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FISH MOVEMENTS IN TRIBUTARIES OF HUNT CREEK

AS REVEALED BY COUNTING WEIRS

by

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Introduction

This report may be considered as a continuation of Report No. 652, March 5, 1941, which bore the same title. The latter presented data resulting from the first 12 months of operation of fish-counting weirs on Fuller Creek (Trib. No. 4) and Tributary No. 5 in the Hunt Creek Experimental Area. The present report covers the next 12-month period for those weirs, and in addition gives records for varying periods of operation for weirs installed on Tributaries 2 and 3.

In Report No. 652 the writer mentioned the desirability of additional weir installations. Recently-constructed traps on Tributaries 2 and 3 have already yielded valuable information. A makeshift trap at the upper end of Fuller Creek has not given satisfaction, and will probably be re-designed in the near future. Early in 1942 a counting weir was installed in the outlet of East Fish Lake, designed to reveal movements of fish into and out of that lake, which was cleaned out with rotenone and re-stocked with brook trout during the late summer and fall of 1941 and the spring of 1942. It will be recalled that, in other years, tagged trout released in the lake have been recovered in the outlet, and that poisoning of the lake revealed the presence there of two Montana grayling which had obviously entered from the outlet. Until recently, movement of fish into the lake following the poisoning was prevented by an insuperable barrier. During the winter, however, the lake was lowered to its original level temporarily, to permit removal of unsightly dead trees from the shore. Horned dace and other undesirable fish are present in the outlet, and a trap, in addition to revealing trout movements, makes it possible to prevent re-invasion of the lake by unwanted rough fish.

In the previous report mention was made of plans for construction of a self-cleaning weir screen of rotary type on Fuller Creek. With the

excellent cooperation by the Fish Division's engineer, Mr. Floyd Fanselow, and by Mr. Gilbert Stewart and his staff at the Forest Fire Experiment Station, construction of this unit is now nearly completed. The concrete bulkheads have been finished for some time, and fabrication of the screen unit is proceeding in the face of some delays occasioned by difficulty in securing certain materials. Unfortunately, exigencies of construction made it necessary to abandon the old weir during the fall of 1941, so that no data were obtained on the downstream movements (heavy in 1940) of that season.

Ever since establishment of the experimental area at Hunt Creek, Institute staff members have been considering various plans for a counting weir to be installed at the lower end of Hunt Creek Section A. Results obtained from such a weir would greatly enhance the value of the stocking and marking experiments, population estimate studies, and creel census being conducted in the entire experimental area. The character of the soil substratum at this point, however, is ill-suited to support standard-type installations, and further trials will be necessary before a satisfactory trap can be built.

The physical character of Fuller Creek (Tributary No. 4) and of Tributary No. 5 near their respective weir sites has been described in Report No. 652. That of Tributaries No. 2 and 3, East Fish Lake outlet, and the extreme upper end of Fuller Creek will be discussed under headings dealing with each of these weirs individually.

Acknowledgments

Until early June, 1941, the weirs were tended chiefly by E. L. Cooper, now with the United States Army. Since his departure, the work has been handled by Lawrence Bush and Paul Barrett, with some assistance during the trout season by Robert Frank and Rhyner Scholma. Valuable assistance in designing new structures has been given by Mr. Fanselow, by Messrs. Foster and Hall of the C.C.C. Planning Division, and by Mr. Stewart of the Forest Fire Experiment Station. Suggestions, and plans and blueprints of existing structures elsewhere, have been received from the Washington State Department of Fisheries, the Fisheries Research Board of Canada, the United States Fish and Wildlife Service, and Professor W. E. Ricker, of Indiana University.

Fuller Creek (Tributary No. 4)

The movement of trout through the Fuller Creek weir can be easiest shown graphically. Graph 1 presents curves showing upstream and downstream movements of trout, summarized by two-week intervals for the period from October 1, 1940, to September 30, 1941. For purposes of ready comparison, the corresponding record for the period from October 1, 1939, to September 30, 1940, is plotted on the same graph.

It will be noticed that no attempt has been made to show trout movement by size or age classes. At times, trout in the experimental area have been roughly assigned to one of the following categories: fry (fish of the year), fingerling, sublegal (fish expected to reach legal size during the following angling season), and legal. However, Dr. Shetter's studies of age-size

relations in the Hunt Creek system have indicated the existence of such wide overlaps in the size range of each age-class that we consider it prudent here to avoid the "fry" and "sublegal" categories for a greater part of the annual cycle, and designate trout passing through the weirs simply as "fingerling" or "legal." During the 1940-41 season of weir operation on Fuller Creek, a great majority of the trout fell in the fingerling class, but an attempt to make provisional assignment of these specimens is presented in Table 1. In explanation of the relatively small number of fry taken, two facts should be borne in mind: First, the size-overlap alluded to above, which makes positive recognition of fry (in the absence of scale readings) difficult and uncertain for a greater part of the year; and, second, the fact that the barrier screen of the old Fuller Creek weir was of half-inch mesh, and therefore far from fry-tight. It is expected that the new rotary screen now under construction will entrap trout of all size ranges except possibly newly hatched fry.

A separate rolled chart (No. 1) accompanying this report shows trout movements, and morning and evening water temperatures, for a 12-month period extending from August 15, 1940, to August 14, 1941. Also accompanying the report is a similar rolled chart (No. 2) covering the preceding 12-month period, to permit ready comparison.

A brief tabulation of upstream and downstream movements for the two annual periods follows:

<u>Period</u>	<u>No. down</u>	<u>No. up</u>
Oct. 1, 1939-Sept. 30, 1940	1,036	28
Oct. 1, 1940-Sept. 30, 1941	403	23

From this it will be seen that the number moving down in 1939-40 was more than 2 1/2 times as great as the number for 1940-41. Yet, the number moving up in 1939-40 was only slightly, and probably not significantly, different from the number moving up in 1940-41.

A glance at Graph 1, and a comparison of the two rolled charts, will reveal at once where nearly half the discrepancy lies as regards downstream movement. In the spring of 1941 there was no heavy downstream migration during the period from April 16 to June 30, as there was in 1940. In Report No. 652 it was suggested, rather tentatively, that the heavy downstream movement in the spring of 1940 might have been a response to the introduction, on April 11, of about 5,000 Montana grayling throughout Fuller Creek. No fish were planted in Fuller Creek during the spring of 1941. Figures for the two periods show that from April 16 to June 30, 1940, 340 trout moved down through the weir; during the corresponding period of 1941, only 37 moved downstream. The difference, 303, is equal to nearly half the total discrepancy between the results of the two annual periods.

The curves of Graph 1 also show a high degree of conformity for the two fall seasons as regards peak movements and rate of decline. However, the downstream movement during the fall of 1939 was considerably larger in 1939 than in 1940. Why this should be is not clear, but it is possible that the heavy downstream movement in the spring of 1940 (not repeated in 1941) may have removed from the upper reaches of Fuller Creek a large number

* Retained by J. W. Leonard.

of trout that ordinarily would have remained in the stream until fall. It is regrettable that the construction of the bulkhead for the new weir rendered it impossible to secure reliable figures for trout movements during the fall of 1941.

If the close agreement of the figures for upstream migration for the two one-year periods be taken, along with observational evidence, as grounds for assuming that the weir works equally well for taking upstream and downstream migrants, it must be obvious that Fuller Creek contributes to Hunt Creek much more than it gains from that source. Whether or not this heavy autumnal influx is to the advantage of the Hunt Creek trout population is another matter. It is worthy of mention that two legal trout tagged while passing down through the Fuller Creek weir during the fall of 1940 were taken by anglers during the 1941 trout season over two miles down Hunt Creek. If, as the writer believes, a prime factor inducing the downstream movement in Fuller Creek is excessive population pressure, and if, as is indicated by studies of the trout and trout-food populations of Hunt Creek the latter stream, too, is overpopulated, the fall migration from Fuller Creek may well be continued down Hunt Creek, and joined by trout from that stream. Occasional isolated bits of evidence, such as the tagging recoveries mentioned above, point in that direction. But a definite statement to that effect cannot be made until a weir has been in operation at the lower end of Hunt Creek Section A, at the downstream terminus of the experimental area.

Fry Trap (Tributary No. 5)

The small weir referred to as the fry trap, placed near the juncture of Hunt Creek with the small spring brook arising just behind the station, took very few fish during the period extending from October 1, 1940, to September 30, 1941. So scanty and irregular was this movement that it has been thought not worth while to prepare a graph for the period. Table 2 lists the trapping results summarized by two-week periods. The total upstream and downstream movement for 1939-40 and 1940-41 are condensed in the following table:

Period	Fry up	Fingerlings up	Fry down	Fingerlings down
1939-1940	300	5	156	38
1940-1941	14	51	6	31

In 1939-40, there were 5 legal trout taken when moving up, 3 when moving down. In 1940-41, however, no legal-size trout passed through the trap either way. In each 12-month period the upstream movement considerably exceeded the downstream. During the first year of operation, a great majority of the total migrations were made up of fry; but in the second, fingerlings were dominant.

By reference to Report No. 652 it may be seen that during the 1939-40 season, about one-half of the downstream, and about three-fourths of the upstream, movements took place prior to January 1, 1940. During the fall of 1940 no very heavy migrations were noted, although there was a considerable upstream movement of fry during August and September. A possibility exists

that construction of the experimental raceways, carried out during the fall of 1940, may have altered in some way the desirability of Tributary No. 5 as compared to Hunt Creek. Sections I-A and I-B end a short distance above the mouth of Tributary No. 5, and may exert some influence on nearby trout movements. This is, of course, conjectural. The weir remains in operation, and further records may clarify the reasons for the disparity between the records for the two years.

Tributary No. 3 (Liljac Stream)

Rollled chart No. 3,*[✓]accompanying this report, shows graphically the movement of trout through a small weir installed near the juncture of Tributary No. 3 with Hunt Creek. Tributary No. 3 has its source as the outlet of Sutton's Pond. Approximately one-half mile below the pond, the stream has been dammed to provide a private trout pond about three acres in area. The private pond has been stocked with rainbow as well as eastern brook trout; and although no reproduction of the former has been known to have taken place, the weir near the mouth of the stream was installed not only to provide data on trout movements but also to insure against rainbows being introduced in Hunt Creek.

Below the private pond, the stream proceeds for about 600 yards through a deep, narrow valley. Then, after crossing the road, it enters a dense cedar swamp, which persists almost to its juncture with Hunt Creek, half a mile below. For a distance of a hundred yards or so just above its mouth, the stream flows through relatively open, sedge-grown marsh. Here the bottom is chiefly sand, muck and organic debris; and the current is sluggish except in time of flood. At such times the stream may overflow its low banks and wander through a plexus of anastomosing temporary channels crisscrossing through the marsh.

The flow of Tributary No. 3 at the weir-site is subject to variation not only in response to rainfall, but also to regulation of the flashboards in the spillway of the private dam. The average flow is probably about 500 gallons per minute.

The trap itself was patterned after the one installed two years ago in Tributary No. 5, and consists of a central box divided into an upstream and a downstream trap, the box itself flanked by wings joining it with the banks, and the whole structure based on 18-inch sheet piling to prevent undercutting. This type of trap has proved to be quite successful on streams having a relatively slow current, a condition obtaining for several hundred yards above the trap. However, the stream is subject to some flooding, and the trap may be replaced by one similar to that installed in Tributary No. 2.

As is shown in the chart, the heaviest trout movement, both up and downstream, occurred during the last half of October, although there was considerable activity during the two-week periods preceding and succeeding this interval. It will be seen hereafter that this agrees very closely with the period of greatest intensity of movement in the Tributary No. 2 weir, and a comparison with the chart for Fuller Creek also will show excellent agreement. There is fair agreement with results obtained from

* Retained by J. W. Leonard.

the Tributary No. 5 weir, although not so striking because of the small total movement of trout through this weir during the 1940-41 season of operation. During the period covered by this report, 219 trout moved up compared with 41 down.

Tributary No. 2 (Pine Ridge Creek)

On July 16, 1941, a two-way weir was placed in operation near the juncture of Tributary No. 2 with Hunt Creek in the upper end of Section A. This weir followed rather closely a design suggested by Mr. Fanselow. Rolled chart No. 4^{*} shows movements through the trap from September 1 to December 15, 1941. It will be seen that trout activity reached its peak during the last half of October. The total number of trout moving upstream during the 5-month period was 311; downstream, 178.

Pine Ridge Creek originates from spring seepages near the southern terminus of the high morainal ridge that lies along a north-south axis about one-half mile east of Section C of Hunt Creek. It enters Hunt Creek just below the boundary line between Section A and Section B. Until within a hundred yards or so of the mouth, its entire course is thickly screened by dense growths of cedar. Throughout the upper two-thirds of its course, trout have never been seen, and food organisms are of rare occurrence. Near the lower end is a series of three beaver dams, one of which was active and all of which were reasonably well repaired throughout the period covered by this report.

The fate of trout moving upstream through the counting weir near the outlet is a matter for some conjecture. It will be noted that, during the fall of 1941, considerably more trout moved up than came down through the weir. It is possible that openings in the dam existed, large enough to permit passage of trout.

(Failure by the Game Division, in spite of repeated requests, to remove the beaver from the lower active dam resulted in several unscreened diversions into Hunt Creek which may have permitted considerable unrecorded movement, especially downstream movement. The presence of these uncontrolled channels is believed to have rendered questionable the results of the operation of this weir during the past year. The Institute must be given a permit to control beaver in the experimental area in any way which may be necessary. A.S.H.)

East Fish Lake Outlet Weir

During the early winter of 1941, a weir was installed in the outlet of East Fish Lake about 50 feet below the spillway of the dam. The V-type design which had proved satisfactory in Tributary 2 was employed (Text Figure 1). Because the stream bed at the site is largely composed of soft marl, wooden sheet piling was driven to serve as a foundation and to prevent undercutting. This weir has a two-fold function: to keep track of possible movements into or out of East Fish Lake by brook trout, and to prevent minnows or other rough fish from entering the lake from the stream. It will be recalled that the lake was treated with rotenone in the fall of 1941, and the use of

* Retained by J. W. Leonard.

live minnows as bait has since been prohibited. Minnows taken in the upstream trap were returned to the stream below the weir. Brook trout moving upstream were tagged and placed above the weir. Trout moving downstream, out of the lake, were permitted to continue downstream.

To date only 5 trout have passed downstream through the weir, and all of these were taken between January 22 and April 23, 1942. Two were tagged trout from the lake, one dead and one alive. The remaining three were fingerlings which, it is believed, were trapped in the short stretch of stream between the lake outlet and the weir when the latter was installed. However, since unmarked trout about six inches in length were caught in East Fish Lake this summer it is possible these fingerlings came from the lake itself. Between January 11 and April 12, 4 mudminnows were taken moving downstream. These are believed to have been trapped between the outlet and the weir. No further downstream movement of fish other than trout was detected until July 6. Between that date and August 1, 9 fine-scaled dace have moved downstream through the weir. Observation has led to the belief that in early July a number of recently-hatched minnow fry were able to pass upstream through the mesh of the weir screens (6 openings per inch). It is not believed possible that any of these small fish could have entered the lake because of the amount of head carried at the dam and the fact that no pool was permitted at the foot of the flash boards in the spillway.

Since the weir was installed, only two trout have moved upstream through it--one 2 $\frac{3}{8}$ inches long on April 18, and another 4 $\frac{3}{4}$ inches long on June 10.

Upstream movements by minnows have occurred in appreciable amount only since May 1. Daily temperature records of the outlet water are not available during the first four months of 1942, as snow conditions did not make daily checking of the weir practical. Records since that time indicate that minnow movements started after the water temperature rose above 50°F. No minnows were taken in the upstream traps during February, March and April. In May, 31 moved into the traps and were replaced below the screen. In June, 28, and in July, 20 were so handled. None of the minnows was marked, and many may well have been "repeaters."

It is planned to keep daily water temperature records of the lake outlet during the fall of this year as long as snow conditions permit, for it is possible that there may be an acceleration of trout movements during this period.

Considerable numbers of water snakes, toads, frogs and crayfish have been taken in the traps. Records of their occurrence are on file, but are not considered pertinent to this report and therefore are not tabulated here.

Other Animals Taken in Traps

In addition to fish, various other organisms are found, from time to time, in the traps. Commonest are frogs, including the green frog (Rana clamitans) and pickerel frog (Rana palustris), and the leopard frog (Rana pipiens).

The wood frog, Rana cantabrigensis, has been taken, but less frequently. During spring, summer and fall, water snakes (Natrix s. sipedon), garter snakes (Thamnophis s. sirtalis), and ribbon snakes (Thamnophis sauritus) are often taken.

Small mammals are sometimes found drowned in the traps. Specimens found in the weirs on Tributaries 2 and 3 were preserved during the period from September 1 to November 1, 1941. These were identified by Dr. W. H. Burt, Curator of Mammals, University of Michigan Museum of Zoology, during a visit to this station. The list is as follows: 4 meadow mice (Microtis p. pennsylvanicus), 1 bog lemming (Synaptomys c. cooperi), 1 short-tailed shrew (Blarina brevicauda talpoides), and 4 jumping mice (Zapus hudsonius).

Some of the larger aquatic insects often appear, especially giant water bugs (Lethocerus americanus) and predacious diving beetles (Dytiscus spp.). Crayfish (Cambarus spp.) are often taken in the Fuller Creek weir during fall and spring.

Discussion

During the period covered by this report, fish movements through the Fuller Creek weir agreed quite closely with those for the year preceding as regards (a) period of greatest activity, and (b) great preponderance of downstream movement as compared with upstream migration.

The recently-installed weirs in Tributaries No. 2 and 3 revealed peak activities at about the same time as those noticed in Fuller Creek, but in the two latter streams, upstream movement was more extensive than downstream. Members of the station staff have noticed that extensive upstream movement through the weirs of Tributaries 2 and 3 generally occurs during a period of heavy rainfall when Hunt Creek is high and turbid. It is possible that the trout run up the smaller tributaries in an effort to escape the flood conditions. It will be noted that most of the trout involved were of fingerling size, so probably were not on spawning migrations. It is also worthy of mention that neither of the lower tributaries has as good spawning facilities as those present in Hunt Creek itself.

Further information on the movements of the upstream and downstream migrants may be expected to result from continued creel census and population estimates, for it has been the practice to jaw-tag all trout 100 millimeters or longer passing through the weirs.

The very considerable degree of consistency exhibited by records for two years of operation of the Fuller Creek weir justifies the placement of confidence in their reliability in indicating the trend of trout movements. However, it must be considered that the physical conditions of Tributaries 2 and 3 differ markedly from those of Fuller Creek. Disparity of figures on upstream-downstream ratios between Fuller Creek and the lower tributaries (which latter are quite consistent with each other) emphasizes the desirability of gathering information on trout movements in a number of

different tributary streams where the effect of such factors as size, physical character, and position within the drainage system may be evaluated. It is believed that continued operation of existing weirs and of others planned in the experimental area will go a long way toward providing a sound basis for management of tributary streams.

INSTITUTE FOR FISHERIES RESEARCH

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Report typed by: R. Bauch



View showing East Fish Lake dam and spillway (background) and two-way fish weir in outlet (foreground).

Table 1

Trout movements through the Fuller Creek weir summarized by two-week periods, shown in terms of trout size-classes. Figures cover the 12-month period from October 1, 1940, to September 30, 1941

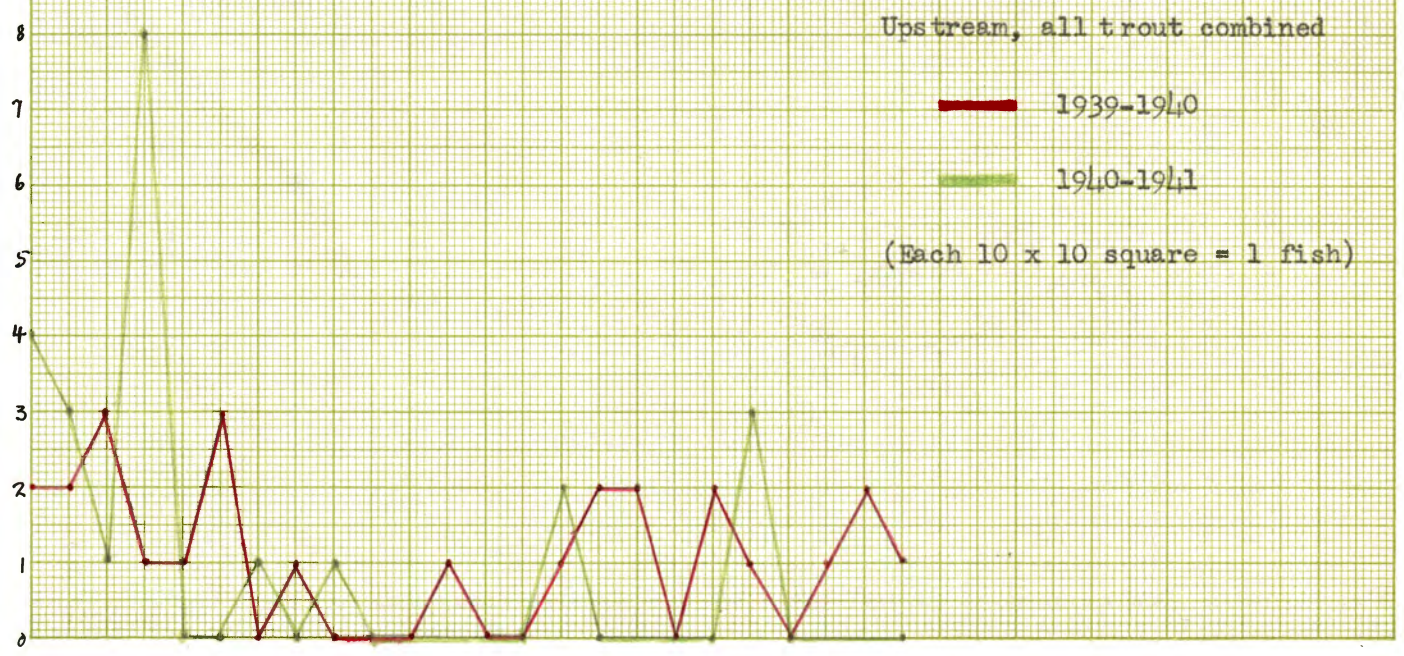
Period	Upstream				Downstream			
	Fry	Fingerling	Sublegal	Legal	Fry	Fingerling	Sublegal	Legal
<u>1940</u>								
Oct. 1-15	2	2	0	0	28	30	12	3
Oct. 16-31	0	3	0	0	0	49	43	4
Nov. 1-15	0	0	1	0	0	52	23	1
Nov. 16-30	0	4	3	1	0	22	11	0
Dec. 1-15	0	0	0	0	0	8	9	0
Dec. 16-31	0	0	0	0	0	8	2	1
<u>1941</u>								
Jan. 1-15	0	1	0	0	0	3	8	0
Jan. 16-31	0	0	0	0	0	1	6	1
Feb. 1-15	0	0	1	0	0	5	5	0
Feb. 16-28	0	0	0	0	0	0	2	0
March 1-15	0	0	0	0	0	3	0	0
March 16-31	0	0	0	0	0	2	0	0
April 1-15	0	0	0	0	0	5	8	0
April 16-30	0	0	0	0	0	7	8	0
May 1-15	0	1	1	0	0	7	1	0
May 16-31	0	0	0	0	0	2	0	0
June 1-15	0	0	0	0	0	0	0	0
June 16-30	0	0	0	0	0	8	2	2
July 1-15	0	0	0	0	0	10	1	0
July 16-31	0	3	0	0	0	13	0	1
Aug. 1-15	0	0	0	0	0	5	0	1
Aug. 16-31	0	0	0	0	0	5	0	0
Sept. 1-15	0	0	0	0	0	11	4	0
Sept. 16-30	0	0	0	0	0	0	0	0
TOTAL	2	14	6	1	28	216	145	14
		23				403		

Table 2

Trout movements through the Tributary 5 weir summarized by two-week periods, shown in terms of trout size-classes. Figures cover the 12-month period from October 1, 1940, to September 30, 1941

Period	Upstream				Downstream			
	Fry	Fingerling	Sublegal	Legal	Fry	Fingerling	Sublegal	Legal
<u>1940</u>								
Oct. 1-15	4	1	0	0	0	0	0	0
Oct. 16-31	5	2	1	0	0	0	0	0
Nov. 1-15	0	6	3	0	0	0	6	0
Nov. 16-30	0	1	0	0	0	0	0	0
Dec. 1-15	0	0	1	0	0	2	2	0
Dec. 16-31	0	1	0	0	0	0	0	0
<u>1941</u>								
Jan. 1-15	0	2	0	0	0	1	0	0
Jan. 16-31	0	1	0	0	0	0	0	0
Feb. 1-15	0	1	0	0	0	0	0	0
Feb. 16-28	0	1	0	0	0	0	0	0
Mar. 1-15	0	0	0	0	0	0	0	0
Mar. 16-31	0	0	0	0	0	1	0	0
April 1-15	0	1	0	0	0	2	2	0
April 16-30	0	0	0	0	0	0	0	0
May 1-15	0	0	0	0	0	3	0	0
May 16-31	0	2	0	0	0	0	0	0
June 1-15	5	0	0	0	5	0	0	0
June 16-30	0	2	0	0	1	0	0	0
July 1-15	0	3	0	0	0	3	0	0
July 16-31	0	11	0	0	0	6	0	0
Aug. 1-15	0	4	0	0	0	3	0	0
Aug. 16-31	0	1	0	0	0	2	0	0
Sept. 1-15	0	1	0	0	0	1	0	0
Sept. 16-30	0	2	0	0	0	0	0	0
TOTAL	14	46	5	0	6	21	10	0
		65				37		

Graph I
Trout movements,
Fuller Creek Weir



KEUFFEL & ESSER CO., N. Y., NO. 358-14
Millimeters, 10th lines heavy.
MADE IN U. S. A.