JOB COMPLETION REPORT

INVESTIGATIONS PROJECTS

State of Montana

Project No. F-5-R-1 Work Plan No. VI Job No. VI-A

Title of Job: Fish Losses in the Pishkun Irrigation Canal and Development of Census Techniques.[1]

Objectives:

To determine the number of trout stranded in the Pishkun Supply Canal, Sun River Project of the U. S. Bureau of Reclamation, at the close of the 1951 irrigation season.

Techniques Used:

The work was accomplished under a cooperative agreement between the Missouri River Basin Studies of the U. S. Fish and Wildlife Service and the Montana State Fish and Game Department.

The Pishkun Supply Canal originates within the Diversion Dam on the North Fork Sun River about 25 miles northwest of Augusta, Montana and runs in an easterly direction approximately 12 miles terminating at Pishkun Reservoir. The seasonal flows of this canal are dependent upon the operation of Gibson Storage Reservoir located about 3 miles upstream from the Diversion Dam. Water is diverted as required by the Sun River Project lands in the vicinity of Fairfield, Montana. During peak demands of the normal irrigation season, April through September the canal carries between 1,000 and 1,300 second-feet of water. Pishkun Canal has been in operation at its present capacity since 1935. There are no devices at the headgates to prevent or reduce the number of fish entering the canal.

Time becomes a vital element in canal loss observations as soon as water levels begin to drop. Several factors come into play which rapidly reduce the opportunity to count the total number of fish stranded. Natural predation, movement of fish to cover, and removal of legal-sized fish by people, obliterates the evidence of the magnitude of the fish kill in a relatively few days. Weather conditions at the time of closure frequently complicate the job still further. With these factors in mind and realizing that a detailed count of 12 miles of canal was not possible, a random sampling method was adopted for the 1951 observations.

The canal has 10 natural divisions or sections composed of five open sections, three tunnels, and two siphons (see attached map). The siphon through Arnold Coulee, located about one-third the distance between Tunnel No. 3 and Pishkun Reservoir, was not considered as a division point; therefore, only eight sections are considered in this report. The location

1/Adapted from "Fish Stranded by the Closure of the Pishkun Supply Canal", A cooperative report by M.R.B.S., Fish & Wildlife Service, & the Montana Fish and Game Department, March 1952.

and length of each section is shown on the accompanying map. The river siphon and tunnels 1, 2, and 3 were censused in their entirety. Sections 2, 4, 6 and 8 were divided into 1/10-mile plots prior to the canal closure date and a random sample method of censusing applied to each section except in Section 2 where approximately 80 percent of the area was censused. About 38 percent of Section 4, 35 percent of Section 6 and 18 percent of Section 8 was censused. A major portion of the censusing was accomplished by using electric fish shockers. Each plot was repeatedly gone over with an electric shocker to recover as large a percentage of fish as possible. In some of the deeper and more inaccessible plots where it was impossible to obtain reliable results with either an AC or DC shocker, powdered cube root was utilized after all other means of censusing and recovering had been tried. The data obtained were recorded by the crew leader after the study plot was censused and at the same time an estimate was made as to the percentage of fish not recovered from the plot.

No attempt was made to determine or estimate the number of trout consumed by predacious birds and mammals during the time when the flows were low or after the water had been shut off tight. Unquestionably, a large number of trout were lost to predators and scavengers since several flocks of mergansers and scores of magpies were observed along the canal.

Findings:

In early May 1951, 1,000 marked, legal-sized rainbow trout, from the Great Falls hatchery were liberated in the North Fork of the Sun River between Gibson and Diversion dams to determine what percent of the legal sized hatchery fish were lost into the diversion and also to determine how far the fish would drift through the canal. Fifty-six of the marked fish were recovered in the canal of which 49 were recovered within the first mile below the headgates (see Table 2.). Only one marked fish was recovered in the lower 5 miles of canal.

Section No. 1 (Tunnel No. 1, 1,200 feet). Within an hour after the gates were closed, a mobile electric shocking unit was taken into the canal and the count was started immediately below the headgates. After all fish had been removed from the tunnel, powdered cube root was used in the tunnel drain located about 400 feet from the headgates so that all fish trapped therein could be recovered. A total of 153 legal and 100 fingerling-size trout were removed from the tunnel and drain (see Table 2.). Of the 253 total, 183 or 72 percent were salvaged and released in the North Fork Sun River below the Diversion Dam. It is believed that 100 percent recovery was made in this section.

Section No. 2 (Open canal, 2,635 feet). An exceptionally large number of fish were stranded in this section of the canal. A very thorough and detailed census was made on approximately 80 percent of this section. One hundred and seventy-two legal-size and 2,907 fingerling and fry-size trout were recovered from this part of the canal and released in the main river below the Diversion dam. Considering the 20 percent of the section not censused and the estimated number of fish that escaped observation in the censused area, approximately 4,600 fish were stranded in this section of canal.

Table 1. Data on trout stranded in the Pishkun Supply Canal, Sun River Project, Bureau of Reclamation, following closure, autumn of 1951.

(1) Sections (And Total Lengths)	(2) Section Actually sampled, in percent	1951 No. of Trout Stranded (3) In sampled areas Legal	(3) In sampled areas Fing.	(4) In unsampled areas Legal	(4) In unsampled areas Fing.	(5) Additional, in Section Legal	(5) Additional, in Section Fing.	(6) Totals Legal	(6) Totals Fing.	1950 (7) Total No. Stranded Legal	(7) Total No. Stranded Fing.
1. Tunnel No. 1 (1200')	100	153	100	0	0	0	0	153	100	5	20
2. Outlet of Tunnel No. 1 to mouth of river siphon (2635')	80	172	2,907	43	726	19	725	234	4,358	710	2,840
3. River siphon (1,397').	100	922	251	0	0	240	1,900	1,162	2,151	500	1,500
4. Outlet of river siphon to mouth of Tunnel No. 2 (13,736').	38	48	1,740	78	2,838	158	3,287	384	7,865	4,300	9,970
5. Tunnel No. 2 (1,147').	100	42	77	0	0	2	35	44	112	125	275
6. Outlet of Tunnel No. 2 to mouth of Tunnel No. 3 (11,927')	34.8	119	1,289	223	2,415	63	7,574	405	11,278	1,650	4,300
7. Tunnel No. 3 (2,380').	100	8	0	0	0	2	40	10	40	100	300
8. Outlet of Tunnel No. 3 to Pishkun Reservoir (29,175)	17.8	82	38	378	175	2,399	5,922	2,859	6,135	2,100	6,000
TOTALS		1,546	6,402	722	6,154	2,883	19,483	5,251	32,039	9,490	25,205
								37,290		34,695	

*Based upon technician's estimates of recovery success in seining, shocking or poisoning efforts. (The recovery success varied throughout the entire canal depending upon the uncontrollable physical factors such as dense aquatic vegetation, deep water, spring-fed areas and porous rocky sections.)

Section No. 3 (River siphon, 1,397 feet). The water in the river siphon was drained down to the outlet level by removing a part of the drain valve mechanism. Once the cap and debris were removed from the 8-inch pipe the water gushed up through the opening with terrific force. It was impossible to recover or even observe all the fish that were forced out through this opening. Many of the fish were mangled almost beyond recognition. Only 60 legal and 38 fingerling trout were actually recovered at the time the siphon was drained. It was estimated that for every legal-size trout recovered, four others escaped and for every fingerling-size recovered, 50 escaped observation. A 2-inch pump was used in pumping the water from the siphon below the drain level. This operation required 2 days and nights to reduce the water level low enough to permit working and successful seining of trapped fish. An additional 862 legal and 213 fingerling-size trout were removed from the siphon and released into the Sun River below the Diversion Dam.

Section No. 4 (Open canal, 13,736 feet). This section extends from the outlet of the river siphon to the inlet of Tunnel No. 2, a little more than 2½ miles of open canal. Ten plots, or 38 percent of the entire section, were censused. Forty-eight legal and 1,740 fingerling-size trout were recovered within the sampled areas. Estimates on the number of fish not observed within the censused plots at the time of censusing were 98 legal and 1,248 fingerling-size fish. From figures based on the random sample and estimates of the fish not recovered within these plots, approximately 384 legal and 7,865 fingerling-size fish were stranded in this section.

Section No. 5 (Tunnel No. 2, 1,147 feet). There was a constant flow of water through this tunnel, consequently it was a difficult task to accurately census this section by the use of artificial light and a stationary electric shocker. The shocker was set up near the inlet and the first 500 feet of tunnel were censused, then the equipment was moved to the outlet and the lower 500 feet censused. With the equipment at hand, approximately 1,000 feet were censused, however, 147 feet in the center of the tunnel were not shocked. Only 42 legal and 77 fingerling-size trout were recovered. However, the counts were not as complete as on Tunnel No. 1 because of the above-mentioned difficulties. It is believed that at least 2 legal and 35 fingerling-size trout were not observed, thus making a total of approximately 44 legal and 112 fingerling-size fish in this section.

Section No. 6 (Open canal, 11,927 feet). Of the 2¼-mile section of canal between the outlet of Tunnel No. 2 and the inlet of Tunnel No.3, eight 1/10-mile plots were censused. One hundred and nineteen legal and 1,289 fingerling-size trout were recovered from these areas. Applying the figures obtained from the random samples and the estimates of fish not observed within the censused areas, there were approximately 405 legal and 11,278 fingerling-size trout stranded in this section of canal.

Table 2. Species composition and summary of trout actually counted in the Pishkun Supply Canal, Sun River Project of the Bureau of Reclamation, autumn of 1951.

Section	Rainbow			Eastern Brook		Cutthroat		Totals	
	Legal	Marked Legal	Fing.	Legal	Fing.	Legal	Fing.	Legal	Fing.
1. Tunnel No. 1 (1,200')	132	4	56	14	44	3		153	100
2. Outlet of Tunnel No. 1 to mouth of river siphon (2,635')	126	22	2,264	24	643	0		172	2,907
3. River Siphon (1,397')	775	24	150	43	101	80	Non Identified	922	251
4. Outlet of River Siphon to mouth of Tunnel No. 2 (13,736')	38	1	1,617	9	123	0		48	1,740
5. Tunnel No. 2 (1,147')	30	2	65	9	12	1		42	77
6. Outlet of Tunnel No. 2 to mouth of Tunnel No. 3 (11,927')	96	2	1,060	21	229	0		119	1,289
7. Tunnel No. 3 (2,380')	7	0	0	1	0	0		8	0
8. Outlet of Tunnel No. 3 to Pishkun Reservoir (29,175')	77	1	36	2	2	2		82	38
TOTALS	1,281	56	5,248	123	1,154	86		1,546	6,402
								7,948	

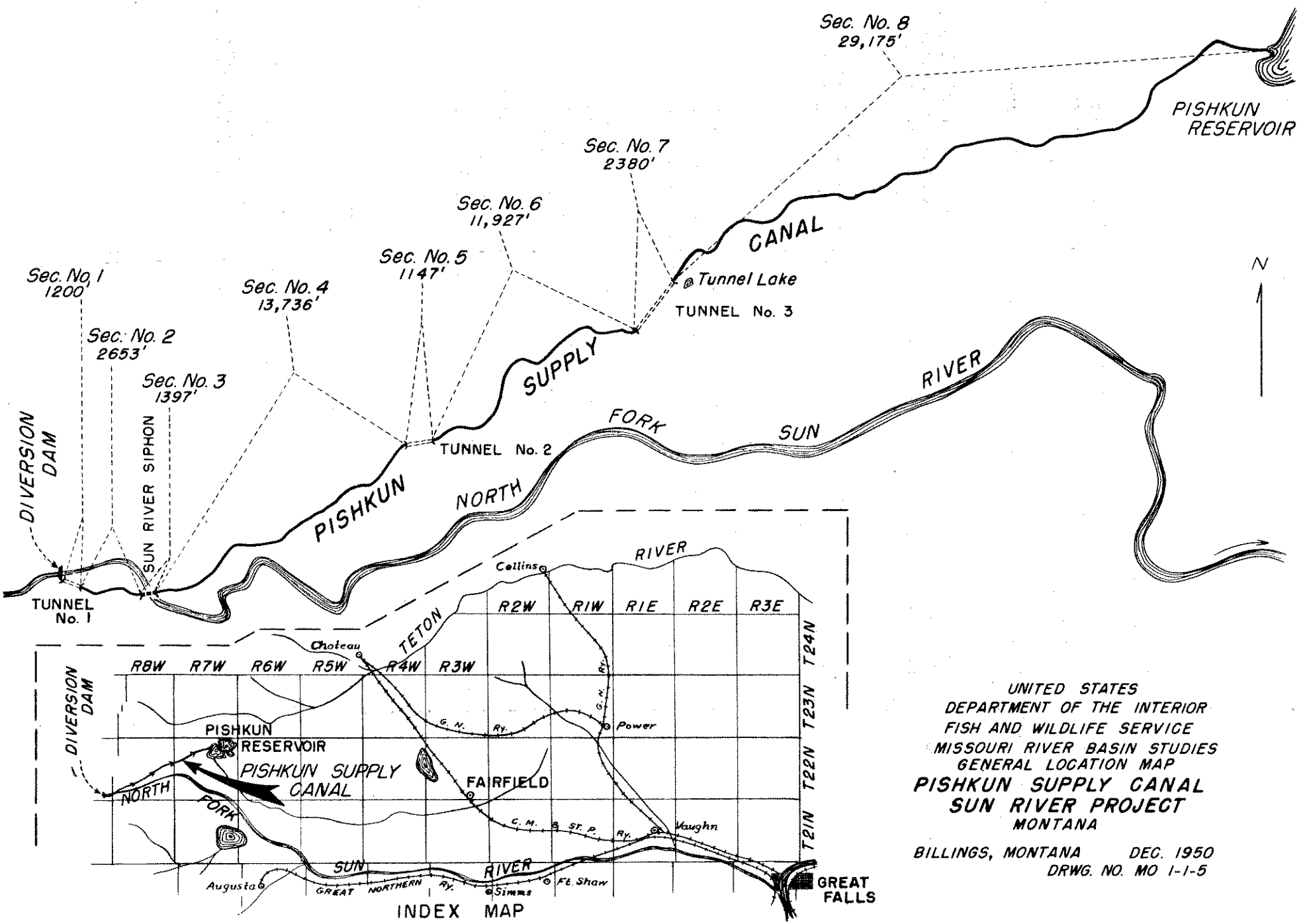
Section No. 7 (Tunnel No. 3, 2,380 feet). Very few fish were observed in this tunnel. Observations were made under extremely poor lighting conditions and no attempt was made to recover the few fish observed. Only 8 legal-sized fish were seen and it was estimated that an additional 2 legal and 40 fingerling-sized fish were unobserved. It is believed that the estimated total of 10 legal and 40 fingerling-size trout is a conservative estimate of the number of fish stranded in this section.

Section No. 8 (Open canal, 29,175 feet). The last 5½ miles of canal between the outlet of Tunnel No. 3 to Pishkun Reservoir was considered as one unit even though there is a siphon through Arnold Coulee located about midway through the section. Ten 1/10-mile plots or 17.8 percent of the entire section were censused. Eighty-two legal and 38 fingerling-size trout were recovered from the sampled plots in this section. It was estimated that at least 427 legal and 1,054 fingerling and fry-size trout were unobserved within the sampled areas. Using the actual count and the estimated figures obtained from the sample plots as a basis, it is believed that approximately 2,399 legal and 5,922 fingerling trout were stranded in this section.

A summary of species composition and numbers of trout actually recovered from the Pishkun Canal is found in Table 3. Weight and length data were obtained on a representative sample of all species of trout recovered from the canal during the study. A sample of 205 legal-size rainbow trout averaged 10.93 inches in length and .509 pounds each. Only six cutthroat trout were sampled and averaged 10.68 inches in length and .46 pounds. A sample of eight eastern brook trout averaged 8.78 inches in length and .29 pounds each. Two 1-pound samples of fingerling-size trout were counted that averaged 213 per pound. The estimated total weights of all size groups are shown in Table 3.

Table 3. Estimated Numbers and Weights of Fish Stranded in Pishkun Supply Canal, 1951

Species	Average Length	Estimated Number Fish Stranded	Average Weights	Estimated Total Weights
Cutthroat	10.68	292	.29	85
Rainbow	10.93	4,541	.51	2,706
Rainbow	Fingerling	26,265	213/pound	123
Eastern Brook	8.78	417	.46	192
Eastern Brook	Fingerling	5,774	213/pound	27
				3,133



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
MISSOURI RIVER BASIN STUDIES
GENERAL LOCATION MAP

PISHKUN SUPPLY CANAL
SUN RIVER PROJECT
MONTANA

BILLINGS, MONTANA DEC. 1950
DRWG. NO. MO 1-1-5

Analysis and Recommendations:

Inasmuch as the operation of the Pishkun Canal during 1951 was reported to be normal, it is assumed that the number of trout stranded can be considered as a typical annual loss for this particular canal.

Annual attempts to prevent the loss through rescue operations are impracticable and economically unsound.

The problem of minimizing or preventing the annual loss on an economically sound basis requires an appraisal of the trout lost from a monetary standpoint and reasonable estimates of the costs of installing and maintaining special contrivances.

Because of insufficient information as regards the engineering problems involved the course which should be followed, to prevent the substantial loss of fish, cannot be stated here.

Summary:

Following the closure of the Pishkun Supply Canal a study was made in order to determine the number of fish left stranded. A system of stratified random sampling by use of electric shocking devices and poison was used to determine the fish population.

One-thousand marked fish were planted above the diversion in order to determine the number and movement of the planted fish into and through the canal. Fifty-six of the marked fish were recovered in the canal. Forty-nine were found within the first mile below the diversion.

The number of fish left stranded in the canal was found to be substantial. The calculated total number of legal-sized fish (7 inches and over, total length) was 5,251, sublegal length (less than 7" T.L.) fish 32,039. The total loss of trout was 37,290.

Data and Reports:

The original data is with the Missouri River Basin Studies, U.S.Fish and Wildlife Service, Billings Field Office, Billings, Montana.

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