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Report No. 1411

OPERATION OF BLACK RIVER BARRIER DAM, 1952-53

Thomas M. Stauffer

Abstract

In 1952, the barrier dam remained essentially the same as in 1951 (I.F.R. Report number 1314), except that an upstream trap was installed along the right bank in the jumping pool just below the steel lip. The purpose of the trap was to trap upstream migrants. The measured "head" of water held by the barrier dam varied from 16 to 29 inches, with an average of two feet. The checking weir was operated upstream from the dam as before.

The barrier dam was operated in the same manner in 1953. The barrier, however, was modified. First, the steel lip was straightened and instead of hanging over downstream in a half circle, it projected downstream 19 inches in an upward direction at a thirty degree angle from vertical. Secondly, the downstream wall of the jumping pool was heightened 18 inches on May 8 and an additional 6 inches on June 9. This had the effect of reducing the head from a range of 30 to 36 inches to 24 inches.

Rainbow trout were partially successful in surmounting the barrier dam in 1952 but were considerably less successful in 1953. In 1952, before the checking weir was installed 68 adult rainbows were trapped

and tagged at the upstream trap of the barrier dam and released below. Of these, 35.3 percent were recovered later above the barrier. After the checking weir was installed, 7 rainbow trout were trapped and tagged at the barrier dam and released below. Three or 43 percent were recovered above the barrier. It was concluded that the barrier dam constituted a partial barrier to migratory rainbow, although not as great as indicated by the percentages.

In 1953 the rainbows were faced with a 30 to 36 inch falls. Only one out of 25 rainbows trapped and tagged at the barrier and released below (before the checking weir was installed) was subsequently recaptured above the dam. After the checking weir was installed, 7 rainbow trout were trapped and tagged at the dam and released below. None were recovered above. Observations at the dam in 1953 demonstrated that rainbows were having considerable difficulty at the dam. Of 225 observed attempts to surmount the barrier dam only 8 were successful. The lack of success in 1953 was thought due to the extreme turbulence in the pool below the barrier caused by the new-type lip. At first glance the curved type lip of 1952 apparently made it easier for rainbow trout to jump the barrier. However, in 1952 the rainbows were faced with an average head of 24 inches, while in 1953 (when they were migrating upstream) the head ranged from 30 to 36 inches. Also, the turbulence observed below the lip in 1953 was not nearly so noticeable in 1952.

Sea lampreys were generally blocked by the dam in both years. In 1952, 14 sea lampreys were able to surmount the barrier. They were able to negotiate the barrier when the head was much reduced by the high level of Lake Michigan and consequent high level of the river

below the dam. In 1953, 26 sea lampreys got over the barrier. These probably made their way up the west bulkhead where it meets the lip. Screening was installed at this point and a 100 percent blockage resulted. The curved-type lip seemed to present a more effective barrier to upstream migrating sea lampreys than did the straight overhanging lip, inasmuch as it prevented sea lampreys from using the bulkhead wall as an avenue of escape. The head of the dam averaged approximately 24 inches in both years while the sea lampreys were migrating upstream.

It is believed that both smelt and suckers (white and longnose) were blocked by the barrier dam in both years.

The peaks of upstream migration of rainbow trout occurred as the spring run-off was receding and at daily midpoint water temperatures ranging from 40° - 50°F. Lamprey migration peaks came at water temperatures over 50°F. and with increased stream flow. Smelt moved upstream most actively on high but falling water levels and at temperatures between 38° and 51°F. Sucker migration peaked at about 50°F. on falling water levels.

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In 1952 the barrier dam remained the same as in 1951 (Institute Report No. 1314), except that an upstream trap was installed along the right bank in the jumping pool just below the curved steel lip. The purpose of the trap was to capture upstream migrating sea lampreys and rainbow trout. No major repair was necessary, although the lip was raised nine inches to cope with the high level of Lake Michigan and the consequent high level below the barrier dam. The measured head (difference in water level between the jumping pool and the impoundment) of water held by the dam varied from 16 to 29 inches (morning reading), with an average of about 24 inches. In the jumping pool directly below and downstream from the steel lip the depth of water fluctuated from 24 to 45 inches, with 30 to 36 inches being the usual depth. A two-way checking weir was again operated 400 yards above the barrier to determine the number of fish and lampreys jumping the barrier. It was installed on May 8. As a further check, observations were made at the barrier to determine methods of escapement.

The barrier was operated in the same manner in 1953, except that observations of sea lampreys at the barrier were very limited. The barrier itself was modified in two ways. First, the steel lip was straightened and instead of hanging over downstream in a half circle,

it projected downstream nineteen inches in an upward direction at a thirty degree angle from vertical. Secondly, the downstream wall of the jumping pool was heightened 18 inches on May 8 and an additional 6 inches on June 9. This was done after it became apparent that rainbow trout were having much difficulty jumping the barrier. The checking weir was installed on May 4.

Rainbow Trout

In 1952 adult rainbow trout were actively migrating upstream from April 9 to May 31 (Table 1). The peak of the run was in April. Those rainbow trout taken in the barrier dam trap were jaw tagged and released below the barrier. This was done in order to determine the percent of the spring run jumping the dam. Methods of recovery were the upstream and downstream traps of the checking weir and angling. Before the checking weir was installed 68 adult rainbows were tagged at the barrier dam trap and released below. Of these, 35.3 percent were recovered later above the barrier dam (Table 2). This percentage constitutes a minimum of those jumping the barrier dam, because the checking weir was not installed at the time of tagging.

After the checking weir was installed 7 rainbow trout were tagged at the barrier dam trap and released below. Of these, 3 or 43 percent were recovered in the upstream trap of the checking weir. It would appear that the barrier dam constitutes a partial barrier to rainbow trout, although this theory is based on a limited sample. Substantiating this theory were 2 ripe rainbows tagged in the dam trap which were recovered some distance below the barrier. One was recovered in Lake Michigan and the other in the East Branch of the Black River, which enters the mainstream below the barrier. These recoveries seem to

Table 1

Catch of Barrier Dam Trap (upstream trap) by Week
(Spring - Early Summer, 1952)

Period	Rainbow trout			Brook trout	Brown trout	Smelt	Suckers		Sea lamprey	
	Adult♂	Adult♀	Parr				White	Longnose	♂	♀
April 8-11	2	0	0	0	1	0	0	0	0	0
April 12-18	4	14	3	0	1	0	0	0	0	0
April 19-25	11	17	8	1	2	560	12	3	0	0
April 26-May 2	3	23	4	0	0	1,274	194	394	4	2
May 3-9	3	4	3	1	1	9	110	405	19	13
May 10-16	1	6	0	1	0	1	111	408	1	0
May 17-23	0	2	10	0	0	0	74	556	24	21
May 24-30	0	1	31	2	0	0	118	310	20	8
May 31-June 6	1	1	15	4	2	0	105	0	6	10
June 7-13	0	0	20	1	0	0	260	36	42	27
June 14-20	0	0	22	1	0	0	80	1	42	19
June 21-27	0	0	45	2	0	0	65	1	102	51
June 28-July 4	0	0	17	2	0	0	3	0	44	16
July 5-11	0	0	16	0	2	0	35	0	59	21
July 12-18	0	0	19	1	0	0	10	0	46	14
July 19-25	0	0	4	2	1	0	17	3	44	26
July 26-Aug. 1	0	0	3	0	1	0	1	0	3	2
Total	25 ⏚	18 ⏚	220	18	11	1,844	1,195	2,117	456	230

⏚ 18 of these totals were recaptures.

Table 2

Catch of Upstream Weir
Trap by Week
(Spring - Early Summer, 1952)

Period	Rainbow trout			Brook trout	Brown trout	Suckers		Sea lamprey	
	Adult ♂	Adult ♀	Parr			White	Longnose	♂	♀
May 9	0	0	0	0	0	11	34	0	0
May 10-16	1	5	2	3	0	64	262	0	0
May 17-23	1	5	7	1	1	27	212	0	0
May 24-30	0	4	4	2	0	4	11	0	0
May 31-June 6	0	4	5	3	1	70	17	0	0
June 7-13	0	2	8	0	0	179	0	1	0
June 14-20	0	1	8	1	0	61	1	0	0
June 21-27	1	0	14	2	0	59	0	5	2
June 28-July 4	0	0	12	0	0	4	0	1	1
July 5-11	0	0	11	0	4	23	0	0	0
July 12-18	0	0	9	0	1	5	0	2	0
July 19-22	0	0	1	0	1	0	0	1	0
Total	3	21	81	12	8	507	537	10	3

Table 3

Catch of Downstream Weir Trap by Week (Spring - Early Summer, 1952)

Period	Rainbow trout			Brook trout	Brown trout	Suckers		Sea lamprey	
	Adult ♂	Adult ♀	Parr			White	Longnose	♂	♀
May 9	0	0	0	0	0	0	0	0	0
May 10-16	1	3	3	1	0	9	20	0	0
May 17-23	4	6	18	1	0	15	218	0	0
May 24-30	7	10	90	0	0	33	234	0	0
May 31-June 6	8	8	87	2	0	70	226	0	0
June 7-13	2	13	82	1	1	33	51	0	0
June 14-20	1	2	121	0	0	54	14	0	0
June 21-27	3	8	102	0	0	100	13	0	0
June 28-July 4	0	3	26	0	0	73	7	0	1
July 5-11	3	3	56	0	0	103	12	0	0
July 12-18	0	1	17	0	0	33	3	0	0
July 19-22	1	19	27	0	0	1	0	0	0
Total	[1] 30	[1] 76	629	5	1	524	798	[2] 0	[2] 1

[1] Plus 2 adults, sex unknown.

[2] Plus 1 sea lamprey, sex unknown.

Table 4

Catch of Barrier Dam
Trap by Week
(Spring - Early Summer, 1953)

Period	Rainbow trout				Brook trout	Brown trout	Smelt	Suckers		Sea lampreys	
	Adult ♂	Adult ♀	Unidentified	Parr				White	Longnose	♂	♀
April 1-3	4	0	0	0	2	1	0	0	0	0	0
April 4-10	9	3	0	2	0	1	0	0	0	1	0
April 11-17	3	2	0	3	1	0	2,718	0	0	0	0
April 18-24	4	4	1	6	1	0	1,793	0	0	0	1
April 25-28 [1]	1	1	0	0	0	0	17	0	0	0	1
May 4-8	3	16	1	9	0	0	1	59	82	9	6
May 9-15	1	3	0	5	1	0	0	57	32	44	27
May 16-22	0	3	0	10	1	0	4	46	120	25	15
May 23-29	0	0	0	10	2	0	0	33	150	7	5
May 30-June 5	0	0	0	32	3	0	0	102	13	51	29
June 6-12	0	0	0	56	1	0	0	32	0	42	22
June 13-19	0	0	0	58	0	0	0	107	0	224	118
June 20-26	0	0	0	17	0	1	0	121	0	407	222
June 27-July 3	0	0	0	20	2	3	0	22	0	131	57
July 4-10	0	0	0	4	0	0	0	0	0	2	1
July 11-17	0	0	0	12	0	0	0	2	0	46	19
July 18-24	1	0	0	19	0	0	0	0	0	29	11
July 25	0	0	0	0	0	0	0	0	0	0	0
Total	26	32	2	263	14	6	4,533	581	397	1,018	534

[1] Trap not operated April 29-May 3

Table 5

Catch of Upstream Trap of the Checking Weir
(Spring - Early Summer, 1953)

Period	Rainbow trout				Brook trout	Brown trout	Suckers		Sea lamprey	
	Adult ♂	Adult ♀	Unidentified	Parr			White	Longnose	♂	♀
April 8	0	0	0	0	0	0	0	0	0	0
May 4-8	3	16	0	11	0	1	42	51	0	0
May 9-15	2	7	0	2	1	0	57	42	0	0
May 16-22	0	1	0	2	0	0	36	82	0	0
May 23-29	0	1	1	0	1	0	40	159	0	0
May 30-June 5	0	2	0	4	4	0	44	28	1	0
June 6-12	0	0	0	12	1	0	30	0	0	0
June 13-19	0	0	0	21	0	0	110	1	15	2
June 20-26	0	0	0	15	1	0	85	0	2	6
June 27-July 3	0	0	0	4	0	0	36	0	0	0
July 4-10	0	0	0	0	0	0	0	0	0	0
July 11-17	0	0	0	3	0	0	0	0	0	0
July 18-24	0	0	0	6	0	1	0	0	0	0
July 25	0	0	0	0	0	0	0	0	0	0
Total	5	27	1	80	8	2	480	363	18	8

Table 6

Catch of Downstream Trap of the Checking Weir
(Spring - Early Summer, 1953)

Period	Rainbow trout				Brook trout	Brown trout	Suckers	
	Adult ♂	Adult ♀	Unident-ified	Parr			White	Longnose
April 8	0	0	0	4	0	1	0	0
May 4-8	0	1	1	84	0	1	0	0
May 9-15	0	3	0	51	0	0	8	9
May 16-22	1	0	0	82	0	0	15	19
May 23-29	0	2	0	50	1	0	12	26
May 30-June 5	5	15	2	315	1	1	36	229
June 6-12	0	1	0	393	0	0	46	20
June 13-19	0	2	0	545	0	0	59	13
June 20-26	0	0	0	314	0	0	51	2
June 27-July 3	0	1	0	318	0	0	167	3
July 4-10	0	0	0	67	0	0	12	1
July 11-17	0	0	0	64	0	0	12	0
July 18-24	0	1	0	60	0	0	6	0
July 25	0	0	0	0	0	0	0	0
Total	6	26	3	2,347	2	3	424	322

indicate that these 2 fish were blocked by the barrier and were seeking other spawning grounds.

Evidence was obtained in 1953 that the partial block may not be as great as indicated by tag recoveries from the upstream trap of the weir. In order to check the efficiency of the upstream trap of the checking weir, 15 rainbows were trapped and tagged at the dam trap and released above the barrier (Table 4). It was found that all rainbows jumping the barrier would not necessarily be trapped in the upstream trap of the checking weir. Only 4 of the 15 were subsequently recaptured in this trap (Table 5). Therefore estimates of the percentage of rainbows successfully jumping the dam when the weir was operating would also be minimal.

The number of adult rainbow which jumped the dam in 1952 was a minimum of 125. Twenty-seven of these were tagged in the barrier dam trap, 18 that had not been tagged in the barrier dam trap were trapped in the upstream trap of the checking weir and 80 which had not been taken in the barrier dam trap or upstream trap of the checking weir were trapped in the downstream trap of the checking weir. These fish ranged in length from 13.8 to 28.4 inches.

In 1953 migratory rainbow trout seemed to have some difficulty in surmounting the barrier. These fish were jumping from a depth of approximately 30 inches. The head, at the time that the rainbows were migrating upstream varied from 30 to 36 inches. Only 1 out of 25 rainbows trapped, tagged and released below the barrier (before the checking weir was installed) was recovered above the barrier. None were recaptured above the barrier from 7 trapped, tagged and released below the barrier after the checking weir was installed. The estimate of the percentage of rainbow successfully jumping the dam when the weir

was operating was minimal because of the demonstrated inefficiency of the upstream trap of the checking weir. Observations of rainbow trout jumping at the barrier also demonstrated that rainbows were having great difficulty in surmounting the barrier. Of 225 observed attempts only 8 were successful. The successful attempts were made near the bulkhead walls on either side of the river and were usually accomplished by swimming directly up the falls.

In 1953, a minimum of 57 adult rainbow trout successfully jumped the barrier. One of these was taken in the dam trap; 32 were trapped in the upstream trap of the weir that had not been trapped in the dam trap and 24 were trapped in the downstream trap of the weir that had not been trapped at the dam or in the upstream trap of the weir (Tables 5 and 6).

During the fall migrations of 1952 and 1953, rainbow trout made few attempts to jump the barrier. In 1952 only 3 lake-run fish were trapped in the upstream trap of the weir and in 1953, 2 were trapped. During both fall seasons, lake-run fish were abundant below the barrier which doubtless interfered somewhat with normal upstream movement at that time of year.

Sea Lampreys

Sea lampreys in 1952 were actively migrating upstream from April 30 to July 28, as shown by the barrier dam trap catch (Table 1). They probably were present below the barrier afterwards, but were not recorded since the trapping operation terminated on August 1. A total of 456 male and 230 female sea lampreys were trapped and destroyed in the barrier dam trap. The peak migration took place during the last week in June and the first two weeks in July. Thirteen sea lampreys

were trapped in the upstream trap of the weir (Table 2), indicating that some sea lampreys got over the barrier in 1952. However, one of these was known to have been inadvertently released above the barrier. Two sea lampreys were taken in the downstream trap of the checking weir, indicating that the upstream trap of the checking weir did not capture all sea lampreys surmounting the barrier.

Five nights of observation at the barrier dam were recorded by Mr. Truman Guard who assisted the writer at the peak of the sea lamprey run. Much of his observation was directed to the underside of the curved lip. He reports that "during this time (5 nights) no lampreys were seen attached to the maximum height of the curve nor to the underside of the downstream portion of the lip, although many were observed jumping to these points." In regard to the sea lampreys taken in the upstream trap of the checking weir he writes ".... this escapement is due probably to the tremendous fluctuation in the water level below the dam, which at times more than completely submerged the downstream portion of the lip. Under these conditions there was practically no barrier to passage. I also observed that when the water level below the dam is raised to such a point that the distance between the downstream edge of the lip and the water level below was only inches, the lampreys started to appear on the wing walls."

Mr. Guard's observations indicate that at least a part of the sea lampreys taken in the upstream trap of the weir gained access when the head of water at the dam was very small. My own observations indicate that there were tremendous water level fluctuations occurring during active sea lamprey migration. The cyclic appearance of the fluctuations (as much as 10 inches in one hour) lead me to believe that seiches as well as the high level of Lake Michigan were the cause. In some cases the

downstream edge of the lip was partially submerged. At these times it would be easy for sea lampreys to surmount the barrier. I agree with Mr. Guard that the extremely high level of Lake Michigan and the water level fluctuation was the cause of the escapement.

* *

In 1953 sea lampreys first appeared at the barrier on April 9, but were not evident in appreciable numbers until May 8 (Table 4). The most active period of upstream migration was from June 13 to June 22. A total of 1,018 male and 534 female sea lampreys were trapped in the dam trap. This was more than twice the number trapped in 1952.

Due to the raising of the lower jumping pool wall and consequent reduction in head, the sea lampreys had only to jump a 24-inch head to surmount the barrier. Twenty-six sea lampreys were trapped in the upstream trap of the checking weir (Table 5). This escapement apparently took place at a point where the steel lip joins the west bulkhead wall. From the limited observations made, it appears as if the sea lampreys were jumping and attaching themselves on the west bulkhead wall in the stream of water coming over the lip, resting, and then swimming up the falls. To prevent this, on June 22 hardware cloth (1/2 inch mesh) was installed on the edge of the lip so that all of the water passing over the lip (in the immediate vicinity of the west bulkhead) must flow through this screen. The screening fitted tightly to the west bulkhead and extended 3 feet along the lip. This screening was in the same plane as the inclined lip and extended 3 inches beyond it. This blocked the sea lampreys and none were subsequently taken in the upstream trap of the checking weir although 299 more were taken in the dam trap.

Smelt and Suckers

Smelt were not able to surmount the barrier. This conclusion was based on observation of the very limited jumping ability of smelt at the barrier.

In 1952 a total of 222 upstream migrating suckers were marked by the removal of the dorsal fin and were released below the barrier. One hundred of these were longnose suckers and 122 were white suckers. The longnose suckers were marked on May 14 and most of the white suckers were marked on June 8. Both of these dates were at or slightly after the peaks of the respective runs. Five of these marked fish were subsequently trapped at the checking weir. It then appears that the vast majority (97.8%) of suckers were blocked by the barrier dam. In view of the exceedingly large number of suckers handled at the dam trap it is entirely possible that these 5 were fish whose fin-clip was overlooked and which were thrown upstream with the unmarked fish. If that were the case, then the barrier dam completely blocked the suckers. No suckers were fin-clipped in 1953 as it was felt that the previous year's research had proven that they were blocked by the barrier.

Upstream Migration of Fish and Sea Lampreys and Relationship with Water Level and Water Temperature

In 1952, adult migratory rainbow trout were migrating upstream most actively during the period April 19-25 and April 26-May 2 (Table 1). This appears to be the period of the most rapid rise in the weekly average of daily midpoint temperatures (Table 7). In this year, at least, the most active upstream migration took place at water temperatures roughly between 40° and 50° F. The river was still

high from the spring run-off but was receding rapidly during the second week. In 1953, the upstream run apparently had several peaks (Table 4). The two most noticeable occurred during the periods April 4-10 and May 2-8. The weekly average of daily midpoint temperatures were 39.1° and 49.6° F. respectively (Table 7). A sudden rise in the weekly average of daily midpoint temperatures was present during the second and strongest peak. The first peak occurred at or near the high point of the spring run-off and the second while the high level of the river due to the spring run-off was receding. The limited evidence obtained indicates that the spring run of adult rainbows takes place while the spring run-off is receding and at water temperatures ranging from 40°-50° F. It is possible, however, that considerable upstream migration had taken place before the water had dropped so that trapping could be initiated in the spring.

In 1952 sea lampreys were first taken in the dam trap when the weekly average of daily midpoint temperatures was 51.3° F. The run was heaviest in the period June 14 to July 11. The weekly average of daily midpoint temperatures during this period varied from 52.2° to 57° F. Periods of greatest activity were observed when the river level was higher than normal due to rains. In 1953, sea lampreys appeared at the dam trap when the weekly average of daily midpoint temperatures was 38° F. However, sea lampreys were not taken in numbers until May 2-8 when the weekly average of daily midpoint temperatures was 49.6° F. The most active migration occurred June 13-26, when the weekly average of daily midpoint temperatures were 55.5° and 55.9° F., respectively. Within this period, the highest peak occurred on June 21. This peak was preceded by a light to medium rain. Judging from the data

Table 7

Average Water Temperature, Water Level and Discharge Data 1952-1953

Period	Average discharge (CFS) from U.S.G.S. [1]	Average water stage		Weekly average of daily midpoint water temperatures		
		U.S.G.S. [1]	Just above barrier dam (inches)	Max.	Min.	Midpoint
1952						
April 1-4	48	3.22	...	38	37.5	[2] 37.8
April 5-11	103	4.15	...	37.4	36.7	37.1
April 12-18	121	4.45	20.0	41.4	39.3	40.4
April 19-25	116	4.36	19.0	47.9	45.6	46.7
April 26-May 2	46	3.18	12.1	52.0	50.6	51.3
May 3-9	28	2.82	10.1	50.9	49.4	50.1
May 10-16	32	2.89	10.5	49.0	48.1	48.6
May 17-23	22	2.68	9.3	48.6	47.4	48.0
May 24-30	20	2.63	8.8	48.4	47.7	48.1
May 31-June 6	30	2.87	10.7	49.0	47.3	48.1
June 7-13	21	2.69	9.5	53.7	51.1	52.4
June 14-20	14	2.54	8.9	54.0	50.4	52.2
June 21-27	18	2.58	9.5	57.3	51.3	54.3
June 28-July 4	20	2.63	9.5	58.7	53.4	56.1
July 5-11	25	2.74	10.0	59.4	54.6	57.0
July 12-18	21	2.66	9.7	60.6	56.6	58.6
July 19-25	80	3.76	16.4	64.0	60.4	62.2
July 26-Aug. 1	38	2.95	11.3	59.6	55.9	57.7
1953						
April 1-3	...	...	[3] 27.8	...	...	...
April 4-10	...	...	28.2	40.3	37.8	[4] 39.1
April 11-17	...	...	29.6	39.3	36.7	38.0
April 18-24	...	...	25.6	42.3	38.0	40.1
April 25-May 1	...	...	25.9	42.8	39.5	41.2
May 2-8	...	...	24.4	52.1	47.1	49.6
May 9-15	...	...	22.7	52.2	48.2	50.2
May 16-22	...	...	20.8	53.4	48.0	50.7
May 23-29	...	...	20.6	52.0	46.8	49.4
May 30-June 5	...	...	22.1	53.9	50.1	52.0
June 6-12	...	...	21.4	54.7	50.1	52.4
June 13-19	...	...	20.1	57.9	53.1	55.5
June 20-26	...	...	21.0	58.3	53.6	55.9
June 27-July 3	...	...	21.8	59.9	55.6	57.7
July 4-10	...	...	20.7	57.9	53.0	55.4
July 11-17	...	...	19.5	58.9	54.3	56.6
July 18-24	...	...	20.2	60.6	56.4	58.5

[1] Data not available for 1953.

[2] Temperatures from U.S.G.S. gaging station about 3 miles upstream from barrier dam.

[3] Readings somewhat different than 1952 because of modification of lip of barrier dam.

[4] These max.-min. temperatures were derived from 3 daily water temperatures taken at the barrier dam (8:00-10:00 a.m., 4:00-6:00 p.m. and 10:00-11:30 p.m.).

available, conditions conducibe to peak migration of sea lampreys are temperatures over 50° F. and an increased volume of flow.

Smelt were taken in large numbers in the dam trap during the period April 19-May 2, 1952. The weekly midpoint water temperatures were 46.7° and 51.3° F., respectively. Note that this movement coincides with the peak rainbow migration and took place as the spring run-off was diminishing. In 1953, smelt were most actively migrating in the period April 11-24, midpoint water temperatures were 38.0° and 40.1°F., respectively. The river was still high, but had passed the peak caused by the spring run-off.

The upstream migration of white suckers was prolonged in 1952, starting April 21 and continuing until July 23. The peak migration took place during the period June 7 to 13 when the average of daily midpoint temperatures was 52.4° F. In 1953, the duration of the migration extended from May 5 to July 3. The 3 peak periods were May 30-June 5, June 13-19 and June 20-26. The average daily midpoint temperatures were 52.0°, 55.5° and 55.9° F., respectively. It appears that peak upstream migration of white suckers takes place at temperatures above 50° F.

In 1952, longnose suckers were most actively migrating upstream from April 26 to May 30. Migration was heavy throughout the period and no outstanding peaks were noted. Upstream migration started when the average daily midpoint temperature was 51.3° F. In 1953 the upstream migration extended from May 2 to June 5. When the run started the daily average midpoint temperature was 49.6° F. The majority of the movements occurred during two periods: May 16-22 and May 23-29. The average daily midpoint temperatures were 50.7° and 49.4° F., ~~re~~ respectively.

Discussion

The curved-type lip seemed to present a more effective barrier to upstream migrating sea lampreys than did the straight overhanging lip. When the sea lampreys were migrating, the average "head" in both years was approximately 24 inches. In 1952, the sea lampreys were able to get over the barrier dam only when the head was greatly reduced. In 1953, when the straight overhang was in use, sea lampreys were able to surmount the barrier at a head of about 24 inches. The straight overhang apparently permitted the lampreys to make use of the bulkheads to negotiate the barrier, while the curved lip presumably prevented this use.

At first glance the curved lip apparently made it easier for rainbow trout to jump the barrier. However, in 1952 the rainbow were faced with a 24-inch head while in 1953 during the peak of the run the head was 30-36 inches. Also, the straight overhang caused extreme turbulence in the jumping pool which was not so apparent with the curved lip. These differences, rather than the straight overhanging lip may have caused the greater difficulty to migrating rainbows in 1953.

It is planned next year (1954) to operate the barrier with the straight overhang, a 24- to 30-inch head, and screening on the bulkhead walls next to the steel lip.

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