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THE OPERATION OF THE PLATTE RIVER WEIR,

NOVEMBER 1, 1941-JUNE 20, 1943

by

David S. Shetter

Previous to the summer of 1941, numerous interested anglers in the northwestern part of the Lower Peninsula agitated at various times for stream improvement devices or dredging activities at the mouth of the Platte River where it enters Lake Michigan. Occasionally the river becomes quite low and temporary sand bars may develop across the mouth. Anglers claimed that fish were not able to enter the Platte River drainage at such times.

Since it was known from past experience that both types of river-mouth improvement suggested by these interested parties were quite expensive, it was decided to determine first whether or not there was a need for such improvements by investigating the numbers of fish migrating upstream into the Platte River drainage, the species involved, and the times of year at which they migrated. The construction and maintenance of a two-way fish trap to block off and count the fish moving in either direction appeared to be the best method by which we could obtain the desired information, as a similar structure had been operated successfully in the Muskegon River below Houghton Lake, at the outlet of Gogebic Lake, and also in several smaller streams.

Survey and building operations,
description of the weir

The lower Platte River, below Round Lake, was cruised in detail both from shore and from a boat on two occasions in July and August of 1941. On the last-mentioned trip the writer was accompanied by Floyd Fanselow, Fish Division Engineer, and the weir site was established in T. 27 N., R. 15 W., Sec. 20 (NE 1/4), approximately 1 1/2 miles upstream from Lake Michigan. This site had the advantage of being close to the county road, the river was comparatively narrow (45 feet), and the greatest depth observed at the time of the August visit at this point was 29 inches.

In August 1941, Ralph Amidon, who has lived and worked on the river for the past twenty years, stated that the river was lower than it ever had been in his memory. He, and others, claimed that the spring floods would not bring the river more than two feet higher than the level of August 1941. However, since January 1942 the water level has been as much as three feet higher, particularly in the late winter and early spring.

Construction of the weir was complicated by the fact that there was a certain amount of boat traffic between the upper river and Lake Michigan from various boat liveries. The final design of the weir was a combination of the features of the Muskegon River weir as used by W. F. Carbine plus the addition of a pair of boat gates operated by pulleys and cranks which were designed by Mr. Fanselow. Fanselow also drew up the bill of materials.

Materials and tools were assembled in late September of 1941. Through the courtesy of Mr. Frank Hoard, District Supervisor of Field Administration, all of the 16 and 8 foot round maple pilings were obtained from road clearing activities on Old Mission Point. Many of the logs which were later milled into rough lumber for slats and braces were also obtained from this locality.

Actual construction work started on October 1, 1941, but had to be delayed for two days while the writer and Ralph Amidon built a power-driven pile-driver^v which was found to be necessary to drive the piling into the rubble and boulders of the bottom formation. The entire structure was placed on single board sheet-piling driven from three to five feet into the bottom to eliminate as far as possible any undercutting. A double row of round pilings supported both the sheet piling and the frames and blocking bars at intervals of five feet. The spacing between the blocking bars was 1 1/2 inches. This allowed all but mature game fish to pass through the structure without being trapped.

During the first few days of construction, the writer directed the activities of the crew. After Dexter B. Reynolds, Jr. arrived, construction was carried on under his supervision, and Mr. Reynolds was the biologist in charge of the weir until April 10, 1943, when he left to enter the armed Services. Rhyner Scholma took his place until June 20, 1943, when the boat gates were lifted and the traps blocked.

A diagram of the weir structure (Figure 1) and the accompanying photograph (Figure 2) show the most prominent features. A and B are the boat gates approximately 5 x 15 feet, C and D are the traps, one for downstream, the other for upstream migrants. The total dimensions of the traps were 12' x 5' x 5'. E and F were stationary blocking arms both about 45' x 5'. G is a generous working platform about 6 feet wide, and 2" x 10" planks were placed on the downstream side of the blocking arms for a catwalk. H was a solid row of single sheet piling 6 feet long, half underground and half above, built as a safety measure across a 150-foot stretch of marsh which had filled in an old oxbow of the river. This arm was carried to

^v Some good photographs of construction work and the pile-driver are in the Institute files.

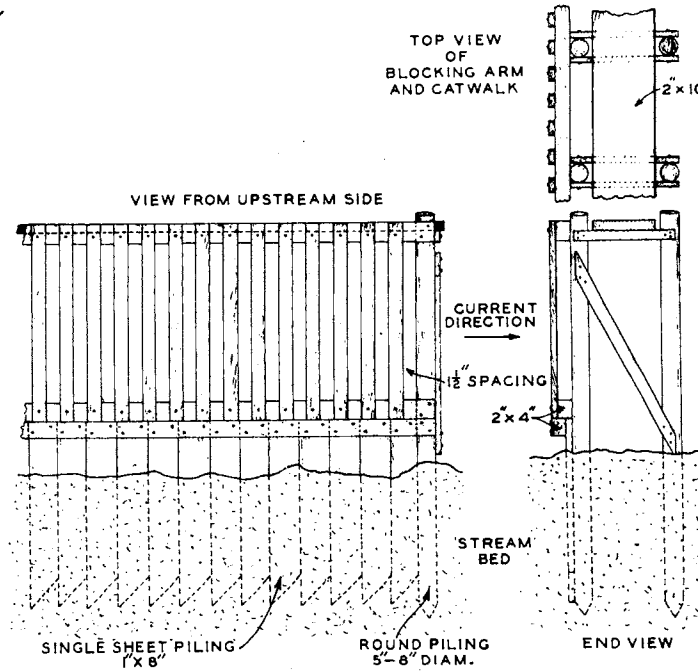
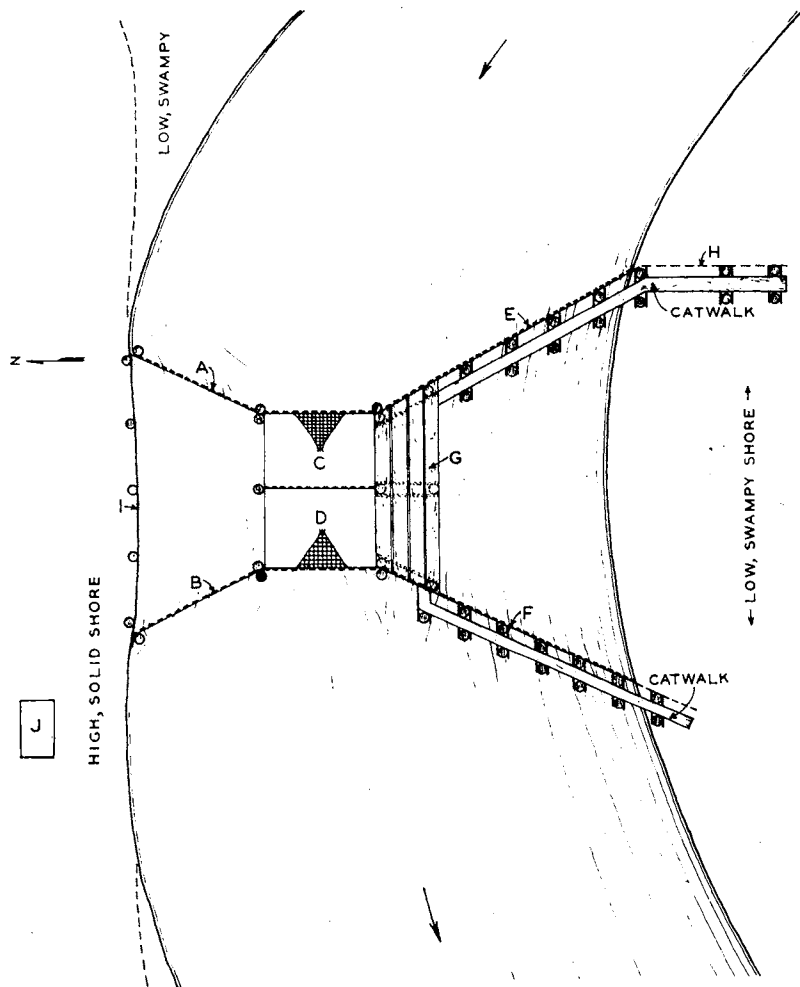


FIG. 1 DIAGRAM OF PLATTE RIVER WEIR

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Fig. 2. Side view of weir showing boat gates.

higher ground on the south side of the river. This row of piling prevented the fish from running past the weir in times of high water. I is a sea wall built to prevent bank erosion in the north bank in the vicinity of the boat slip. The blocking arms, traps, boat gates and sea wall were also built on a row of single sheet piling to prevent undercutting insofar as possible (see diagram). Triple Wakefield piling could not be used because of the difficulties encountered in driving into the subsurface material of rubble and boulders, which split and separated the construction units. J is the attendant's cabin, part of which was moved to the site and added to from lumber remaining after the completion of the weir structure.

Weir operation and data collected

The weir was in constant operation except for the periods January 5-22, 1942, December 17-23, 1942, and January 19-26, 1943, when sudden blizzards and rapidly dropping temperatures formed slush ice. Pressure from ice and snow broke the boat gates on the first two occasions and necessitated their repair. After that time the boat gates were opened for short periods on three occasions in February 1943 ^{when} ~~such~~ such ice was in the river.

The traps were inspected at least five times daily and water and air temperatures recorded. Water levels were also taken. During 1942 all upstream migrants were either tagged or fin-clipped. All, or a good random sample, of each day's trap catch was weighed and measured and sex determined so that data are at hand with which to establish the average size of the adult fish in the runs. Scale samples are available for almost the entire rainbow trout run of 1942. When time is available for a study of this series of scales, some interesting information on the age composition of a rainbow trout spawning run should be forthcoming; also the growth rate of Platte River rainbows can be determined.

During the winter of 1942-1943 attempts were made to secure three rainbow trout weekly to learn something about the feedings habits of this species during the winter when in the river. Only a few stomachs were obtained because of deep snow, high water, unsafe shelf ice, and a scarcity of fish in the Platte River above Platte Lake during the winter.

Observations were made periodically in all parts of the river in an attempt to determine the earliest date of spawning after January 1943. Numerous redds were dug up, both below the weir and in the Upper Platte River, but no redds containing eggs were discovered until April 19, 1943 at a location near Clark's Mill above the Platte River Rearing Station.

Complete ovaries from five females were obtained to determine the number of eggs per female. These have not yet been counted. A larger series from rainbow trout of various sizes should be obtained in the future.

Periodic observations were made in the river mouth and depth measurements taken to ascertain the depth of water available in the channel and the position of the channel.

In addition to these various researches, the biologist in charge conducted partial creel censuses on Platte, Round and Crystal lakes during the winter of 1941-42, and constructed, placed, and examined at bi-weekly intervals, experimental smelt egg traps in Crystal Lake (see Report No. 792). During the summer and fall months creel censuses were operated in cooperation with boat livery proprietors on Platte and Round lakes, and Reynolds personally collected numerous creel census records from the lower Platte River.

Number of fish handled

The number of fish running and the direction of their movement is presented in Table 1. The time periods when no fish or very few fish entered the traps have been lumped. The periods when the runs were heaviest

Table 1. Summary of fish taken in the traps of the Platte River Weir, November 1, 1941 to June 20, 1943. () indicates number of dead fish picked up at weir.

Time Period	Year	Rainbow trout ^a		Suckers ^b		Other fish ^c	
		Up	Down	Up	Down	Up	Down
Nov., Dec.	1941	1	4	4	...	12 Ci, 32Y	...
Jan., Feb.	1942	...	...	...	...	...	...
March-April 2	1942	17	1	1	1	59 Sm	...
April 3-9	1942	220	...	4	...	139 sm	...
April 10-16	1942	344	7 (4)	26	...	18 sm, 1 W	...
April 17-23	1942	121	2 (2)	1043	...	1 NP	1 D
April 24-30	1942	51	7 (5)	447	...	...	1 D
May 1-7	1942	2	1 (1)	313	...	1 Rb	2 D, 1 Sm
May 8-31	1942	1	6 (5)	51	...	3 Y	...
June-Sept.	1942	...	1 (1)	...	...	...	...
Oct. 1-7	1942	12	...	...	...	...	...
Oct. 8-31	1942	...	...	5	...	37 Y	...
Nov., Dec.	1942	...	1	4	1 (1)	4 Y	...
SUBTOTAL, 1942		768	26 (18)	1894	2 (1)	1 NP, 1 Rb, 216 Sm, 1 W, 44 Y	4 D, 1 Sm
Jan.-March	1943	...	1	...	...	...	...
April 1-15	1943	...	...	...	...	...	...
April 16-30	1943	113	4 (1)	206	1	3 W	2 NP (2)
May 1-15	1943	57	2	1075	...	1 B, 1 D, 1 S	3 D
May 16-31	1943	18	59	762	166	3 Rb, 1 L	...
June 1-20	1943	8	1	424	...	1 B, 1 C, 1 D, 9 Rb, 1 NP	...
SUBTOTAL, 1943		196	67 (1)	2467	167	2 B, 1 C, 2 D, 1 L, 1 NP, 12 Rb, 1 S, 3 W	2 NP (2) 3 D
TOTALS		965	97 (19)	4365	169 (1)	2 B, 12 Ci, 1 C, 2 D, 1 L, 2 NP, 13 Rb, 1 S, 216 Sm, 4 W, 76 Y	7 D, 2 NP (2), 1 Sm

^a = Salmo gairdnerii irideus

^b = Includes both common suckers (C. commersonii) and fine-scaled suckers (C. catostomus)

^c = Key to other fish:

B = Bullhead (Ameiurus sp.)

C = Carp (Cyprinus carpio)

Ci = Cisco (Leucichthys artedi)

D = Dogfish (Amia calva)

L = Lawyer (Lota maculosa)

NP = Northern pike (Esox lucius)

Rb = Rock bass (Ambloplites rupestris)

S = Smallmouth black bass (Micropterus dolomieu)

Sm = Smelt (Osmerus mordax)

W = Walleyed pike (Stizostedion vitreum)

Y = Yellow perch (Perca flavescens)

are given by two-week intervals. From this table the reader will note that the heaviest run of all species of fish occurs between March 1-May 31; just when may depend on the weather conditions.

Rainbow Trout

In 1942 the spring upstream spawning migration of rainbow (steel-head) trout extended from about March 25 to May 10. In 1943 the spring movement did not start through the weir until April 19 and extended to June 14, presumably because of the late cold spring weather.

There was a marked difference in the number of fish in the two spring upstream migrations. In 1942, 756 adults were passed through the trap; in 1943 only 196 mature rainbows were dipped over. Possible reasons for this difference are (a) leakage of fish through holes in the weir or boatslip in 1943, (b) fewer fish actually migrating into Platte River, (c) discouragement of fish from running in 1943 by opening-day anglers.

We know that the weir was not always fish-tight since recoveries of both tagged and fin-clipped fish were recorded in 1943 on their upstream runs that had not been noted to have passed downstream. These fish could have passed downstream either when the boat gates were lifted for navigation, when ice had broken the boat gates, or through undercut holes in the southern end of the upstream blocking arm. This latter place was a source of trouble and required constant filling with wood and stone to keep the structure fish-tight during 1943 because of the exceptionally high water.

In both years before starting on their upstream migrations between 500 and 800 large adult rainbows entered and stayed in the river between the weir and Lake Michigan from mid-November until they felt the spawning urge during the following spring. In 1942 the heavy run started on April 5 and the majority of fish had been dipped over the weir by the time the fishing season opened on April 25. In 1943, delayed by cold weather, the

fish did not begin to move up to the weir until April 19, and when the fishing season opened on April 24 many anglers fished over the concentration of big rainbows in the river below the weir, both from shore and from boats. According to Scholma and Amidon, the angling activity frightened the trout to such an extent that the majority of the fish which were below the weir left the lower river and returned to Lake Michigan. It would appear that fewer fish were handled at the weir in 1943 chiefly because of the latter situation, although it is known that some fish passed through the undercut already mentioned. Visual observations by both Reynolds and Scholma prior to the start of the run indicated that approximately the same number of adults entered the lower river from Lake Michigan in both years.

Time does not permit a detailed analysis of the length and weight of the rainbow trout, but from random samples of the 1942 data, it may be estimated with a fair degree of accuracy that the average size of the rainbow trout passing the weir was 9 pounds (27 $\frac{5}{8}$ inches). These fish ranged in weight from 2 to 18 pounds, and in length from 17 to 34 $\frac{5}{8}$ inches. The 1943 run appeared to be of similar character in length and weight.

Suckers (both common and fine-scaled have been lumped)

The spring upstream run of suckers was larger in 1943 than in 1942 (2,467 in 1943, 1,894 in 1942). During the 1943 run all suckers taken were distributed to the public free of charge to anyone possessing a fishing license for the current year. In 1942 all suckers trapped were passed upstream to continue their spawning migration.

Based on the weight data for the suckers available from the 1942 work (when the suckers averaged 2.49 pounds in weight), a total of 6,143 pounds of free fish were distributed at the Platte River weir and helped to alleviate the meat shortage in that general area during May and June of 1943. Many were cooked as fresh fish; and a goodly number were also canned and

smoked. In this connection it might be mentioned that the fine-scaled suckers were found to be better for smoking than the common sucker according to Ralph Amidon.

Fall movements upstream

When the weir was installed one fact we wished to determine was whether or not adult rainbows migrated during the fall months into the Platte River. The weir was not completed in time to catch the migrants, if any great movement took place, in the fall of 1941. In 1942 a large concentration of fish was observed in late September and early October about 1/2 mile below the weir, and on the night of October 4, 1942 ten trout entered the trap. Two more fish entered a few days later. This constituted the fall upstream migration of 1942. A small number of suckers moved upstream at the same time.

Downstream migrations of trout and suckers

The downstream movements through the weir were confined chiefly to the spring spawning periods, and immediately following the spawning periods. In 1942 only 24 rainbows were caught in the downstream traps and of these 18 were dead from spawning injuries and spear wounds. In 1943 sixty-six (of which only one was dead) returned downstream through the weir. Almost no suckers passed downstream through the weir in 1942, but in 1943 a total of 166 suckers were caught in the downstream trap.

Small rainbow trout (6" - 10") were observed in the vicinity of the weir during July 1942, and the writer took two on flies at that time. These small fish were probably moving through the 1 1/2-inch spring of the weir with no difficulty and their numbers could not be determined.

Other fish handled

In addition to the rainbow trout, the common and the fine-scaled suckers, which ran in the largest numbers, the following species of fish

were taken in the traps:

Yellow perch	(76 up)
Ciscoes	(12 up)
Smelt	(216 up, 1 down)
Walleyed pike	(4 up--one a 10-pounder)
Northern pike	(2 up, 2 down dead)
Rock bass	(13 up)
Bullhead (sp?)	(2 up)
Dogfish	(2 up, 7 down)
Lawyer	(1 up)
Carp	(1 up)
Smallmouth bass	(1 up)

The perch and ciscoes moved upstream in the fall and winter months, and the smelt ran just before and with the rainbows in 1942. In addition to those recorded, many thousands of immature fish ~~were~~ passed through the weir untrapped as they were able to go through the 1 1/2-inch spacing. In October of 1942 the writer observed the fall migration of small perch (3 - 6 inches) which formed a continuous band about 2 feet by 2 feet from the river mouth to the weir along each bank of the stream. The spring and early summer migration of the lake shiners was of a similar magnitude. The remaining species ran with or just after the rainbow trout and suckers. Carp, dogfish, and northern pike were noted by Reynolds to spawn in the marshy, weedy oxbows in the vicinity of the weir.

Rainbow trout marked and recovered

After completion of the blocking arms on November 1, 1941 and until Reynolds left the weir on April 10, 1943, all fish passing through the

weir were marked, either by tagging or fin-clipping if they were in good condition. Because many of the spent rainbows going through the weir in a downstream direction were in poor condition or almost dead, attempts were not made by Reynolds to mark such fish in 1942. Tags were used only on the rainbow trout and northern pike; the other fish were fin-clipped. In the year following November 1941 the fin removed was the right pectoral. Fish passing the weir after January 1943 were counted only, and weights and measurements taken on what few marked fish were recovered. Rhyner Scholma^{*} did mark 25 downstream migrants by clipping the left pectoral fin during late May of 1943; otherwise none of the migrants of 1943 were marked.

From November 1941 until November 1942, 174 rainbow trout were marked with numbered jaw-tags, and all the rest (598) of the migrants were marked by clipping the right pectoral fin. All suckers and other fish moving upstream were marked, either with a numbered tag or by clipping the left pectoral fin. In 1942 only 4 rainbow trout were fin-clipped and two were tagged going in a downstream direction.

In Table 2 will be found a summary of the marking activities and the number of recoveries made in both years and the method of recovery. More than three-fourths of the 88 recoveries to date have been made by anglers. Of the 174 rainbows tagged at the weir, 34 (or 19.5 per cent) have been recaptured. Of 598 rainbow trout fin-clipped, 54 (or 9.0 per cent) have been reported. The 88 recoveries represent a total recovery percentage to date of 11.4 per cent. Many marked fish are known to have been caught and not reported.

*Scholma has only one arm but nevertheless carried out his duties creditably at the weir in replacing Reynolds during the period April 10-June 20, 1943.

Table 2. Summary of rainbow trout marked and recovered from operations of the Platte River weir, November 1942 - July 1943

Method of marking	Number marked	Year	Recovered by anglers in		Recovered by weir in				Total recoveries	
			1942	1943	1942		1943		Number	Per Cent
					Up	Down	Up	Down		
Tagged	174	1942	25 ^a	4	...	1 ^b	3	1	34	19.5
Fin-clipped	598	1942	48	1	...	...	4	1	54	9.0
Totals	772	...	73	5	...	1	7	2	88	11.4

^a = One recovery from Lake Michigan by commercial fisherman off Manitou Island on October 21, 1942.

^b = A tagged fish found dead in weir trap for downstream migrants.

All marked fish caught by angling were taken in the Platte River drainage above the weir, chiefly between the town of Honor and the US-131 highway bridge just below the Platte River Rearing Station. Unverified reports were received that marked fish were captured in Round Lake in midsummer.

The recovery of four 1942 fin-clipped and three 1942 tagged fish by the trap as they moved upstream in 1943 (plus the recovery of a rainbow trout tagged at the weir by a commercial fisherman off Manitou Island in October 1942) indicate that a number of the upstream migrants were able to return to Lake Michigan undetected by the operator either through undiscovered holes, when boats went through the gates, or at the previously mentioned times of ice pressure and ice damage.

A small amount of data on growth in length and weight were obtained from the recoveries made at the weir in 1943. In most instances the data given by anglers obviously were not accurate as they recorded excessive gains or losses in lengths for a comparatively few days of freedom. The accuracy of the scales which they used for weighing might also be questioned. The two recoveries of fish which were actually measured at the weir showed gains of $1 \frac{3}{4}$ inches in length and $2 \frac{3}{4}$ pounds in weight, and $2 \frac{1}{2}$ inches and $2 \frac{3}{4}$ pounds both in $12 \frac{1}{2}$ months.

Rainbow trout fishing of the Platte River

The Platte River above Platte Lake contains brook and brown trout as well as rainbows. The latter, and particularly the big lake run fish such as were handled at the weir, are the chief drawing card of this stream. In a normal year the opening day of the trout season finds most of the big fish above Platte Lake in the upper river and on or in the vicinity of spawning beds. The fishing in the general locality (between Platte Lake

and Clark's mill) for these large fish is familiar to almost everyone either through newspaper or magazine accounts or through fishing experience or observation.

It is the habit of the spawning fish after they have completed their reproductive activities to drift downstream, more or less borne by the current. As they recover from their strenuous reproductive labors these fish take a lure with much more abandon than when they were on or near the redds.

During the two spring seasons when the weir was in place, hundreds of rainbow trout were concentrated in about 1/2 mile of water above the weir, either because they were afraid of the structure or because they lay there by choice. In both 1942 and 1943 a fairly large number of spent fish were captured by anglers. In 1942 Reynolds observed and measured 42 large fish taken between May 16 and June 2. After the latter date the fish moved back upstream to Platte and Round Lakes, both of which have considerable areas of deep, cold water. Temperature was apparently not the factor which caused them to move to these lakes since at the time they left the vicinity of the weir stream water temperatures ranged from 55° to 62°F., and the water level was still higher than normal at the time of departure.

A similar concentration of rainbow trout of all sizes was observed above the weir from May 23 to June 19 by Rhyner Scholma (reported in a letter dated June 19, 1943). This school of fish attracted many anglers, who because of the high water did most of their fishing from boats. The situation is comparable to that now in effect at Guiley Pond in Iosco County and Bear Creek in Manistee County (where the adult rainbows are prevented from returning to the big lake after spawning by screens) except that it is on a larger scale.

The reactions of Scholma to the situation were stated in his letter of June 19 as follows:

"The fishing pressure above the weir has driven many of the trout back upstream where they will be fished over later by bass fishermen This is what the local sportsmen desire. They want to have the fish come up the river into the lakes and prevented from returning to Lake Michigan. I believe that, if the weir is left in, there should be some ruling made concerning fishing below the weir prior to completion of spawning activities to prevent a recurrence of what happened this spring. The fish were countless below the weir until the 2nd day of the season, but were driven back into Lake Michigan by the extreme fishing pressure...."

"Summing up and giving my own reactions. I believe the weir is a definite asset to sport fishing on the lower Platte.

- 1st. It prevents the early return of rainbow to Lake Michigan.
- 2nd. It provided a vantage point for tourists to see real rainbow in actual natural condition (a big factor).
- 3rd. The removal of suckers and predators has been a big boost to local conservation and should be continued

Apparently the Beulah sportsmen had points 1 and 3 in mind in presenting their recent petition to continue the maintenance of the weir. This is in direct contrast to the feelings of a number of Honor residents who have advocated the dismantling of the weir since the day of its completion, both vocally and in print.

(Because of the results of the studies by John R. Greeley of rainbow trout reproduction in various Michigan streams, we do not believe that the removal of a certain percentage of these large adult fish will adversely affect trout fishing in the Platte River. If carried to extremes the average age (and size) of the big trout in the run might be lowered and the population of small rainbow in the river might be somewhat reduced. The growth rate and present population density of immature rainbow trout in the Platte River has not been determined, but judging by Greeley's work on the Pere Marquette River there may be too many at present for the best growth. A reduction in the number of large adult rainbow and of young rainbow

presumably would favor brook and brown trout resulting in an increase in their number. -- A.S.H.)

Observation on the channel depths at the river mouth

In July and August of 1941, when the river was at its lowest level in the memory of the local inhabitants, the main channel at the river mouth varied in depth from 18 to 30 inches. During the period of weir operation the lowest recorded maximum depth of the channel at the river mouth was 17 inches on September 13, 1942. From then on to May 22, 1943 the maximum channel depth varied between 27 and 30 inches. On June 1, 1943 there were 4 feet of water in the channel, and on June 15, 1943, 3 feet. Fish were able to enter the river at any time during the 20 months of observation.

The position of the river mouth changed noticeably, particularly in 1943. The confluence of the river with Lake Michigan was approximately 700 feet west and somewhat south of where it was observed in August 1941.

Improved methods of handling large fish

Some adverse criticism was received by Reynolds and the writer because of the manner in which the mature rainbows were handled for marking during the 1942 run. Since no marking operations of such magnitude, either in size of the run or the size of the fish, had been attempted before, we did not know what to expect. Reynolds performed a difficult assignment very capably in handling and marking with a limited amount of assistance and almost no previous experience. Because the fish would struggle violently in the net and on the measuring board, considerable amounts of eggs and milt were lost from time to time, but such losses were unavoidable if the fish were to be weighed, measured, and marked.

During 1943 the use of a 2 1/2 per cent solution of ether to anesthetize these large fish has been tested and appears to hold considerable promise

should we ever desire to mark such large fish at a later date. This would eliminate almost all of the loss of spawn to which the anglers previously objected, and would also make the measuring and marking task much easier for investigators.

Future operations on the Platte River

Because of war-time conditions, detailed daily operations at the Platte River weir and in the vicinity will have to be discontinued. It is suggested that the weir be left in place and operated on the following schedule:

June 15-April 1. Leave boat gates and traps out and permit free movement of fish (according to past records at the weir little or no movement takes place in this period). During this time the structure would require only periodic inspection and cleaning to remove water-borne debris.

April 1-June 15. Install boat gates and trap entrances and dip over fish, keeping track of all species running. A qualified biologist will have to be stationed at the weir during this period and provided with adequate assistance at the peak of the rainbow run. If personnel is available, some detailed investigations could be carried on at this time. If it seems desirable of continuing the distribution of suckers and rough fish to the public, this could be carried on as in 1943. The boat gates and traps would be left in place until well after the spawning season in the spring in order to give anglers an opportunity to fish over the large trout before they return to Round and Platte lakes, or to Lake Michigan.

INSTITUTE FOR FISHERIES RESEARCH

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