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A study of the sturgeon sucker in Great Slave Lake

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THE UNIVERSITY OF ALBERTA

A STUDY OF THE STURGEON SUCKER IN GREAT SLAVE LAKE 1950-51

A DISSERTATION

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by

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ABSTRACT

Commercial fishing for whitefish in Great Slave Lake has been proceeding since 1945. Its competitor, the sturgeon sucker, has been scarcely exploited by this fishery. A two-year study of the suckers was begun in the summer of 1950 to learn something of the general biology of the species and to determine if the removal of whitefish had changed their rate of growth or abundance.

Sampling was done with standardized nets and young fish were caught by seining. Some 1100 suckers were examined.

Data concerning growth in length and weight are provided. Mortality rate and growth coefficient are discussed.

Spawning habits are examined. The sucker is found to spawn in the spring in streams. Age of spawning fish, number of eggs and condition are discussed.

INTRODUCTION

Investigations carried out in the years 1944 to 1947 demonstrated that lake trout, common whitefish and ciscoes dominated the fish population of Great Slave Lake; the former two species now support an extensive gill-net fishery.

The sturgeon sucker (Catostomus catostomus Forster) ranked fourth in numbers and fifth in weight in standard gill-net catches. It is a bottom-feeding fish and hence a competitor of the whitefish. With removal of whitefish by fishermen, the suckers might increase in numbers and growth and slowly replace the more valuable whitefish.

The fishery on Great Slave has been operating since 1945; several million pounds of whitefish have been removed annually. The purpose of this work is to determine if the removal of whitefish has made any change in the rate of growth of the sturgeon sucker.

The author was employed by the Central Fisheries Research Station as a Research Assistant during the summers of 1950 and 1951. Samples were collected at that time.

The sturgeon sucker is called by a variety of names: longnose sucker, northern sucker and fine-scaled sucker. Since only two species of suckers have been identified in Great Slave Lake, no difficulty was encountered in recognition. The common sucker (Catostomus commersoni Lacépède) is easily distinguished when adult; it was taken only occasionally in shallow water. The identity of small suckers was checked by counting scales on the caudal-peduncle; the sturgeon sucker has 17 or more, the common, 13 or less.

Little has been published about the sturgeon sucker. D. S. Rawson (1951) calculated the growth rate of 86 fish caught in Great Slave Lake. He also determined the length-weight relationship by drawing a smooth curve through a length versus weight plot of 350 fish. The largest specimens examined were four between 50 and 51 cm. in length. They weighed from 4 to $4\frac{3}{4}$ pounds and were 13 and 14 years old. The rate of growth in Great Slave was found to be almost identical with that in Lake Minnewanka, Banff, and very much faster than in Pyramid Lake, Jasper (Rawson and Elsey, 1950). The food of 160 specimens was examined; in most cases advanced digestion and debris made volumetric analysis impossible. The average percentage by volume of all foods taken was: amphipods (mainly Pontoporeia), 63; chironomid larvae, 15; other aquatic insects (mainly caddis), 11; and sphaeriids, 9. Traces of gastropods, mayfly and damsel-fly nymphs were found.

D. S. Rawson and C. A. Elsey (1948) calculated the growth rate of 76 fish from Pyramid Lake, Jasper. No difference was observed between rates of growth of males and females but females lived longer. The largest individual examined was 12.4 inches long and weighed 13.4 ounces. Spawning began about June 10, continued to a maximum in the third week in June and was usually complete by July 1. Spawning took place in the streams and certain shallow rocky parts of the lake. Fish in spawning condition moved freely into the streams at temperatures of 11 to 14 degrees C., but lingered in the lake near the stream mouth when the inflowing water was at 9 degrees C. or lower. Forty percent of males and 12 percent of females were sexually mature at 4 years (spawning in their fifth summer). At 5 years 65 percent of the males and 20 percent of the females were mature and at 6 years all the individuals were mature. Young suckers were found to feed mostly on zooplankton; Cladocera made up 66 percent of their food; Cyclops, 4 percent; chironomid larvae and pupae, 6 percent; Gammarus, 1 percent and terrestial insects, 23 percent. The food of larger specimens consisted of: Amphipods, 72 percent; chironomid larvae and pupae, 19 percent; mayfly nymphs, 5 percent; Cladocera, 1.5 percent; sphaeriids, 1.2 percent; snails, 0.6 percent; and miscellaneous, 0.7 percent.

The rate of growth of the sturgeon sucker in Pyramid Lake was compared with that in nearby Lake Patricia and Lake Minnewanka, Banff. It was found to grow faster by one third in the former, and faster by one half in the latter.

W. A. Clemens (1939) obtained 3 sturgeon suckers in gill-nets; one at 200 feet (60 meters) and two at 100 feet (30 meters) in Okanogan Lake. The two at 100 feet were 11 3/8 inches (25.7 cm.) and 16½ inches (38.5 cm.). The food consisted chiefly of midge larvae with considerable numbers of ostracods, copepods (Cyclops) and water mites.

K. D. Carlander (1944) calculated an average condition factor (K-value) of 1.96 for 6 fish taken at Lake of the Woods.

K. D. Carlander and S. Eddy (1942) calculated the rate of growth of suckers up to 5 years from a study of 20 fish from Minnesota lakes.

F. Neave and A. Bajkov (1929) calculated growth rate up to 4 years of fish taken in Jasper Park lakes.

METHODS OF SAMPLING

During the summer of 1950 samples were collected by any means available; the majority of the fish was obtained from commercial fishermen. The legal mesh size on Great Slave Lake is 5½ inch stretched measure. Samples were also taken in 4½ and 3 inch gill-nets and from seine hauls.

The following summer (1951) a standard gang of light weight cotton gill-nets was supplied by the Fisheries Research Board. The mesh sizes were 1½ inch, 2 inch, 3 inch, 4 inch, 5 inch and 5½ inch. These nets (50 yards each) greatly extended the range of sizes taken.

Catch in Different Mesh Sizes.

The numbers, average length and average weight of suckers caught in the various meshes are shown in Table I.

Table I. Average lengths and weights of suckers taken in various meshes of the standard gang gill-nets.

(Numbers of specimens are shown in parentheses.)

1½ in.		2 in.		3 in.		4 in.		4½ in.		5 in.		5½ in.	
cm.	lb	cm.	lb.	cm.	lb.	cm.	lb.	cm.	lb.	cm.	lb.	cm.	lb.
16.3	0.13	24.0	0.44	33.8	1.2	40.8	1.9	44.2	2.3	45.7	3.0	50.2	4.0
(9)		(19)		(33)		(47)		(5)		(10)		(497)	
4 rejects										Total 624 fish.			

Ninety-eight suckers were omitted from Table I as they were taken in the Hay River during the spring of 1952

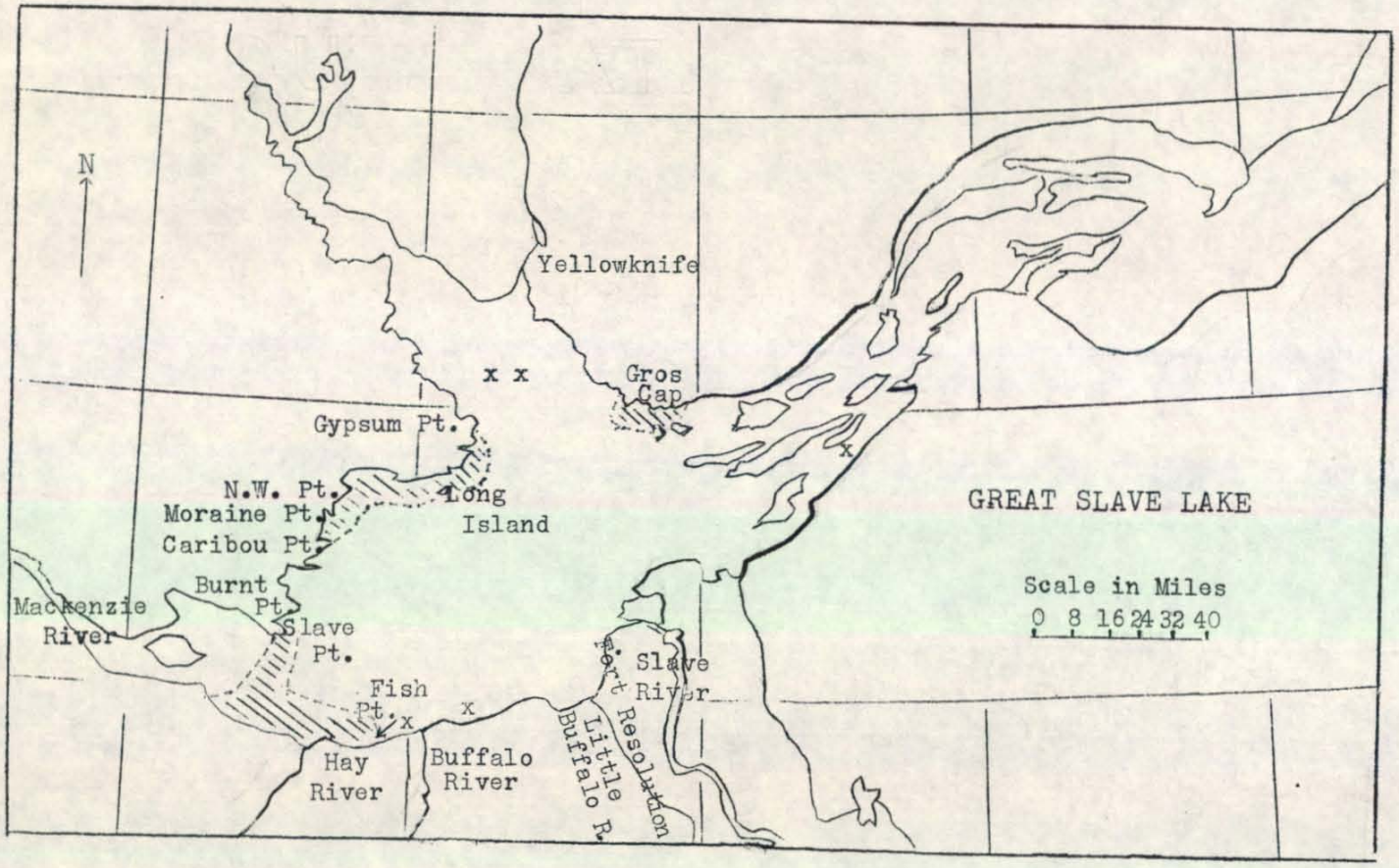
when the effectiveness of the nets used was decreased by river-borne debris clogging the meshes.

The large number of samples received from the 5½ inch gill-nets of the commercial fishermen accounts for the number of samples listed under 5½ inch mesh. A good deal of overlapping of sizes taken in successive meshes was noted and a wide range of lengths was obtained. The average lengths and weights are similar to those obtained by D. S. Rawson (1951) except in the 5½ inch mesh. The discrepancy is probably explained by the difference in the number of samples. The figures in Table I for the 5½ inch mesh are averages of 497 fish. Rawson's figures are averages for 25 fish taken in the same size mesh. The smallest sucker taken by gill-nets was 14.2 cm., weighed 1 ounce and was 2 years old. The largest taken was 64.2 cm., weighed 7.3 pounds and was 19 years old.

Catch in Seine Hauls

In 1950 seine hauls were made in the Hay River one quarter mile up from the mouth, on Aug. 22, 27 and 29; 23 sturgeon suckers were captured. All were found to be in their first season and ranged in size from 38 mm. to 80 mm. A few seine hauls in the lake did not yield any suckers.

In 1951 two seine hauls were made in the Hay River, one quarter mile up from the mouth, on Aug. 15;


N
Yellowknife
x x
Gros Cap
Gypsum Pt.
N.W. Pt.
Moraine Pt.
Caribou Pt.
Long Island
GREAT SLAVE LAKE
Scale in Miles
0 8 16 24 32 40
Burnt Pt.
Mackenzie River
Slave Pt.
Fish Pt.
Slave River
Fort Resolution
Little Buffalo R.
Hay River
Buffalo River

these resulted in the capture of 301 sturgeon suckers all in their first season and ranging from 33 mm. to 66 mm. Thirty-three mm. was the smallest sucker taken in the study; it was found to have scales formed.

Distribution of Samples

Due to the large area of Great Slave Lake (10,500 square miles) it was not possible to obtain samples from the whole lake. Efforts were concentrated on sampling the south and west shores; some samples were obtained from the Gros Cap area.

Figure I (opposite page 7) shows (cross hatch) the location of the majority of the samples. Isolated samples are marked X. In analyzing the samples the fish from Fish Point to Slave Point were treated as one population and designated Hay River samples; those from Caribou Bay to Long Island were treated as a second population and called Moraine Point samples. The numbers of suckers from each are: Hay River 532 and Moraine Point 194. The Moraine Point suckers include 17 caught in the Gros Cap area.

Depth Distribution

The northern sucker was found in shallow water in May and June. Samples were taken at Hay River in from 18 to 30 feet. In July and August they were found at greater depths and most of the samples were taken in from 30 to 60 feet;

some were caught at 80 feet off Burnt Point. The standard gang was set in shallow water from 6 to 24 feet and most of the smaller samples were taken at these depths; the depths and localities of samples are recorded in Table II.

Table II. Depths at which suckers were taken in different localities.

Dates	Locality	Depth
June 28, 1950	Burnt Pt.	50' - 80'
June 28-30, 1950 August 15-21, 1951	Hay River	18' - 30'
July 17-26, 1950 July 1-9, 1951	N.W. Pt.	30' - 60'
July 17, 1950	Caribou Bay	25' - 48'
July 20-31, 1950 July 1-9, 1951	Moraine Pt.	30' - 60'
July 27, 1950 July 16-30, 1951	Long Island	4' - 65'
August 11-24, 1950	Fish Pt.	20' - 50'
August 13, 1951	High Pt.	30' - 40'
August 7-18, 1951	Slave Pt.	60' - 60'
August 18-20, 1951	West Channel	44' - 60'

AGE AND GROWTH

The rate of growth of the sturgeon sucker was investigated by age determination of 726 individuals. The fork lengths of the fish were measured in millimeters immediately after capture.

Impressions of the scales were made on plastic slides with a press made from a notary seal. Age was determined by counting the annuli with the aid of a binocular microscope. The interpretation was checked by projecting the images of the scale impressions in a dark room. Annuli were detected by the presence of incomplete circuli, erosion and cutting over. The annuli were most discernable in the anterior field but cutting over was best seen along the postero-lateral scale radii.

From examination of the scales the annuli appear to be laid down in June. The age of the fish was taken to be equal to the number of annuli; thus, a fish of Age Group 11 (11 annuli) would be actually in its twelfth summer.

Comparative Growth of Northern and Southern Populations

When the ages of all the fish had been determined in this way, the fish were arranged into two groups, northern and southern. Table III shows the age groups and the average length of each age group for the Hay River samples

(southern) and the Moraine Pt. samples (northern). The 1950 and 1951 samples are combined.

Table III. Numbers and average length of suckers of each age group in the northern and southern populations.

Age Group	Hay River Area		Moraine Pt. Area	
	Average length (mm.)	No. of Samples	Average Length (mm.)	No. of Samples
2	179	3	152	4
3	203	12	170	2
4	239	7	253	1
5	306	4	290	4
6	308	5	314	3
7	363	11	330	10
8	412	19	372	13
9	479	64	403	31
10	496	101	433	41
11	496	128	465	31
12	517	66	499	14
13	530	50	510	13
14	541	32	518	14
15	557	18	547	4
16	575	7	527	4
17	586	5	579	2
18			607	2
19			642	1
Totals		532		194

The average lengths in centimeters for each age group were plotted against the age, as shown in figure II (facing page 11). There appears to be a definite indication

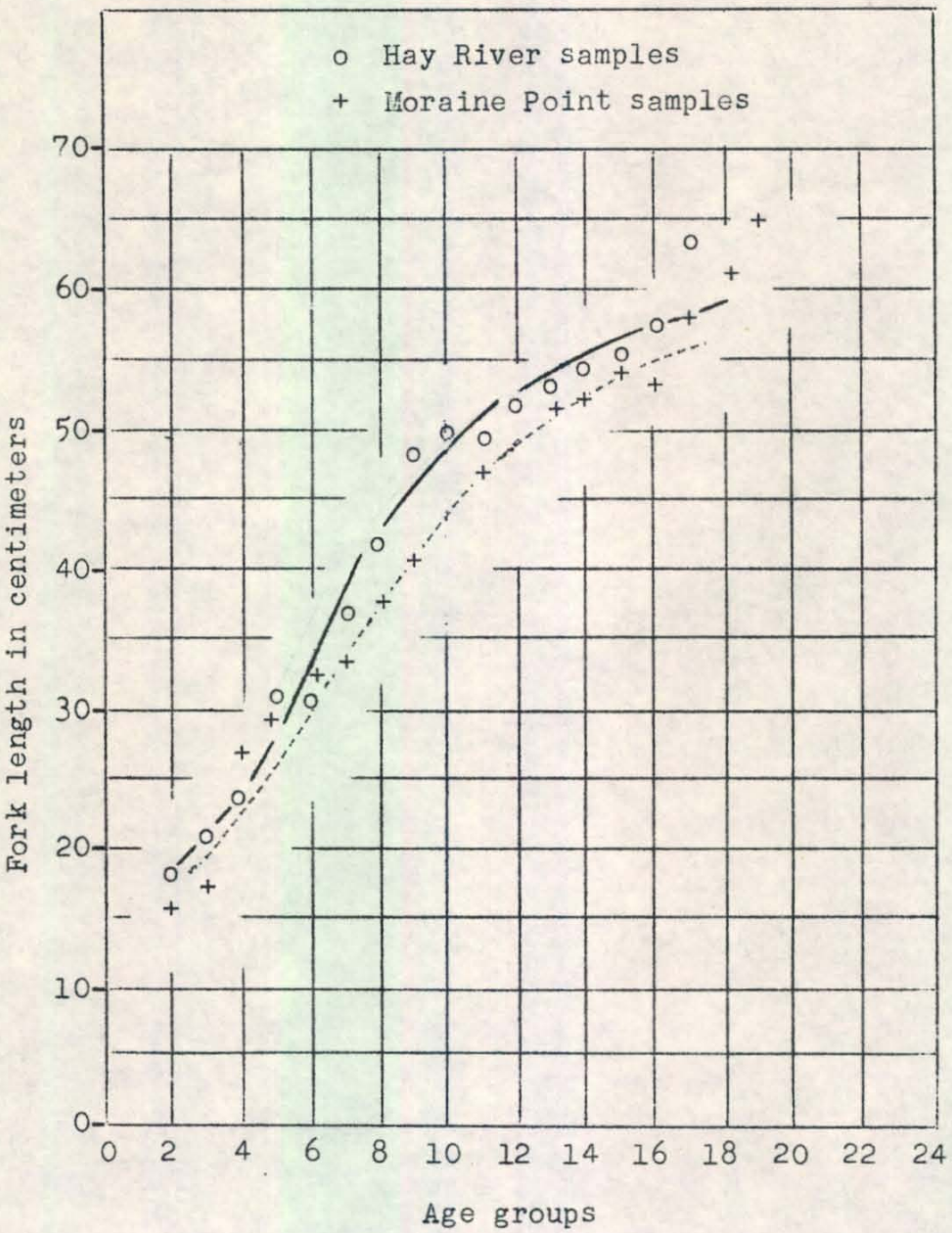


Figure II. Growth in length of Moraine Pt. (northern) and Hay River (southern) sturgeon suckers in Great Slave Lake.

that the rate of growth along the south shore is more rapid than that along the north and west shore. It can be noted especially, in the range from 8 to 14 years, from which most of the samples came, that the average length of the southern fish was greater than the average of northern fish of the same age class. Since the south shore is shallow and receives several rivers which are rich in organic material (i.e. the Slave, Buffalo and Hay Rivers) the conditions for growth would be expected to be more favorable than in the more barren northern areas.

The commercial fishermen caught great numbers of suckers all along the south shore from the Slave Delta to Deep Bay in the summers of 1950 and 1951. In some catches the suckers considerably outnumbered the whitefish. This was especially so in Deep Bay. However the suckers appear to be encountered in large numbers only in a narrow band between the two places named above. In the rest of the lake the commercial fishermen take only the occasional sucker.

Growth of Males and Females

In Table IV the average lengths of males and females of each age group are shown. The data are combined for the north and south populations.

Table IV. Average lengths of males and females of each age group.

Age Group	Av. Length Females	No. of Samples	Av. Length Males	No. of Samples
2	163	7		
3	198	14		
4	241	8	(immature)	
5	298	8		
6	310	8		
7	349	17	384	4
8	379	22	423	10
9	452	55	459	40
10	477	98	479	44
11	496	117	474	42
12	516	63	506	17
13	534	44	510	19
14	536	33	529	13
15	562	17	526	6
16	568	9	562	1
17	584	7		
18	607	2		
19	642	1		
Totals		530		196

Positive identification of sex was very difficult in suckers younger than seven years except for a few individuals. In this study fish younger than seven were classed as immature. The data in Table IV are plotted in Figure III (facing page 13). A smooth curve has been drawn through the female points. The immature lengths were plotted to extend the lower end of the curve. The males appear as points scattered on both sides of the curve. This indicates

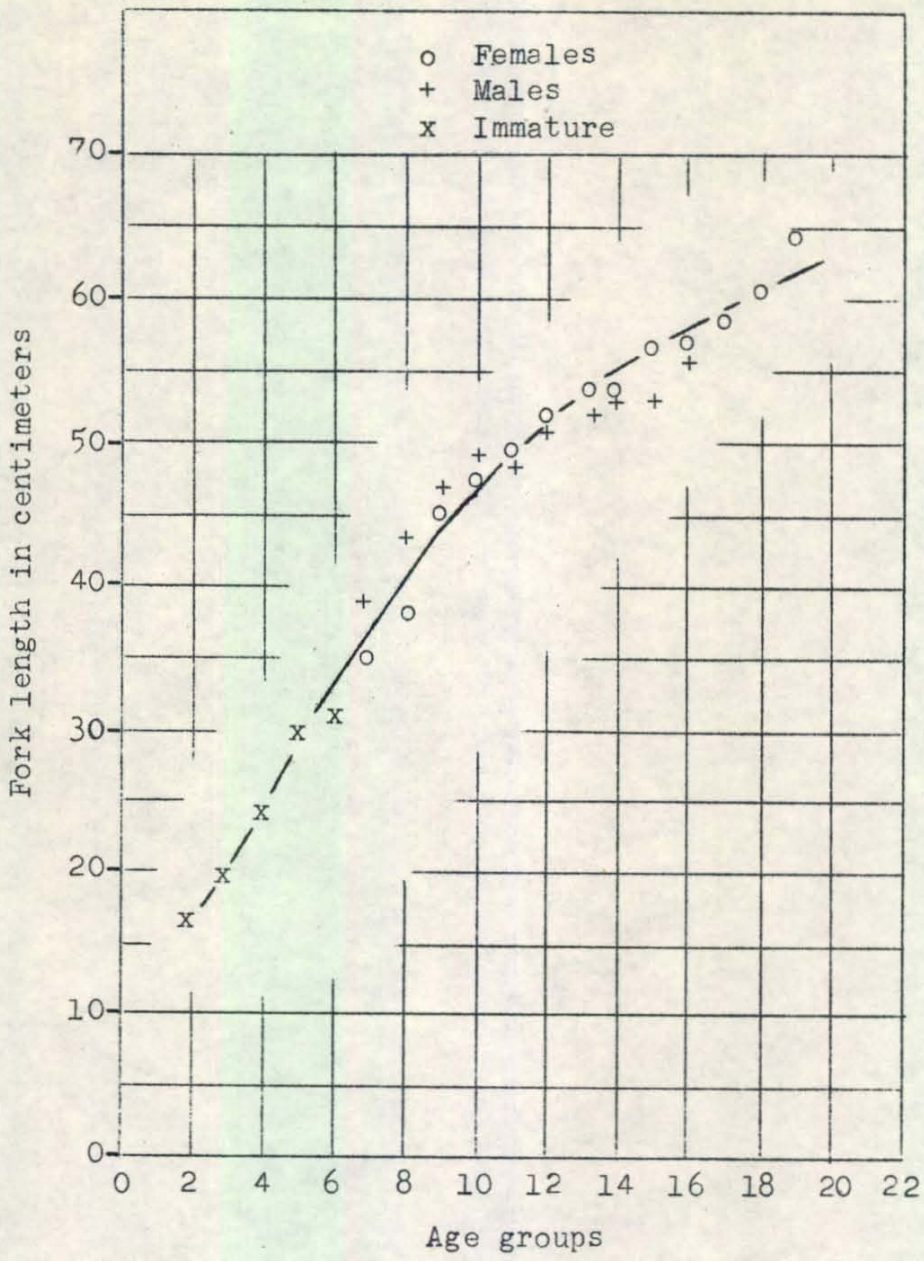


Figure III. Growth in length of male and female sturgeon suckers in Great Slave Lake.

that both sexes increase in length at approximately the same rate. There is no definite indication that either sex grows faster than the other. The analysis indicates however that the female suckers outlive the males. No males were captured older than 16 years, whereas females were taken as old as 19 years.

Age Composition of Catch

Edser[1] (1908) grouped a catch of fish into size-classes of equal breadth and plotted the logarithms of the frequency of occurrence of fish in each class. A curve resulted which had a steeply ascending left limb, a dome shaped upper portion, and a long descending right limb which in his example was straight or nearly so through its entire length. This was soon recognized as a convenient method of representing catches graphically.

Baranov[2] (1918) christened such a graph a catch curve and pointed out its most interesting feature, which is, that taken in conjunction with a uniform yearly increase in length of the fish, straightness of the right limb indicates a uniform rate of survival of the fish from year to year and at the same time provides a convenient numerical estimate of it.

The rate of survival, s, from such a curve

1. Paper by Edser (1908) referred to in a publication by Ricker (1948).
2. Paper by Baranov (1918) referred to in a publication by Ricker (1948).

is commonly computed by taking the difference in logarithm between age n and n-1, a negative quantity; it can be written with a positive mantissa and then antilogged, giving s directly. The compliment of s expresses the annual mortality rate.

The ascending left limb and the dome of the catch curve represent age classes which are incompletely captured by the gear used to take the sample: that is, they are taken less frequently in relation to their abundance, than are older fish. This may come about either because the younger fish are more thickly distributed in another part of the body of water than that principally fished, or because they are less ready to enter the nets. It is impossible to find out anything definite about the actual mortality rate during the years covered by the left limb and dome of the curve because sampling of the population is not random.

Straightness of the right limb, or any part of it is usually interpreted in the manner described by Baranov which involves the following conditions:

1. The survival rate is uniform with age over the age groups in question.

2. Since survival rate is the compliment of mortality rate, and the latter is compounded of fishing and natural mortality, this will usually mean that each of these individually is uniform.

3. The sample is taken randomly from the age

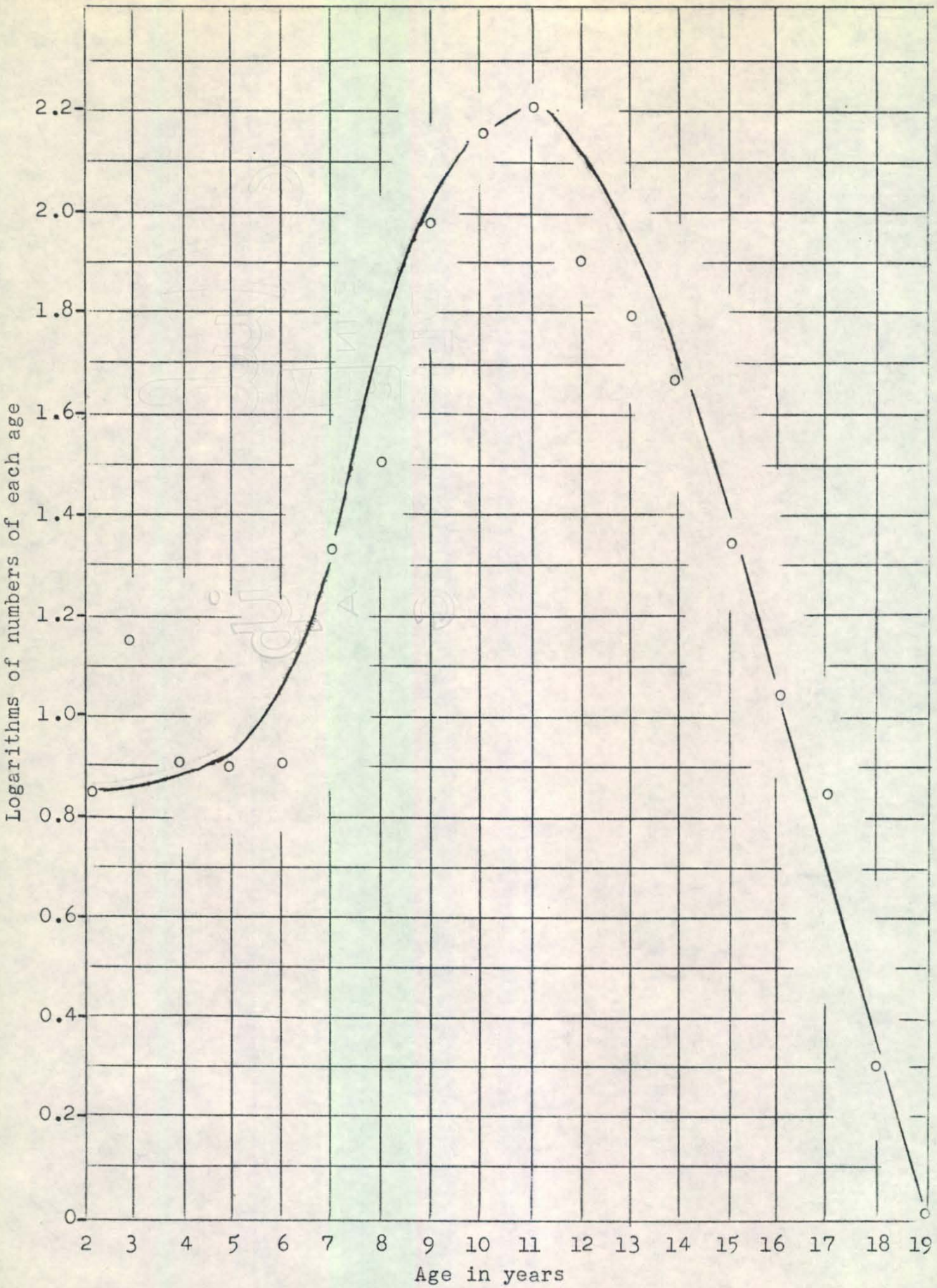


Figure IV. Catch curve of the sturgeon sucker in Great Slave Lake.

groups involved. (If the sample is representative of the commercial catch, this condition is implied in 2 above.)

4. The age-groups in question were equal in numbers at the time each was being recruited to the fishery.

If these conditions are satisfied the right limb is a curve of survivorship which is both age specific and time specific.

The logs of data in Table V were plotted against the ages and a smooth curve was drawn through the plots as shown in Figure IV (facing page 15). The straight descending limb of the resulting curve shows an average survival rate of 45% each year after the suckers reached 11 years. The compliment of the survival rate represents the annual mortality rate of the suckers; in this case 55%.

Since the majority of suckers was taken in $5\frac{1}{2}$ inch mesh, it appears that the 11 year old class is most susceptible to this gear. The samples taken in smaller mesh were included to extend the ascending limb of the curve. The curve cut the horizontal axis at 19 years indicating that suckers attain the life span of approximately 20 years.

Comparison of 1950-51 Suckers with Samples Taken 1944-45-46.

During the period 1944-46, Dr. D. S. Rawson collected samples of sturgeon suckers from Great Slave Lake

with a standard gang of gill-nets similar to those used by the author in 1950-51. The growth data of these suckers have been published (Rawson, 1951). It is important to learn if these suckers were growing at a lesser rate than they do now. In order to compare this earlier sample with the author's data it is necessary to be sure the age determinations were made in the same way. Dr. Rawson very kindly sent his measurements and scale samples; these have been studied by the author; the age interpretations made by Rawson have been changed to suit the author's interpretation. Rawson's modified data are shown in Table V compared to the author's 1950-51 data.

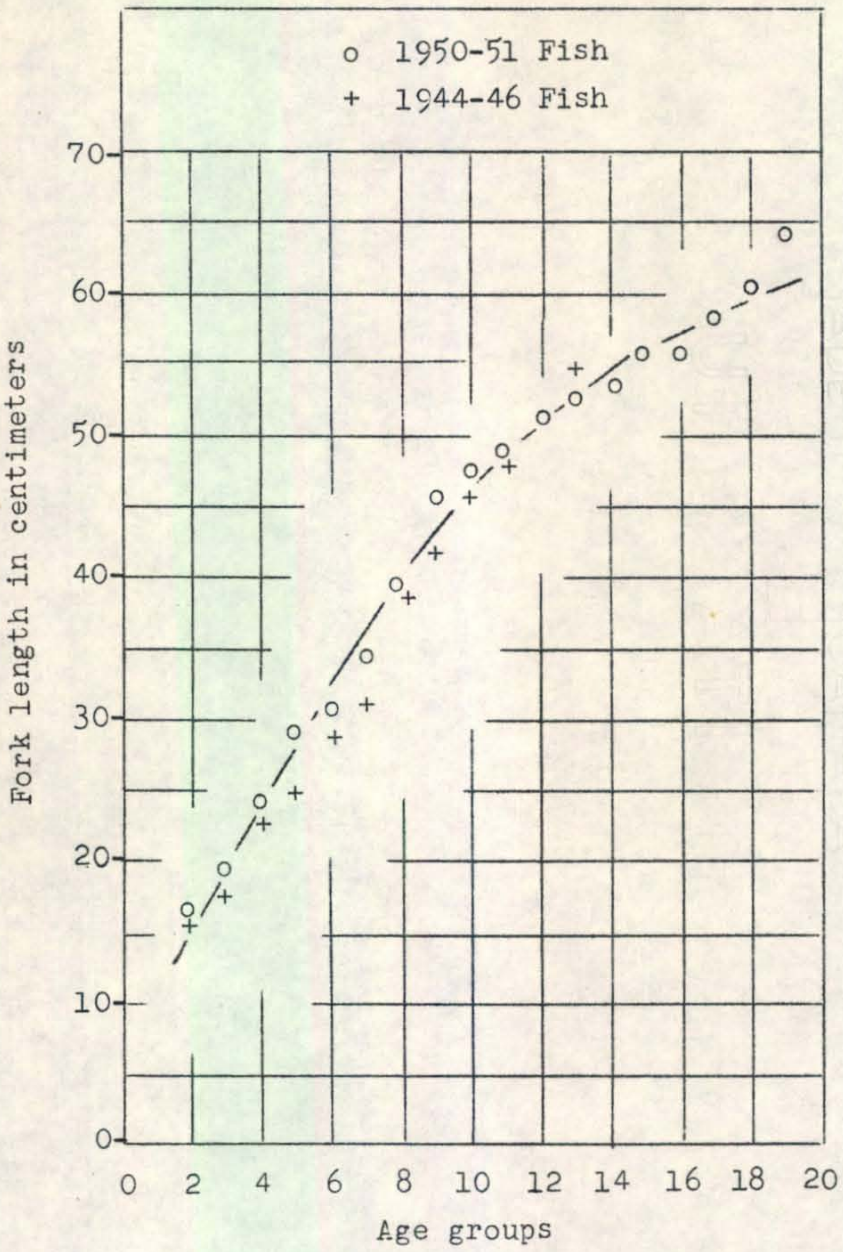


Figure V. Growth in length of 1944-46 and 1950-51 sturgeon suckers in Great Slave Lake.

Table V. Numbers and average length of fish of each age group 1944-46 compared to 1950-51.

Age Group	1944-46.		1950-51.	
	Av. Length (mm.)	No. of Samples	Av. Length (mm.)	No. of Samples
2	158	3	163	7
3	177	10	198	14
4	224	6	241	8
5	248	6	298	8
6	288	9	310	8
7	321	9	347	21
8	386	9	396	32
9	413	5	455	95
10	456	6	477	142
11	474	12	489	159
12	552	2	514	80
13	538	7	526	63
14			534	46
15			555	22
16			556	11
17			584	7
18			607	2
19			642	1
Totals		84		726

The 1950-51 age-length data have been plotted and a smooth growth curve drawn (Figure V facing page 17). The average lengths of the 1944-46 suckers have been plotted on the same axes; the points were found to scatter on both sides of the smooth curve. Thus there appears to have been no significant change in the sturgeon sucker since 1946.

This would indicate that the commercial fishery has had no measurable effect on the sucker. The 1950-51 samples were obtained largely in an area of the lake 20 miles each way from Hay River while the 1944-46 samples were largely from the Ft. Resolution area, but since the geographical conditions are similar over the whole south shore region the growth rate should be relatively constant.

WEIGHT-LENGTH RELATIONSHIP

Immediately after capture of the suckers, the fork length was measured in millimeters and the weight taken in pounds. In order to convert fork length to standard length (snout to end of vertebral column) a factor was derived from the data on 84 of Dr. Rawson's scale envelopes which had standard length in millimeters and fork length in inches. The equation arrived at was,

Fork length X 0.88 - Standard length.

pounds were converted to grams directly.

Coefficient of Condition

*The coefficient of condition is a measure of the relative "fatness" of the fish. Weight in fishes may be considered a function of the length. If form and specific gravity were constant throughout life the relationship could

* Ref. Lagler (1950).

be expressed by the cube law,

$$W = KL^3$$

where W = weight

L = length

and K = a constant

Actually, in nature, it has been found that the value of K is not constant for an individual, a species or a population but that it is subject to a wide range of variation. The value K expresses the relative "well being" of a fish and may be used to measure the effects of environment.

The K-values were worked out for random samples of suckers from each of the areas sampled and also were calculated for the 1944-46 samples. The equation used was,

$$k = \frac{100\ W}{L^3}$$

where K = coefficient of condition

W = weight in grams

and L = standard length in mm.

K was multiplied by 100 to give a convenient value. The data are shown in Table VI.

Table VI. K-values for suckers from different areas of the lake. (Numbers of samples in parentheses).

Locality	1944-46		1950		1951	
Hay River			1.87	(34)	1.98	(95)
Fish Pt.			*1.83	(31)		
			**2.00	(68)		
Ft. Resolution	1.73	(51)				
Slave Pt.					2.04	(33)
Moraine Pt.			2.01	(51)	1.88	(44)
Long Island					1.77	(73)
Gros Cap					2.02	(17)
Yellowknife Bay	1.74	(32)				

* Depth 20' - 40'
** Depth 50' - 65'

In Table VI the figures in parentheses represent the number of suckers from each locality for which K was determined. The K-values represent averages of these numbers. It is seen that the K-value varies from area to area over small distances. Suckers in 20 - 40 feet of water north of Fish Pt. in 1950 showed an average K-value of 1.83, while only a few miles away, in water 50 - 60 feet deep, the

average K-value was 2.00. Also the K-value varied from year to year. Samples taken off Moraine Pt. in 1950 showed a K-value of 2.01 while samples from the same locality in 1951 showed a K-value of 1.88. The K-values for the 1944-46 suckers taken from the Ft. Resolution and Yellowknife Bay areas were almost identical to that obtained in 1951 at Long Island.

A mean K-value for the sturgeon sucker in Great Slave Lake was obtained by averaging the data in Table VI. It was found to be K = 1.90. This figure represents the average of 529 fish from all the areas sampled.

K.D. Carlander (1944) computed an average condition factor, K = 1.96, for 6 sturgeon suckers from Lake of the Woods. This figure is almost equal to the mean for Great Slave Lake.

Sexual Dimorphism in Weight

The weights of male and female suckers were averaged for each 5 cm. interval; the data are presented in Table VII.

Table VII. Average weight of males and females for each 5 cm. length interval.

Interval	Females		Males	
	Av. Weight (lb)	No. of Samples	Av. Weight (lb)	No. of Samples
10.1 - 15.0	0.1	2		
15.1 - 20.0	0.2	10	(immature)	
20.1 - 25.0	0.3	13		
25.1 - 30.0	0.75	14		
30.1 - 35.0	1.1	23	1.1	1
35.1 - 40.0	1.7	32	1.9	10
40.1 - 45.0	2.5	70	2.5	42
45.1 - 50.0	3.2	129	3.4	76
50.1 - 55.0	4.0	142	4.1	54
55.1 - 60.0	4.8	74	4.8	11
60.1 - 65.0	6.4	13		
Totals		522		194

Suckers below 35 cm. were too immature to identify sex except in one case, a male, in the 30 - 35 cm. group. The average weights of males and females listed in the table are almost identical. There is no evidence of sexual dimorphism in weight of the sturgeon sucker. No males were taken longer than 60 cm; 13 females exceeded this length. These larger females grow heavier than the males but, as was shown in a previous section, this is simply because they live longer.

Growth Coefficient

* The aforementioned equation $W = KL^3$ cannot be employed to describe the general weight-length relationship in populations of fishes due to the failure of the cube law on which it is based to describe accurately the relationship of length and weight in many forms of fishes.

The following more general equation is a more satisfactory method of describing this relationship in fish.

$$W = CL^n$$

where W = weight

L = length

and C = a constant.

In this equation the values of both C and n are derived empirically.

The data have been arranged as shown in Table VIII.

* Ref. Lagler (1950).

Table VIII. Empirical treatment of data for derivation of C and n in the equation $W = CL^n$. Average weights for each 10 mm. interval and number of samples are shown for 1950-51 fish.

No. of Fish	Standard Length(mm.)	Log L	Weight (gm.)	Log W	Log LX Log W	$(\log L)^2$
2	128		36			
1	139		57			
2	144		36			
1	153		71			
3	224		228			
1	242		324			
1	251		324			
3	257		324			
3	264		410			
6	277	2.4425	436	2.6395	6.4470	5.9658
5	287	2.4579	436	2.6395	6.4876	6.0413
5	293	2.4669	456	2.6590	6.5595	6.0856
6	303	2.4814	547	2.7380	6.7941	6.1573
3	312	2.4942	638	2.8048	6.9957	6.2210
5	321	2.5065	684	2.8351	7.1062	6.2825
13	329	2.5172	730	2.8633	7.2075	6.3363
9	337	2.5276	775	2.8893	7.3030	6.3888
10	346	2.5391	844	2.9263	7.4302	6.4470
9	355	2.5502	958	2.9814	7.6032	6.5035
21	364	2.5611	958	2.9814	7.6357	6.5592
17	373	2.5717	1049	3.0207	7.7683	6.6136
27	382	2.5821	1140	3.0569	7.8932	6.6672
30	390	2.5911	1231	3.0903	8.0073	6.7138
37	399	2.6010	1305	3.1156	8.1037	6.7652
37	408	2.6107	1314	3.1186	8.1417	6.8158
42	417	2.6201	1414	3.1504	8.2544	6.8649
40	428	2.6314	1505	3.1776	8.3615	6.9243
23	434	2.6375	1627	3.2112	8.4695	6.9564
44	442	2.6454	1696	3.2294	8.5431	6.9981
43	451	2.6542	1733	3.2388	8.5964	7.0448
52	460	2.6628	1815	3.2589	8.6778	7.0905
31	470	2.6721	1915	3.2882	8.7704	7.1401
39	478	2.6794	1978	3.2963	8.8321	7.1792
30	487	2.6875	2066	3.3151	8.9093	7.2227
26	495	2.6946	2257	3.3535	9.0363	7.2609
12	504	2.7024	2508	3.3994	9.1865	7.3030
639		69.7886		82.2725	213.1212	180.5488

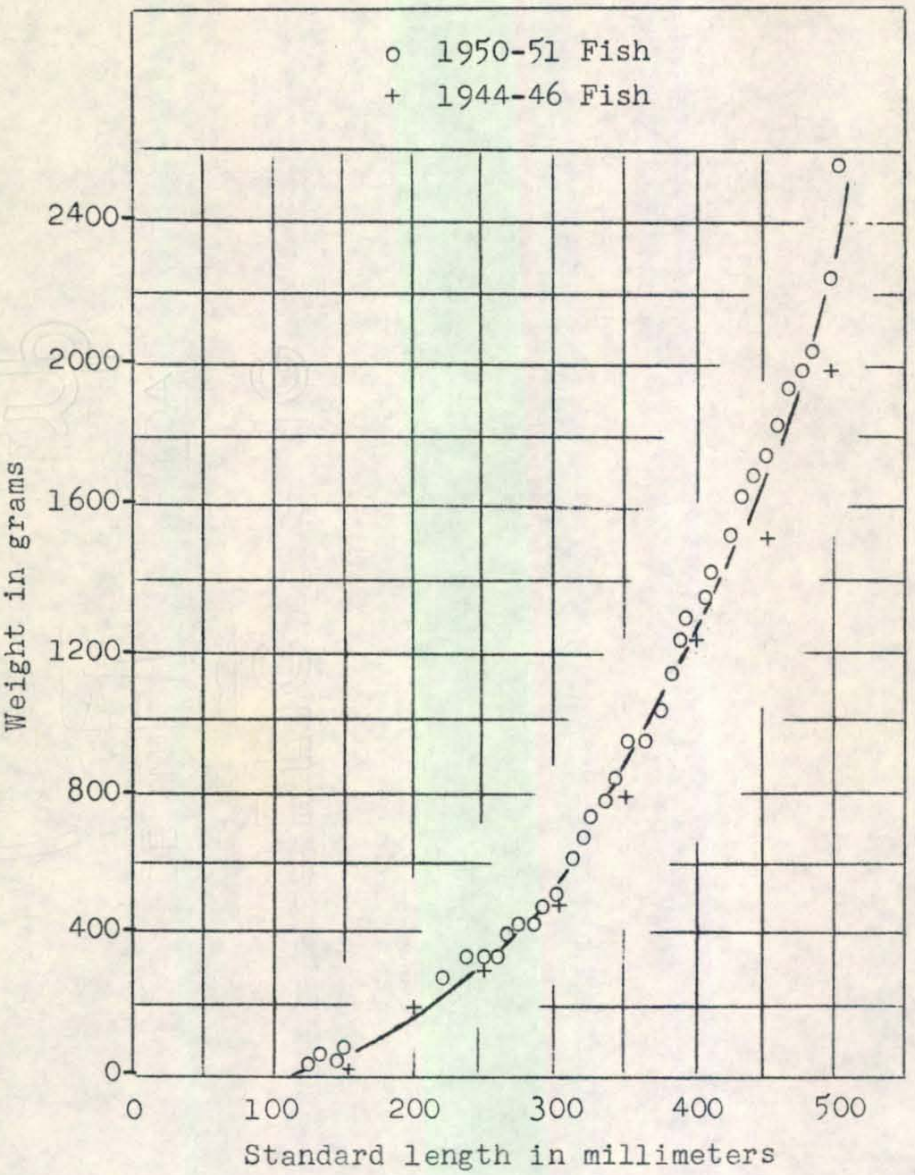


Figure VI. Weight-length relationship of the sturgeon sucker in Great Slave Lake.

The average weight in pounds was taken for each 10 mm. interval of fork length. The figure shown for the length is the average of all the lengths in the interval.

The data were converted from fork length to standard length as in the calculation of K-values.

The averages for 639 fish were plotted and a smooth curve drawn through them as shown in Figure VI, (facing page 25).

The average weight for each 5 cm. interval, derived from the 1944-46 fish, (Rawson 1951) were plotted on the same axes for comparison. The groups fitted the 1950-51 curve quite well except for the last two plots. This may be explained by the larger number of samples included in the 1950-51 averages.

A value for C in the equation $W = CL^n$ was derived by substituting the data in Table VI in the equation,

$$\log C = \frac{\Sigma \log W \cdot \Sigma(\log L)^2 - \Sigma \log L \cdot \Sigma(\log L \cdot \log W)}{N \cdot \Sigma(\log L)^2 - (\Sigma \log L)^2}$$

log C was found to be -4.4014. This value of log C was substituted in the equation,

$$n = \frac{\Sigma \log W - (N \cdot \text{Log } C)}{\Sigma \log L}$$

The value of n was found to be 2.88. This figure 2.88 is the growth coefficient for the sturgeon sucker.

Normally n is constant for each species of fish. With this in mind the standard lengths and weights in grams of Rawson's 1944-46 suckers were analyzed in the same manner (Table IX).

Table IX. Average weights per 5 cm. interval for 350 fish 1944-46.

Standard Length (mm.)	Weight (gm.)	log L	Log W	log L X log W	$(\log L)^2$
150	57	2.1761	1.7559	3.8210	4.7354
200	170	2.3010	2.2304	5.1322	5.2946
250	280	2.3979	2.4472	5.8681	5.7499
300	450	2.4771	2.6532	6.5722	6.1360
350	740	2.5441	2.8692	7.2995	6.4724
400	1110	2.6021	3.0453	7.9242	6.7709
450	1480	2.6532	3.1703	8.4114	7.0395
500	1960	2.6990	3.2923	8.8859	7.2846
		19.8505	21.4638	53.9145	49.4833

The data in Table IX yield a value of log C of -4.4572 and a value for n of 2.88. This value for n was exactly equal to that obtained for the 1950-51 suckers. The values for log C differed slightly in the two sets of data.

The weight-length relationship of the sturgeon sucker may be confidently expressed, therefore, with the formula -

$$\log W = -4.4014 + 2.88 \log L$$

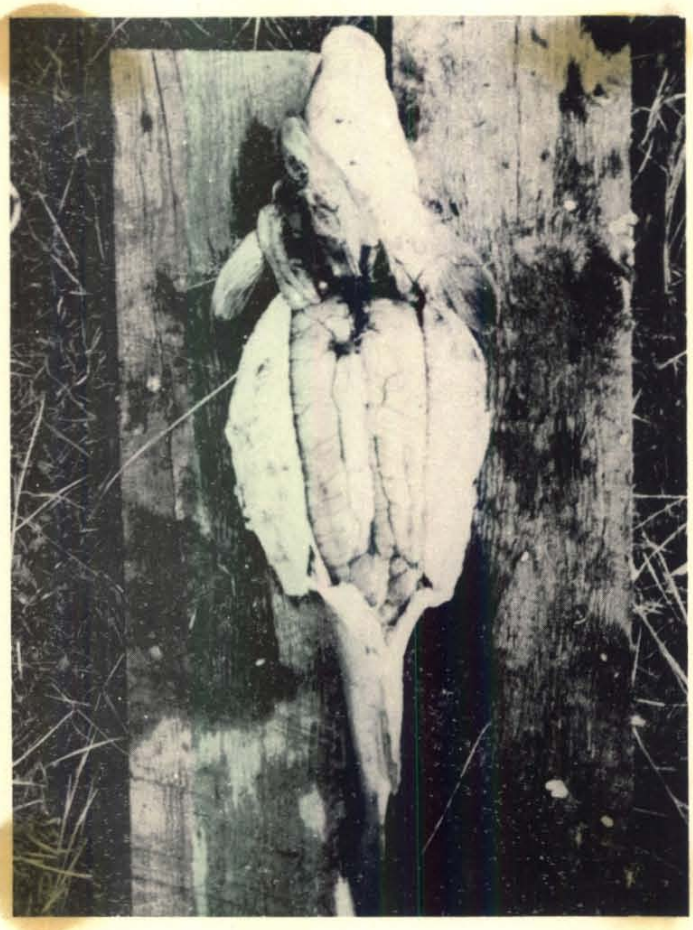


FIGURE VII

PHOTOGRAPH OF A RIPE FEMALE SUCKER SHOWING THE APPEARANCE AND SIZE OF THE OVARIES.

or, in its non-logarithmic form by, -

$$W = 0.000252L^{2.88}$$

By substituting a known length in either of these formulae the weight may be obtained, and vice-versa.

SPAWNING HABITS

Talks with the inhabitants of Hay River disclosed that sturgeon suckers appear in the river in large numbers immediately following the spring break up which usually occurs in May. They are taken in nets set to catch dog food.

The author made arrangements with Mr. H. Camsell, the game warden at Hay River, to keep records of the suckers caught in his net from the time the ice left until the author's arrival in Hay River.

The spring of 1951 proved to be an unusual one. The ice broke above Hay River on May 1 and 2, and a jam formed which caused flooding of the town from May 3 to May 6, the date the ice in the mouth finally broke.

The water level continued high and the current swift because of a long period of rain and snow. Mr. Camsell finally set his net (marked No. 1 on Figure X facing page 30) on May 17.

The author arrived in Hay River May 27 and began examining the suckers. At first it was feared that the spawning run would be over, but upon investigation the fish

FIGURE VIII

PHOTOGRAPH OF A RIPE MALE SUCKER SHOWING

THE APPEARANCE OF THE TESTES.

in the river were found to be immature.

Description of Ripe Fish

A typical ripe female has a gold greenish back and a reddish pink coloration along the lateral line. When being removed from the net such females extrude eggs in large quantities. The pink lateral coloration was more noticeable in the early summer than later in the season and may have a connection with the spawning condition. The ovaries completely filled the abdominal cavity as shown in Figure VII (facing page 27) which is a photograph of a female in ripe condition.

A spent female was much the same in outward appearance but the ovaries were much reduced, containing very small eggs and in some cases were quite fatty, which may have meant they had been eating heavily for some time after spawning. In some spent fish the ovaries were ribbon like.

A female was considered immature when the ovaries were filled with eggs which were smaller and less developed than those in the ripe condition.

A typical ripe male is a gray green gold color along the back with a bright pink stripe along the lateral line. Nuptial tubercles, or pearl organs, develop along the rays of the anal and caudal fins and are very noticeable both to sight and touch.

FIGURE IX

PHOTOGRAPH OF A RIPE MALE SUCKER (UPPER) AND

A RIPE FEMALE SUCKER (LOWER).

These are definite indicators of a male sucker in breeding condition, becoming much reduced and hardly noticeable later in the summer. The testes are highly convoluted and white in appearance as shown in Figure VIII (facing page 28), a photograph of a male sucker in spawning condition with the testes exposed. Milt exudes easily when a ripe male is handled.

In the spent condition the testes are much reduced and hardened. The nuptial tubercles are beginning to disappear. Figure IX (facing page 29) shows a photograph of a ripe male and ripe female.

Time of Spawning Run

Because of the late spring and the cold run-off from the snow, the water temperature may have been lower than that required for optimum spawning conditions. The high water level and the extremely turbid condition of the water may also have had a retarding effect upon the spawning. As may be seen in Figure X (facing page 30) net No. 1 was situated in a position across the main channel and took an average of 7 suckers per day for a period of a month (Table XI).

One problem was to determine if the suckers were travelling up stream to spawn or down stream after spawning.

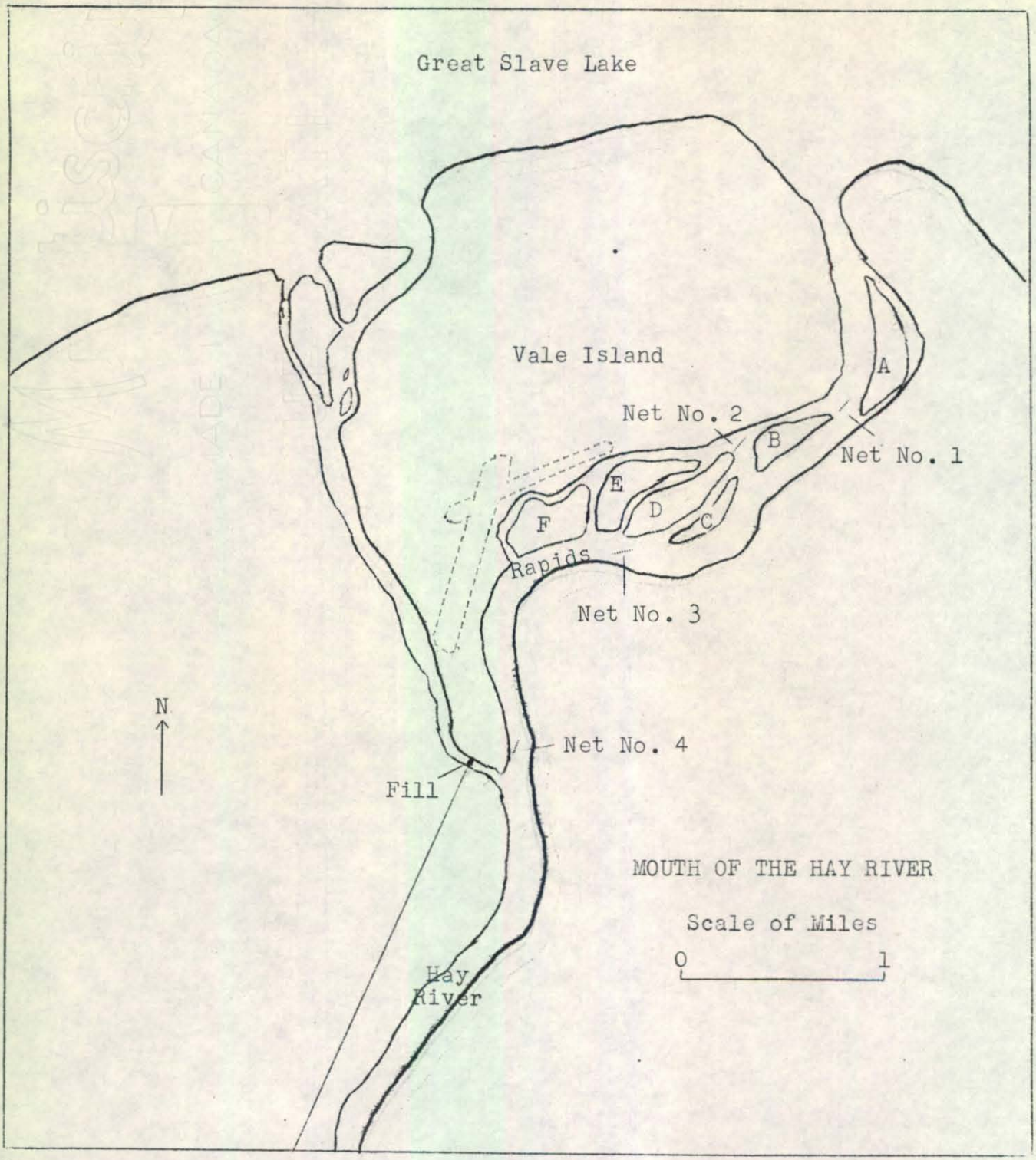


Figure X. Map of the mouth of the Hay River showing location of nets used in the spawning study.

Nets 2, 3 and 4 were set as indicated in Figure X. Net No. 2 was set at the downstream point of Island D but failed to take one sucker in 10 days although pike, whitefish and pike-perch were taken. Net No. 3 was set in a backwater at the foot of the rapids across from the upstream point of Island D. Net No. 4 was set in an eddy above the rapids and about 3 miles from the mouth of the river. The catches of these nets are shown in Table X.

Table X. Condition of suckers taken in 4 nets, June 9-17.

Date	Net No. 3	Net No. 4	Net No. 1	Lake
June 9		3 (1R M, 1R F, 1S F)	5	
10	1R F		8	
11	1R F	1R F	7	
12	1R M		3	1S F
13		2 (1R M, 1R F)		5S FF
14			9	2S FF
15			3	
17			2	10 (2S MM, 7S FF, 1I F)

Table X lists the numbers and condition of suckers taken in nets Nos. 3 and 4, and fish examined from nets

in the lake. The numbers taken in net No. 1 for the same dates are included for comparison. The condition of the suckers in net No. 1 is noted in Table XI and discussed later.

Fish were taken in net No. 3 as late as June 12. Since the net was in an eddy beside swift water the fish may have been resting before proceeding upstream to spawn somewhere above the rapids. Confirming this supposition is the fact that ripe fish were taken in net No. 4, above the rapids, until June 13. There is approximately 30 miles of river between the rapids and Louise Falls, which form an impassible barrier to fish. The sturgeon sucker might spawn anywhere in this area.

The spawning act was not observed due to the extreme turbidity of the water.

The fish examined from nets in the lake, in the period under discussion, were mainly in a spent condition (Table X) suggesting that they had already returned from spawning. No indication could be found that any suckers were spawning in the lake.

Table XI shows the condition of the suckers taken in the Hay River during the study.

Table XI. Condition of suckers taken in Hay River May 17 - June 24 and surface water temperatures.

		Females			Males			
Date	No. of Fish	Im.	Ripe	Spent	Im.	Ripe	Spent	Surface Temp.
May 17	7							
18	5							
19	7							
21	7							
22	8							
23	6							
24								
25	18							
26								
27	8							
28	3							
29	3	2	1					
31	7	7						
June 2	5							
4	7	4	3					
6	8	3	2	2			1	54° F
7	7	2	4	1				54° F
8	3	1	1	1				
9	8	1	4	2			1	
10	9	1	7	1				
11	9	3	4	1		1		59° F
12	5	1	1	1		1	1	
13	7	3	1	2		1		
14	11	1	5	5				
15	3	1	1	1				
17	12	1		9			2	
18	3							60° F
21	4		1	3				
22	4			3			1	
23	4							
24	7			6			1	
Total	*195	31	35	38		3	7	

* 81 fish not sexed.

Examination of Table XI shows that an average of 7 suckers per day was taken in the river. After June 6 the percentage of immature fish was very low and after June 17 none was taken. Ripe fish were taken up to June 15 and one additional ripe female was taken June 21. After June 17 all the fish with the aforementioned exception were found to be in a spent condition indicating that they were returning to the lake.

Only 3 ripe males were taken, on June 11, 12 and 13. All the remaining males taken were in a spent condition.

Surface water temperatures were recorded on 4 dates. On June 6 and 7 the temperature was 54°F and by June 11 had risen to 59°F. By this date most of the spawning appears to have been over and this range 54 - 59°F could be the maximum temperature at which spawning takes place. On June 18 the surface temperature was 60°F and the suckers seemed to be on their way back to the lake.

D. S. Rawson and C. A. Elsey (1948) found that, in Pyramid Lake, sturgeon suckers in spawning condition moved into the streams at temperatures of 52 - 57°F (11 - 14°C), but remained in the lake when the inflowing water was at 50°F (9°C) or lower; this is close to the temperature range observed in Great Slave Lake.

Mr. Camsell kept a net in the position of net No. 1 all summer and reported that after July 4 only an occasional sturgeon sucker was taken. This would indicate that the sturgeon sucker does not frequent the river during the summer months.

Thus spawning appears to take place in the Hay River in the spring over a period ranging from break up to June 15. Surface water temperature was in the 50 - 60°F range over the latter portion of this period.

Rawson and Elsey (1948) found that spawning of the sturgeon sucker in Pyramid Lake took place from June 10 to July. This is roughly one month later than in Great Slave Lake.

Age and Sex of Spawning Suckers

The age and sex of the suckers caught in Hay River during the spawning run are shown in Table XII.

Table XII. Numbers and sex of each age group of spawning suckers.

Age Group	9		10		11		12		13		14		15	
Sex	F	M	F	M	F	M	F	M	F	M	F	M	F	M
No.of Fish	5	-	23	3	32	5	17	2	6	-	3	-	1	1

The Table shows that no suckers younger than 9 years were taken. It was seen previously (Table V) that sex could not be determined in suckers under 7 years and although sex could be determined in some 7-year-olds they were not sufficiently developed to spawn. The absence of 8-year-olds in the samples indicates that they, too, were probably too immature to spawn; their absence does not seem to be due to net selectivity. Net No. 1 was of 5 inch mesh and as seen in Table I, a 5 inch mesh size took suckers of an average length of 45.7 cm. Since the average length for female eight-year-olds was 37.9 cm. and for male eight-year-olds 43.3 cm. they would be within the catch range of the 5 inch mesh. If eight-year-olds had been in the run in considerable numbers it seems likely that at least one would have shown up. Hence it may be assumed from the available data that the sturgeon sucker makes its first spawning run at the age of nine years.

It was seen in Pyramid Lake (Rawson and Elsey 1948) that 40 percent of males and 12 percent of female sturgeon suckers were sexually mature at 4 years (spawning in their fifth summer). At 5 years 65 percent of the males and 20 percent of the females were mature and at 6 years all individuals were mature. Thus the sturgeon sucker in Great Slave Lake takes at least 3 years longer to reach sexual maturity than in Pyramid Lake.

The greatest numbers taken were in the 11-year-old class. The oldest fish taken were a male and a female, each 15 years old. However, older females were taken later in the summer containing large numbers of eggs.

The Table also shows that females taken outnumbered the males by 87 to 11 or a ratio of 8:1. The sex ratio obtained from the total samples (excluding immature individuals) was 485 females to 196 males or 2.5:1. It would be expected that the sex ratio at spawning time would be similar since the gear used was of the same type. The small numbers of males taken might indicate that the main spawning run was over when the samples were taken and that just the late spawners, mostly females, were caught. It is well known for other fishes that the males arrive before the females on the spawning grounds.

Condition Factors of Spawning Suckers

Table XIII lists the condition factors computed for suckers in ripe and spent condition.

Table XIII. Condition factors for ripe and spent suckers.

K Ripe Fish	No. of Fish	K Spent Fish	No. of Fish
1.98	25	2.04	9
1.76	3	2.12	20
1.91	15	2.07	7
Av.1.94	43	Av.2.09	36

The average K-value in each case was arrived at by dividing the sum of the K-values for each group by the total samples in each group. The results appear to be unusual in that the spent fish display a better K-value than the ripe fish containing eggs. This may indicate that the suckers do not eat during the spawning period; the spent fish may eat voraciously and quickly gain back lost weight. The numbers of samples analyzed may be insufficient to draw firm conclusions, but in each of the 3 groups analyzed the spent fish had a higher K-value than the ripe fish.

Egg Production

Ovaries were removed from eight ripe females and the eggs were counted by a volumetric method. Three 5 cc. samples were taken, one from each end and one from the middle, of each ovary. The volume of each sample was measured by displacement of water in a graduated cylinder. The eggs in each sample were counted and an average number of eggs per cc. determined.

The volume of the remaining ovary was then found by displacement of water. The total number of eggs was calculated by proportion, knowing the total volume and the average number of eggs per cc.

The data are given in Table XIV.

Table XIV. Egg counts of eight suckers.

No.	Age	Length mm.	Weight lb.	Eggs Per cc.	Vol. of Ovary (cc.) minus samples	No. of Eggs
1	9	450	2.4	168	103	17,525
2	10	526	4.3	177	357	60,307
3	11	465	3.4	120	322	38,746
4	13	568	4.5	120	359	42,432
5	11	505	3.6	195	106	20,817
6	10	490	3.5	226	173	38,104
7	12	505	3.5	156	223	24,795
8	14	523	3.4	171	219	37,312

In order to determine the percentage error of the volumetric method, one set of eggs (No. 8 Table XIV) was determined volumetrically and the eggs were then counted one at a time. The volumetric figure was 37,312 eggs, the actual count 38,195, a difference of 833 or an error of 2%.

Four sets of eggs were counted while fresh (Nos. 1 to 4) and four sets were preserved in 5% formalin and counted later. It was found that the preserved eggs were easier to handle than the fresh eggs.

An examination of Table XIV disclosed that the number of eggs in a fish is not a function of the age. A nine-year-old fish, (the youngest age class represented in the spawning run(Table XIII)) contained the smallest number of eggs 17,525; but a ten-year-old fish had the largest number of eggs 60,307. The nine-year-old fish weighed 2.4 pounds and the ten-year-old 4.3 pounds. A fourteen-year-old fish had 37,312 eggs.

Eggs from fresh ovaries were examined and found to vary in diameter from 1.5 mm. to 3 mm. The eggs at the anterior end of the ovary had a yolk the same size as those at the posterior end but the latter were invested with a thicker envelope.

As a follow up to the spawning study two seine hauls were made one quarter mile from the mouth of Hay River on August 15, 1951. Of the 338 small fish taken

7 were pikeperch, 30 were spottail minnows, and 301 were sturgeon suckers.

The smallest taken was 33 mm; it had acquired its scales each of which consisted of the focus and 2 or 3 circuli. The largest taken was 66 mm. and was also in the first season but the scales had formed more circuli. The average length of the fish was 50 mm.

In 1950 seine hauls were made on August 22, 27, 29 and 23 sturgeon suckers were taken ranging from 38 mm. to 80 mm. They were all in their first summer. Since the spawning suckers were taken in the spring and fry were taken from the river in the early fall the supposition that the sturgeon sucker spawns in the river seems to be confirmed.

Seine hauls were made along the lake shore but did not yield any suckers.

SUMMARY

1. The purpose of this study has been to gather information regarding the sturgeon sucker Catostomus catostomus, in Great Slave Lake and to determine if its rate of growth has been affected by the removal of its competitor, the whitefish, in the commercial fishery which began in 1945.

2. A survey is given of the methods and gear used in sampling the sucker population. A map shows the localities from which samples were taken.

3. The sturgeon sucker is most numerous in the southern waters of Great Slave Lake.

4. Growth rate studies indicate that the suckers along the north west shore grow more slowly than those along the south shore.

5. Males and females grow at the same rate.

6. The analysis of a catch curve provides an estimate of total annual mortality of 55 percent.

7. Evidence is presented which indicates that no significant change in the rate of growth of the sucker has occurred in the period 1946-1951. Thus it appears that the whitefish fishery has had no measurable effect on the sucker.

8. A mean K-value of 1.90 has been calculated.

9. No sexual dimorphism in weight is evident.

10. The growth coefficient of the sturgeon sucker was calculated from empirical data. When used in a

weight-length formula, weight may be calculated from a known length and vice versa.

11. Some details of spawning habits are presented. It is hoped that these will provide a nucleus of information for those who undertake additional investigations.

12. Suckers in spawning condition are described.

13. Spawning appears to take place in the Hay River in the spring over a period ranging from break-up to June 15.

14. Surface water temperatures were in the 50-60°F range over the latter part of this spawning period.

15. Suckers are found to spawn for the first time in their ninth year.

16. Females contain from 17,000 to 60,000 eggs.

ACKNOWLEDGMENTS.

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