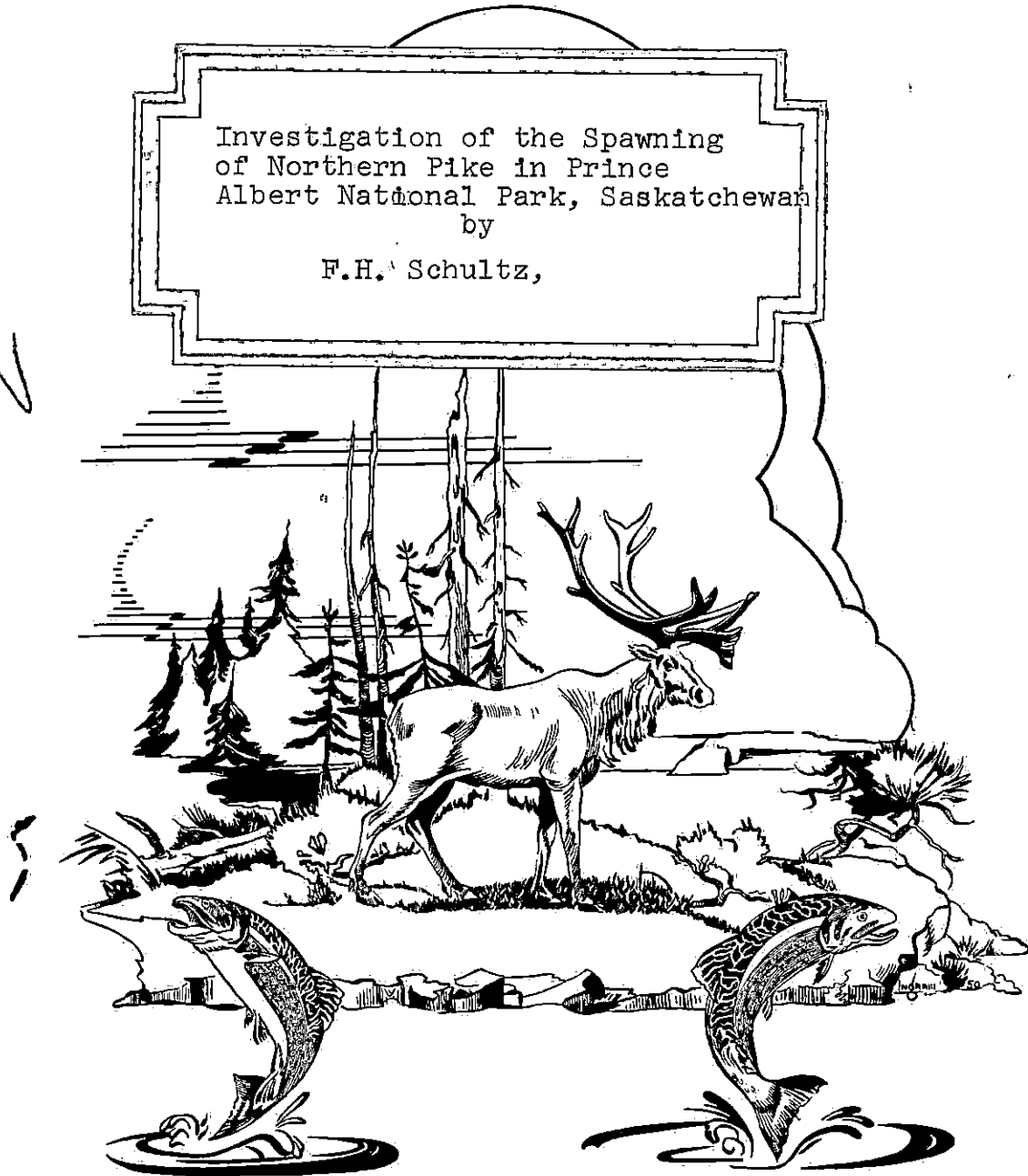


# WILDLIFE MANAGEMENT BULLETIN

Investigation of the Spawning  
of Northern Pike in Prince  
Albert National Park, Saskatchewan  
by  
F.H. Schultz,



DEPARTMENT OF NORTHERN AFFAIRS  
AND NATIONAL RESOURCES  
NATIONAL PARKS BRANCH  
CANADIAN WILDLIFE SERVICE

SERIES 3

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CANADA  
DEPARTMENT OF NORTHERN AFFAIRS  
AND  
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NORTHERN PIKE IN PRINCE ALBERT  
NATIONAL PARK, SASKATCHEWAN,  
1953

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F. H. Schultz

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Wildlife Management Bulletins are produced to make available to wildlife administrators the information contained in reports which are submitted by officers of the Canadian Wildlife Service.

The reports do not, in most cases, cover extensive studies and are not written primarily for publication. Recommendations arising from the studies are not included.

## INTRODUCTION

During the period May 2 to June 7, 1953, limnological investigations were carried out in Prince Albert National Park, Saskatchewan, to obtain information on the population of northern pike (Esox lucius) in Lake Waskesiu. Particular attention was paid to spawning and the effect of beaver colonies on the migration of pike at spawning time. Figure 1 is a map showing the locality of the investigation.

An attempt was made to assess the importance of Mud Creek and other streams in pike reproduction, and to determine what action could be taken to improve the spawning facilities for pike.

The ecological features of this part of Saskatchewan resemble somewhat those of Algonquin Provincial Park in Ontario, but present some unique limnological problems. Prince Albert National Park contains large lakes and swampy watersheds, and there are many beaver colonies on its streams and lakes.

## ACKNOWLEDGMENTS

Mr. Alex Pease of Waskesiu gave valuable assistance and advice and generously permitted the use of his commercial fishing establishment for drying nets and examining specimens.

## INVESTIGATION OF MUD CREEK

### History

As the result of an investigation of angling conditions in Lake Waskesiu by Dr. V.E.F. Solman in 1946, beaver required for transplantation in Wood Buffalo National Park in 1947 and 1948 were live trapped in that part of Prince Albert National Park. During the summer of 1951 reports were received that female northern pike taken in Lake Waskesiu still had eggs in their coelomic cavities. It was suspected that this failure to release eggs was a result of inadequate spawning facilities. It was suggested that Mud Creek, one of the two largest streams flowing into the lake, which is believed to be

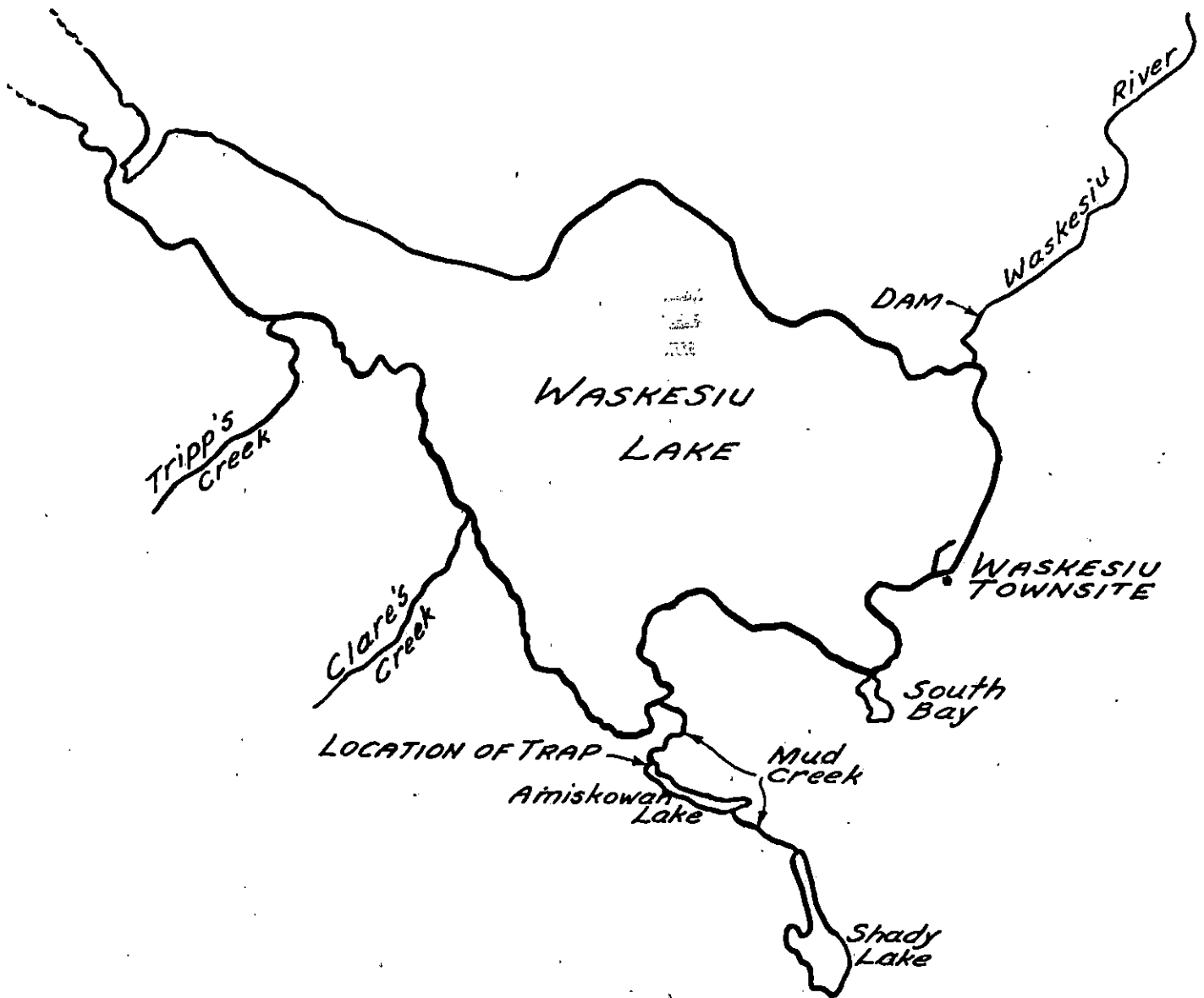


Fig. 1 - Map of general area of Mud Creek showing main areas of investigation and location of trap.

one of the main spawning areas for the pike of the lake, was over-populated by beaver, and that so many dams had been built across its channel that the pike could not ascend the stream to reach the spawning areas.

After discussing the matter with limnologists of the Canadian Wildlife Service, park authorities removed 98 beaver from Mud Creek and broke down several dams in 1952. The Superintendent of the park was authorized to remove up to 300 beaver from the general area in 1953, and early in the spring of that year 276 were trapped and removed.

### Reconnaissance

Upon arrival at the park on May 2, 1953, a reconnaissance of Mud Creek from Lake Wasquesiu to Shady Lake (Fig. 1) was carried out immediately. It was found that there was a fairly good channel up to Amiskowan or Mud Lake because of high water and the previous removal of dams. Between Amiskowan Lake and Shady Lake there were still several dams that had not been removed, and these could have prevented the pike from reaching the upper spawning grounds. This matter was brought to the attention of park authorities and the dams were dynamited to allow free passage for the pike along the entire length of the stream. During a second reconnaissance on May 3, it was noted that a large number of fish, including walleye or pickerel (Stizostedion vitreum), common white suckers (Catostomus commersoni), and northern suckers (C. catostomus), as well as northern pike, were already moving in the stream.

### Trapping Operation

During the reconnaissance on May 3 a location for a trap to catch fish migrating upstream was decided upon. On May 4, poles were cut and driven into the stream bed. The trap and the wings leading into it were constructed of one-inch chicken wire, secured to the poles by fence staples and anchored to the bottom by means of baling wire and large boulders. The trap was completed about 4 p.m. and it soon became apparent that a heavy run of fish was being caught.

It was found that fish released from the trap were so greatly fatigued from their struggle in the trap that they were unable to swim against the current, which was fairly rapid in that location. It was necessary to carry such fish in wash-tubs up-stream to a place with little current. The handling of hundreds of pounds of fish in this way was injurious to the fish and unduly laborious. It was therefore decided to move the trap

to a quieter part of the stream.

This transfer was completed on May 6. The trap continued in operation until 9 a.m. on May 15. It was cleared daily at about 8 a.m., 2 p.m., and 8 p.m.

The location of the trap on Mud Creek is shown in Figure 1.

Number and Species of Fish Trapped

All fish proceeding upstream and entering the trap were counted, and most of them were released on the upstream side of the trap. During the period May 4 to May 15, inclusive, a total of 13,266 fish were tallied. The total comprised 3,031 northern pike, 2,344 walleye, and 7,891 common and northern suckers. The common sucker was the most abundant species.

The daily totals for May 5 to 14, inclusive, are given in Table 1, which does not include the count made at 8 p.m. on May 4. The data for each day include counts of fish that entered the trap between 8 p.m. of the preceding day and 8 p.m. of that day. The fish trapped between 8 p.m. May 14 and 9 a.m. May 15 were not included in the totals. Figure 2 illustrates diagrammatically the relative daily numbers of pike and walleye and the relative size of the daily totals of all species.

Table 1. Daily Counts of Fish Trapped in Mud Creek, May 5 to 14.

Species	Day of Month										Totals
	5	6	7	8	9	10	11	12	13	14	
Pike	1,100	1,073	580	76	53	17	1	10	23	17	2,950
Walleye	780	940	378	99	51	23	7	3	18	22	2,321
Suckers	1,511	1,436	1,666	1,210	767	115	45	243	381	331	7,705
Totals	3,391	3,449	2,624	1,385	871	155	53	256	422	370	12,976

From Figure 2 it may be seen that the daily totals of fish taken form a normal recessional curve except for one fluctuation the cause of which is discussed below.



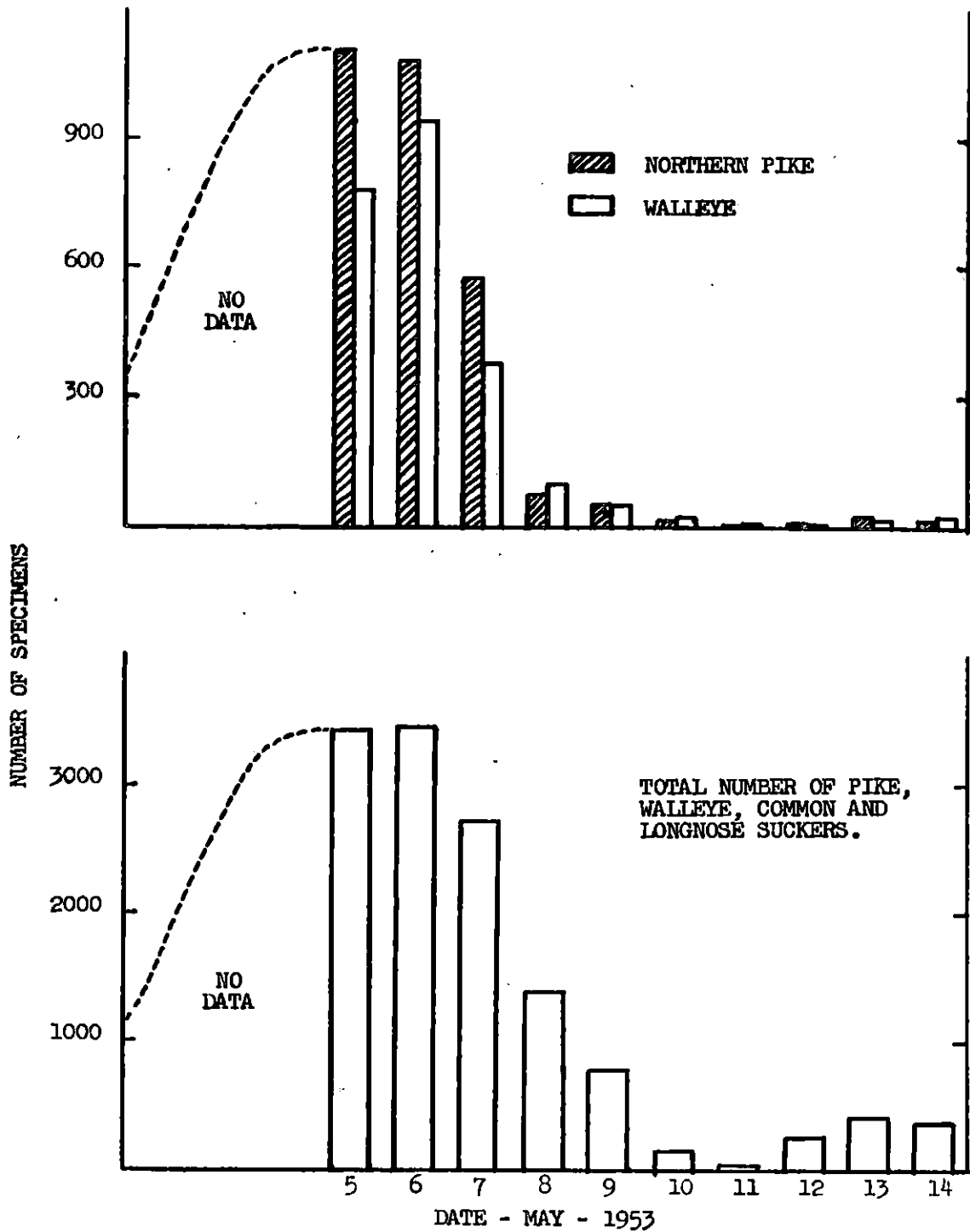


Fig. 2 - Histograms showing total daily collections of fish and comparative daily collections of pike and walleye from the trap on Mud Creek.

Considering the data presented above, it seems probable that the migration run of pike was sampled at its maximum during the first 24-hour period of trapping. The curve formed by the daily frequency distribution of pike is also a normal recessional one.

The numbers of walleye followed consistently the numbers of pike, except that there were fewer walleye than pike each day. It is important to notice that the migration run from Lake Waskesiu seems to occur at about the same time for walleye as for pike.

#### Fluctuation in the Spawning Run

It may be noted from Table 1 and Figure 2 that the greatest numbers of fish were trapped on the first days of the trapping period, and that the decline was steady until May 10. On May 10 the temperature dropped suddenly, and about six inches of snow fell, causing rapid cooling of the water. A decline in the number of fish entering the trap followed immediately. During the three days beginning May 12 the water temperature rose to nearly what it was before the snowfall, and the numbers of fish taken were about what could have been expected with uniform water temperature. The weather observations, the morning and afternoon temperatures, and the daily numbers of fish trapped for May 9 to 14, inclusive, were as follows:

Day of Month	9	10	11	12	13	14
Weather observations	Rain, colder	Heavy snow, cold	Snow flurries, cold	Clear, warmer	Clear, warmer	Clear, warm
Water temperature (degrees C.)						
a.m.	9	6	1	4	7	10
p.m.	-	4	2	5	7	-
Number of fish	871	155	53	256	422	370

Apparently there is a correlation between the size of the spawning run of northern pike, walleye, and suckers, and the temperature of the water. This constitutes a definite behaviour pattern or activity gradient, the amount of activity being directly proportional to the temperature.

This observation may support the concept advanced by some physiologists (Fry, 1947) that activity is merely the process of using energy released by metabolism, and that whatever controls metabolism must necessarily control activity. In this case temperature represents the controlling factor; lowering the temperature decreases the metabolic rate and breaks the activity pattern. This does not presuppose that activity and metabolism are the same, or that measures of activity are equivalent to measures of metabolism.

Length Frequency of Pike

Length frequency data were obtained from 71 pike examined during the trapping period and from an additional 297 pike from which only length measurements were taken, most of them being afterwards released alive. All lengths were measured in inches from the tip of the snout to the fork of the tail.

The data obtained from the total of 368 fish are presented by length groups in Table 2. The same data were used to construct a length frequency graph which appears in Figure 3.

Table 2. Length Distribution of 368  
Mature Pike from Mud Creek.

<u>Length in Inches</u>	<u>Number of Fish</u>	<u>Per Cent of Total</u>
17	1	0.3
18	8	2.2
19	9	2.4
20	31	8.4
21	48	13.0
22	60	16.4
23	48	13.0
24	53	14.4
25	34	9.2
26	24	6.5
27	13	3.5
28	13	3.5
29	7	1.9
30	6	1.6
31	4	1.1
32	2	0.5
33	1	0.3
34	1	0.3
35	1	0.3
36	1	0.3

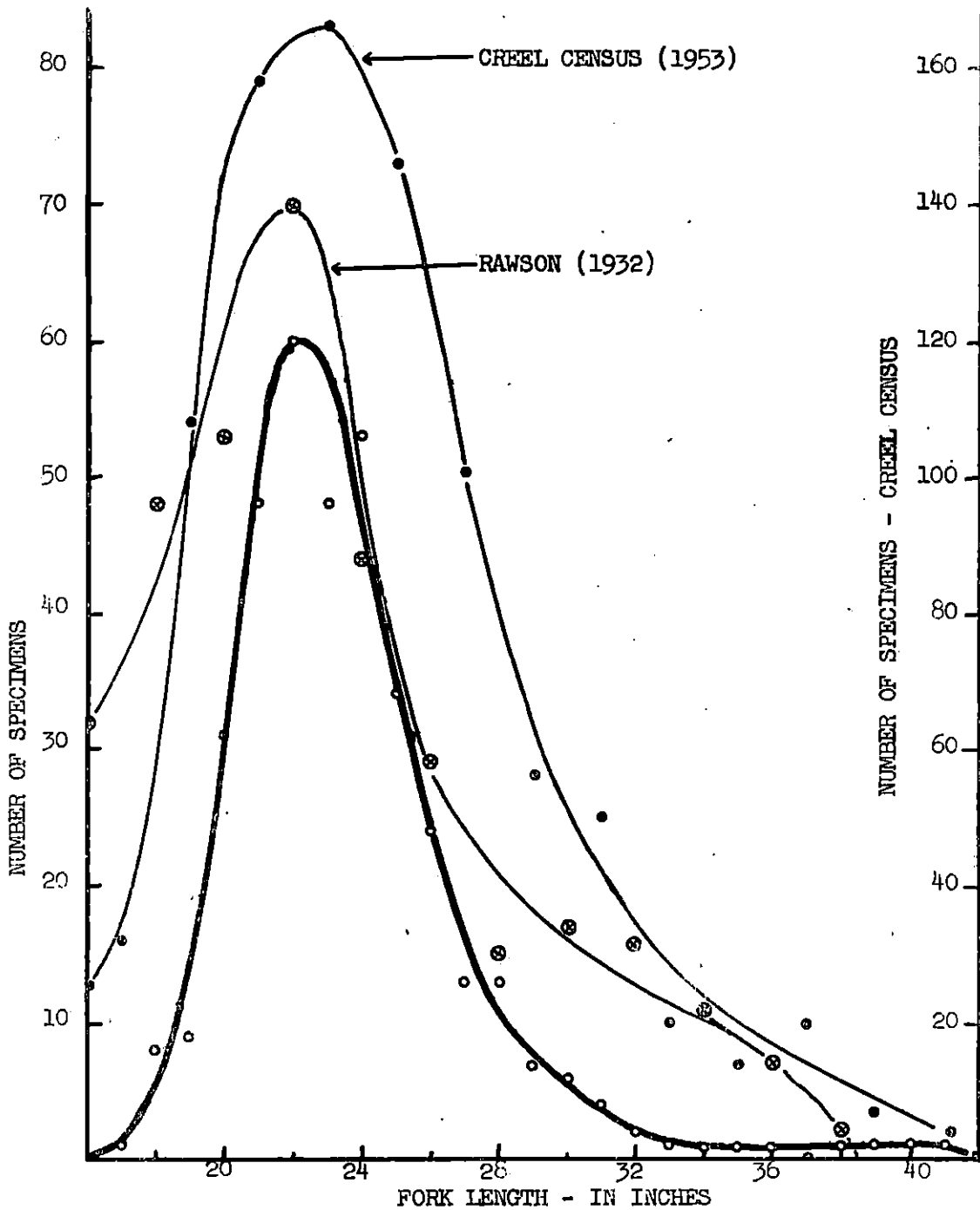


Fig. 3 - Length-frequency relationships for northern pike from Lake Waskesiu obtained by Schultz in 1953, by Rawson (1932), and by analysis of creel census data collected in 1953 (Cuerrier and Ward, 1954).

Table 2 (Cont'd)

Length in Inches	Number of Fish	Per Cent of Total
37	Nil	-
38	1	0.3
39	Nil	-
40	1	0.3
41	1	0.3
Totals	368	100.0

It may be noted that the length-frequency graph is a normal curve, the peak being at the length of 22 inches, and that a very large proportion (more than 65 per cent) of the fish running the stream were in the length classes from 20 to 24 inches, inclusive. Few (about 5 per cent) were under 20 inches in length and there was only one 17-inch fish and none under that length. About 26 per cent were from 25 to 30 inches in length and only 4 per cent were longer than 30 inches.

The observations indicate that pike do not mature and ascend the stream to spawn until they are at least 17 inches long, and that most of them do not mature until they reach a length of approximately 20 inches. In terms of age this means that pike do not mature until the fourth year, and in most cases not until the fifth year.

Length data from Mud Creek collected in 1931 and presented in centimetres by Rawson (1932) were converted to inches and used in plotting a curve which is shown for comparative purposes in Figure 3. The third curve in this figure is derived from fork-length measurements of specimens taken by anglers from Lake Waskesiu during the summer of 1953 and reported on creel census cards. These two curves follow closely the curve for fish taken from the spawning run in 1953 and also have the frequency peak at about 22 inches. It is apparent that little change took place in the length-class composition of the pike between 1931 and 1953. Larger numbers in the greater length-classes were taken by anglers than from the spawning run; this may have been due to selective angling, since most anglers use heavier tackle when they know that larger fish are present and can be taken. They are particularly likely to do so in Prince Albert National Park because many of them participate in an annual fish derby where prizes for the largest specimens are offered. From the point of view of management, it is desirable to take large fish rather than those which are too small to have had an opportunity to spawn.

Since a representative part of the pike population of Lake Waskesiu ascends Mud Creek each spring to spawn, and since the lengths of pike that run in the creek are similar to those of pike taken by anglers in the lake, there is an opportunity to obtain desirable information on the population by studying the Mud Creek spawning run each year, without reference to the anglers' catches.

#### Yearling Pike

During the trapping period it was noted that many northern pike from about seven inches to about 12 inches in length were present in the creek but were not being taken in the trap, although some of the largest were caught in the mesh of the wire screening. Further observation showed that all these fish were proceeding downstream from the spawning areas to the lake. The ages of some of them were determined, and it was found that they were one-year-olds, undoubtedly from the 1952 spawn. The hatch takes place about June 1, and the young fish are free-swimming by the middle of that month. By August they should be migrating towards the lake, but in 1952 they must have been prevented from doing so by low water and the beaver dams blocking the channel. They must have remained in the creek and in Shady Lake during the winter, to begin their downstream migration in the spring of 1953, when the water level rose high enough to allow them to pass over the dams. It was impossible to count these fish, as they were not caught in the trap, but there were literally thousands of them.

Several of these small pike were examined and found to be immature. They appeared to be feeding for the most part on amphipods, large numbers of which exist in the shallow, weedy areas of Mud Creek and Amiskowan Lake. Rawson (1932) also captured a number of pike less than 18 inches in length. He mentioned that pike are at least that length before maturity, so presumably the small fish taken by him were also moving downstream and were taken in a downstream trap.

#### Rate of Growth of Pike

The ages of 75 pike from Mud Creek were determined by reading scales, and tabulated along with their weights and lengths in order to study the relationship between age and growth in Lake Waskesiu. The data are given in the appendix (Table 4).

The average weights and lengths for various year classes were calculated and appear below in Table 3. From this data a length-age relationship was constructed, and is shown in Figure 4. A similar curve plotted from Rawson's 1931 data is shown in the same figure for comparison.

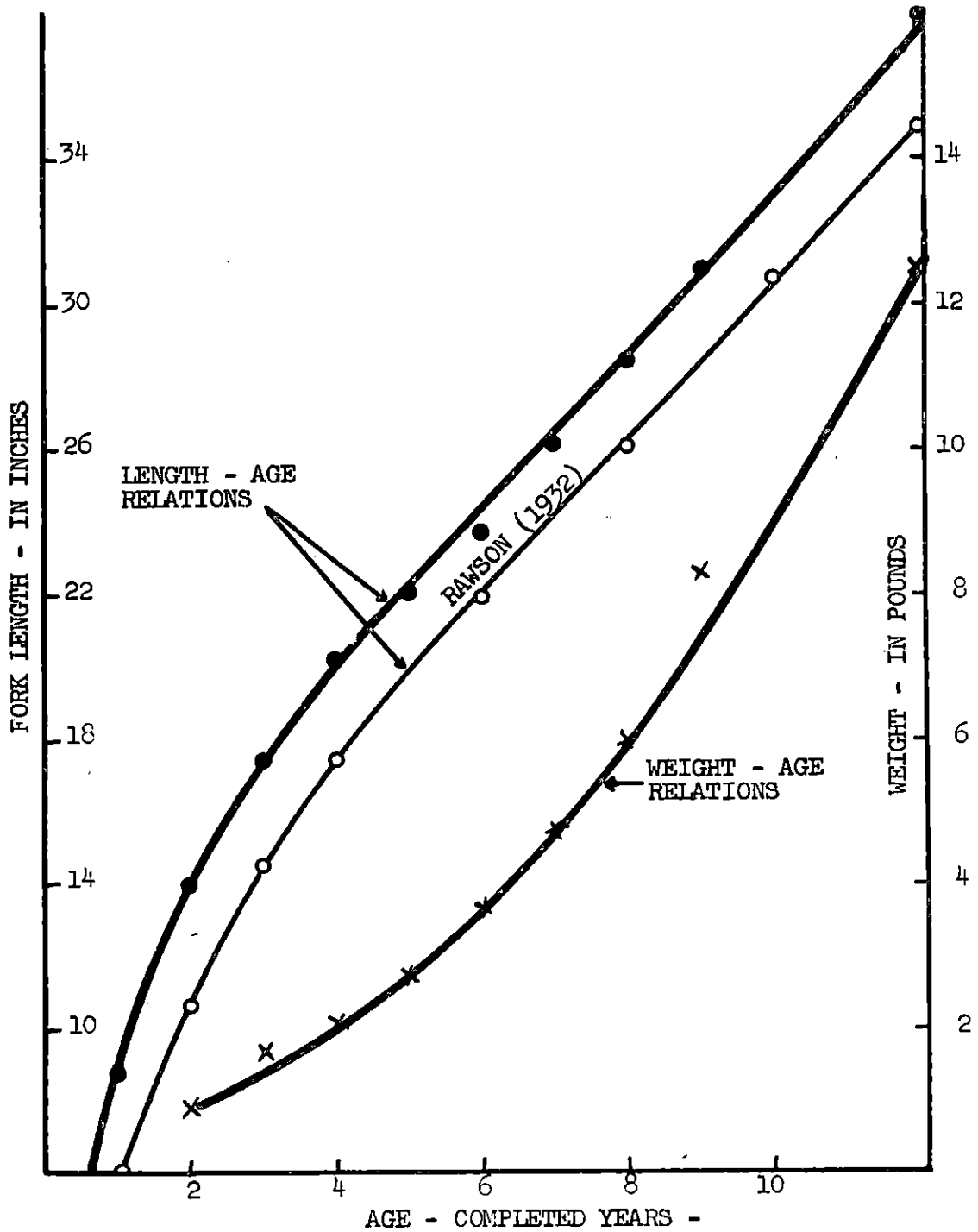


Fig. 4 - Length-age relationships of pike taken by Schultz in 1953, and by Rawson in 1932; and weight-age relationships of pike taken by Schultz in 1953.

Table 3. Average Fork Lengths and Average Weights of Year Classes of Pike from Mud Creek.

Age (Completed Years)	Number of Specimens	Average Fork Length (Inches)	Average Weight (Pounds)
1	3	8.8	0.2
2	1	14.0	0.9
3	1	17.5	1.7
4	5	20.2	2.1
5	13	22.0	2.7
6	31	23.7	3.7
7	8	26.1	4.8
8	8	28.5	6.0
9	4	31.0	8.3
10	Nil	-	-
11	"	-	-
12	1	38.0	12.5

It may be noted that the pike grow rapidly in length during the first two years of age, and still rapidly, although less so, during the next two years. After the fourth year, there is a regular annual increase in length of two to two and a half inches until the pike are at least 12 years of age. No pike older than 12 years was recorded, although it is known that this is not the maximum age for pike.

A curve for the weight-age relationship for pike was constructed from the data in Table 3, and is also shown in Figure 4. It is unlike that for the length-age relationship, since the weight of the fish increases slowly during the first four years when the increase in length is rapid. Also, after the fourth year, when length is increasing regularly and at a slower rate, weight is increasing with progressively greater rapidity each year. At four years of age the average weight is about two pounds; at eight years, about six pounds; and at 12 years, more than 12 pounds.

The growth curves for 1953 are similar to those obtained from the 1931 data, indicating that there has been little change in the growth rate. However, they show that in 1953 the average lengths of various age groups were from two to three inches greater than in 1931. This difference seemed



to originate during the first year or two of age. In order to establish whether the same interpretations had been used in scale reading, samples of scales were sent to Dr. Rawson, who agreed with the interpretations used in 1953.

The difference in length could have resulted from an increase in the amount of natural food in Lake Waskesiu or a decrease in the population, either of which would have reduced the competition for food. However, the fact that it occurred at an early age suggests that it may have resulted from a change in the environment. It was mentioned in the previous section that young pike, undoubtedly from the 1952 hatch, were found in the creek in May, 1953, having been prevented until then from migrating down to the lake; and that these young pike had many amphipods in their stomachs. This suggests that the beaver dams may have served a useful purpose by creating large ponds to serve as natural reservoirs with higher summer temperatures and better food supply than in the lake, and by retaining the young pike in them over the winter. If enough beaver were left in the area to repair the dams each summer and maintain them through the winter, this desirable situation could be continued. If all dams were opened about April 15 and kept open until June 1, mature fish could ascend the stream to spawn and young fish from the previous year could continue going down to the lake at that time.

#### Sex Ratio and Spawning

Data on the sex and maturity of the 75 fish whose ages were determined are included in Table 4 (Appendix). In the case of fish taken from the spawning run, sex and maturity were obtained easily from external observation. Four specimens of young fish proceeding downstream, six specimens from anglers' catches, and 18 specimens which succumbed during the trapping operations, were examined internally. Each fish was assigned a stage of maturity according to the following designations:

- Stage 0 - Fish immature, gonads small, sex determinable only under microscope.
- Stage 1 - Progressive stages in development
- "    2 between immaturity and spawning.
- "    3
- "    4
- Stage 5 - Gonads fully mature; fish ready to spawn.
- Stage 6 - Spawning recently completed.

Of the 75 fish, 46 (61 per cent) were females and 29 (39 per cent) were males. Apparently the ratio of females to males in the Mud Creek spawning run was about 3:2.

The stomachs of 18 pike that succumbed from the trapping operations and six pike captured by anglers were examined and all these were found empty.

The data indicate that male pike in Lake Waskesiu do not grow to a large size, since there were no males more than seven years of age or longer than 28 inches. However, the males compared favourably in weight and length with females in the same age groups.

Observations by local residents indicated that the spawning run began as early as April 24 or 25, increased gradually to a maximum between May 3 and May 6, and was practically complete by May 15. It would appear that the trapping operations began during the peak of the run and ended when the run was nearly finished. It may be assumed that only one-half of the run was counted, and that at least 6,000 pike, 5,000 walleye, and 15,000 suckers passed up the stream to spawn. The size of these figures makes clear the importance of Mud Creek as a natural spawning site.

Much time was spent along lower Mud Creek and Amiskowan Lake in attempting to locate the spawning areas, observe spawning action, and collect eggs and small fry. These attempts were unsuccessful. It is believed that when the channel was opened for the entire length of the creek the pike continued up to Shady Lake and most of the spawning took place there. Beartrap Creek, draining into Shady Lake, was extensively dammed by beaver and provided little opportunity for pike to migrate.

During a trip to the Heart Lakes on May 19, a female and two male pike were observed in the spawning act. These fish showed periods of violent activity, with much bodily contact, during which egg laying appeared to be going on. Between the periods of activity there were periods of quiescence lasting from three to eight minutes; at such times the female was relatively still, while the males swam slowly around her and gave her occasional nudges. In this case the spawning act took place in a weedy area close to shore in about three feet of water. Apparently there was no particular choice of location; the fish remained some distance off the bottom during the spawning act.

### Angling for Pike in Mud Creek

By May 15 each year the spawning run in Mud Creek is practically completed and the fish are beginning to return to Lake Waskesiu. Anglers realized that there was a concentration of fish in the stream at that time and took full advantage of it. Creel census records were made on May 17 and 18, listing 127 fish taken by 70 anglers. This may represent only a small percentage of the actual spring catch from the stream.

As a result of recommendations concerning this angling, Mud Creek was posted and no angling was allowed there in 1954.

### OTHER SPAWNING AREAS

Mud Creek is only one of the spawning areas that contribute fry to the fisheries of Lake Waskesiu. While the spawning run in the creek was in progress ice prevented the use of boats in examining other spawning areas, but four areas accessible from the roads of the park were visited. These were South Bay, Clare's Creek, Tripp's Creek, and Waskesiu River.

South Bay is a small water area at the southeast corner of Lake Waskesiu. Rawson reported that many pike spawned in this bay each year. When visited on May 13, 1953, it was blocked off from the lake by a large sand bar, except for an outlet stream too small for pike to pass up to spawn. Several pike were seen in the shallow water at the mouth of the stream. The bay appeared to be an excellent spawning location if the pike could reach it.

Clare's Creek runs into Lake Waskesiu about a mile north of the mouth of Mud Creek, after crossing the road leading to the Narrows. Reconnaissances of this creek were carried out on May 7 and 11. There were many beaver dams along the creek. Common and longnose suckers were seen making their way with difficulty up the stream, but no pike were seen in it at any time. This stream appeared to be too small and narrow to be significant in the management of the pike of the lake.

Tripp's Creek, about a mile farther up the road to the Narrows, was also investigated on May 7 and 11 and found to have beaver dams all along its course. A few suckers were seen in the stream, but the dams undoubtedly prevented any extensive spawning migration. No northern pike were seen in the stream and it did not appear to have much importance for the pike population.

Waskesiu River, the outlet from Lake Waskesiu, runs northeast from the eastern side of the lake and empties into Montreal Lake after leaving the park. At the time of the spawning run in early May, several observation periods were spent along the river, and great numbers of pike and walleye were observed

moving in the water, some of them down-stream. The river is dammed a short distance from the lake to maintain the water level, but the stop-logs are usually removed to allow an early spring run-off. Unfortunately this occurs at the time of the spawning migration of pike, walleye, and suckers. It was noted that many pike and walleye were going down-stream and many suckers up-stream. It appeared that this would result in a net loss to the fishing economy of Lake Waskesiu. When the stop-logs were replaced, the pike and walleye would be prevented from returning to Lake Waskesiu and would probably proceed to Montreal Lake, while the suckers would be trapped in Lake Waskesiu. It was understood that the authorities of the park were considering a diversion of water from Lake Waskesiu into the Heart Lakes as a recreational project to increase the depth of water in Crean Lake and thus provide water for the canal between Heart and Crean Lakes. This project, if completed, could be expected to prevent the heavy annual loss of pike from Lake Waskesiu and the heavy annual influx of suckers. Thus in addition to recreational values, the fisheries in the Heart Lakes and Lake Waskesiu would benefit.

#### SUMMARY AND CONCLUSIONS

During the period May 2 to June 7, 1953, the spawning run of northern pike in Mud Creek, Prince Albert National Park, was investigated. Beaver had been removed from this stream in 1947, 1948, 1951, and 1953, and beaver dams were dynamited to give the pike free passage in the stream at the commencement of the investigation.

The creek was found to be an important spawning area for the pike of Lake Waskesiu. A trap was operated from May 4 to 15 and 3,031 pike, 2,344 walleye, and 7,891 common and longnose suckers were captured. The total spawning run was estimated to be 6,000 pike, 5,000 walleye, and 15,000 suckers. The run probably began about April 24, was at its peak on May 6, and was almost completed when trapping ended on May 15. A fluctuation of the run during cold weather following a snow-storm suggested an activity gradient related to water temperature.

Length measurements were obtained for 368 mature pike. The length distribution showed a normal curve with the peak at 22 inches and 65 per cent between 20 and 24 inches. Creel census data indicated that anglers in Lake Waskesiu obtained pike in comparable length ranges, suggesting the possibility of ascertaining the length composition of the pike population of the lake by annual study of the spawning run in the creek.

The weights and ages of 75 specimens were determined, and these specimens were examined for sex, maturity, and stomach contents. Apparently pike in Lake Waskesiu do not mature before reaching a length of 17 inches and an age of four years; and most of them mature at about 20 inches in length and five years of age. Increase in length is rapid during the first four years of life and regular at two to two and a half inches thereafter up to 12 years of age. Weight growth accelerates with age, the averages being about two pounds at four years of age, six pounds at eight years of age, and 12 pounds at 12 years of age. Comparison with 1932 data showed that the only apparent change was a slight increase in average lengths, originating in the first year. This is attributed to the retention of the pike in the upper reaches of the creek by beaver dams, during their first winter.

All stomachs of mature pike were empty. Immature pike moving down-stream appeared to have been feeding exclusively on amphipods.

In a sample of 75 mature fish, 26 were females. No males examined were longer than 28 inches or more than seven years of age. Spawning was not observed in Mud Creek, but an observation of spawning in a nearby lake is described.

During the investigation of Mud Creek three other possible spawning areas along the lake were examined, and found to be unimportant to the pike population. A large annual loss of pike and influx of suckers due to migration in the Waskesiu river appeared to be resulting from the presence of a dam near the outlet of that stream. Anglers appeared to be taking an unduly large catch from the pike returning down-stream to the lake after spawning.

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APPENDIX

Table 4. Data from the Examination of 75 Northern Pike from Mud Creek.

Date	Length in Inches	Weight (Pounds)	Sex and Maturity	Age in Completed Years	Stomach Contents
May 9#	7.0	0.1	? (imm.)	1	Amphipods
" 5#	9.5	0.2	F - 1	1	Amphipods
" 5#	10.0	0.3	F - 1	1	Amphipods
" 5#	14.0	0.9	M - 2	2	empty
" 5	29.5	7.5	F - 5	7	"
" 5	29.5	7.1	F - 5	8	"
" 5	24.3	4.0	F - 5	6	"
" 5	25.0	4.8	F - 5	6	"
" 5	20.3	2.4	M - 5	5	"
" 5	20.5	2.3	M - 5	5	"
" 5	18.0	1.6	M - 5	4	"
" 5	24.0	4.5	M - 5	6	"
" 5	20.3	2.3	M - 5-6	5	"
" 7	25.8	5.4	F - 5-6	6	"
" 7	24.0	3.6	F - 5	6	"
" 7	27.8	5.7	M - 5	7	"
" 7	21.5	2.9	M - 5	5	"
" 7	23.5	3.1	M - 5	5	"
" 7	20.8	2.3	M - 5	4	"
" 7	23.5	3.9	F - 5	6	"
" 8	23.0	2.9	M - 5	5	"
" 9	24.3	3.0	F - 5	5	"
" 12	24.5	4.1	M - 5	6	released
" 12	23.0	3.3	M - 5	6	"
" 12	21.0	2.1	M - 5	4	"
" 12	25.0	3.5	M - 5	6	"
" 13	24.5	4.3	F - 5	7	"
" 13	22.5	3.0	F - 5	6	"
" 13	24.5	4.7	F - 5	7	"
" 13	23.5	3.5	M - 5	6	"
" 13	23.5	3.0	F - 5	5	"
" 13	25.0	3.4	F - 5	6	"
" 13	23.5	3.9	F - 5	6	"
" 13	21.5	2.5	M - 5	5	"
" 13	22.0	2.5	M - 5	5	"
" 13	22.5	3.7	F - 5	6	"

Table 4 (Cont'd)

Date	Length in Inches	Weight (Pounds)	Sex and Maturity	Age in Completed Years	Stomach Contents
May 13	24.0	3.7	M - 5	6	released
" 13	31.0	8.7	F - 5	9	"
" 13	25.0	4.1	F - 5	7	"
" 13	23.5	3.7	F - 5	6	"
" 13	17.5	1.7	M - 5	3	"
" 13	31.0	7.8	F - 5	9	"
" 13	28.5	6.3	F - 5	8	"
" 13	28.5	5.9	F - 5	8	"
" 13	24.0	4.6	F - 5	6	"
" 13	23.5	3.7	F - 5	6	"
" 13	26.0	5.7	F - 5	6	"
" 13	20.5	2.3	F - 5	4	"
" 13	24.0	3.5	F - 5	6	"
" 14	20.5	2.0	M - 5	4	"
" 14	21.0	3.1	M - 5	5	"
" 14	30.0	6.9	F - 5	8	"
" 14	22.0	2.7	M - 5	6	"
" 14	23.5	2.7	F - 5	5	"
" 14	22.0	2.6	M - 5	6	"
" 14	29.0	6.7	F - 5	8	"
" 14	24.5	4.4	F - 5	8	"
" 14	22.0	3.1	M - 5	6	"
" 14	24.5	4.1	M - 5	6	"
" 14	20.5	2.2	M - 5	5	"
" 14	25.0	4.7	F - 5	6	"
" 14	25.0	3.8	M - 5	7	"
" 14	23.5	2.9	F - 5	6	"
" 14	23.0	3.4	F - 5	6	"
" 14	23.0	3.1	F - 5	6	"
" 14	21.0	3.0	F - 5	6	"
" 15	31.0	8.8	F - 5	9	"
" 15	27.0	4.4	F - 5	8	"
" 15	23.0	3.1	M - 5	6	"
" 16/	26.3	4.3	F - 6	7	empty
" 16/	24.5	3.1	F - 6	6	"
" 16/	38.0	12.5	F - 6	12	"
" 16/	26.0	4.1	F - 6	7	"
" 16/	31.0	6.3	F - 6	8	"
" 16/	31.0	8.0	F - 6	9	"

# - Young fish proceeding downstream

/ - Caught by anglers.

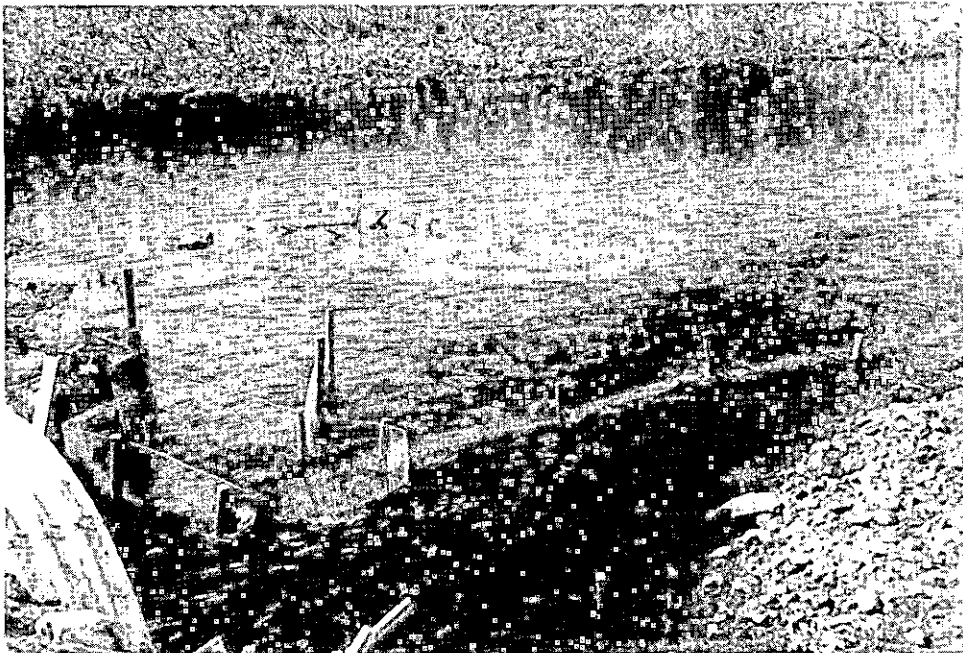
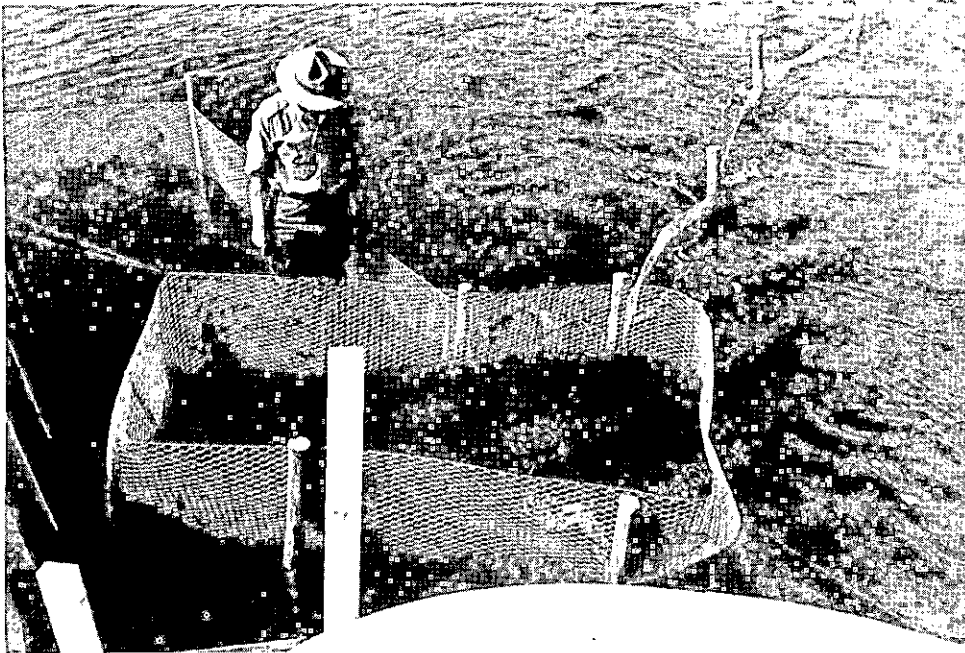


Fig. 5. Two views of first trap in Mud Creek. Underwater funnel leading into trap has been inked onto picture in upper print.



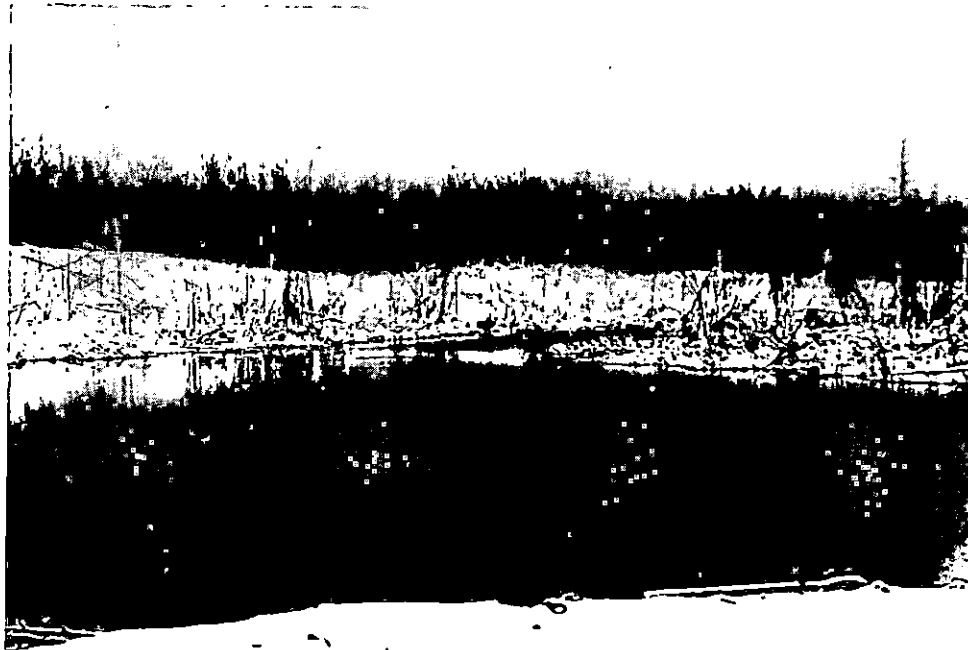


Fig. 6. Mud Creek below trap site, May 12, 1953.



Fig. 7. Second trap constructed in calmer water, May 12, 1953.

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