their drainage to Soldiers Pond.

The drainage area lies at an altitude ranging from approximately 525 to 725 feet above sea level. The terrain ranges from almost entirely barrens and marsh to some small stand of fir, birch, tamarack, and spruce.

Most of the area lies in a region of Precambrian rocks of the Holyrood plutonic series. The drainage basin contains Hadrynian granodiorite, quartz monzonite, granite, and quartz diorite. Lesser amounts of Precambrian volcanic and sedimentary rocks are also found in the drainage area. Most of the strata in this area are of volcanic origin and have been classified as belonging to the Harbour Main Group. This portion of the drainage area contains acidic to mafic volcanic rocks, slate, greywacke, conglomerate, and metamorphic equivalents (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Soldiers Pond is presented in Figure 1, and the morphometric parameters are given in Table I.

Table I. Morphometry of Soldiers Pond

Area, including islands (acres) 355.9 (ha.) 144.1	Area, excluding islands (acres) 333.6 (ha.) 135.1
Maximum length (mi.) 1.4 (km.) 2.2	Maximum effective length (mi.) 1.1 (km.) 1.7
Maximum width (mi.) 0.8 (km.) 1.3	Maximum effective width (mi.) 0.8 (km.) 1.3
Mean width (mi.) 0.4 (km.) 0.7	Volume (cu.ft.) 1.28×10^8 (cu.m.) 3.63×10^6
Maximum depth (ft.) 23.0 (m.) 7.0	Mean depth (ft.) 8.8 (m.) 2.7

Table I. (Cont'd)

Mean depth-maximum depth ratio 0.38 Volume development 1.15

Perimeter, including islands (mi.) 7.9 (km.) 12.7 Perimeter, excluding islands (mi.) 5.3 (km.) 8.5

Shore development, including islands 2.98 Shore development, excluding islands 2.06

Direction of Major Axes NE-SW

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	5,286,900	121.4	36.4
5-10	3,039,600	69.8	20.9
10-15	3,767,100	86.5	25.9
15-20	2,048,200	47.0	14.1
over 20	389,000	8.9	2.7
TOTAL	1.45×10^7	333.6	

Soldiers Pond is relatively irregular in shape (shore development index = 2.98) and its shores are rather gently sloped. The mean depth of the lake is only 8.8 feet and the maximum depth is only 23 feet. Approximately 97 percent of the lake area is included in the 0-20 feet range of depth. This range is generally accepted as having the most value for fish production in a lake. Soldiers Pond would appear then to be a very productive lake in terms of its morphometry.

b. Surface Water Chemistry. The analysis of the surface water of Soldiers Pond appears in Table II.

Soldiers Pond, like all lakes on the Avalon Peninsula, has very soft water. However, the waters of Soldiers Pond are the softest of those studied to date. Information collected to date suggests lakes on the Avalon Peninsula have an average T.D.S. value of approximately 30 ppm; the surface waters of Soldiers Pond have a mean T.D.S. value of 22.6 ppm. The concentration of such nutrients as calcium, phosphate, magnesium, sodium, potassium, chloride, and nitrate is appreciably less in Soldiers Pond water than in other Avalon Peninsula lakes investigated, in fact the

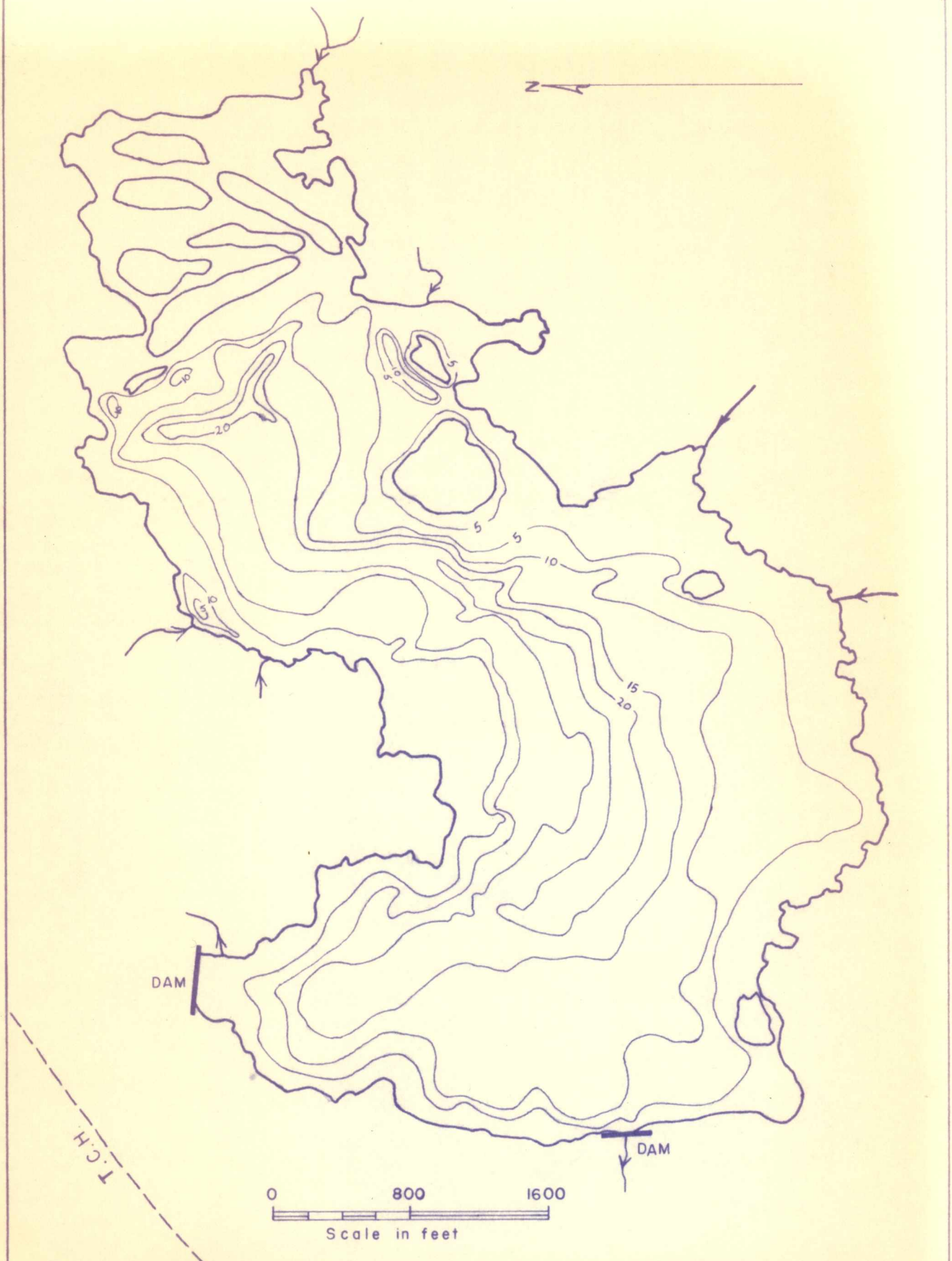


FIGURE 1. BATHYMETRIC MAP OF SOLDIERS POND

sum of constituents in Soldiers Pond water was a very low 12.2 ppm in comparison with an average of approximately 20 ppm for Avalon Peninsula lake waters.

Table II. Analysis of surface water of Soldiers Pond (samples collected August, 1971)

	Range	Mean
pH	5.7 - 6.1	5.9
Alkalinity as $CaCO_3$	1.0 - 2.3 ppm	1.4 ppm
Total hardness as $CaCO_3$	3.4 - 5.0 ppm	4.3 ppm
Sp. conductance, micromhos at 25°C	19.1 - 24.4	21.7
Total dissolved solids	20.8 - 24.6 ppm	22.6 ppm
Colour (Hazen units)	-	20
Turbidity (Units)	0.68 - 1.20	0.92
Total organic carbon	3.5 - 4.5 ppm	3.8 ppm
Calcium (Ca)	0.7 - 0.8 ppm	0.8 ppm
Magnesium (Mg)	-	0.4 ppm
Sodium (Na)	-	2.7 ppm
Potassium (K)	-	0.2 ppm
Sulphate (SO_4)	1.4 - 2.6 ppm	1.9 ppm
Chloride (Cl)	-	4.1 ppm
Phosphate (PO_4) total	-	0.05 ppm
dissolved	-	0.05 ppm
Nitrate (NO_3)	-	0.005 ppm
Silica (SiO_2)	-	0.9 ppm
Sum of constituents	11.6 - 12.6 ppm	12.2 ppm

c. Morphoedaphic Index and Lake Productivity. The mineral content of lake water is of prime importance in determining the amount of fish a lake can produce. The mineral content of natural waters is usually expressed as the specific conductance. The specific conductance at 25°C of Soldiers Pond water ranged from 19.1 to 24.4 micromhos, depending on sampling station. Total dissolved solids (T.D.S.) is a more significant limnological parameter and is derived from the specific conductance by means of a simple calculation (Wiseman, 1970). T.D.S values for Soldiers Pond water ranged from 20.8 to 24.6 ppm with a mean value of 22.6 ppm. By dividing the T.D.S. of Soldiers Pond water by the mean depth of the lake we obtain the morphoedaphic index of the lake. Using this calculation we find the morphoedaphic index of Soldiers Pond is 2.57, which means Soldiers Pond has an estimated annual fish production or yield of 3.21 pounds per acre per year, or 1,072 pounds per year. A suggested maximum sustained yield of sport fish from

Soldiers Pond is 1,072 pounds annually. The average yield from Avalon Peninsula lakes investigated to date is approximately 3 pounds per acre per year, indicating Soldiers Pond is slightly more productive than average.

B. Fish Species Present

Soldiers Pond and its drainage system contain only three fish species, and all are native to Newfoundland waters. Two of the species are of recreational value and include the landlocked Atlantic salmon (ouananiche), Salmo salar Linnaeus 1758, and the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815. Ouananiche are the slightly dominant species in terms of numbers, however, ouananiche are considerably smaller, on the average, than brook trout. The American eel, Anguilla rostrata (Le Sueur) 1817 was captured infrequently in Soldiers Pond, however, the extent of the population is unknown.

C. Age and Size Composition of the Sport Species

1. Brook Trout

The oldest and largest brook trout observed during the survey on Soldiers Pond was V^{+} years of age with a fork length of 23.7 centimeters.

The age-length distribution of 164 brook trout sampled at Soldiers Pond during July, 1971, is given in Table III.

2. Ouananiche

An ouananiche 19.9 cm. fork length and VII^{+} years of age holds the known longevity and size record at Soldiers Pond.

Table IV shows the age-length distribution of 306 ouananiche sampled at Soldiers Pond during July, 1971.

D. Growth Rates of the Sport Species

The growth rates of brook trout and ouananiche were determined through the method of back-calculation.

1. Brook Trout

Using the Monastyrsky method of back-calculation, from paired observations of fish length and scale length, a log-log regression was calculated and is as follows:

Table III. Age-length distribution of brook trout taken in gill nets and live-traps during July, 1971, in Soldiers Pond

Fork length (cm.) (Class mark)	Age-class				
	II+	III+	IV+	V+	Total
12.55	3(75.0)	1(25.0)	-	-	4(2.4)
14.55	3(37.5)	5(62.5)	-	-	8(4.9)
16.55	1(1.9)	40(75.5)	12(22.6)	-	53(32.3)
18.55	-	13(29.5)	31(70.5)	-	44(26.8)
20.55	-	4(11.1)	30(83.3)	2(5.6)	36(22.0)
22.55	-	-	14(82.4)	3(17.6)	17(10.4)
24.55	-	-	1(50.0)	1(50.0)	2(1.2)
Total	7	63	88	6	164

Table IV. Age-length distribution of ouananiche taken in gill nets and live-traps during July, 1971, in Soldiers Pond

Fork length (cm.) (Class mark)	Age-class						Total
	II+	III+	IV+	V+	VI+	VII+	
8.55	25(23.4)	79(73.8)	3(2.8)	-	-	-	107(35.0)
10.55	9(18.0)	32(64.0)	9(18.0)	-	-	-	50(16.3)
12.55	5(7.1)	31(44.3)	24(34.3)	5(7.1)	5(7.1)		70(22.9)
14.55	-	12(17.9)	28(41.8)	22(32.8)	5(7.5)	-	67(21.9)
16.55	-	-	3(30.0)	1(10.0)	6(60.0)	-	10(3.3)
18.55	-	-	-	-	1(100.0)	-	1(0.3)
20.55	-	-	-	-	-	1(100.0)	1(0.3)
Total	39	154	67	28	17	1	306

$$\text{Log } L_f + 1.0775 \text{ Log } L_s + 0.8303$$

$$\text{or} \quad L_f + 6.808\ L_s^{1.0775}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table V.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Soldiers Pond brook trout

Annulus	I	II	III	IV	V
Scale length (x43)	0.79	1.40	1.96	2.50	2.98
Fish fork length (cm.)	5.3	9.7	14.0	18.2	22.0
Fish fork length (in.)	2.1	3.8	5.5	7.2	8.7

Generally, the growth rate of Soldiers Pond brook trout is considerably slower than the mean growth rate of fish from other Avalon Peninsula lakes.

2. Ouananiche

Using the Lee method of back-calculation, from paired observations of fish length and scale length, a least squares regression was calculated and is as follows:

$$L_f = 3.20\ L_s + 0.77$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

The growth rate of Soldiers Pond ouananiche is extremely slower than the mean growth rate of fish from other Avalon Peninsula lakes; and in fact is one of the slowest growth rates exhibited by populations studied to date.

E. Food Habits of the Sport Species

1. Brook trout

The result of the analysis of the food habits of 137 brook trout

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Soldiers Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII
Scale length (x43)	0.78	1.55	2.52	3.36	3.85	4.33	4.80
Fish fork length (cm.)	3.3	5.7	8.8	11.5	13.1	14.6	16.1
Fish fork length (in.)	1.3	2.2	3.5	4.5	5.2	5.8	6.3

taken in Soldiers Pond during July, 1971, is given in Table VII. Generally, it appears that Soldiers Pond brook trout are totally insectivorous.

Table VII. The food habits of Soldiers Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents	
	Empty	Benthic and/or Terrestrial Invertebrates
11.55	-	2(100.0)
15.55	19	31(100.0)
19.55	27	39(100.0)
23.55	11	8(100.0)
Total	57	80

2. Ouananiche

Table VIII shows the result of the analysis of the food habits of 75 ouananiche taken in Soldiers Pond during July, 1971. Generally, the smaller fish appear to be relying heavily on zooplankton as a food source, while the larger individuals appear to consume a greater proportion of benthos and terrestrial organisms.

Table VIII. The food habits of Soldiers Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents		
	Empty	Zooplankton	Benthic and/or Terrestrial Invertebrates
11.55	15	14(63.6)	8(36.4)
15.55	7	8(27.6)	21(72.4)
19.55	1	-	1(100.0)
Total	23	22	30

FINNIES POND

A. Limnology

1. Location

Finnies Pond is situated at 47°22' North Latitude and 53°04' West Longitude. It lies approximately 22 miles south-west of the city of St. John's along the Trans Canada Highway. Finnies Pond has an elevation of approximately 625 feet above sea level.

2. Uses

a. Industrial. The waters of Finnies Pond are impounded to form a hydro-electric reservoir supplying water to the generating station at Seal Cove. The lake suffers from severe summer and winter drawdowns, with summer drawdowns exceeding 10 feet not uncommon.

b. Recreational. Finnies Pond presently experiences light fishing pressure on its resident salmonid species. In addition to angling, the lake sustains a moderate amount of swimming and picnicing and some light boating activity. The lake is occasionally used for camping and waterfowl hunting, while a moderate amount of ptarmigan hunting is conducted in the immediate area of the lake. There is, at present, no cabin development on Finnies Pond. A significant portion of the drainage area lies within the Butter Pot Provincial Park boundary.

3. Characteristics of the Drainage Area

Finnies Pond empties into Conception Bay via Big Otter Pond,

Little Otter Pond, Gull Pond East, White Hill Pond, Seal Cove Pond, and the Seal Cove River. The drainage area of Finnies Pond occupies 8.0 square miles. Of the total drainage area, 2.3 square miles are in standing water. Two major drainage systems and two minor systems contribute their drainage to Finnies Pond.

The drainage area lies at an altitude ranging from approximately 625 to 925 feet above sea level. The terrain ranges from almost entirely barren land and marshes to some small stands of fir, tamarack, and spruce. As mentioned earlier, a portion of the drainage area lies within the boundaries of the Butter Pot Provincial Park.

Most of the area lies in a region of Precambrian volcanic and sedimentary rocks. Lesser amounts of Precambrian rocks of the Holyrood plutonic series also occur within the drainage area. Most of the strata in the area are of volcanic origin and have been classified as belonging to the Harbour Main Group, and include acidic to mafic volcanic rocks, slate, greywacke, conglomerate, and metamorphic equivalents. The lesser amounts of plutonic rocks found within the drainage area include Hadrynian granodiorite, quartz monzonite, granite, and quartz diorite (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Finnies Pond is presented in Figure 1, the morphometric parameters are given in both the English and metric systems in Table I.

Table I. Morphometry of Finnies Pond

Area, including islands (acres) 400.0 (ha.) 161.9	Area, excluding islands (acres) 384.2 (ha.) 155.5
Maximum length (mi.) 1.4 (km.) 2.3	Maximum effective length (mi.) 1.2 (km.) 2.0
Maximum width (mi.) 0.8 (km.) 1.4	Maximum effective width (mi.) 0.8 (km.) 1.4
Mean width (mi.) 0.5 (km.) 0.7	Volume (cu.ft.) 2.09×10^8 (cu.m.) 5.92×10^6
Maximum depth (ft.) 46.0 (m.) 14.0	Mean depth (ft.) 12.5 (m.) 3.8
Mean depth-maximum depth ratio 0.27	Volume development 0.82
Perimeter, including islands (mi.) 6.3 (km.)10.1	Perimeter, excluding islands (mi.) 5.7 (km.) 9.2
Shore development, including islands 2.24	Shore development, excluding islands 2.09
Direction of Major Axes N-S	

Table I. (Cont'd)

Depth (ft.)	Area $(ft)^2$	Area (acres)	%
0-5	4,498,000	103.2	26.9
5-10	3,636,400	83.5	21.7
10-15	2,586,200	59.4	15.5
15-20	2,436,700	55.9	14.6
20-25	1,775,900	40.8	10.6
25-30	998,400	22.9	6.0
30-35	518,400	11.9	3.1
35-40	207,300	4.8	1.2
40-45	56,200	1.3	0.3
over 45	21,800	0.5	0.1
Total	1.67×10^7	384.2	

Finnies Pond is fairly irregular in shape (shore development index = 2.24) and its shores are moderately sloped. The mean depth is 12.5 feet and the maximum depth is 46 feet. Approximately 79 percent of the lake area is 20 feet or less in depth. Finnies Pond would appear, then, to be a moderately productive lake in terms of its physical features.

b. Surface Water Chemistry. The analysis of the surface water of Finnies Pond appears in Table II. Finnies Pond is obviously not productive in terms of its water quality as it is characterized by fairly acidic and poorly mineralized water. The waters of Finnies Pond are among the poorest, in terms of mineral content, of Avalon Peninsula lake waters investigated to date. It would appear then that the poor water quality overshadows the favourable effect of the lake's physical features and results in an overall low level of productivity.

c. Morphoedaphic Index and Lake Productivity. The specific conductance at $25^{\circ}C$ of Finnies Pond water ranges from 20.1 to 25.7 micromhos depending on the sampling station. Converting the specific

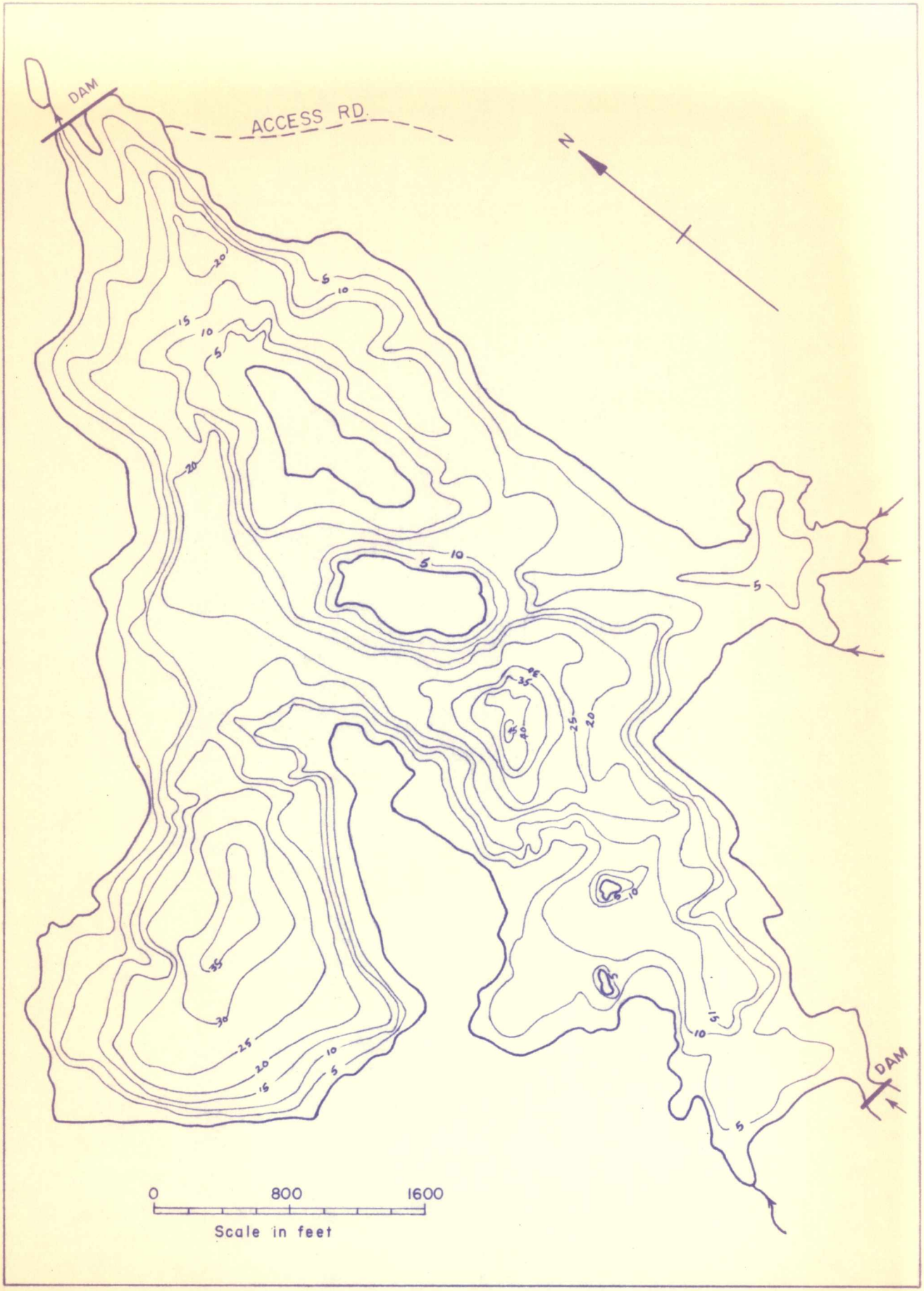


FIGURE I. BATHYMETRIC MAP OF FINNIES POND

Table II. Analysis of surface water of Finnies Pond (samples collected June, 1971)

	Range	Mean
Alkalinity as $CaCO_3$	1.5 - 3.0 ppm	2.3 ppm
Total hardness as $CaCO_3$	3.6 - 3.7 ppm	3.6 ppm
pH	4.7 - 6.2	5.9
Color (Hazen units)	-	20
Total organic carbon	2.5 - 4.0 ppm	3.5 ppm
Turbidity (units)	-	1.2
Sp. conductance, micromhos at 25°C	20.1 - 25.7	23.2
Total dissolved solids	21.5 - 25.5 ppm	23.7 ppm
Calcium (Ca)	-	0.8 ppm
Magnesium (Mg)	-	0.4 ppm
Sodium (Na)	-	2.9 ppm
Potassium (K)	-	0.2 ppm
Sulphate (SO_4)	1.1 - 1.4 ppm	1.3 ppm
Chloride (Cl)	-	4.7 ppm
Phosphate (PO_4) Total Diss.	0.02 - 0.06 ppm	0.04 ppm
Bicarbonate (HCO_3)	-	2.8 ppm
Carbonate (CO_3)	-	0.0 ppm
Nitrate (NO_3)	0.007 - 0.011 ppm	0.009 ppm
Silica (SiO_2)	0.9 - 1.0 ppm	1.0 ppm
Sum of constituents	12.4 - 13.0 ppm	12.7 ppm

conductance values to T.D.S. values we find the waters of Finnies Pond range from 21.5 to 25.5 ppm., with a mean of 23.7 ppm. The mineral content of Finnies Pond is considerably lower than the average for lakes in this area which is approximately 30 ppm. Using the T.D.S. of the lake water and the mean depth of the lake we find the morphoedaphic index to be 1.90 for Finnies Pond. The potential fish production or yield of Finnies Pond is approximately twice the square root of the morphoedaphic index or 2.76 pounds per acre per year, or 1,060 pounds per year. The average yield per year from Avalon Peninsula lakes investigated to date is approximately 3 pounds per acre, therefore Finnies Pond is light to moderately productive.

B. Fish Species Present

Three species of fish inhabit Finnies Pond and its drainage systems. Two are of sport value and include the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815, and the landlocked Atlantic salmon (ouananiche), Salmo salar Linnaeus 1758; both are native species.

Ouananiche are the slightly dominant species in terms of numbers, however, ouananiche are considerably smaller, on the average, than brook trout. The American eel, Anguilla rostrata (Le Sueur) 1817 was captured frequently in Finnies Pond and the specimens collected were the largest taken in all the lakes surveyed. Individuals weighing 5 and 6 pounds were common, however, in terms of numbers, the extent of the population is unknown.

C. Age and Size Composition of the Sport Species

1. Brook Trout

A brook trout 32.0 cm. fork length and VI+ years of age holds the known longevity and size record at Finnies Pond.

The age-length distribution of 398 brook trout sampled at Finnies Pond during June, 1971, is given in Table III.

Table III. Age-length distribution of brook trout taken in live-traps and gill nets during June, 1971, in Finnies Pond

Fork length (cm.) (Class mark)	Age-class						
	I+	II+	III+	IV+	V+	VI+	Total
8.55	1(100.0)	-	-	-	-	-	1(0.3)
10.55	1(14.3)	6(85.7)	-	-	-	-	7(1.8)
12.55	-	9(40.9)	13(59.1)	-	-	-	22(5.5)
14.55	-	6(9.7)	53(85.4)	3(4.9)	-	-	62(15.6)
16.55	-	-	65(72.2)	25(27.8)	-	-	90(22.6)
18.55	-	-	18(21.2)	64(75.3)	3(3.5)	-	85(21.4)
20.55	-	-	6(9.7)	49(79.0)	7(11.3)	-	62(15.6)
22.55	-	-	-	35(85.4)	6(14.6)	-	41(10.3)
24.55	-	-	-	7(53.8)	6(46.2)	-	13(3.3)
26.55	-	-	-	2(40.0)	2(40.0)	1(20.0)	5(1.3)
28.55	-	-	-	-	5(71.4)	2(28.6)	7(1.8)
30.55	-	-	-	-	2(100.0)	-	2(0.5)
32.55	-	-	-	-	-	1(100.0)	1(0.3)
Total	2	21	155	185	31	4	398

2. Ouananiche

The oldest and largest ouananiche observed during the survey on Finnies Pond was VII+ years of age with a fork length of 25.6 centimeters.

The age-length distribution of 1121 ouananiche sampled at this lake during June, 1971, is given in Table IV.

Table IV. Age-length distribution of ouananiche taken in live-traps and gill nets during June, 1971, in Finnies Pond

Fork length (cm.) (Class mark)	Age-class							
	I+	II+	III+	IV+	V+	VI+	VII+	Total
8.55	3(4.2)	63(87.5)	6(8.3)	-	-	-	-	72(6.4)
10.55	-	3(1.7)	165(94.3)	7(4.0)	-	-	-	175(15.6)
12.55	-	9(1.5)	554(90.8)	47(7.7)	-	-	-	610(54.4)
14.55	-	-	107(44.6)	133(55.4)	-	-	-	240(21.4)
16.55	-	-	-	8(50.0)	8(50.0)	-	-	16(1.4)
18.55	-	-	-	1(25.0)	2(50.0)	1(25.0)	-	4(0.4)
20.55	-	-	-	-	1(100.0)	-	-	1(0.1)
22.55	-	-	-	-	-	1(100.0)	-	1(0.1)
24.55	-	-	-	-	-	-	1(100.0)	1(0.1)
26.55	-	-	-	-	-	-	1(100.0)	1(0.1)
Total	3	75	832	196	11	2	2	1121

D. Growth Rates of the Sport Species

The growth rate of both brook trout and ouananiche were determined through the method of back-calculation.

1. Brook Trout

The Monastyrsky method of back-calculation in which a log-log

regression is calculated from paired observations of fish length and scale length was used for brook trout.

The regression equation for fish length and scale length is as follows:

$$\text{Log } L_f + 1.0121 \text{ Log } L_s + 0.8520$$

$$\text{or} \quad L_f = 7.112\ L_s^{1.0121}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table V.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Finnies Pond brook trout

Annulus	I	II	III	IV	V	VI
Scale length (x43)	0.88	1.57	2.12	2.72	3.28	3.95
Fish fork length (cm.)	6.2	11.2	15.2	19.6	23.7	28.6
Fish fork length (in.)	2.4	4.4	6.0	7.7	9.1	11.3

Generally, the growth rate of brook trout in Finnies Pond is about average in comparison to the mean growth rate of fish from other Avalon Peninsula populations.

2. Ouananiche

The Lee method of back-calculation was chosen to determine the growth rate of ouananiche in Finnies Pond.

From paired observations of fish length and scale length a least squares regression was calculated and is as follows:

$$L_f = 3.29\ L_s + 1.20$$

The average scale elgnths for each year of life and the corresponding calculated fish lengths are given in Table VI.

The growth rate of ouananiche in Finnies Pond is considerably slower than the mean growth rate exhibited by Avalon Peninsula populations.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Finnies Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII
Scale length (x43)	0.87	1.99	3.10	4.01	4.95	6.27	7.35
Fish fork length (cm.)	4.1	7.8	11.4	14.4	17.5	21.8	25.4
Fish fork length (in.)	1.6	3.1	4.5	5.5	6.8	8.6	10.0

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 66 brook trout taken in Finnies Pond during June, 1971, is given in Table VII.

Table VII. The food habits of Finnies Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic-Terr. Invert.	*Fish
15.55	2	4(100.0)	-	-
19.55	6	15(100.0)	-	-
23.55	6	18(100.0)	-	-
27.55	3	6(75.0)	3(25.0)	-
31.55	-	-	1(33.3)	2(66.7)
Total	17	43	4	2

*Ouananiche

Generally, it appears that at the smaller sizes, Finnies Pond brook trout are insectivorous. However, as they become larger they begin to switch to a diet containing some fish (ouananiche). The largest brook trout in the lake appear to be predominantly piscivorous.

2. Ouananiche

A total of 133 ouananiche were captured for food studies at Finnies Pond and the analysis of the stomach contents is given in Table VIII.

It would appear that ouananiche in this lake are mostly zooplankton feeders at the smaller sizes while the larger individuals rely heavily on benthic and terrestrial invertebrates as food organisms.

Table VIII. The food habits of Finnies Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents		
	Empty	Zooplankton	Benthic and/or Terrestrial Invertebrates
11.55	17	28(77.8)	8(22.2)
15.55	25	19(40.4)	28(59.6)
19.55	1	-	4(100.0)
23.55	-	-	2(100.0)
27.55	-	-	1(100.0)
Total	43	47	43

FIVE MILE POND WEST

A. Limnology

1. Location

Five Mile Pond West is situated at 47°20' North Latitude and 53°04' West Longitude. It lies approximately 24 miles south-west of the city of St. John's along the junction of the Witless Bay Line and the Trans Canada Highway. Five Mile Pond West has an elevation of approximately 675 feet above sea level.

2. Uses

a. Industrial. During the early 1930's the waters of Five Mile Pond West were impounded to form a hydro-electric reservoir supplying water,

through a number of downstream reservoirs, to the generating station at Seal Cove. The hydro dam has long since fallen into disrepair and the lake now suffers from a permanent drawdown. The waters of Five Mile Pond West are still utilized in the generation of electricity at Seal Cove although the lake no longer serves as a reservoir.

b. Recreational. Five Mile Pond West presently experiences light to moderate fishing pressure on its resident salmonid species. In addition to angling, the lake sustains a moderate amount of swimming, picnicing, and camping, and some light boating activity. The lake is only occasionally used for waterfowl hunting, however, there is a high amount of ptarmigan hunting conducted in the immediate area of the lake. There is, at the present time, a very small cabin development on the lake consisting of 2 or 3 units.

3. Characteristics of the Drainage Area

Five Mile Pond West empties into Conception Bay via Five Mile Pond East, Finnies Pond, Big Otter Pond, Little Otter Pond, Gull Pond East, White Hill Pond, Seal Cove Pond, and the Seal Cove River. The drainage area of Five Mile Pond West occupies 3.2 square miles. Of the total drainage area, 0.9 square miles are in standing water. Two major drainage systems and five minor systems contribute their drainage to Five Mile Pond West.

The drainage area lies at an altitude ranging from approximately 675 to 925 feet above sea level. The terrain is almost entirely composed of barrens and marshes with occasional small stands of fir, tamarack, and spruce.

In terms of geology, most of the drainage area lies in a region of Precambrian volcanic and sedimentary rocks. Lesser amounts of Precambrian rocks of the Holyrood plutonic series also occur within the drainage area. Most of the strata in the area are of volcanic origin and have been classified as belonging to the Harbour Main Group, and include acidic to mafic volcanic rocks, slate, greywacke, conglomerate, and metamorphic equivalents. The lesser amounts of plutonic rocks found within the drainage area include Hadrynian granodiorite, quartz monzonite, granite, and quartz diorite (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. An underwater topographical map of Five Mile Pond West is presented in Figure 1, and the morphometric data are given in Table I.

Five Mile Pond West is fairly irregular in shape as evidenced by its having a shore development index of 2.41; a perfectly circular lake would have a value of 1 as its shore development index. The shores of this lake are gently sloped and its mean depth is only 7.6 feet. The maximum depth of Five Mile Pond West is 24 ft. Approximately 97 percent

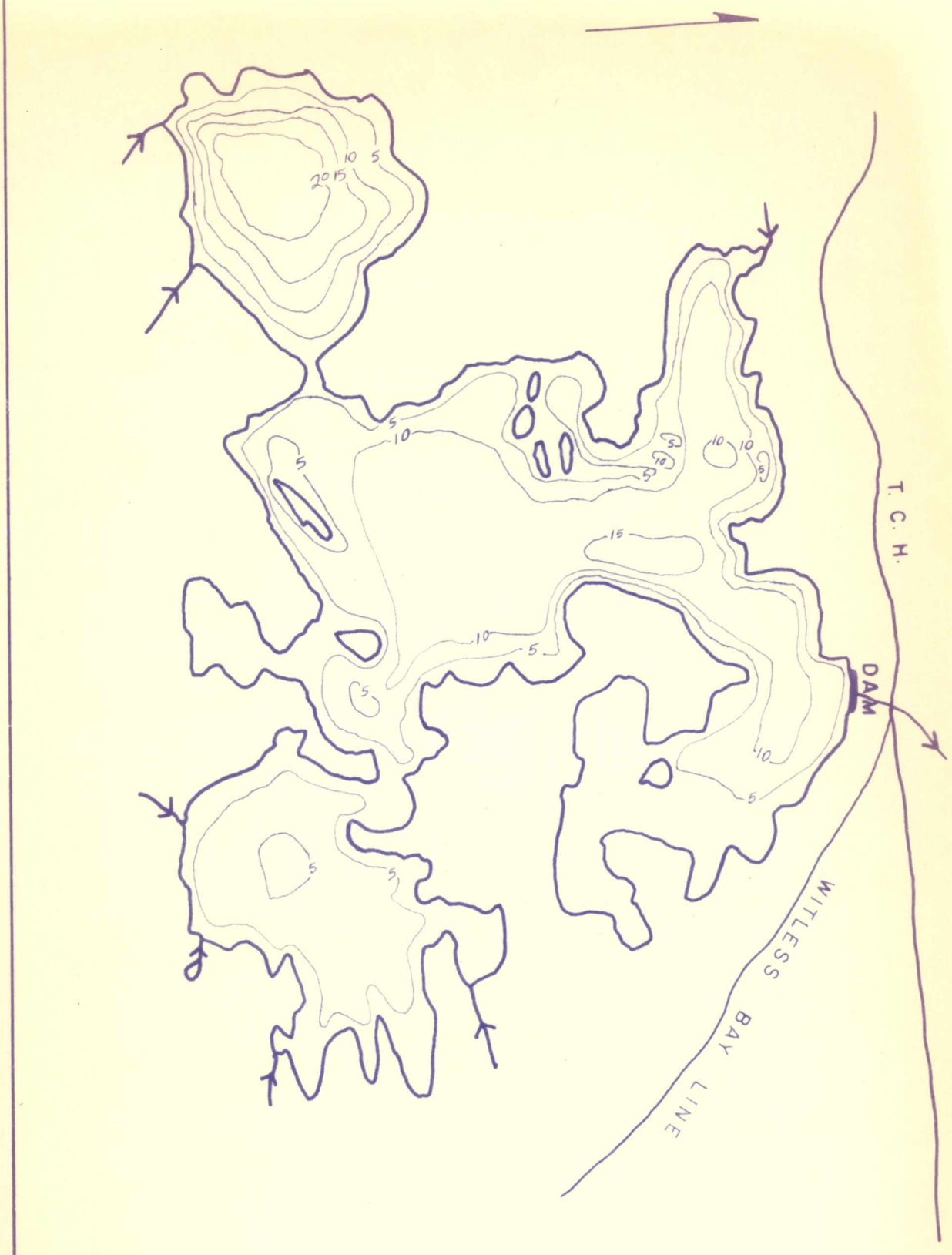


FIGURE I. BATHYMETRIC MAP OF FIVE MILE WEST POND

Table I. Morphometry of Five Mile Pond West

Area, including islands (acres) 219.6 (ha.) 88.9	Area, excluding islands (acres) 212.5 (ha.) 86.0
Maximum length (mi.) 0.8 (km.) 1.3	Maximum effective length (mi.) 0.7 (km.) 1.1
Maximum width (mi.) 0.6 (km.) 1.0	Maximum effective width (mi.) 0.6 (km.) 1.0
Mean width (mi.) 0.4 (km.) 0.6	Volume (cu.ft.) 7.02×10^7 (cu.m.) 1.99×10^6
Maximum depth (ft.) 24.0 (m.) 7.3	Mean depth (ft.) 7.6 (m.) 2.3
Mean depth-maximum depth ratio 0.32	Volume development 0.96
Perimeter, including islands (mi.) 4.9 (km.) 7.9	Perimeter, excluding islands (mi.) 4.1 (km.) 6.6
Shore development, including islands 2.41	Shore development, excluding islands 2.02

Direction of Major Axes E-W

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	3,610,000	82.8	39.0
5-10	2,850,000	65.4	30.8
10-15	2,100,000	48.2	22.6
15-20	440,000	10.1	4.8
over 20	260,000	6.0	2.8
Total	9,260,000	212.5	

of the lake area is 20 feet or less in depth. Five Mile Pond West would appear then to be a very productive lake in terms of its physical features.

b. Surface Water Chemistry. The analysis of the surface water

of Five Mile Pond West appears in Table II. Generally speaking, this lake is not overly productive in terms of its water quality as it is characterized by poorly mineralized water. The waters of Five Mile Pond West are among the lowest, in terms of mineral content, of Avalon Peninsula lake waters analysed to date. It appears, then, that the below average water fertility dampens the favourable effect of the lake's physical features and results in an overall lowering of productivity.

Table II. Analysis of surface water of Five Mile Pond West (samples collected August, 1972)

	Range	Mean
Alkalinity as $CaCO_3$	-	2.5 ppm
Total hardness as $CaCO_3$	3.9 - 4.2 ppm	4.1 ppm
pH	6.1 - 6.2	6.2
Color (Hazen units)	10 - 20	-
Turbidity (units)	0.21 - 0.34	0.28
Sp. conductance, micromhos at 25°C	25.2 - 28.6	26.9
Total dissolved solids	25.2 - 27.6 ppm	26.4 ppm
Calcium (Ca)	1.0 - 1.2 ppm	1.1 ppm
Magnesium (Mg)	-	0.3 ppm
Sodium (Na)	2.3 - 2.4 ppm	2.4 ppm
Potassium (K)	-	0.3 ppm
Sulphate (SO_4)	-	1.8 ppm
Chloride (Cl)	4.0 - 4.4 ppm	4.2 ppm
Phosphate (PO_4) Total	0.01 - 0.12 ppm	0.07 ppm
Dissolved	0.003 - 0.03 ppm	0.02 ppm
Bicarbonate (HCO_3)	4.3 - 5.1 ppm	4.7 ppm
Nitrate (NO_3)	-	0.030 ppm
Silica (SiO_2)	-	0.2 ppm
Sum of constituents	11.5 - 12.2 ppm	11.9 ppm

C. Morphoedaphic Index and Lake Productivity. The mineral content of lake water is of prime importance in determining the productivity of lakes. The mineral content of natural waters is usually expressed as the total dissolved solids (T.D.S.). The mineral content of Five Mile Pond West water ranges from 25.2 - 27.6 ppm with a mean value of 26.4 ppm. By dividing the T.D.S. of lake water by the average depth of the lake we calculate the morphoedaphic index for that lake. The estimated potential yield of fish from a lake is approximately twice the square root of the morphoedaphic index. Five Mile Pond West has a morphoedaphic index of 3.47 and a potential fish yield of 3.73 pounds per acre per year. A suggested maximum sustained yield of sport fish from this lake is 793 pounds annually.

The average estimated yield from lakes on the Avalon Peninsula is approximately 3 pounds per acre per year, indicating Five Mile Pond West is considerably more productive than average.

B. Fish Species Present

Five Mile Pond West and its drainage systems contain only three fish species, and all are native to Newfoundland waters. Two of the species are of sport fishing value and include the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815, and the land-locked Atlantic salmon (or ouananiche), Salmo salar Linnaeus 1758. Ouananiche are the slightly dominant species in terms of number, however, ouananiche are considerably smaller, on the average, than brook trout. The American eel, Anguilla rostrata (Le Sueur) 1817 was captured infrequently in Five Mile Pond West, however, the extent of the population is unknown.

C. Age and Size Composition of the Sport Species

1. Brook Trout

The oldest and largest brook trout observed during the study at Five Mile Pond West was V^+ years of age with a fork length of 26.0 centimeters.

The age-length distribution of 163 brook trout sampled at Five Mile Pond West during August, 1972, is given in Table III.

2. Ouananiche

A ouananiche 19.5 cm. fork length and VI^+ years of age holds the known longevity and size record at Five Mile Pond West.

Table IV gives the age-length distribution of 221 ouananiche sampled at Five Mile Pond West during August, 1972.

D. Growth Rates of the Sport Species

The growth rate of brook trout and ouananiche were determined through the method of back-calculation.

1. Brook Trout

Using the Monastyrsky method of back-calculation, from paired observations of fish length and scale length, a log-log regression was

Table III. Age-length distribution of brook trout taken in gill nets and live traps during August, 1972, in Five Mile Pond West

Fork length (cm.) (Class mark)	Age-class				
	II+	III+	IV+	V+	Total
10.55	3(100.0)	-	-	-	3(1.8)
12.55	4(100.0)	-	-	-	4(2.5)
14.55	3(50.0)	3(50.0)	-	-	6(3.7)
16.55	14(26.4)	38(71.7)	1(1.9)	-	53(32.5)
18.55	1(1.7)	51(85.0)	8(13.3)	-	60(36.8)
20.55	-	11(42.3)	15(57.7)	-	26(16.0)
22.55	-	1(20.0)	4(80.0)	-	5(3.1)
24.55	-	-	3(60.0)	2(40.0)	5(3.1)
26.55	-	-	-	1(100.0)	1(0.6)
Total	25	104	31	3	163

Table IV. Age-length distribution of ouananiche taken in gill nets and live-traps during August, 1972, in Five Mile Pond West

Fork length (cm.) (Class mark)	Age-class					
	II+	III+	IV+	V+	VI+	Total
8.55	4(50.0)	4(50.0)	-	-	-	8(3.6)
10.55	2(3.1)	58(92.1)	3(4.8)	-	-	63(28.5)
12.55	2(2.6)	39(50.0)	36(46.2)	1(1.2)	-	78(35.3)
14.55	-	12(18.2)	39(59.1)	15(22.7)	-	66(29.9)
16.55	-	1(33.3)	1(33.4)	1(33.3)	-	3(1.4)
18.55	-	-	1(33.3)	1(33.4)	1(33.3)	3(1.4)
Total	8	114	80	18	1	221

calculated and is as follows:

$$\text{Log } L_f = 1.0900 \text{ Log } L_s + 0.8055$$

$$\text{or} \quad L_f = 6.390\ L_s^{1.0900}$$

The average scale lengths for each year of life and the corresponding fish lengths are given in Table V.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Five Mile Pond West brook trout

Annulus	I	II	III	IV	V
Scale length (x43)	0.89	1.65	2.28	2.81	3.48
Fish fork length (cm.)	5.6	11.1	15.7	19.7	24.9
Fish fork length (in.)	2.2	4.4	6.2	7.8	9.8

Generally, the growth rate of Five Mile Pond West brook trout is about identical to the mean growth rate exhibited by brook trout in Avalon Peninsula lakes.

2. Ouananiche

Using the Lee method of back-calculation, from paired observations of fish length and scale length, a least squares regression was calculated and is as follows:

$$L_f = 3.18\ L_s + 0.83$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

The growth rate of Five Mile Pond West ouananiche is significantly slower than the mean growth rate of fish from other Avalon Peninsula lakes, and in fact is one of the slower growth rates exhibited by populations investigated to date.

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 113 brook trout

taken in Five Mile Pond West during August, 1972, is given in Table VII. Generally, it appears the brook trout in this lake are totally insectivorous.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Five Mile Pond West ouananiche

Annulus	I	II	III	IV	V	VI
Scale length (x43)	1.01	2.08	3.28	4.11	4.81	5.60
Fish fork length (cm.)	4.0	7.4	11.3	13.9	16.1	18.5
Fish fork length (in.)	1.6	2.9	4.5	5.5	6.3	7.3

Table VII. The food habits of Five Mile Pond West brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents	
	Empty	Benthic and/or Terrestrial Invertebrates
15.55	15	20 (100.0)
19.55	27	45 (100.0)
23.55	1	5 (100.0)
Total	43	70

2. Ouananiche

Table VIII shows the result of the analysis of the food habits of 221 ouananiche taken in Five Mile Pond West during August, 1972. Generally, the smaller fish appear to be relying heavily on zooplankton as a source of food, while the larger individuals appear to consume a greater proportion of benthos and terrestrial organisms.

Table VIII. The food habits of Five Mile Pond West ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents		
	Empty	Zooplankton	Benthic and/or Terr. Invertebrates
7.55	2	1(100.0)	-
11.55	111	34(82.9)	7(17.1)
15.55	46	14(73.7)	5(26.3)
19.55	-	-	1(100.0)
Total	159	49	13

BIG TRIANGLE POND

A. Limnology

1. Location

Big Triangle Pond is situated at 47°20' North Latitude and 53°12' West Longitude. It lies approximately 30 miles south-west of the city of St. John's along the Trans Canada Highway. Big Triangle Pond has an elevation of approximately 325 feet above sea level.

2. Uses

a. Industrial. At the present time the waters of Big Triangle Pond have no industrial use.

b. Recreational. At present, Big Triangle Pond experiences a moderate fishing pressure on its resident salmonid species, as well as a very light fishery for anadromous Atlantic salmon which are occasionally taken in the scheduled waters of the lake's inlet and outlet. In addition to angling, other recreational activities on the lake include a moderate amount of boating and waterfowl hunting with lesser amounts of swimming, picnicing, and camping. Considerable rabbit hunting and some grouse and ptarmigan hunting is carried on in proximity to Big Triangle Pond. There is presently no summer cabin development on this lake.

3. Characteristics of the Drainage Area

Big Triangle Pond empties into Conception Bay via Little Triangle Pond, Daniels Brook, and North Arm River. The drainage area of the lake occupies 18.4 square miles. Of the total drainage area of Big Triangle Pond, 4.2 square miles are in standing water. One major drainage system and one minor system contribute their drainage to Big Triangle Pond.

The drainage area lies at an altitude ranging from approximately 325 to 975 feet above sea level. The terrain ranges from mostly climax forest of spruce, fir, and birch to small areas of barrens and marshland. Historically, there has been considerable logging activity within the drainage area.

Most of the area lies in a region of Precambrian volcanic and sedimentary rocks. Lesser amounts of Precambrian rocks of the Holyrood plutonic series also occur within the drainage area. Most of the strata in the area are of volcanic origin and have been classified as belonging to the Harbour Main or Conception Groups. These two Groups include, respectively, Hadrynian acidic to mafic volcanic rocks, slate, greywacke, conglomerate, and metamorphic equivalents; and Hadrynian slate, siltstone, greywacke, conglomerate, and minor volcanic rocks. The small amount of plutonic rocks found within the drainage area include Hadrynian granodiorite, quartz monzonite, granite, quartz diorite, diorite, gabbro, and monzonite (Geological Survey of Canada, Map 1231 A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Big Triangle Pond is presented in Figure 1, and the morphometric parameters are given in Table I.

Big Triangle Pond is fairly irregular in shape (shore development index = 2.53) and its shores are rather gently sloped. The mean depth of the lake is only 9.1 feet and the maximum depth is only 24 feet. Approximately 90 percent of the lake area is included in the 0-20 feet range of depth. This depth range is generally accepted as accounting for most of the fish production in a lake. Big Triangle Pond appears, on the basis of its morphometry, to be a very productive lake.

b. Surface Water Chemistry. The analysis of the surface water of Big Triangle Pond appears in Table II.

Although Big Triangle Pond has soft water, as do all lakes in eastern Newfoundland, the waters of Big Triangle Pond are among the hardest to be found in the area to date. The mineral content of Big Triangle Pond water is considerably higher than average for lakes on the Avalon Peninsula. The concentration of such nutrients as calcium, phosphate and bicarbonate are the highest recorded for Avalon Peninsula lakes investigated to date. Generally then, it would appear that the waters of

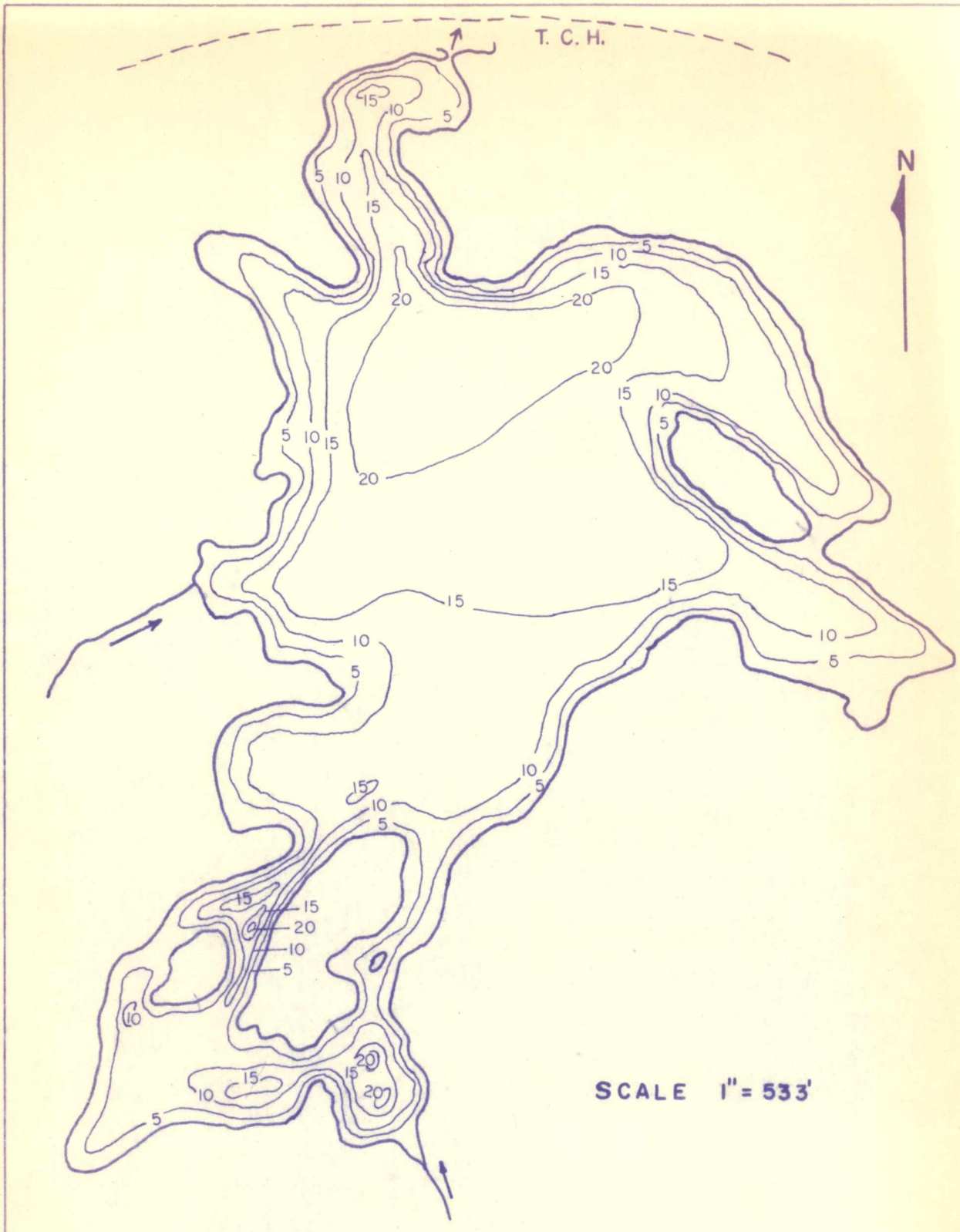


FIGURE I. BATHYMETRIC MAP OF BIG TRIANGLE POND

Table I. Morphometry of Big Triangle Pond

Area, including islands (acres) 119.0 (ha.) 48.2	Area, excluding islands (acres) 108.7 (ha.) 44.0
Maximum length (mi.) 0.8 (km.) 1.2	Maximum effective length (mi.) 0.7 (km.) 1.1
Maximum width (mi.) 0.6 (km.) 0.9	Maximum effective width (mi.) 0.6 (km.) 0.9
Mean width (mi.) 0.2 (km.) 0.4	Volume (cu.ft.) 3.46×10^7 (cu.m.) 9.79×10^5
Maximum depth (ft.) 24.0 (m.) 7.3	Mean depth (ft.) 9.1 (m.) 2.8
Mean depth - maximum depth ratio 0.38	Volume development 1.14
Perimeter, including islands (mi.) 4.0 (km.) 6.5	Perimeter, excluding islands (mi.) 3.2 (km.) 5.2
Shore development, including islands 2.53	Shore development, excluding islands 2.01

Direction of Major Axes NE-SW

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	492,440	11.3	10.4
5-10	1,265,940	29.1	26.7
10-15	1,346,160	30.9	28.4
15-20	1,138,320	26.1	24.1
over 20	492,780	11.3	10.4
Total	4.74×10^6	108.7	

Table II. Analysis of surface water of Big Triangle Pond (samples collected June, 1969 and July, 1970)

	Range	Mean
Alkalinity as $CaCO_3$	8.9 - 13.3 ppm	10.8 ppm
Total hardness as $CaCO_3$	11.0 - 14.0 ppm	12.6 ppm
pH	6.8 - 7.1	6.9
Color (Hazen units)	25 - 30	-
Oxygen consumed ($KMnO_4$)	6.7 - 7.3 ppm	6.9 ppm
Turbidity (units)	0.60 - 0.87	-
Sp. conductance, micromhos at 25°C	29.1 - 43.1	35.5
Total dissolved solids	28.3 - 38.0 ppm	32.7 ppm
Calcium (Ca)	-	3.9 ppm
Magnesium (Mg)	-	0.7 ppm
Sodium (Na)	-	3.4 ppm
Potassium (K)	-	0.4 ppm
Sulphate (SO_4)	2.8 - 3.5 ppm	3.1 ppm
Chloride (Cl)	6.0 - 6.4 ppm	6.2 ppm
Phosphate (PO_4) Total	0.02 - 0.27 ppm	0.13 ppm
Dissolved	0.00 - 0.02 ppm	0.01 ppm
Bicarbonate (HCO_3)	10.5 - 11.2 ppm	10.9 ppm
Carbonate (CO_3)	-	0.0 ppm
Nitrate (NO_3)	-	0.00 ppm
Silica (SiO_2)	0.6 - 0.7 ppm	0.6 ppm
Sum of constituents	23.3 - 24.1 ppm	23.7 ppm

this lake are as nutrient-rich as any on the Avalon Peninsula.

c. Morphoedaphic Index and Lake Productivity. The mineral content of lake water and the morphometry of the lake are of prime importance in determining the amount of fish a lake can produce. Both the water quality and morphometry of Big Triangle are conducive to good levels of fish production by Avalon Peninsula standards. The T.D.S. value of Big Triangle Pond water ranged from 28.3 to 38.0 ppm with a mean value of 32.7 ppm. By dividing the T.D.S. of the lake water by the mean depth of the lake we calculate a morphoedaphic index of 3.59, which means Big Triangle Pond has an estimated annual fish production or yield of 3.79 pounds per acre per year, or 451 pounds per year. The estimated annual yield per acre of sport fish from this lake is one of the highest of the Avalon Peninsula lakes investigated to date.

B. Fish Species Present

Big Triangle Pond and its drainage system contains only four

fish species, and all are native to Newfoundland waters. Only two of the species are of recreational value and include the landlocked and anadromous forms of the Atlantic salmon, Salmo salar Linnaeus 1758, and the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815. The Atlantic salmon is the dominant sport species in terms of numbers and size, with the landlocked component of the species (ouananiche) comprising the bulk of the population by far. Anadromous salmon (grilse) only occasionally utilize the lake. The threespine stickleback, Gasterosteus aculeatus Linnaeus 1758 occurs in the lake in large numbers. The American eel, Anguilla rostrata (Le Sueur) 1817 also occurs in Big Triangle Pond, however, the extent of the population is unknown.

C. Age and Size Composition of the Sport Species

1. Brook Trout

The oldest and largest brook trout observed during the survey on Big Triangle Pond was V+ years of age with a fork length of 32.5 centimeters.

The age-length distribution of 56 brook trout sampled at Big Triangle Pond during June, 1969, is given in Table III.

Table III. Age-length distribution of brook trout taken in gill nets during June, 1969, in Big Triangle Pond

Fork length (cm.) (Class mark)	Age-class				
	II+	III+	IV+	V+	Total
14.55	1(100.0)	-	-	-	1(1.8)
16.55	20(100.0)	-	-	-	20(35.7)
18.55	7(70.0)	3(30.0)	-	-	10(17.9)
20.55	1(20.0)	4(80.0)	-	-	5(8.9)
22.55	-	10(100.0)	-	-	10(17.9)
24.55	-	-	1(100.0)	-	1(1.8)
26.55	-	-	3(100.0)	-	3(5.4)
28.55	-	-	1(100.0)	-	1(1.8)
30.55	-	-	1(50.0)	1(50.0)	2(3.6)
32.55	-	-	-	3(100.0)	3(5.4)
Total	29	17	6	4	56

2. Ouananiche

A ouananiche 37.7 cm. fork length and IX^{+} years of age holds the known longevity and size record at Big Triangle Pond.

Table IV shows the age-length distribution of 100 ouananiche sampled at Big Triangle Pond during June, 1969.

3. Anadromous Salmon

Although no anadromous salmon were taken in Big Triangle Pond during the study, available information suggests that the run entering the lake is composed entirely of grilse ranging from 2 to 4 pounds in weight and these fish are either 3:1, + or 4:1, + years of age.

D. Growth Rates of the Sport Species

The growth rate of brook trout and ouananiche were determined through the method of back-calculation.

1. Brook Trout

Using the Monastyrsky method of back-calculation, from paired observations of fish length and scale length, a log - log regression was calculated and is as follows:

$$\text{Log } L_f = 1.1051 \text{ Log } L_s + 0.8494$$

$$\text{or } L_f = 7.069\ L_s^{1.1051}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table V.

Generally, the growth rate of Big Triangle Pond brook trout is considerably faster than the mean growth rate of fish from other Avalon Peninsula lakes, and in fact is one of the fastest growing populations of those studied to date.

2. Ouananiche

The Lee method of back-calculation was used to determine the growth rate of ouananiche. From paired observations of fish length and scale length, a least squares regression was calculated and is as follows:

$$L_f = 3.97\ L_s + 1.82$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

Table IV. Age-length distribution of ouananiche taken in gill nets during June, 1969, in Big Triangle Pond.

Fork length (cm.) (Class mark)	Age-class								
	II+	III+	IV+	V+	VI+	VII+	VIII+	IX+	Total
14.55	1(20.0)	5(80.0)	-	-	-	-	-	-	6
16.55	-	4(100.0)	-	-	-	-	-	-	4
18.55	-	3(60.0)	2(40.0)	-	-	-	-	-	5
20.55	-	3(15.0)	16(80.0)	1(5.0)	-	-	-	-	20
22.55	-	-	12(100.0)	-	-	-	-	-	12
24.55	-	-	3(20.0)	10(66.7)	2(13.3)	-	-	-	15
26.55	-	-	-	2(13.3)	12(80.0)	1(6.7)	-	-	15
28.55	-	-	-	1(7.7)	9(69.2)	2(15.4)	1(7.7)	-	13
30.55	-	-	-	-	-	4(80.0)	1(20.0)	-	5
32.55	-	-	-	-	-	1(25.0)	3(75.0)	-	4
34.55	-	-	-	-	-	-	-	-	-
36.55	-	-	-	-	-	-	-	-	-
38.55	-	-	-	-	-	-	-	1(100.0)	1
Total	1	15	33	14	23	8	5	1	100

The growth rate of Big Triangle Pond ouananiche is considerably faster than the mean growth rate of fish from other Avalon Peninsula lakes.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Big Triangle Pond brook trout

Annulus	I	II	III	IV	V
Scale length (x43)	0.75	1.53	2.24	2.93	3.53
Fish fork length (cm.)	5.1	11.3	17.2	23.2	28.5
Fish fork length (in.)	2.0	4.5	6.8	9.1	11.2

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Big Triangle Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII	VIII	IX
Scale length (x43)	1.00	2.35	3.58	4.69	5.38	6.32	6.84	7.37	9.00
Fish fork length (cm.)	5.8	11.2	16.0	20.4	23.2	26.9	29.0	31.1	37.6
Fish fork length (in.)	2.3	4.4	6.3	8.0	9.1	10.6	11.4	12.2	14.8

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 56 brook trout taken in Big Triangle Pond during June, 1969, is given in Table VII. Generally, it appears that brook trout in Big Triangle Pond are mainly insectivorous at the smaller sizes but become piscivorous as they become larger.

2. Ouananiche

Table VIII shows the result of the analysis of the food habits of 100 ouananiche taken in Big Triangle Pond during June, 1969. Generally speaking, ouananiche in this lake are insectivorous during the early years of life but switch to a diet of fish (sticklebacks) as they become larger.

Table VII. The food habits of Big Triangle Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic-Terr. Invert.	*Fish
15.55	2	19(100.0)	-	-
19.55	1	13(92.9)	-	1(7.1)
23.55	-	6(54.5)	1(9.1)	4(36.4)
27.55	1	2(66.7)	-	1(33.3)
31.55	-	1(20.0)	2(40.0)	2(40.0)
Total	4	41	3	8

*Sticklebacks

Table VIII. The food habits of Big Triangle Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic-Terr. Invert.	*Fish
15.55	3	7(100.0)	-	-
19.55	4	20(95.2)	-	1(4.8)
23.55	3	15(62.5)	5(20.8)	4(16.7)
27.55	4	7(29.2)	7(29.2)	10(41.6)
31.55	1	1(12.5)	1(12.5)	6(75.0)
35.55	-	-	-	-
39.55	-	-	-	1(100.0)
Total	15	50	13	22

*Sticklebacks

SOUTHERN PEAK POND

A. Limnology

1. Location

Southern Peak Pond is situated at 47°19' North Latitude and 53°12' West Longitude. It lies approximately 30 miles south-west of the city of St. John's approximately 1 mile off the Trans Canada Highway. Southern Peak Pond has an elevation of approximately 335 feet above sea level.

2. Uses

a. Industrial. The waters of Southern Peak Pond have no industrial use at the present time.

b. Recreational. At present, Southern Peak Pond experiences a very light fishing pressure on its resident salmonid species, as well as an extremely light fishery for sea-run Atlantic salmon which are infrequently taken in the non-scheduled waters of the lake's inlet and outlet. In addition to angling, other recreational activities on the lake include a very small amount of boating and camping. A moderate amount of waterfowl and rabbit hunting and some grouse and ptarmigan hunting is conducted in proximity to Southern Peak Pond. There is no summer cabin development on this lake at the present time.

3. Characteristics of the Drainage Area

Southern Peak Pond empties into Conception Bay via Big Triangle Pond, Little Triangle Pond, Daniels Brook, and North Arm River. The drainage area of the lake occupies 17.7 square miles. Of the total drainage area of Southern Peak Pond, 4.0 square miles are in standing water. Two major drainage systems and one minor system contribute their drainage to Southern Peak Pond.

The drainage area lies at an altitude ranging from approximately 335 to 975 feet above sea level. The terrain of the lake's drainage area ranges from mostly climax forest of spruce, fir, and birch to small areas of barrens and marshes. In past years, there has been considerable logging activity within the drainage area.

Most of the drainage area lies in a region of Precambrian volcanic and sedimentary rocks. Lesser amounts of Precambrian rocks of the Holyrood putonic series also occur within the drainage area. Most of the strata in the area are of volcanic origin and have been classified as belonging to the Harbour Main or Conception Groups. These two groups include, respectively, Hadrynian acidic to mafic volcanic rocks, slate, siltstone, greywacke, conglomerate, and minor volcanic rocks. The small amount of plutonic rocks found within the

drainage area include Hadrynian grandiorite, quartz monzonite, granite, quartz diorite, diorite, gabbro, and monzonite (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Southern Peak Pond is presented in Figure 1; the morphometric parameters are given in Table I.

Table I. Morphometry of Southern Peak Pond

Area, including islands (acres) 187.5 (ha.) 75.9	Area, excluding islands (acres) 186.4 (ha.) 75.4
Maximum length (mi.) 1.1 (km.) 1.8	Maximum effective length (mi.) 1.1 (km.) 1.8
Maximum width (mi.) 0.6 (km.) 0.9	Maximum effective width (mi.) 0.6 (km.) 0.9
Mean width (mi.) 0.3 (km.) 0.4	Volume (cu.ft.) 1.45×10^8 (cu. m.) 4.10×10^6
Maximum depth (ft.) 47.0 (m.) 14.3	Mean depth (ft.) 13.6 (m.) 4.2
Mean depth-maximum depth ratio 0.29	Volume development 0.87
Perimeter, including islands (mi.) 3.8 (km.) 6.1	Perimeter, excluding islands (mi.) 3.5 (km.) 5.6
Shore development, including islands 1.99	Shore development, excluding islands 1.82

Direction of Major Axes NNE-SSW

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	933,000	21.4	11.5
5-10	1,280,000	29.4	15.8
10-15	1,119,000	25.7	13.8
15-20	1,267,000	29.1	15.6
20-25	1,672,000	37.7	20.2

Table I (Cont'd)

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
25-30	880,000	20.2	10.8
30-35	548,000	12.6	6.8
35-40	326,000	7.5	4.0
40-45	96,000	2.2	1.2
over 45	26,000	0.6	0.3
Total	8.12×10^6	186.4	

Southern Peak Pond is fairly regular in shape (shore development index = 1.99) and its shores are fairly sharply sloped. Approximately 57 percent of the lake area is 20 feet or less in depth. The mean depth is 13.6 feet and the maximum depth is 47 feet. Southern Peak Pond would appear then to be a fairly unproductive lake in terms of its physical features.

b. Surface Water Chemistry. The analysis of the surface water of Southern Peak Pond appears in Table II. Southern Peak Pond is obviously fairly productive (by Avalon Peninsula standards) in terms of its water quality as it is characterized by neutral, and moderately mineralized, water. The waters of this lake are among the richest in terms of mineral content, of Avalon Peninsula lake waters investigated to date. It would appear then that the high water quality may overshadow the relatively unfavourable effect of the lake's physical features and result in an overall good level of productivity.

c. Morphoedaphic Index and Lake Productivity. The specific conductance at 25°C of Southern Peak Pond water ranges from 29.7 to 41.0 micromhos depending on sampling station. Converting the specific conductance values to T.D.S. values we find the waters of Southern Peak Pond range from 28.4 to 36.6 ppm, with a mean of 32.4 ppm. The mineral content of Southern Peak Pond is slightly higher than the average for lakes in the Avalon area which is approximately 30 ppm. Dividing the T.D.S. of the lake water by the mean depth of the lake we find the morphoedaphic index to be 2.38 for Southern Peak Pond. The yield from Southern Peak Pond is approximately twice the square root of the morphoedaphic index or 3.09 pounds per acre per year, or 596 pounds per year. The average annual yield from Avalon Peninsula lakes is estimated to be approximately 3 pounds per acre, therefore,

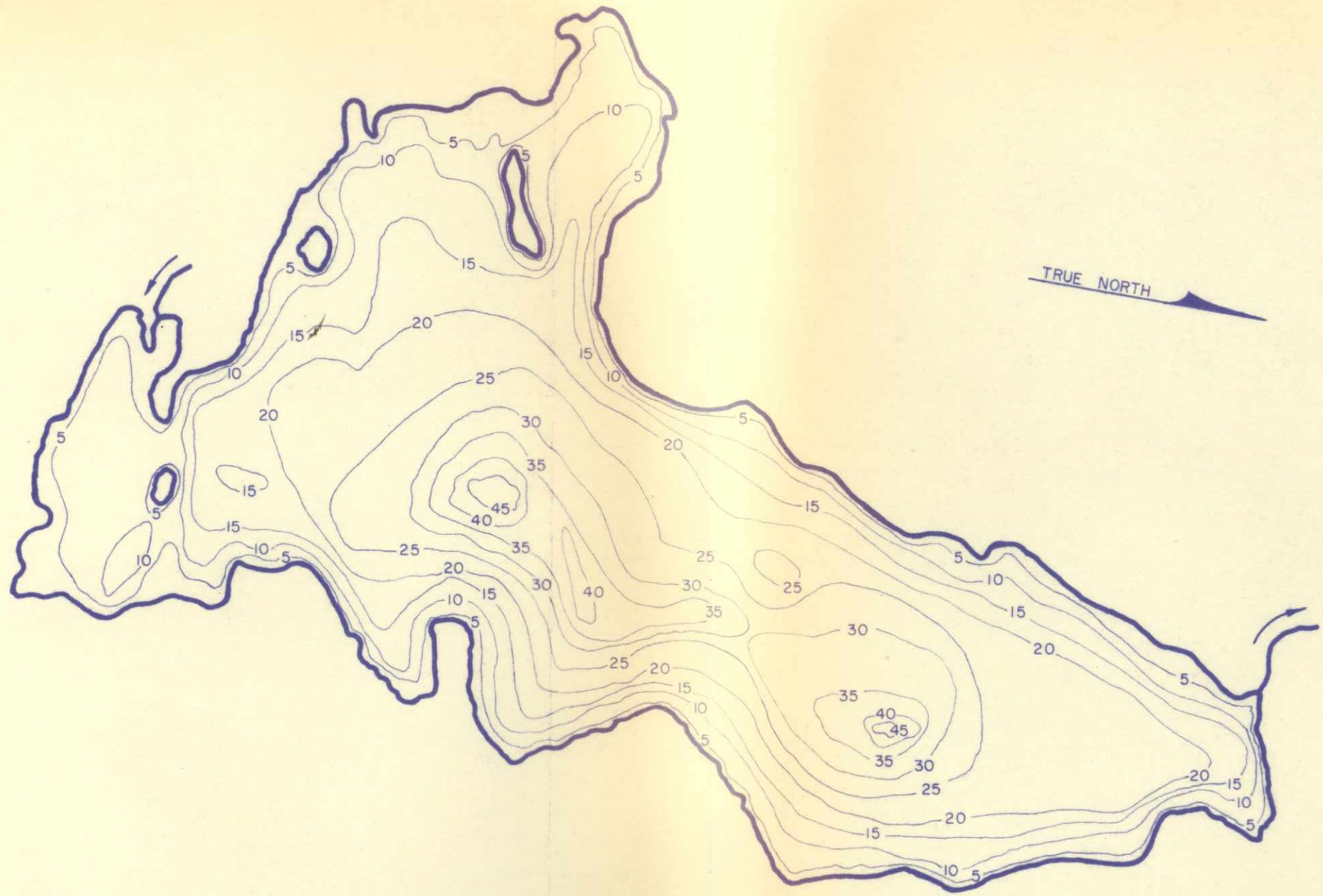


FIG. 1. BATHYMETRIC MAP OF SOUTHERN PEAK POND

Table II. Analysis of surface water of Southern Peak Pond (samples collected June, 1969 and July, 1970).

	Range	Mean
Alkalinity as $CaCO_3$	9.1 - 12.7 ppm	10.7 ppm
Total hardness as $CaCO_3$	11.0 - 13.3 ppm	12.5 ppm
pH	6.8 - 7.0	6.9
Color (Hazen units)	25 - 30	-
Oxygen consumed ($KMnO_4$)	3.2 - 5.5 ppm	4.7 ppm
Turbidity (units)	0.41 - 0.65	-
Sp. conductance, micromhos at 25°C	29.7 - 41.0	35.3
Total dissolved solids	28.4 - 36.6 ppm	32.4 ppm
Calcium (Ca)	3.9 - 4.5 ppm	4.1 ppm
Magnesium (Mg)	0.6 - 0.7 ppm	0.7 ppm
Sodium (Na)	3.4 - 3.6 ppm	3.5 ppm
Potassium (K)	-	0.4 ppm
Sulphate (SO_4)	2.8 - 4.5 ppm	3.5 ppm
Chloride (Cl)	5.9 - 6.2 ppm	6.0 ppm
Phosphate (PO_4) Total	0.00 - 0.03 ppm	0.01 ppm
Dissolved	-	0.00 ppm
Bicarbonate (HCO_3)	-	11.1 ppm
Carbonate (CO_3)	-	0.0 ppm
Nitrate (NO_3)	-	0.00 ppm
Silica (SiO_2)	0.8 - 0.9 ppm	0.9 ppm
Sum of constituents	23.6 - 25.1 ppm	24.5 ppm

Southern Peak Pond is fairly productive.

B. Fish Species Present

Four species of fish inhabit Southern Peak Pond and its drainage systems, and all are native to Newfoundland waters. Two are of sport value and include the landlocked and anadromous forms of the Atlantic salmon, Salmo salar Linnaeus 1758, and the eastern brook trout Salvelinus fontinalis (Mitchill) 1815. Salmon is the dominant sport species in terms of both number and size, with the landlocked form of the species (ouananiche) comprising the bulk of the population by far. Anadromous salmon (grilse) are found in the lake infrequently. The threespine stickleback, Gasterosteus aculeatus Linnaeus 1758, occurs in the lake in large numbers and is an important forage species. The American eel, Anguilla rostrata (Le Sueur) 1817 is also a resident of Southern Peak Pond, however, as is the case for this fish generally, little is known about the extent and nature of the population.

C. Age and Size Composition of the Sport Species

1. Brook Trout

A brook trout 31.4 cm. fork length and V+ years of age holds the known longevity and size record at Southern Peak Pond.

Very few brook trout were captured in this lake during the course of gill-netting operations, however, the age-length distribution of this small sample is presented in Table III.

2. Ouananiche

The oldest and largest ouananiche observed during the survey on Southern Peak Pond was VIII+ years of age with a fork length of 34.2 centimeters.

The age-length distribution of 121 ouananiche sampled at this lake during June, 1969, is given in Table IV.

3. Anadromous Salmon

No anadromous salmon were captured in Southern Peak Pond during the course of the survey, however, available information suggests the fish entering the lake are entirely grilse ranging from 2 to 4 pounds in weight and they are either 3:1, + or 4:1, + years of age.

D. Growth Rates of the Sport Species

The rate of growth of brook trout and ouananiche populations were determined through the method of back-calculation.

1. Brook Trout

The Monastyrsky method of back-calculation in which a log-log regression is calculated from paired observations of fish length and scale length was used for brook trout.

The regression equation for fish length and scale length is as follows:

$$\text{Log } L_f = 1.0946 \text{ Log } L_s + 0.8618$$

$$\text{or } L_f = 7.274 \, L_s^{1.0946}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table V.

Table III. Age-length distribution of 25 brook trout taken in gill nets during June, 1969, in Southern Peak Pond

Fork length (cm.) (Class mark)	Age-class				
	II+	III+	IV+	V+	Total
16.55	2(100.0)	-	-	-	2(8.0)
18.55	3(75.0)	1(25.0)	-	-	4(16.0)
20.55	-	5(100.0)	-	-	5(20.0)
22.55	-	3(100.0)	-	-	3(12.0)
24.55	-	1(20.0)	4(80.0)	-	5(20.0)
26.55	-	-	2(100.0)	-	2(8.0)
28.55	-	-	2(66.7)	1(33.3)	3(12.0)
30.55	-	-	-	1(100.0)	1(4.0)
Total	5	10	8	2	25

Table IV. The age-length distribution of 121 ouananiche sampled at Southern Peak Pond during June, 1969.

Fork length (cm.) (Class mark)	Age-class						
	III+	IV+	V+	VI+	VII+	VIII+	Total
14.55	4(100.0)	-	-	-	-	-	4(3.3)
16.55	17(94.4)	1(5.6)	-	-	-	-	18(14.9)
18.55	12(37.5)	20(62.5)	-	-	-	-	32(26.4)
20.55	1(4.3)	18(78.3)	4(17.4)	-	-	-	23(19.0)
22.55	-	6(31.6)	10(52.6)	3(15.8)	-	-	19(15.7)
24.55	-	2(25.0)	6(46.2)	5(38.5)	-	-	13(10.7)
26.55	-	-	2(25.0)	5(62.5)	1(12.5)	-	8(6.6)

Table IV. (Cont'd)

Fork length (cm.) (Class mark)	Age-class						
	III+	IV+	V+	VI+	VII+	VIII+	Total
28.55	-	-	-	1(33.3)	1(33.4)	1(33.3)	3(2.5)
30.55	-	-	-	-	-	-	-
32.55	-	-	-	-	-	-	-
34.55	-	-	-	-	-	1(100.0)	1(0.8)
Total	34	47	23	14	2	2	121

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Southern Peak Pond brook trout

Annulus	I	II	III	IV	V
Scale length (x43)	0.71	1.46	2.23	2.85	3.47
Fish fork length (cm.)	5.0	11.0	17.5	22.9	28.4
Fish fork length (in.)	1.9	4.3	6.9	9.0	11.2

The growth rate of brook trout in Southern Peak Pond is considerably faster than the mean growth rate of trout from those Avalon Peninsula lakes investigated to date.

2. Ouananiche

The Lee method of back-calculation was chosen to determine the growth rate of Southern Peak Pond ouananiche.

From paired observations of fish length and scale length a least squares regression was calculated and is as follows:

$$L_f = 3.32\ L_s + 1.22$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Southern Peak Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII	VIII
Scale length (x43)	1.05	2.31	3.70	4.86	5.75	6.86	8.35	9.75
Fish fork length (cm.)	4.7	8.9	13.5	17.4	20.3	24.0	28.9	33.6
Fish fork length (in.)	1.9	3.5	5.3	6.9	8.0	9.5	11.4	13.2

The growth rate of ouananiche in Southern Peak Pond is slightly faster than the mean growth rate exhibited by Avalon Peninsula populations.

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 25 brook trout taken in Southern Peak Pond during June, 1969, is given in Table VII.

Table VII. The food habits of Southern Peak Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic-Terr. Invert.	*Fish
15.55	-	2(100.0)	-	-
19.55	2	7(100.0)	-	-
23.55	3	3(60.0)	2(40.0)	-
27.55	1	-	3(75.0)	1(25.0)
31.55	-	-	-	1(100.0)
Total	6	12	5	2

*Sticklebacks

Generally speaking, brook trout in Southern Peak Pond are insectivorous at the younger ages (smaller sizes), however, at a length of 8 or 9 inches fish begins to appear in their diet and the trout become piscivorous for the most part.

2. Ouananiche

Table VIII illustrates the results of the analysis of the food habits of 121 ouananiche captured in Southern Peak Pond during June, 1969. Generally, ouananiche in this lake are similar to the brook trout in their food habits; they are insectivorous during the early years of life but rely heavily on a diet of fish (sticklebacks) as they become larger.

Table VIII. The food habits of Southern Peak Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic-Terr. Invert.	*Fish
15.55	5	17(100.0)	-	-
19.55	12	38(88.4)	2(4.6)	3(7.0)
23.55	6	19(73.1)	2(7.7)	5(19.2)
27.55	1	3(30.0)	1(10.0)	6(60.0)
31.55	-	-	-	-
35.55	-	-	-	-
Total	24	77	5	15

*Sticklebacks

SOUTHWEST POND

A. Limnology

1. Location

Southwest Pond is situated at 47°21' North Latitude and 53°13' West Longitude. It lies approximately 32 miles south-west of the city

of St. John's along the Trans Canada Highway. Southwest Pond has an elevation of approximately 375 feet.

2. Uses

a. Industrial. At the present time the waters of Southwest Pond have no industrial use.

b. Recreational. At present, Southwest Pond experiences a light to moderate fishing pressure on its resident salmonid species. In addition to angling, other recreational activities on the lake include a small amount of boating, swimming, picnicing, camping, and waterfowl hunting. Considerable rabbit hunting and some grouse hunting is carried on in proximity to Southwest Pond. The Seventh-Day Adventist Church operates a summer camp on the shore of the lake, and this is the only cabin-type development on Southwest Pond.

3. Characteristics of the Drainage Area.

Southwest Pond empties into Conception Bay via Harbour Main Pond and Maloneys River. The drainage area of the lake occupies 1.7 square miles. Of the total drainage area of Southwest Pond, 0.7 square miles are in standing water. Two small drainage systems contribute their drainage to Southwest Pond.

The drainage area lies at an altitude ranging from approximately 375 to 525 feet above sea level. The terrain is almost entirely a climax forest of fir, spruce, and birch; there is, however, some abandoned farmland within the drainage area. In past years, there has been considerable logging activity within the boundaries of the drainage area.

The area lies in a region of Precambrian volcanic and sedimentary rocks. The strata in the area have been classified as belonging to two Groups, the Conception Group and the Harbour Main Group. Rocks of the Conception Group include Hadrynian slate, siltstone, greywacke, conglomerate, and minor acidic rocks; while Hadrynian acidic to mafic volcanic rocks, slate, greywacke, conglomerate, and metamorphic equivalents comprise the Harbour Main Group (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Southwest Pond is presented in Figure 1, and the morphometric parameters are given in Table I.

The shore development index of Southwest Pond is 2.04 which indicates the lake is fairly regular in shape. The slope of the shores of Southwest Pond is moderate and the lake has a maximum depth of 47 feet; the mean depth is 14.8 feet. Only 59 percent of the lake area

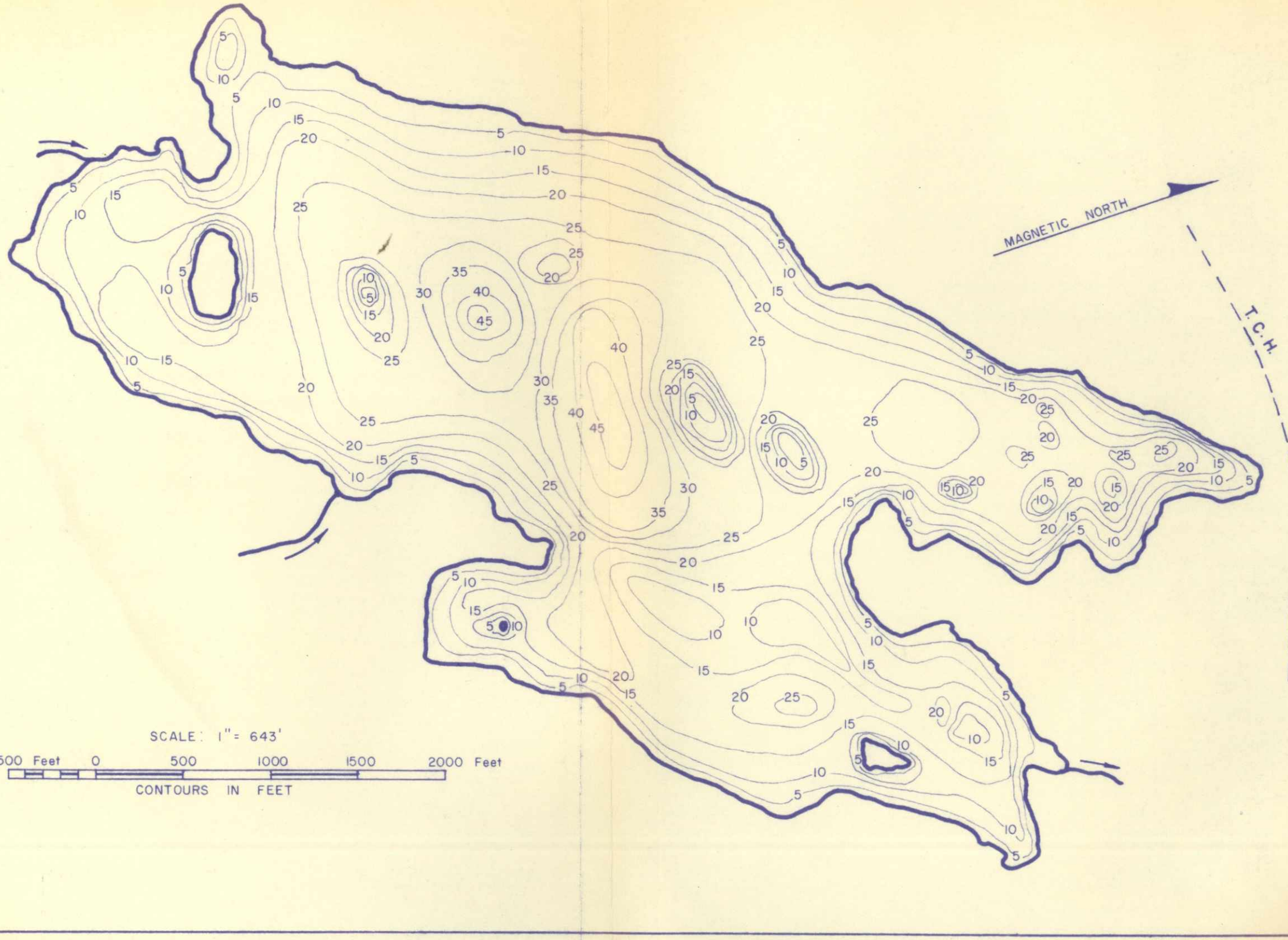


FIG. 1. BATHYMETRIC MAP OF SOUTHWEST POND

Table I. Morphometry of Southwest Pond

Area, including islands (acres) 345.3 (ha.) 139.8	Area, excluding islands (acres) 341.6 (ha.) 138.3
Maximum length (mi.) 1.4 (km.) 2.3	Maximum effective length (mi.) 1.4 (km.) 2.3
Maximum width (mi.) 0.6 (km.) 1.0	Maximum effective width (mi.) 0.6 (km.) 1.0
Mean width (mi.) 0.4 (km.) 0.6	Volume (cu.ft.) 2.69×10^8 (cu. m.) 7.62×10^6
Maximum depth (ft.) 47.0 (m.) 14.3	Mean depth (ft.) 14.8 (m.) 4.5
Mean depth - maximum depth ratio 0.31	Volume development 0.93
Perimeter, including islands (mi.) 5.3 (km.) 8.5	Perimeter, excluding islands (mi.) 4.8 (km.) 7.7
Shore development, including islands 2.03	Shore development excluding islands 1.84

Direction of Major Axes NE-SW

Depth	Area $(ft.)^2$	Area (acres)	%
0-5	1,371,000	31.5	9.2
5-10	1,963,000	45.1	13.2
10-15	2,557,000	58.7	17.2
15-20	2,922,000	67.1	19.6
20-25	2,520,000	57.8	16.9
25-30	2,100,000	48.2	14.1
30-35	593,000	13.6	4.0
35-40	488,000	11.2	3.3
40-45	262,000	6.0	1.8
over 45	104,000	2.4	0.7
Total	1.49×10^7	341.6	

is included in the 0-20 feet range of depth. This depth range is generally accepted by limnologists as having the most potential for fish production in lakes. Southwest Pond would appear, on this basis, to be relatively unproductive.

b. Surface Water Chemistry. The analysis of the surface water of Southwest Pond appears in Table II.

Table II. Analysis of surface water of Southwest Pond (samples collected August, 1970)

	Range	Mean
Alkalinity as $CaCO_3$	2.0 - 3.6 ppm	2.8 ppm
Total hardness as $CaCO_3$	6.0 - 8.0 ppm	6.9 ppm
pH	6.1 - 6.5	6.2
Color (Hazen units)	-	40
Oxygen consumed ($KMnO_4$)	7.9 - 8.7 ppm	8.3 ppm
Turbidity (units)	0.43 - 0.60	-
Sp. conductance, micromhos at 25°C	33.7 - 34.3	34.1
Total dissolved solids	31.3 - 31.7 ppm	31.6 ppm
Calcium (Ca)	1.5 - 1.6 ppm	1.5 ppm
Magnesium (Mg)	0.6 - 0.7 ppm	0.6 ppm
Sodium (Na)	-	3.9 ppm
Potassium (K)	-	0.3 ppm
Sulphate (SO_4)	2.7 - 3.0 ppm	2.9 ppm
Chloride (Cl)	-	6.6 ppm
Phosphate (PO_4) Total	0.02 - 0.03 ppm	0.03 ppm
Dissolved	0.02 - 0.03 ppm	0.03 ppm
Bicarbonate (HCO_3)	4.2 - 4.4 ppm	4.3 ppm
Carbonate (CO_3)	-	0.0 ppm
Nitrate (NO_3)	-	0.00 ppm
Silica (SiO_2)	1.1 - 1.2 ppm	1.1 ppm
Sum of constituents	18.9 - 19.3 ppm	19.1 ppm

Southwest Pond has soft water, as do all lakes in eastern Newfoundland, however, the waters of Southwest Pond are slightly harder than the average for the Avalon Peninsula. The concentration of such nutrients as calcium and bicarbonate are slightly higher than usual and this is reflected in better-than-average values for alkalinity, total hardness, pH, and specific conductance.

c. Morphoedaphic Index and Lake Productivity. The most important factors determining the amount of fish a lake can yield are the mineral content of the water and the morphometry of the lake itself. As we have already discussed, the physical features of South-

west Pond do not appear to be conducive to good fish production. However, the slightly better-than-average mineral content (specific conductance or total dissolved solids) of the lake water would tend to improve production somewhat so that we would expect production or yield to be about average for lakes in this area. In fact the morphoedaphic index (T.D.S. ÷ mean depth) of Southwest Pond is 2.12 which means the potential yield of fish from this lake is 2.91 pounds per acre per year. The average for lakes on the Avalon Peninsula is approximately 3 pounds per acre per year. A suggested creel limit or maximum sustained yield for Southwest Pond is 1,027 pounds annually.

B. Fish Species Present

Southwest Pond and its drainage systems contain only four fish species, and all are native to our waters. Only two of the species are of recreational value and include the eastern brook trout (or mud trout), Salvelinus fontinalis (Mitchill) 1815, and the landlocked Atlantic salmon (or ouananiche), Salmo salar Linnaeus 1758. The brook trout is by far the dominant sport species in terms of number and size. The threespine stickleback, Gasterosteus aculeatus Linnaeus 1758 is an important forage species generally distributed throughout the lake in large numbers. The fourth fish species occurring in Southwest Pond is Anguilla rostrata (Le Sueur) 1817, the American eel. The eel is the largest fish living in the lake and is obviously an important cog in the lake ecosystem, however, very little is known of its population structure.

C. Age and Size Composition of the Sport Species

1. Brook trout

The oldest and largest brook trout observed during the survey on Southwest Pond was VI^{+} years of age with a fork length of 30.9 centimeters.

The age-length distribution of 378 brook trout sampled at Southwest Pond during August, 1970, and October, 1971, is given in Table III.

2. Ouananiche

A ouananiche 26.6 cm. fork length and V^{+} years of age holds the known longevity and size record at Southwest Pond.

Table IV shows the age-length distribution of 145 ouananiche sampled at Southwest Pond during August, 1970, and October, 1971.

Table III. Age-length distribution of brook trout taken in gill nets and live traps during August, 1970, and October, 1971, in Southwest Pond

Fork length (cm.) (Class mark)	Age-class						
	I+	II+	III+	IV+	V+	VI+	Total
8.55	12(100.0)	-	-	-	-	-	12(3.2)
10.55	10(66.7)	5(33.3)	-	-	-	-	15(4.0)
12.55	8(33.3)	16(66.7)	-	-	-	-	24(6.3)
14.55	-	44(80.0)	11(20.0)	-	-	-	55(14.6)
16.55	-	10(16.9)	49(83.1)	-	-	-	59(15.6)
18.55	-	-	46(68.7)	21(31.3)	-	-	67(17.7)
20.55	-	-	2(7.3)	58(96.7)	-	-	60(15.9)
22.55	-	-	2(17.6)	31(58.5)	20(37.7)	-	53(14.0)
24.55	-	-	-	3(17.6)	14(82.4)	-	17(4.5)
26.55	-	-	-	-	7(100.0)	-	7(1.9)
28.55	-	-	-	-	4(80.0)	1(20.0)	5(1.3)
30.55	-	-	-	-	-	4(100.0)	4(1.1)
Total	30	75	110	113	45	5	378

D. Growth Rates of the Sport Species

The principle of back-calculation was applied to determine the rate of growth of brook trout and ouananiche in Southwest Pond.

1. Brook Trout

Using the Monastyrsky (or exponential) method of back-calculation, from paired parameters of fish length and scale length, a log-log regression was calculated; the equation for scale length on fish length is as follows:

$$\text{Log } L_f = 1.1434 \text{ Log } L_s + 0.7379$$

or $$L_f = 5.469\ L_s^{1.1434}$$

Table IV. Age-length distribution of ouananiche taken in gill nets and live traps during August, 1970 and October, 1971, in Southwest Pond

Fork length (cm.) (Class mark)	Age-class					
	I^+	II^+	III^+	IV^+	V^+	Total
10.55	1(50.0)	1(50.0)	-	-	-	2(1.4)
12.55	1(50.0)	19(95.0)	-	-	-	20(13.8)
14.55	-	14(70.0)	6(30.0)	-	-	20(13.8)
16.55	-	4(16.7)	17(70.8)	3(12.5)	-	24(16.6)
18.55	-	1(2.1)	32(66.7)	14(29.2)	1(2.0)	48(33.1)
20.55	-	-	7(35.0)	12(60.0)	1(5.0)	20(13.8)
22.55	-	-	-	1(14.3)	6(85.7)	7(4.8)
24.55	-	-	-	1(50.0)	1(50.0)	2(1.4)
26.55	-	-	-	-	2(100.0)	2(1.4)

Table V shows the average scale lengths for each year of life and the corresponding calculated fish lengths.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Southwest Pond brook trout

Annulus	I	II	III	IV	V	VI
Scale length (x43)	0.87	1.44	2.14	2.74	3.39	4.20
Fish fork length (cm.)	4.7	8.3	13.1	17.3	22.1	28.2
Fish fork length (in.)	1.9	3.3	5.2	6.8	8.7	11.1

Generally, the growth rate of Southwest Pond brook trout is considerably slower than the mean growth rate of fish from other Avalon Peninsula lakes, and in fact is one of the slowest growing populations of those studied to date.

2. Ouananiche

The Lee method (direct proportion) of back-calculation was used to determine the growth rate of ouananiche. From paired parameters of fish length and scale length, a least squares regression equation was calculated; the equation of scale length on fish length is as follows:

$$L_f = 3.48\ L_s + 2.21$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Southwest Pond ouananiche

Annulus	I	II	III	IV	V
Scale length (x43)	1.04	2.03	3.38	4.37	5.52
Fish fork length (cm.)	5.8	9.3	14.0	17.4	21.4
Fish fork length (in.)	2.3	3.7	5.5	6.9	8.4

The growth rate of Southwest Pond ouananiche is slightly faster than the mean growth rate of fish from other lakes on the Avalon Peninsula.

E. Food Habits of the Sport Species

1. Brook Trout

Table VII presents the result of the analysis of the food habits of 103 brook trout taken in Southwest Pond during August, 1970.

Generally speaking, it appears that brook trout in Southwest Pond are mainly insectivorous at the smaller sizes but become piscivorous as they become larger.

2. Ouananiche

Table VIII shows the result of the analysis of the food habits of 47 ouananiche taken in Southwest Pond during August, 1970. Generally, it appears that ouananiche are totally insectivorous in this lake although forage fish (sticklebacks) abound.

Table VII. The food habits of Southwest Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic-Terr. Invert.	*Fish
15.55	2	13(100.0)	-	-
19.55	3	43(93.5)	2(4.3)	1(2.2)
23.55	3	25(78.1)	3(9.4)	4(12.5)
27.55	-	-	1(50.0)	1(50.0)
31.55	-	-	1(50.0)	1(50.0)
Total	8	81	7	7

*Sticklebacks

Table VIII. The food habits of Southwest Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents	
	Empty	Benthic and/or Terrestrial Invertebrates
15.55	1	9(100.0)
19.55	5	29(100.0)
23.55	-	4(100.0)
27.55	-	1(100.0)
Total	6	43

HARBOUR MAIN POND

A. Limnology

1. Location

Harbour Main Pond is situated at 47°23' North Latitude and 53°12' West Longitude. It lies approximately 32 miles southwest of the city of St. John's just off the Trans Canada Highway. Harbour Main Pond has an elevation of approximately 275 feet.

2. Uses

a. Industrial. At the present time the waters of Harbour Main Pond have no industrial use.

b. Recreational. At present, Harbour Main Pond experiences a very light fishing pressure on its resident salmonid species. In addition to angling, other recreational activities on the lake include a very small amount of boating, swimming, picnicing, camping, and waterfowl hunting. Considerable rabbit hunting and some grouse and ptarmigan hunting is carried on in proximity to Harbour Main Pond. The only cabin development on Harbour Main Pond is one unit located at the north-west tip of the lake.

3. Characteristics of the Drainage Area

Harbour Main Pond empties into Conception Bay via Maloneys River. The drainage area of the lake occupies 5.4 square miles. Of the total drainage area of Harbour Main Pond, 1.7 square miles are in standing water. Three minor drainage systems and one major system contribute their drainage to Harbour Main Pond.

The drainage area lies at an altitude ranging from approximately 275 to 530 feet above sea level. The terrain is mostly a climax forest of fir, spruce, and birch; there is, however, a small amount of barrens within the drainage area. In past years there has been considerable logging activity within the boundaries of the drainage area. A small amount of farming is also conducted in the area.

The area lies in a region of Precambrian volcanic and sedimentary rocks. The strata in the area have been classified as belonging to two groups, the Conception Group and the Harbour Main Group. Rocks of the Conception Group include Hadrynian slate, siltstone, greywacke, conglomerate, and minor acidic rocks, while Hadrynian acidic to mafic volcanic rocks, slate, greywacke, conglomerate, and metamorphic equivalents comprise the Harbour Main Group (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Harbour Main Pond is presented in Figure 1; the morphometric data are given in Table I.

Table I. Morphometry of Harbour Main Pond

Area, including islands (acres) 515.6 (ha.) 208.7	Area, excluding islands (acres) 500.2 (ha.) 202.5
Maximum length (mi.) 1.9 (km.) 3.0	Maximum effective length (mi.) 1.9 (km.) 3.0
Maximum width (mi.) 0.6 (km.) 1.0	Maximum effective width (mi.) 0.6 (km.) 1.0
Mean width (mi.) 0.4 (km.) 0.7	Volume (cu.ft.) 2.36×10^8 (cu. m.) 6.69×10^6
Maximum depth (ft.) 38.0 (m.) 11.6	Mean depth (ft.) 10.8 (m.) 3.3
Mean depth-maximum depth ratio 0.28	Volume development 0.85
Perimeter, including islands, (mi.) 11.3 (km.) 18.2	Perimeter, excluding islands (mi.) 8.8 (km.) 14.2
Shore development, including islands 3.54	Shore development, excluding islands 2.80
Direction of Major Axes NE-SW	

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	5,935,100	136.3	27.2
5-10	6,694,700	153.7	30.7
10-15	2,879,300	66.1	13.2
15-20	3,414,700	78.3	15.7
20-25	1,554,200	35.7	7.1
25-30	818,100	18.8	3.8
30-35	237,000	5.4	1.1
over 35	255,700	5.9	1.2
Total	2.18×10^7	500.2	

Harbour Main Pond is fairly irregular in shape; the shore development index equals 3.54 For the most part the shores of the lake are fairly gently sloped. The mean depth is only 10.8 feet while the maximum depth is 38 feet. Approximately 87 percent of the lake area is included in the 0-20 feet range of depth. Harbour Main Pond would appear, at least in terms of its morphometry, to be a fairly productive environment for sport fish.

b. Surface Water Chemistry. The analysis of the surface water of Harbour Main Pond appears in Table II. Like all natural inland waters in eastern Newfoundland, the waters of Harbour Main Pond are very soft, and characterized by low alkalinity, hardness, and mineral content. However, the water quality (degree of mineralization) of this lake is comparable to the average for lakes in this geographic area.

Table II. Analysis of surface water of Harbour Main Pond (samples collected August, 1971).

	Range	Mean
Alkalinity as $CaCO_3$	3.0 - 5.2 ppm	3.9 ppm
Total hardness as $CaCO_3$	6.0 - 7.0 ppm	6.4 ppm
pH	6.3 - 6.8	6.5
Color (Hazen units)	-	10
Total organic carbon	2.5 - 4.5 ppm	3.7 ppm
Turbidity (units)	0.73 - 0.78	0.76
Sp. conductance, micromhos at 25°C	28.1 - 37.2	33.1
Total dissolved solids	27.3 - 33.8 ppm	30.8 ppm
Calcium (Ca)	1.7 - 1.8 ppm	1.7 ppm
Magnesium (Mg)	-	0.6 ppm
Sodium (Na)	-	3.8 ppm
Potassium (K)	0.3 - 0.4 ppm	0.3 ppm
Sulphate (SO_4)	2.1 - 2.6 ppm	2.3 ppm
Chloride (Cl)	6.0 - 6.5 ppm	6.3 ppm
Phosphate (PO_4) Total	0.05 - 0.08 ppm	0.06 ppm
Dissolved	0.05 - 0.07 ppm	0.06 ppm
Bicarbonate (HCO_3)	3.7 - 6.3 ppm	4.8 ppm
Nitrate (NO_3)	-	0.005 ppm
Silica (SiO_2)	1.1 - 1.2 ppm	1.1 ppm
Sum of constituents	19.0 - 19.5 ppm	19.2 ppm

c. Morphoedaphic Index and Lake Productivity. The amount of dissolved nutrients (T.D.S.) in Harbour Main Pond water ranges from 27.3 to 33.8 ppm depending on sampling station; the mean value was calculated to be 30.8 ppm which is average for lake water on the Avalon Peninsula. By dividing the T.D.S. of the lake water by the

mean depth of the lake we arrive at a morphoedaphic index of 2.85 for Harbour Main Pond. The potential fish yield of a lake is calculated by the approximation:

$$\text{Yield} = 2\sqrt{\text{Morphoedaphic Index}}$$

Using this equation we find that Harbour Main Pond has an estimated fish production (yield) of 3.38 pounds per acre per year, or 1,688 pounds per year. Since Avalon Peninsula lakes investigated to date range in yield from approximately 2-4 pounds per acre per year, Harbour Main Pond is fairly productive.

B. Fish Species Present

Four fish species are to be found in Harbour Main Pond and its drainage systems. Only two of the species are of recreational fishing value and include the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815, and the landlocked Atlantic salmon (ouananiche), Salmo salar Linnaeus 1758; both are native salmonid species. Brook trout are by far the dominant sport species in this lake in terms of both number and size. The three-spine stickleback, Gasterosteus aculeatus Linnaeus 1758, is an important forage species for the sport species and is generally distributed throughout the lake in large numbers. The American eel, Anguilla rostrata (Le Sueur) 1817, is also a resident of the lake; unfortunately little is known of its population characteristics.

C. Age and Size Composition of the Sport Species

1. Brook Trout

A brook trout 29.5 cm. fork length and VI^+ years of age holds the known longevity and size record at Harbour Main Pond.

The age-length distribution of 198 brook trout sampled at Harbour Main Pond during August, 1971, is given in Table III.

2. Ouananiche

The oldest and largest ouananiche observed during the survey on Harbour Main Pond was VII^+ years of age with a fork length of 26.5 cm.

The age-length distribution of 163 ouananiche sampled at this lake during August, 1971, is given in Table IV.

D. Growth Rates of the Sport Species

The growth rates of brook trout and ouananiche were determined by utilizing the method of back-calculation.

Table III. Age-length distribution of brook trout taken in gill nets and live-traps during August, 1971, in Harbour Main Pond

Fork length (cm.) (Class mark)	Age-class						
	I+	II+	III+	IV+	V+	VI+	Total
10.55	1(8.3)	11(91.7)	-	-	-	-	12(6.1)
12.55	-	26(89.7)	3(10.3)	-	-	-	20(14.6)
14.55	-	23(76.7)	7(23.3)	-	-	-	30(15.2)
16.55	-	4(26.7)	11(73.3)	-	-	-	15(7.5)
18.55	-	-	20(55.6)	16(44.4)	-	-	36(18.2)
20.55	-	-	8(23.5)	26(76.5)	-	-	34(17.2)
22.55	-	-	-	23(95.8)	1(4.2)	-	24(12.1)
24.55	-	-	-	3(30.0)	7(70.0)	-	10(5.1)
26.55	-	-	-	-	3(75.0)	1(25.0)	4(2.0)
28.55	-	-	-	-	2(50.0)	2(50.0)	4(2.0)
Total	1	64	49	68	13	3	198

1. Brook Trout

The Monastyrsky method of back-calculation in which a log-log regression is calculated from paired observations of fish length and scale length was used for this species.

The regression equation for fish length and scale length is as follows:

$$\text{Log } L_f = 1.2290 \text{ Log } L_s + 0.6790$$

$$\text{or } L_f = 4.775 \, L_s^{1.2290}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table V.

Table IV. Age-length distribution of ouananiche taken in gill nets and live-traps during August, 1971, in Harbour Main Pond

Fork length (cm.) (Class mark)	Age-class							
	I+	II+	III+	IV+	V+	VI+	VII+	Total
8.55	1(16.7)	5(83.3)	-	-	-	-	-	6(3.7)
10.55	6(20.0)	24(80.0)	-	-	-	-	-	30(18.5)
12.55	-	11(100.0)	-	-	-	-	-	11(6.8)
14.55	-	13(40.6)	19(59.4)	-	-	-	-	32(19.8)
16.55	-	3(6.5)	39(84.8)	4(8.7)	-	-	-	46(28.4)
18.55	-	-	2(20.0)	8(80.0)	-	-	-	10(6.2)
20.55	-	-	-	8(61.5)	4(30.8)	1(7.7)	-	13(8.0)
22.55	-	-	-	2(28.6)	2(28.6)	3(42.8)	-	7(4.3)
24.55	-	-	-	-	3(75.0)	1(12.5)	1(12.5)	5(2.5)
26.55	-	-	-	-	-	2(66.7)	1(33.3)	3(1.9)
Total	7	56	60	22	9	7	2	163

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Harbour Main Pond brook trout

Annulus	I	II	III	IV	V	VI
Scale length (x43)	0.87	1.61	2.32	2.98	3.67	4.40
Fish fork length (cm.)	4.0	8.6	13.4	18.3	23.6	29.5
Fish fork length (in.)	1.6	3.4	5.3	7.2	9.3	11.6

Generally, the growth rate of brook trout in Harbour Main Pond is considerably slower than the mean growth rate of fish from other Avalon Peninsula lakes.

2. Ouananiche

The Lee method of back-calculation was chosen to determine the growth rate of ouananiche in Harbour Main Pond.

From paired observations of fish length and scale length a least squares regression was calculated and is as follows:

$$L_f = 2.94\ L_s + 2.30$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

The growth rate of ouananiche in Harbour Main Pond is about comparable to the mean growth rate of ouananiche from other Avalon Peninsula lakes.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Harbour Main Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII
Scale length (x43)	1.07	2.22	3.65	5.11	6.08	6.80	8.00
Fish fork length (cm.)	5.5	8.8	13.0	17.3	20.2	22.3	25.8
Fish fork length (in.)	2.2	3.5	5.1	6.8	8.0	8.8	10.2

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 29 brook trout taken in gill nets from Harbour Main Pond during August, 1971, is given in Table VII.

Generally, the smaller sized brook trout in this lake are insectivorous, however, the larger individuals are more piscivorous in nature, utilizing sticklebacks as forage.

2. Ouananiche

A total of 22 ouananiche were captured for food studies at Harbour Main Pond and the analysis of the stomach contents is given in Table VIII. It would appear that, like the brook trout in this lake, ouananiche are predominantly insectivorous at the smaller sizes but forage on sticklebacks as they become larger.

Table VII. The food habits of Harbour Main Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents		
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish
15.55	2	-	-
19.55	5	4(66.7)	2(33.3)
23.55	4	4(57.1)	3(42.9)
27.55	2	1(33.3)	2(66.7)
Total	13	9	7

*Sticklebacks

Table VIII. The food habits of Harbour Main Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents		
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish
15.55	4	6(100.0)	-
19.55	-	5(100.0)	-
23.55	2	2(66.7)	1(33.3)
27.55	-	1(50.0)	1(50.0)
Total	6	14	2

*Sticklebacks

NINE ISLAND POND SOUTH

A. Limnology

1. Location

Nine Island Pond South is situated at 47°22' North Latitude and 53°15' West Longitude. It lies approximately 34 miles south-west of the city of St. John's along the Trans Canada Highway. Nine Island Pond South has an elevation of approximately 320 feet.

2. Uses

a. Industrial. The waters of Nine Island Pond South have no industrial use at the present time.

b. Recreational. At present, Nine Island Pond South experiences a very light fishing pressure on its resident salmonid species. In addition to angling, other recreational activities on the lake include a moderate amount of boating, swimming, picnicing, and lesser amounts of camping and waterfowl hunting. Considerable rabbit hunting and some grouse hunting is carried on in proximity to Nine Island Pond South. There is presently no cabin development on this lake.

3. Characteristics of the Drainage Area

Nine Island Pond South empties into Conception Bay via First and Second Salmon Ponds and Salmon River. The drainage area of Nine Island Pond South occupies 10.6 square miles; of the total drainage area of this lake, 2.5 square miles are in standing water. Two major drainage systems and one minor system contribute their drainage to Nine Island Pond South.

The drainage area lies at an altitude ranging from approximately 320 to 575 feet above sea level. The terrain is entirely a climax forest of fir, spruce, and birch; there is considerable logging activity within the drainage area.

In terms of geology, the drainage area lies in a region of Precambrian sedimentary and volcanic rocks. Most of the strata in the area are of sedimentary origin and have been classified as belonging to the Conception Group. The drainage basin contains Hadrynian siltstone, conglomerate, slate, greywacke, and minor volcanic rocks (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Nine Island Pond South is presented in Figure 1, and the morphometric parameters are given in Table I.

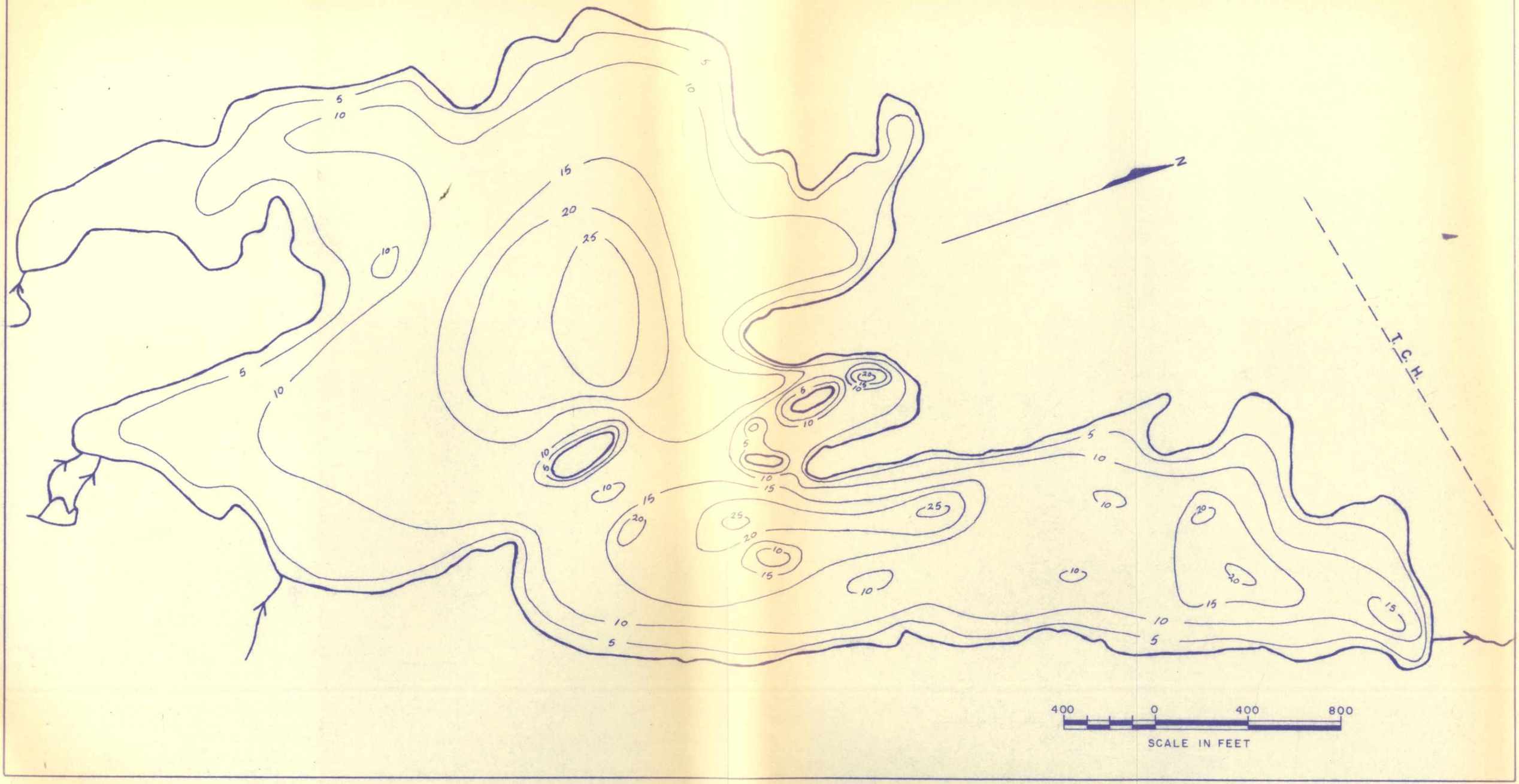


FIGURE I. BATHYMETRIC MAP OF NINE ISLAND POND SOUTH

Table I. Morphometry of Nine Island Pond South

Area, including islands (acres) 203.6 (ha.) 82.4	Area, excluding islands (acres) 202.5 (ha.) 82.0
Maximum length (mi.) 1.12 (km.) 1.80	Maximum effective length (mi.) 1.12 (km.) 1.80
Maximum width (mi.) 0.53 (km.) 0.85	Maximum effective width (mi.) 0.53 (km.) 0.85
Mean width (mi.) 0.28 (km.) 0.45	Volume (cu.ft.) 9.85×10^7 (cu.m.) 2.80×10^6
Maximum depth (ft.) 27.0 (m.) 8.2	Mean depth (ft.) 11.1 (m.) 3.4
Mean depth - Maximum depth ratio 0.41	Volume development 1.23
Perimeter, including islands (mi.) 4.61 (km.) 7.42	Perimeter, excluding islands (mi.) 4.29 (km.) 6.90
Shore development, including islands 2.31	Shore development, excluding islands 2.15

Direction of Major Axes NE-SW

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	1,485,400	34.1	16.8
5-10	2,158,400	49.6	24.5
10-15	3,334,500	76.7	37.9
15-20	1,048,500	24.1	11.9
20-25	582,000	13.4	6.6
over 25	198,600	4.6	2.3
Total	8.81×10^6	202.5	

The shore development index of Nine Island Pond South is 2.31 which indicates the lake is fairly irregular in shape. The slope of the

shores of Nine Island Pond South is rather gentle and the lake has a mean depth of 11.1 feet; the maximum depth is 27 feet. Approximately 91 percent of the lake area is included in the 0-20 feet range of depth. This is the range of depth generally accepted as having the most potential for sport fish production in lakes. Nine Island Pond South would appear, on this basis, to be relatively productive.

b. Surface Water Chemistry. The analysis of the surface water of Nine Island Pond South appears in Table II. The lake appears to be fairly dystrophic as evidenced by the heavily stained, slightly acidic, lightly mineralized, and high organic carbon concentration waters.

c. Morphoedaphic Index and Lake Productivity. The most important factors determining the amount of fish a lake can yield are the mineral content of the water and the morphometry of the lake. As we have just seen, the physical features of Nine Island Pond South appear to be fairly conducive to good fish production. However, the slightly unfavourable water quality (mineral content) of the lake water would tend to depress the potential for fish production somewhat. The morphoedaphic index (T.D.S. ÷ mean depth) of Nine Island Pond South is 2.62 which means the potential yield of sport fish from this lake is 3.24 pounds per acre per year. The average for lakes studied to date on the Avalon Peninsula is approximately 3 pounds per acre per year, therefore, Nine Island Pond South is a slightly better than average environment for sport fish production. A suggested creel limit or maximum sustained yield for this lake is 3.24 pounds per acre per year or a total of 658 pounds annually.

B. Fish Species Present

Nine Island Pond South and its drainage system contain five fish species, all of which are native to Newfoundland waters. Only two of the species are of recreational value and include the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815, and the landlocked Atlantic salmon (or ouananiche), Salmo salar Linnaeus 1758. The ouananiche is by far the dominant sport species in terms of numbers, however, brook trout are dominant in terms of size. The threespine stickleback, Gasterosteus aculeatus Linnaeus 1758, and the landlocked American smelt, Osmerus mordax (Mitchill) 1815 are important forage species generally distributed throughout the lake in large numbers. A detailed study of the life-history and ecology of the smelt population of Nine Island Pond South and the potential of this species as a forage fish for introduction into other lakes is presently being conducted. The fifth fish species occurring in the lake is the Americam eel, Anguilla rostrata (Le Sueur) 1817. Very little is known of the status of the eel population except it is the largest fish living in the lake and is undoubtedly a serious competitor and predator.

Table II. Analysis of surface water of Nine Island Pond South (samples collected August, 1970)

	Range	Mean
Alkalinity as $CaCO_3$	1.0 - 2.8 ppm	1.8 ppm
Total hardness as $CaCO_3$	5.7 - 6.0 ppm	6.0 ppm
pH	5.8 - 6.2	5.9
Color (Hazen units)	-	70
Oxygen consumed ($KMnO_4$)	10.6 - 13.0 ppm	11.5 ppm
Turbidity (units)	0.38 - 0.85	-
Sp. conductance, micromhos at 25°C	29.5 - 31.2	30.7
Total dissolved solids	28.3 - 29.5 ppm	29.1 ppm
Calcium (Ca)	1.3 - 1.4 ppm	1.4 ppm
Magnesium (Mg)	-	0.6 ppm
Sodium (Na)	-	3.6 ppm
Potassium (K)	-	0.3 ppm
Sulphate (SO_4)	2.9 - 3.4 ppm	3.1 ppm
Chloride (Cl)	5.9 - 6.0 ppm	6.0 ppm
Phosphate (PO_4) Total	-	0.03 ppm
Dissolved	0.02 - 0.03 ppm	0.03 ppm
Carbonate (CO_3)	-	0.0 ppm
Bicarbonate (HCO_3)	2.7 - 3.4 ppm	3.2 ppm
Nitrate (NO_3)	-	0.00 ppm
Silica (SiO_2)	1.2 - 1.3 ppm	1.2 ppm
Sum of constituents	17.5 - 17.9 ppm	17.7 ppm

C. Age and Size Composition of the Sport Species

1. Brook Trout

The oldest and largest brook trout observed during the survey on Nine Island Pond South was VI^+ years of age with a fork length of 37.3 centimeters.

The age-length distribution of 60 brook trout sampled at Nine Island Pond South during the period 1970-1972, is given in Table III.

2. Ouananiche

A ouananiche 28.0 cm. fork length and $VIII^+$ years of age holds the known longevity and size record at Nine Island Pond South.

Table IV shows the age-length distribution of 382 ouananiche sampled at Nine Island Pond South during 1970 and 1971.

Table III. Age-length distribution of brook trout taken in gill nets and live-traps during selected dates in 1970, 1971, and 1972, in Nine Island Pond South

Fork length (cm.) (Class mark)	Age-class						
	I+	II+	III+	IV+	V+	VI+	Total
8.55	2(100.0)	-	-	-	-	-	2(3.3)
10.55	5(83.3)	1(16.7)	-	-	-	-	6(10.0)
12.55	-	5(100.0)	-	-	-	-	5(8.3)
14.55	-	3(100.0)	-	-	-	-	3(5.0)
16.55	-	2(50.0)	2(50.0)	-	-	-	4(6.7)
18.55	-	1(20.0)	3(60.0)	1(20.0)	-	-	5(8.3)
20.55	-	-	5(83.3)	1(16.7)	-	-	6(10.0)
22.55	-	-	2(40.0)	3(60.0)	-	-	5(8.3)
24.55	-	-	1(16.7)	5(83.3)	-	-	6(10.0)
26.55	-	-	-	4(66.7)	2(33.3)	-	6(10.0)
28.55	-	-	-	2(66.7)	1(33.3)	-	3(5.0)
30.55	-	-	-	-	2(66.7)	1(33.3)	3(5.0)
32.55	-	-	-	1(50.0)	1(50.0)	-	2(3.3)
34.55	-	-	-	-	1(50.0)	1(50.0)	2(3.3)
36.55	-	-	-	-	-	2(100.0)	2(3.3)
Total	7	12	13	17	7	4	60

D. Growth Rates of the Sport Species

The principle of back-calculation was applied to determine the rate of growth of brook trout and ouananiche in Nine Island Pond South.

Table IV. Age-length distribution of ouananiche taken in gill nets and live-traps during selected dates in 1970 and 1971, in Nine Island Pond South

Fork length (cm.) (Class mark)	Age-class								
	I+	II+	III+	IV+	V+	VI+	VII+	VIII+	Total
8.55	11(73.3)	4(26.7)	-	-	-	-	-	-	15(3.9)
10.55	5(5.8)	73(83.9)	9(10.3)	-	-	-	-	-	87(22.8)
12.55	-	35(54.7)	29(45.3)	-	-	-	-	-	64(16.8)
14.55	-	4(4.2)	72(75.8)	19(20.0)	-	-	-	-	95(24.9)
16.55	-	-	1(2.8)	29(82.9)	5(14.3)	-	-	-	35(9.2)
18.55	-	-	1(2.0)	8(16.3)	36(73.5)	4(8.2)	-	-	49(12.8)
20.55	-	-	-	1(4.0)	7(28.0)	17(68.0)	-	-	25(6.5)
22.55	-	-	-	-	-	4(57.1)	3(42.9)	-	7(1.8)
24.55	-	-	-	-	-	-	2(100.0)	-	2(0.5)
26.55	-	-	-	-	-	-	1(50.0)	1(50.0)	2(0.5)
28.55	-	-	-	-	-	-	-	1(100.0)	1(0.3)
Total	16	116	112	57	48	25	6	2	382

1. Brook Trout

Using the Monastyrsky (or exponential) method of back-calculation, from paired parameters of fish length and scale length, a log-log regression was calculated; the equation for scale length on fish length is as follows:

$$\text{Log } L_f = 1.1727 \text{ Log } L_s + 0.7770$$

$$\text{or} \quad L_f = 5.984 \, L_s^{1.1727}$$

Table V shows the average scale lengths for each year of life and the corresponding calculated fish lengths.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Nine Island Pond South brook trout

Annulus	I	II	III	IV	V	VI
Scale length (x43)	0.75	1.5	2.29	2.93	3.50	4.15
Fish fork length (cm.)	4.3	9.7	15.8	21.1	26.0	31.8
Fish fork length (in.)	1.7	3.8	6.2	8.3	10.2	12.5

Generally, the growth rate of Nine Island Pond South brook trout is comparable to the mean growth rate of fish from other Avalon Peninsula lakes.

2. Ouananiche

The Lee method (direct proportion) of back-calculation was used to determine the growth rate of ouananiche. From paired data on fish length and scale length, a least squares regression equation was calculated; the equation of scale length on fish length is as follows:

$$L_f = 2.90 \, L_s + 2.93$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

The growth rate of ouananiche in Nine Island Pond South is considerably slower than the mean growth rate of fish from other lakes studied on the Avalon Peninsula.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Nine Island Pond South ouananiche

Annulus	I	II	III	IV	V	VI	VII	VIII
Scale length (x43)	0.89	1.74	2.99	4.04	4.90	5.87	6.84	7.30
Fish fork length (cm.)	5.5	8.0	11.6	14.7	17.1	20.0	22.8	24.1
Fish fork length (in.)	2.2	3.2	4.6	5.8	6.7	7.9	9.0	9.5

E. Food Habits of the Sport Species

1. Brook Trout

Table VII presents the result of the analysis of the food habits of 37 brook trout taken in Nine Island Pond South during the period 1970-1972.

Generally speaking, it appears that brook trout in this lake are predominantly insectivorous at the smaller sizes but become piscivorous as they become larger, relying on smelt and sticklebacks.

Table VII. The food habits of Nine Island Pond South brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents		
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish
19.55	1	5(71.4)	2(28.6)
23.55	3	6(75.0)	2(25.0)
27.55	2	2(28.6)	5(71.4)
31.55	1	-	4(100.0)
35.55	2	-	2(100.0)
Total	9	13	15

* 10 trout foraging on sticklebacks; 3 trout foraging on smelt; 2 trout foraging on sticklebacks and smelt.

2. Ouananiche

Table VIII shows the result of the analysis of the food habits of 97 ouananiche taken in Nine Island Pond South during August and September, 1970. Generally, it appears that ouananiche are totally insectivorous in this lake although forage fish (smelt and sticklebacks) abound. The younger, smaller fish appear to feed on both zooplankton and benthos, while the larger individuals rely totally on benthic and terrestrial invertebrates.

Table VIII. The food habits of Nine Island Pond South ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents		
	Empty	Zooplankton	Benthic and/or Terrestrial Invertebrates
11.55	-	2(66.7)	1(33.3)
15.55	4	3(12.5)	21(87.5)
19.55	15	-	42(100.0)
23.55	4	-	3(100.0)
27.55	1	-	1(100.0)
Total	24	5	68

MIDDLE GULL POND

A. Limnology

1. Location

Middle Gull Pond is situated at 47°22' North Latitude and 53°18' West Longitude. It lies approximately 35 miles south-west of the city of St. John's, just off the Trans Canada Highway. Middle Gull Pond has an elevation of approximately 440 feet above sea level.

2. Uses

a. Industrial. At the present time the waters of Middle Gull Pond have no industrial use.

b. Recreational. At this point in time there is a light to moderate fishing pressure exerted for resident salmonid species. In addition to angling other recreational uses include a moderate amount of boating, some swimming and picnicing, and a limited amount of camping and waterfowl hunting. Some rabbit, ptarmigan, and grouse hunting is carried on in proximity to Middle Gull Pond. There is a substantial summer cabin development consisting of 20-25 units, located at the north-east end of the lake.

3. Characteristics of the Drainage Area

Middle Gull Pond empties into St. Mary's Bay via Colinet River and numerous named and unnamed ponds, lakes, and rivers. The drainage area of the lake occupies 4.3 square miles. Of the total drainage area, 1.8 square miles are in standing water. Only intermittent surface drainage contributes to Middle Gull Pond waters; there are no drainage systems per se. Most of the water in this lake originates as ground water, and there are numerous areas of up-welling.

The drainage area lies at an altitude of approximately 440 to 725 feet above sea level. The terrain ranges from mostly climax forest of fir, spruce, and birch to some barren land. There is considerable logging activity within the boundary of the drainage area.

Geologically, the drainage area lies in a region of Precambrian sedimentary and volcanic rocks. Most of the strata in the area are of sedimentary origin and have been classified as belonging to the Conception Group. The drainage basin contains Hadryrian siltstone, conglomerate, slate, greywacke, and minor volcanic rocks (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Middle Gull Pond is presented in Figure 1, and the morphometric data are given in Table I.

Middle Gull Pond is very irregular in shape and this is indicated by its having a shore development index of 4.16; its shores, however, are very steeply sloped. The maximum depth of the lake is 107 feet and this is the deepest lake investigated to date on the Avalon Peninsula. The mean depth of Middle Gull Pond is 33.8 feet. Approximately 26 percent of the lake area is included in the 0-20 feet depth range and as this is the generally accepted depth range for most fish production, we may conclude that, in terms of its morphometry, Middle Gull Pond is a very unproductive lake.

b. Surface Water Chemistry. The analysis of the surface water of Middle Gull Pond appears in Table II.

Middle Gull Pond, like the vast majority of insular Newfoundland fresh waters, has very soft water. The waters of this lake,

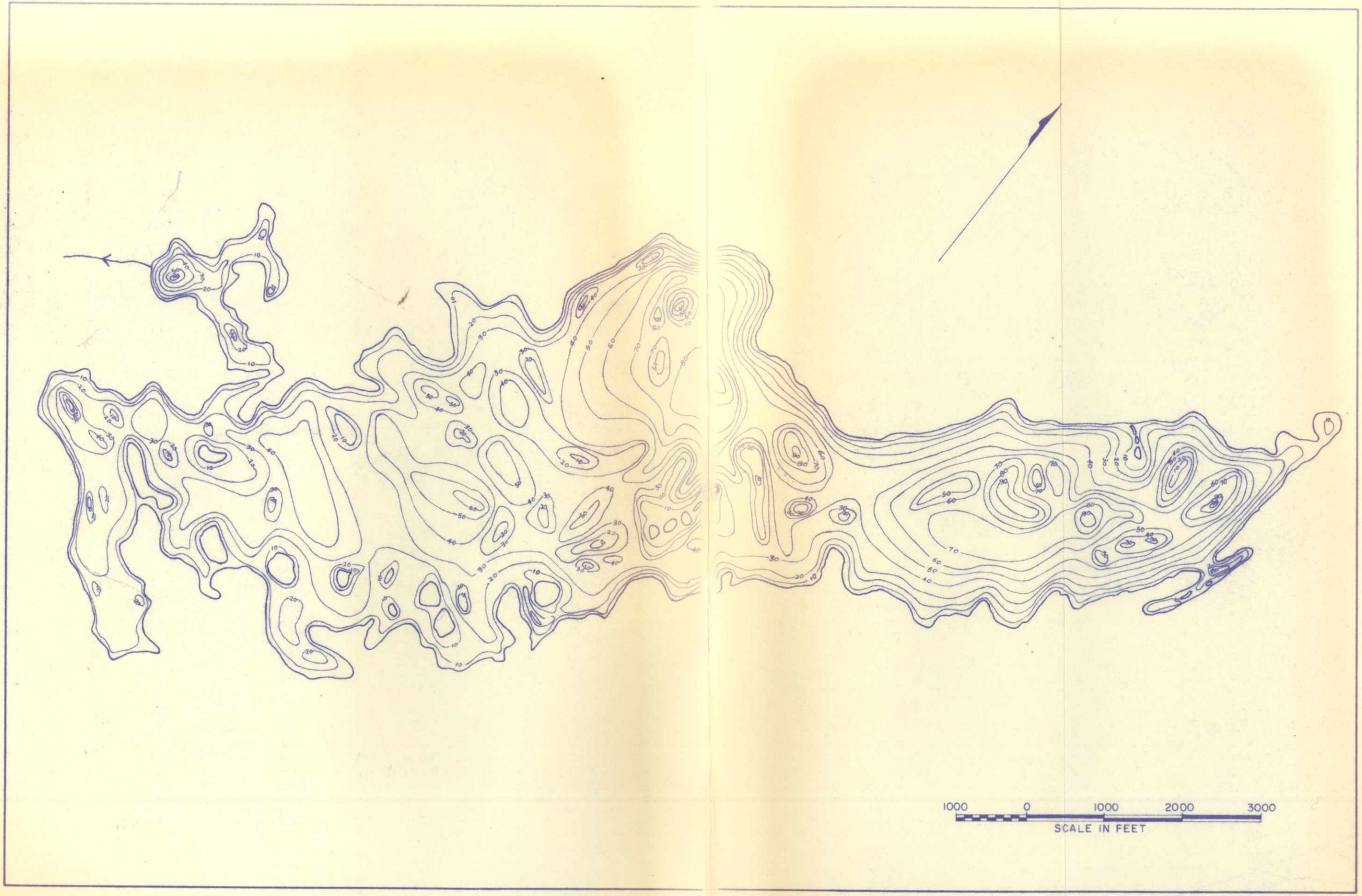


FIGURE 1. BATHYMETRIC MAP OF MI LE GULL POND

Table I. Morphometry of Middle Gull Pond

Area, including islands (acres) 776.5 (ha.) 314.4	Area, excluding islands (acres) 757.2 (ha.) 306.6
Maximum length (mi.) 3.0 (km.) 4.8	Maximum effective length (mi.) 3.0 (km.) 4.8
Maximum width (mi.) 0.9 (km.) 1.5	Maximum effective width (mi.) 0.9 (km.) 1.5
Mean width (mi.) 0.4 (km.) 0.6	Volume (cu.ft.) 1.20×10^9 (cu. m.) 3.40×10^7
Maximum depth (ft.) 107.0 (m.) 32.6	Mean depth (ft.) 33.8 (m.) 10.3
Mean depth - maximum depth ratio 0.32	Volume development 0.96
Perimeter, including islands (mi.) 16.2 (km.) 26.1	Perimeter, excluding islands (mi.) 13.4 (km.) 21.6
Shore development, including islands 4.16	Shore development, excluding islands 3.48
Direction of Major Axes ENE-WSW	

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-10	3,145,500	72.2	9.5
10-20	5,298,200	122.6	16.2
20-30	6,248,200	143.3	18.8
30-40	5,924,600	136.0	18.0
40-50	3,660,300	84.0	11.1
50-60	3,069,200	70.5	9.3
60-70	3,289,200	75.4	10.0
70-80	1,349,500	31.0	4.1
80-90	737,000	16.8	2.2
90-100	239,600	5.5	0.7
over 100	40,100	0.9	0.1
Total	3.30×10^7	757.2	

Table II. Analysis of surface water of Middle Gull Pond (samples collected July, 1970)

	Range	Mean
Alkalinity as $CaCO_3$	2.0 - 8.7 ppm	5.3 ppm
Total hardness as $CaCO_3$	4.6 - 5.7 ppm	5.1 ppm
pH	5.8 -6.2	6.0
Color (Hazen units)	-	5
Oxygen consumed ($KMnO_4$)	1.8 - 3.0 ppm	2.4 ppm
Turbidity (units)	0.35 - 0.85	-
Sp. conductance, micromhos at 25°C	24.2 - 26.3	25.3
Total dissolved solids	24.4 - 26.0 ppm	25.2 ppm
Calcium (Ca)	0.8 - 1.2 ppm	1.0 ppm
Magnesium (Mg)	-	0.5 ppm
Sodium (Na)	3.3 - 3.6 ppm	3.5 ppm
Potassium (K)	-	0.2 ppm
Sulphate (SO_4)	1.5 - 2.3 ppm	2.0 ppm
Chloride (Cl)	5.8 - 6.3 ppm	6.0 ppm
Phosphate (PO_4) Total	0.02 - 0.03 ppm	0.03 ppm
Dissolved	0.01 - 0.03 ppm	0.02 ppm
Bicarbonate (HCO_3)	-	2.2 ppm
Carbonate (CO_3)	-	0.0 ppm
Nitrate (NO_3)	-	0.00 ppm
Silica (SiO_2)	-	0.2 ppm
Sum of constituents	14.1 - 15.0 ppm	14.6 ppm

however, are among the softest of those encountered to date on the Avalon Peninsula. Available information suggests Avalon Peninsula lakes have an average mineral content (T.D.S.) of approximately 30 ppm; the waters of Middle Gull Pond have a mean T.D.S. value of only 25.2 ppm.

c. Morphoedaphic Index and Lake Productivity. The amount of dissolved nutrients (T.D.S.) and the mean depth of a lake are the two major factors affecting the amount of fish a given lake can produce. The total dissolved solids of Middle Gull Pond water ranges from 24.4 to 26.0 ppm, with a mean of 25.2 ppm. The mean depth of this lake is 33.8 feet. The T.D.S. of lake water divided by the mean depth gives the morphoedaphic index of productivity of that lake, for Middle Gull Pond this index is 0.75 which is the lowest recorded for Avalon Peninsula lakes to date. The estimated potential production (yield) of a lake is approximately twice the square root of this index; for Middle Gull Pond the figure is calculated to be 1.73 pounds per acre per year or 1,310 pounds annually. Generally, lakes in this geographic area have an annual production of approximately 2-4 pounds per acre.

B. Fish Species Present

Five species of fish inhabit Middle Gull Pond. Three of the species are of sport value and these include, the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815, the landlocked Atlantic salmon (ouananiche), Salmo salar Linnaeus 1758, and the landlocked arctic char, Salvelinus alpinus (Linnaeus) 1758. Brook trout are the dominant species in terms of numbers, however, ouananiche attain much greater sizes. The arctic char is the smallest of the three sport species and is the least abundant. The threespine stickleback, Gasterosteus aculeatus Linnaeus 1758, is generally distributed throughout the lake and is an important forage species. The American eel, Anguilla rostrata (Le Sueur) 1817 is also a resident of Middle Gull Pond, however, it is believed to occur infrequently, perhaps the result of this lake being relatively far inland.

C. Age and Size Composition of the Sport Species

1. Brook Trout

The oldest and largest brook trout observed during the survey on Middle Gull Pond was VIII^{+} years of age with a fork length of 39.4 centimeters.

The age-length distribution of 165 brook trout sampled at Middle Gull Pond during June - July, 1970, is given in Table III.

2. Ouananiche

A ouananiche 46.8 cm. fork length and XI^{+} years of age holds the known longevity and size record at Middle Gull Pond.

Table IV shows the age-length distribution of 97 ouananiche sampled at Middle Gull Pond during June - July, 1970.

3. Arctic Char

The oldest and largest arctic char captured during the study was V^{+} years of age with a fork length of 24.4 centimeters.

The age-length distribution of the 58 arctic char collected at Middle Gull Pond during June - July, 1970, is shown in Table V.

D. Growth Rates of the Sport Species

The growth rates of brook trout, ouananiche, and arctic char were determined through the method of back-calculation.

Table III. Age-length distribution of brook trout taken in gill nets during June - July, 1970, in Middle Gull Pond

Fork length (cm.) (Class mark)	Age-class							
	II+	III+	IV+	V+	VI+	VII+	VIII+	Total
14.55	1(100.0)	-	-	-	-	-	-	1(0.6)
16.55	9(60.0)	6(40.0)	-	-	-	-	-	15(9.1)
18.55	-	9(100.0)	-	-	-	-	-	9(5.5)
20.55	-	1(4.8)	20(95.2)	-	-	-	-	21(12.7)
22.55	-	-	15(53.6)	13(46.4)	-	-	-	27(16.4)
24.55	-	-	8(22.2)	28(77.8)	-	-	-	36(21.8)
26.55	-	-	-	25(92.6)	2(7.4)	-	-	27(16.4)
28.55	-	-	-	13(81.3)	3(18.7)	-	-	16(9.7)
30.55	-	-	-	-	5(100.0)	-	-	5(3.0)
32.55	-	-	-	-	1(100.0)	-	-	1(0.6)
34.55	-	-	-	-	4(100.0)	-	-	4(2.4)
36.55	-	-	-	-	-	1(100.0)	-	1(0.6)
38.55	-	-	-	-	-	-	1(100.0)	1(0.6)
Total	10	16	43	79	15	1	1	165

Table IV. Age-length distribution of ouananiche taken in gill nets during June - July, 1970, in Middle Gull Pond

Fork length (cm.) (Class mark)	Age-class									
	III+	IV+	V+	VI+	VII+	VIII+	IX+	X+	XI+	Total
16.55	4(80.0)	1(20.0)	-	-	-	-	-	-	-	5(5.2)
18.55	4(44.4)	4(44.4)	1(11.2)	-	-	-	-	-	-	9(8.3)
20.55	-	13(76.5)	4(23.5)	-	-	-	-	-	-	17(17.5)
22.55	-	-	5(100.0)	-	-	-	-	-	-	5(5.2)
24.55	1(25.0)	-	3(75.0)	-	-	-	-	-	-	4(4.1)
26.55	-	1(33.3)	2(66.7)	-	-	-	-	-	-	3(3.1)
28.55	-	1(33.3)	1(33.4)	1(33.3)	-	-	-	-	-	3(3.1)
30.55	-	-	1(50.0)	1(50.0)	-	-	-	-	-	2(2.1)
32.55	-	-	-	-	1(50.0)	1(50.0)	-	-	-	2(2.1)
34.55	-	-	-	2(66.7)	-	1(33.3)	-	-	-	3(3.1)
36.55	-	-	-	1(12.5)	5(62.5)	1(12.5)	1(12.5)	-	-	8(8.2)
38.55	-	-	-	-	6(54.5)	4(36.4)	1(9.1)	-	-	11(11.3)
40.55	-	-	-	1(7.6)	6(46.2)	4(30.8)	1(7.7)	1(7.7)	-	13(13.4)
42.55	-	-	-	-	1(12.5)	2(25.0)	4(50.0)	-	1(12.5)	8(8.2)

Table IV. (Cont'd)

Fork length (cm.) (Class mark)	Age-class									
	III+	IV+	V+	VI+	VII+	VIII+	IX+	X+	XI+	Total
44.55	-	-	-	-	-	1(50.0)	1(50.0)	-	-	2(2.1)
46.55	-	-	-	-	-	-	1(50.0)	-	1(50.0)	2(2.1)
Total	9	20	17	6	19	14	9	1	2	97

Table V. Age-length distribution of arctic char taken in gill nets during June - July, 1970, in Middle Gull Pond

Fork length (cm.) (Class mark)	Age-class					
	I^+	II^+	III^+	IV^+	V^+	Total
8.55	7(58.3)	5(41.7)	-	-	-	12(20.7)
10.55	-	11(100.0)	-	-	-	11(19.0)
12.55	-	-	8(100.0)	-	-	8(14.0)
14.55	-	-	12(70.6)	5(29.4)	-	17(29.3)
16.55	-	-	1(50.0)	1(50.0)	-	2(3.4)
18.55	-	-	-	3(100.0)	-	3(5.2)
20.55	-	-	-	1(50.0)	1(50.0)	2(3.4)
22.55	-	-	-	-	1(100.0)	1(1.7)
24.55	-	-	-	-	2(100.0)	2(3.4)
Total	7	16	21	10	4	58

1. Brook Trout

The Monastyrsky method of back-calculation was chosen to determinte the growth rate of Middle Gull Pond brook trout.

From paired observations of fish length and scale length, a log-log regression was calculated and is as follows:

$$\text{Log } L_f = 0.9018 \text{ Log } L_s + 0.9500$$

$$\text{or} \quad L_f = 8.913 \, L_s^{0.9018}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

Generally, the growth rate of Middle Gull Pond brook trout is comparable to the mean growth rate of trout from other Avalon Peninsula populations.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Middle Gull Pond brook trout

Annulus	I	II	III	IV	V	VI	VII	VIII
Scale length (x43)	0.70	1.30	1.82	2.41	2.92	3.60	4.35	5.00
Fish fork length (cm.)	6.2	11.3	15.3	19.7	23.4	28.3	33.6	38.0
Fish fork length (in.)	2.4	4.5	6.0	7.8	9.2	11.1	13.2	15.0

2. Ouananiche

The Lee method of back-calculation which has proven suitable for the Genus Salmo, generally, was chosen to calculate the growth rate of Middle Gull Pond ouananiche.

From paired observations of fish length and scale length, a least squares regression was calculated and is as follows:

$$L_f = 3.13\ L_s + 1.58$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VII.

Table VII. Actual scale length (x43) and calculated fish length at annulus formation of Middle Gull Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Scale length (x43)	1.07	1.99	3.44	4.89	6.51	8.32	9.87	11.06	12.51	13.12	13.85
Fish fork length (cm.)	4.9	7.8	12.4	16.9	22.0	27.6	32.5	36.2	40.7	42.7	44.9
Fish fork length (in.)	1.9	3.1	4.9	6.7	8.7	10.9	12.8	14.3	16.0	16.8	17.7

Generally speaking, the growth rate of Middle Gull Pond ouananiche over four years of age is somewhat faster than the mean growth rate of fish of this age from other Avalon Peninsula lakes. The growth rate of the younger fish in Middle Gull Pond is, however, somewhat slower than average.

3. Arctic char

The Monastyrsky method of back-calculation has been found to be most suitable in determining the growth rate of fish of the Genus Salvelinus generally (Wiseman, 1970), and was chosen to calculate the growth rate of Middle Gull Pond arctic char.

From paired data on fish length and scale length, a log-log regression was calculated and is as follows:

$$\text{Log } L_f = 1.1345 \text{ Log } L_s + 0.7467$$

$$\text{or} \quad L_f = 5.581 \, L_s^{1.1345}$$

The average scale lengths for the completion of each annulus formation and the corresponding calculated fish lengths are given in Table VIII.

Table VIII. Actual scale length (x43) and calculated fish length at annulus formation of Middle Gull Pond arctic char

Annulus	I	II	III	IV	V
Scale length (x43)	0.77	1.38	2.00	2.54	3.30
Fish fork length (cm.)	4.2	8.0	12.3	16.1	21.6
Fish fork length (in.)	1.7	3.2	4.8	6.3	8.5

Middle Gull Pond is the only Avalon Peninsula lake investigated to date which has an arctic char population and for this reason it is impossible to relate the growth rate of fish in this lake to a mean for the geographic area as a whole. It is obvious, however, that the growth rate is slow.

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 165 brook trout taken in Middle Gull Pond during the period June - July, 1970, is given in Table IX. Generally, it appears that brook trout in this lake are mainly insectivorous at the smaller sizes but become predominantly piscivorous as they become larger, preying on both sticklebacks and small ouananiche.

Table IX. The food habits of Middle Gull Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrest. Invert.	*Fish and Benthic Terrest. Invert.	*Fish
10.55	1	16(100.0)	-	-
19.55	2	27(96.4)	1(3.6)	-
23.55	6	48(84.2)	5(8.8)	4(7.0)
27.55	2	30(73.2)	4(9.8)	7(17.0)
31.55	-	1(16.7)	-	5(83.3)
35.55	-	-	1(20.0)	4(80.0)
39.55	-	-	-	1(100.0)
Total	11	122	11	21

2. Ouananiche

Table X illustrates the results of the analysis of the food habits of 97 ouananiche captured in Middle Gull Pond during June - July, 1970. Generally, ouananiche in this lake are similar to the brook trout in their food habits; they are insectivorous during the early years of life but rely heavily on a diet of fish as they become older and larger.

3. Arctic Char

The result of the analysis of the food habits of 58 arctic char taken in Middle Gull Pond during June - July, 1970, is given in Table XI.

It appears the arctic char in Middle Gull Pond are totally insectivorous, at least over the range of size of captured fish. Generally, the younger and smaller fish rely heavily on zooplankton while the larger individuals feed on macro-invertebrates.

Table X. The food habits of Middle Gull Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrest. Invert.	*Fish and Benthic Terrest. Invert.	*Fish
15.55	1	4(100.0)	-	-
19.55	2	23(95.8)	1(4.2)	-
23.55	-	8(88.9)	1(11.1)	-
27.55	-	2(33.3)	1(16.7)	3(50.0)
31.55	-	1(25.0)	-	3(75.0)
35.55	1	-	-	10(100.0)
39.55	3	-	-	21(100.0)
43.55	-	-	-	10(100.0)
47.55	-	-	-	2(100.0)
Total	7	38	3	49

*Sticklebacks, ouananiche, brook trout, and arctic char.

Table XI. The food habits of Middle Gull Pond arctic char expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents		
	Empty	Zooplankton	Benthic and/or Terrestrial Invertebrates
11.55	5	26(100.0)	-
15.55	2	16(94.1)	1(5.9)
19.55	-	3(60.0)	2(40.0)
23.55	-	-	3(100.0)
Total	7	45	6

COLLIERS BIG POND

A. Limnology

1. Location

Colliers Big Pond is situated at 47°24' North Latitude and 53°21 West Longitude. It lies approximately 40 miles south-west of the city of St. John's at the junction of the Roaches Line and the Trans Canada Highway. Colliers Big Pond has an elevation of approximately 390 feet above sea level.

2. Uses

a. Industrial. The waters of Colliers Big Pond have no industrial use at the present time.

b. Recreational. At present, Colliers Big Pond experiences a light to moderate fishing pressure on its resident salmonid sport species. In addition to angling, other recreational activities on the lake include a moderate amount of boating, swimming, picnicing, and a lesser amount of camping. Some rabbit, ptarmigan, and grouse hunting is carried on in proximity to Colliers Big Pond. There is presently a small summer cabin development of four units on the lake.

3. Characteristics of the Drainage Area

Colliers Big Pond empties into Conception Bay via Cross Pond, Black Duck Pond, Graces Gullies, Healeys Pond, a number of unnamed lakes and ponds, and Colliers River. The drainage area of Colliers Big Pond occupies 1.9 square miles of which 0.3 square miles are in standing water. Only one drainage system contributes its water to Colliers Big Pond.

The lake's drainage area lies at an altitude ranging from approximately 390 to 560 feet above sea level. The terrain is composed of almost entirely climax forest of fir, spruce, and birch; there is some barren land within the boundary, however.

With respect to geology, the drainage area lies in a region of Precambrian sedimentary and volcanic rocks. Most of the strata in the area are of sedimentary origin and have been classified as belonging to the Conception Group. The drainage basin contains Hadrynian siltstone, conglomerate, slate, greywacke, and minor volcanic rocks. (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Colliers Big Pond is presented in Figure 1, and the morphometric parameters are given in Table I.

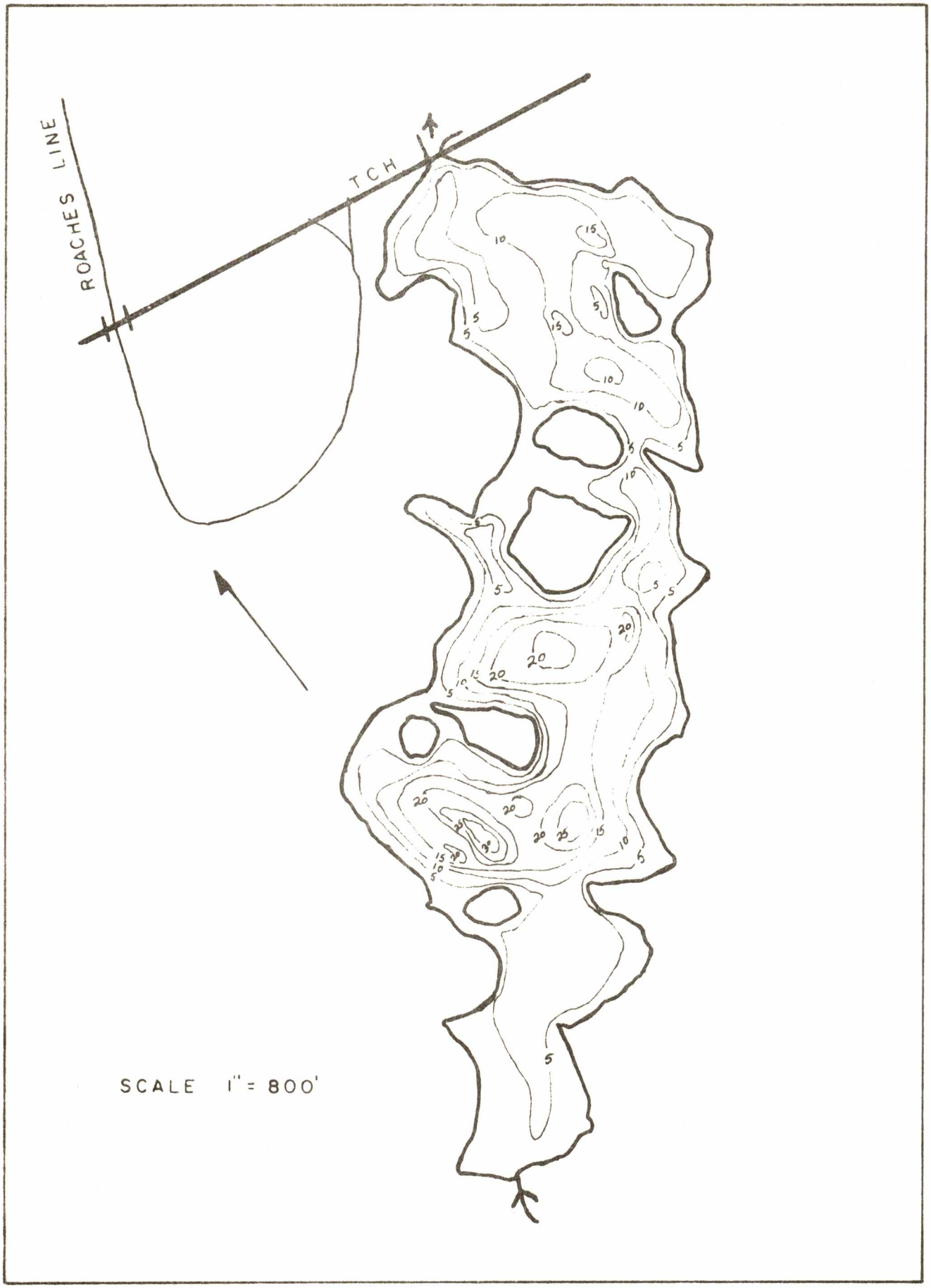


FIGURE 1. BATHYMETRIC MAP OF COLLIERS BIG POND

Table I. Morphometry of Colliers Big Pond

Area, including islands (acres) 173.2 (ha.) 70.1	Area, excluding islands (acres) 157.1 (ha.) 63.6
Maximum length (mi.) 1.2 (km.) 1.9	Maximum effective length (mi.) 1.1 (km.) 1.8
Maximum width (mi.) 0.4 (km.) 0.6	Maximum effective width (mi.) 0.4 (km.) 0.6
Mean width (mi.) 0.2 (km.) 0.3	Volume (cu.ft.) 5.84×10^7 (cu. m.) 1.65×10^6
Maximum depth (ft) 34.0 (m.) 10.4	Mean depth (ft.) 8.5 (m.) 2.6
Mean depth - maximum depth ratio 0.25	Volume development 0.75
Perimeter, including islands (mi.) 5.0 (km.) 8.0	Perimeter, excluding islands (mi.) 3.5 (km.) 5.6
Shore development, including islands 2.85	Shore development, excluding islands 2.00

Direction of Major Axes NNE - SSW

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	2,390,000	54.8	34.9
5-10	2,280,000	52.3	33.3
10-15	1,120,000	25.6	16.3
15-20	620,000	14.3	9.1
20-25	360,000	8.3	5.3
25-30	50,000	1.2	0.8
Over 30	30,000	0.6	0.4
Total	6.85×10^6	157.1	

The shore development index of Colliers Big Pond is 2.85, which indicates the lake is fairly irregular in shape. The shores of the lake are gently sloped for the most part and the mean depth is only 8.5 feet. The maximum depth of Colliers Big Pond is 34 feet. Approximately 94 percent of the lake area is included in the 0-20 feet range of depth. This depth range is generally accepted as being responsible for the majority of sport fish production in a lake. Colliers Big Pond appears then to be a relatively productive lake in terms of its morphometry.

b. Surface Water Chemistry. The analysis of the surface water of Colliers Big Pond appears in Table II. The lake water is quite soft, however, it is considerably harder than the average for lakes on the Avalon Peninsula. The mineral content or total dissolved solids of Colliers Big Pond ranges from 36.0 to 37.6 ppm, with an average of 37.0 ppm. The average recorded mineral content for Avalon Peninsula lakes is considerably lower at approximately 30 ppm.

Table II. Analysis of surface water of Colliers Big Pond (samples collected August, 1972)

	Range	Mean
Alkalinity as $CaCO_3$	2.4 - 2.5 ppm	2.4 ppm
Total hardness as $CaCO_3$	4.9 - 5.0 ppm	5.0 ppm
pH	5.8 - 6.1	6.0
Color (Hazen units)	-	5
Turbidity (units)	0.13 - 0.29	0.21
Sp. conductance micromhos at 25°C	40.3 - 42.4	41.6
Total dissolved solids	36.0 - 37.6 ppm	37.0 ppm
Calcium (Ca)	-	1.0 ppm
Magnesium (Mg)	-	0.6 ppm
Sodium (Na)	4.8 - 6.0 ppm	5.3 ppm
Potassium (K)	0.4 - 0.6 ppm	0.5 ppm
Sulphate (SO_4)	1.6 - 2.1 ppm	1.8 ppm
Chloride (Cl)	8.5 - 8.8 ppm	8.6 ppm
Phosphate (PO_4) Total	0.005 - 0.040 ppm	0.018 ppm
Dissolved	0.003 - 0.010	0.007 ppm
Bicarbonate (HCO_3)	2.0 - 3.1 ppm	3.0 ppm
Nitrate (NO_3)	-	0.02 ppm
Silica (SiO_2)	1.0 - 1.2 ppm	1.1 ppm
Sum of constituents	20.0 - 20.3 ppm	20.1 ppm

c. Morphoedaphic Index and Lake Productivity. The two most important factors determining the amount of fish a lake can yield are the mineral content of the water and the morphometry of the lake. As we have just seen, the physical features of Colliers Big Pond appear

to be conducive to good fish production. The considerably better-than-average mineral content of the lake would also tend to inflate the potential for fish production somewhat, so we would expect above average productivity to result in Colliers Big Pond. The morphoedaphic index (T.D.S. ÷ mean depth) of Colliers Big Pond is calculated to be 4.35 which means the potential yield of sport fish from this lake is 4.17 pounds per acre per year. This is the highest yield recorded for Avalon Peninsula lakes investigated to date; the average for all lakes studied is approximately 3 pounds per acre per year. A suggested creel limit or maximum sustained yield for Colliers Big Pond is 4.17 pounds of sport fish per acre per year or a total of 655 pounds annually.

B. Fish Species Present

Colliers Big Pond and its drainage system contain four fish species, all of which are native to Newfoundland waters. Only two of the species are of recreational value and include the eastern brook trout Salvelinus fontinalis (Mitchill) 1815, and the landlocked Atlantic salmon (or ouananiche), Salmo salar Linnaeus 1758. The ouananiche is by far the dominant sport species in terms of both number and size. The threespine stickleback, Gasterosteus aculeatus Linneaus 1758 is an important forage species generally distributed in large numbers throughout the lake. The American eel, Anguilla rostrata (Le Sueur) 1817 also occurs in Colliers Big Pond. Very little is known of the status of the eel population except it is perhaps the largest fish living in the lake and is undoubtedly a serious competition and predator.

C. Age and Size Composition of the Sport Species

1. Brook Trout

The oldest and largest brook trout observed during the investigation at Colliers Big Pond was V^+ years of age with a fork length of 33.5 centimeters.

The age-length distribution of 60 brook trout sampled at Colliers Big Pond during July, 1972, is given in Table III.

2. Ouananiche

A ouananiche 41.5 cm fork length and $VIII^+$ years of age holds the known size record at Colliers Big Pond.

Two fish IX^+ years of age and 38.4 cm. and 40.1 cm. fork length, respectively, were the oldest fish observed during the study.

Table IV gives the age length distribution of 232 ouananiche sampled at Colliers Big Pond during July, 1972.

Table III. Age-length distribution of brook trout taken in gill nets and live-traps during July, 1972, in Colliers Big Pond

Fork length (cm.) (Class mark)	Age-class					
	I^+	II^+	III^+	IV^+	V^+	Total
10.55	3(100.0)	-	-	-	-	3(5.0)
12.55	2(66.7)	1(33.3)	-	-	-	3(5.0)
14.55	-	6(100.0)	-	-	-	6(10.0)
16.55	-	1(100.0)	-	-	-	1(1.7)
18.55	-	4(66.7)	2(33.3)	-	-	6(10.0)
20.55	-	1(8.3)	11(91.7)	-	-	12(20.0)
22.55	-	-	8(61.5)	5(38.5)	-	13(21.7)
24.55	-	-	3(37.5)	5(62.5)	-	8(13.3)
26.55	-	-	1(25.0)	3(75.0)	-	4(6.7)
28.55	-	-	-	1(50.0)	1(50.0)	2(3.3)
30.55	-	-	-	1(100.0)	-	1(1.7)
32.55	-	-	-	-	1(100.0)	1(1.7)
Total	5	13	25	15	2	60

Table IV. Age-length distribution of ouananiche taken in gill nets and live traps during July, 1972, in Colliers Big Pond

Fork length (cm.) (Class mark)	Age-class								
	II+	III+	IV+	V+	VI+	VII+	VIII+	IX+	Total
10.55	4(100.0)	-	-	-	-	-	-	-	4(1.7)
12.55	18(100.0)	-	-	-	-	-	-	-	18(7.8)
14.55	40(72.7)	15(27.3)	-	-	-	-	-	-	55(23.7)
16.55	6(60.0)	3(30.0)	1(10.0)	-	-	-	-	-	10(4.3)
18.55	1(5.0)	6(30.0)	12(60.0)	1(5.0)	-	-	-	-	20(8.6)
20.55	3(20.0)	12(80.0)	-	-	-	-	-	-	15(6.5)
22.55	5(21.7)	12(52.2)	6(26.1)	-	-	-	-	-	23(9.9)
24.55	2(8.7)	9(39.1)	10(43.5)	2(8.7)	-	-	-	-	23(9.9)
26.55	-	-	4(18.2)	10(45.5)	8(36.3)	-	-	-	22(9.5)
28.55	-	-	1(8.3)	3(25.0)	7(58.4)	1(8.3)	-	-	12(5.2)
30.55	-	-	-	5(41.7)	6(50.0)	1(8.3)	-	-	12(5.2)
32.55	-	-	-	-	3(60.0)	2(40.0)	-	-	5(2.2)
34.55	-	-	-	1(25.0)	1(25.0)	2(50.0)	-	-	4(1.7)
36.55	-	-	-	-	-	1(50.0)	1(50.0)	-	2(0.9)
38.55	-	-	-	-	-	-	1(50.0)	1(50.0)	2(0.9)
40.55	-	-	-	-	-	1(20.0)	2(40.0)	2(40.0)	5(2.2)
Total	69	34	51	36	27	8	4	3	232

D. Growth Rates of the Sport Species

The principle of back-calculation was applied to determine the rate of growth of brook trout and ouananiche.

1. Brook Trout

Using the Monastyrsky (or exponential) method of back-calculation from paired parameters of fish length and scale length, a log-log regression was calculated; the equation for scale length on fish length is as follows:

$$\text{Log } L_f = 1.0562 \text{ Log } L_s + 0.8753$$

$$\text{or} \quad L_f = 7.504 \, L_s^{1.0562}$$

Table V shows the average scale lengths for each year of life and the corresponding calculated fish lengths.

Generally, the growth rate of Colliers Big Pond brook trout is considerably faster than the mean growth rate of trout from other Avalon Peninsula lakes.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Colliers Big Pond brook trout

Annulus	I	II	III	IV	V
Scale length (x43)	0.76	1.54	2.32	2.97	3.85
Fish fork length (cm.)	5.6	11.8	18.3	23.7	31.2
Fish fork length (in.)	2.2	4.7	7.2	9.3	12.3

2. Ouananiche

The Lee method (direct proportion) of back-calculation was used to determine the growth rate of ouananiche. From paired data on fish length and scale length, a least squares regression equation was calculated; the equation of scale length on fish length is as follows:

$$L_f = 3.18 \, L_s + 0.25$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Colliers Big Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII	VIII	IX
Scale length (x43)	1.25	2.58	4.60	5.98	7.40	8.59	10.00	11.80	12.90
Fish fork length (cm.)	4.2	8.5	14.9	19.3	23.8	27.6	32.1	37.8	41.3
Fish fork length (in.)	1.7	3.3	5.9	7.6	9.4	10.9	12.6	14.9	16.3

Generally, the growth rate of ouananiche in Colliers Big Pond is somewhat faster than the mean growth rate of fish from other lakes studied on the Avalon Peninsula.

E. Food Habits of the Sport Species

1. Brook Trout

Table VII presents the result of the analysis of the food habits of 47 brook trout taken in Colliers Big Pond during July, 1972.

Generally speaking, it appears that brook trout in this lake are predominantly insectivorous at the smaller sizes but become mainly piscivorous as they become larger, relying on sticklebacks as forage. It is interesting to note the occurrence of shrews as a food item.

Table VII. The food habits of Colliers Big Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents				
	Empty	Benthic and/or Terr. Inverts.	*Fish and Benthic and/or Terr. Inverts.	*Fish	**Other
15.55	-	1(100.0)	-	-	-
19.55	1	16(100.0)	-	-	-
23.55	6	14(93.3)	1(6.7)	-	-
27.55	2	2(50.0)	1(25.0)	1	1(25.0)
31.55	-	-	-	2(100.0)	-
Total	9	33	2	2	1

*Sticklebacks **Four shrews

2. Ouananiche

Table VIII shows the result of the analysis of the food habits of 83 ouananiche taken in Colliers Big Pond during July, 1972.

Generally, the ouananiche in Colliers Big Pond are insectivorous at the smaller sizes and predominantly piscivorous at the larger sizes relying on sticklebacks as forage. As in the case with brook trout, shrews occasionally occur inthe diet of ouananiche.

Table VIII. The food habits of Colliers Big Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents				
	Empty	Benthic and/or Terr. Inverts.	*Fish and Benthic and/or Terr. Inverts.	*Fish	**Other
19.55	3	15(93.8)	-	1(6.2)	-
23.55	5	10(47.6)	3(14.3)	8(38.1)	-
27.55	6	2(16.7)	3(25.0)	7(58.3)	-
31.55	5	-	-	3(75.0)	1(25.0)
35.55	2	-	-	2(100.0)	-
39.55	3	-	-	3(100.0)	-
Total	24	28	6	24	1

*Sticklebacks
**Shrews

NINE ISLAND POND

A. Limnology

1. Location

Nine Island Pond is situated at 47°26' North Latitude and 53°17' West Longitude. It lies approximately 40 miles southwest of the city of St. John's just off the Roaches Line about 2 miles north of the overpass on the Trans Canada Highway. Nine Island Pond has an elevation of approximately 375 feet above sea level.

2. Uses

a. Industrial. At this point in time, the waters of Nine Island Pond have no industrial use.

b. Recreational. At present, Nine Island Pond experiences a light to moderate fishing pressure on its resident salmonid species. In addition to angling, other recreational pursuits on this lake include a moderate amount of boating, swimming, and picnicing and lesser amounts of camping and waterfowl hunting. There is a substantial amount of small game (ptarmigan and rabbit) hunting conducted in proximity to Nine Island Pond. There is presently a fairly extensive summer cabin development on the lake consisting of some 30-40 units. This development consists, for the most part, of a cluster of cabins at each end of the lake. The cabins at the north end are somewhat older as this part of the lake has been accessible via the Colliers Road for many years. The cabins at the south end of the lake are accessible via the Roaches Line and development in this area is more recent and, in fact, is expanding.

3. Characteristics of the Drainage Area

Nine Island Pond empties into Conception Bay via Black Duck Pond, Graces Gully, Healeys Pond, and Colliers River. The drainage area of the lake occupies 2.2 square miles of which 0.7 square miles are in standing water. Two minor drainage systems and one major system contribute their drainage to Nine Island Pond.

The drainage area of Nine Island Pond lies at an altitude of approximately 375 to 550 feet above sea level. The terrain is almost entirely composed of barrens with infrequent and modest stands of fir, spruce, tamarack, and birch. The barren land habitat of the drainage area has been developed to a fair extent in the form of commercial blueberry picking grounds. There is also a moderate amount of farmland within the drainage boundary.

In terms of geology, the drainage area of Nine Island Pond lies in a region of Precambrian sedimentary and volcanic rocks. Most of the strata in the area are of sedimentary origin and have been classified as belonging to the Conception Group. The drainage basin contains Hadrynian siltstone, conglomerate, slate, greywacke, and minor volcanic rocks (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Nine Island Pond is presented in Figure 1, and the morphometric parameters of the lake are given in Table I.

Nine Island Pond is moderately irregular in shape as evidenced by its having a shore development index of 2.24. The shores of the lake

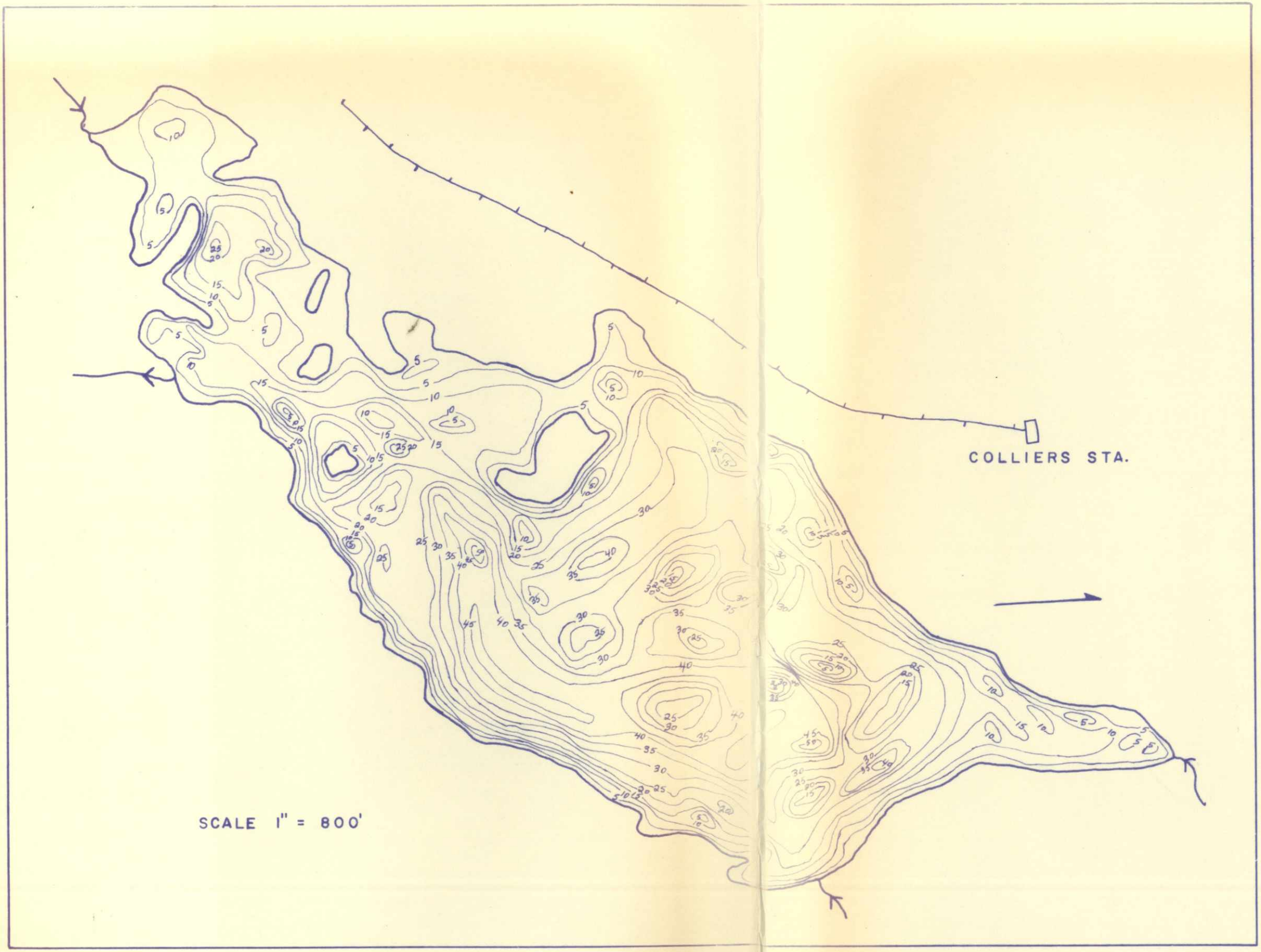


FIGURE 1. BATHYMETRIC MAP OF NINE ISLAND POND

Table I. Morphometry of Nine Island Pond

Area, including islands (acres) 408.3 (ha.) 165.2	Area, excluding islands (acres) 400.5 (ha.) 162.1
Maximum length (mi.) 1.7 (km.) 2.7	Maximum effective length (mi.) 1 (km.) 2.3
Maximum width (mi.) 0.7 (km.) 1.1	Maximum effective width (mi.) 0.7 (km.) 1.1
Mean width (mi.) 0.4 (km.) 0.6	Volume (cu.ft.) 3.52×10^8 (cu. m.) 9.97×10^6
Maximum depth (ft.) 53.0 (m.) 16.2	Mean depth (ft.) 20.2 (m.) 6.2
Mean depth - maximum depth ratio 0.38	Volume development 1.14
Perimeter, including islands (mi.) 6.3 (km.) 10.1	Perimeter, excluding islands (mi.) 5.3 (km.) 3.5
Shore development, including islands 2.24	Shore dcevelopment, excluding islands 1.89

Direction of Major Axes NE-SW

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	2,510,000	57.7	14.4
5-10	2,720,000	62.4	15.6
10-15	1,900,000	43.7	10.9
15-20	1,650,000	37.9	9.5
20-25	1,790,000	41.2	10.3
25-30	2,530,000	58.1	14.5
30-35	1,580,000	36.2	9.0
35-40	1,430,000	32.9	8.2
40-45	1,150,000	26.4	6.6
45-50	150,000	3.4	0.8
over 50	30,000	0.6	0.1
Total	1.74×10^7	400.5	

are fairly steeply sloped and the maximum depth is 53 feet. The mean depth of the lake is 20.2 feet. Approximately 50 percent of the lake area is included in the 0-20 feet range of depth. This depth range is generally accepted by limnologists as accounting for most of the fish production in a lake. Nine Island Pond appears, on the basis of its morphometry, to be a relatively unproductive lake.

b. Surface Water Chemistry. The analysis of the chemical constituents of the surface water of Nine Island Pond appears in Table II.

Table II. Analysis of surface water of Nine Island Pond (samples collected June, 1972)

	Range	Mean
Alkalinity as $CaCO_3$	2.4 - 2.8 ppm	2.6 ppm
Total hardness as $CaCO_3$	3.9 - 4.1 ppm	4.0 ppm
pH	6.2 - 6.3	6.3
Color (Hazen units)	-	5
Total organic carbon	2.5 - 6.5 ppm	4.5 ppm
Turbidity	0.2 - 0.4 ppm	0.3 ppm
Sp. conductance, micromhos at 25°C	32.8 - 34.3	33.8
Total dissolved solids	30.6 - 31.7 ppm	31.3 ppm
Calcium (Ca)	0.7 - 0.8 ppm	0.7 ppm
Magnesium (Mg)	-	0.5 ppm
Sodium (Na)	-	3.4 ppm
Potassium (K)	-	0.3 ppm
Sulphate (SO_4)	2.3 - 3.1 ppm	2.8 ppm
Chloride (Cl)	4.8 - 5.1 ppm	5.0 ppm
Phosphate (PO_4) Total	0.010 - 0.015 ppm	0.013 ppm
Bicarbonate (HCO_3)	2.9 - 3.4 ppm	3.2 ppm
Nitrate (NO_3)	-	0.005 ppm
Silica (SiO_2)	0.1 - 0.2 ppm	0.1 ppm
Sum of constituents	14.0 - 15.6 ppm	14.8 ppm

The mineral content of Nine Island Pond is comparable to the average for lakes on the Avalon Peninsula. The mineral content (T.D.S.) of Nine Island Pond water ranges from 30.6 to 31.7 ppm with a mean of 31.3 ppm. The average for a number of lakes in this geographic area is approximately 30 ppm. Generally then, it would appear that the waters of this lake are as nutrient-rich as the average for Avalon Peninsula lakes.

c. Morphometric Index and Lake Productivity. The mineral content of lake water and the morphometry of the lake are the principal

factors determining the amount of fish a lake can produce or yield. As we have already seen, the morphometry of Nine Island Pond can not be considered conducive to good levels of sport fish production. The mineral content of the lake water is about average for lakes in this geographic area. Thus we see that although the water fertility of the lake is about average, the morphometry is not really conducive to good levels of fish production, and we would expect a below-average level of fish production in Nine Island Pond. Combining the data on water fertility with the morphometric data (T.D.S. ÷ mean depth of the lake), we calculate the morphoedaphic index of productivity for Nine Island Pond to be 1.55. The potential fish yield of a lake is approximately twice the square root of the morphoedaphic index. Nine Island Pond has a potential annual maximum sustained yield of 2.49 pounds per acre or a total of 998 pounds. This yield is somewhat lower than the average for lakes on the Avalon Peninsula, which is approximately 3 pounds per acre per year.

B. Fish Species Present

Only four fish species, all of which are native, are found in Nine Island Pond and its drainage systems. Only two of the species are of sport fishing value and include the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815, and the landlocked Atlantic salmon (or ouananiche), Salmo salar Linnaeus 1758. The brook trout is the dominant sport species in terms of numbers, however, the ouananiche is a bigger fish, on the average, than the brook trout. The threespine stickleback, Gasterosteus aculeatus Linnaeus 1758, is a forage species and is generally distributed throughout the lake in large numbers. Anguilla rostrata (Le Sueur) 1817, the American eel, is also a resident of the lake, however, little is known of the extent of the population.

C. Age and Size Composition of the Sport Species

1. Brook Trout

A brook trout 36.2 cm. in fork length and VI^{+} years of age holds the known size and longevity record at Nine Island Pond.

The age-length distribution of 207 brook trout sampled at Nine Island Pond during June, 1972, is given in Table III.

2. Ouananiche

A ouananiche IX^{+} years of age with a fork length of 58.1 cm. was the oldest and largest fish observed during the course of the study on Nine Island Pond. Table IV gives the age-length distribution of 139 ouananiche sampled at the lake during June, 1972.

Table III. Age-length distribution of brook trout taken in gill nets and live traps during June, 1972, in Nine Island Pond

Fork length (cm.) (Class mark)	Age-class						
	I+	II+	III+	IV+	V+	VI+	Total
8.55	5(100.0)	-	-	-	-	-	5(2.4)
10.55	12(50.0)	12(50.0)	-	-	-	-	24(11.6)
12.55	12(40.0)	16(50.0)	3(10.0)	-	-	-	31(15.0)
14.55	-	11(84.6)	2(15.4)	-	-	-	13(6.3)
16.55	-	4(66.7)	2(33.3)	-	-	-	6(2.9)
18.55	-	11(39.1)	16(56.5)	1(4.4)	-	-	28(13.5)
20.55	-	1(5.0)	19(85.0)	2(10.0)	-	-	22(10.6)
22.55	-	-	13(61.9)	8(38.1)	-	-	21(10.1)
24.55	-	-	7(26.9)	19(73.1)	-	-	26(12.6)
26.55	-	-	7(38.9)	10(55.6)	1(5.5)	-	18(8.7)
28.55	-	-	-	6(100.0)	-	-	6(2.9)
30.55	-	-	-	2(100.0)	-	-	2(1.0)
32.55	-	-	-	1(50.0)	1(50.0)	-	2(1.0)
34.55	-	-	-	-	1(50.0)	1(50.0)	2(1.0)
36.55	-	-	-	-	-	1(100.0)	1(0.5)
Total	29	55	69	49	3	2	207

Table IV. Age-length distribution of ouananiche taken in gill nets and live traps during June, 1972, in Nine Island Pond

Fork length (cm.) (Class mark)	Age-class									
	I+	II+	III+	IV+	V+	VI+	VII+	VIII+	IX+	Total
8.55	5(100.0)	-	-	-	-	-	-	-	-	5(3.6)
10.55	-	6(100.0)	-	-	-	-	-	-	-	6(4.3)
12.55	-	10(80.0)	3(20.0)	-	-	-	-	-	-	13(9.3)
14.55	-	2(28.6)	5(71.4)	-	-	-	-	-	-	7(5.0)
16.55	-	11(63.7)	6(36.4)	-	-	-	-	-	-	17(12.2)
18.55	-	3(33.3)	5(50.0)	1(16.7)	-	-	-	-	-	9(6.4)
20.55	-	-	11(50.0)	11(50.0)	-	-	-	-	-	22(15.8)
22.55	-	-	6(42.9)	8(57.1)	-	-	-	-	-	14(10.1)
24.55	-	-	1(6.7)	13(86.7)	1(6.6)	-	-	-	-	15(10.8)
26.55	-	-	1(20.0)	2(40.0)	2(40.0)	-	-	-	-	5(3.6)
28.55	-	-	-	1(33.3)	2(66.7)	-	-	-	-	3(2.2)
30.55	-	-	-	-	3(100.0)	-	-	-	-	3(2.2)
32.55	-	-	-	2(40.0)	2(40.0)	1(20.0)	-	-	-	5(3.6)
34.55	-	-	-	-	2(33.3)	4(66.7)	-	-	-	6(4.3)
36.55	-	-	-	-	-	-	-	-	-	-
38.55	-	-	-	-	-	2(100.0)	-	-	-	2(1.4)
40.55	-	-	-	-	-	2(100.0)	-	-	-	2(1.4)
42.55	-	-	-	-	-	-	2(100.0)	-	-	2(1.4)
44.55	-	-	-	-	-	-	-	1(100.0)	-	11(0.7)
48.55	-	-	-	-	-	-	1(100.0)	-	-	1(0.7)
58.55	-	-	-	-	-	-	-	-	1(100.0)	1(0.7)
Total	5	32	38	38	12	9	3	1	1	139

D. Growth Rates of the Sport Species

The growth rate of Nine Island Pond brook trout and ouananiche were determined through the method of back-calculation.

1. Brook Trout

Using the Monastyrsky or exponential method of back-calculation, from paired observations on fish length and scale length, a log-log regression was calculated and is as follows:

$$\text{Log } L_f = 1.1409 \text{ Log } L_s + 0.8221$$

$$\text{or} \quad L_f = 6.639\ L_s^{1.1409}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table V.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Nine Island Pond brook trout

Annulus	I	II	III	IV	V	VI
Scale length (x43)	0.83	1.64	2.50	3.15	3.88	4.35
Fish fork length (cm.)	5.2	11.7	18.9	24.6	31.2	35.5
Fish fork length (in.)	2.1	4.6	7.4	9.7	12.3	14.0

Generally speaking, the growth rate of brook trout in Nine Island Pond is considerably faster than the mean growth rate of fish from Avalon Peninsula lakes, and in fact is one of the faster growth rates encountered to date.

2. Ouananiche

The Lee method of back-calculation was employed to determine the rate of growth of landlocked salmon or ouananiche in Nine Island Pond. From paired data on fish length and scale length, a least squares regression was calculated and is as follows:

$$L_f = 3.04\ L_s + 1.34$$

The growth rate of Nine Island Pond ouananiche is presented in Table VI.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Nine Island Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII	VIII	IX
Scale length (x43)	1.18	3.01	4.91	6.78	9.12	11.59	13.12	15.00	18.00
Fish fork length (cm.)	4.9	10.5	16.3	22.0	29.1	36.6	41.2	48.5	56.1
Fish fork length (in.)	1.9	4.1	6.4	8.7	11.5	14.4	16.2	19.1	22.1

The growth rate exhibited by ouananiche in Nine Island Pond is vastly faster than the mean growth rate of ouananiche from other Avalon Peninsula lakes and in fact is the fastest growth rate of any ouananiche population studied to date on the Avalon Peninsula.

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 121 brook trout taken in Nine Island Pond during June, 1972, is given in Table VII. Generally speaking, it would appear that brook trout in Nine Island Pond are mainly insectivorous at the smaller sizes but become more or less piscivorous as they become larger, relying to a large extent on sticklebacks as forage.

Table VII. The food habits of Nine Island Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic and/or Terr. Inverts.	*Fish
15.55	-	4(100.0)	-	-
19.55	6	36(100.0)	-	-
23.55	7	37(100.0)	-	-
27.55	2	21(95.5)	1(4.5)	-
31.55	-	2(50.0)	1(25.0)	1(25.0)
35.55	-	-	1(33.3)	2(66.7)
Total	15	100	3	3

*Sticklebacks

2. Ouananiche

Table VIII gives the result of the food habits analysis of 81 ouananiche taken in Nine Island Pond during June, 1972. Generally, the food habits of ouananiche in this lake are similar to those of the brook trout in that the smaller, younger fish are predominantly insectivorous utilizing benthic and terrestrial invertebrates, while the larger, older individuals in the population are predominantly piscivorous relying on the stickleback as a forage fish.

Table VIII. The food habits of Nine Island Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic and/or Terr. Inverts.	*Fish
15.55	-	6(100.0)	-	-
19.55	4	20(95.2)	-	1(4.8)
23.55	9	10(71.4)	1(7.2)	3(21.4)
27.55	2	2(66.7)	-	1(33.3)
31.55	2	1(20.0)	-	4(80.0)
35.55	-	2(33.3)	-	4(66.7)
39.55	-	-	-	4(100.0)
43.55	1	-	-	2(100.0)
47.55	-	-	-	1(100.0)
57.55	-	-	-	1(100.0)
Total	18	41	1	21

*Sticklebacks

GRAND POND

A. Limnology

1. Location

Grand Pond is situated at 47°27' North Latitude and 53°22' West

longitude. It lies approximately 44 miles south-west of the city of St. John's at the junction of the Trans Canada Highway and the Hodgewater Line. Grand Pond has an elevation of approximately 330 feet above sea level.

2. Uses

a. Industrial. At the present time the waters of Grand Pond have no industrial use.

b. Recreational. At present there is a moderate to heavy fishing pressure exerted for resident salmonid species. In addition to angling, other recreational uses include a moderate amount of boating, swimming, and picnicing, and a limited amount of camping and waterfowl hunting. Some rabbit hunting is carried on in proximity to Grand Pond. Much of the recreational activities conducted at Grand Pond are the result of a fairly extensive summer cabin development consisting of some 50-60 units located mainly along the Hodgewater Line and the Trans Canada Highway.

3. Characteristics of the Drainage Area

Grand Pond empties into St. Mary's Bay via Hodgewater Pond, numerous unnamed lakes and ponds, and Rocky River. The drainage area of the lake occupies 4.8 square miles, and of this total area, 1.3 square miles are in standing water. One major drainage system and two minor systems contribute their drainage to Grand Pond.

The drainage area lies at an altitude of approximately 330 to 525 feet above sea level. The terrain is composed of mainly climax forest of fir and spruce; there are limited areas of barrens within the drainage boundary. There is no industrial development, such as farming or logging, within the drainage area.

The Grand Pond drainage area lies in a region of Precambrian sedimentary and volcanic rocks. Most of the strata in the area are of sedimentary origin and have been classified as belonging to the Hodgewater Group. The drainage basin contains Hadrynian siltstone, arkose, conglomerate, slate, and acidic to intermediate volcanic rocks (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A bathymetric map of Grand Pond is presented in Figure 1, and the morphometric parameters are given in Table I.

Grand Pond is very irregular in shape and this is indicated by its having a shore development index of 4.00; its shores are moderately sloped. The maximum depth of Grand Pond is 48 feet while the mean depth is 12.7 feet. Approximately 80 percent of the lake area is included in the 0-20 feet depth range and as this is the generally

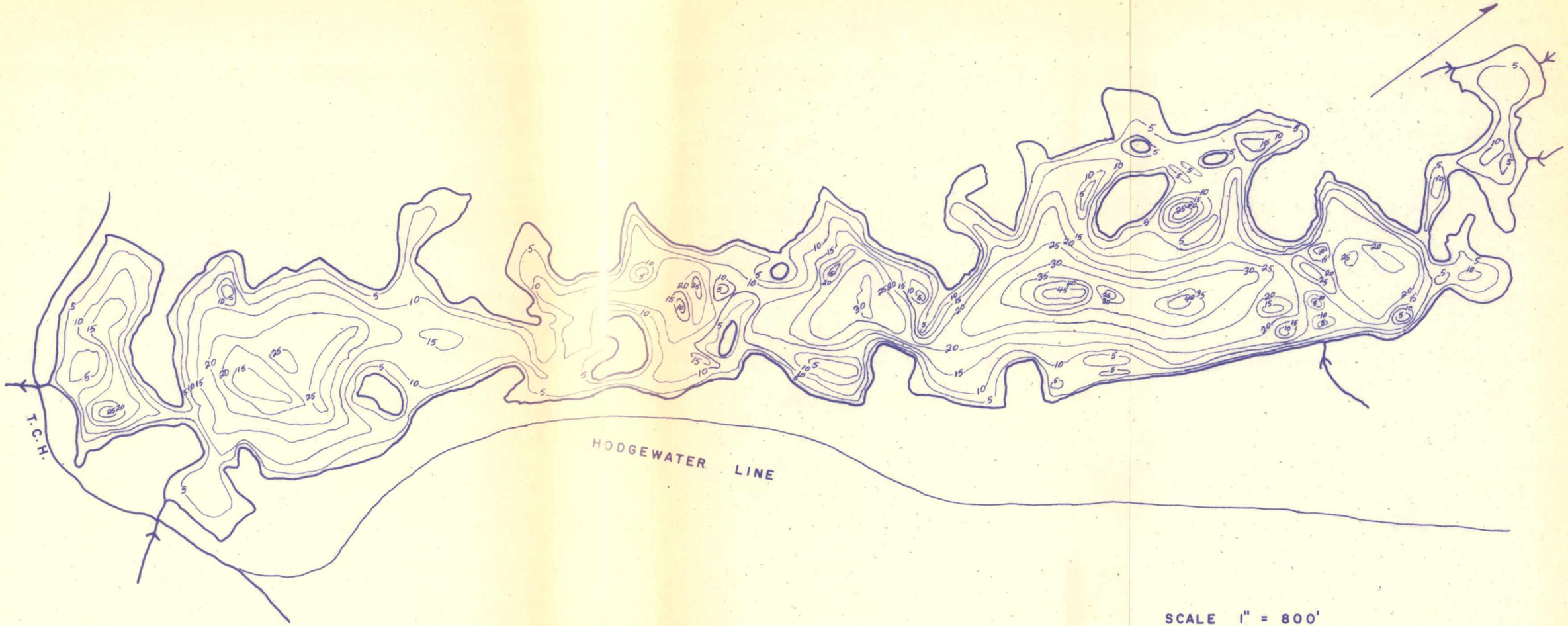


FIGURE I. BATHYMETRIC MAP OF GRAND POND

Table I. Morphometry of Grand Pond

Area, including islands (acres) 462.5 (ha.) 187.2	Area, excluding islands (acres) 450.0 (ha.) 182.1
Maximum length (mi.) 2.3 (km.) 3.7	Maximum effective length (mi.) 1.7 (km.) 2.7
Maximum width (mi.) 0.5 (km.) 0.8	Maximum effective width (mi.) 0.5 (km.) 0.8
Mean width (mi.) 0.3 (km.) 0.5	Volume (cu.ft.) 2.50×10^8 (cu. m.) 7.08×10^6
Maximum depth (ft.) 48.0 (m.) 14.6	Mean depth (ft.) 12.7 (m.) 3.9
Mean depth - maximum depth ratio 0.26	Volume development 0.78
Perimeter, including islands (mi.) 11.9 (km.) 19.2	Perimeter, excluding islands (mi.) 10.4 (km.) 16.7
Shore development, including islands 4.00	Shore development, excluding islands 3.51

Direction of Major Axes NE-SW

Depth (ft.)	Area $(ft)^2$	Area (acres)	%
0-5	4,030,000	92.6	20.6
5-10	4,960,000	113.8	25.3
10-15	3,830,000	88.0	19.6
15-20	2,790,000	64.0	14.2
20-25	1,980,000	45.5	10.1
25-30	1,220,000	28.0	6.2
30-35	550,000	12.7	2.8
35-40	130,000	3.0	0.7
40-45	80,000	1.8	0.4
over 45	30,000	0.6	0.1
Total	1.96×10^7	450.0	

accepted depth range for most fish production in lakes, we may conclude that, in terms of its morphometry, Grand Pond is a fairly productive lake.

b. Surface Water Chemistry. The analysis of the surface water of Grand Pond appears in Table II. All lakes on the Avalon Peninsula have very soft water. The waters of Grand Pond are, however, slightly harder than average. Available data suggest lakes on the Avalon Peninsula have an average T.D.S. value of approximately 30 ppm, the waters of Grand Pond have a mean T.D.S. value of 33.7 ppm. The concentration of such nutrients as calcium, bicarbonate, and nitrate is slightly greater in Grand Pond water than in most Avalon Peninsula lakes investigated.

Table II. Analysis of surface water of Grand Pond (samples collected July, 1972)

	Range	Mean
Alkalinity as $CaCO_3$	2.3 - 2.7 ppm	2.5 ppm
Total hardness as $CaCO_3$	4.1 - 4.9 ppm	4.6 ppm
pH	6.1 - 6.2	6.2
Color (Hazen units)	5 - 10	-
Total organic carbon	-	6.0 ppm
Turbidity (Units)	0.18 - 0.30	0.25
Sp. conductance, micromhos at 25°C	34.3 - 41.2	37.0
Total dissolved solids	31.7 - 36.7 ppm	33.7 ppm
Calcium (Ca)	0.9 - 1.0 ppm	1.0 ppm
Magnesium (Mg)	-	0.6 ppm
Sodium (Na)	3.5 - 3.6 ppm	3.6 ppm
Potassium (K)	-	0.3 ppm
Sulphate (SO_4)	2.1 - 2.5 ppm	2.4 ppm
Chloride (Cl)	5.6 - 6.1 ppm	5.8 ppm
Phosphate (PO_4) Total	0.003 - 0.01 ppm	0.006 ppm
Dissolved	0.003 - 0.005 ppm	0.004 ppm
Bicarbonate (HCO_3)	2.8 - 3.3 ppm	3.1 ppm
Nitrate (NO_3)	0.020 - 0.095 ppm	0.052 ppm
Silica (SiO_2)	-	0.8 ppm
Sum of constituents	-	15.8 ppm

c. Morphoedaphic Index and Lake Productivity. The amount of dissolved nutrients (T.D.S.) and the mean depth of a lake are the two major factors affecting the amount of fish a lake can produce or yield. The total dissolved solids of Grand Pond water ranges from 31.7 to 36.7 ppm. with a mean of 33.7 ppm. The mean depth of the lake is 12.7 feet.

The T.D.S. of lake water divided by the mean depth gives the morphoedaphic index of productivity of that lake, for Grand Pond this index is 2.65. The estimated potential production (yield) of a lake is approximately twice the square root of this index; for Grand Pond the figure is calculated to be 3.26 pounds per acre per year or 1,667 pounds annually. Generally, lakes in this geographic area have an annual production of approximately 2-4 pounds per acre.

B. Fish Species Present

Four species of fish inhabit Grand Pond and its drainage systems. Only two of the species are of sport fishing value and these include the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815, and the landlocked Atlantic salmon (ouananiche), Salmo salar Linnaeus 1758. Brook trout are the dominant species in terms of number, however, ouananiche attain greater sizes on the average. The threespine stickleback, Gasterosteus aculeatus Linnaeus 1758, is generally distributed throughout the lake in large numbers and is an important forage species. The American eel, Anguilla rostrata (Le Sueur) 1817 is also a resident of the lake, however, the extent of the population is unknown.

C. Age and Size Composition of the Sport Species

1. Brook Trout

The oldest and largest brook trout observed during the survey on Grand Pond was VI^{+} years of age with a fork length of 41.5 centimeters.

The age-length distribution of 797 brook trout sampled at Grand Pond during July, 1972, is given in Table III.

2. Ouananiche

A ouananiche 45.2 cm. fork length and VIII^{+} years of age was the largest specimen captured during the course of the study, however, a X^{+} years of age fish of 43.1 cm. fork length was the oldest recorded.

Table IV shows the age-length distribution of 329 ouananiche examined at Grand Pond during July, 1972.

D. Growth Rates of the Sport Species

The growth rates of brook trout and ouananiche were determined through the method of back-calculation.

1. Brook Trout

The Monastyrsky method of back-calculation was chosen to

Table III. Age-length distribution of brook trout taken in gill nets and live traps during July, 1972, in Grand Pond

Fork length (cm.) (Class mark)	Age-class							
	0^+	I^+	II^+	III^+	IV^+	V^+	VI^+	Total
4.55	1(100.0)	-	-	-	-	-	-	1(0.1)
6.55	4(66.7)	2(33.3)	-	-	-	-	-	6(0.8)
8.55	5(22.7)	17(77.3)	-	-	-	-	-	22(2.8)
10.55	-	237(91.9)	21(8.1)	-	-	-	-	258(32.4)
12.55	-	95(29.3)	229(70.7)	-	-	-	-	324(40.7)
14.55	-	8(9.0)	81(91.0)	-	-	-	-	89(11.2)
16.55	-	-	29(74.4)	10(25.6)	-	-	-	39(4.9)
18.55	-	-	15(42.9)	20(57.1)	-	-	-	35(4.4)
20.55	-	-	1(10.0)	8(80.0)	1(10.0)	-	-	10(1.3)
22.55	-	-	-	5(100.0)	-	-	-	5(0.6)
24.55	-	-	-	-	1(100.0)	-	-	1(0.1)
26.55	-	-	-	-	2(100.0)	-	-	2(0.3)
28.55	-	-	-	1(50.0)	1(50.0)	-	-	2(0.3)
32.55	-	-	-	-	-	1(100.0)	-	1(0.1)
36.55	-	-	-	-		1(100.0)	-	1(0.1)
40.55	-	-	-	-	-	-	1(100.0)	1(0.1)
Total	10	359	376	44	4	2	1	797

Table IV. Age-length distribution of ouananiche taken in trap nets and gill nets during July, 1972, in Grand Pond

Fork length (cm.) (Class mark)	Age-class										
	I+	II+	III+	IV+	V+	VI+	VII+	VIII+	IX+	X+	Total
4.55	2(100.0)	-	-	-	-	-	-	-	-	-	2(0.6)
6.55	8(45.5)	9(54.5)	-	-	-	-	-	-	-	-	17(5.2)
8.55	-	46(100.0)	-	-	-	-	-	-	-	-	46(14.0)
10.55	-	40(88.9)	5(11.1)	-	-	-	-	-	-	-	45(13.7)
12.55	-	12(40.0)	18(60.0)	-	-	-	-	-	-	-	30(9.2)
14.55	-	7(21.7)	16(52.2)	5(17.4)	2(11.3)	-	-	-	-	-	30(9.2)
16.55	-	3(11.8)	11(41.2)	8(29.4)	4(17.6)	-	-	-	-	-	26(7.9)
18.55	-	1(3.8)	11(30.8)	13(38.5)	9(26.9)	-	-	-	-	-	34(10.3)
20.55	-	-	8(33.3)	8(33.3)	5(19.0)	3(14.3)	-	-	-	-	24(7.3)
22.55	-	-	-	8(100.0)	-	-	-	-	-	-	8(2.4)
24.55	-	-	-	6(46.2)	5(38.5)	1(7.7)	1(7.7)	-	-	-	13(4.0)
26.55	-	-	-	3(50.0)	2(33.3)	1(16.7)	-	-	-	-	6(1.8)
28.55	-	-	-	1(20.0)	3(60.0)	-	1(20.0)	-	-	-	5(1.5)
30.55	-	-	-	3(50.0)	-	3(50.0)	-	-	-	-	6(1.8)
32.55	-	-	-	-	-	-	1(100.0)	-	-	-	1(0.3)
34.55	-	-	-	1(16.7)	1(16.7)	2(33.3)	1(16.7)	-	1(16.7)	-	6(1.8)
36.55	-	-	-	-	1(14.3)	2(28.6)	2(28.6)	1(14.3)	1(14.3)	-	7(2.1)
38.55	-	-	-	-	-	1(9.1)	5(45.5)	3(27.3)	-	2(18.2)	11(3.3)
40.55	-	-	-	-	-	-	4(80.0)	-	1(20.0)	-	5(1.5)
42.55	-	-	-	-	-	-	1(20.0)	1(20.0)	2(40.0)	1(20.0)	5(1.5)
44.55	-	-	-	-	-	1(50.0)	-	1(50.0)	-	-	2(0.6)
Total	10	118	69	56	32	14	16	6	5	3	329

determine the growth rate of Grand Pond brook trout.

From paired observations of fish length and scale length, a log-log regression was calculated and is as follows:

$$\text{Log } L_f = 1.2822 \text{ Log } L_s + 0.7967$$

$$\text{or} \quad L_f = 6.262\ L_s^{1.2822}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table V.

Table V. Actual scale length (x43) and calculated fish length at annulus formation of Grand Pond brook trout

Annulus	I	II	III	IV	V	VI
Scale length (x43)	0.96	1.73	2.51	3.19	3.76	4.20
Fish fork length (cm.)	5.9	12.7	20.4	27.7	34.4	39.4
Fish fork length (in.)	2.3	5.0	8.0	10.9	13.5	15.5

Generally, the growth rate of Grand Pond brook trout is considerably faster than the mean growth rate of brook trout from other Avalon Peninsula populations, and in fact, is the fastest growth rate exhibited to date for a brook trout population in an Avalon Peninsula lake.

2. Ouananiche

The Lee, or direct proportion, method of back-calculation was used to determine the growth rate of Grand Pond ouananiche.

From paired data on fish length and scale length, a least squares regression was calculated and is as follows:

$$L_f = 3.06\ L_s + 1.51$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VI.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Grand Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII	VIII	IX	X
Scale length (x43)	1.13	2.50	3.88	5.35	6.54	8.21	9.74	11.01	12.08	13.73
Fish fork length (cm.)	5.0	9.2	13.4	17.9	21.5	26.6	31.3	35.2	38.5	43.5
Fish fork length (in.)	2.0	3.6	5.3	7.1	8.5	10.5	12.3	13.9	15.2	17.1

Generally, the growth rate of Grand Pond ouananiche is slightly faster than the mean growth rate of ouananiche from other Avalon Peninsula populations.

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 72 brook trout taken in Grand Pond during July, 1972, is given in Table VII. Generally. the trout in this lake are predominantly insectivorous at the smaller sizes but become more piscivorous as they become larger, utilizing sticklebacks as forage.

Table VII. The food habits of Grand Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents		
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish
15.55	9	10(100.0)	-
19.55	12	28(100.0)	-
23.55	3	3(100.0)	-
27.55	3	1(100.0)	-
31.55	-	1(100.0)	-
35.55	-	-	1(100.0)
39.55	-	-	1(100.0)
Total	27	43	2

*Sticklebacks

2. Ouananiche

Table VIII illustrates the results of the analysis of the food habits of 59 ouananiche captured in Grand Pond during July, 1972. Generally, ouananiche in this lake are similar to the brook trout in their food habits; they are insectivorous during the early years of life relying on zooplankton, benthos, and terrestrial invertebrates. Older and larger fish rely more heavily on a diet of sticklebacks.

Table VIII. The food habits of Grand Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents				
	Empty	Zooplankton	Benthic and/or Terr. Invert.	*Fish and Benthic and/or Terr. Invert.	*Fish
19.55	8	2(33.3)	4(66.7)	-	-
23.55	7	1(11.1)	3(33.3)	1(11.1)	4(44.4)
27.55	2	-	2(28.6)	-	5(71.4)
31.55	3	-	-	-	1(100.0)
35.55	-	-	-	-	8(100.0)
39.55	2	-	-	-	4(100.0)
53.55	1	-	-	-	1(100.0)
Total	23	3	9	1	23

*Sticklebacks

SNOWS POND

A. Limnology

1. Location

Snows Pond is situated at 47°28' North Latitude and 53°24' West Longitude. It lies approximately 46 miles south-west of the city of St. John's just off the Trans Canada Highway. Snows Pond has an elevation of approximately 215 feet above sea level.

2. Uses

a. Industrial. At this point in time the waters of Snows Pond have no industrial use.

b. Recreational. At present, Snows Pond experiences a light fishing pressure on its resident salmonid species, as well as a very light fishery for anadromous Atlantic salmon, which are occasionally taken in the scheduled waters of the lake's outlet. In addition to angling, other recreational activities on the lake include a moderate amount of boating, swimming, and picnicing and lesser amounts of waterfowl hunting and camping. Some rabbit and ptarmigan hunting is carried on in proximity to Snows Pond. There is presently a modest summer cabin development on Snows Pond consisting of some 10-15 units. This development is, for the most part, confined to the north basin which is accessible by road from Clarkes Beach.

3. Characteristics of the Drainage Area

Snows Pond empties into Conception Bay via The Pond that Feeds the Brook and North River. The drainage area of the lake occupies 8.2 square miles; of this total drainage area, 3.0 square miles are in standing water. One major drainage system and eight minor systems contribute their drainage to Snows Pond.

The drainage area of Snows Pond lies at an altitude ranging from approximately 215 to 575 feet above sea level. The terrain is about equally divided between climax forest of fir and spruce and barrens. Historically, there has been considerable logging activity within the boundary of the drainage area. There is also some farm land within the drainage area.

The drainage area of Snows Pond lies in a region of Precambrian sedimentary and volcanic rocks. Most of the strata in the area are of sedimentary origin and have been classified as belonging to the Hodgewater Group. The drainage basin contains Hadrynian siltstone, arkose, conglomerate, slate, and acidic to intermediate volcanic rocks (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. Bathymetric maps of Snows Pond North and South (the two basins of the lake) are presented in Figures 1 and 2, and the morphometric parameters of the two basins are given in Tables I and II.

Snows Pond is fairly irregular in shape as evidenced by shore development indices of 2.73 and 2.69 for the South and North basins respectively. The shores of the lake are rather gently sloped and the mean depth of the two basins combined is only 9.9 feet. The maximum

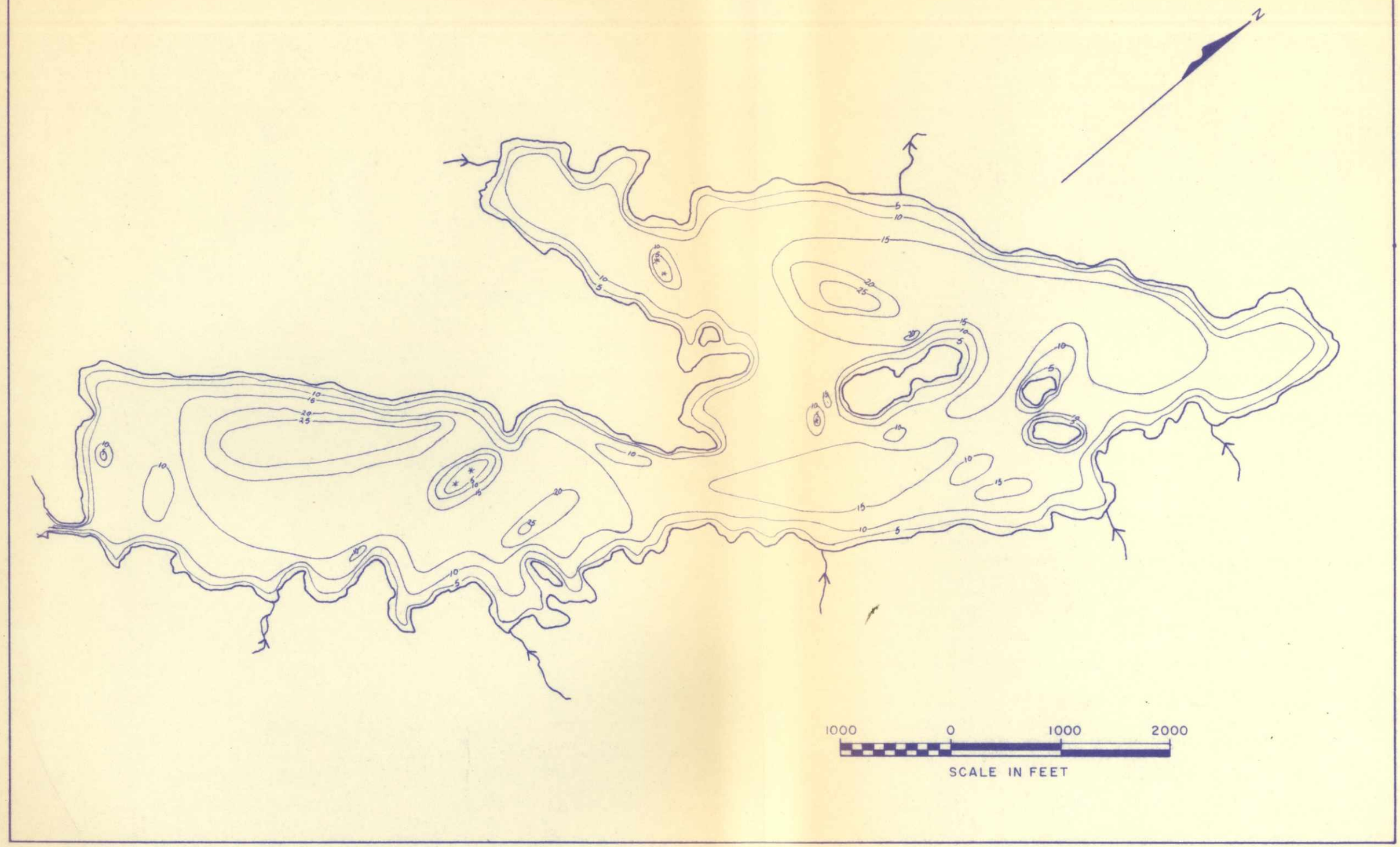


FIGURE 2. BATHYMETRIC MAP OF SNOWS POND (NORTH)

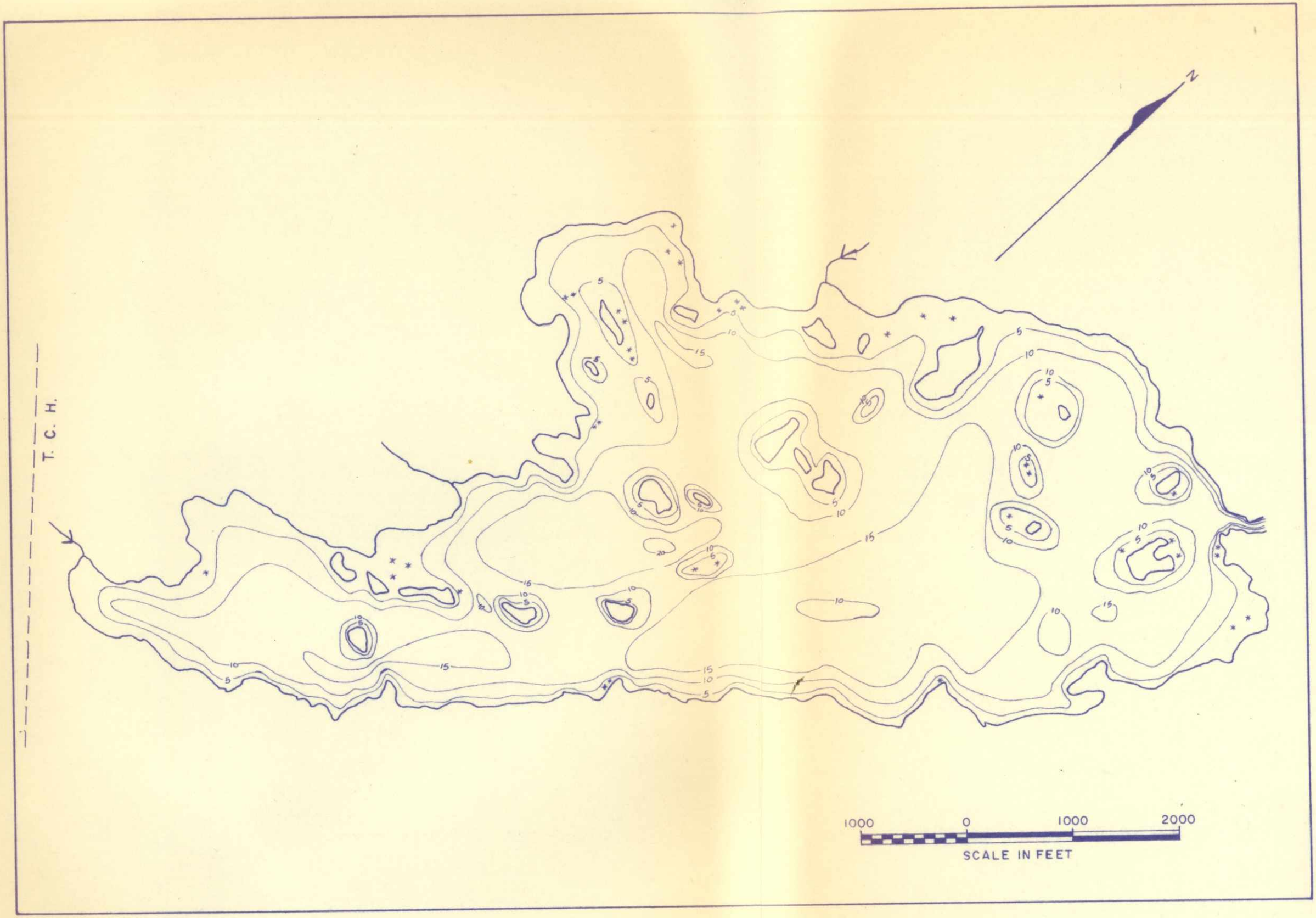


FIGURE 1. BATHYMETRIC MAP OF SNOWS POND (SOUTH)

Table I. Morphometry of Snows Pond (South)

Area, including islands (acres) 707.0 (ha.) 286.2	Area, excluding islands (acres) 681.0 (ha.) 275.7
Maximum length (mi.) 2.1 (km.) 3.4	Maximum effective length (mi.) 1.9 (km.) 3.0
Maximum width (mi.) 0.9 (km.) 1.4	Maximum effective width (mi.) 0.9 (km.) 1.4
Mean width (mi.) 0.3 (km.) 0.4	Volume (cu.ft.) 2.88×10^8 (cu. m.) 8.16×10^6
Maximum depth (ft.) 23.0 (m.) 7.0	Mean depth (ft.) 9.4 (m.) 2.9
Mean depth - maximum depth ratio 0.41	Volume development 1.23
Perimeter, including islands (mi.) 10.2 (km.) 16.3	Perimeter, excluding islands (mi.) 6.8 (km.) 10.9
Shore development, including islands 2.73	Shore development, excluding islands 1.85

Direction of Major Axes NE-SW

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	5,838,300	134	19.7
5-10	6,787,500	156	22.9
10-15	15,213,800	349	51.2
15-20	1,803,400	41	6.0
over 20	40,100	1	0.2
Total	2.97×10^7	681	

Table II. Morphometry of Snows Pond (North)

Area, including islands (acres) 563.0 (ha.) 227.9	Area, excluding islands (acres) 550.0 (ha.) 222.7
Maximum length (mi.) 2.1 (km.) 3.4	Maximum effective length (mi.) 2.1 (km.) 3.4
Maximum width (mi.) 0.6 (km.) 1.0	Maximum effective width (mi.) 0.6 (km.) 1.0
Mean width (mi.) 0.2 (km.) 0.4	Volume (cu.ft.) 3.07×10^8 (cu. m.) 8.69×10^6
Maximum depth (ft.) 27.0 (m.) 8.2	Mean depth (ft.) 12.5 (m.) 3.8
Mean depth - maximum depth ratio 0.46	Volume development 1.38
Perimeter, including islands (mi.) 8.9 (km.) 14.4	Perimeter, excluding islands (mi.) 7.8 (km.) 12.5
Shore development, including islands 2.69	Shore development, excluding islands 2.37

Direction of Major Axes SW-NE

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	2,918,500	67	12.2
5-10	3,503,500	80	14.6
10-15	9,057,400	208	37.8
15-20	6,936,100	159	28.9
20-25	875,100	20	3.6
Over 25	694,300	16	2.9
Total	2.40×10^7	550	

depth of Snows Pond is 27 feet. Approximately 97 percent of the lake area is included in the 0-20 feet range of depth. This depth range is generally accepted by limnologists as accounting for most of the fish production in a lake. Snows Pond appears, on the basis of its morphometry, to be a very productive fish habitat.

b. Surface Water Chemistry. The analysis of the chemical constituents of the surface water of Snows Pond appears in Table III.

Table III. Analysis of surface water of Snows Pond (samples collected August, 1970

	Range	Mean
Alkalinity as $CaCO_3$	2.2 - 2.4 ppm	2.3 ppm
Total hardness as $CaCO_3$	2.5 - 2.7 ppm	2.6 ppm
pH	5.8 - 6.5	6.1
Color (Hazen units)	20 - 40	-
Oxygen consumed ($KMnO_4$)	6.0 - 8.3 ppm	7.0 ppm
Turbidity (units)	1.40 - 1.70	-
Sp. conductance, micromhos at 25°C	27.0 - 29.8	28.4
Total dissolved solids	26.5 - 28.5 ppm	27.5 ppm
Calcium (Ca)	-	1.0 ppm
Magnesium (Mg)	-	0.6 ppm
Sodium (Na)	3.5 - 3.7 ppm	3.6 ppm
Potassium (K)	0.3 - 0.4 ppm	0.3 ppm
Sulphate (SO_4)	2.4 - 2.9 ppm	2.7 ppm
Chloride (Cl)	5.6 - 5.9 ppm	5.8 ppm
Phosphate (PO_4) Total	0.02 - 0.03 ppm	0.02 ppm
Dissolved	0.02 - 0.03 ppm	0.02 ppm
Bicarbonate (HCO_3)	2.7 - 2.9 ppm	2.8 ppm
Nitrate (NO_3)	-	0.00 ppm
Silica (SiO_2)	0.2 - 0.5 ppm	0.0 ppm
Sum of constituents	15.3 - 16.4 ppm	15.7 ppm

The mineral content of Snows Pond is considerably lower than the average for lakes on the Avalon Peninsula. The mean T.D.S. value of Snows Pond water is 27.5 ppm. while the average for a number of lakes in this geographic area is approximately 30 ppm. Generally, then, it would appear that the waters of this lake are somewhat less nutrient-rich than the average for Avalon Peninsula lakes.

c. Morphoedaphic Index and Lake Productivity. The mineral content of lake water and the morphometry of the lake are of prime importance in determining the amount of fish a lake can produce. As

we have just seen, the morphometry of Snows Pond is considered to be quite conducive to good levels of sport fish production. The mineral content of natural waters is generally expressed as the specific conductance or total dissolved solids. The mineral content (total dissolved solids) of Snows Pond ranges from 26.5 to 28.5 ppm, with a mean of 27.5 ppm, which we have already stated is somewhat lower than average for the Avalon Peninsula area. Thus we see that although the morphometry of this lake is conducive to good levels of fish production, below average water fertility tends to depress the favourable effects of morphometry and results in an overall lower level of fish production. Combining the data on water fertility with morphometric data (T.D.S. ÷ mean depth), we calculate the morphoedaphic index for Snows Pond to be 2.78. The potential fish yield of a lake is approximately twice the square root of the morphoedaphic index. Snows Pond has a potential annual maximum sustained yield of 3.33 pounds per acre or a total of 4,166 pounds. This yield is somewhat higher than the average for lakes on the Avalon Peninsula, which is approximately 3 pounds per acre per year.

B. Fish Species Present

Snows Pond and its drainage systems contain four fish species all of which are native to Newfoundland. Only two of the species are of recreational value and include the landlocked and anadromous forms of the Atlantic salmon, Salmo salar Linnaeus 1758, and the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815. The brook trout is the slightly dominant sport species in terms of numbers, however, the salmon (resident and anadromous forms) is larger, on the average, than the trout. Anadromous salmon (grilse) are taken in the lake infrequently. The threespine stickleback, Gasterosteus aculeatus Linnaeus 1758 occurs in the lake in large numbers and is generally distributed. The American eel, Anguilla rostrata (Le Sueur) 1817 is prevalent in Snows Pond, however, extensive information on the status of the population is not available.

C. Age and Size Composition of the Sport Species.

1. Brook Trout

The oldest brook trout observed during the survey on Snows Pond was VII^{+} years of age and had a fork length of 34.9 centimeters. The largest brook trout captured, however, was 37.0 centimeters in fork length and was V^{+} years of age.

Table IV shows the age-length distribution of 163 brook trout sampled at Snows Pond during July and August, 1970.

2. Ouananiche

A ouananiche IX^{+} years of age with a fork length of 42.5 cm.

Table IV. Age-length distribution of brook trout taken in gill nets during July and August, 1970, in Snows Pond

Fork length (cm.) (Class mark)	Age-class						
	II+	III+	IV+	V+	VI+	VII+	Total
14.55	1(100.0)	-	-	-	-	-	1(0.6)
16.55	9(52.9)	8(47.1)	-	-	-	-	17(10.4)
18.55	-	42(91.5)	4(8.5)	-	-	-	47(28.8)
20.55	-	9(26.5)	25(73.5)	-	-	-	34(20.9)
22.55	-	1(4.8)	19(90.5)	1(4.7)	-	-	21(12.9)
24.55	-	-	17(81.0)	3(14.3)	1(4.7)	-	21(12.9)
26.55	-	-	8(66.7)	4(33.3)	-	-	12(7.4)
28.55	-	-	1(25.0)	3(75.0)	-	-	4(2.5)
30.55	-	-	-	1(100.0)	-	-	1(0.6)
32.55	-	-	-	2(66.7)	1(33.3)	-	3(1.8)
34.55	-	-	-	-	-	1(100.0)	1(0.6)
36.55	-	-	-	1(100.0)	-	-	1(0.6)
Total	10	61	74	15	2	1	163

was the oldest observed during the study, however, a fish having a fork length of 46.1 cm. and VII+ years of age was the largest observed.

Table V shows the age-length distribution of 122 ouananiche sampled at Snows Pond during July and August, 1970.

3. Anadromous Salmon

Although only two anadromous salmon were taken in Snows Pond during the study, available information suggests that the run entering the lake is composed entirely of grilse ranging from 2 to 4 pounds in weight and these fish are either 3:1, + or 4:1, + years of age.

Table VI presents the age and size data on the two fish captured during the 1970 study.

Table V. Age-length distribution of ouananiche taken in gill nets during July and August, 1970 in Snows Pond

Fork length (cm.) (Class mark)	Age-class							
	III+	IV+	V+	VI+	VII+	VIII+	IX+	Total
14.55	1(33.3)	2(66.7)	-	-	-	-	-	3(2.5)
16.55	1(16.7)	4(66.7)	1(16.6)	-	-	-	-	6(4.9)
18.55	1(5.0)	8(40.0)	8(40.0)	3(15.0)	-	-	-	20(16.4)
20.55	1(4.5)	4(18.2)	8(36.4)	9(40.9)	-	-	-	22(18.0)
22.55	-	3(11.5)	8(30.8)	12(46.2)	3(11.5)	-	-	26(21.3)
24.55	-	2(10.0)	9(45.0)	6(30.0)	3(15.0)	-	-	20(16.4)
26.55	-	-	3(50.0)	3(50.0)	-	-	-	6(4.9)
28.55	-	-	-	2(100.0)	-	-	-	2(1.6)
30.55	-	-	1(25.0)	2(50.0)	1(25.0)	-	-	4(3.3)
32.55	-	-	-	1(50.0)	1(50.0)	-	-	2(1.6)
34.55	-	-	-	1(100.0)	-	-	-	1(0.8)
36.55	-	-	-	2(66.7)	1(33.3)	-	-	3(2.5)
38.55	-	-	1(25.0)	-	2(50.0)	1(25.0)	-	4(3.3)
40.55	-	-	-	-	-	-	-	-
42.55	-	-	-	1(50.0)	-	-	1(50.0)	2(1.6)
44.55	-	-	-	-	-	-	-	-
46.55	-	-	-	-	1(100.0)	-	-	1(0.8)
Total	4	23	39	42	12	1	1	122

Table VI. Age and Size of two anadromous salmon taken in gill nets during July and August, 1970, in Snows Pond

Fork length (cm.)	Weight (gm. and lb.)	Age (years)
47.1	1044 gm. 2.3 lb.	3:1 +
47.6	1135 gm. 2.5 lb.	4:1 +

D. Growth Rates of the Sport Species

The growth rate of Snows Pond brook trout and ouananiche were determined through the method of back-calculation.

1. Brook Trout

Using the Monastyrsky method of back-calculation, from paired data on fish length and scale length, a log-log regression was calculated and is as follows:

$$\text{Log } L_f = 1.1879 \text{ Log } L_s + 0.7948$$

$$\text{or} \quad L_f = 6.234\ L_s^{1.1879}$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VII.

Table VII. Actual scale length (x43) and calculated fish length at annulus formation of Snows Pond brook trout

Annulus	I	II	III	IV	V	VI	VII
Scale length (x43)	0.76	1.37	1.99	2.59	3.23	3.80	4.30
Fish fork length (cm.)	4.5	9.1	14.1	19.3	25.1	30.8	35.3
Fish fork length (in.)	1.8	3.6	5.6	7.6	10.0	12.1	13.9

Generally, the growth rate of Snows Pond brook trout during the first five years of life is somewhat slower than the mean growth rate of fish from the Avalon Peninsula lakes, however, the rate of growth in later years is comparable or even slightly faster than average.

2. Ouananiche

The Lee method of back-calculation was used to determine the growth rate of Snows Pond ouananiche. From paired observations of fish length and scale length, a least squares regression was calculated and is as follows:

$$L_f = 3.52\ L_s + 0.80$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VIII.

Table VIII. Actual scale length (x43) and calculated fish length at annulus formation of Snows Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII	VIII	IX
Scale length (x43)	0.88	1.81	3.03	4.22	5.34	6.36	8.44	10.70	12.30
Fish fork length (cm.)	3.9	7.2	11.5	15.7	19.6	23.2	30.5	38.5	44.1
Fish fork length (in.)	1.5	2.8	4.5	6.2	7.7	9.1	12.0	15.2	17.4

The growth rate exhibited by Snows Pond ouananiche is generally substantially slower than the mean growth rate of fish from other Avalon Peninsula lakes.

E. Food Habits of the Sport Species

1. Brook Trout

The result of the analysis of the food habits of 153 brook trout taken in Snows Pond during July and August, 1970, is given in Table IX. Generally, it appears that brook trout in Snows Pond are mainly insectivorous at the smaller sizes but become more or less piscivorous as they become larger, relying to a large extent on sticklebacks as forage.

2. Ouananiche

Table X shows the result of the analysis of the food habits of 113 ouananiche taken in Snows Pond during July and August, 1970. Generally, the food habits of ouananiche in Snows Pond are similar to those of the brook trout in that the smaller fish are predominantly insectivorous while the larger individuals are mainly piscivorous.

3. Anadromous Salmon

Both salmon captured in Snows Pond did not have any food in their stomachs. It is a general rule that anadromous salmon cease feeding upon entering fresh water.

Table IX. The food habits of Snows Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terr. Inverts.	*Fish and Benthic Terr. Inverts.	*Fish
15.55	4	14(100.0)	-	-
19.55	25	49(96.1)	-	2(3.9)
23.55	12	24(82.8)	1(3.4)	4(13.8)
27.55	4	5(50.0)	1(10.0)	4(40.0)
31.55	1	-	-	2(100.0)
35.55	1	-	-	-
Total	47	92	2	12

*Sticklebacks

Table X. The food habits of Snows Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrest. Inverts.	*Fish and Benthic Terrest. Inverts.	*Fish
15.55	1	6(85.7)	-	1(14.3)
19.55	5	32(100.0)	-	-
23.55	15	23(76.7)	3(10.0)	4(13.3)
27.55	3	1(16.7)	-	5(83.3)
31.55	-	-	1(25.0)	3(75.0)
35.55	2	-	1(50.0)	1(50.0)
39.55	2	-	-	1(100.0)
43.55	1	-	-	1(100.0)
47.55	1	-	-	-
Total	30	62	5	16

*Sticklebacks

GOOSE POND

A. Limnology

1. Location

Goose Pond is situated at 47°26' North Latitude and 53°31' West Longitude. It lies approximately 50 miles south-west of the city of St. John's at the junction of the old Whitbourne Road and the Trans Canada Highway. Goose Pond has an elevation of approximately 220 feet above sea level.

2. Uses

a. Industrial. At the present time the waters of Goose Pond have no industrial use.

b. Recreational. At present, Goose Pond experiences a light fishing pressure on its resident salmonid fish stocks. In addition to angling, other recreational activities on the lake include a small amount of boating, swimming, picnicing, and waterfowl hunting. There is a limited amount of small game hunting for rabbits and grouse carried on in proximity to Goose Pond. There is presently a modest summer cabin development, consisting of three units, located on Goose Pond.

3. Characteristics of the Drainage Area

Goose Pond empties into Trinity Bay via Dildo Pond and Dildo Brook. The drainage area of the lake occupies 1.2 square miles of which 0.5 square miles are in standing water. Only intermittent surface drainage contributes to Goose Pond waters; there are no drainage systems per se. Most of the water in this lake originates as ground water.

The drainage area lies at an altitude ranging from approximately 220 to 275 feet above sea level. The terrain is almost entirely a climax forest of fir and spruce; there is, however, some barren land within the area. Historically, there has been considerable logging activity within the boundary of the drainage area and there was limited farming conducted as well.

The drainage area of Goose Pond lies in a region of Precambrian sedimentary and volcanic rocks. Most of the strata in the area are of sedimentary origin and have been classified as belonging to the Hodgewater Group. The drainage basin contains Hadrynian siltstone, arkose, conglomerate, slate, and acidic to intermediate volcanic rocks (Geological Survey of Canada, Map 1231A, 1967).

4. Physical and Chemical Environment

a. Morphometry. A map of the underwater topography of Goose Pond is presented in Figure 1, and the morphometric parameters are given in Table I.

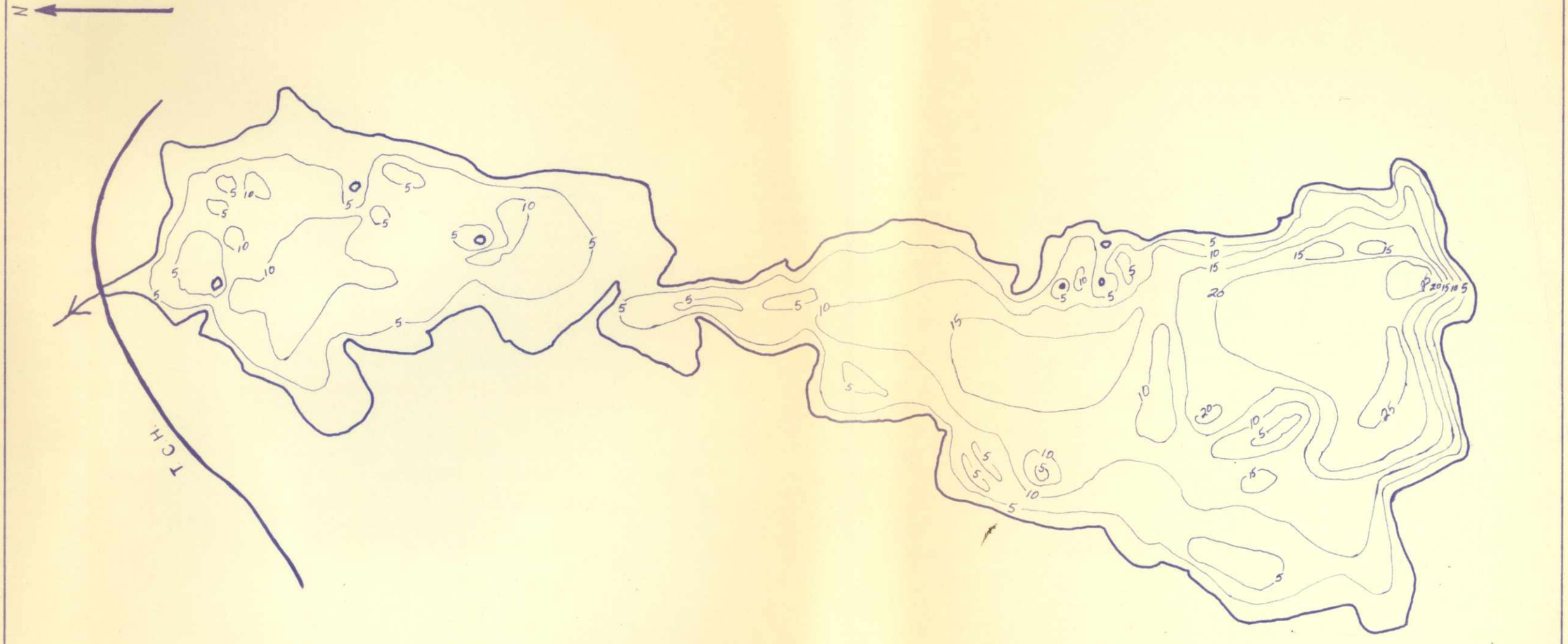


FIGURE I. BATHYMETRIC MAP OF GOOSE POND

Table I. Morphometry of Goose Pond

Area, including islands (acres) 319.1 (ha.) 129.1	Area, excluding islands (acres) 318.0 (ha.) 128.7
Maximum length (mi.) 1.7 (km.) 2.7	Maximum effective length (mi.) 1.7 (km.) 2.7
Maximum width (mi.) 0.6 (km.) 1.0	Maximum effective width (mi.) 0.6 (km.) 1.0
Mean width (mi.) 0.3 (km.) 0.5	Volume (cu.ft.) 1.33×10^8 (cu. m.) 3.77×10^6
Maximum depth (ft.) 26.0 (m.) 7.9	Mean depth (ft.) 9.6 (m.) 2.9
Mean depth-maximum depth ratio 0.37	Volume development 1.11
Perimeter, including islands (mi.) 5.5 (km.) 8.9	Perimeter, excluding islands (mi.) 5.3 (km.) 8.5
Shore development, including islands 2.19	Shore development, excluding islands 2.13
Direction of Major Axes N-S	

Depth (ft.)	Area $(ft.)^2$	Area (acres)	%
0-5	3,760,000	86.4	27.2
5-10	4,620,000	106.0	33.3
10-15	2,840,000	65.3	20.5
15-20	1,310,000	30.1	9.5
20-25	1,160,000	26.6	8.4
Over 25	160,000	3.6	1.1
Total	1.39×10^7	318.0	

Goose Pond appears to be a fairly productive trout lake in terms of its morphometry. Its shoreline is fairly irregular as indicated by a shore development index of 2.19; the shores of Goose Pond are fairly

gently sloped and the maximum depth is only 26 feet. The mean depth of the lake is 9.6 feet. Approximately 90 percent of the lake area is included in the 0-20 feet depth range. This depth range is generally accepted by limnologists as having the most potential for fish production in lakes.

b. Surface Water Chemistry. The analysis of the surface water of Goose Pond appears in Table II.

Table II. Analysis of surface water of Goose Pond (samples collected August, 1972)

	Range	Mean
Alkalinity as $CaCO_3$	2.7 - 4.1 ppm	3.6 ppm
Total hardness as $CaCO_3$	6.1 - 6.4 ppm	6.3 ppm
pH	6.4 - 6.5	6.5
Color (Hazen units)	5 - 10	-
Turbidity (units)	0.10 - 0.16	0.12
Sp. conductance, micromhos at 25°C	36.4 - 41.2	39.2
Total dissolved solids	33.2 - 36.7 ppm	35.2 ppm
Calcium (Ca)	1.3 - 1.4 ppm	1.3 ppm
Magnesium (Mg)	0.7 - 0.8 ppm	0.7 ppm
Sodium (Na)	3.5 - 4.1 ppm	3.8 ppm
Potassium (K)	0.25 - 0.35 ppm	0.30 ppm
Sulphate (SO_4)	1.5 - 2.6 ppm	2.1 ppm
Chloride (Cl)	5.8 - 7.3 ppm	6.7 ppm
Phosphate (PO_4) Total	0.003 - 0.010 ppm	0.005 ppm
Dissolved	-	0.003 ppm
Bicarbonate (HCO_3)	3.3 - 5.0 ppm	4.4 ppm
Nitrate (NO_3)	0.015 - 0.020 ppm	0.018 ppm
Silica (SiO_2)	0.3 - 0.7 ppm	0.5 ppm
Sum of constitients	16.3 - 18.7 ppm	17.8 ppm

Goose Pond has soft water, as do all lakes in eastern Newfoundland, however, the waters of Goose Pond are considerably harder than the average for the Avalon Peninsula. The concentration of nutrients is considerably higher than usual and this is reflected in better-than-average values for alkalinity, total hardness, pH and specific conductance.

c. Morphoedaphic Index and Lake Productivity. The most important factors determining the amount of fish a lake can produce or yield are the mineral content of the water and the morphometry of the lake itself. As we have already stated, the physical features

of Goose Pond appear to be conducive to good fish production. The better-than-average mineral content (total dissolved solids) of the lake also is conducive to good levels of fish production. Therefore, we would expect the potential production of sport fish to be somewhat higher than average in Goose Pond. In fact, the morphoedaphic index (T.D.S. ÷ mean depth) of Goose Pond is calculated to be 3.67 which means the potential yield of fish from this lake is 3.83 pounds per acre per year. The average for lakes investigated to date on the Avalon Peninsula is approximately 3 pounds per acre per year. A value of 3.83 for Goose Pond is considerably higher than average and in fact is one of the highest levels of fish production encountered to date. A suggested creel limit or maximum sustained yield for Goose Pond is 1,218 pounds annually.

B. Fish Species Present

Goose Pond contains five fish species all but one of which are native to the waters of Newfoundland. Three of the species are of recreational value and include two native species, the eastern brook trout, Salvelinus fontinalis (Mitchill) 1815, and the landlocked Atlantic salmon (ouananiche), Salmo salar Linnaeus 1758. The third sport fish inhabiting the lake is an introduced species, the brown trout, Salmo trutta Linnaeus 1758. The brown trout is by far the dominant sport species both in terms of number and size, ouananiche are intermediate in terms of size and abundance, while brook trout are present in the lowest number and smallest size. The threespine stickleback Gasterosteus aculeatus Linnaeus 1758 is an important forage species generally distributed throughout the lake in large numbers. The fifth fish species occurring in Goose Pond is Anguilla rostrata (Le Sueur) 1817, the American eel. The eel is one of the larger fish living in the lake and is obviously an important cog in the lake's ecosystem, however, very little is known of its population structure.

C. Age and Size Composition of the Sport Species

1. Brook Trout

The oldest and largest brook trout observed during the survey on Goose Pond was V^+ years of age with a fork length of 29.2 centimeters.

The age-length distribution of 39 brook trout sampled at Goose Pond during August, 1972, is given in Table III.

2. Ouananiche

A ouananiche 40.3 cm. fork length and $VIII^+$ years of age was the largest observed during the Goose Pond study. However, a 40.0 cm. fork length and IX^+ years of age fish was the oldest recorded for Goose Pond.

Table III. Age-length distribution of brook trout taken in gill nets and live traps during August, 1972, in Goose Pond

Fork length (cm.) (Class mark)	Age-class					
	I^+	II^+	III^+	IV^+	V^+	Total
12.55	1(100.0)	-	-	-	-	1(2.6)
14.55	1(100.0)	-	-	-	-	1(2.6)
16.55	-	1(33.3)	2(66.7)	-	-	3(7.7)
18.55	-	8(61.5)	5(38.5)	-	-	13(33.3)
20.55	-	1(11.1)	7(77.8)	1(11.1)	-	9(23.1)
22.55	-	-	7(100.0)	-	-	7(17.9)
24.55	-	-	2(66.7)	1(33.3)	-	3(7.7)
26.55	-	-	-	1(100.0)	-	1(2.6)
28.55	-	-	-	-	1(100.0)	1(2.6)
Total	2	10	23	3	1	39

Table IV shows the age-length distribution of 115 ouananiche sampled at Goose Pond during August, 1972.

3. Brown Trout

A brown trout 59.8 cm. fork length and $XIII^+$ years of age holds the known longevity and size record at Goose Pond.

Table V shows the age-length distribution of 426 brown trout captured at Goose Pond during November, 1971, and August, 1972.

D. Growth Rates of the Sport Species

The principle of back-calculation was applied to determine the rate of growth of brook trout, ouananiche, and brown trout in Goose Pond.

1. Brook Trout

Using the Monastyrsky (or exponential) method of back-calculation,

Table IV. Age-length distribution of ouananiche taken in gill nets and live-traps at Goose Pond during August, 1972

Fork length (cm.) (Class mark)	Age - class								
	II+	III+	IV+	V+	VI+	VII+	VIII+	IX+	Total
8.55	1(100.0)	-	-	-	-	-	-	-	1(0.9)
10.55	7(100.0)	-	-	-	-	-	-	-	7(6.1)
12.55	3(75.0)	1(25.0)	-	-	-	-	-	-	4(3.5)
14.55	1(20.0)	4(80.0)	-	-	-	-	-	-	5(4.3)
16.55	3(18.8)	11(68.7)	2(12.5)	-	-	-	-	-	16(13.9)
18.55	1(7.1)	8(57.2)	5(35.7)	-	-	-	-	-	14(12.2)
20.55	-	2(50.0)	2(50.0)	-	-	-	-	-	4(3.5)
22.55	-	1(9.1)	8(72.7)	2(18.2)	-	-	-	-	11(9.6)
24.55	-	3(11.1)	13(48.2)	10(37.0)	1(3.7)	-	-	-	27(23.5)
26.55	-	2(22.2)	4(44.4)	2(22.2)	1(11.2)	-	-	-	9(7.8)
28.55	-	-	4(40.0)	2(20.0)	4(40.0)	-	-	-	10(8.7)
30.55	-	-	-	-	-	1(100.0)	-	-	1(0.9)
32.55	-	-	-	-	1(100.0)	-	-	-	1(0.9)
34.55	-	-	-	-	-	2(100.0)	-	-	2(1.7)
36.55	-	-	-	-	-	1(100.0)	-	-	1(1.7)
38.55	-	-	-	-	-	-	-	-	-
40.55	-	-	-	-	-	-	1(50.0)	1(50.0)	2(1.7)
Total	16	32	38	16	7	4	1	1	115

Table V. Age length distribution of brown trout taken in gill nets, live-traps, and seine during November, 1971 and August, 1972, in Goose Pond

Fork length (cm.) (Class mark)	Age-class													
	I+	II+	III+	IV+	V+	VI+	VII+	VIII+	IX+	X+	XI+	XII+	XIII+	Total
4.55	1(100.0)	-	-	-	-	-	-	-	-	-	-	-	-	1(0.2)
6.55	2(100.0)	-	-	-	-	-	-	-	-	-	-	-	-	2(0.5)
8.55	1(50.0)	1(50.0)	-	-	-	-	-	-	-	-	-	-	-	2(0.5)
10.55	2(18.2)	9(81.8)	-	-	-	-	-	-	-	-	-	-	-	11(2.6)
12.55	-	20(63.0)	11(37.0)	-	-	-	-	-	-	-	-	-	-	31(7.3)
14.55	-	7(22.7)	21(68.2)	3(9.1)	-	-	-	-	-	-	-	-	-	31(7.3)
16.55	-	1(8.3)	9(75.0)	2(16.7)	-	-	-	-	-	-	-	-	-	12(2.8)
18.55	-	1(12.2)	4(44.4)	4(44.4)	-	-	-	-	-	-	-	-	-	9(2.1)
20.55	-	-	2(16.7)	8(66.6)	2(16.7)	-	-	-	-	-	-	-	-	12(2.8)
22.55	-	-	2(10.5)	3(15.8)	14(73.7)	-	-	-	-	-	-	-	-	19(4.5)
24.55	-	-	-	5(11.6)	23(53.5)	15(34.9)	-	-	-	-	-	-	-	43(10.1)
26.55	-	-	-	2(5.6)	15(41.7)	17(47.1)	2(5.6)	-	-	-	-	-	-	36(8.5)
28.55	-	-	-	1(2.6)	4(10.5)	20(52.6)	11(28.9)	2(5.4)	-	-	-	-	-	38(8.9)
30.55	-	-	-	-	4(14.8)	8(9.6)	10(37.0)	5(18.6)	-	-	-	-	-	27(6.3)
32.55	-	-	-	-	-	8(25.8)	21(67.7)	2(6.5)	-	-	-	-	-	31(7.3)
34.55	-	-	-	-	-	4(26.7)	8(53.3)	2(13.3)	1(6.7)	-	-	-	-	15(3.5)
36.55	-	-	-	-	-	4(30.8)	4(30.8)	5(38.4)	-	-	-	-	-	13(3.1)
38.55	-	-	-	-	-	5(27.8)	3(16.6)	5(27.8)	5(27.8)	-	-	-	-	18(4.2)
40.55	-	-	-	-	-	1(8.3)	3(25.0)	3(25.0)	5(41.7)	-	-	-	-	12(2.8)
42.55	-	-	-	-	-	-	2(16.7)	5(41.7)	4(33.3)	1(8.3)	-	-	-	12(2.8)
44.55	-	-	-	-	-	-	-	5(38.5)	4(30.8)	3(23.1)	1(7.6)	-	-	13(3.1)
46.55	-	-	-	-	-	-	-	3(42.8)	2(28.6)	2(28.6)	-	-	-	7(1.6)
48.55	-	-	-	-	-	-	-	-	-	6(54.5)	3(27.3)	1(9.1)	1(9.1)	11(2.6)
50.55	-	-	-	-	-	-	-	-	-	1(50.0)	1(50.0)	-	-	2(0.5)
52.55	-	-	-	-	-	-	-	-	-	3(50.0)	1(16.7)	1(16.7)	1(16.7)	6(1.4)
54.55	-	-	-	-	-	-	-	-	-	2(33.3)	2(33.3)	1(16.7)	1(16.7)	6(1.4)
56.55	-	-	-	-	-	-	-	-	-	1(25.0)	-	1(25.0)	2(50.0)	4(0.9)
58.55	-	-	-	-	-	-	-	-	-	-	-	1(100.0)	-	1(0.2)
60.55	-	-	-	-	-	-	-	-	-	-	-	-	1(100.0)	1(0.2)
Total	6	39	49	28	62	82	64	37	21	19	8	5	6	426

from paired parameters of fish length and scale length, a log - log regression was calculated; the equation for scale length on fish length is as follows:

$$\text{Log } L_f = 0.8871 \text{ Log } L_s + 0.9460$$

$$\text{or} \quad L_f = 8.830\ L_s^{0.8871}$$

Table VI shows the average scale lengths for each year of life and the corresponding calculated fish lengths.

Generally, the growth rate of Goose Pond brook trout is considerably faster than the mean growth rate of fish from other Avalon Peninsula lakes, and in fact is one of the faster growing populations of those studied to date.

Table VI. Actual scale length (x43) and calculated fish length at annulus formation of Goose Pond brook trout

Annulus	I	II	III	IV	V
Scale length (x43)	0.78	1.61	2.30	2.88	3.60
Fish fork length (cm.)	7.1	13.5	18.5	22.6	27.5
Fish fork length (in.)	2.8	5.3	7.3	8.9	10.8

2. Ouananiche

The Lee method (direct proportion) of back-calculation was used to determine the growth rate of ouananiche. From paired observations of fish length and scale length, a least squares regression equation was calculated and is as follows:

$$L_f = 3.68\ L_s + 1.01$$

The calculated growth rate of Goose Pond ouananiche as determined by back-calculation, is presented in Table VII.

Generally, the growth rate of Goose Pond ouananiche is considerably faster than the mean growth rate of fish from other Avalon Peninsula lakes, and in fact is one of the fastest growing populations of those studied to date.

Table VII. Actual scale length (x43) and calculated fish length at annulus formation of Goose Pond ouananiche

Annulus	I	II	III	IV	V	VI	VII	VIII	IX
Scale length (x43)	1.12	2.87	4.30	5.83	6.75	8.29	9.35	10.10	10.60
Fish fork length (cm.)	5.1	11.2	16.8	22.5	25.9	31.5	35.4	38.2	40.0
Fish fork length (in.)	2.0	4.4	6.6	8.9	10.2	12.4	13.9	15.0	15.8

3. Brown Trout

The Lee method of back-calculation was used to determine the growth rate of brown trout in Goose Pond. From paired data on the variables scale length and fish length, a least squares regression equation was calculated; the equation of scale length on fish length for brown trout in Goose Pond is as follows:

$$L_f = 3.91\ L_s + 1.12$$

The average scale lengths for each year of life and the corresponding calculated fish lengths are given in Table VIII.

Table VIII. Actual scale length (x43) and calculated fish length at annulus formation of Goose Pond brown trout

Annulus	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Scale length (x43)	1.15	2.23	3.58	4.91	6.15	7.29	8.45	9.77	10.75	11.75	12.80	13.75	14.56
Fish fork length (cm.)	5.6	9.9	15.1	20.3	25.2	29.6	34.2	39.3	43.2	47.1	51.2	54.3	57.5
Fish fork length (in.)	2.2	3.9	5.9	8.0	9.9	11.7	13.5	15.5	17.0	18.5	20.2	21.4	22.6

Generally speaking, the growth rate of Goose Pond brown trout is slightly slower than the mean growth rate of brown trout from other Avalon Peninsula lakes, however, Goose Pond produces the largest brown trout of any lake investigated to date.

E. Food Habits of the Sport Species

1. Brook Trout

Table IX presents the result of the analysis of the food habits of 29 brook trout taken in Goose Pond during August, 1972.

Table IX. The food habits of Goose Pond brook trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic and/or Terr. Inverts.	*Fish
19.55	4	11(84.6)	1(7.7)	1(7.7)
23.55	4	6(100.0)	-	-
27.55	-	1(50.0)	-	1(50.0)
Total	8	18	1	2

*Sticklebacks

From data presented in Table IX, it would appear that brook trout in Goose Pond are predominantly insectivorous, at least at the smaller size, only a small percentage of trout examined were foraging on sticklebacks.

2. Ouananiche

The result of the analysis of the food habits of 76 ouananiche taken in Goose Pond during August, 1972, is presented in Table X. The data indicate that the smaller and younger fish are relying predominantly on invertebrates as forage while the larger and older individuals are more piscivorous in their food habits utilizing the threespine stickleback as forage.

Table X. The food habits of Goose Pond ouananiche expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents			
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic and/or Terr. Invert.	*Fish
19.55	9	5(100.0)	-	-
23.55	17	19(95.0)	-	1(5.0)
27.55	8	6(60.0)	-	4(40.0)
31.55	-	1(50.0)	-	1(50.0)
35.55	-	-	1(33.3)	2(66.7)
39.55	1	-	-	1(100.0)
Total	35	31	1	9

*Sticklebacks

3. Brown Trout

Table XI shows the result of the analysis of the food habits of 77 brown trout taken in Goose Pond during August, 1972.

Generally speaking, it appears that brown trout in Goose Pond are feeding predominantly on invertebrates at the smaller sizes but vertebrates become a more important dietary item as the fish become larger. In addition to fish, shrews are a fairly common item in the diet of larger brown trout.

Table XI. The food habits of Goose Pond brown trout expressed as frequency of occurrence (percentages in parentheses)

Fork length (cm.) (Class mark)	Stomach contents				
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic and/or Terr. Inverts.	*Fish	**Other
19.55	-	3(100.0)	-	-	-
23.55	7	3(75.0)	-	1(25.0)	-
27.55	4	8(80.0)	-	1(10.0)	1(10.0)

Table XI. (Cont'd)

Fork length (cm.) (Class mark)	Stomach contents				
	Empty	Benthic and/or Terrestrial Invertebrates	*Fish and Benthic and/or Terr. Inverts.	*Fish	**Other
31.55	4	5(83.3)	1(16.7)	-	-
35.55	5	4(80.0)	-	1(10.0)	-
39.55	4	5(55.6)	1(11.1)	2(22.2)	1(11.1)
43.44	1	2(33.3)	1(16.7)	3(50.0)	-
47.55	1	-	1(33.3)	1(33.4)	1(33.3)
51.55	-	-	-	-	-
55.55	3	-	-	-	1(100.0)
59.55	1	-	-	-	-
Total	30	30	4	9	4

* Sticklebacks, brook trout, ouananiche, and brown trout
** Shrews and invertebrates, or shrews and *fish.

REFERENCES

Geological Survey of Canada, Ottawa, 1967. Map no. 1231A, Geology, Island of Newfoundland.

Ryder, R. A. 1965. A method for estimating the potential fish production of North-Temperate lakes. Trans. Am. Fish. Soc., 94(3): 214-218.

Wiseman, R. J. 1970. The limnology and ecology of Petty Harbour Long Pond: an unfished reservoir. Unpublished office report No. 65, Res. Dev. Br., Dept. of Fisheries and Forestry of Canada, St. John's, Nfld., 70 p.

_____. 1971. The limnology, ecology, and sport fishery of Thomas Pond: a multi-use reservoir. Unpublished office report no. 73, Res. Dev. Br., Fisheries Service, Department of the Environment, St. John's, Nfld., 150 p.

_____. 1972. The limnology, ecology, and sport fishery of Paddys Pond: a heavily fished lake near metropolitan St. John's, Newfoundland. Unpublished office report no. 84, Res. Dev. Br., Fisheries Service, Department of the Environment, St. John's, Nfld., 157 p.

APPENDICES

Table 1. Morphometric, edaphic, and potential fish production (yield) data for selected Avalon Peninsula lakes

Lake	Mean Depth (ft.)	T.D.S.	T.D.S. / Mean Depth	Potential Yield (lb./acre/yr.)	Lake Area (acres)	Potential Yield (lb./yr.)
Petty Hr. Long Pond	21.3	33.8	1.59	2.52	428	1,079
Thomas Pond	13.3	27.0	2.03	2.85	255	727
Paddys Pond	10.4	28.2	2.71	3.29	526	1,731
Gull Pond	14.0	38.8	2.77	3.33	140	466
Loon and Little Soldiers Pond	14.2	26.0	1.83	2.71	167	453
Soldiers Pond	8.8	22.6	2.57	3.21	334	1,072
Finnies Pond	12.5	23.7	1.90	2.76	384	1,060
Five Mile Pond West	7.6	26.4	3.47	3.73	213	795
Big Triangle Pond	9.1	32.7	3.59	3.79	119	451
Southern Peak Pond	13.6	32.4	2.38	3.09	193	596
Southwest Pond	14.8	31.6	2.14	2.93	353	1,034
Harbour Main Pond	10.8	30.8	2.85	3.38	500	1,688
Nine Island Pond South	11.1	29.1	2.62	3.24	203	658
Middle Gull Pond	33.8	25.2	0.75	1.73	757	1,310
Grand Pond	12.7	33.7	2.65	3.26	450	1,467
Snows Pond	9.9	27.5	2.78	3.33	1,251	4,166
Colliers Big Pond	8.5	37.0	4.35	4.17	157	655
Nine Island Pond	20.2	31.3	1.55	2.49	401	998
Goose Pond	9.6	35.2	3.67	3.83	318	1,218
Ocean Pond	15.0	31.6	2.04	2.86	815	2,331
Dildo Pond	32.7	29.1	0.89	1.87	970	1,814
Hogans Pond	16.0	37.3	2.32	3.05	147	448
Mean		30.5	2.43	3.07		

Table 2. Back-calculated growth in fork length (cm.) for brook trout in selected Avalon Peninsula lakes

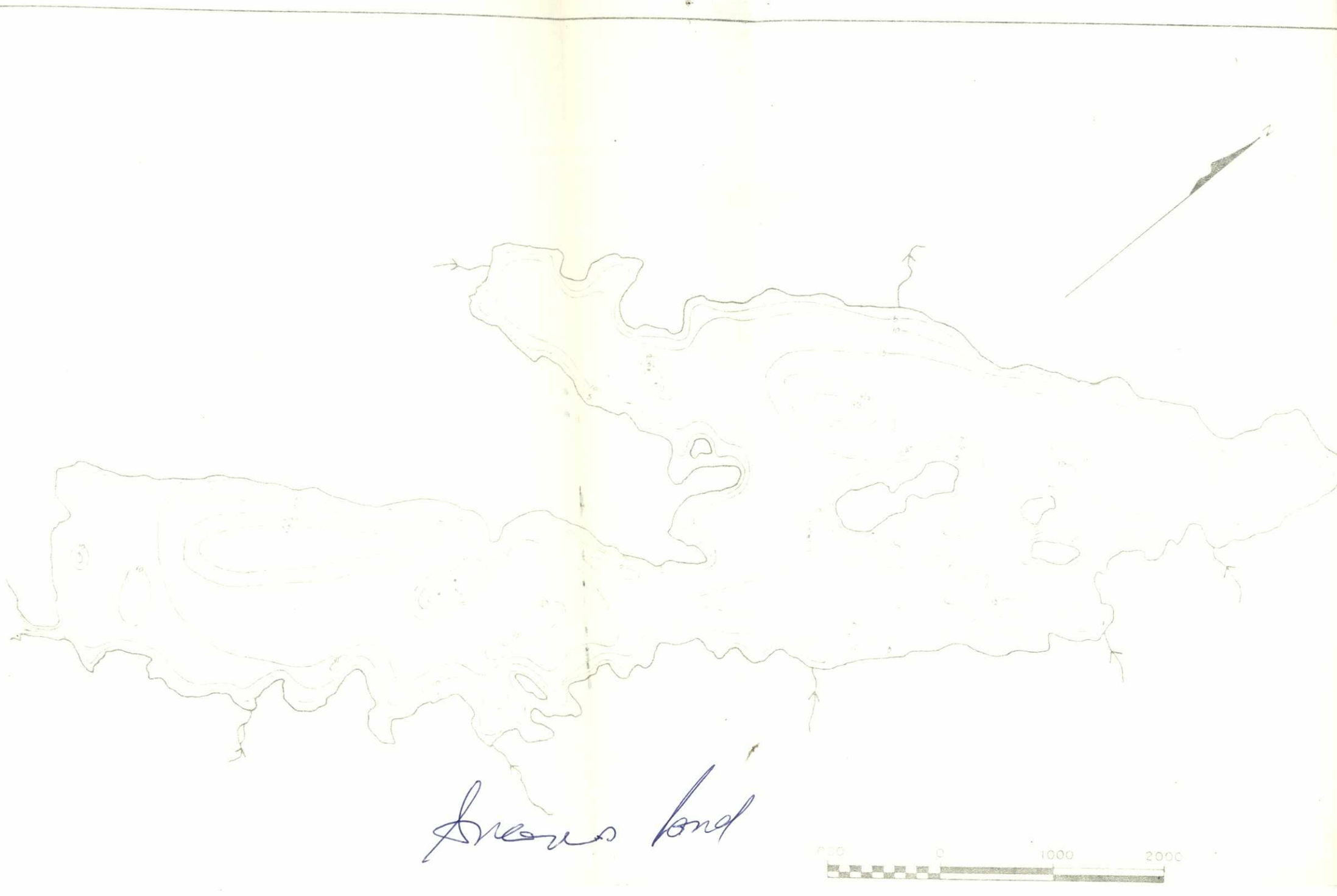
Lake	Annulus							
	I	II	III	IV	V	VI	VII	VIII
Paddys Pond	4.5	9.6	15.2	20.2	24.3	28.5	-	-
Thomas Pond	5.5	10.8	16.4	20.9	24.9	28.2	31.4	-
Petty Harbour Long Pond	5.1	9.9	15.5	21.3	25.8	30.8	33.1	35.5
Windsor Lake	5.8	11.3	16.6	20.5	24.3	-	-	-
Big Triangle Pond	5.1	11.3	17.2	23.2	28.5	-	-	-
Angle Pond	7.9	14.8	20.0	26.0	32.2	-	-	-
Harveys Pond	7.1	11.7	15.8	19.8	24.0	-	-	-
Donneys Pond	5.9	10.2	14.4	18.1	22.9	-	-	-
Petty Harbour Rocky Pond	6.0	10.3	14.7	18.7	23.9	-	-	-
Stephens Pond	5.0	10.5	15.6	22.5	26.5	-	-	-
Shag Pond	5.2	11.0	15.4	-	-	-	-	-
Snows Pond	4.5	9.1	14.1	19.3	25.1	30.8	35.3	-
Southwest Pond	4.7	8.3	13.1	17.3	22.1	28.2	-	-
Middle Gull Pond	6.2	11.3	15.3	19.7	23.4	28.3	33.6	38.0
Colliers Big Pond	5.6	11.8	18.3	23.7	31.2	-	-	-
Goose Pond	7.1	13.5	18.5	22.6	27.5	-	-	-
Grand Pond	5.9	12.7	20.4	27.7	34.4	38.4	-	-
Gull Pond	6.6	11.9	16.3	21.5	24.5	28.4	-	-
Loon & Little Soldiers Pond	5.9	10.2	14.5	18.5	23.5	32.0	-	-
Soldiers Pond	5.3	9.7	14.0	18.2	22.0	-	-	-
Finnies Pond	6.2	11.2	15.2	19.6	23.7	28.6	-	-
Southern Peak Pond	5.0	11.0	17.5	22.9	28.4	-	-	-
Nine Island Pond South	4.3	9.7	15.8	21.1	26.0	31.8	-	-
Five Mile Pond West	5.6	11.1	15.7	19.7	24.9	-	-	-
Nine Island Pond	5.2	11.7	18.9	24.6	31.2	35.5	-	-
Roundabout Pond	6.3	12.6	18.7	24.5	30.3	-	-	-
Topsail Pond	5.0	9.9	15.0	20.0	-	-	-	-
Bay Bulls Long Pond	5.0	11.2	17.2	23.0	28.4	-	-	-
Harbour Main Pond	4.0	8.6	13.4	18.3	23.6	29.5	-	-
Mean (cm.)	5.5	10.9	16.1	21.1	26.2	30.7	33.4	36.8
(in.)	2.2	4.3	6.3	8.3	10.3	12.0	13.1	14.5

Table 3. Back-calculated growth in fork length (cm.) for ouananiche in selected Avalon Peninsula lakes

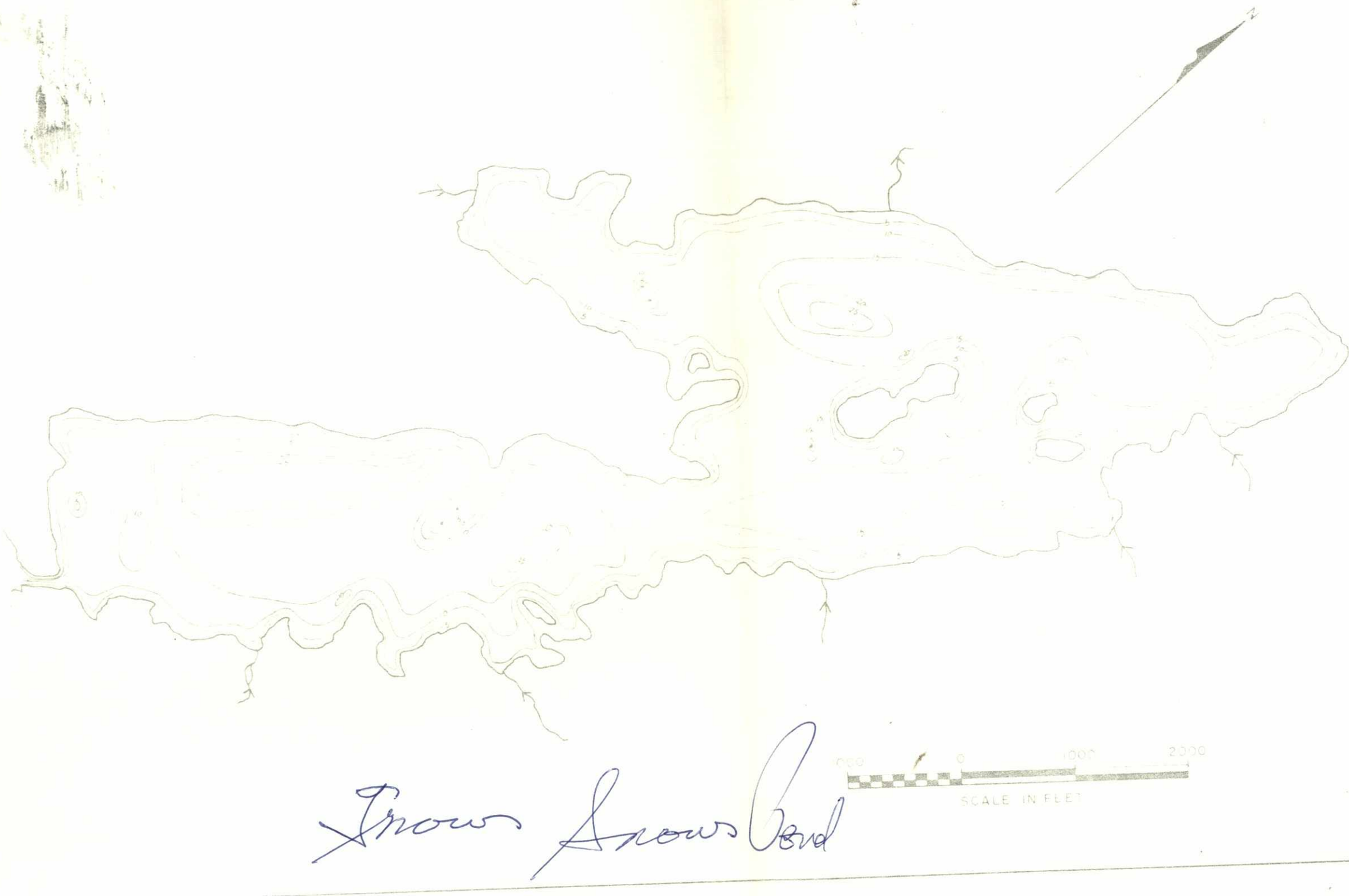
Lake	Annulus										
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Paddys Pond	5.7	9.0	14.6	19.0	23.1	25.9	28.1	-	-	-	-
Thomas Pond	4.7	10.0	15.4	20.1	23.0	25.5	28.2	-	-	-	-
Bay Bulls Long Pond	5.6	9.1	15.1	19.4	24.3	28.1	29.9	-	-	-	-
Donneys Pond	6.2	10.2	14.5	17.7	20.3	22.4	-	-	-	-	-
Forest Pond	4.7	9.1	13.1	16.4	19.1	21.1	-	-	-	-	-
Topsail Pond	4.2	8.5	11.2	13.9	16.0	18.7	23.0	25.7	-	-	-
Harveys Pond	4.0	7.7	10.7	13.0	14.8	19.9	22.0	-	-	-	-
Ocean Pond	5.6	10.3	15.3	20.9	23.7	27.1	29.6	31.1	-	-	-
Big Triangle Pond	5.8	11.2	16.0	20.4	23.2	26.9	29.0	31.1	37.6	-	-
Southern Peak Pond	4.7	8.9	13.5	17.4	20.3	24.0	28.9	33.6	-	-	-
Middle Gull Pond	4.9	7.8	12.4	16.9	22.0	27.6	32.5	36.2	40.7	42.7	44.9
Snows Pond	3.9	7.2	11.5	15.7	19.6	23.2	30.5	38.5	44.1	-	-
Southwest Pond	5.8	9.3	14.0	17.4	21.4	-	-	-	-	-	-
Nine Island Pond South	5.5	8.0	11.6	14.7	17.1	20.0	22.8	24.1	-	-	-
Soldiers Pond	3.3	5.7	8.8	11.5	13.1	14.6	16.1	-	-	-	-
Loon & Little Soldiers Pond	4.2	7.1	10.7	13.3	15.0	-	-	-	-	-	-
Colliers Big Pond	4.2	8.5	14.9	19.3	23.8	27.6	32.1	37.8	41.3	-	-
Grand Pond	5.0	9.2	13.4	17.9	21.5	26.6	31.3	35.2	38.5	43.5	-
Goose Pond	5.1	11.2	16.8	22.5	25.9	31.5	35.4	38.2	40.0	-	-
Finnies Pond	4.1	7.8	11.4	14.4	17.5	21.8	25.4	-	-	-	-
Harbour Main Pond	5.5	8.8	13.0	17.3	20.2	22.3	25.8	-	-	-	-
Nine Island Pond	4.9	10.5	16.3	22.0	29.1	36.6	41.2	48.5	56.1	-	-
Five Mile Pond West	4.0	7.4	11.3	13.9	16.1	-	-	-	-	-	-
Tom Waldrons Pond	4.5	8.5	14.4	19.5	24.8	28.7	30.9	33.0	35.6	-	-
Fourth Pond	4.4	8.0	12.6	16.7	20.0	23.1	25.1	-	-	-	-
Mean (cm.)	4.8	8.8	13.3	17.3	20.6	24.7	28.4	34.4	41.7	43.1	44.9
(in.)	1.9	3.5	5.2	6.8	8.1	9.7	11.2	13.5	16.4	17.0	17.8

Table 4. Back-calculated growth in fork length (cm.) for brown trout in Avalon Peninsula lakes

Lake	Annulus												
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Paddys Pond	6.2	10.9	16.5	22.1	26.5	30.0	33.6	38.3	45.4	52.0	-	-	-
Thomas Pond	6.0	12.1	18.3	23.9	27.1	31.1	33.9	37.1	40.1	-	-	-	-
Windsor Lake	8.2	15.7	22.1	27.3	32.0	35.5	38.4	42.4	-	-	-	-	-
Long Pond	8.8	13.9	19.3	23.4	27.6	31.6	34.7	37.3	-	-	-	-	-
Western Island Pond	6.7	11.7	19.2	24.6	29.1	32.8	37.5	-	-	-	-	-	-
Topsail Pond	7.4	11.4	16.7	20.3	22.8	26.5	29.9	-	-	-	-	-	-
Bay Bulls Middle Pond	6.6	10.5	15.0	19.7	23.8	27.3	30.1	33.6	-	-	-	-	-
Gull Pond	5.5	10.7	17.0	24.7	30.3	36.1	40.2	43.3	47.3	51.6	-	-	-
Goose Pond	5.6	9.9	15.1	20.3	25.2	29.6	34.2	39.3	43.2	47.1	51.2	54.3	57.5
Mean (cm.)	6.8	11.9	17.7	22.9	27.2	31.2	34.7	38.8	44.0	50.2	51.2	54.3	57.5
(in.)	2.7	4.7	7.0	9.0	10.7	12.3	13.7	15.3	17.3	19.8	20.2	21.4	22.6


Arans Island
000
0
1000
2000


N
Arrow Pond


N
1000
0
1000
2000
SCALE IN FEET
Snows Snows Pond

Southern Peak Lead

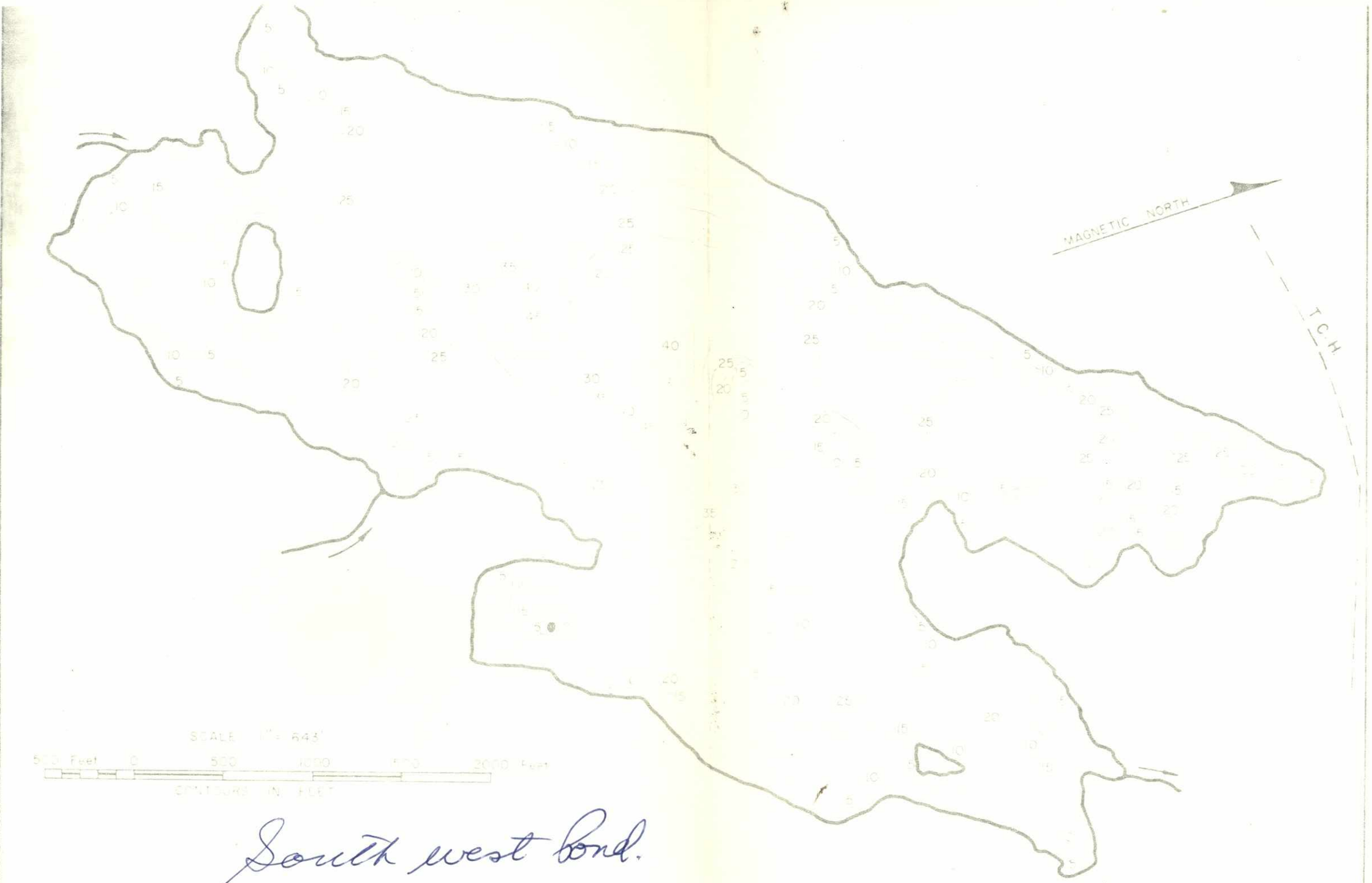
SCALE 1" = 550'

500 Feet 0 500 1000 1500 2000 Feet

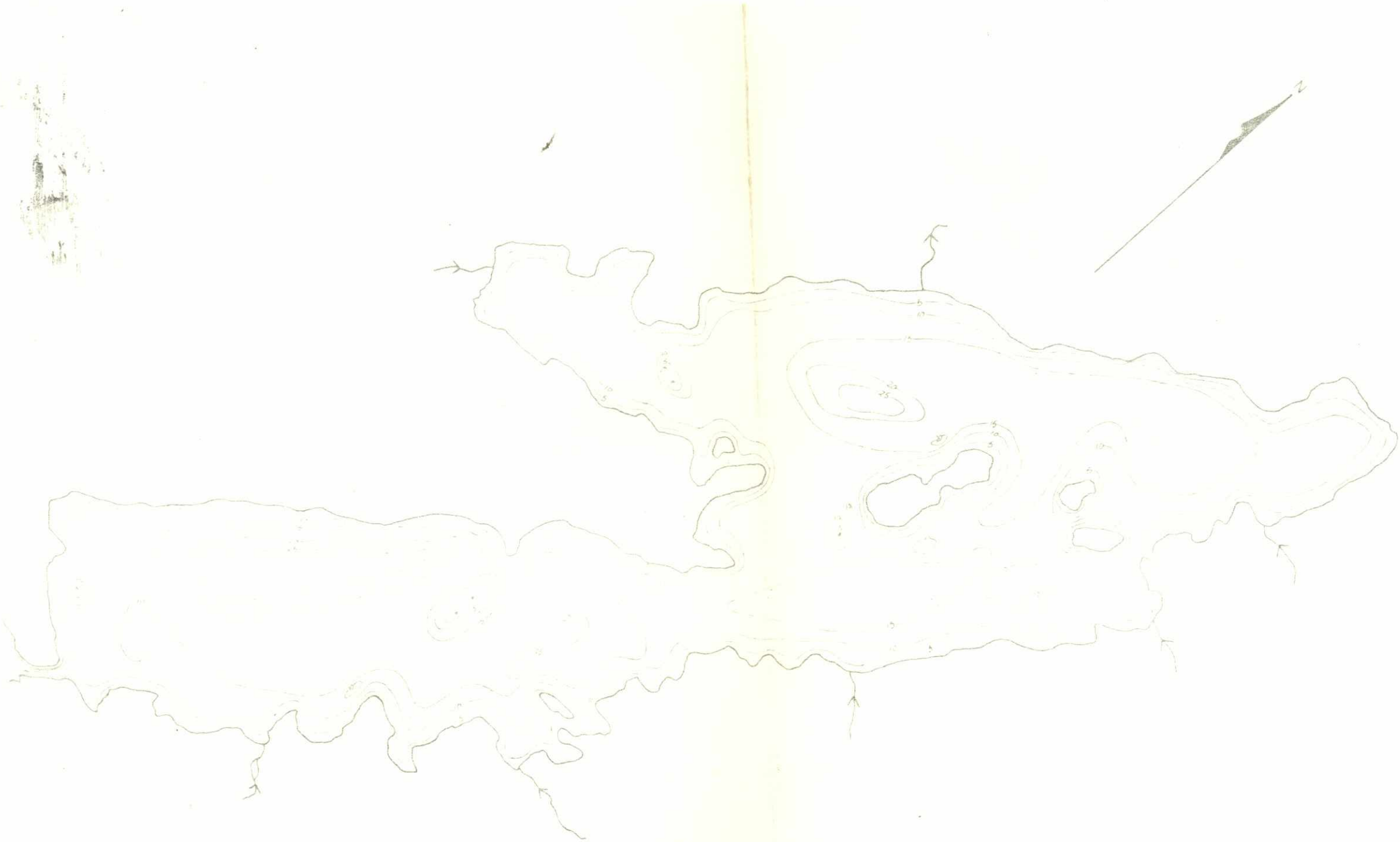
Southern Beach Pond

SCALE 1" = 550'

500 Feet 0 500 1000 1500 2000 Feet



South west Bond.



Snows Pond