PROGRESS REPORT NO. 5

THE RATTLING BROOK ADULT SALMON TRANSFER PROJECT

1956 - 1958

by
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INTRODUCTION

One of the main efforts of the Fish Culture Development Branch in Newfoundland has been to open up hitherto unused spawning areas to increase the salmon runs, and ensure that where logging and power dams are erected adequate provisions are made to protect the existing populations.

This Branch was first informed in 1955 of a proposed hydro development at Rattling Brook, Notre Dame Bay, Newfoundland (Figure 1). Briefly, plans called for construction of a dam, thirty feet high on two of the major lakes in this watershed, and a powerhouse situated 400 feet upstream from the river mouth (Figure 2). Water to supply the powerhouse would be carried through a pipe-line, thus causing approximately two miles of river bed to be without water.

As little information was available at that time regarding its status as a salmon stream, a brief aerial survey was made of the watershed in 1955, and plans then drawn up for construction of a counting fence in 1956.

Results obtained from the fence count warranted consideration of various means whereby this salmon run might be preserved. Since the type of power project proposed for Rattling Brook ruled out construction of fishways, it was felt that the most feasible method, in view of the size of the salmon run, would be to transfer the adult fish to unused spawning areas in another river.

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Several nearby rivers not presently being utilized by salmon were examined to assess their potential as salmon producing streams, and of these Great Rattling Brook (Figure 1) appeared the most suitable. Great Rattling Brook, a tributary of the Exploits River, drains into it approximately five miles below Grand Falls. Its drainage area is approximately ~~600~~ 502 square miles, of which 50 miles is presently accessible to salmon. The total stream mileage is 180 miles, of which 25 miles is accessible to salmon. Comparing this river with Rattling Brook which has 160 square miles drainage area (109 square miles accessible), and 30 miles of stream (25 miles accessible), it was agreed that Great Rattling Brook was capable of supporting the Rattling Brook salmon run.

The factors which favoured use of this river for the adult salmon transfer were (1) plans already called for the construction in 1958 of a fishway over a complete obstruction located 7 miles upstream from the river mouth, thus by establishing a run above this obstruction these areas would be immediately utilized; (11) a suitable road linked the two rivers, thus affording economical transportation; and (111) adequate spawning areas are available above the obstruction.

This report will describe the construction and operation of the adult salmon counting fence, the subsequent transfer, and results obtained.

MATERIALS AND METHODS

An adult salmon counting fence (Figure 3) was

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constructed across Rattling Brook during the late Spring of 1956. Several sections of the river were examined as possible sites for this structure but due to high water conditions prevalent at that time, it was necessary to place it near the river mouth at high tide mark.

The fence consisted of 250 feet of piling reaching across the river and supported by piers placed 15 feet apart. A 60 foot section of piling in the centre was stepped down and on it rested twelve 5 foot sections of paneling. These panels, constructed of 1 inch by 3 inch board placed on edge 1½ inches apart, rested upright on the piling and was supported by "A" frames. Three wooden traps, approximately 5 feet square, were placed a few feet upstream from the toe of the piling. Attached to each trap was a wooden tunnel measuring 18 inches by 18 inches leading out through the panels. Salmon moving into the river could move upstream only by entering the tunnels and into the traps where they were counted and released.

Some difficulty was experienced especially during the first month of operation in keeping the fence "fish tight". This was due, to some extent, to high spring floods during construction, and also the presence of loose gravel and sand on the river bottom caused some erosion. Although several washouts did occur, it is felt that only a small number of salmon, if any, escaped upstream through these sections. This was due to repairs being promptly effected.

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The counting fence was built for operation during the 1956 season only, but, with some alterations and repairs, it served as a trapping device for the salmon

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transfer from Rattling Brook in 1957, 1958. This work was done prior to the 1957 salmon run and included (1) bulldozing a 300 foot side road to link the fence with the Trans-Canada highway; (11) construction of a holding trap; and (111) construction of a loading platform between the fence and side road.

Method of Transfer 1957

A truck, with a carrying capacity of 4,000 lbs. had been ordered by the Fish Culture Branch for the salmon transfer, but was not available for the 1957 salmon run. A one-half ton pickup truck equipped with a specially constructed salmon tank was used during that year. The salmon tank (Figure 4) measured 4 feet long, 3½ feet wide, 2 5/6 feet deep, and had a 200 gallon capacity. It was constructed of galvanized iron reinforced by angle iron. A carbon rod (Figure 5) inserted in a slot on the tank floor, was connected by rubber hose to an oxygen tank mounted on the rear of the truck. A regulated oxygen supply diffusing through the carbon rod into the water was maintained while enroute.

The method used in 1957 to convey salmon from the counting traps to the transfer truck was as follows: Salmon on entering the counting trap were moved to an adjoining holding trap to await transportation. When a sufficient number had been trapped, a wire mesh partition was moved across the trap to confine the salmon to the section of the trap on the bottom of which rested a collapsible bag (Figure 6). An overhead steel cable, 250 feet in length, led from the holding trap directly across the river to the loading platform. To remove salmon from

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the trap, the canvas bag was hoisted by means of a block and tackle attached to the steel cable. When the bag was sufficiently raised to clear the trap, it was guided along the cable to the loading platform where the salmon were lowered into the tank. An oxygen pressure of 5 psi. was used while the transfer was being made. On arrival at Great Rattling Brook the salmon were removed singly in a small canvas sheet.

Method of Transfer, 1958

Experience gained in the 1957 operation showed that improvements could be instituted to enable the transfer to operate more efficiently. The following changes were incorporated during 1958:

1. Replacement of the one-half ton pickup with a heavier truck capable of carrying two salmon tanks.
2. The method of moving salmon from the holding trap to the transfer truck via the steel cable caused salmon to exercise vigorously. It also necessitated for a smooth operation that there be two men to hoist the salmon and two men to empty salmon into the tanks.

   In 1958 the cable was replaced by an overhead wooden trough (Figure 7) which extended from the traps to the loading platform. The trough (Figure 8) measured 6 inches at the bottom, 9 inches at the top, and had a depth of 12 inches. A portable gasoline pump supplied water to both the trough and salmon tanks. The fish were lifted from the trap in a canvas bag by two men and emptied into the trough where they swam along the trough and

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dropped into the salmon tanks.

3. It was felt that the transfer of fish from the counting trap to an adjoining holding trap caused unnecessary handling, consequently it was decided to allow the salmon to remain in the counting traps until transferred. A baffle (Figure 9) was placed in each trap at the exit of each tunnel to prevent salmon from leaving the traps. This baffle reduced the opening at the tunnel exit to 8 inches. Several variations in types of baffles were used but it was found that in order to design one to hold salmon in the traps it would at the same time reduce the water flow in the tunnels. It appears that the determining factor in holding salmon in these counting traps is not the type of baffle used but the velocity of the water flowing through the traps. At Rattling Brook, during high tide, salmon are quite active in the traps, and consequently find the tunnel exit more quickly. In 1959 it is planned to revert to a holding trap similar to that used in 1957.

4. A collapsible canvas bag supported by a top wooden frame measuring 3½ feet by 2 feet was used to dip salmon from the tank for release at Great Rattling Brook. This bag was especially useful for holding fish

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in the tank near the water surface while awaiting tagging.

In 1957 and 1958 a small percentage of the salmon were tagged at Great Rattling Brook prior to their release. The tag (Figure 10) was of the Peterson type, white, attached to the base of the dorsal fin. Printed on each tag was its number and where the recovered tag was to be forwarded. Salmon were tagged and scale sampled by having the tagging box (Figure 10) partly submerged in water. This method enabled all necessary work to be effected without causing undue stress on the fish.

RESULTS

Rattling Brook Salmon Run, 1956-1958 Inclusive

The counting fence, in 1956, did not begin operation until June 17, and salmon had already begun to enter the river. Several minor washouts occurred during the first two weeks operation, during which time a few salmon probably passed through while repairs were being effected. In addition, a run of salmon small enough to pass through the fence panels entered this river in November. It was, therefore, necessary to include in the total run an estimation of the numbers of salmon passing through the fence other than through the counting traps.

In 1957 and 1958, when the fence was operated as a device to capture adult salmon for transfer to Great Rattling Brook, no washouts occurred and operations began prior to the salmon run. It was felt that the fence count plus the number angled downstream from the fence represented the total run to the river.

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Table I shows the total run during each year the counting fence operated at Rattling Brook.

Table I

Statistics of Rattling Brook Salmon Runs, 1956-1958.

Where Taken	1956	1957	1958
Fence count	596	636	820
Estimated number not in fence count	150	-	-
Number died downstream from fence	-	1	-
Number angled downstream from fence	24	28	30
Total	770	665	850

Size composition of Rattling Brook Run: During the three years that the fence has been in operation, records have been kept of the size composition of the Rattling Brook run. Since the salmon were not individually weighed, an estimate of the weight of each salmon was made by the field staff attending the fence. In this report, salmon weights are broken down into two groups, those weighing less than 6 lbs., and those weighing 6 lbs. and over. Table II shows the percentage in each group for three successive years.

Table II

Size variation Rattling Brook Salmon Run, 1956-58.

YEAR	Percentage of Salmon	
	Less than 6 lbs	6 lbs & over
1956	62.4	37.6
1957	70.0	30.0
1958	84.2	15.8
Average	72.2	27.8

Life History of the Rattling Brook Salmon

Number of Samples: Scale samples were taken in 1957 of all the fish that had died during that year's transfer operation. In 1958 samples were taken of all the mortalities and also of some of the tagged fish. A total of 56 samples were obtained during 1957 and 1958.

Method of Sampling: Scale samples were taken from the area of the salmon located between the posterior part of the dorsal fin and the lateral line. Scales were removed from the dead fish by means of a knife, whereas on tagged fish, samples were obtained by removing scales individually with a pair of tweezers. This latter method was more acceptable in that it eliminated the necessity of cleaning the scales prior to being read.

Designation of Age Groups: Two features have been used in designating the age-groups, namely, the age when it was captured and the year of its life in which it migrated to sea. These are expressed symbolically by two numbers - the large numeral indicates the year it was caught, and its subscript the year in which it migrated seaward.

Example: 5_4 - A fish that migrated to sea in its fourth year, and spent one year at sea. It should be noted that all samples were obtained at the counting fence, Rattling Brook; hence a fish of this age would be returning to spawn in its fifth year. For purposes of conformity, any tables extracted from other papers are converted to the formula as described above.

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Ages of Fish Returning to Rattling Brook: Table III shows that approximately 80 percent of the fish sampled are five year old fish returning to spawn after spending one year at sea. The second largest age group, comprising 7-20 percent of the total sample, are six years old and similarly returning to spawn after one year at sea. It is realized that such a small sample does not necessarily give a true representation of the total run to Rattling Brook. Since fish spending only one year at sea usually range from 3-6 pounds in weight, it would appear that between 85-100 percent of the run are under 6 pounds. Table II, however, shows by actual count that only 70-85 percent of fish are under 6 pounds, thus it can be seen that the figure of 85-100 percent is somewhat higher than the actual case.

Table III

Percentage of fish in various age groups.
Numerals in brackets indicate total number in each age group.

YEAR	4_3	5_3	5_4	6_3	6_4	6_5	7_3
1957	-	-	80(11)	-	20(3)	-	-
1958	5(2)	-	81(34)	-	7(3)	5(2)	2(1)

River Age: Table IV shows that salmon returning to Rattling Brook had spent from 3 to 5 years in the river before migrating to sea. In 1957, out of a total sample of 14, all had gone to sea in their fourth year. Similar scale sampling of 42 salmon in 1958 revealed that 88 percent had gone to sea during their fourth year, 7 percent in the third year, and 5 percent in the fifth year. Table IV also compares these results with those of Blair, 1935, on the Miramichi River; Blair, 1939, in Notre Dame Bay;

and Murray, 1956 on the Little Codroy River. When comparing these results it must be remembered that the majority of samples obtained by Blair were from the commercial fishery. Due to the large mesh size such a sample would probably include only a small percentage of small salmon. It can be seen that the river life of the Rattling Brook salmon agrees closely with those of the Little Codroy and the Miramichi Rivers in that the majority of smolts migrate to sea in their fourth year. Undoubtedly a larger sample from Rattling Brook would show that, as in other rivers, at least a small proportion remain 5 or 6 years in the river.

TABLE IV
Comparison of river age at Rattling Brook with those of other areas on the Atlantic coast.

LOCATION	Percentage of river age classes						No.of fish
	3	4	5	6	7	8	
Rattling Brook, Nfld. 1957		100.0					14
Rattling Brook, Nfld. 1958	7.0	88.0	5.0				42
Little Codroy R. Nfld. 1954	30.0	61.0					198
Little Codroy R. Nfld. 1955	23.0	77.0					114
Notre Dame Bay Nfld. 1939	2.8	29.2	2.2	13.5	1.7	0.1	178
Miramichi R. N.B. 1931	15.1	78.1	6.6	.2			155

Salmon transferred to Great Rattling Brook

The number of salmon transferred represents most of the fish trapped at the counting fence during 1957 and 1958. Seven fish in 1957 and two in 1958 died at the Rattling Brook holding traps. In addition, two fish escaped upstream while being removed from the traps in 1958 and ten similarly escaped in 1958. This accounted for the difference in the total fence count (Table I) and the actual numbers transferred as given in T

Table V

Salmon transferred and percentage mortality involved.

	1957	1958
Released at Great Rattling Brook	610	786
Died enroute	17	22
Total	627	808
Percentage mortality	2.7	2.7

Tagging of Transferred Salmon

In conjunction with the salmon transfer, a limited number of salmon were tagged prior to their release at Great Rattling Brook. It was hoped, in doing this, to determine -

(i) their dispersement throughout Great Rattling Brook,

(ii) whether they would return to Rattling Brook during the same or subsequent years, and,

(iii) the number returning to Great Rattling Brook in following years.

Table VI lists the number of salmon tagged and the recoveries by anglers during the years 1957 and 1958.

Table VI

Results of tagging programme, 1957-58.

Year	Number Tagged	Number Recoveries	Location
1957	87	1	Bishop's Falls dam.
		4	Tote Brook.
1958	128	Nil	

Dispersement of Transferred Salmon at Great Rattling Brook

Salmon were released in 1957 in a section of the river located approximately 2 miles upstream from the complete obstruction at Camp No. 1 (Point A, Fig. 11). It follows therefore that any salmon sighted in the river above the obstruction must necessarily be those which were transferred from Rattling Brook. The methods of determining the dispersement of these salmon were by spot checks on various sections of the river by the transfer crew, and reports received from anglers and loggers in that area. Unfortunately, extra staff was not available to make extensive checks on salmon movements, but those that were made revealed that a large number had entered the Tote Brook tributary. A logging dam located one mile upstream on this tributary held up salmon for approximately three weeks during which time both tagged and untagged salmon were seen in the pool below. Several salmon were taken by anglers fishing in that general area. Although checks were made further upstream on the main river and loggers were questioned, no salmon were reported elsewhere. Two anglers, however, reported seeing several kelts at Camp 45 dam during the early Spring of 1958 and since no obstructions exist between this dam and the releasing point some salmon no doubt spawned in that area during Autumn of 1957.

In 1958, to ensure suitable dispersion throughout the river, approximately one-half of the total number transferred were released two and one-half miles upstream from the Tote Brook tributary (Point B, Fig. 11). A Fisheries Warden was assigned to patrol Great Rattling Brook to check salmon movements and record anglers'

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catches. The transfer crew also visited sections of the river periodically and questioned workmen in that area. Figure 11 shows that in 1958 salmon had, in addition to entering Tote Brook, spread throughout the main river as far as Camp 45 on the North Branch and LeDrews Steady on the South Branch. One angler reported seeing a salmon at the exit of Rushy Pond located on the Rushy Pond tributary. Both the Fisheries Warden and transfer crew visited this tributary periodically but no salmon were sighted; and it is felt that if any number of salmon had entered this stream they would have been located.

Condition of Salmon after Transfer and Tagging

In 1958 a number of salmon were held in a holding trap at Great Rattling Brook to determine what effect, if any, the transfer and subsequent tagging had on these fish. A trap, 10 feet in length and similar to those used at Rattling Brook counting fence was constructed in a pool at release point A. One-half of the fish were tagged prior to being placed in the trap. Table VII shows that of a total of 45 salmon held, one tagged and one untagged fish died in the trap. The salmon transferred in trip #32 and 44 were very lively when released from the holding trap, however, those in trip #38 appeared sluggish when placed in the trap. It is felt that factors other than tagging are responsible for the poor condition of some of the transferred fish. It should be noted that the "safe" loading limit per salmon tank is considered to be between 60-65 pounds of fish. A total of 22 fish were transferred in each tank during trip #38; this amounted to roughly 88 pounds of fish per tank. It is possible that this overloading caused an unfavourable condition during the transfer.

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TABLE VII

Condition of transferred salmon held in holding trap.

Trip No.	No. Salmon Held	No. Salmon Tagged	H_2O Temp. (F°)	CONDITION			
				4 hrs.	8 hrs.	12 hrs.	24 hrs.
29	10	5	58	Resting at bottom of trap.	Moving about trap.	Released in good condition.	
38	23	12	66	Resting on bottom of traps	No change.	2 salmon dead, balance appear sluggish when released.	
44	12	6	73	Resting at bottom of trap.	Not observed.	Not observed.	Released in good condition

DISCUSSION

Counting Fence: The adult salmon counting fence at Rattling Brook served well both for determining the size of the run to that river, and later as a method of trapping salmon for transfer to Great Rattling Brook. The advantages of this type fence are:

1. A fairly accurate count can be obtained. Only a few minutes daily are required to check over the fence for possible weak points where washouts might occur.
2. A heavy flow in the tunnels attract salmon, thus assuring a minimum holdup outside the fence.
3. The traps and panels are easily cleared of debris.
4. Excess water may be released during floods by removing one or more panels.

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Adult Salmon Transfer: A salmon transfer, similar to the Rattling Brook operation is not known to have been attempted elsewhere. It was therefore not definitely known (1) whether the fish would be in good condition on reaching Great Rattling Brook; (2) if they would adapt themselves to the "new" river; and (3) if they would successfully spawn in these new areas. With the equipment being presently used it has been possible to transfer and release the fish in good condition. Spot checks on various sections of the river together with reports of kelts being sighted in the headwaters indicate strongly that these salmon are adapting themselves to this river. In 1959 it is intended to determine which areas salmon are utilizing and to what extent a run is being established.

Mortality: As reported in "Results" of this report, roughly 3 percent of the fish died while enroute and a small number were sluggish when released. In considering the probable cause of these mortalities, one or more of the following conditions may have been a contributing factor:

1. Temperature - Adverse temperature changes can be a direct cause of death of fishes. The temperature of the water used in the salmon tanks was the same as those of Rattling Brook and it did not vary more than two degrees throughout the transfer. It is considered therefore that the temperature of the water did not cause the mortalities.

2. Vigorous Activity - During a transfer of this kind, of necessity, a certain amount of activity is involved. Salmon must be moved from the

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traps into the tanks and removed again at Great Rattling Brook. There is also constant vibration of the tanks while enroute. Black, experimenting with two year old kamloops trout showed that fifteen minutes vigorous activity caused the lactic acid content in the blood to increase from 9 mg. percent to 76 mg. percent. Huntsman (1938) reported overexertion as the cause of death of captive fish. Unfortunately no studies have been made on the effect of activity on Atlantic salmon. It is possible that handling and transportation of salmon at Rattling Brook may cause these mortalities, but it is not thought to be the primary cause.

3. Excess Oxygen (supersaturation) - When the transfer first began in 1957, varying amounts of diffused oxygen was supplied to the tanks while enroute. It was found that a maximum pressure of 5 pounds per square inch appeared to be most suitable. In 1958, however, several tests (Table X appendix) were carried out to determine the amounts of oxygen used by salmon during these trips, and also the amount present in the tanks when diffused oxygen was supplied. Two determinations showed that the water in these tanks were between 120-190 percent saturated. In order to fully evaluate this situation a brief discussion of the results obtained by others will be made.

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Birge and Juday, 1911 reports that virtually no effect of any sort resulted from water supersaturated up to 223 percent. Work on fish ponds by Wiebe, 1933 showed no significant effects resulting from high concentrations of dissolved oxygen. Woodbury (1942) attributed the death of a large number of fish in Lake Waubesa, Wisconsin to the blocking of the capillaries in the gill filamints by gas emboli. The saturation of the water at that time was 171 to 327 percent. Brown (1957) states that supersaturation of water with atmospheric gases (chiefly nitrogen and oxygen) can cause fatal "gas-bubble disease" when either one of the following conditions are present.

1. The total pressure of the dissolved gases greatly exceeds the hydrostatic pressure, including the atmospheric pressure.

2. The creating of a partial vacuum over air saturated water resulting in a reduction of the hydrostatic pressure.

Brown also states that gas bubble disease cannot be caused by mere bubbling of pure nitrogen or oxygen through water, which drives out one gas and substitutes another without increasing the total gas tension.

Considering the aforementioned conditions in relation to the mortality of salmon during the Rattling Brook transfer, it can be said that condition 2 would not apply because the tank covers are loose enough to allow the atmosphere and the pure oxygen bubbles forming on the water surface to readily interchange. It is possible that condition 1 may be present and cause at least some of

the mortalities.

Value of Rattling Brook as a Salmon Stream

The results obtained in 1956 from the operation of the adult salmon counting fence at Rattling Brook substantiated the belief that this river supported a medium sized salmon run. Although an exact count was not obtained, it did serve in supplying a basis on which the fate of the run could be determined. In assessing its value to the Province, both the commercial fishery and the sports fishery must be considered.

Commercial Fishery: - Some idea of the value of the Rattling Brook salmon run to the commercial fishery may be gathered by using the results of work done on other rivers in Newfoundland. Mr. Murray in 1957 stated that for the Little Codroy River commercial fishermen caught roughly the same number of marked fish as were counted through their fence. These fish had previously been fin-clipped when they were smolts migrating to sea. Using such a basis for Rattling Brook with a population of approximately 800 salmon, it would mean that this river supplies roughly 800 salmon (5000 lbs.) to the commercial fishery. This is not a large figure, but when it is considered that the average shore fisherman depends on various species of fish to earn a livlihood, thus a good catch of salmon could make the difference between a poor fishing return and an average one.

Sports Fishery: Table VIII shows that in 1956 (the year previous to the salmon transfer) anglers spent 1311 rod days on this river catching a total of 1328 lbs. of salmon. In yield to the angler this compares favourably

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with salmon rivers (Table VIII) in this Protection District.

TABLE VIII

1956 angling returns on the important salmon rivers in Protection District 9B.

RIVER	ROD DAYS	NUMBER OF SALMON	WEIGHT (lbs)
Campbellton	212	78	287
Exploits	1040	482	2048
Peters	140	26	103
Northern Arm	195	66	276
Point Leamington	528	237	903
West Brook	769	472	1651
Rattling Brook	1311	253	1328

Great Rattling Brook Potential as a Salmon Stream

Surveys of Great Rattling Brook have indicated that some 60 miles of suitable spawning area exists on this stream. These areas are confined chiefly to the main stream and the Tote Brook tributary. Some idea of the number of salmon this stream could support may be gathered by using information obtained from the Rattling Brook counting fence and from studies on Atlantic salmon by Elson and Kerswell, 1955.

The fence count at Rattling Brook during 1956, 1957, and 1958 shows that on an average 70 percent of the salmon are 6 lbs. and under and 30 percent are over 6 lbs. It is assumed that those 6 lbs. and under average 4 lbs. and those over 6 lbs. average 10 lbs. Also, the average run to this river during that period is 760 fish, of

which 532 average 4 lbs. and 228 average 10 lbs. The total poundage for each group would then be 2128 lbs. of salmon 6 lbs. and under, and 2280 lbs. of salmon over 6 lbs. Elson and Kerswell state that for a small to medium sized stream (30-70 miles of salmon rearing water), an estimated 150 lbs. of female salmon are required to bring the stream to its highest production level. Unfortunately, no information is available to definitely state what is the actual sex ratio of salmon migrating to our streams. Murray's studies in 1955-56 on kelts report that salmon under 6 lbs. were predominantly male (80-83 percent), whereas salmon over 6 lbs. had a greater proportion of females (69-75 percent). Since these figures were arrived at from a total sample of 182 fish, the limits of using such figures must be borne in mind. It does, however, support the belief that the 6 lbs. and under group are comprised of a majority of males and in the over 6 lbs. group at least half are female. In order to estimate the number of female salmon entering Rattling Brook it will be assumed that the sex ratio for 6 lbs. and under salmon is 75:25 - M:F, and for the over 6 lbs. 50:50 - M:F. The total poundage of the smaller salmon would be 532 (25 percent of 2128 lbs) and that of the larger salmon would be 1140 (50 percent of 2280 lbs). This would give a total of 1672 lbs. of female salmon entering Rattling Brook.

Great Rattling Brook, having 180 miles of stream is somewhat larger than the stream described by Elson and Kerswell, and could probably support 200 lbs. of female salmon per mile, rather than 150 lbs. This latter figure, however, will be used while bearing in mind that the estimated number of salmon will not

necessarily represent the capacity of the stream. It has already been shown that at Rattling Brook an estimated 1672 lbs. of female salmon supports a population of 760 salmon. Proportionately then, Great Rattling Brook would require 27,000 lbs. (180 x 150) of female salmon to bring this stream to its highest production level. It has already been shown that at Rattling Brook an estimated 1672 lbs. of female salmon supports a population of 760 fish; proportionately then, Great Rattling Brook could support a population of 12,272 salmon.

If this river could be made to support a population of ~~12,272~~ ≈ 12,000 fish, it would mean a sizeable contribution to both the commercial and sports fisheries.

Commercial Fishery: Assuming that 50 percent of the total run native to any river is taken by the commercial fisherman, then Great Rattling Brook could be expected to yield roughly ~~12,272~~ 12,000 salmon to that fishery.

Sports Fishery: The location of Great Rattling Brook is such that it is accessible by road and rail. Unlike many Newfoundland rivers, any section may be easily reached due to the network of logging roads in that area. This river could not only replace the loss of Rattling Brook as a salmon stream, but provide additional area to relieve the angling pressure on other nearby rivers. A comparison with Gander River, where the angling catch is approximately 2,000 fish out of a total run of 12,000 to 15,000 fish, would indicate the possible future contribution of Great Rattling Brook to the sports fishery.

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Angling Returns at Great Rattling Brook

Prior to 1957, salmon angling was confined to the section of the river between Camp I and the river mouth. During the two years that the salmon transfer has continued, it has not been necessary to prohibit angling for the transferred salmon because (1) anglers were not accustomed to fishing in that section of the river above Camp I dam, and (2) the A.N.D. Company, who owns the access roads to this stream, prohibits unauthorized persons from using these roads during the summer months when the fire hazard is high. In 1957 and 1958 not more than five licensed anglers have fished this stream, consequently the total catch has been small. Table IX shows that in 1957 a total of 12 salmon were angled as compared with a total of 2 salmon angled in 1958. The two factors which probably

TABLE IX

Number of transferred salmon angled in 1957 & 1958.

YEAR	NUMBER SALMON ANGLED		TOTAL
	Tagged	Untagged	
1957	5	7	12
1958		2	2

accounted for this reduction in 1958 were (1) the placing of one-half of the transferred salmon above Tote Brook tributary where the fishing effort had been greatest in 1957, and (2) a Fisheries Warden was assigned to patrol Great Rattling Brook; this, we believe, acted as a check against illegal fishing in areas where salmon tend to hold up.

SUMMARY

The Department of Fisheries was informed by the Newfoundland Light & Power Company Ltd. in 1955 of a proposed hydro-electric development on Rattling Brook, Norris Arm, Newfoundland. An aerial survey of this river was made and in 1956 an adult salmon counting fence was constructed and operated during the salmon run. The Fish Culture Development Branch, after studying the power project plans and the results of the counting fence, felt that it would be both difficult and costly to maintain the run to Rattling Brook. It was decided to transfer this run to the unused spawning areas available at Great Rattling Brook, which is a large tributary of the Exploits River. Available information suggests that this river when stocked could support a run of approximately 12,000 fish.

In 1957 and 1958 salmon were trapped at the Rattling Brook counting fence, placed in water filled tanks supplied with oxygen, and transferred by truck to Great Rattling Brook. While the great majority of fish transferred were in good condition when released, a small number were sluggish and died enroute. A mortality of 2.7 percent was incurred during each year's transfer. Various tests made in 1958 tended to suggest that oxygen supersaturation of the water in the salmon tanks and vigorous activity during the transfer may be the chief causes.

Spot checks on various sections of Great Rattling Brook in 1957 and 1958 revealed that the transferred salmon were adapting themselves to the "new" river. Approximately 16 percent of the released salmon were tagged prior to their release. Thus far, all recoveries with one exception have been taken at

Great Rattling Brook. This would tend to indicate that the majority of salmon remain in the river rather than going downstream.

Limited scale sampling of a small percentage of the Rattling Brook run showed that the ages of the fish varied from 4 to 7 years. These samples also showed that the river life ranged from 3 to 4 years, the four year age group representing between 80 to 100 percent of the total sample.

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LIST OF APPENDICES

APPENDIX A

Dissolved Oxygen Determinations

Three analyses (Rideal Modification of Winkler Method) of the water in the salmon transfer tanks were made to determine roughly (1) the percentage saturation of dissolved oxygen present when diffused oxygen was supplied to the salmon tanks, and (2) the amount of dissolved oxygen used by salmon during the period taken for the transfer. Two salmon tanks were used, tank #1 was supplied with oxygen and tank #2 was oxygen independent. Water samples were taken before and after the transfer was made.

Salmon transported in Tank #1 (O_2 supplied) were observed to be more active while enroute. It was also noted that during the latter stages of the trip several remained close to the water surface and occasionally swam around the tank for a brief time with their heads protruding from the water. It is not known what significance this action may have, but it is believed that fish acting in this manner have a reduced sense of perception. In Tank #2 salmon rested quietly throughout the trip, but responded less actively to touch as those in Tank #1. On release at Great Rattling Brook fish in both tanks appeared to be in good condition.

TABLE X

Results of dissolved oxygen determinations.

Numerals in brackets indicate percentage of saturation.

Tank #1 - O_2 supplied			Tank #2 - O_2 independent			
Weight Sal.per tank	Before transfer (Ppm)	After transfer (Ppm)	Weight Sal.per tank	Before transfer (Ppm)	After transfer (Ppm)	Amount O_2 Used
45	6.3(62)	16.8(190)	45	6.3(62)	3.8(40)	1.74 cc/l
34	6.8(68)	12.4(120)	54	6.8(68)	3.6(33)	2.23 cc/l
			0	9.2(80)	9.1(80)	.069cc/l

From Table X it can be calculated that one pound of salmon uses approximately .04 cc/l of oxygen per trip. Assuming the maximum safe capacity load to be 60 pounds, then the total volume required per trip would be 2.4 cc/l. Using 6.3 Ppm (lowest value obtained in three tests) as the dissolved oxygen content of water in the tanks at the beginning of the transfer, 60 pounds of fish would reduce this value to 2.7 Ppm at the completion of the trip. Rounsefell and Everhart quotes Lindroth (1949) as determining 2.2 Ppm as the minimum oxygen requirements for Atlantic salmon. Assuming this amount (2.2 Ppm) to be correct, then at no time during the tests was the oxygen below the minimum requirements.

A "dry run" (test #3) was made to determine the loss of oxygen from the water other than the amount used by salmon. This loss was calculated at one percent and considered to be insignificant in the foregoing calculations.

In Tank #1 (O_2 supplied) the amount of dissolved oxygen doubled during the trip and resulted in supersaturation of the water.

The following conclusions may be made from these experiments:

1. Water in the salmon tanks supplied with an oxygen pressure of 5 psi. causes supersaturation as high as 190 percent.
2. Transferring salmon without additional oxygen could cause the amount of dissolved oxygen to drop below the minimum requirements.
3. Further tests should be made varying the oxygen pressure in order to determine the amount required to obtain optimum conditions.

APPENDIX B

TABLE XI

Samples of 1957 Rattling Brook adult salmon run grouped by age, length, and early history.

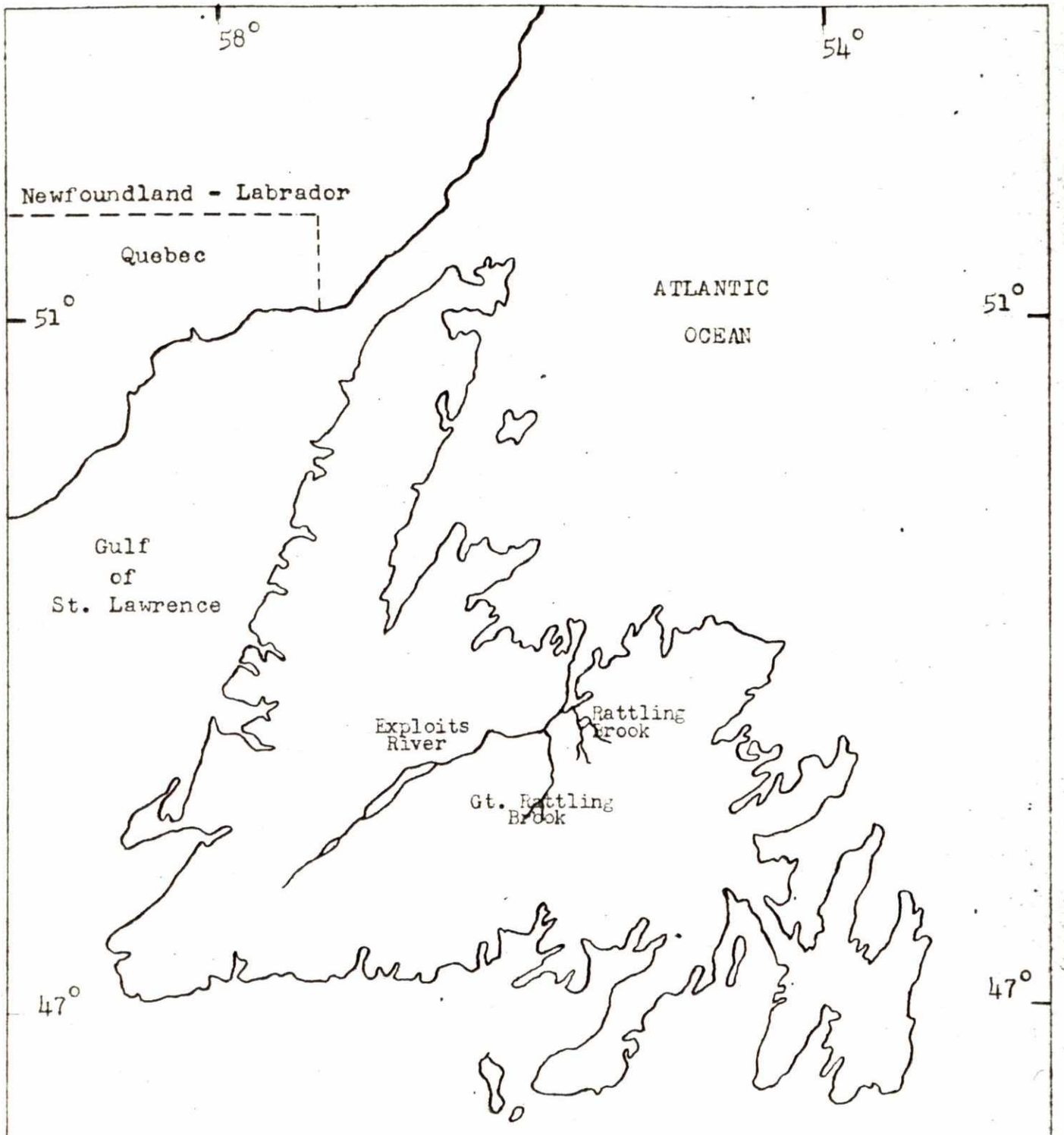
FORK LENGTH (In.)	NO. OF INDIVIDUALS					TOTAL
	4_3	5_4	6_4	6_5	7_3	
19		1				1
19¼		1				1
20		1				1
20¼		1				1
20½		3				3
21		2				2
21¼		2				2
28			1			1
30			1			1
33			1			1
Total		11	3			14
Percentage of Total		80	20			100

TABLE XII

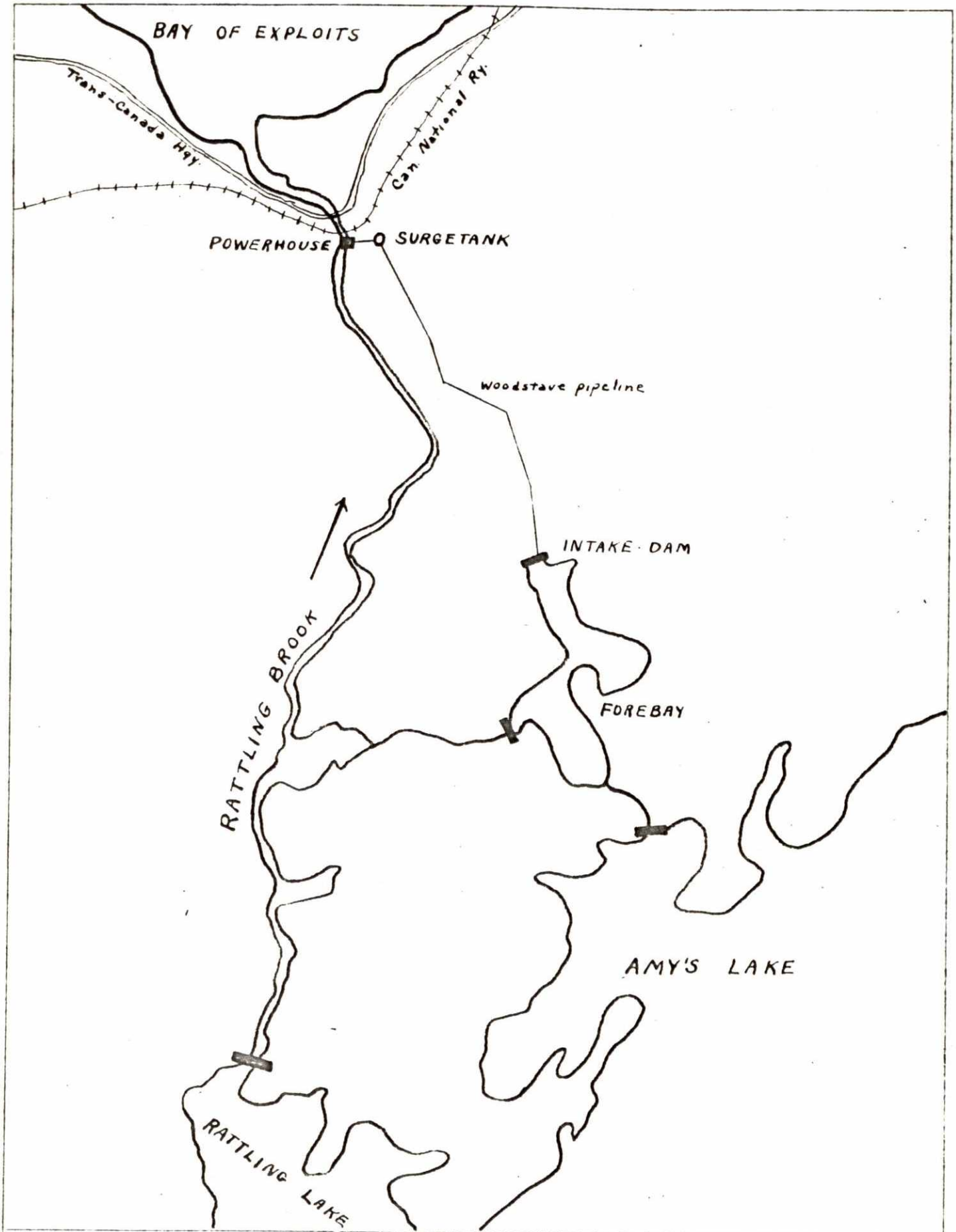
Samples of the 1958 Rattling Brook adult salmon run grouped by age, length, and early history.

FORK LENGTH (In.)	NO. OF INDIVIDUALS					TOTAL
	4_3	5_4	6_4	6_5	7_3	
18	2	3				5
18½		3				3
19		6				6
19½		5				5
20		2				2
21		1		1		2
21¼		3				3
22		3				3
22½		2				2
22¾		1		1		2
23		1				1
23½		1				1
23¾		1				1
24			1			1
24¾		1				1
25½		1				1
26½			1			1
30?			1			1
32¼					1	1
Total	2	34	3	2	1	42
Percentage of Total	5	81	7	5	2	100

APPENDIX C



DRAWN.	DEPARTMENT OF FISHERIES, CANADA	DATE:
CHECK:	Fig. I - Island of Newfoundland showing location of Rattling Brook and Great Rattling Brook.	SCALE:
APPROVED:		DWG. No.



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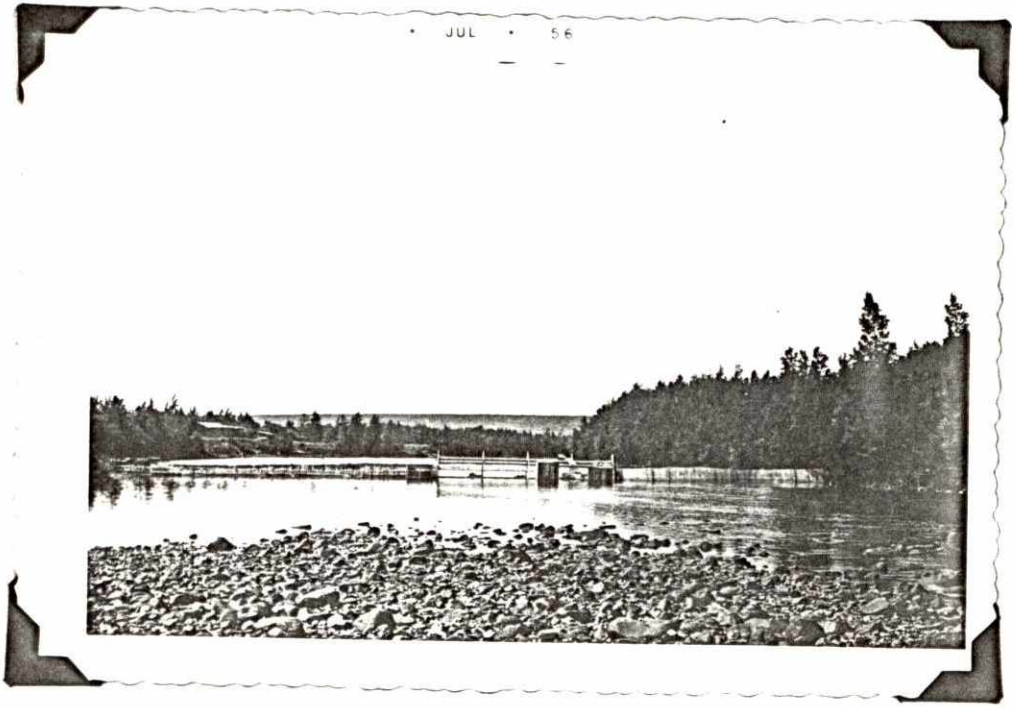
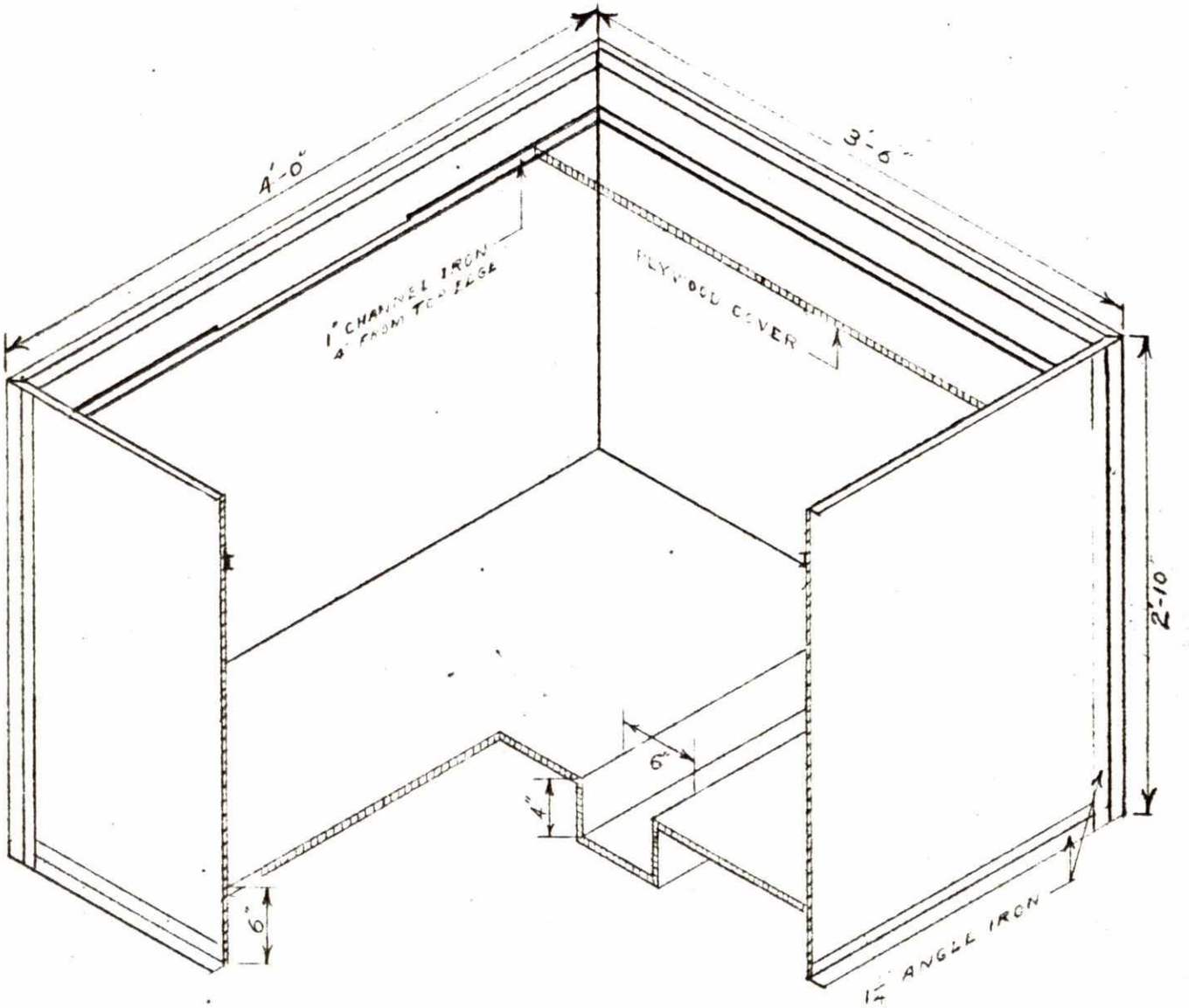


Figure 3 Adult Salmon Counting Fence at Rattling Brook, Norris Arm.



DRAWN:	DEPARTMENT OF FISHERIES, CANADA	DATE:
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APPROVED:		DWG. No.

Figure 5 Position of carbon rod in salmon transfer tank.

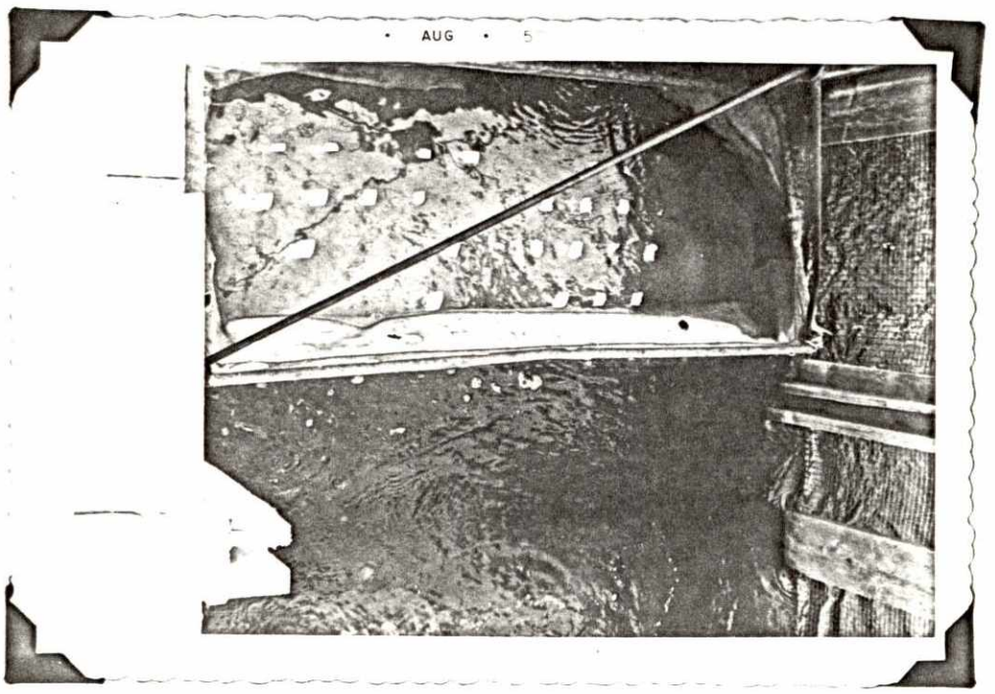
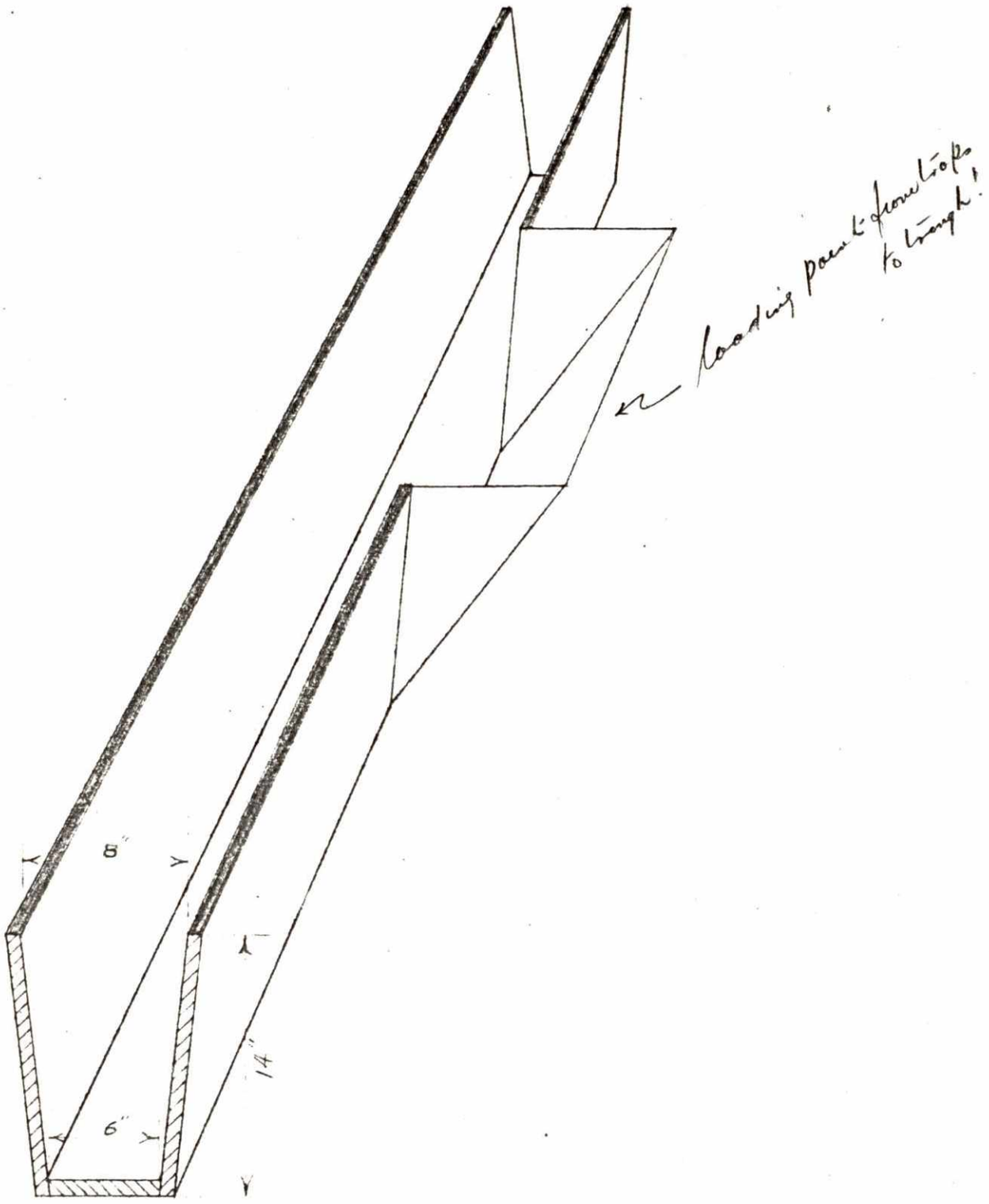


Figure 6 Collapsible canvas bag used for removing salmon from trap.

Figure 7 Overhead wooden trough for transferring salmon to loading platform at extreme right.



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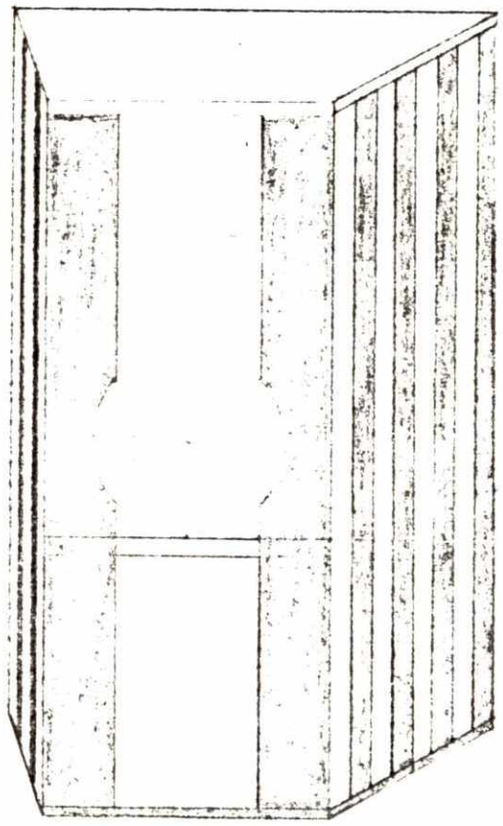

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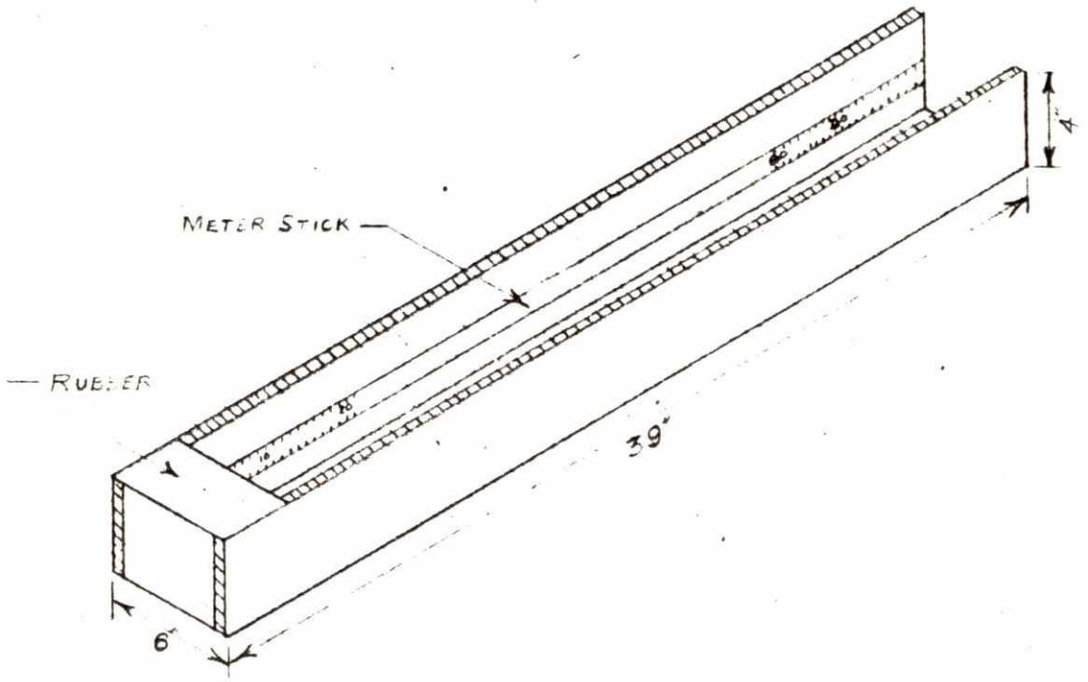

TAGGING BOX

TAG.

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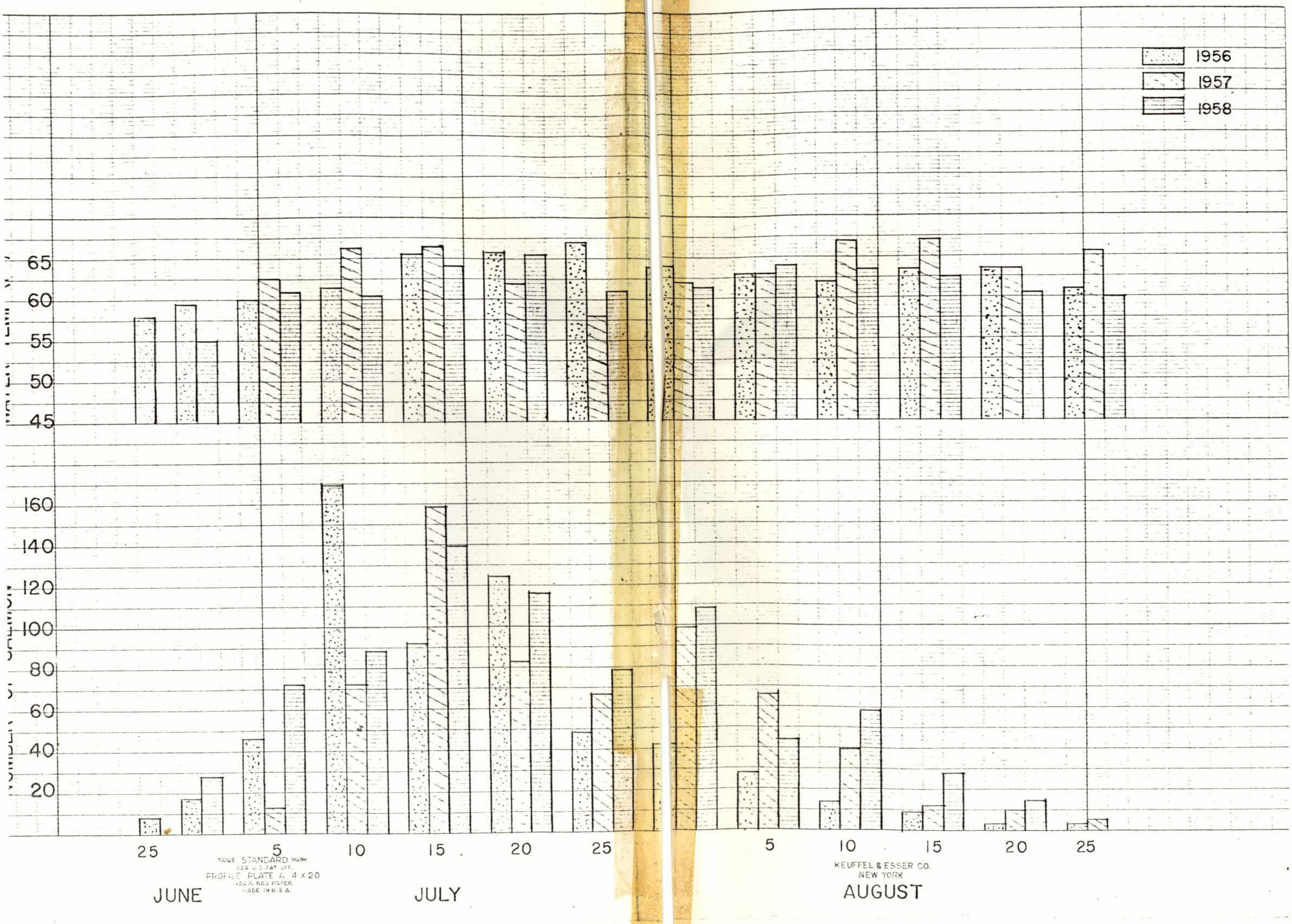

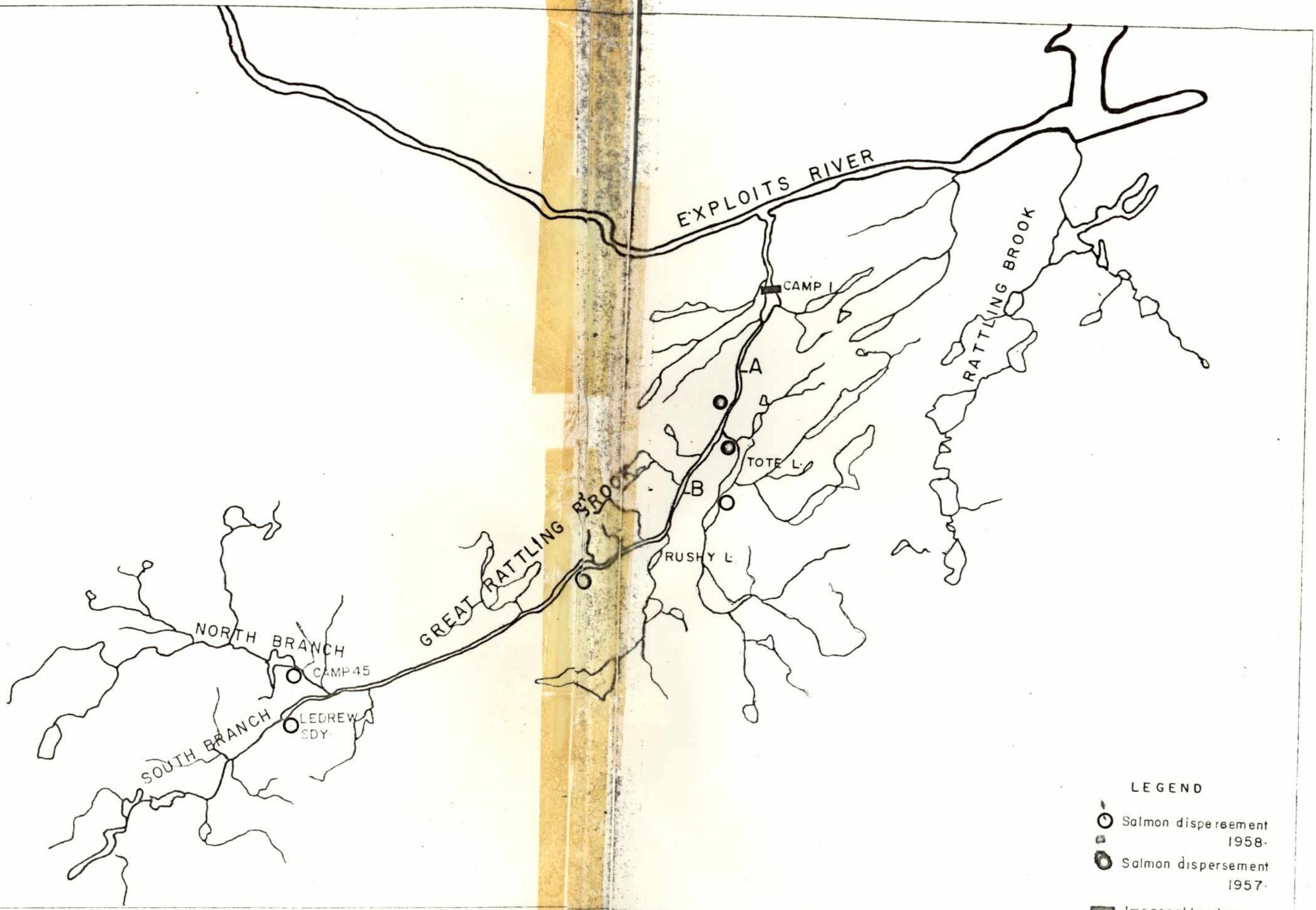

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CHECK:		SCALE:	CHECK:	Fig. 11: Known salmon dispersements in 1957 and 1958.	SCALE: 1" : 20,000'
APPROVED:		DWG. NO.	APPROVED:		DWG. NO: