THE LAKE TROUT FISHERY IN ALGONQUIN PARK FROM 1936 TO 1945

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Abstract

The average lengths of lake trout (*Cristivomer namaycush*) captured in the various Algonquin Park lakes during the decade varied from 13.3 to 24.8 inches and the number captured per 100 boat-hours from 39 to 154. When the average length of fish captured is plotted against number captured per unit effort, all the points fall below a line which begins at a length of 13.3 inches with an availability of 220, rises to an availability of 355 at 15.5 inches, and drops lower as the size increases until at 24 inches the line falls below 100 fish per hour. This line has been taken as the standard for availability of lake trout in Algonquin Park and a fishing index has been proposed which compares each fishery with this standard curve. Certain lakes have shown marked annual fluctuations in size and abundance of lake trout that suggest the progression of major year classes through the fisheries. More detailed examination of the catch statistics indicates that an extremely uneven success of year classes of lake trout appears to be universal in the Algonquin Park lakes.

Introduction

With the completion of the tenth year of the Algonquin Park creel census, it was felt that sufficient material had been accumulated to warrant a compilation of the data in order to discover what trends the lake trout fisheries had taken over that period, and to see whether the conclusions drawn from the two preliminary analyses (Fry and Kennedy, 1937; Fry, 1939) had been substantiated by subsequent developments.

Algonquin Park has an area of approximately 2,700 square miles and is situated in the Precambrian shield with the parallels 45° 45′ N. and 78° 30′ W. intersecting near its center. There are about 200 lakes which support populations of game fish. The largest of these is Lake Opeongo with an area of 20.1 square miles, and there are about 15 lakes with areas from 5 to 15 square miles. The majority of the lakes which sustain lake trout fishing are from 100 to 1,000 acres. Lake trout populations occur in a few lakes as small as 30 acres.

The method of conducting the Algonquin Park creel census was described by Fry (1939). Major emphasis has been placed on the collection of statistics concerning the size composition and fishing effort rather than the total catch. Thus, for most lakes, we have de-

Reprinted from Volume 75 (1945), Transactions of the American Fisheries Society.
Published 1948. Printed in U. S. A.

scriptions of the fishery based on samples of the catch rather than statistics of production derived from a measurement of the total yield. In certain lakes where the circumstances permitted a more complete census, as in Opeongo, statistics for the production of the fishery have also been obtained.

The present report deals with the lake trout, which is the most important game fish in the Park. The speckled trout (*Salvelinus fontinalis*) and the smallmouth black bass (*Micropterus dolomieu*) are second in importance, and the statistics for these, it is hoped, will be the subject of subsequent analyses. In addition to the above species, northern pike (*Esox lucius*), pikeperch (*Stizostedian vitreum*), and the maskinonge (*Esox masquinongy*) are captured in a limited region in the northwest corner of the Park.

The Standard Profile of Availability

In studying the lake trout fishery in Algonquin Park over the last 10 years, it becomes obvious that there has been extreme variation not only in the size of the lake trout captured in one lake from year to year, and between all the lakes in the Park, but also in the number of fish caught per 100 boat-hours, or "availability" of the fish. A comparison can be made between the lakes by reference to Table 1, which presents a synopsis of the years 1939 to 1945. The data for the years 1936 to 1938 have already been published by Fry (1939).

Extreme as the afore-mentioned variations have been, all the lakes for which the data are sufficiently complete fit into the picture of the trout fishery of the Park described by Fry (1939) which was briefly: that for all the lakes covered by the records of those three years a contour line could be drawn describing the limits of their potential, and, that most of the lakes would fall beneath this profile of perfection. With the intention of analysing the figures for the last 10 years, we have employed the same pattern by constructing Figure 1 which relates the average length with the number captured per 100 boat-hours for all the lakes with records for 50 or more fish (data from Table 1). This graph also includes those lakes from 1936 to 1938 plotted on a similar graph by Fry (1939, Figure 12). The more extensive information covering the last seven years, confirms in all its major points the picture presented in 1939, and perhaps that interpretation may now be considered valid. However, one slight modification has been made, *viz.:* that the peak availability of 426 based on the record of 17 fish for Cradle Lake 1938, has proven too extreme, so that a peak of 355 is sufficient to enclose the later records. From Figure 1 it will be noted that most of the lakes still fall below the boundary line, which we term the standard profile of availability, beginning at 220 availability and running through 355 to reach a lower availability as the average annual length increases towards 24 inches. As on the graph printed in 1939, there is a small group of lakes (circled)

TABLE 1.—*Synopsis of creel-census returns for lake trout captured in various Algonquin Park lakes in the years 1939-1945*

[The unit for fishing effort is based on two men in one boat. Lengths were measured to the fork of the tail.]

Name of lake	1939			1940			1941			1942			1943			1944			1945		
	Number of fish reported	Average length (inches)	Number of fish per 100 hours	Number of fish reported	Average length (inches)	Number of fish per 100 hours	Number of fish reported	Average length (inches)	Number of fish per 100 hours	Number of fish reported	Average length (inches)	Number of fish per 100 hours	Number of fish reported	Average length (inches)	Number of fish per 100 hours	Number of fish reported	Average length (inches)	Number of fish per 100 hours	Number of fish reported	Average length (inches)	Number of fish per 100 hours
Big Crow	86	20.4	145	46	18.7	180	.....	.....	.....	43	21.3	83	44	20.0	142	23	19.7	115	14	15.9	101
Big Trout	51	20.7	93	52	21.7	200	35	21.5	206	42	16.9	200	41	21.2	300	40	21.3	115	46	23.3	128
Black Bear	74	24.8	80	13	19.6	130	9	15.7	100	27	18.0	159	32	15.8	300	.....	.....	.....	126	21.5	58
Burnt Island	479	24.7	78	21	23.8	75	87	15.6	63	62	21.6	102	23	21.1	70	197	19.0	127	80	19.9	135
Butt	263	16.4	170	338	16.1	320	Closed			154	.....	270	Closed			17	19.2	225	Closed		
Cache	93	15.5	52	52	15.7	79	68	14.9	77	80	15.3	89	125	14.7	92	127	15.5	116	101	15.2	81
Canisbay	74	14.7	126	Closed			27	14.7	93	Closed			229	14.1	181	Closed			214	14.4	143
Canoe	38	28.4	86	19	22.7	90	2	23.0	80	3	29.1	100	1	.....	.....	5	14.4	.....	57	20.8	135
Cedar	12	.....	75	.....	.....	.....	1	.....	200	.....	.....	.....	59	20.1	95	136	18.0	99	.....	.....	.....
Crooked	96	16.4	148	.....	.....	.....	.....	.....	.....	38	17.3	192	94	16.5	176	29	17.0	170	3	18.3	100
Delano	9	.....	.....	.....	.....	.....	43	15.2	210	Closed			146	13.5	267	Closed			94	14.0	157
Dickson	23	22.2	77	11	.....	.....	52	19.8	87	38	20.6	130	41	22.2	142	78	19.7	85	37	18.0	104
Happyisle	73	18.5	120	76	15.7	144	50	16.7	100	77	15.9	183	75	15.0	139	78	17.1	97	21	17.6	85
Harness	.....	.....	.....	21	14.0	155	14	14.7	113	Closed			64	15.0	205	Closed			20	18.6	99
Head	Closed			105	15.1	177	Closed			169	16.0	130	Closed			76	15.4	118	Closed		
La Muir	64	22.8	94	9	26.1	170	6	.....	120	.....	.....	.....	35	19.8	194	91	21.8	197	44	21.2	134
La Vieille	.....	.....	.....	24	19.0	.....	282	19.2	187	62	17.5	204	16	18.2	266	95	20.6	107	200	19.8	143
Little Island	44	15.2	93	Closed			99	17.1	130	Closed			125	14.8	135	Closed			95	18.2	80
Louisa	373	14.2	219	320	15.2	191	153	15.6	163	180	16.8	310	193	14.0	280	156	15.5	197	343	15.4	258
MacIntosh	40	17.8	114	.....	.....	.....	10	18.0	286	Closed			.....	.....	.....	Closed			68	18.2	131
Merchant	.....	.....	.....	137	16.8	182	Closed			97	17.7	201	Closed			131	17.2	106	Closed		
North Tea	.....	.....	.....	13	.....	100	1	.....	.....	.....	.....	.....	86	21.7	127	82	19.4	169	.....	.....	.....
Opeongo	1,233	18.4	112	1,133	17.9	120	885	17.4	97	504	18.5	111	704	18.4	126	835	18.8	126	1,139	19.7	101
Penn	54	17.0	60	.....	.....	.....	7	24.0	100	Closed			13	.....	.....	Closed			100	17.6	139
Proulx	107	23.7	73	15	23.3	73	Closed			.....	.....	.....	Closed			31	23.9	63	Closed		
Ragged	65	20.6	92	Closed			20	18.2	95	Closed			79	19.8	99	Closed			77	19.0	74
Red Rock	331	18.1	113	Closed			216	17.9	120	Closed			87	18.7	153	Closed			78	17.4	69
Rock	84	17.2	90	24	.....	77	6	.....	120	36	15.9	130	.....	.....	.....	.....	.....	.....	33	14.5	85
Smoke	224	21.7	51	167	20.0	81	64	17.9	106	37	19.2	120	50	18.5	129	86	18.7	124	254	18.6	94
Source	49	13.6	160	.....	.....	.....	85	13.5	44	59	14.6	53	201	15.7	50	58	18.0	39	74	16.1	81
Tanamakoon	13	13.2	70	51	.....	160	16	14.0	62	50	13.3	86	10	14.0	125	14	16.5	73	125	14.4	96
Two Rivers	18	16.8	82	121	15.7	117	2	18.0	50	38	15.6	107	71	17.3	117	90	18.0	124	125	17.8	101
Whitefish	16	15.5	76	2	22.0	.....	6	21.0	34	16	18.1	134	.....	.....	.....	4	16.6	200	84	17.4	89

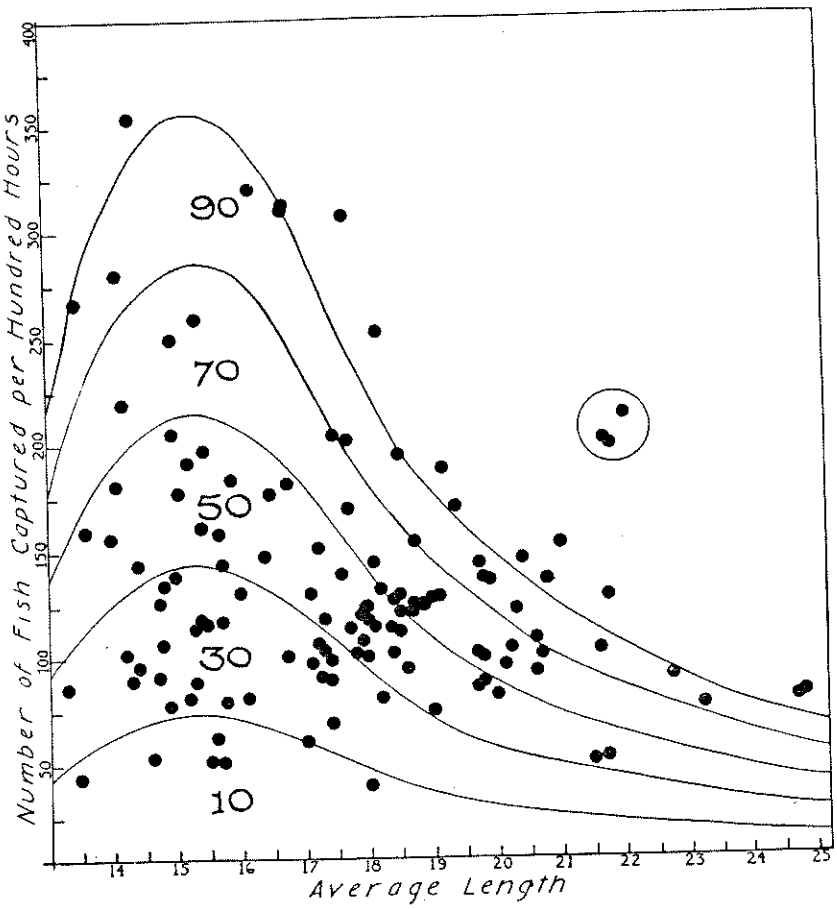

FIGURE 1.—The relationship between number of lake trout taken per 100 boat-hours (availability) and the average fork length of lake trout captured in Algonquin Park lakes. Data from Table 1. Only records based on more than 50 fish are plotted.

clustered around the junction of the 200-availability line and the 22-inch line, which indicate far better fishing. Again we feel that since the fishing season is shorter and since the lakes are not fished so intensely, Hogan 1937, Big Trout 1940, and La Muir 1944 do not fall into the general pattern.

The explanation offered for this general pattern is briefly, that there are three factors which influence the Algonquin Park fishery. These factors are fishing pressure, variations in the size at maturity, and the rate at which the larger fish consume the smaller trout.

Fishing, in addition to natural mortality, reduces the average age and size of a lake trout population. In a lake where the lake trout mature at a small size, heavy fishing by the tackle now in use, will not deplete the stock entirely. A sufficient number will be left to spawn and the fishery will be perpetuated. When judged by their availability, lakes in which the average length of the trout is about 16 inches and which contain substantial numbers of mature fish have the densest trout population.

An Index for the Lake Trout Fishery

The general classification, founded on the two variables, length and availability, offers a rational basis for grouping the lake trout fisheries. But a more convenient and practical evaluation of changes in the quailty of the fisheries would be based on an index of one variable. Such an index is possible if the theory is accepted that all populations tend toward their ultimate potential if permitted to do so, and that the potential for all lakes would be a series of points on the boundary curve. Therefore, a lake on the standard profile of availability might be considered, under the fishing conditions of Algonquin Park, to have the best possible fishing and to be at 100 percent of perfection. Some confusion might be caused by the exclusion of 11 recordings, exclusive of those circled, which are not encompassed by the 100-percent line. These data were intentionally excluded since it was thought best to make the standard something below the extremes encountered. This action is admittedly arbitrary.

Just as lakes on the standard profile of availability can be considered at 100 percent of perfection, so are lakes beneath that curve at various lower percentages of perfection. Contour lines at 20-percent intervals have been plotted on Figure 1 for what might be termed particular percentages of perfection. Each section thus divided is labelled at the mean percentage of that section, so that all lakes lying within zero and 20 percent are considered at 10 percent of perfection, those between 20 percent and 40 percent are rated at 30 percent of their potential, and so on. It would be simple to subdivide the graph still further, but neither the data nor the results warrant such a division. More lakes lie between the 40-percent and 60-percent contours than within any of the other zones and approximately two-thirds of the records lie between the 20-percent and 80-percent contours.

In Table 2 we have assigned those lakes for which we have records of 25 or more fish a year and which yield 50 or more fish in some years, to their percentage zones. It demonstrates at what percentage of perfection was the annual catch from each lake. While the table includes only a few lakes, there are sufficient to indicate a remarkable variation from year to year in some lakes, and but slight alteration in others. For example, the index for Louisa varied from 110 in 1938 to 50 in 1940; Opeongo dropped from 70 in 1936 to a low of 30 in 1941

TABLE 2.—*Quality of lake trout fishing in various Algonquin Park lakes, 1936-1945, as measured by the fishing index proposed in the text*

Name of lake	1936	1937	1938	1939	1940	1941	1942	1943	1944	1945
Big Trout	....	110	....	70	110	110	70	110	90	110
Burnt Island	....	....	....	110	90	10	90	50	70	90
Cache	....	30	30	10	30	30	30	30	30	30
Canisbay	....	....	50	30	Closed	30	Closed	50	Closed	50
Dickson	....	110	....	70	....	50	90	110	50	50
Happyisle	....	70	50	50	50	30	50	30	30	30
Head	....	50	30	Closed	50	Closed	30	Closed	30	Closed
La Vieille	....	90	70	....	....	110	70	110	90	90
Little Island..	....	....	30	30	Closed	50	Closed	30	Closed	30
Louisa	....	70	110	70	50	50	90	90	50	70
Merchant	....	90	90	....	50	....	70	Closed	30	Closed
Opeongo	70	70	50	50	50	30	50	70	70	70
Proulx	....	90	90	90	90	Closed	....	Closed	70	Closed
Ragged	....	30	Closed	70	Closed	50	Closed	70	Closed	50
Red Rock	70	70	Closed	50	Closed	50	Closed	70	Closed	30
Smoke	....	50	50	50	50	50	70	70	70	50
Source	....	30	30	30	....	10	10	10	10	30
Tanamakoon..	....	....	30	30	....	10	30	30	30	30
Two Rivers ..	....	30	....	30	30	30	30	50	50	50

and rose again to 70 in 1945; Red Rock has fluctuated between 70 and 30; and Cache remained static at 30, except for 1939 when it dropped to 10 percent. Cache, then, will be found on Figure 1 between the 20-percent and 40-percent contours according to the average length per annum.

FLUCTUATION IN LOUISA LAKE

Louisa Lake provides the most striking example of fluctuation from year to year in an individual lake. During the 10-year period the fishery has failed, has recuperated and has failed again. The course of these changes is shown in Figure 2 where the availability is plotted against the average annual length. Whereas Table 2, which shows Louisa lake changing from 110 to 50, can indicate only the extent of the flux, this graph gives direction as well as extent. It is a picture of the increase or decrease in the average length of the fish caught, plotted against the increase or decrease in the availability. In 1937, the availability was 240 and the average length was 16.7 inches. In 1938 the availability rose to 355, but the average length decreased to 14.4 inches. The following year the availability had fallen to 219 but the average length remained approximately the same. Continuing the line around, it becomes apparent that there is a marked pattern of two cycles in the period. The year 1942 corresponds to 1937 with a high average length, but 1943 returns to a low average length. The years 1944 and 1945 are continuing a third cycle. While this cycle appears definite in Louisa, it is not at all certain that we should expect its continuation. (Figures for 1946 seem to indicate a variation in the cycle, since the availability reached an all-time low at 98 with the average annual length at 14.5 inches.) However, whether the cycle is regular or not, the data strongly suggest a progression of at least two major year classes through the fishery.

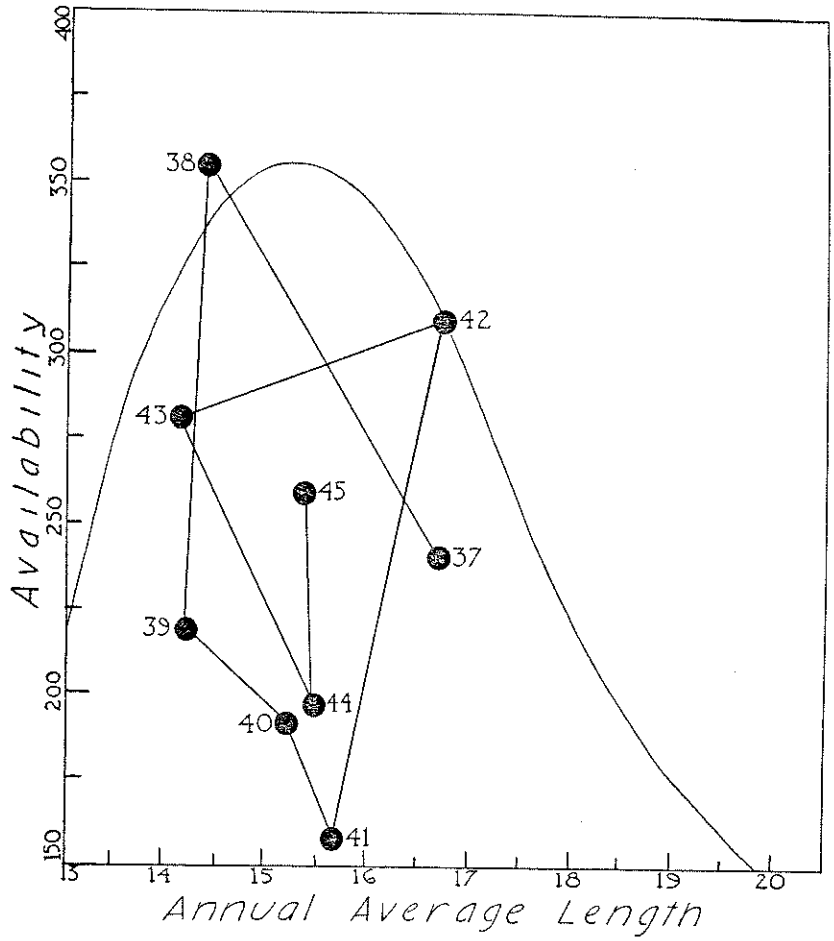

FIGURE 2.—Annual changes in average fork length and availability in lake trout captured in Lake Louisa.

YEAR-CLASS VARIATION IN LAKE TROUT POPULATIONS

Figures for Lake Louisa lack detail to demonstrate the fluctuation in the year classes as they progress through the fishery, but an exceedingly clear example of both successful and unsuccessful year classes passing through can be seen in the records for Merchant lake. Figure 3 is a comparison between the availability data according to length for the years 1940 and 1942, the lake being closed to fishing in 1941. In 1940, the peak availability occurred at 18 inches. In 1942 the highest availability had shifted to 37.7 at 19 inches. Moreover, there was a complete shift of the whole availability curve with the size

classes under 19 inches having a lower availability than in 1940 while the classes above 18 inches had a higher availability, except for the largest size classes. Evidently the successful year class which had a modal length of 18 inches in 1940, had grown to 19 inches in 1942. In addition, the fact that the 1942 graph begins at 14 inches instead of 13 inches, as in 1940, and the fact that the fish from 15 inches to 18 inches in 1942 do not reach so high an availability as in the previous fishing year, indicate that there was a year-class failure. In short, if the procession of year classes had all been of equal strength, the picture would have been approximately the same for both years, or

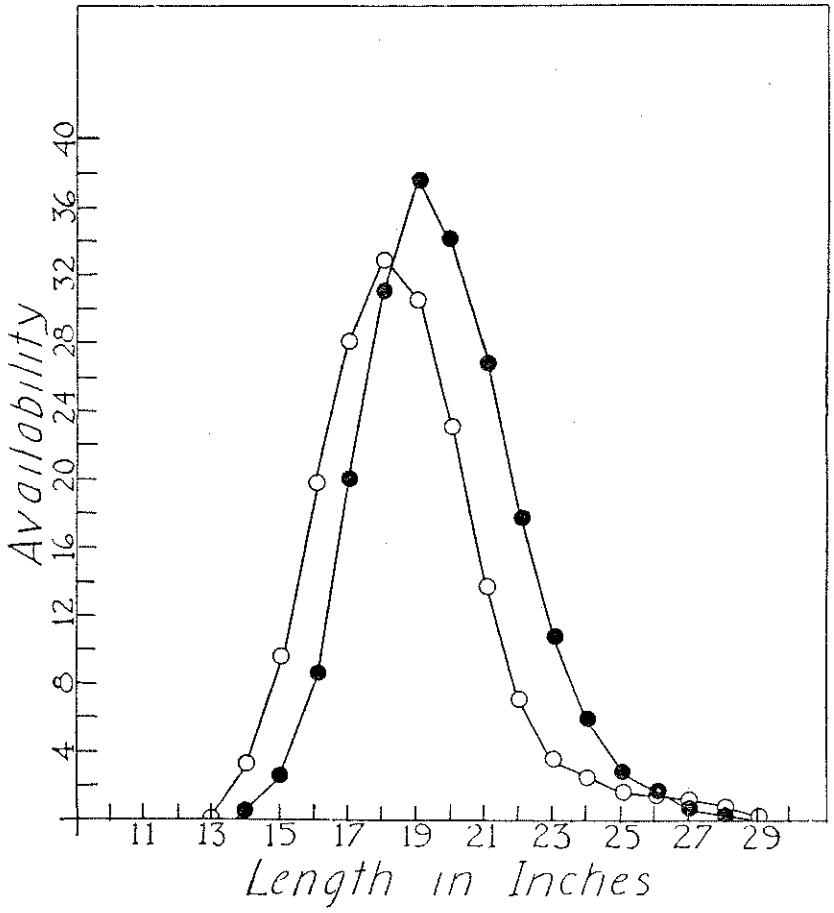

FIGURE 3.—Availiability of lake trout of various lengths in Merchant Lake in 1942 (solid dots) as compared with 1940. The lake was closed to fishing in 1941. Original values smoothed twice by threes.

rather, since a year of closure intervened, there should even have been a further reinforcement of the small size classes.

Although Figure 3 clearly illustrates a relationship in the fishery for 2 years, the parade of year classes through the various lakes from the time they enter the fishery to the time they are finally exterminated can be displayed more distinctly by relating each year to the 10 years covered in this survey. Figures 4-8 illustrate what appear to be numerous examples of the fluctuation of year-class strength in lake trout populations.

These histograms demonstrate the difference between the availabilty of each size class for one year and the average availability for each size for the 10 years. It should be borne in mind that these figures are not a direct indication of the abundance of fish in a lake, but only give a measure of the angling success—a datum which is influenced by meteorological conditions, by the skill of the angler and by fishing pressure, as well as by the abundance of fish in the lake. Nevertheless, availability can be taken as a measure of abundance for all but minor annual fluctuations. Whether the figures are influenced by the fishing conditions or not, it is obvious that year classes which enter

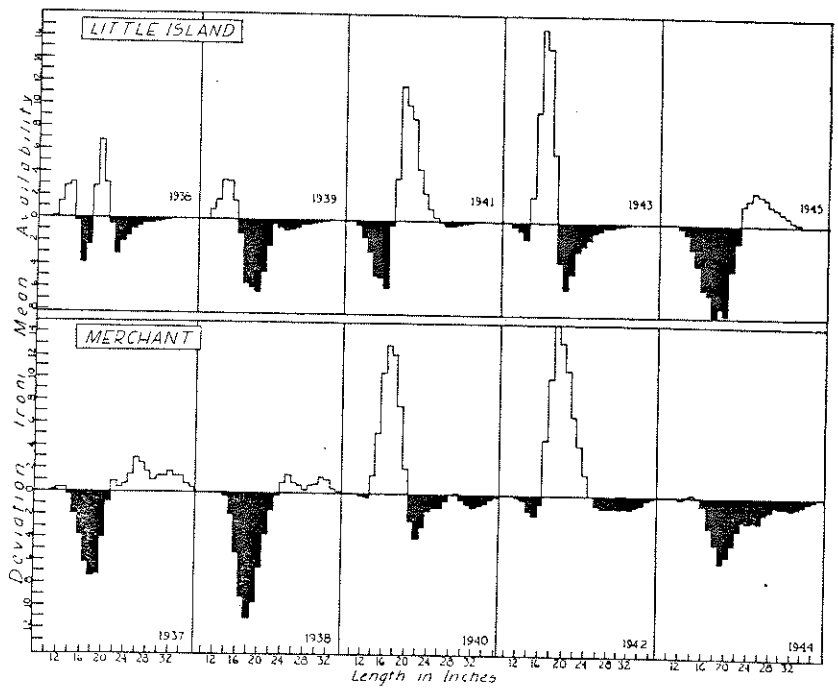

FIGURE 4.—Annual variations in the availability of lake trout in Merchant and Little Island Lakes as compared with the 10-year mean, smoothed twice by threes.

below the average availability, without recovering within a year or two, give evidence of year-class failures.

The graph for Merchant Lake (Figure 4) further demonstrates the success of one year class, and the failure of the subsequent year class. In Merchant Lake for 1937, there was a slight advantage over the 10-year mean in the 12- and 13-inch sizes, followed by a decrease in those from 14 inches to 19 inches. The availability of sizes from 22 to 32 inches was higher than the average. In 1938 the availability of all sizes up to and including 23 inches dropped sharply. A minor increase occurred for those from 24 to 32 inches, but even these had decreased below the 1937 level. Thus, the two years 1937 and 1938 give evidence not only of heavy removal of the existing stock, but also of a failure in the entering year classes which probably originated several years previously.

In 1939, the lake was closed for the first time, and 1940 shows a remarkable improvement. A major year class (or group of year classes) apparently moved in, causing a jump over the mean in the 14- to 20-inch sizes. Because the growth of lake trout is rather slow, the size classes from 20 inches up had not recuperated. By 1942, the dominant year class, first shown in 1940, increased in length until it ranged from 16 inches to 22 inches. But there was nothing to take its place. No other year class followed, so that in 1942, the 12- to 16-inch group fell below the mean. The successful year class from 16 to 22 inches in 1942 must have been practically wiped out in that year, since the year 1944 found the trout fishing extremely poor.

Figure 4 also illustrates the trend in Little Island Lake. In 1938 there is evidence of two major year classes, one with a size range of 14 inches and less, the other at 18 to 20 inches. This latter group was removed in the year's fishing, with the result that in 1939 the only successful year classes shown above the zero line are the new ones which had grown as large as 15 inches. Given an opportunity to grow in 1940, when the lake was closed, this year class group moved into the size bracket from 18 to 25 inches. However, it appears that they were fished so intensively during the next fishing year (1943) that, if they did not actually vanish from the lake, they certainly fell far below normal in the fishery. During the same period, new major year classes suddenly appeared, measuring from 14 to 18 inches in 1943. This group was likely in the 11- to 15-inch size classes in 1942 and would have entered the fishery in that year if the lake had been open to angling. They were also heavily fished so that in 1945, although they had moved into the 22-inch to 32-inch size group, their numbers were greatly depleted.

The data for Happyisle Lake (Figure 5) cover the 10-year period with no closures. The successful year classes measuring from 18 inches to 32 inches in 1937, underwent a marked decrease in 1938, but staged a slight recovery in 1939. Presumably this 1939 increase indicates that part of the lack of success in 1938 was due to poor

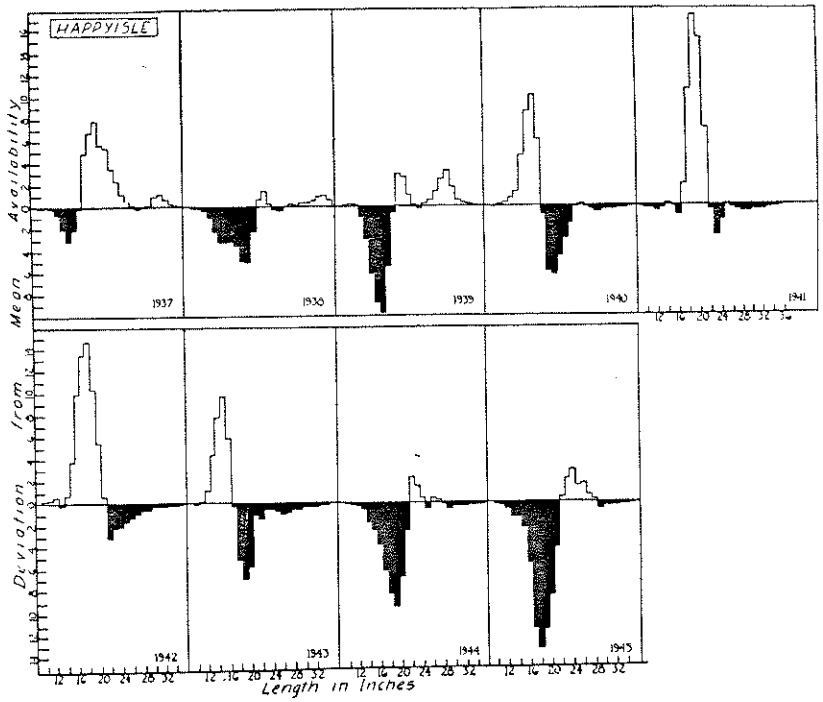

FIGURE 5.—Annual variations in the availability of lake trout in Happyisle Lake as compared with the 10-year mean, smoothed twice by threes.

fishing conditions. In 1939 the group was evidently annihilated so far as the fishery is concerned. It was followed in 1940 by the appearance of successful year classes occupying the position from 11 to 18 inches. By 1941, these lake trout had grown to a length of 22 inches, and although they did not reach beyond that length in 1942, their number was augmented by classes immediately following which were but slightly apparent in 1941. However, by 1943, they dropped below the mean to be succeeded by fish that were from 10 to 14 inches in 1942 and which had increased by 1943 to 16 inches. The histograms for 1944 and 1945 reveal a peculiarity for which the explanation possibly lies in the effect of meteorological conditions on fishing, but the effect may merely be the result of random variation of the data. Those year-class groups measuring around 19 inches to 20 inches in 1942, although apparently knocked out of the fishery in 1943, recovered sufficiently to show an increase over the average from 22 inches to 27 inches in 1944. Because there is no evidence of a new year class developing during the years 1944 and 1945, it can be concluded that a few years previous to 1944 there was a year-class failure.

There is inadequate information for Smoke Lake (Figure 6) before 1939, but the great deficiency in all sizes for both 1939 and 1940, indicates a very decisive failure of, not one, but several year classes. By 1941, the fishery recovered slightly, and new year classes moved into the sizes 10 inches to 20 inches. By 1942, the larger sizes of this latest year-class group dropped out of sight, but the sizes from 15 inches to 19 inches increased in strength. Following them came another year class shown at 11 inches. The fish measuring from 26 to 32 inches most probably represent the reappearance in the fishery

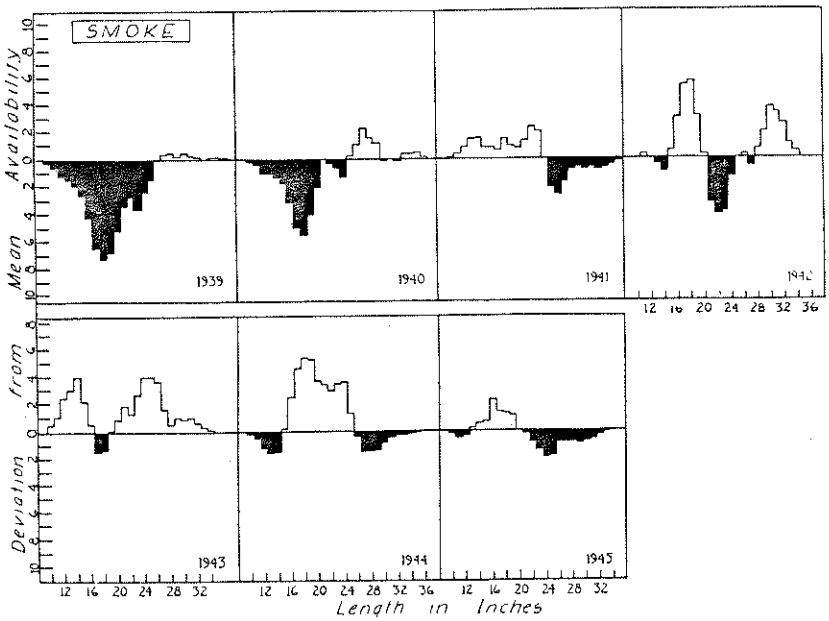

FIGURE 6.—Annual variations in the availability of lake trout in Smoke Lake as compared with the 10-year mean, smoothed twice by threes.

of the year classes plotted between 25 and 32 inches in 1940. Thus, the histogram for 1942 gives a strong indication of the succession of at least two different major year classes through the fishery. For 1943, the second oldest year-class group combined with the next below it to show an increase over the mean from 19 inches to 32 inches. The youngest year-class group possibly indicated in 1942 at 11 inches, climbed above the average between 10 and 16 inches the following year. These fish combined in 1944 with the remnants of the two older classes to cause an improvement in the sizes from 15 inches to 25 inches. But the bulk of the oldest year class had disappeared from view by 1944 and there is some evidence that the strength of the

entering year class was below normal. In the 1945 figures there is evidence of a further failure in the entering year class and those size classes which had better than average availability probably still owed their advantage to the year class entering in 1943.

In Cache Lake (Figure 7) the fisherman's chances of capturing lake trout were never better than average from 1938 to 1942, reaching their lowest point in 1940. In 1944 his chances improved immensely. Possibly the reason for the success of certain size groups in 1937 and 1944, the two good years for Cache Lake, is that in 1937 the lake was planted with mature wild lake trout. The capture of many of these fish during that season no doubt accounts for the better fishing in that year. However, about 200 were placed in the lake in the fall after fishing had stopped and it is possible that the increase in 1944 was due to the successful spawning of these planted fish, since the 7-year

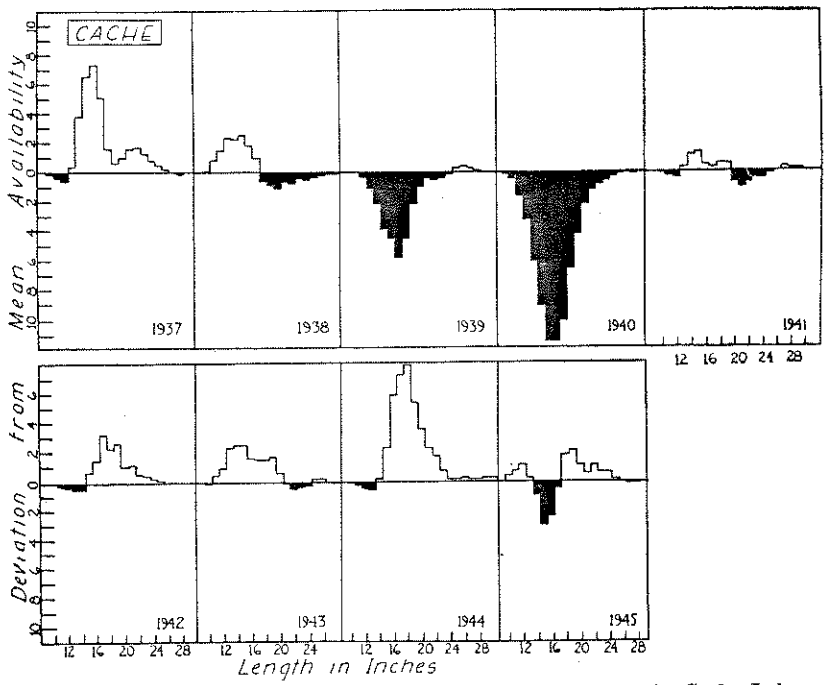

FIGURE 7.—Annual variations in the availability of lake trout in Cache Lake as compared with the 10-year mean, smoothed twice by threes.

interval is approximately the time required in Cache Lake for lake trout to reach a size large enough to take the bait.

The most accurate and detailed information derived from the creel census of the Algonquin Park lakes was obtained from the Opeongo

fishery (Figure 8). Since the main laboratory is stationed on this, the largest lake in the Park, and since the means of access to the lake are limited, close observation can be maintained there. The annual catch

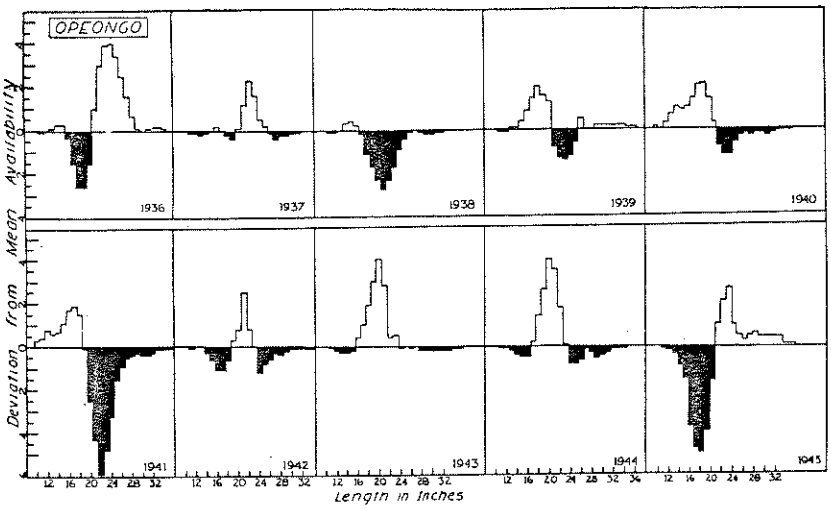

FIGURE 8.—Annual variations in the availability of lake trout in Lake Opeongo as compared with the 10-year mean, smoothed twice by threes.

from Opeongo far surpasses that of any other lake in the Park, averaging approximately 1,100 per annum. The first three years demonstrate the decline of the fishery with no new year classes following in immediate succession. The graph for 1939 reveals that the group barely visible above the average line at 15 inches in 1938 had increased in size and availability so that the fishery as a whole was better than average. In 1940 there appears to have been a further reinforcement resulting from the success of the subsequent year class. The same seems to be true in 1941. However, the intensity of the fishery during those years was sufficient to reduce these year classes soon after they had entered it. In the later war years, the fishing pressure dropped and subsequent to 1941 the latter of these major year classes show signs of progressing through the fishery. No new major year classes appear to have entered the fishery from 1941 to 1945. The progress of the year classes in the fishery from 1941 to 1945 is somewhat halting even in these smoothed curves. This irregularity probably occurred because Opeongo Lake has three distinct basins which in summer at least, contain discrete populations of lake trout. The amount of data concerning each of these populations tends to be roughly in proportion to the excellence of the fishing each population presents at any particuar time; consequently the Opeongo data are heterogeneous in spite of their relative completeness.

Every fishery described above has shown at least one major fluctuation which it seems reasonable to ascribe to a variation in the success of year classes. These examples were not chosen because they emphasize such a variation in year classes, but simply because they comprise all the fisheries for which we possess data sufficient to enable us to plot in detail the changes which have occurred in the size composition of the catches. Hence, variations in year-class strength in lake trout fisheries such as these, appear to be not only clearly defined but also practically universal.

Discussion

The most striking feature of this analysis of the lake trout fisheries is the great irregularity in the success of year classes. The data as presented in Figures 4-8 give only a qualitative appreciation of the true situation since only deviations from mean availability are shown. However, the extent of these deviations on a proportional basis can be calculated by comparing the magnitude of these absolute deviations with the appropriate mean availabilities given in Table 3. Thus, in Opeongo Lake in 1941 the drop in the size classes 20 to 32 inches. represents at least a 50-percent decrease from the mean. The rise above the mean in the same lake in that year over the range 10 to 18 inches is equivalent to an increase of about 35 percent.

The fluctuations in the early years of the census at least could not have been the result of excessive angling pressure in previous years, since the Algonquin Park highway was not opened until 1936 and many of these lakes were relatively inaccessible before that time. The fluctuations, then, as is the case with most other such variations in the strength of year classes, can be attributed to phenomena other than human interference. What these phenomena are, or in what years they operated with adverse effect on the recruitment have not yet been discovered. Fortunately substantial scale collections from a number of these lakes are on file, and thus there is the possibility of determining the age composition of the catches and of learning which were the successful and which the unsuccessful year classes.

Since the aim of fishery management is to produce consistently the most attractive angling possible, this great variation in year-class strength presents a serious problem. This is particularly so in lake trout fisheries where the attractiveness of the fishing depends on a single species and there is in general no other fish which the angler may take if the lake trout are scarce in any particular year. Presumably management practices should be sought which tend to compensate for these fluctuations in recruitment.

The discovery of this great fluctuation in year-class strength, together with the fact that lake trout grow so slowly throws light on the somewhat varying success so far as lake trout are concerned which has resulted from our program of alternate closure of small lakes in

TABLE 3.—*Mean availabilty of lake trout by size classes in various Algonquin Park lakes during the period 1936-1945.*
[The values given represent the number of fish of a given size captured per 100 boat-hours. The number of years represented in each average may be found by counting the panels in Figures 4-8.]

Name of lake	Fork length in inches																						
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Cache	0.9	2.1	6.6	9.9	14.0	15.6	13.6	7.4	4.3	1.6	1.3	0.8	0.7	0.5	0.2	0.2	0.0	0.0	0.1	0.0	0.0	0.0	0.0
Happyisle	0.7	0.6	1.9	4.8	14.5	20.9	27.2	19.9	21.4	5.3	7.1	1.5	2.3	1.3	2.4	0.0	0.6	0.5	0.4	0.0	0.4	0.3	0.3
Little Island..	0.0	3.2	6.1	7.3	15.1	17.4	13.5	28.0	6.6	4.7	2.6	1.0	2.5	0.0	1.1	0.2	0.1	0.6	0.1	0.0	0.0	0.0	0.0
Merchant	0.0	0.3	0.4	1.5	5.2	13.5	24.0	27.8	22.2	14.7	11.0	4.5	2.9	1.1	5.5	0.5	1.2	1.2	0.8	0.7	1.7	0.2	1.8
Opeongo	0.5	0.5	1.4	2.0	4.1	5.9	9.7	14.6	19.3	17.9	14.3	8.7	5.2	2.9	2.0	0.9	0.7	0.5	0.6	0.4	0.3	0.2	0.4
Smoke	1.5	0.3	2.5	1.4	3.0	7.3	13.0	9.1	12.4	4.2	7.9	5.1	6.5	5.8	5.7	1.5	0.6	1.0	1.8	1.0	1.7	0.0	0.2

Algonquin Park. However, since this program was not initiated on a wide scale until 1939 it is perhaps still too early to come to any definite conclusions with regard to its ultimate value.

The data presented here also give a further indication of the relative sparseness of the lake trout populations in these lakes. The best figures to illustrate this point are those for Opeongo Lake. Although this lake has an area of 20.1 square miles and has a very extensive shore development, the removal of approximately 1,500 lake trout in a year appears to suppress effectively any benefit to be derived from a major year class beyond the second year after its entry. This estimate is based on the catches from 1938 to 1942. The removal of 1,500 lake trout represents one fish per eight and one-half acres.

The standard profile of availability which appears to be of some value in the classification of the Algonquin Park fisheries is probably of only local significance. However, it does seem useful in assessing management practice within this particular administrative area.

Acknowledgments

Investigation into the lake trout fishery has been made possible since 1938 through grants from the National Research Council of Canada, and through the financial support of the Department of Lands and Forests of the Province of Ontario. The work was carried out in the Ontario Fisheries Research Laboratory, Department of Zoology, University of Toronto. Mr. F. A. MacDougall, Deputy Minister of Lands and Forests and Dr. W. J. K. Harkness, Chief of the Division of Fish and Wildlife, formerly the Director of the Ontario Fisheries Research Laboratory, have given their whole-hearted encouragement to this work. Further credit should go to the several junior members of the staff, who each year filed a painstaking report on the lakes they had studied: Messrs. W. A. Kennedy, J. S. Hart, J. R. Brett, K. H. Doan, A. W. F. Banfield, D. W. Kirk, F. L. Balmer, N. V. Martin, J. A. Long, N. D. Martin, and A. Schell.

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