

Original: Fish Division  
cc: Education-Game  
Institute for Fisheries  
Research  
J. W. Moffett  
J. A. Scully  
V. C. Applegate  
Marquette Laboratory  
L. R. Anderson  
T. M. Stauffer  
ADDRESS  
UNIVERSITY MUSEUMS ANNEX  
ANN ARBOR, MICHIGAN

INSTITUTE FOR FISHERIES RESEARCH  
DIVISION OF FISHERIES  
MICHIGAN DEPARTMENT OF CONSERVATION  
COOPERATING WITH THE  
UNIVERSITY OF MICHIGAN

ALBERT S. HAZZARD, PH.D.  
DIRECTOR

January 25, 1952

Report No. 1314

EXPERIMENTAL OPERATION OF THE BLACK RIVER

SEA LAMPREY BARRIER, 1951

By

Thomas M. Stauffer

Abstract

RECEIVED  
FEB 7 1952  
FISH DIVISION

The barrier dam is located on the Black River in Mackinac County, about three-fourths of a mile upstream from the mouth. The dam holds a head of water which varies from 2 to 3 feet. The spillway consists of a platform 31 feet long and 3 feet wide. Steel plates are bolted to the downstream side of the spillway and curve downstream in a 18-inch half circle. The purpose of this dam is to determine whether a structure of this type will block sea lampreys from their spawning grounds, but at the same time permit food and game fish (especially rainbow trout) to surmount it. To check on the effectiveness of the barrier dam, a weir was installed upstream from the barrier. Observations were conducted at the barrier dam and checking weir from April 9 to July 5 and from September 7 to November 14. Sea lampreys, rainbow trout, suckers and smelt were all actively migrating upstream during the spring and early summer observations. Rainbow trout were actively migrating upstream during the fall period.

Last year sea lampreys were quite successful in penetrating the barrier dam. At the time it was thought that the escapement was due

to structural failure. The belief was substantiated this year when the structure was sound and no sea lampreys escaped upstream. This year, no sea lampreys were observed to jump the barrier, none were taken in the checking weir, and no redds were observed between the barrier and the checking weir.

It is not known what percent of the total number of spring run rainbows were successful in surmounting the barrier. However, a total of 172 adult fish, ranging from 14.1 to 29.0 inches, which were taken at the weir, are known to have jumped the barrier. This figure must be considered a minimum because of other factors involved. A plan for next years operation has been evolved whereby the percent of the total run that successfully jumps the dam can be determined. Of 177 observed attempts to jump the barrier, 33 or 19 percent were successful. I believe that the majority of adult rainbow trout were able to surmount the barrier. Fall run rainbows showed little inclination to attempt to jump the barrier.

Smelt were not able to jump the barrier as shown by the weir catch and the observation period.

Suckers were not able to surmount the structure. Those observed jumping could not attain a height of more than 1 1/2 feet and none were taken in the upstream trap of the checking weir. Although suckers were able to pass the dam last year, it is now established that they were able to penetrate the dam because of structural failures.

Original: Fish Division  
cc: Education-Game  
Institute for Fisheries  
Research  
J. W. Moffett  
J. A. Scully  
V. C. Applegate  
Marquette Laboratory  
L. R. Anderson  
T. M. Stauffer  
UNIVERSITY MUSEUMS ANNEX  
ANN ARBOR, MICHIGAN

INSTITUTE FOR FISHERIES RESEARCH  
DIVISION OF FISHERIES  
MICHIGAN DEPARTMENT OF CONSERVATION  
COOPERATING WITH THE  
UNIVERSITY OF MICHIGAN

ALBERT S. HAZZARD, PH.D.  
DIRECTOR

January 25, 1952

Report No. 1314

EXPERIMENTAL OPERATION OF THE BLACK RIVER  
SEA LAMPREY BARRIER, 1951

By

Thomas M. Stauffer

Introduction

Operation of the experimental sea lamprey barrier continued generally as that of last year (Institute Report No. 1280). Construction, purpose and mode of operation were explained in some detail in that report. Last year (1950), the experiment was ended abruptly by a period of exceedingly high water on June 26, which undercut the barrier to such an extent that it was entirely useless. On March 12, 1951, this damage was repaired by the Lake and Stream Improvement Section of the Fish Division under the supervision of Arthur Feldhauser. Twelve-foot steel sheet piling was placed along the upstream face of the dam. This piling was extended far into the bank on either side. In addition, the bulkheads were packed with red clay, which added greatly to the stability of the structure. When the steel sheet piling was installed the by-pass and trap were removed. This repair work made the dam physically sound and no undercutting occurred during the 1951 season. On October 29 a trap was installed in the jumping pool of the barrier dam. The purpose of this trap was to take sea lampreys and

rainbow trout during the 1952 spring season. A few (19) rainbows were trapped and tagged there this fall.

The initial total cost of the barrier was \$3,460.48. The cost in 1951 for repair, landscaping and installing the trap was \$2,268.48, making a total construction cost of \$5,728.96.

The barrier dam was in continuous operation from March <sup>12,</sup> ~~of~~ 1951 (~~exact date unknown~~) until this writing. Observations at the barrier dam and checking weir were conducted April 9 to July 5 and September 6 to November 14. Sea lampreys, rainbow trout, suckers and smelt were all actively migrating during the spring and early summer. Rainbow trout were actively migrating during the fall period of observation. During the first period of observation the depth of water in the jumping pool varied from 30 to 42 inches, depending on the amount of water in the river. It was also affected by the level of Lake Michigan. A strong south wind would increase the depth greatly, and conversely a strong offshore wind would diminish the depth of water. The head of water held by the dam varied from 2 to 3 feet.

#### Checking weir

To check on the effectiveness of the barrier, a weir (with upstream and downstream traps) was installed by the U. S. Fish and Wildlife Service upstream from the barrier dam. The weir conceivably would catch all upstream migrants which succeeded in surmounting the barrier.

The checking weir site was moved upstream from that of last year. The new location was approximately 1 1/2 miles upstream from the barrier. It was constructed on a gravel bottom and remained fish tight throughout the spring and early summer operation. During the spring, operation was continuous, May 8 to July 5. The weir

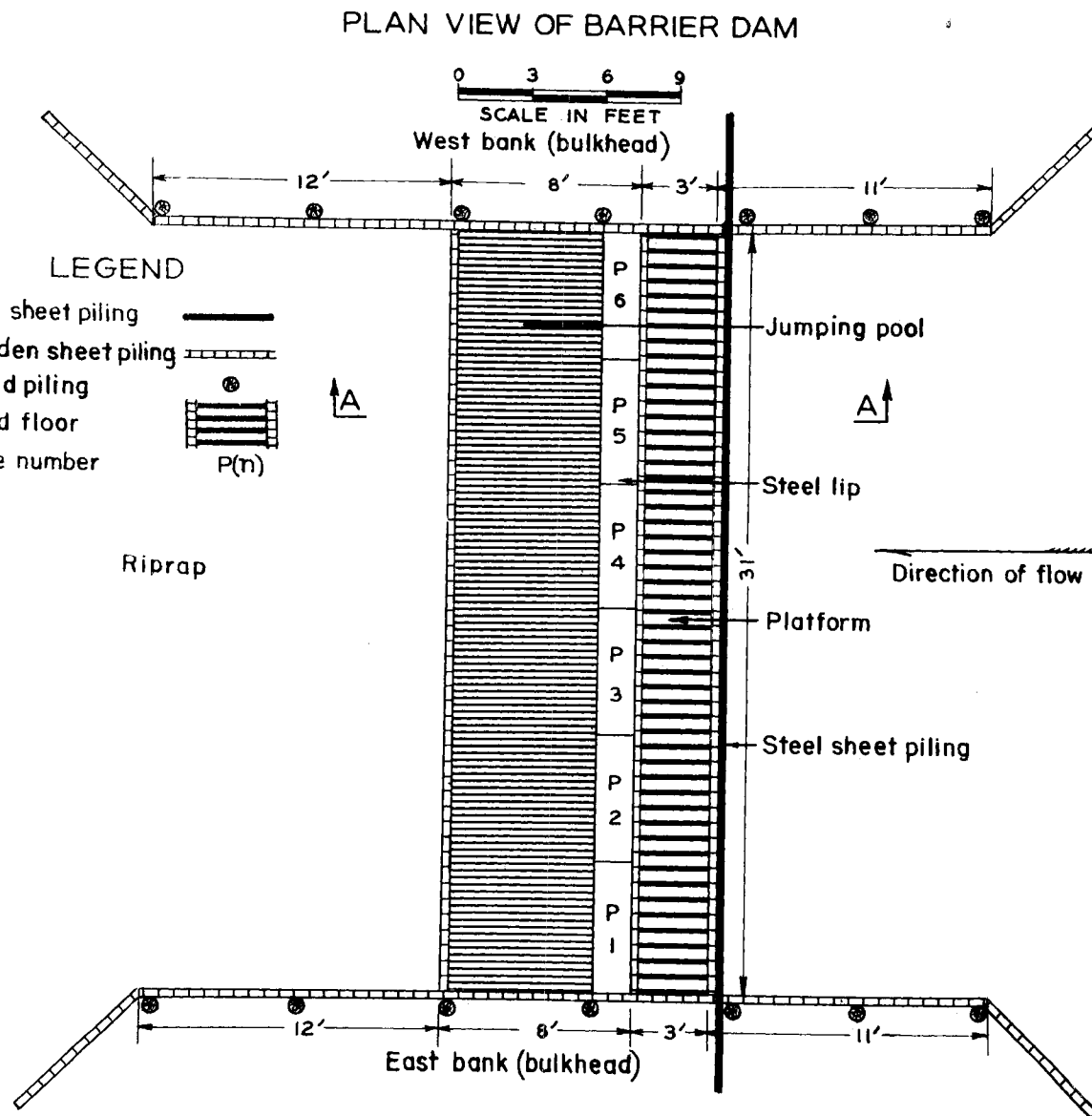


Figure 1

SECTION VIEW OF BARRIER DAM  
SECTION A-A

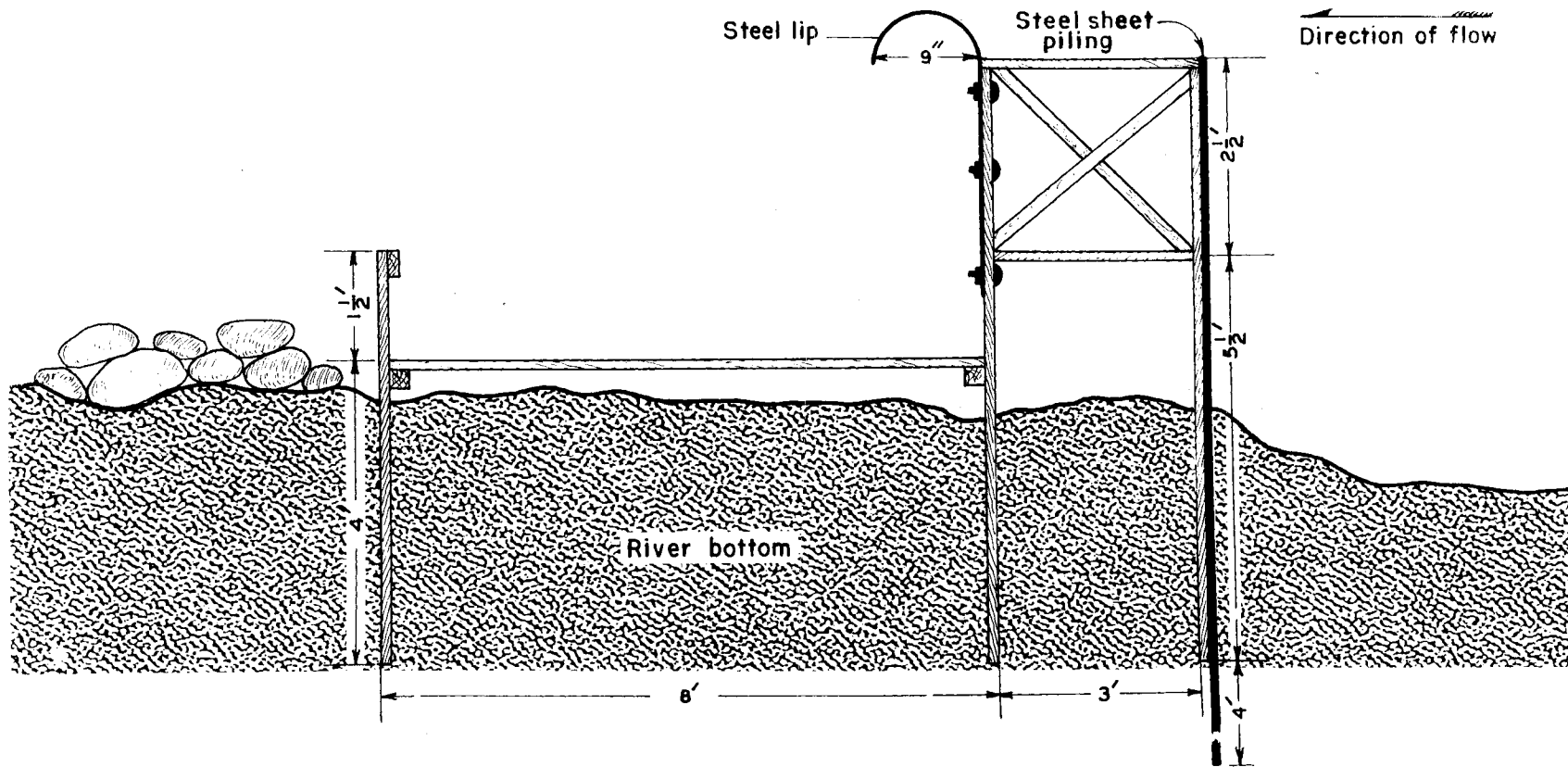


Figure 2.

operation in the fall was very brief. The periods of operation were: September 17 to 26, October 2, October 29 to 31, November 1 and November 3 and 4. Great difficulty was encountered with leaves clogging the screens and consequent undercutting of the foundation. (Figure 3)

#### Sea lamprey

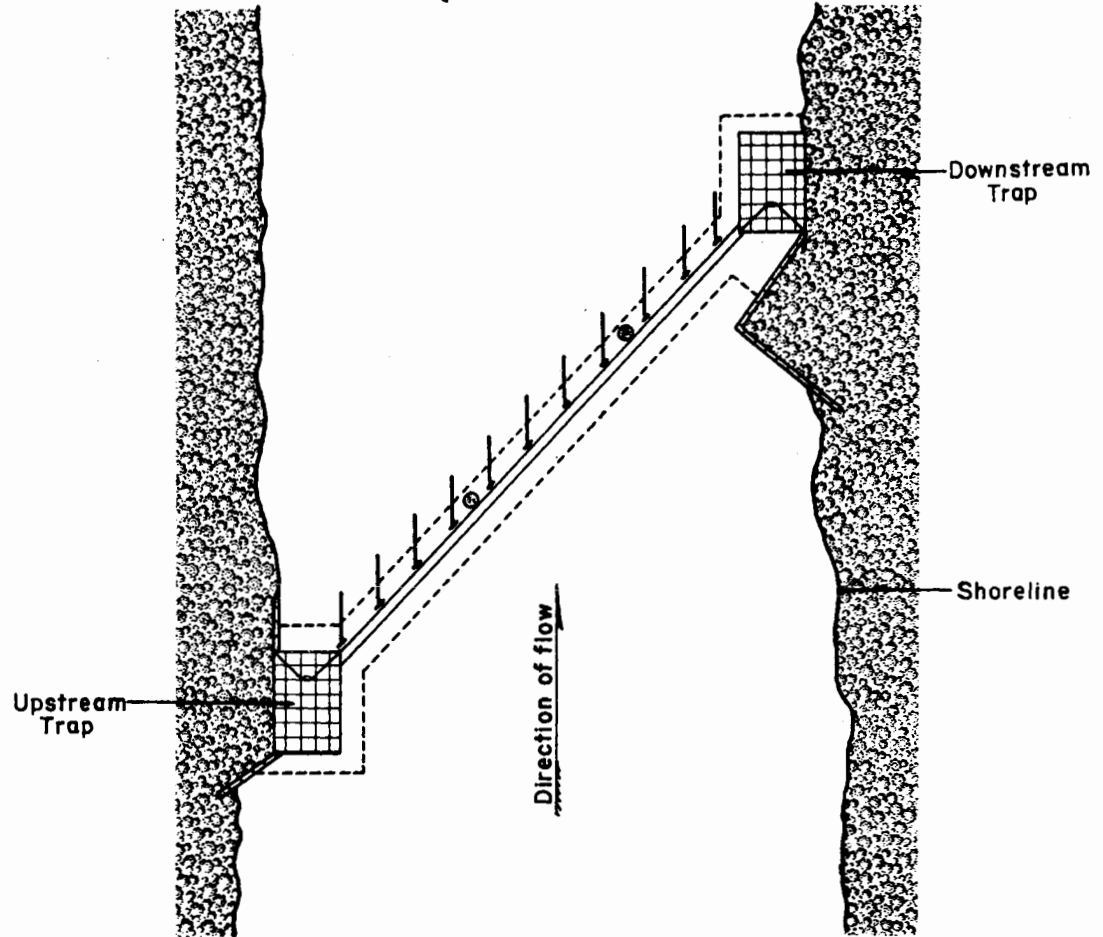
Sea lampreys were first observed below the barrier dam on May 30 by the writer. However, one was reportedly seen below the dam on May 18, and 4 were snagged by anglers on May 29. Sea lampreys were present below the dam in varying numbers until July 5, and may have been present after this date. Dates of observed greatest activity below the dam were: May 21, June 10, 19, 25 and 27.

When night observations were made at the dam, illumination was provided by two Coleman lanterns hung about 4 feet downstream from the lip and 2 feet above it. The observer was stationed on the bank about 20 feet downstream. From this point the entire lip could be seen with the exception of about 1 foot of Plate 1. On occasions, the observer moved closer to spots of unusual activity. A tour of inspection of points of special interest was conducted every half hour. The points checked included the bulkhead walls, a cave in behind the west bulkhead, the immediate area where the plates (lip) meet the bulkheads, the lip itself and an area a short distance (about 30 feet) downstream. On 52 different occasions, 98 hours were spent observing the action of fish and lampreys at the dam.

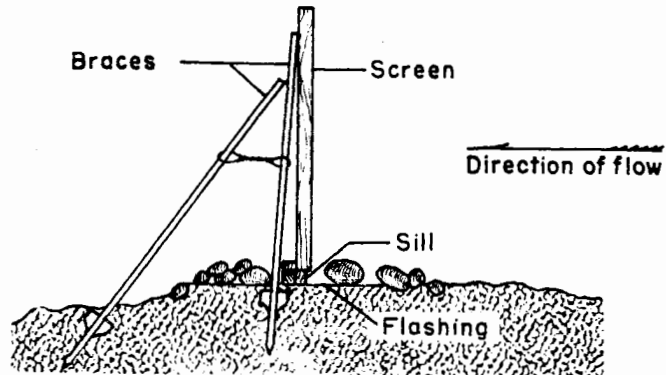
During the period of formal observation, not one sea lamprey was noted to successfully jump the barrier. Most of the sea lampreys attempting to jump the barrier were observed next to the east or west bulkhead. Few were seen to attempt the middle portion of the barrier.

# CHECKING WEIR

DIAGRAMMATIC PLAN VIEW  
(NOT TO SCALE)



## SECTIONAL VIEW



- LEGEND
- Sheet piling
  - Round piling
  - Edge of flashing

Figure 3.



The plate next to the west wall was the scene of the greatest activity. Perhaps this was because the barrier was highest here, hence, a smaller flow of water. The areas of concentration in order of importance appeared to be the west side (bulkhead) of the jumping pool, the east side (bulkhead) of the jumping pool and the cave in behind the west bulkhead. Approximately 30 attempts by sea lampreys to jump the barrier were recorded. Many more could not be recorded because of the short time elapsing between jumps. Generally the sea lamprey would attempt to jump through the air rather than try to swim up the falls. Usually the lampreys would jump from an area within 1 foot of the falls. Seldom did they jump more than halfway up the falls. Those which jumped from the jumping pool and landed on or in the falls were immediately swept downstream. Their sense of direction was poor and many times they would jump straight up or parallel with the falls. If by chance their leap carried them to something solid, they would immediately attach themselves. Many jumped to and clung to a point high (12 to 18") on the west wall close to the falls. However, after clinging a short time, they would drop to the jumping pool below. They could not work higher by use of the sucker mouth alone. None were observed clinging to the lip itself. Apparently the current is too strong.

The checking weir was operated from May 8 to July 5, and during this period no sea lampreys were taken. However, there was about 200 yards of available spawning area between the checking weir and the barrier. Many sea lamprey redds were seen in this area last year but no redds or lampreys were seen this year when the area was carefully checked on June 6 and 8 (Table 1).

Table 1.--Dates and time of observation period

Date	Time		Hours
	From	To	
4-11-51	8:00 p.m.	9:15 p.m.	1.25
4-12-51	3:10 p.m.	4:50 p.m.	1.66
4-12-51	5:50 p.m.	6:55 p.m.	1.08
4-13-51	3:20 p.m.	4:15 p.m.	0.92
4-14-51	4:15 p.m.	5:00 p.m.	0.75
4-16-51	4:00 p.m.	5:00 p.m.	1.00
4-17-51	2:00 p.m.	3:00 p.m.	1.00
4-19-51	4:30 p.m.	5:00 p.m.	0.50
4-19-51	7:30 p.m.	8:30 p.m.	1.00
4-20-51	4:00 p.m.	5:00 p.m.	1.00
4-24-51	7:10 p.m.	10:00 p.m.	2.16
4-25-51	8:00 a.m.	9:00 a.m.	1.00
4-25-51	7:00 p.m.	8:30 p.m.	1.50
4-26-51	5:00 p.m.	10:15 p.m.	5.25
4-27-51	7:15 p.m.	10:00 p.m.	2.75
4-28-51	4:30 p.m.	5:00 p.m.	0.50
4-30-51	6:30 p.m.	7:20 p.m.	0.84
4-30-51	7:40 p.m.	11:00 p.m.	3.33
5-1-51	6:15 p.m.	7:00 p.m.	.75
5-1-51	7:20 p.m.	9:45 p.m.	2.42
5-2-51	4:00 p.m.	10:30 p.m.	6.50
5-3-51	4:15 p.m.	5:15 p.m.	1.00
5-3-51	6:15 p.m.	10:00 p.m.	3.75
5-4-51	6:30 p.m.	10:00 p.m.	3.50
5-5-51	6:30 p.m.	9:00 p.m.	2.30

5-6-51	6:45 p.m.	?	?
5-8-51	8:30 p.m.	10:00 p.m.	2.50
5-9-51	7:15 p.m.	10:15 p.m.	3.00
5-10-51	7:15 p.m.	9:30 p.m.	2.25
5-11-51	7:15 p.m.	10:00 p.m.	2.75
5-12-51	6:15 p.m.	9:00 p.m.	2.75
5-13-51	6:30 p.m.	9:00 p.m.	2.50
5-14-51	8:00 p.m.	10.00 p.m.	2.00
5-15-51	8:15 p.m.	9:30 p.m.	1.25
5-16-51	9:00 p.m.	10:00 p.m.	1.00
5-17-51	7:15 p.m.	10:00 p.m.	2.75
5-18-51	8:00 p.m.	10:00 p.m.	2.00
5-21-51	8:00 p.m.	10:45 p.m.	2.75
5-25-51	8:00 p.m.	10:00 p.m.	2.00
5-31-51	8:45 p.m.	10:00 p.m.	1.25
6-10-51	9:00 p.m.	11:00 p.m.	2.00
6-11-51	8:30 p.m.	10:30 p.m.	2.00
6-14-51	9:00 p.m.	11:30 p.m.	2.50
6-15-51	9:00 p.m.	10:15 p.m.	1.25
6-17-51	8:30 p.m.	10:00 p.m.	1.50
6-18-51	9:30 p.m.	10:00 p.m.	0.50
6-19-51	9:00 p.m.	10:15 p.m.	1.25
6-20-51	9:00 p.m.	10:30 p.m.	1.50
6-25-51	8:30 p.m.	10:45 p.m.	2.25
6-26-51	9:00 p.m.	10:30 p.m.	1.50
6-27-51	8:45 p.m.	10:00 p.m.	1.25
6-28-51	8:00 p.m.	10:00 p.m.	2.00

---

Total hours

97.96

---

### Spring run rainbow trout

It was noted from the dam observations that rainbow trout were very actively migrating on April 12, 24, 26, 27, 30 and May 1, 2 and 3. The upstream migration was light after these dates. Those fish seen jumping April 12 to 26 were jumping from a 30- to 36-inch depth of water and were attempting to surmount a falls of some 30 to 36 inches. The exact head is not known. In this period some 85 attempts by rainbows were made, only 9 (11 percent) of these were successful. In order to increase the number of successful attempts an 8-inch plank was added to the top of the downstream wall of the jumping pool. The plank increased the depth of water in the jumping pool an estimated 6 to 8 inches depending upon the water level existing below the jumping pool, and reduced the head to 24 to 30 inches. At times the jumping pool dam was submerged by as much as 2 inches (before addition of the 8-inch plank) due to the high level of Lake Michigan as mentioned earlier. After the plank was installed, 92 attempts to jump the falls were made by rainbow trout. Of these, 24 were successful, or 26 percent. Apparently, the plank was of some aid since the percent of successful attempts rose 15 percent. The plank probably aided by increasing the depth of water (6 to 8 inches) in the jumping pool, and thus reducing the height of the falls.

A total of 33 successful attempts were recorded during the observation period. Of these 9 (27 percent) swam up the falls and over the lip to negotiate the barrier. Eleven (33 percent) jumped from a point 1 foot or less downstream from the falls, lit on the lip and swam upstream. Seven (21 percent) jumped from points unknown, landing on the lip and proceeding upstream. The exact method of ascent was not observed for

6 (19 percent). The location of the attempts, both successful and unsuccessful, are shown below.

Location of attempts	Plate 1	Plate 2	Plate 3	Plate 4	Plate 5	Plate 6	Unknown	Total
Successful attempts	2	3	4	2	3	8	11	33
Unsuccessful attempts	5	7	11	8	16	24	73	143
Total	7	10	15	10	19	32	84	176
Percent of successful attempts	29	30	27	20	16	25	...	19

The plates refer to the steel lip of the dam, which consisted of six sections. They are numbered from east to west (Figure 1). As the number of the plates gets higher, the number of attempts observed is progressively larger. The reason for this, I believe, was the lesser volume of water flowing over Plate 6. The volume is progressively greater eastward until Plate 1 is reached where the volume is greatest. Usually there was a 2-to 3-inch difference in the depth of water flowing over Plates 1 and 6. It would seem as if the rainbow trout choose plates where a smaller volume is flowing for their jumping attempts in preference to plates where a larger volume is present. Although rainbow trout appeared to prefer the smaller volume of water, they were just as successful when they attempted to ascend through the larger volume of water. The percentage of successful attempts is even higher for the lower numbered plates, but in view of the small number of attempts observed is not considered significant.

Since the total number of the fish attempting to jump the barrier is unknown, it is impossible to calculate the percent of the total run which was successful in ascending the dam. Future plans include tagging all rainbow trout taken in the dam trap and releasing them downstream from the dam. The percent of these fish successfully jumping the barrier can be determined by the number subsequently taken in the checking weir. Also, perhaps an estimate can be made of the total adult spawning run. The following formula illustrates.

$$\frac{TD}{X} = \frac{TW}{Y}$$

where:

TD = Number of adult fish tagged at dam.

TW = Number of adult fish tagged at dam and subsequently taken in weir.

Y = Number of unmarked adult fish taken in weir.

X = Total number of unmarked adult fish which attempted to jump barrier and failed.

TD + Y + X = Total adult spawning run.

The checking weir was not put into operation until the upstream spawning run was largely over (May 8). It functioned until July 5. During this period 21 adult rainbow trout, ranging from 14.1 to 25.0 inches, were taken in the upstream weir trap. To arrive at the weir these fish conceivably must have jumped the barrier. It is not thought that these were fish seen jumping at the barrier, since those seen at the barrier were noted previous to the weir installation. Of these fish, 10 were killed for thyroid specimens, 6 were released upstream after being tagged and may have been caught by anglers or remained upstream, and 5 (identified by tags) were subsequently recaptured in the downstream weir trap. The downstream weir catch totaled 161 adults

ranging in size from 14.6 to 29.0 inches. The weir catch, both upstream and downstream is tabulated in a report on migration which is to follow. Five of these were fish taken previously in the upstream trap. Five were fish tagged last fall and, as such, did not have to surmount the barrier to reach the spawning grounds, i.e., they could have remained above the checking weir all winter and probably did. In order to arrive at the total number of rainbow trout taken in the downstream trap which had jumped the barrier and migrated above the weir before it was put in, it is necessary to subtract the 5 fall run fish and the 5 fish previously taken in the upstream trap. This leaves a total of 151 adults which had jumped the barrier and migrated above the weir before May 8. By adding the number of fish which jumped the barrier after May 8 (upstream weir catch) we arrive at a minimum total of 172 adult rainbows which we know negotiated the barrier successfully. Several factors indicate that this figure was a minimum. The number taken by anglers, both above and below the weir, is unknown, but certainly cannot be discounted. Some adults probably remained upstream from the weir or may have gone down after the weir was removed (July 5). The adult rainbows were quite wary of the weir and often as many as 10 to 15 were observed within an area 20 feet above. Often, on the particular visit that they were observed, more would be in the downstream trap and the following visit also would find the trap empty. Once in the downstream trap, the adult rainbows frequently would find their way out again. It is thought that some of these fish returned upstream to the deeper holes. Several reports of catching large adult rainbows above the weir in July and August were brought to my attention. Between the weir and the barrier dam there were about 200 yards of good spawning area. Trout spawning here would not be taken in the checking weir. This area was checked

on June 8 when the peak of spawning activity was long past. Thirteen definite rainbow trout redds were counted, as well as 12 possible redds.

A spawning check indicated that there were considerable numbers of rainbows spawning above the weir. An estimated one third to one half of the available spawning area was checked and 48 definite redds and 24 possible redds were seen. These counts were made May 7, 10 and June 14. The area in the immediate vicinity of the weir was heavily utilized for spawning. It was interesting to note that one persistent rainbow trout attempted to build a redd directly in front of the downstream trap. Although every effort was made to discourage this fish, it succeeded in covering the bottom of the downstream trap with egg-size gravel on the average of twice a day for a period of several days. Even though the gravel was taken out of the trap and placed in the redd, the next visit would find the bottom of the trap covered with rocks again.

#### Fall run rainbow trout

The fall run rainbows were first reported in the river on the Labor Day week end and may have been present before. Fall observations were not initiated until September 7 and were continued until November 14. Lake run rainbow trout were present in the river throughout this period.

It is my opinion that rainbow trout during this period did not show any inclination to ascend the barrier. This opinion is based on three observations. Number one is the fact that no rainbow trout were observed attempting to jump the barrier. No formal observation was attempted, but some time was spent at the dam taking creel census, water level, water temperature and caring for the dam trap. Anglers reported but 2 small fish attempting to surmount the falls during the



entire season. Number two is that to my knowledge no fall run fish were caught above the barrier. Also, during the checking weir operation, September 17 to 26, October 2, October 29 to 31, November 1, 3 and 4, no lake run rainbows were taken.

#### Smelt

Smelt first appeared at the barrier on April 25 and were present until May 5. Many thousands were observed below the dam and many were seen in the jumping pool. Very few attempted to jump the barrier. Those which did, could only jump 6- to 12-inches in a vertical direction. No smelt were taken at the checking weir. It is concluded that smelt were not able to surmount the barrier.

#### Suckers

The suckers migrating up the Black River included the white or common sucker and the sturgeon sucker. They first appeared below the dam on April 29, when 6<sup>\*</sup> were taken. They were present until at least May 21. Only 2 suckers were observed to attempt to jump the falls. Only 1 succeeded in getting its own length out of water and the other jumped halfway up the falls. No adult suckers were taken in the checking weir, but 67 immature white suckers were taken in the downstream trap. It is apparent that suckers could not pass the barrier.

#### American brook lampreys, brown trout and sticklebacks

The American brook lampreys were present in large numbers below the dam during the period May 30 to June 16. None were observed attempting to jump the lip, and it is thought that the dam constituted a barrier to them. Two lake run brown trout (18 to 20 inches) were taken on July 4 in the upstream weir trap. These fish were bright silver and

presumably had just come from Lake Michigan. To arrive at the weir, they would have had to jump the barrier. Ninespined sticklebacks were unable to ascend the dam. Large numbers were seen immediately below the dam, while none were seen above.

#### Conclusion

1. Last year sea lampreys were quite successful in penetrating the barrier dam. At the time it was thought that the escapement was due to structural failure. The belief was substantiated this year when the structure was sound and no sea lampreys escaped upstream. This year no sea lampreys were observed to jump the barrier, none were taken in the checking weir, and no redds were observed between the barrier and checking weir.

2. It is not known what percent of the total number of spring run rainbows were successful in surmounting the barrier. However, a total of 172 adult fish ranging from 14.1 to 29.0 inches which were taken at the weir are known to have jumped the barrier. This figure must be considered a minimum because of other factors involved. A plan for next year's operation has been evolved whereby the percent of the total run that successfully jumped the dam can be determined. Of 176 observed attempts to jump the barrier by rainbow trout, 33 (19 percent) were successful. I believe that the majority of adult rainbow trout were able to surmount the barrier. Fall run rainbows showed little inclination to attempt to jump the barrier.

3. Smelt were not able to surmount the barrier, as shown by the weir catch and the observation period.

4. Suckers were not able to surmount the barrier. Those observed jumping could not attain a height of more than 1 1/2 feet and none were

taken in the upstream trap of the checking weir. Although suckers were able to pass the dam last year, it is now established that they were able to penetrate the dam because of structural failures.

5. American brook lampreys apparently were blocked by the barrier. Two lake run brown trout were able to surmount the barrier. Ninespined sticklebacks could not jump the barrier.

INSTITUTE FOR FISHERIES RESEARCH

Thomas M. Stauffer

Approved by: A. S. Hazzard

Typed by: M. C. Tait