

Original: Fish Division
cc: Education-Game
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INSTITUTE FOR FISHERIES RESEARCH
DIVISION OF FISHERIES
MICHIGAN DEPARTMENT OF CONSERVATION
COOPERATING WITH THE
UNIVERSITY OF MICHIGAN

314

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April 3, 1942

ADDRESS
UNIVERSITY MUSEUMS ANNEX
ANN ARBOR, MICHIGAN

REPORT NO. 764

A SUMMARY OF RESULTS OF THE OPERATION OF
THE LAKE GOGEBIC WEIR, 1940-41
by
Paul Eschmeyer

Prompted by the succession of lean fishing years from 1936 to 1939, interested individuals and groups began to search for a solution to the problem of improving the fishing in Lake Gogebic. There resulted the re-emphasis of an opinion heard from time to time for at least the past decade among both sportsmen and resort operators that large numbers of walleyes and other fish were escaping each year down the Ontonagon River outlet and were failing to return to the lake. The basis for the belief that fish were leaving the lake is believed to be the fact that fishing in the early season has frequently been good near the railroad bridge about 500 feet upstream from the Bergland Dam. Continued poor fishing in the lake was the basis for the belief that the fish were continuing on down the river from this point, rather than going back to the lake. Sentiment for the prevention of the supposed migration of fish from Lake Gogebic grew, and, in 1939, a petition was circulated around Bergland for the installation of an electric fence across the lake outlet. Formal action requesting the installation of a fish screen to prevent the movement was initiated by the Lake Gogebic Development Association in the spring of 1939.

In a meeting of the Board of Supervisors of Ontonagon County, held in the Court House in the Village of Ontonagon on Monday, June 26, 1939, the following resolution was passed:

"Whereas inland lake fishing is an important attraction to the tourist, and
Whereas the pike and other fish are rapidly being depleted in Lake Gogebic.

"Now, therefore, Be it Resolved that the Board of Supervisors of Ontonagon County do hereby endorse the move of the Lake Gogebic Development Association and hereby petition the Conservation Department of Michigan for authority and cooperation in determining and erecting the proper type of screen to be placed at the outlet of Lake Gogebic."

On July 5, a resolution adopted by the Gogebic County Board of Supervisors at a regular monthly meeting held at the Court House in the City of Bessemer read in part:

"Resolved:

1. That the Board of Supervisors of Gogebic County, Michigan, go on record requesting the Conservation Commission of the State of Michigan to screen the outlet of Lake Gogebic so as to keep the Pike and other fish in Lake Gogebic."

During the July 14, 1939 meeting of the Conservation Commission, that body, after some discussion, instructed the Fish Division "to conduct a thorough survey of Lake Gogebic in order to obtain all available data on which to base recommendations for the improvement of fishing conditions".

A complete biological survey of Lake Gogebic had been made in 1938, and the results were reported upon in 1941.

On August 11, 1939, it was suggested by Mr. F. A. Westerman, Chief of the Fish Division, to Dr. A. S. Hazzard, Director of the

Eschmeyer, Paul H., "Fisheries Survey of Lake Gogebic, Ontonagon and Gogebic Counties", Institute for Fisheries Research Report No. 657, March 17, 1941 (manuscript).

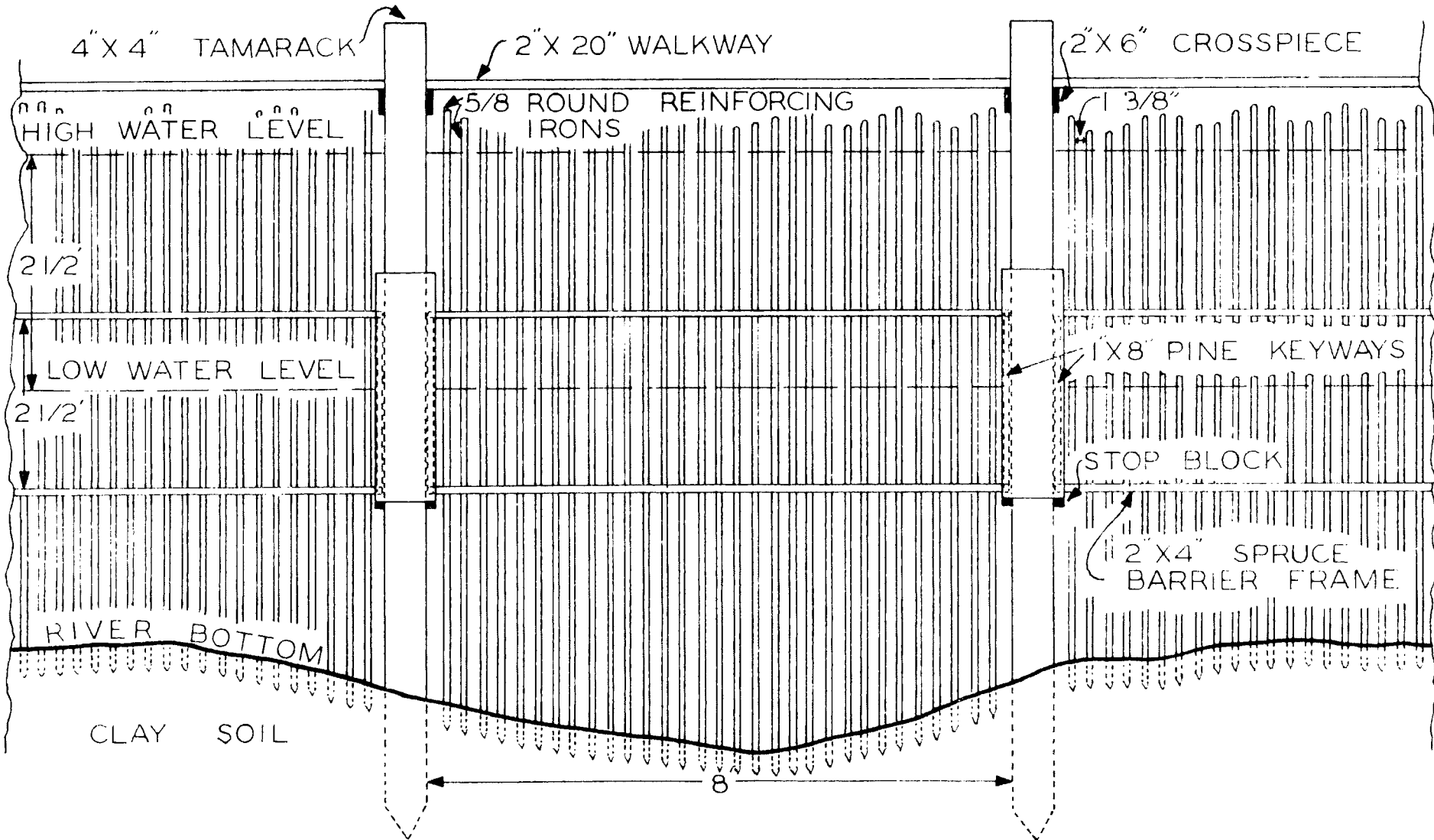
Institute for Fisheries Research, that before the Division was prepared to make recommendations with regard to a screen at the outlet of Lake Gogebic, a more thorough study of conditions would be needed, including a downstream trap to determine that movement of fish takes place.

Arrangements were made for the erection of a weir across the outlet of Lake Gogebic, with 2 traps, in order that fish passing upstream and downstream might be counted. The structure was completed on April 4, 1940 under the supervision of Roy Johnston, and its operation was begun 6 days later. It was operated from April 10, 1940 to September 14, 1941. The results of the operation of the weir are discussed in the following pages of this report. In addition to the results with regard to fish movement, notes concerning the construction, cost and efficiency of the weir are included. A summary of water temperatures, weather data and water levels during the first 6 months of weir operation is also included (Table IX) for use as a reference in this report and because of the general value of the data for any future investigations which may be carried on at Lake Gogebic.

Location and Construction of Weir

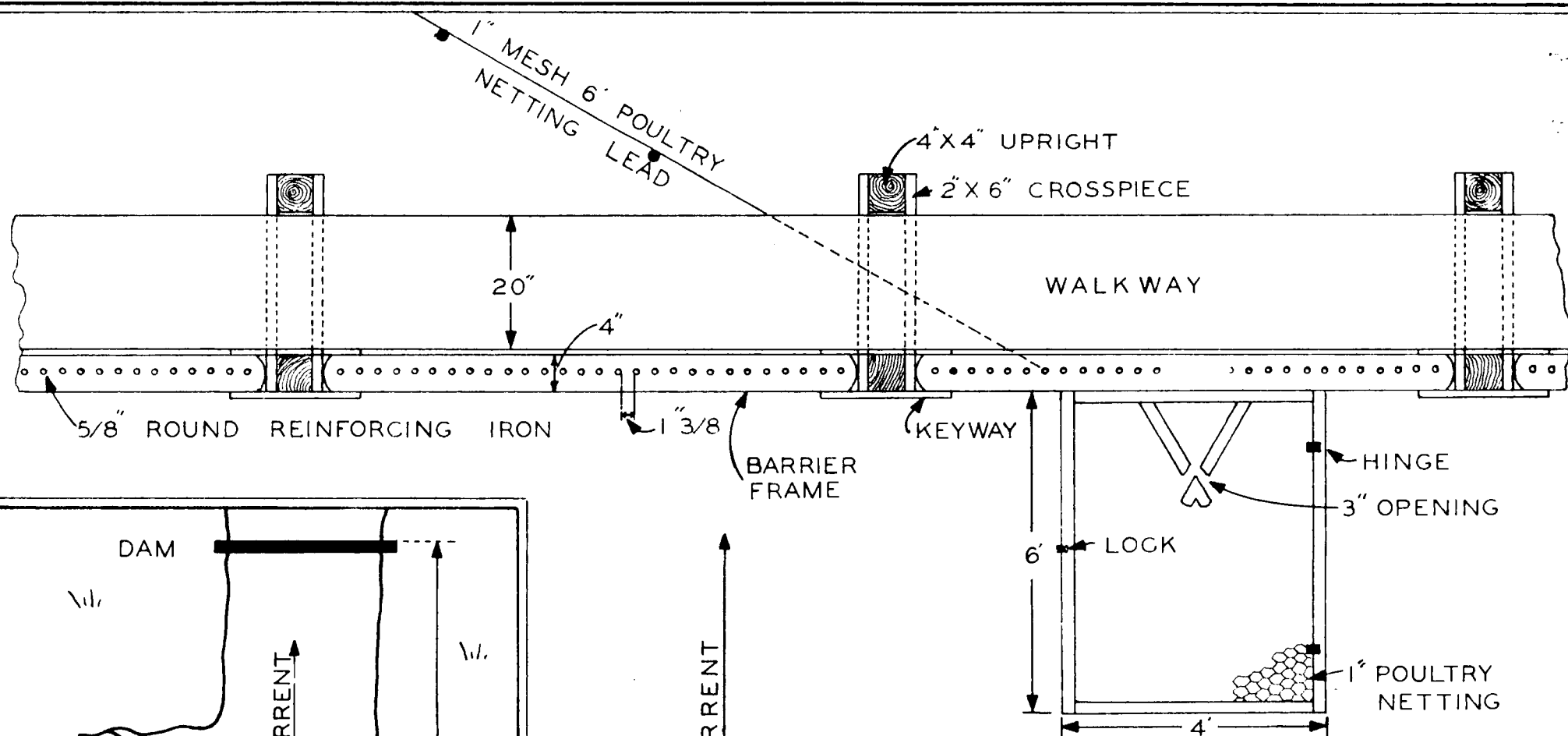
The Gogebic weir crossed the Ontonagon River (at right angles to the banks) at a point about 10 feet below the Ontonagon River Bridge of the Duluth, South Shore and Atlantic Railroad, and about 500 feet above the Bergland Dam of the Copper District Power Company. The structure was located in the N. W. 1/4 of Section 3, T. 48 N., R. 42 W., in Ontonagon County. At this point the river ranges from 132 to 145 feet in width and from 6 to 9 feet in maximum depth, depending upon the stage of the water level.

The details of construction of the weir are shown in the accompanying figures which are based on sketches provided by Mr. Roy H. Johnston,

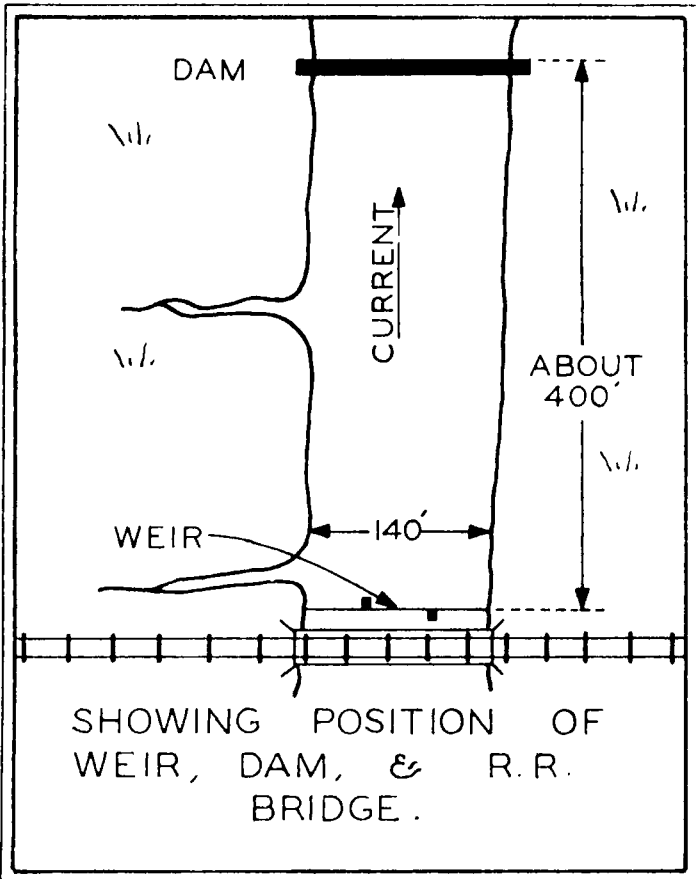


FRONT SECTIONAL VIEW
OF A PORTION OF THE
GOGEBIC WEIR

(ADAPTED FROM A DIAGRAM
PROVIDED BY R Y H JOHNSTON.)



TOP VIEW OF A PORTION OF THE GOGEBIC WEIR AT LOW WATER LEVEL.



ADAPTED FROM A DIAGRAM PROVIDED BY R Y H. JOHNSTON.

Superintendent of Fish-cultural Operations in Hatchery District No. 1.

Drafting was done by Mr. Clarence Flaten of the Institute staff.

The principal supports which held the structure in place were 4-inch by 4-inch tamarack posts, sharpened at one end and driven into the stream bed. These were placed in a double row. A lateral (upstream-downstream) distance of 2 feet separated the individuals of each pair of posts, while the distance between pairs (cross stream) was 8 feet. Each pair of lateral posts was joined by two 6-inch by 2-inch cross-pieces, which in turn supported a double row of 2-inch by 10-inch planks which constituted the cross-walk. The upstream 4 x 4 posts were fitted with outside keyways to receive rectangular frames, 8 feet by $2\frac{1}{2}$ feet, made from 2-inch by 4-inch lumber, in which the 4-inch dimensions faced each other. Along the center line of the opposed 4-inch faces of the 8-foot top and bottom 2 x 4's of the frames, there was drilled a continuous series of $\frac{3}{4}$ -inch holes, spaced 2 inches from center to center. The completed frames were dropped between the outside keyways of the upstream 4 x 4's. Their vertical position and uniform depth were made secure by stop blocks in the keyways.

Through the opposed holes in the frames were dropped bars of $\frac{5}{8}$ -inch round reinforcing iron of various prepared lengths to conform to the stream depths. The $\frac{5}{8}$ -inch bars fit freely in the $\frac{3}{4}$ -inch holes, gradually working into the river bottom, so that no underwash could occur. The $\frac{5}{8}$ -inch bars placed at 2-inch intervals left an opening of about $1\frac{3}{8}$ inches between the bars of the weir. The guides provided by the frame furnished a uniform opening between all rods, from top to bottom.

A downstream and an upstream trap were placed in the weir. The former trap was located on the downstream side of the weir, about 60 feet from the west shore and the latter was placed on the upstream side of the weir, about 40 feet from the east shore. The traps were about

6 feet long, 4 feet wide and 5 feet deep and were screened on sides, top and bottom with one-inch poultry netting. Due to the considerable fluctuation of the water, it was necessary to make a longitudinal V-shaped opening, running almost the full depth of the traps, with the vertex of the V extending inward about one foot. At the vertex of the V was left a 3-inch opening for the fish to enter the trap. To make more difficult the return of fish out of the weir, a closed V-shaped structure was fastened in such a manner as to close from direct return approach the opening leading into the weir.

A platform was constructed between the two traps to provide space for the tagging, weighing and measuring operations conducted at the weir.

The entire weir was anchored to the railroad bridge by guide wires leading from the 4 x 4's of the weir to the timbers of the bridge. Several planks were also used in a similar manner to anchor the weir.

When operation of the weir was first begun, no leads were used to guide the fish into the traps. In early May, 1940, however, partial leads were installed for both upstream and downstream traps, made of 1-inch poultry netting, of 6-foot depth. The lead for the downstream trap extended from the east bank toward the downstream weir opening, and that for the upstream weir from the west bank to the upstream weir opening, at angles of about 30 degrees from the weir. It soon became evident that the leads were not improving the efficiency of the weir. Many logs and much debris were intercepted by them, and the uneven contour of the river bottom made placement of the leads difficult. They were not maintained, and the weir can be considered as having been without leads during most of the period of its operation.

The weir was posted against trespass and fishing was not permitted for a distance of about 150 yards above the weir and between the weir

and the dam. This was considered necessary to insure the proper and efficient operation of the weir and to prevent the fishermen's catches from influencing the amount of normal fish movement in the stream. Over 100 fishermen were turned away during the first 10 days of the season in 1940. All showed a commendable willingness to cooperate when the reason for the posting of the area above and below the weir was made known by the weir operator.

The Duluth, South Shore and Atlantic Railroad, through the Superintendent, Mr. H. F. Schmidt, Marquette, kindly approved the right-of-way for the weir, part of which was on railroad property, and which was in part anchored to the railroad bridge.

C.C.C. Camp Gogebic (U. S. Forest Service) made a substantial contribution to the completion of the weir by providing 27 man-days of labor for constructing the frames which held in place the iron bars of the barrier.

Cost of Construction of Weir

An itemized account of the cost of construction of the Gogebic weir is shown in Table I.

Table I

Cost of Construction of Gogebic Weir[✓]

Item	Use	Cost
<u>A. Materials</u>		
650 pcs. 5/8-inch x 16 feet deformed steel	Barrier	\$352.50
640 feet 2-inch x 10-inch x 16 feet spruce	Cross-walk	32.00
400 feet 2-inch x 10-inch x 16 feet pine	Cross-walk	30.00
427 feet 2-inch x 4-inch x 16 feet spruce	Barrier frames	21.35
496 feet 4-inch x 4-inch x 12 feet tamarack	Upright posts	19.84
320 feet 2-inch x 6-inch x 16 feet spruce	Bracing and scaffolding	16.00
400 feet 1-inch x 8-inch x 16 feet #2 pine	Key-ways for frames	11.00
160 feet 2-inch x 4-inch x 12 feet hemlock	Cross-braces	5.60
8 feet 1-inch x 12-inch pine	Signs	.80
20 feet 2-inch x 4-inch x 6 feet, and 2-inch x 6-inch x 8 feet lumber	Signs	.64
125 spikes	Construction	5.65
Poultry netting	Wings	10.00
Poultry netting and staples	Traps	4.25
2-3/4-inch bits	Boring holes in frames	.60
2 padlocks, hasps, sets hinges	Trap covers	1.60
120 gallons gasoline	Hauling material and crew	18.00
6 quarts oil	" " "	.72
Total cost of materials used		\$530.55
<u>B. Labor</u>		
27 man-days C.C.C. labor at (estimated) \$2.00	Making barrier frames	54.00
22 man-days, Watersmeet Hatchery at \$4.00	Installing weir	88.00
Labor	Hauling steel to weir location	2.00
Labor	For sharpening chisels for cutting steel	1.50
Total cost of labor		\$145.50
Total cost of materials and labor		\$676.05

[✓] From figures supplied by Mr. Roy H. Johnston

At the time the weir was dismantled, all of the steel bars were recovered and used in construction work at the Watersmeet Hatchery. Much of the lumber used retained some value after the completion of the study.

Operation of the Gogebic Weir

The traps of the Gogebic weir were checked two to three times daily during the principal spring run of fishes and at least 3 times per week during the remainder of the period of operation, extending from April 10, 1940, to September 14, 1941. During this period there were 2 periods during which the structure was not in effective operation. The first of these occurred on June 2, 1940, when a sudden storm and high water caused the weir to choke up with swamp vegetation and debris. Sufficient pressure was exerted to cause a break-through. Two 8-foot sections of the west end of the weir went out. The structure was repaired on the following day. The second period during which the weir was not operating efficiently was of more significance, lasting from April 14 to May 11, 1941, which covers the period of most movement in the previous year. Late at night on the former date, several boom sticks, bridge timbers, deadheads and debris, accompanied by a fast current and the high water characteristic of spring run-off, exerted sufficient pressure on the weir to break loose a 40-foot section near the center of the barrier and flatten it against the stream bottom. Repairs were undertaken immediately and were thought to have been completed within 3 days. The dark brown color of the high water, however, prevented a thorough inspection of the lower portions of the weir in the deeper parts of the stream. In the absence of heavy catches of fish during the period when these had occurred the previous year, it was strongly suspected that the weir was not as fish-tight as it had previously been. Several small openings were repaired in the shallower portions of the weir, but it was

not until May 11 that the deeper waters could be pierced to sufficient depth by a spotlight to permit final repairs to be made.

Although data concerning fish movement during April and early May, 1941, would have been very desirable for comparison with the previous year, it is highly improbable that any conclusions which might be based on the previous year's work would have been materially altered. The weir was in effective operation for a full year. The fact that no fish were taken during the first 8 days operation of the weir in 1940 indicates that it was in place early enough to fully measure the heavy spring movement of fish which was missed in 1941. The weir was in place about 20 days before the ice left Lake Gogebic in 1940, and remained in effective operation until one day before the ice left Lake Gogebic in 1941. It follows that both from the standpoint of time and the annual cycle of physical phenomena in Lake Gogebic (temperature, fluctuation of water level, spring run-off, time of ice removal, etc.), the weir measured the amount of fish movement through the Lake Gogebic outlet for a full year.

The Gogebic weir was operated from April 10, 1940 to October 15, 1940 by Mr. Richard Bohland. Mr. Johnson, caretaker of the Copper District Power Company dam just below the weir cared for its operation from October 16, 1940 to April 15, 1941. Mr. Dexter Reynolds operated the weir from April 16, 1941 to September 14 of that year, at which time it was dismantled. In addition to the operation of the weir, Mr. Bohland and Mr. Reynolds conducted an intensive creel census on the fishing in Lake Gogebic. The results of that study are being made the subject of another report now being prepared.

In the operation of the weir, the principal duty of the operator was the removal of the fish from the traps with a dipnet and the keeping of

records concerning the numbers and species of fish caught. All walleyes and northern pike were tagged and measured and in some cases weighed and scale samples taken for age determinations. The right pectoral fin of suckers in the upstream trap was removed to permit future identification of all suckers which had passed through the trap, and to differentiate these fish from those passing through the downstream trap, from which the right pelvic fin was removed. Rock bass, smallmouth bass, crappies and perch were similarly fin-clipped.

Following the collection of the desired data concerning each fish and fin-clipping or tagging, the fish were released above or below the weir, depending on the direction in which they were headed when captured. Fish caught in the downstream trap were released on the downstream side of the weir, while those caught in the upstream trap were released on the upstream side of the weir. In other words, free movement of the fish upstream or downstream through the weir, although briefly delayed by the duration of the stay in the weir traps, was not otherwise impeded.

A second duty of the weir operator was the removal of debris from the upstream side of the weir, and, when necessary, the removal of bars from a section of the weir to permit the passage of huge logs or timbers which frequently come down the outlet, particularly during high water periods.

Results of Weir Operations

A summary of the results of operation of the Lake Gogebic weir is shown in Tables II, III, and IV. Table II gives a day by day account of the fish taken in upstream and downstream traps. In Table III, the catch of fish is summarized in weekly periods, while in Table IV, monthly totals are given. Two of the tables, as well as parts of other tables to follow, were partially finished by Mr. W. F. Carbine of the Institute staff before being completed by the writer.

Table II

Daily Record of Fish Passing Through
Gogebic Weir, 1940-41
Retakes in () ✓

Date	Suckers		Walleyes		Northern pike		Crappies		Perch		Rock bass		S. M. bass	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
<u>1940</u>														
April 18	...	...	...	...	...	1	...	...	...	...	...	...	...	...
" 22	1	...	...	...	...	...	...	...	...	...	...	...	...	...
" 23	...	1	...	...	1	2	...	...	...	...	...	...	...	...
" 24	...	3	...	...	...	1	...	...	...	...	...	...	...	...
" 25	7	12	3	1	(1)	1	...	...	...	...	...	...	...	...
" 26	(1) 20	35	7	6	(1)	1	...	...	...	...	...	...	...	...
" 27	(5) 5	49	1	1	...	1	...	...	...	...	...	...	...	...
" 28	7	(1) 90	1	2	(1)	...	...	1	1	...	...	...	...	...
" 29	(3) 6	(5) 53	(1)	2	...	...	...	1	...	...	1	...	...	...
" 30	(9) 8	(10) 139	...	5	...	...	...	...	...	...	...	...	...	...
Totals	(18) 54	(16) 382	(1) 12	17	(3) 1	7	1	1	1	...	1	...	...	...
May 1	(2) 1	5	...	...	...	...	...	...	...	...	...	...	...	...
" 2	1	...	...	...	...	...	...	...	...	...	...	...	...	...
" 3	(1)	...	...	...	...	...	...	...	...	...	...	...	...	...
" 4	...	1	...	...	...	...	...	...	...	...	...	...	...	...
" 7	(1)	...	...	2	...	...	...	...	1	...	...	...	...	...
" 8	2	...	...	7	...	...	...	...	...	...	...	...	...	...
" 9	...	...	...	14	...	...	...	1	1	...	...	...	...	...
" 10	2	...	...	1	...	...	...	2	...	...	...	...	...	...
" 11	5	(1)	...	4	...	...	...	1	...	...	1	...	1	1
" 12	(4) 4	5	...	...	...	...	...	...	1	...	...	...	1	1
" 13	(1) 5	1	...	1	...	...	...	...	...	...	1	...	1	1
" 14	(1) 2	...	...	1	...	...	...	...	...	...	...	...	...	...
" 15	(1) 1	...	...	...	...	...	...	...	...	...	...	...	...	...
" 16	3	...	...	...	...	...	...	...	...	...	...	...	...	...
" 17	(2) 6	...	1	...	...	...	...	1	...	...	...	...	...	...
" 18	2	...	1	...	...	...	...	...	...	...	...	...	...	...
" 19	2	...	...	...	...	...	...	...	...	...	...	...	...	...
" 21	...	...	...	3	...	...	...	1	...	...	...	...	...	...
" 23	...	1	...	2	...	...	...	...	...	...	...	1	...	...
" 26	...	1	...	...	...	...	...	...	...	...	...	...	...	...
Totals	(13) 36	(1) 14	2	35	...	...	...	6	1	2	...	3	...	3
June 3	1	...	...	...	...	...	...	...	...	...	...	...	...	...
" 5	(2) 1	1	...	...	...	...	...	...	...	...	...	...	...	...
" 7	...	...	...	...	...	...	...	...	...	...	1	...	...	...
" 8	(2) 3	...	1	...	...	1	...	...	...	...	2	...	...	...
" 9	(1) 5	...	1	...	...	...	...	...	...	...	1	...	...	...
" 11	(3)	...	...	...	...	...	...	...	...	...	...	...	...	...
" 12	(1)	...	...	...	...	...	...	...	...	...	3	...	...	...
" 13	(1) 1	...	...	...	...	...	...	...	...	...	1	...	...	...
" 14	1	1	...	1	...	...	...	...	...	...	1	...	...	...

* Numbers in parentheses indicate fish which had been previously captured, going in the opposite direction. These are not included in the totals for each month.

(Continued)

Table II
(Continued)

Date	Suckers		Walleyes		Northern pike		Crappies		Perch		Rock bass		S. M. bass		
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	
June 15	1	1	...	...	...	...	...	...	5	...	1	...	
" 16	1	...	...	...
" 17	...	1	...	...	...	...	...	...	...	...	(1)	1	...	...
" 19	1	...	...	...	...	...	...	1	2	1	...	
" 21	...	1	...	...	...	...	...	...	...	...	(1)	4	...	...
" 22	3	...	...	...
" 24	1	1	...	...
" 26	1	...	...
" 27	4	...	...	...
" 28	1	...	...	...
" 29	(1)	...	...	...
" 30	1	...	...	...
Totals	(10)	14	2	3	3	...	1	(3)	25	10	2	...
July 1	...	1	...	...	...	...	...	...	...	...	1	...	...	...
" 2	...	1	...	...	...	...	...	...	...	...	(1)	2	...	...
" 3	5	...	...	...
" 8	1	...	...	...	...	...	...	1	...	...	...
" 9	1	...	1	...	...	...	...	1	...	...	...
" 10	1	...	...	...	...	...	...	3	...	...	...
" 11	1	...	...	...	...	...	...	...	...	...	...
" 12	1	...	...	...	...	...	...	1	...	...	...
" 13	...	1	...	...	...	...	...	...	...	...	...	...	...	...
" 15	...	1	...	...	...	...	...	...	...	...	...	...	...	...
" 19	(1)	...	...	...	...	...	...	...	...	...	...	...	...	...
" 20	(1)	2	...	2	...	3	...	1	...	...	3	...	...	...
" 21	(1)	...	...	...	...	1	...	...	...	...	1	...	...	...
" 22	1	...	...	...
" 24	1	...	...	...	...	...	...	...	...	...	...
" 25	2	...	...	...	...	...	...	1	...	...	...
" 28	(1)	...	...	...	...	...	...	...	...	...	...	...	...	...
" 29	1	...	...	...	...	...	...	...	...	...	...
Totals	(4)	6	...	11	...	5	...	1	...	...	(1)	20	...	...
Aug. 1	...	3	...	...	...	...	...	...	...	...	...	...	...	...
" 6	1	...	...	...
" 9	1	...	...	...	...	...	...	...	...	...	...
" 10	1	...	...	...
" 18	...	1	...	...	...	...	...	...	...	...	...	...	...	...
" 20	1	...	...	...	...	...	1	...	...	...	...	...
" 21	...	2	...	...	...	...	...	...	...	...	...	...	...	...
" 23	...	1	...	...	...	...	...	...	...	...	1	...	...	...
" 24	...	1	...	1	...	...	...	...	...	...	...	...	...	...
" 25	...	(1)	...	...	...	...	...	...	...	...	...	...	...	...
" 28	1	...	...	...	...	...	...	...	...	...	...
" 31	2	...	...	...	...	...	...	1	...	...	...
Totals	8	(1)	1	5	...	...	...	...	1	...	4	...	...	...

(Continued)

Table II
(Continued)

Date	Suckers		Walleyes		Northern pike		Crappies		Perch		Rock bass		S. M. bass	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
Sept. 1	1	...	...	...	...	...	...	...	1	...	...	...
" 2	1	...	...	...	...	...	...	...	...	...	...	...
" 3	2	...	...	...	...	...	...	...	...	...	...	...
" 4	3	...	...	...	...	...	...	...	...	...	...	...
" 7	1	...	...	...	...	...	...	...	...	...	...	...
" 11	1	...	...	...	...	...	...	...	...
" 12	2	...	...	...	...	...	...	...	...	...	...	...
Totals	10	...	...	1	...	...	...	...	1	...	...	...
Oct. 6	1	...	...	...	...	...	...	...	...	...	...	...
" 26	1	...	...	...	...	...	...	...	...	...	...
" 30	1	...	...	...	...	...	...	...	...
Totals	1	1	...	1	...	...	...	...	...	...	...	...
Nov. 10	1	1	...	...	...	...	...	...	...	...
Totals	1	1	...	...	...	...	...	...	...	...
<u>1941</u>														
April 11	1	...	...	...	...	...	...	...	...
" 13	1	...	...	1	...	...	...	...	...	...	...	...
" 14	1	...	...	...	...	...	...	...	...	...	...	...	...	...
" 23	1	...	...	...	...	...	...	...	...
" 30	...	1	...	...	...	...	...	...	...	...	...	...	...	...
Totals	1	1	1	...	...	3	...	...	...	...	...	...	...	...
May 1	1	...	...	...	...	...	...	...	...	...	...	...	...	...
" 3	L.M. bass 1
" 4	...	2	...	...	...	...	...	...	...	...	...	...	...	...
" 13	1	...	...	...	...	...
" 14	1	...	...	...
" 15	2	...	...	...	...	...	...	...	...	...	...	...	...	...
" 19	1	...	1	...	...	...	...	...	...	...	...	...	...	...
" 20	1
" 22	1	...	...	...
" 28	1	...	...	...	...	...	...	...	1	...	...	...
Totals	4	2	2	...	...	...	...	...	1	...	3	...	S.M. bass 1	L.M. " 1
June 17	1	...	...	...	...	...	...	...	...	...
" 27	1	...	...	...	...	...	...	...	...	...
" 28	1	...	...	...	...	...	...	...	...	...
Totals	3	...	...	...	...	...	...	...	...	...
July 2	1	...	...	...	...	...	...	...	...	...
" 7	1	...	...	...	...	...	...	...	1	...	1	...	...	...
" 10	1	...	...	...	...	...
" 20	5	...	...	...	...	...	...	...	...	...	...	...
Totals	1	...	5	...	1	...	...	...	2	...	1	...	...	...

Table III

Weekly Catch of Fish, Lake Gogebic Weir, 1940-41.
(Numbers include retakes)

Date	Suckers		Walleyes		Northern pike		Crappies		Perch		Rock bass		S. M. bass	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
<u>1940</u>														
April 14-20	...	...	...	...	...	1	...	...	...	...	...	...	...	...
" 21-27	34	100	11	8	3	6	...	...	...	...	...	...	...	...
" 28-May 4	43	304	2	9	1	...	1	1	1	...	1	...	...	...
May 5-11	10	1	...	28	...	...	...	4	...	2	...	1	...	1
" 12-18	32	6	2	2	...	...	...	1	1	...	...	1	...	2
" 19-25	2	1	...	5	...	...	...	1	...	...	...	1	...	...
" 26-June 1	...	1	...	...	...	...	...	...	...	...	...	...	...	...
June 2-8	9	1	1	...	...	1	...	...	...	...	...	3	...	...
" 9-15	13	1	2	2	...	...	...	...	...	...	9	2	1	...
" 16-22	2	...	...	1	...	...	...	...	...	...	11	3	1	...
" 23-29	...	...	...	...	...	...	...	...	...	...	7	2	...	...
" 30-July 6	2	...	...	...	...	...	...	...	...	...	10	...	...	...
July 7-13	1	...	5	...	1	...	...	...	...	...	6	...	...	...
" 14-20	5	...	2	...	3	...	1	...	...	...	3	...	...	...
" 21-27	1	...	3	...	1	...	...	...	...	...	3	...	...	...
" 28-Aug. 3	4	...	1	...	...	...	...	...	...	...	...	...	...	...
Aug. 4-10	...	...	1	...	...	...	...	...	...	...	2	...	...	...
Aug. 18-24	5	1	1	...	...	...	...	...	1	...	1	...	...	...
" 25-31	...	1	3	...	...	...	...	...	...	...	1	...	...	...
Sept. 1-7	...	...	8	...	...	...	...	...	...	...	1	...	...	...
" 8-14	...	...	2	...	...	1	...	...	...	...	...	...	...	...
Oct. 6-12	...	...	1	...	...	...	...	...	...	...	...	...	...	...
" 20-26	...	...	...	1	...	...	...	...	...	...	...	...	...	...
" 27-Nov. 2	...	...	...	...	...	1	...	...	...	...	...	...	...	...
Nov. 10-16	...	...	...	...	1	1	...	...	...	...	...	...	...	...
<u>1941</u>														
April 6-12	...	...	...	...	...	1	...	...	...	...	...	...	...	...
" 13-19	1	...	1	...	...	1	...	...	...	...	...	...	...	...
" 20-26	...	...	...	...	...	1	...	...	...	...	...	...	...	...
" 27-May 3	1	1	...	...	...	...	...	...	...	...	...	...	L.M. Bass	1
May 4-10	...	2	...	...	...	...	...	...	...	...	...	...	...	...
" 11-17	2	...	...	...	...	...	...	...	1	...	1	...	...	...
" 18-24	1	...	1	...	...	...	...	...	...	...	1	...	...	1
" 25-31	...	...	1	...	...	...	...	...	...	...	1	...	...	...
June 15-21	...	...	...	...	1	...	...	...	...	...	...	...	...	...
" 22-28	...	...	...	...	2	...	...	...	...	...	...	...	...	...
" 29-July 5	...	...	...	...	1	...	...	...	...	...	...	...	...	...
July 6-12	1	...	...	...	...	...	...	...	2	...	1	...	...	...
" 20-26	...	...	5	...	...	...	...	...	...	...	...	...	...	...
Totals	169	420	53	56	14	14	2	7	6	2	59	13	2	4
													L.M. Bass	1

Table IV

Monthly Record of Fish Passing Through Gogebic Weir, 1940-41.✓

Month	Suckers		Walleyes		Northern pike		Crappies		Perch		Rock bass		S. M. bass	
	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down	Up	Down
<u>1940</u>														
April	(18)✓** 54	(16) 382	(1) 12	17	(3) 1	7	1	1	1	...	1	...	...	...
May	(13) 36	(1) 174		2 35	...	...	...	6	1	2	...	3	...	3
June	(10) 14	2		3 3	...	1	...	...	...	...	(3) 25	10	2	...
July	(4) 6	...		11 ...	5	...	1	...	...	...	(1) 20	...	...	...
August		8 (1) 1		5 ...	...	...	...	...	1	...	4	...	...	...
September	...	...		10 ...	...	1	...	...	...	...	1	...	...	...
October	...	...		1 1	...	1	...	...	...	...	...	...	...	...
November	...	...	...	...	1	1	...	...	...	...	...	...	...	...
<u>1941</u>														
April		1 1		1 ...	...	3	...	...	...	...	...	...	...	...
May		4 2		2 ...	...	...	...	...	1	...	3	...	...	1
June	...	...	...	...	3	...	...	...	...	...	...	...	...	L.M. Bass 1
July		1 ...		5 ...	1	...	...	...	2	...	1	...	...	...
Totals	(45) 124	(18) 402	(1) 52	56	(3) 11	14	2	7	6	2	(4) 55	13	2	4
														L.M. Bass 1
Total Fish Passing Through Weir (including retakes):														
	169	420	53	56	14	14	2	7	6	2	59	13	2	4
														L.M. Bass 1

* Only months during which fish movement occurred are shown.

** Numbers in parentheses indicate fish which had been previously captured, going in the opposite direction. These are not included in the totals for each month.

The species of fish caught in the Gogebic weir are as follows:
common sucker (Catostomus commersonii), walleye (Stizostedion vitreum),
northern pike (Esox lucius), black crappie (Pomoxis nigro-maculatus),
yellow perch (Perca flavescens), rock bass (Ambloplites rupestris),
smallmouth bass (Micropterus dolomieu) and largemouth bass (Huro salmoides).

A comparison of the numbers of fish going upstream and downstream reveals that, during the period of effective operation of the weir (essentially April 10, 1940 - April 14, 1941; May 11 - September 14, 1941), the lake suffered a total "loss" of 251 suckers, 3 walleyes, 5 crappies, 2 smallmouth bass and 1 largemouth bass. In return, 4 perch and 46 rock bass moved into the lake from the river. If these species are grouped, a total gain for the lake of 39 game fish is shown.

During the spring of 1940, the annual spawning migration of suckers to stream habitat apparently began on about April 24 and continued until May 1. Upstream migration also reached its peak during the same period, although fewer individuals were involved. Apparently suckers spawn in the river both above and below the weir. Those passing upstream were probably native river fish, moving toward the outlet to spawn. The sex of suckers passing through the weir was recognizable without dissection (i.e., the fish were not yet fully spent) as late as June 13. From April 10 to June 13, there were 320 females and 175 males among the 495 suckers whose sex could be determined without dissection. Seventy females and 30 males were counted going upstream, while 250 females and 145 males were observed going down. Occasional suckers continued passing through the weir throughout the summer.

Most walleyes went downstream between April 25 and May 26, which corresponds well with the apparent height of the spawning season during

1940. There is an apparent relation between the movement of the walleyes and their spawning activities. It appears possible that some of the fish may enter the outlet to spawn, although it is known that very large numbers of the walleyes in the lake spawn along the eastern shore.* Although no observations of actual spawning were made in the outlet, some walleyes were seen by the operator of the weir in 1940 upstream from the weir and above the railroad bridge. On May 5, from 75 to 100 walleyes were seen near the railroad bridge. Smaller numbers were also seen on May 7, 8 and 9. On May 12, three walleyes were seen below the weir, headed toward it. Isolated groups of from 2 to 3 walleyes and occasional suckers were seen above the weir as late as June 6. None of the group of walleyes seen on May 5 or thereafter showed any particular disposition to move toward or through the weir, according to the field notes of the weir operator. All maintained their position in the quieter portion of the stream, oriented themselves with heads upstream and showed little lateral movement. This adds some weight to the supposition that the walleyes may have been exhibiting spawning behavior, since the fish assemble themselves into groups during their spawning activities in the lake, with the heads of all the individuals of a group frequently oriented in the same direction, and with little alongshore movement occurring. It is hoped that the nature of the concentration of walleyes in the outlet can be further investigated in 1942. If walleyes spawn in the stream as well as in the lake, the concentration of walleyes reported by fishermen in the past, near the railroad bridge, becomes explained. Such stream spawning might also explain the occasional short intervals of good walleye fishing

* Eschmeyer, Paul H., "Notes on the Natural Reproduction of the Walleyed Pike in Lake Gogebic", Institute for Fisheries Research Report No. 695, November 17, 1941 (manuscript).

which occur at the Slate River Bridge, at the extreme south end of the lake.

Walleyes returned to the lake in small numbers throughout the summer. Since the later almost exclusively upstream migration has no recognizable connection with the actual spawning of the fish, there is somewhat of a suggestion that some walleyes are hatched and spend part of their early life in the river and gradually work their way up into the lake. Whether or not the walleyes actually spawn in the West Branch of the Ontonagon River remains to be determined, however.

The sex of walleyes (particularly males) could be recognized without dissection as late as May 21. The sex of 51 fish examined showed 32 males and 19 females.

The principal downstream movement of northern pike occurred during April. Probably these fish were headed toward the marsh areas adjacent to the west bank of the river just below the railroad bridge. Upstream movement is pretty well scattered throughout the summer season.

Rock bass movement, most of which was upstream from the weir, occurred principally during June and July. This pretty well covers the spawning season of this species in Lake Gogebic, and the movement is thought to be a spawning migration toward the outlet or into the lake. It may not be an annual occurrence, however, since no such trend can be seen in the fish taken in the weir in 1941.

The occurrence of other fish species was too light to permit further analysis. Apparently some movement of fish upstream and downstream occurs throughout the year, except during the period of ice cover, when practically all movement appears to cease.

Most of the fish passing through the Lake Gogebic weir were fairly good sized. It was not considered practical to trap immature fish and,

except for several walleyes captured, undersized fish of all species were able to pass through the 1 5/8-inch openings in the weir.

Table V
Average Total Lengths of Fish Taken in Gogebic Weir

Species	Upstream			Downstream			Combined Upstream and Downstream	
	Minimum length	Average length	Maximum length	Minimum length	Average length	Maximum length	Number measured	Average length
Northern pike	15 5/8	16 7/8	18 7/8	15 3/4	18 3/4	29 3/4	15	18
Walleyes	12 7/8	16 1/2	19 1/4	12 3/8	17 1/2	27 3/4	95	17
Rock bass	6 3/8	8 7/8	11 3/8	6 3/4	9 3/8	11 3/8	69	8 7/8
Crappies	13	13	13	11 7/8	13 3/4	14 1/8	9	13 1/2
Perch	8 1/4	9 5/8	11	12	12	12	4	10 1/2
Smallmouth bass	14	14 7/8	15 3/4	17	17 3/4	20 1/4	5	16 5/8

The table shows that the fish passing downstream are slightly larger than those passing upstream. This is true of all species. This uniform difference in average size of fish passing upstream as compared to those passing downstream cannot be readily explained. Since the difference is very slight and all the fish concerned are of legal size, however, the discrepancy has no particular significance from the standpoint of the fisheries in the lake or river.

During the period of operation of the weir, a number of dead fish came floating downstream and lodged in front of the weir. An occasional walleye, northern pike and crappie became lodged between the bars of the weir while attempting to pass through it. In most cases dead fish were measured and an attempt was made to determine the cause of death, before they were discarded. A list of the fish found dead and their average sizes is shown in Table VI. All the fish apparently died of injuries

or non-epidemic diseases. Many of the perch found were egg bound.

Table VI

Dead Fish Found at Lake Gogebic Weir

Species	Number	Average total length of those measured
Walleye	24	18 $\frac{3}{8}$
Perch	31	12 $\frac{3}{4}$
Crappies	7	13 $\frac{1}{2}$
Rock bass	6	...
Northern pike	4	15 $\frac{3}{8}$
Suckers	1	...

As was earlier mentioned, northern pike and walleyes and a few other fish were tagged before being released, after being removed from the traps of the weir. A summary of the fish tagged and the place of their release with respect to the weir, is shown in Table VII.

Of the 65 tagged fish released below the weir and the 50 fish released above the weir, a total of 12 tags have been turned in by fishermen. This is a return of 10.4 per cent. A list of the returns made by anglers to date is shown in Table VIII.

Table VII

Summary of Fish Tagged at Gogebic Weir, 1940

Released above weir (upstream)					Released below weir (downstream)				
Tag No.	Standard length, mm.	Total length, mm.	Sex (where known)	Date of tagging	Tag No.	Standard length, mm.	Total length, mm.	Sex (where known)	Date of tagging
<u>Walleyed pike</u>									
14017	302	360	...	7/20	14054	330	395	♂	4/25
14051	365	436	...	4/25	14062	352	420	♂	4/26
14052	330	390	♂	4/25	14063	395	463	♂	"
14053	338	406	...	"	14064	408	481	...	"
14055	330	395	♂	4/26	14065	375	438	...	"
14056	372	436	♂	"	14066	318	382	♂	"
14057	360	432	♂	"	14067	390	462	♂	"
14058	375	444	♀	"	14068	390	450	♀	4/27
14059	392	465	♀	"	14071	365	432	♂	4/28
14060	325	385	♂	"	14072	315	377	♂	"
14061	338	408	♂	"	14074	354	424	...	4/29
14069	392	458	♂	4/27	14075	333	400	♂	"
14073	332	398	♂	4/28	14076	320	383	♂	4/30
14111	342	405	...	5/17	14077	265	304	...	"
14112	350	420	♂	5/18	14078	395	470	♀	"
14116	340	414	♂	6/8	14079	352	420	♂	"
14118	330	394	...	6/15	14080	270	326	...	"
14121	385	455	...	7/8	14081	405	477	♀	5/7
14122	393	467	...	7/10	14082	376	446	♂	"
14123	304	368	...	7/11	14083	370	436	♀	5/8
14124	300	358	...	7/12	14084	330	401	♂	"
14125	390	465	...	7/20	14085	340	402	♂	"
14126	400	472	...	7/24	14086	480	560	♀	"
14127	315	375	...	7/25	14087	352	422	♂	"
14128	410	490	...	7/29	14088	408	483	...	"
14129	388	462	...	8/9	14089	345	412	♂	5/9
14130	296	354	...	8/24	14090	405	482	♀	"
14131	370	446	...	8/28	14091	450	537	♀	"
14132	295	353	...	8/31	14092	374	450	♀	"
14133	318	376	...	"	14093	394	471	♀	"
14134	350	415	...	9/1	14094	355	427	♀	"
14135	300	363	...	9/2	14095	356	432	♀	"
14136	385	456	...	9/3	14096	396	471	♀	"
14137	350	425	...	"	14097	360	427	♂	"
14138	295	355	...	9/4	14098	405	480	♀	"
14139	370	443	...	"	14099	355	435	♂	"
14140	380	460	...	"	14100	472	560	♀	"
14141	370	448	...	9/5	14101	348	422	♂	"
14142	410	490	...	9/12	14102	332	383	...	5/10
14143	380	458	...	"	14103	353	433	♂	5/11
14144	345	416	...	10/6	14104	368	440	♂	"
					14105	352	420	♂	"
					14106	370	444	♂	"
					14109	440	510	...	5/13

(Continued)

Table VII

(Continued)

Released above weir (upstream)					Released below weir (downstream)				
Tag No.	Standard length, mm.	Total length, mm.	Sex (where known)	Date of tagging	Tag No.	Standard length, mm.	Total length, mm.	Sex (where known)	Date of tagging
<u>Walleyed pike (continued)</u>									
					14110	400	475	...	5/14
					14113	327	395	♀	5/21
					14114	365	433	...	"
					14115	428	508	...	5/23
					14117	362	436	...	6/14
					14119	382	455	...	6/15
					14120	365	433	...	6/19
					14145	380	454	...	10/26
					50102	610	700	...	5/8
<u>Northern pike</u>									
14004	360	420	♂	4/23	14001	365	416	...	4/18
14013	373	438	...	7/9	14002	405	468	♂	4/23
14014	410	479	...	7/20	14003	570	653	♂	4/23
14015	335	395	...	"	14005	450	515	♂	4/24
14016	342	401	...	"	14006	415	480	...	4/25
14018	378	440	...	7/21	14007	390	450	...	4/26
					14008	382	437	...	4/27
					14009	340	399	...	5/8
					14019	380	455	...	9/11
<u>Smallmouth bass</u>									
14010	295	355	...	6/15	14107	360	430	...	5/11
14011	330	399	...	6/19	14108	327	406	♀	5/12
					50103	422	515	♀	5/13
<u>Perch</u>									
14070	278	322	♀	4/28					

Table VIII

Returns From Fish Tagged at Lake Gogebic Weir

Species	Tag number	Date of tagging	Date of capture	Days out	Place of capture
Walleye	14094	5/ 9/40	5/16/40	7	Between Bergland dock and opposite shore.
Walleye	14086	5/ 8/40	5/20/40	12	At Bergland Dam.
Northern pike	14003	4/23/40	6/ 5/40	43	Slate River Bridge.
Walleye	14091	5/ 9/40	6/ 7/40	29	At lake outlet.
Walleye	14095	5/ 9/40	6/19/40	41	Bergland Dam.
Walleye	14052	4/25/40	6/26/40	62	East shore, N. E. end of lake.
Walleye	14096	5/ 9/40	6/26/40	48	Bergland Dam.
Walleye	?	?	6/26/40	?	Released by angler (N. E. shore). Number not taken.
Walleye	14058	4/26/40	7/ 6/40	71	Near 6-mile Bay.
Northern pike	14005	4/25/40	7/ 3/40	69	One mile west of Bergland.
Northern pike	14002	4/23/40	10/13/40	173	Between Bergland dock and east shore.
Walleye	14117	6/14/40	2/11/41	242	Near lake outlet.
Walleye	14097	5/ 9/40	5/20/41	376	Bergland dam.

Comparison of Table VIII with Table VII shows the following to be true: Walleyes no. 14091, 14094 and 14117, and northern pike no. 14003 and 14002, although released on the downstream side of the weir, were caught above it, without having been captured in going through the barrier the second time.

Northern pike no. 14005 was caught going downstream on April 24 and was again captured on the way upstream on April 25 before being taken by an angler. Northern pike no. 14006 and 14008, which went downstream on April 25 and April 27, were also captured on their way upstream (April 26 and 28, respectively), but have not been reported since. Walleye no. 14066, released below the weir on April 26, returned upstream through the weir 3 days later, on April 29.

The passage of tagged fish from the downstream side of the weir to the lake without being captured is an unfortunate but irrefutable indication that the weir was not 100 per cent efficient in trapping the fish traveling up the outlet stream. As has been mentioned, a temporary break in the weir occurred on June 2, 1940, and walleye no. 14091 and northern pike no. 14002 and 14003 may have passed through the weir at that time. Walleyes no. 14117 and 14094 may have passed through the weir while bars were pulled to let floating logs through the structure. The larger logs, particularly boom logs, which at times came down the river chained together in pairs or threes, sometimes required the opening of as much as a three- or four-foot section of the weir for periods as long as a half hour, in order for them to be successfully maneuvered through the barrier. No defect in the construction of the upstream trap was ever reported by weir operators.

The records show that 5 of the 65 fish placed in the water on the downstream side of the weir returned unobserved to the lake. Not one of

the 50 fish placed above the weir is known to have returned downstream without being caught in the weir traps. This suggests that more fish than were actually counted went upstream through the weir, but no factual evidence can be found to indicate that there was any unobserved downstream movement of fish. All tag returns of fish taken below the weir were of fish which were last seen going downstream from the weir.

Construction of an entirely fish-tight weir in a flowing stream of the depth and width and with the water fluctuation of the Lake Gogebic outlet is extremely difficult, if not impossible. Similar escape of a few fish past a weir, undetected, was reported by Mr. W. F. Carbine in his report on the operation of a weir in the Muskegon River.♠

The only evidence that fish are leaving Lake Gogebic must be gleaned from the fact that, of the 65 fish tagged and released on the downstream side of the weir, only 4 were recovered on their way back upstream. Five others are known to have gone back upstream (by tag returns from Lake Gogebic) without being detected, which tends to suggest that many others may have done likewise. Forty-five of the 402 suckers which went downstream were recaptured going back up, while 18 of the 124 migrating upstream were caught going back down. Of the 13 rock bass which went downstream, 4 are known to have come back up.

The fact that 4 of the downstream recoveries were at the Bergland Dam may suggest to the reader that these fish may have been trapped below the dam, unable to come back up. A study of the field notes of Mr. Bohland, the weir operator, however, shows this not to be the case. On May 20, when the first recovery was made, all the gates of the dam were wide

♠ Carbine, W. F., "Operation of the Muskegon River Fish Weir, 1940", Institute for Fisheries Research Survey Report No. 685, August 12, 1941 (manuscript).

open and the water level was high, making it possible for any fish to pass across the dam without inconvenience and without the use of the fish-way. One other tagged fish was caught on June 19 and a third was taken on June 26. As late as June 14, 3 gates were still open, permitting fish passage in either direction without obstacle. Although it has frequently been claimed that fish crossing the dam are unable to return to the lake, the evidence seems to indicate that the few fish which do cross the dam remain there by preference rather than by compulsion, at least (in 1940) for the period from April 30 to June 14. It is not known whether walleye no. 14097 remained below the dam throughout the year or whether the fish returned to the lake undetected (as some others did) and returned while the weir was out of order in 1941 (April 15-May 11). Certain it is that the fish had several opportunities to return to the lake without using the fish-way during the period between the tagging and the capture by an angler.

Occasional observations were made on the operation of the fish-way at the Bergland Dam during the spring of 1940. The effectiveness of the device in lifting fish over the dam cannot be easily determined and no attempts were made to find the number and species of fish which use it. In 1940, the water was too low to permit the device to operate until April 28, when the water had reached a level of 29 $\frac{3}{4}$ inches. During the succeeding month the mechanical operation of the ladder seemed to be fairly good, although the buckets failed to trip on some occasions while on others the operation was intermittent. On July 1, the top row of planks just west of the fish ladder were removed to take care of excess water. This caused the buckets to become partially submerged, preventing its operation. The device operated only occasionally after this time and ceased on August 21, when the water level again became too

low. Since the gates of the dam were open, making it passable for fish from April 30 to June 14, the spawning migrations of almost all species had stopped for the year, making the efficiency of the fish-way a matter of less than primary importance.

The major conclusions to be derived from the operation of the Gogebic weir are as follows:

1. There is some upstream and downstream movement of fish in the upper portion of the West Branch of the Ontonagon River, near Lake Gogebic, throughout the period when the lake is not covered with ice. The major movement is concentrated in the period from mid-April to the end of June. Suckers, walleyes, northern pike and rock bass, in that order, are the species observed most frequently in the river at that time.

2. Except in the case of suckers, there was observed no significant loss of fish from Lake Gogebic by migration down the outlet. More game fish were counted going upstream than were counted going downstream during the period of operation of the weir. The figures indicate that the erection of a fish screen for the prevention of fish movement out of Lake Gogebic would not benefit the fishery in that water.

INSTITUTE FOR FISHERIES RESEARCH

By Paul Eschmeyer

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Table IX

Temperatures, Weather Data, and Water Levels at Lake Gogebic Weir, 1940.

(All water level readings are $1\frac{1}{2}$ inches higher than the zero reading of the water level gauge at the Bergland Dam.)

Date	Time	Water temperature		Air temperature		Sky	Weather	Wind	Water level
		Max.	Min.	Max.	Min.				
April 10	8:00 A.M.	33	32	...	...	Clear	Cool	Calm	...
	10:00 A.M.	33	32	...	...	Clear	Cool	Calm	...
11	8:00 A.M.	33	32	...	...	...	Snowing	Northeast	...
	10:00 P.M.	33	32	26	8	...	...	...	...
12	8:00 A.M.	33	32	31	9	Cloudy	Cool	Light	...
	10:00 P.M.	33.5	32.5	42.5	20	Cloudy	Snowing	Calm	...
13	8:00 A.M.	33.5	32	31	65	Ptly cloudy	Cool	Calm	2 $\frac{3}{4}$
14	8:00 A.M.	34	32	50	20	Clear	Mild	Calm	3 $\frac{5}{8}$
	10:00 P.M.	34.5	32.5	59	33.5	Cloudy	Mild	Calm	...
15	8:00 A.M.	35	32	45	32	Ptly cloudy	Mild	Calm	3 $\frac{1}{4}$
	10:00 P.M.	34.5	32.5	52	27	Clear	Cool	Calm	3 $\frac{1}{2}$
16	8:00 A.M.	34.5	33	38	22	Clear	Mild	Calm	3 $\frac{7}{8}$
	10:00 P.M.	37	33	49.5	27	Clear	Cool	Calm	4 $\frac{3}{8}$
17	8:00 A.M.	36.5	32.5	38	24.5	Cloudy	Cool	East	5 $\frac{1}{4}$
	10:00 A.M.	34.5	32.5	48	29	Cloudy	Cool	Calm	5 $\frac{3}{8}$
18	8:00 A.M.	34	32.5	36	18	Clear	Cool	North	5 $\frac{3}{8}$
19	8:00 A.M.	33	32	40	22.5	Clear	Mild	Calm	6 $\frac{1}{2}$
	10:00 P.M.	34	32	60	36.5	Cloudy	Warm	Calm	8 $\frac{5}{8}$
20	8:00 A.M.	34	32	45	28	Clear	Warm	Calm	8 $\frac{1}{2}$
	10:00 P.M.	35	32	64	29.5	Clear	Warm	Calm	9 $\frac{5}{8}$
21	8:00 A.M.	32	32	44	24	Clear	Mild	Calm	10 $\frac{5}{8}$
22	8:00 A.M.	32.5	32	...	...	Cloudy	Cool	East	12 $\frac{1}{2}$
	10:00 P.M.	35	32	48	33	Cloudy	Cool	...	14 $\frac{3}{4}$
23	8:00 A.M.	33.5	32	36	28	Clear	Mild	Calm	16
	10:00 P.M.	39	33	50	34	Cloudy	Sleet	North	17 $\frac{1}{4}$
24	8:00 A.M.	37	33	37	31	Cloudy	Cool	Northwest	19
	10:00 P.M.	41	35	47.5	27	Clear	Cool	North	20 $\frac{1}{2}$
25	8:00 A.M.	36	33.5	31	24	Cloudy	Cool	Northeast	21 $\frac{3}{4}$
	10:00 P.M.	41	34.5	43	26.5	Clear	Cool	Northeast	23 $\frac{1}{8}$
26	8:00 A.M.	40	36	39.5	23	Clear	Cool	North	23 $\frac{1}{2}$
	10:00 P.M.	46	31.5	52	28.5	Clear	Warm	Calm	25 $\frac{3}{8}$
27	8:00 A.M.	41	38	42	25	Clear	Warm	South	26
	12:00 P.M.	62.5	42	45.5	40	Cloudy	Rain	South	27 $\frac{1}{2}$
28	9:00 A.M.	43	41	52.5	44.5	Cloudy	Rain	South	28 $\frac{5}{8}$
	10:00 P.M.	47	41.5	68	50	Ptly cloudy	Warm	South	29 $\frac{3}{4}$
29	8:00 A.M.	46	44	63	58	Cloudy	Rain	South	30 $\frac{5}{8}$
	10:00 P.M.	51	46	72	48	Cloudy	Warm	Calm	30 $\frac{3}{4}$
30	8:00 A.M.	49	46	49.5	42	Cloudy	Rain	North	33 $\frac{3}{4}$
	10:00 P.M.	46.5	40.5	46	26	Cloudy	Snow	North	34 $\frac{3}{4}$
May 1	8:00 A.M.	40	36.5	32.5	24.5	Cloudy	Cold, snow	North	35
	10:00 P.M.	36	36	30	25	Cloudy	Cold, snow	North	35
2	8:00 A.M.	35	34	31.5	27.5	Cloudy	Snow	North	35 $\frac{5}{8}$
3	8:00 A.M.	36	34.5	35.5	28.5	Clear	Cool	North	36
	10:00 P.M.	39.5	37.5	55.5	26	Clear	Warm	North	36
4	8:00 A.M.	38.5	37	44.5	23.5	Clear	Warm	South	36

(Continued)

Table IX

Temperatures, Weather Data, and Water Levels at Lake Gogebic Weir, 1940.
(Continued)

Date	Time	Water temperature		Air temperature		Sky	Weather	Wind	Water level
		Max.	Min.	Max.	Min.				
May 5	8:00 A.M.	40	39.5	58	38	Clear	Warm	South	35 1/2
	10:00 P.M.	43.5	42.5	73	52	Clear	Warm	South	35.1/2
6	8:00 A.M.	42.5	42	59	42.5	Clear	Cool	West	35 1/2
	10:00 P.M.	48.5	43	58	38	Cloudy	Cool	West	34
7	8:00 A.M.	45	43.5	37.5	30.5	Cloudy	...	South	33 3/4
	10:00 P.M.	48.5	45	55	36.5	Cloudy	...	Northwest	34 1/4
8	8:00 A.M.	45	44.5	44	35	Cloudy	Warm	Calm	34
	10:00 P.M.	50	37	60	36	Clear	Warm	West	33 1/2
9	8:00 A.M.	47	46	53.5	30	Clear	Warm	West	33
	10:00 P.M.	51	47	67	46	Cloudy	Rain	Northwest	32 1/2
10	8:00 A.M.	50	48.5	48.5	38.5	Clear	Cool	East	32 5/8
	10:00 P.M.	51	48.5	60	43.5	Clear	Warm	East	32 1/4
11	8:00 A.M.	51	49	56	32	Clear	Warm	Calm	32 5/8
	10:00 P.M.	56	50	70	55	Ptly cloudy	Warm	Calm	33 1/4
12	8:00 A.M.	55.5	52	67.5	57	Clear	Warm	South	33
	10:00 P.M.	59	52.5	84	60	Ptly cloudy	Sultry	South	33
13	8:00 A.M.	59	55.5	64	52	Clear	Warm	East	32 3/4
	10:00 P.M.	59	56	78	55	Ptly cloudy	Rain	North	32 7/8
14	8:00 A.M.	57	54	56	38	Cloudy	Rain	North	32 3/4
	10:00 P.M.	54	48	40	36	Cloudy	Rain	North	33
15	8:00 A.M.	47.5	45.5	38	34	Cloudy	Mist	North	33
	10:00 P.M.	46.5	42	36	31	Cloudy	Snow	North	33 1/2
16	8:00 A.M.	43.5	42	34	32	Cloudy	Mist	North	33 5/8
	10:00 P.M.	43	41.5	37.5	33	Cloudy	Rain	North	34
17	8:00 A.M.	43.5	42	42	34	Cloudy	Cool	North	33 3/4
	10:00 P.M.	48	41	58	36	Clear	Warm	Calm	33 3/4
18	8:00 A.M.	47	45	56	32	Clear	Warm	South	33 5/8
	10:00 P.M.	49	47	52	43	Cloudy	Rain	Northwest	33 5/8
19	8:00 A.M.	48.5	45	44	39	Cloudy	Warm	Northwest	37 5/8
	10:00 P.M.	50	45.5	58.5	42.5	Cloudy	Rain	Northwest	38 1/2
20	8:00 A.M.	49	48	54	46	Cloudy	Mild	Southwest	39 1/2
	10:00 P.M.	52	50	59	41	Clear	Mild	Northwest	39 3/4
21	8:00 A.M.	50.5	50	60	38	Clear	Warm	Northwest	39 3/4
	10:00 P.M.	53	47	64	47.5	Clear	Warm	Northwest	39 1/2
22	8:00 A.M.	53	51	55	36	Clear	Warm	North	39
	10:00 P.M.	55	54	60	41	Clear	Warm	North	39
23	8:00 A.M.	53.5	52.5	53	38	Clear	Warm	North	38 1/2
	10:00 P.M.	55	52	58	40	Clear	Warm	North	37 7/8
24	8:00 A.M.	51.5	50	42.5	40	Cloudy	Rain	North	37 7/8
	10:00 P.M.	50	48	48	40	Clear	Warm	Northeast	37 1/2
25	8:00 A.M.	51	51	63.5	45.5	Ptly cloudy	Rain	Northeast	37
	10:00 P.M.	50	50	44.5	42	Cloudy	Rain	...	36 5/8
26	8:00 A.M.	50	50	48	44	Cloudy	Rain	...	37 1/2
	10:00 P.M.	50.5	50.5	54	43.5	Cloudy	...	Calm	38
27	8:00 A.M.	50.5	50.5	53.5	48.5	Clear	Warm	Northwest	38 5/8
	10:00 P.M.	54.5	50.5	69.5	43.5	Clear	Warm	Calm	38 3/8
28	8:00 A.M.	50.5	50.5	53.5	48.5	Clear	Warm	Calm	38 3/8
	10:00 P.M.	54.5	50.5	69.5	43.5	Clear	Warm	North	38 1/8

(Continued)

Table IX

Temperatures, Weather Data, and Water Levels at Lake Gogebic Weir, 1940.
(Continued)

Date	Time	Water temperature		Air temperature		Sky	Weather	Wind	Water level	
		Max.	Min.	Max.	Min.					
May	30	8:00 A.M.	54	52	65	36.5	Clear	Warm	Calm	38 1/8
		10:00 P.M.	61	57.5	79	49	Clear	Warm	Northeast	37 5/8
	31	8:00 A.M.	56	56.5	68	43	Clear	Warm	Calm	37 1/2
		10:00 P.M.	57.5	55.5	80	51	Clear	Warm	Northwest	36 5/8
June	2	8:00 A.M.	59.5	52	83.5	54	Clear	Warm	South	36
		10:00 P.M.	62	60	88	61.5	Ptly cloudy	Rain	South	35.5
	3	8:00 A.M.	61.5	60	72	56	Clear	Warm	South	34 1/8
		10:00 P.M.	65	61	84	56.5	Cloudy	Rain	South	33 3/4
	4	8:00 A.M.	64	62	58	52	Cloudy	Rain	East	34
		10:00 P.M.	65	60.5	61	45	Cloudy	Rain	West	34
	5	8:00 A.M.	61	59	59	46	Clear	Warm	Calm	33 3/8
		10:00 P.M.	66.5	60	75.5	54	Clear	Hot	East	32 1/2
	6	8:00 A.M.	63	59.5	59	54	Cloudy	Warm	South	33 1/8
		10:00 P.M.	60.5	59.5	64	56	Cloudy	Rain	South	33 1/2
	7	8:00 A.M.	60.5	60	61.5	58	Cloudy	Rain	Calm	33 1/4
		10:00 P.M.	62	60	66.5	55.5	Cloudy	Rain	Northeast	33
	8	8:00 A.M.	61.5	60.5	57.5	46	Cloudy	Cool	Northeast	33
		9	8:00 A.M.	62	58.5	64	38.5	Cloudy	Cool	East	34 5/8
	10:00 P.M.		61.5	58.5	68	58.5	Cloudy	Cool	South	35
	10	8:00 A.M.	62	61	66	54	Clear	Warm	Northwest	35
		10:00 P.M.	65.5	60.5	74	50	Cloudy	Warm	Northwest	34
	11	8:00 A.M.	64	61	51.5	40.5	Cloudy	Cool	North	33 3/4
		10:00 P.M.	66	61	67.5	44.5	Clear	...	...	33 3/4
	12	8:00 A.M.	64	61	60	40	Cloudy	Warm	Northwest	33 1/2
		10:00 P.M.	71.5	61	80	59.5	Clear	Hot	Northwest	34 1/8
	13	8:00 A.M.	71	66	67	47	Clear	Cool	North	33 1/4
		10:00 P.M.	70.5	67	68	43	Clear	Warm	Calm	33 1/2
	14	8:00 A.M.	68	64	65.5	64	Cloudy	Warm	South	34 1/8
		10:00 P.M.	70	64	85.5	60	...	...	...	32
	15	8:00 A.M.	68	64	64	51	Ptly cloudy	Warm	West	32 3/4
	16	8:00 A.M.	70.5	64	76	45	Clear	Warm	South	33 5/8
10:00 P.M.		70.5	67	82	67	Clear	Warm	South	32 1/2	
17	8:00 A.M.	70	68	72	61	Cloudy	Warm	Southwest	33 1/8	
	10:00 P.M.	71.5	68	77	62	...	...	Southwest	33	
18	8:00 A.M.	70.5	68	66	55.5	Cloudy	Warm	North	32 1/2	
20	8:00 A.M.	68	61	49.5	36	Clear	Cool	North	32 1/2	
	10:00 P.M.	...	...	75	38	...	...	...	...
21	8:00 A.M.	67.5	62	55	32	Cloudy	Cool	...	32 5/8	
22	8:00 A.M.	66.5	62.5	72	52	Cloudy	Warm	South	32 3/4	
23	8:00 A.M.	64.5	62	70	54.5	Cloudy	Mist	North	32 1/2	
24	8:00 A.M.	62.5	59	52	46.5	Cloudy	Rain	North	32 1/8	
25	8:00 A.M.	60	58	59	46	Clear	Cool	North	34 1/4	
	10:00 P.M.	...	...	78	44	Clear	Cool	North	...	
26	8:00 A.M.	62	58	55	38	Cloudy	Cool	North	34 5/8	
27	8:00 A.M.	63.5	60	63	48	Clear	Warm	West	34 1/2	

(Continued)

Table IX

Temperatures, Weather Data, and Water Levels at Lake Gogebic Weir, 1940.
(Continued)

Date	Time	Water temperature		Air temperature		Sky	Weather	Wind	Water level
		Max.	Min.	Max.	Min.				
June 28	8:00 A.M.	67.5	62	64	54	Clear	Warm	North	34 1/2
29	8:00 A.M.	...	...	59	46.5	Clear	Warm	Northwest	34 3/4
<u>Air temperature at time given in Column 2.</u>									
July 30	8:00 A.M.	66.5	62.5	59		Clear	Cool	North	33 1/2
1	8:00 A.M.	68	63	58		Ptly cloudy	Cool	Northeast	32 1/2
2	8:00 A.M.	66.5	64	58.5		Clear	Cool	North	33
3	8:00 A.M.	68	65	59		Clear	Cool	North	32 3/4
4	8:00 A.M.	71	66.5	66		Clear	Warm	Southwest	32 5/8
5	8:00 A.M.	74	70	74		Clear	Warm	Southwest	32 3/8
6	8:00 A.M.	78	75	73		Clear	Warm	South	33 5/8
7	8:00 A.M.	76	72.5	70		Cloudy	Warm	South	31 3/4
8	2:00 P.M.	78	71	75		Clear	Warm	North	31 1/2
9	8:00 A.M.	79	71	67		Clear	Warm	Southwest	31 7/8
10	8:00 A.M.	78	72	70		Clear	Warm	South	31
11	8:00 A.M.	77.5	72	60		Cloudy	Cool	Northeast	31 1/4
12	8:00 A.M.	74	69	58		Cloudy	Cool	Northeast	30 3/8
13	8:00 A.M.	74	69	64		Clear	Cool	Southwest	31 1/4
14	8:00 A.M.	72	67	61		Cloudy	Mist	Southwest	31 1/8
15	8:00 A.M.	68.5	66	61		Ptly cloudy	Warm	North	30 1/4
16	8:00 A.M.	74.5	66.5	64		Clear	Warm	Southwest	30
17	8:00 A.M.	74	69	62		Cloudy	Cool	West	29 3/4
18	8:00 A.M.	70	68	66		Cloudy	Mild	Southwest	29
19	8:00 A.M.	74	68	...		...	...	...	28 3/8
20	8:00 A.M.	77.5	72	75		Cloudy	Rain	Southwest	29 3/4
21	8:00 A.M.	80	68.5	72		Clear	Warm	North	31 3/4
22	8:00 A.M.	77	74	78		Clear	Warm	Southwest	31 1/2
23	8:00 A.M.	77.5	72	83		Clear	Warm	Southwest	30 5/8
24	8:00 A.M.	83	74	67		Cloudy	Rain	Southwest	28 1/2
25	8:00 A.M.	80	77	72		Cloudy	Warm	Southwest	31
26	8:00 A.M.	78	74	65		Ptly cloudy	Warm	North	31
27	8:00 A.M.	77.5	74	65		Cloudy	Misty	South	30 5/8
28	8:00 A.M.	77	73.5	69		Ptly cloudy	Warm	South	31 3/4
29	8:00 A.M.	78	74	75		Cloudy	Warm	South	31 3/8
30	8:00 A.M.	78.5	74.5	66		Clear	Warm	Northeast	30 7/8
31	8:00 A.M.	80.5	74	69		Clear	Warm	Southwest	30 1/2
Aug. 1	5:00 P.M.	78.5	72	62		Cloudy	Rain	West	30 5/8
3	8:00 A.M.	72	69.5	73.5		Clear	Warm	South	29 3/4
4	8:00 A.M.	77	71	71		Cloudy	Warm	Calm	30 1/2
5	8:00 A.M.	80	75	69		Cloudy	Warm	Southwest	30 1/2
6	8:00 A.M.	76	72	65		Clear	Cool	Southwest	29 3/4
7	8:00 A.M.	76	72	68		Clear	Warm	Southwest	29 3/4
8	8:00 A.M.	75.5	72	69		Clear	Warm	South	29
9	8:00 A.M.	78	72.5	70		Clear	Warm	Calm	28 7/8

Table IX

Temperatures, Weather Data, and Water Levels at Lake Gogebic Weir, 1940.
(Continued)

Date	Time	Water temperature		Air temperature at time given		Sky	Weather	Wind	Water level
		Max.	Min.	in Column 2					
Aug. 10	8:00 A.M.	81.5	75	70		Cloudy	Warm	Calm	28 3/8
11	8:00 A.M.	78	75	73		Cloudy	Warm	South	28
12	8:00 A.M.	80	75.5	71		Clear	Warm	South	27 3/4
14	8:00 A.M.	81	74	70		Clear	Warm	South	27 3/4
15	8:00 A.M.	...	...	71		Cloudy	Mist	Southwest	...
16	8:00 A.M.	79	75	69		Clear	Warm	South	28
17	8:00 A.M.	80	76	68		Clear	Warm	North	27 3/8
18	8:00 A.M.	79	74	60		Cloudy	Cool	North	27 1/2
19	8:00 A.M.	74	68.5	55		Cloudy	Cool	North	26 1/4
20	8:00 A.M.	69	64	52		Clear	Cool	South	26 3/4
21	8:00 A.M.	67.5	64	57		Cloudy	Rain	Southwest	27
22	8:00 A.M.	67.5	64	51		Cloudy	Rain	North	26 3/8
23	8:00 A.M.	65	61	46		Clear	Cool	Southwest	26 3/8
24	8:00 A.M.	66	62	50		Clear	Cool	Southwest	26 1/2
25	8:00 A.M.	66	62.5	54		Cloudy	Cool	Southwest	26 3/4
26	8:00 A.M.	63	61	56		Cloudy	Mist	Southeast	26 1/2
27	8:00 A.M.	61	60	57		Cloudy	Mist	East	26 3/8
28	8:00 A.M.	63	60	54		Cloudy	Mist	South	26 1/4
29	8:00 A.M.	63	60	67		Cloudy	Cool	South	27
30	8:00 A.M.	64	62	58		Cloudy	Cool	Southwest	26 7/8
31	8:00 A.M.	64	62	59		Cloudy	Cool	North	26
Sept. 1	8:00 A.M.	64	62	59		Cloudy	Cool	North	26 1/4
2	8:00 A.M.	65	62	55		Clear	Cool	Southwest	26 1/4
3	8:00 A.M.	69.5	62.5	63.5		Clear	Warm	Calm	26 1/4
4	8:00 A.M.	75	67	67		Clear	Warm	Calm	26
5	8:00 A.M.	72	69	70		Clear	Warm	Calm	26
6	8:00 A.M.	77	71.5	66.5		Clear	Warm	Calm	26 1/4
7	8:00 A.M.	77.5	74	69		Clear	Warm	South	25 3/4
8	8:00 A.M.	77	72	61		Cloudy	Cool	North	25 3/4
9	8:00 A.M.	73.5	68	54		Cloudy	Rain	North	25 1/4
11	8:00 A.M.	69	56.5	46		Cloudy	Cool	North	25
12	8:00 A.M.	85	54	46		Clear	Cool	South	25 1/2
13	8:00 A.M.	60	56	51.5		Clear	Cool	North	24 5/8
14	8:00 A.M.	61	58	52		Clear	Cool	North	25
15	8:00 A.M.	63	59	46		Clear	Cool	Calm	25
16	8:00 A.M.	63	59	55		Clear	Cool	Southwest	24 7/8
17	8:00 A.M.	62	60	60		Cloudy	Cool	West	24 7/8
18	8:00 A.M.	63	60	66		Clear	Warm	South	24 1/8
19	8:00 A.M.	67	63	69		Cloudy	Warm	Southwest	24 7/8
20	8:00 A.M.	64.5	69.5	70.5		Cloudy	Misty	Southwest	23 5/8
21	8:00 A.M.	70	67	62.5		Clear	Warm	Calm	22 3/4
22	8:00 A.M.	73	68	55		Clear	Cool	Southwest	22 7/8
23	8:00 A.M.	72	68	60		Cloudy	Rain	Southwest	23
25	8:00 A.M.	68.5	57	50		Clear	Cool	North	22 1/2
26	8:00 A.M.	59	53	43		Clear	Cool	West	22 5/8

Table IX

Temperatures, Weather Data, and Water Levels at Lake Gogebic Weir, 1940.
(Continued)

Date	Time	Water temperature		Air temperature	Sky	Weather	Wind	Water level
		Max.	Min.	at time given in Column 2				
Sept. 27	8:00 A.M.	56	54	54	Clear	Cool	Southwest	22 1/2
28	8:00 A.M.	57	54	53	Cloudy	Cool	Southwest	22
29	8:00 A.M.	60	55	49	Cloudy	Misty	Southeast	21 1/2
30	8:00 A.M.	59	55	51	Clear	Warm	Southwest	21 5/8
Oct. 1	8:00 A.M.	64	56	50	Clear	Cool	Southwest	21 1/2
2	8:00 A.M.	64	59	47.5	Clear	Cool	Southwest	21 1/4
3	8:00 A.M.	65	60	49	Clear	Cool	South	21 1/2
4	8:00 A.M.	64	60	58	Cloudy	Warm	Southwest	21 1/2
5	8:00 A.M.	61.5	56	57	Clear	Warm	Southwest	22 1/4
6	8:00 A.M.	60	56.5	52	Cloudy	Warm	North	21
7	8:00 A.M.	58	54	43	Clear	Cool	Northwest	20
9	8:00 A.M.	53	50	38	Clear	Cool	South	19 1/2
10	8:00 A.M.	54	50	51	Cloudy	Warm	Southwest	19 1/4
11	8:00 A.M.	54	49	51	Cloudy	Warm	West	19
12	8:00 A.M.	56	53	52.5	Cloudy	Rain	North	19 1/8
13	12:30 P.M.	56	51	57.5	Clear	Warm	North	18 3/8
14	8:00 A.M.	54	52	42	Cloudy	Misty	Southwest	17 5/8
15	8:00 A.M.	53	52	36.5	Ptly cloudy	Cool	North	17 1/2
16	8:00 A.M.	53	51.5	40	Cloudy	Cool	South	18 1/2