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A TWO-WAY FISH TRAP FOR USE IN STUDYING STREAM-FISH MIGRATIONS*

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Introduction

This paper will describe the structure and method of installation of a two-way fish trap that is being used to provide further knowledge concerning the role of tributary streams in contributing to the fish life of the more heavily-fished trout streams of Michigan. Data from such a trap operated continuously in Canada Creek, Presque Isle County, Michigan, over one calendar year (January 1-December 31, 1937) will be presented to illustrate the type of information available. Other types of data which might be secured by the use of such a trap will be discussed.

The Two-way Fish Trap

The credit for the design of this two-way fish trap belongs to Robert L. Fortney, Supervisor of the State Fish Hatchery at Paris, Michigan, Dr. Clarence Tarzwell, now of the TVA Wildlife Division, and Dr. Carl L. Hubbs, Curator of Fishes at the Museum of Zoology, Ann Arbor, Michigan. The trap is a combination of the ideas of these gentlemen.

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* Contribution from the Institute for Fisheries Research, Michigan Department of Conservation and University of Michigan.

The trap consists of a main arm (A) that blocks the stream at an angle of approximately 60 degrees, to which are attached the traps proper (see Figure 1). The trap that catches the fish moving upstream is located at the upstream end of the main arm, and the trap which catches the fish moving downstream is located at the downstream end of the main arm. Both traps are partially embedded in the stream banks.

The main arm of the trap and the trap sides proper are constructed from 2-inch by 8-inch lumber and small-bore pipe or concrete reinforcing rods of the desired lengths (depending on the depth of the water). The frame of the main arm is made from 2-inch by 8-inch lumber, braced at 18-inch intervals with the same stock. Holes are drilled near the upstream edge of the frame for the insertion of rods which may be spaced at any interval depending on the size of the fish one may wish to trap. The rods are passed through the frame and driven into the bottom to a depth of three or four feet (see Figure 1).

The entrances to the traps are located at the intersections of the trap arms (B and C) with the main arm. At these junctions a space of three to five inches is left to allow for the entrance of large fish. A "funnel" or double lead should be placed inside the trap by driving additional pipe so that once fish find their way into the trap they will not escape. The sides of the trap nearest the banks can be made from 1-inch by 4-inch lumber, and if this diagonal half is floored with rough stock, it will prevent the banks from washing. Hinged covers provided with locks will prevent predators and poachers from removing any captured fish. Trapped fish may be removed with a large scap net, counted, measured, weighed and sent on their way.

This two-way trap is set up most easily by first drilling the holes in the frame before assemblage. The stream banks should be excavated to the proper dimensions so that the banks will accommodate the trap boxes, and the bare frame placed in position in the stream. The rods or pipes can then be inserted in the holes and driven firmly into the stream bottom. Unless the current is very swift, the driven rods will provide a secure anchorage.

If 3/8-inch spacing is used between the bars, such a trap will stop trout as small as 6 inches, and will not raise the water level behind it, provided that the traps and the main arm are kept free of floating debris. Such a trap requires daily attendance during the winter months, or anchor and shelf ice will clog it and cause the stream to flow around the ends. If it is desirable to trap fish smaller than six inches, a removable screen of fine mesh should be placed on the upstream side of the frame. The use of such a screen will necessitate cleaning at much more frequent intervals.

The cost of materials for this type of fish trap will vary according to the size of the stream and especially according to the cost of the pipe or reinforcing rod used. Scrap pipe or rod that may still be in good condition for the above purpose may often be purchased at junk yards for extremely low rates. The cost of materials for installations made in Michigan to date (including the cost of the traps proper) has not been over four dollars per foot of the main arm. All have been constructed by CCC labor.

Type of Data Obtainable

The following table (Table 1) summarizes the results from the operations of a two-way fish trap in Canada Creek, located in the southwest corner of Presque Isle County, Michigan. The Canada Creek trap was installed by the

Presque Isle CCC Camp, a camp maintained for World War Veterans by the Michigan Civilian Conservation Corps. Members of the camp operated the trap and recorded the data obtained from the operations. Data sheets (Fig. 2) filled out daily by the trap attendants form the basis for the summary table. With the exception of the first three months, when there was practically no movement of fish, the data are summarized by seven and eight day periods (four periods to the month).

Discussion of Results

The species of fish taken in the traps were as follows: brook trout (Salvelinus fontinalis), brown trout (Salmo trutta), rainbow trout (Salmo gairdnerii irideus), common sucker (Catostomus c. commersonii), northern pike (Esox lucius), yellow perch (Perca flavescens), rock bass (Ambloplites rupestris), bluegill (Helioperca machrochira), small-mouthed bass (Micropterus dolomieu), bullhead (Ameiurus sp.), shiner (genus and species not known) and chub (genus and species not known). Three snapping turtles (Chelydra serpentina) were also taken.

The outstanding feature of the data (Table 1) is the apparent continued movements of the sucker population during the year after the water has warmed to a point past an average minimum temperature of 40 degrees. The suckers were by far the most numerous fish in the catch. In contrast to many Michigan streams, their spawning run during the spring months was predominantly in a downstream direction. More than twice as many suckers had been trapped on downstream migrations as had moved into the upstream trap by the end of May, at which time the great majority of the suckers should have completed spawning. Downstream runs of spawning suckers have been previously recorded by Cox (1896) from Lake Washington in southern Minnesota, and by Hankinson (1908) from Walnut Lake in southeastern Michigan.

However, the common sucker of Oneida Lake in New York is considered by Adams and Hankinson (1928) to be an anadromous fish. It is very possible that many of the suckers in Canada Creek taken on downstream runs were individuals which have moved out of any of the small lakes which are tributary to the Canada Creek drainage for the purpose of spawning.

The heaviest downstream run came during the week when the average minimum water temperature was 43 degrees. No movements of suckers took place until the average minimum water temperature had reached 38.3 degrees. There was a compensating return of the sucker population beginning the first week in September. During September, October, November and December more than 1.7 times as many suckers moved into the upstream trap as into the downstream trap. As in the spring of the year, the greatest number of suckers seemed to move when the average minimum water temperatures were between 51 and 37.6 degrees. The size range of the suckers trapped was from 6 to 20 inches, total length. If Fowler's data (1912) may be assumed to apply to the suckers of Canada Creek, the majority of individuals were mature.

The heaviest run of brook trout occurred during the fall months of the year in an upstream direction. The run started during the first week of September and reached its peak during the third week of October. There seemed to be no spawning run of brown trout during the fall months of the year, but there was a small but noticeable run upstream during the month of July.

With the exception of the rainbow trout, the majority of the trout were mature individuals of legal length (7 inches, total length) or larger. The length of all individuals varied from 5 to 14 inches, total length.

The northern pike exhibited movements somewhat similar to those of the sucker during the spring months. They differed, however, in that there was no return run upstream in the fall, but a continued downstream

movement. The northern pike taken in the traps varied in size from 12 to 24 inches total length. During the early spring they probably entered Canada Creek in order to spawn in some of the more quiet and weedier backwaters.

The bluegills noted in the summary table may have moved into Canada Creek for the purpose of spawning, but were more likely casual migrants from one or more of the several lakes connected with the stream. The same statement possibly applies to the perch, rock bass, small-mouthed bass and bullheads taken by the traps. The capture of three snapping turtles in the upstream trap indicates the possibility that this species may move toward the cooler headwaters during the warmer summer months.

Although Canada Creek is classed as a trout stream, trap records would indicate that comparatively few trout were present in the stream (or else if present did not tend to exhibit much movement), despite the fact that Canada Creek is a tributary of the Black River, a supposedly "fair" trout stream. The apparent scarcity of trout may be due in part to the presence of warm overflow waters issuing out of four small and one rather large lake which contribute to the Canada Creek drainage above the trap. These lakes probably have a warming effect on the stream temperatures during the summer months. From the number of northern pike and spiny-rayed fishes taken in the trap throughout the year, one might conclude that Canada Creek is rather marginal trout habitat.

Other Types of Data Obtainable

Through the use of such two-way fish traps properly located on important tributary streams, it would be possible to determine very accurately the number of adult trout seeking out that particular tributary for spawning (Cf. Taft, 1936, and other Pacific coast investigators on trout and salmon).

The use of a fine-meshed screen on the trap after the upstream passage of the adults would make it possible to study the downstream movements of the progeny resulting from the spawning adults. Such information should aid in the clarification of questions concerning the efficiency of natural reproduction. The time of spawning migrations in relation to air and water temperatures also might be studied more thoroughly.

It would be possible, by combining marking experiments and creel censuses on streams having traps located at their mouths, to determine what percentage of the fisherman's catch is comprised of fish which have moved into those streams. Such information would be valuable in the determination of stocking policies.

Plants of marked hatchery-reared trout above and below such traps would make possible a study of the migratory tendencies of hatchery-reared fish. Such an experiment was attempted in Canada Creek during the trout season of 1937. Five hundred jaw-tagged brook trout (average total length 5.5 inches) were planted, 250 above the trap and 250 below the trap. No marked fish were trapped, but 141 were recorded by the census takers as having been caught by fishermen and released. Either these brook trout were too small to be caught by the traps, or they exhibited no movement.

Two other tributary streams in the state have been blocked during the past fall with two-way fish traps, and releases of marked trout have been made above them in an attempt to obtain more information concerning the migratory habits of fingerling trout in feeder streams, but as yet there are no data on these streams available.

Summary

1. An inexpensive two-way fish trap for use in streams was described and brief instructions for construction and installation were given.

2. Continuous data over the period of one year obtained from the operation of such a trap located in Canada Creek, Presque Isle County, Michigan were given and discussed briefly. These data are excellent testimony to the feasibility of this type of trap for use in stream-fisheries research.

3. Other types of data which might be obtained from the use of such a trap were discussed briefly.

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Table 1

Average Maximum and Minimum Air and Water Temperatures, Number and Species of Fish Moving Upstream and Downstream in Canada Creek (Summarized by Seven and Eight Day Periods for the Year 1937*)

Month	Day	Average Temperature Air Max.	Air Min.	Water Max.	Water Min.	Moving Upstream: Brook	Brown	Rainbow	Sucker	N. Pike	Perch	Rock Bass	Bluegill	Catfish	Moving Downstream: Brook	Brown	Rainbow	Sucker	N. Pike	Perch	Rock Bass	Bluegill	Catfish	
January	1-31	31.6	10.7	39.1[1]		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	
February	1-28	32.9	18.5	35.6[1]		...	...	...	...	...	...	...	...	...	5	...	...	...	...	...	...	...	...	
March	1-31	33.7	14.5	38.5	33.8	...	4	1	...	...	...	...	...	...	7	1	...	...	...	...	...	...	...	
April	1-7	45.3	27.0	38.6	38.3	1	...	...	1	7	...	...	...	...	3	...	...	87	3	...	...	...	...	
	8-15	49.2	25.6	48.5	41.0	...	...	...	30	6	4	...	...	...	2	...	...	257	20	...	...	...	...	
	16-23	50.8	28.2	47.8	43.0	12	...	...	47	4	7	...	...	...	...	...	...	375	5	2	...	...	...	
	24-30	53.3	37.4	51.6	43.0	...	...	1	35	1	10	...	...	...	...	...	...	246	1	1	...	...	...	
May	1-7	68.3	34.4	58.1	50.3	...	...	...	211	1	2	2	...	...	11	...	...	197	1	...	...	...	...	1 small mouth, 8 shiners (D)
	8-15	65.5	34.1	58.2	48.4	...	...	37	95	...	1	2	3	...	...	...	...	61	1	1	...	...	...	17 small mouth (U)
	16-23	62.4	40.1	58.1	50.0	...	...	...	94	1	...	...	2	...	...	...	...	28	...	...	...	1	...	
	24-31	81.5	46.1	64.6	56.1	1	...	...	140	...	...	5	6	...	...	...	...	87	...	...	...	5	1	1 small mouth (D)
June	1-7	77.1	44.1	62.6	58.0	6	...	...	34	...	...	...	3	...	1	1	...	28	...	...	...	2	...	
	8-15	75.7	38.7	64.1	56.5	3	...	1	19	...	...	...	...	3	...	...	...	19	...	...	1	12	3	
	16-23	82.1	50.6	66.0	58.7	...	4	...	12	...	...	...	...	...	...	...	...	4	...	...	...	2	1	1 snapping turtle (2 lb.) (U)
	24-30	82.6	50.1	65.0	59.9	...	...	...	8	...	...	...	...	1	...	1	...	4	...	...	...	2	1	
July	1-7	86.4	48.4	68.4	63.0	1	3	...	2	...	...	...	...	...	...	...	...	3	...	...	...	...	...	
	8-15	88.7	58.5	71.4	67.4	...	18	...	21	...	...	...	...	...	...	...	...	1	...	...	...	...	...	2 snapping turtles (3 and 4 lb.) (U)
	16-23	74.1	61.4	81.4	69.1[2]	...	3	...	13	...	...	...	...	...	...	...	...	1	...	...	...	...	...	
	24-31	67.1	61.2	75.7	66.0[2]	2	2	...	141	...	...	...	...	...	...	...	...	28	...	...	...	...	1	1 small mouth (D)
August	1-7	87.8	57.1	74.0	63.4	...	...	...	15	...	...	...	...	...	...	...	...	1	...	...	...	1	1	
	8-15	86.5	55.0	72.7	64.4	...	...	...	7	...	...	...	...	...	...	...	...	...	...	...	...	2	...	
	16-23	81.0	51.6	67.5	61.6	1	...	...	9	...	...	...	...	...	1	...	...	1	1	...	...	2	...	
	24-31	90.4	52.5	69.9	62.9	...	2	...	3	1	...	...	2	...	...	...	...	...	...	...	...	...	...	
September	1-7	79.4	52.1	69.6	61.1	7	2	...	37	3	...	9	23	...	2	...	...	27	...	...	22	21	1	10 small mouth (U)
	8-15	68.0	53.0	66.1	50.6	...	...	...	188	...	14	3	38	4	4	...	2	54	...	2	11	8	5	
	16-23	68.1	40.4	58.1	50.1	4	...	...	210	...	2	...	...	2	...	...	...	34	...	...	...	...	...	
	24-30	64.9	37.1	54.4	50.0	3	...	...	98	...	2	...	...	2	...	...	...	86	5	...	...	...	...	3 small mouth (D)
October	1-7	64.6	40.6	55.3	46.7	3	...	1	36	...	...	...	...	...	...	...	...	37	5	...	...	...	...	
	8-15	48.8	27.0	47.1	38.2	8	...	...	114	1	...	...	...	...	...	...	...	64	5	...	...	...	...	
	16-23	51.9	33.8	46.5	38.5	23	...	...	268	4	...	...	...	...	...	...	...	127	11	...	3	...	...	
	24-30	51.8	29.6	46.2	38.0	10	...	1	54	...	...	...	...	...	1	...	3	41	6	...	2	...	...	
November	1-7	52.0	28.6	40.6[1]		4	...	1	27	...	...	...	...	...	...	...	1	24	2	...	...	...	...	
	8-15	46.8	28.1	42.0[1]		11	...	3	62	2	...	...	...	...	...	...	...	79	2	...	...	...	...	
	16-23	32.5	21.8	36.0[1]		1	...	3	16	...	...	...	...	...	6	...	...	27	5	...	...	...	...	
	24-30	40.8	26.0	37.6[1]		3	...	...	36	...	...	...	...	...	6	...	1	29	2	...	1	...	...	
December	1-7	27.3	16.7	34.7	33.1	...	...	...	3	...	...	...	...	...	3	...	...	16	1	...	...	...	...	
	8-15	21.8	9.5	33.1	32.3	...	...	...	1	...	...	...	...	...	1	...	...	8	...	...	...	...	...	
	16-23	29.9	17.4	33.0	32.0	...	...	...	...	...	...	...	...	...	...	...	...	2	...	...	...	...	...	
	24-31	29.6	15.1	34.1	32.6	...	...	...	1	1	...	...	...	...	1	...	...	4	...	...	...	...	...	
Totals						104	38	49	2088	32	42	21	72	12	54	3	5	2087	76	6	40	58	14	

*) With the exceptions of Jan., Feb., and March which are entire months when very few fish moved.

[1] Only 5 p.m. water temperature taken.

[2] Original temperature obviously wrong; these determined by interpolation.

U Upstream.

D Downstream.

Figure 1. Plan of two-way fish trap used in Michigan streams.

Figure 2

DAILY RECORD
OF
FISH WEIR

Name of Stream _____

Date _____

Air Temp _____ Water Temp _____

Weather (Warm) (Cool) (Cold) (Windy) (Calm)

Sky (Clear) (¼ Cloudy) (½ Cloudy) (Clouded)

Time of Examination _____ A.M. _____ P.M.

Number of fish in upstream trap

Species	No. Taken	Size Range*
Brown Trout		
Brook Trout		
Rainbow Trout		

Number of fish in downstream trap

Species	No. Taken	Size Range*
Brown Trout		
Brook Trout		
Rainbow Trout		

*(On size range--measure a dozen fish that range from the smallest to the largest of the species).