DEPARTMENT OF NATURAL RESOURCES
Division of Fish, Game & Enforcement

Madison, Wisconsin

Bureau of Fish Management

Report No. 24

EVALUATION OF BROWN TROUT FINGERLING STOCKING PROGRAMS IN THE LOWER WILLOW RIVER AND THE ECONOMICS THEREOF

by

Ludwig Frankenberger
Black River Falls, Wisconsin

SUMMARY

Fingerling stocking of brown trout in the Lower Willow River and Race was evaluated at two different stocking densities over a 6-year period.

While stocking at high densities, overwinter survival varied from 20-26.3%. Cost analysis on a per fish basis revealed that spring stocking of legal brown trout in numbers equal to the number of fall fingerling survivors would have been significantly cheaper and would have provided the angler with substantially larger fish.

Stocking fall fingerling brown trout at lower densities resulted in overwinter survival rates of 11.6 to 40.1%. Using the 3-year average, it was again determined that an equal number of larger spring planted legal brown trout could have been provided at less cost.

Under present stocking practices and policies, it is apparent that in this stream, the stocking of legal-size trout each spring will provide more and larger fish per dollar than will a fall fingerling program.

May 21, 1969

Introduction

A brown trout fingerling stocking program was initiated in the Lower Willow River in St. Croix County. The program began at the request of county residents interested in the fishery. They felt that fingerling stocking was more effective than legal-size stocking. The program was predicated on the assumption that the survival of stocked fingerling trout will be high where competition and predation from large trout or a large trout population is low. The Lower Willow was known to have a low trout population in what was considered good trout habitat and was therefore considered a good candidate. This paper provides a summary of the evaluation of the fingerling stocking program here.

Initial plans called for experimentally stocking a high density of fingerling brown trout between two and three inches in length in late summer for three consecutive years. These plans were extended to further evaluate refinements in fingerling stocking over an additional three-year period. Numbers stocked were based on the numbers of fingerling that could be stocked in place of each hatchery-reared legal-sized trout which would be put into the stream under normal stocking procedures. More fish were stocked here under the experimental plans during this period than would have been done if existing policies and procedures had been followed.

The stocking program was evaluated by conducting population estimates in April and October of each year prior to and immediately after the fishing season.

Economics of the program were evaluated by using hatchery production cost figures. To judge the effects of a stocking program, statewide trout needs and hatchery production costs must be considered.

Description

The Willow River, a tributary to the St. Croix River, has its origin in northwestern Wisconsin. A series of hydro-electric dams create impoundments along its lower reaches. The specific section of stream concerned in this study is a tailwater area approximately two miles long immediately below one of the dams (Fig. 1). The land along the majority of the stream is owned by the Northern States Power Company. The stream splits into two channels 1.25 miles below the dam. One channel is one mile long and the other ¾ of a mile long. The study area consists of two main channels and the portion of stream between the upper junction of the channels and the dam (Fig. 2).

The three sections of stream have an average width of 56 feet, an average depth of two feet, and are treated as one continuous stretch of stream. The stream bottom is composed of 60 percent gravel, 10 percent rubble, 20 percent sand, and 10 percent silt. Winter water temperatures range from 35°F. to 36°F. at 0°F. air temperature. Summer water temperatures seldom exceed 68°F. Water temperatures fluctuate slowly due to the fact that the dam is no longer used to generate power and the water gates are set to discharge water from below the thermocline. The water gates are adjusted to pass the normal flow of water from the watershed throughout the year.

The stream flows through a wooded area throughout the length of the study area. The timber stand consists primarily of a mature stand of elm trees (Ulmus americanum). Prickly ash (Zanthoxylum americanum); alder (Alnus incana); oak (Quercus sp.); maple (Acer rubrum); popple (Populus sp.) and box elder (Acer negundox) are also present. Instream vegetation consists mainly of waterweed (Anacharis), coontail (Ceratophyllum) and a few scattered beds of watercress (Nasturtium).

Brown trout (Salmo trutta) is the primary game fish. Other fishes present include brook trout (Salvelinus fontinalis), walleye (Stizostedion vitreum), yellow perch (Perca flavescens), log perch (Percina caprodes), Johnny darter (Etheostoma nigrum), rainbow darter (Etheostoma caeruleum), largemouth bass (Micropterus salmoides), black crappie (Pomoxis nigromaculatus), bluegill (Lepomis machrochirus), central mudminnow (Umbra lima), northern pike (Esox lucius), white sucker (Catostomus commersoni), carp (Cyprinus carpio), blacknose dace (Rhinichthys atratulus), creek chub (Semotilus atromaculatus), common shiner (Notropis cornutus), black bullhead (Ictalurus melas), and brook stickleback (Eucalia inconstans). Brown trout are the most numerous species of fish, followed by white suckers and rainbow darters.

Stocking

From 1952 through 1956 the average quota of legal-size trout allotted for stocking in the Lower Willow River was about 3,500 per year. Thereafter, fingerlings were stocked, records for which are shown in Table 1.

The brown trout fingerling stocked in the 1957-1959 period were stocked in August and September of each year; their size varied from 85.8 per pound to 122.1 per pound.

The brown trout fingerling stocked in the 1960-1962 period were also stocked in August and September of each year; their size varied from 29 per pound to 70 per pound.

In 1959, 10% of the trout stocked (7,668) were marked by fin clipping. In the second phase of the study, all of the stocked trout were marked by fin clipping.

The stocking program for this one stream was evaluated in terms of its impact on the entire state program.

The number of brown trout fingerlings present in State hatcheries in August and September was averaged for four years including the 1957-59 period. During this time, the Lower Willow River received 9.9% of the total state average production each year of brown trout fingerlings.

Methods

Population estimates were made in April and October of each year before and after the fishing season. Under normal flow conditions, this stream is impossible to shock effectively. The Northern States Power Company cooperated by closing the gates at the dam during the day so that only a small volume of water flowed through the dam. It was then possible to effectively sample the trout present with electrofishing gear. As many as 10,379 brown trout have been captured during the first shocker run in the combined sections of stream. At night, the water gates were opened to normal operating conditions; this assisted in a good redistribution of marked trout in the stream.

Direct current electric shockers similar to those described by Shetter (1948) and Frankenberger (1960) were employed to capture the trout. Estimates of the trout populations were calculated each April and October before and after the fishing season, employing the Peterson mark and recapture method described by Ricker (1958). Only yearling and older trout were included in the April estimates because young-of-the-year were too small to sample effectively with the gear employed.

In April, 1958, because of gear limitations, only the Race and Willow were shocked. In October, 1958, shocking stations were expanded to include one-half of the upper section. In the spring of 1959, the rest of the stream up to the dam was sampled by using a boat-rigged shocker as described by Frankenberger (1960).

Because the brown trout fingerling are normally stocked in August and September just prior to the electro-fishing operations, it was felt that the extra handling involved in including these fish in population estimate procedures might be causing undue mortality. In the fall of 1959, all fingerling under 5.5 inches in length were immediately released upon capture (Table 2). If the extra handling caused an excessive mortality, the strength of 1959 year class should have been increased by the immediate release of the fingerling trout. This was not the case as there was only slight increase in the overwinter survival of the 1959 year class (Table 4).

In 1959, 25 percent of the trout stocked were put in the upper section and 38 percent and 37 percent were put in the Race and Willow respectively and marked with a different fin clip. The marking project showed that there was very little migration of the marked trout into or out of the respective sections. Furthermore, since all three sections are combined, this migration movement can be discounted.

There was some movement of fish but the study suggested that in terms of the total population, the movement was not extensive and probably did not influence the population estimate data.

Estimate of Trout Numbers

Population estimate data (Tables 2 and 3) showed a rather sudden increase in the brown trout population starting in 1958. The spring 1958 population showed a 1,688.8% increase over the spring 1957 brown trout population. The maximum number of brown trout over 5.5 inches in length occurred in April of 1959. During the investigation, the majority of trout (52%) stocked in the fall were still sub-legal during the April electro-fishing operations (Table 3).

Overwinter survival rates of the 2- to 3-inch fingerling stocked during the first period varied from 20 to 26.3% and during the second period from 11.6 to 40.1% (Table 4). Southern Wisconsin streams stocked with 5- to 8-inch fish in the fall had overwinter survival rates varying from 27- to 74% of the number originally released (Brynildson, 1961).

There was very little natural reproduction in the stream and a very low fall population prior to 1958. Some evidence of natural reproduction was noted in 1960 and there was a substantial contribution to the trout population of native brown trout in the 1961-1963 period.

Costs

For several years prior to 1957, the average quota of legal-size trout allotted for stocking on the Lower Willow River was about 3500 trout per year. On the basis of Conservation Commission policy and Department budgets, it must be assumed that this was the approximate number of legal-size trout which could be stocked and still obtain equitable distribution of hatchery-reared, legal-size trout to other trout waters in the State.

Trout production costs directly related to raising fish (labor, food, etc.) were averaged for a three-year period in the Wild Rose Hatchery (Table 5). The cost figures quoted do not include administrative costs, capital costs, or distribution costs. The average cost of a fingerling brown trout stocked in August or September was $.036 while the average cost of a legal-size trout held over winter and stocked in April or May was $.095. On the basis of a cost of $.095 per brown trout and an annual average quota of 3500 legal-size trout, $332.50 is the average annual cost of producing legal trout for the Lower Willow under present Department policies. This cost figure can be said to be the maximum amount which could rightfully be spent and yet assure equitable distribution of monies allotted for trout production over the state as a whole.

The total cost of the three-year stocking program based on an average fingerling cost and on the number of trout fingerling stocked was $7,634.83 for the first three-year period. Under a legal-size stocking program, $997.50 would have been spent in the same period. The difference between the amount of money for stocking that "should" have been spent under a legal-size stocking

program and the actual amount that was spent under the fingerling stocking program was $6,637.33 for the three-year period (Table 5).

An average of 16,421 fingerling brown trout survived to April of each year (Table 4). The cost of each surviving fingerling trout was $0.155 (total cost for all prorated over the survivors). The average size of these trout varied from 5.5- to 5.7 inches during the three-year period (Table 4). Natural mortality undoubtedly occurred to the sub-legal trout resulting from the fingerling stocking between April and the time the smaller fish reached a legal size of 6 inches. This mortality would therefore increase the cost to more than $0.155 per fish. This would increase the difference in cost between hatchery-reared legal-size trout ($.095) and the cost of each surviving yearling ($0.155).

The average cost of fingerling stocking for each year of the first three-year period was $2,544.94. If 16,421 hatchery-reared legal-size trout (average number of fingerlings that survived over winter) had been stocked in the Lower Willow River each year, the average cost of trout stocking (at $0.95 per fish) would have been $1,559.99 per year. This would have been a saving of $985.26 per year and all of the trout would have been legal size and immediately available to the fisherman.

During the second phase of the study, (1960-1962), 10,500 marked fingerling brown trout were stocked in September of each year instead of 3,500 legal-size trout stocked just prior to fishing season.

Population estimates conducted on these fish just prior to opening day indicated overwinter survival rates varying from 1,224 to 4,218 (Table 3). There seemed to be a correlation between the survival rate and the size of the fish at the time of stocking. Fish stocked in 1962 were approximately twice as large as those stocked in the two prior years and had a correspondingly higher survival rate.

If the overwinter survival rate is averaged out for the three years involved, the angler would have received more fish for his angling dollar under the legal-size fish stocking program than under the fingerling stocking program and the fish would have been of larger size.

Discussion

In the entire stream, the brown trout population varied from a low of 886 trout in April of 1957 to a high of 27, 172 in October of 1958. Overwinter survival to the first April following stocking of the fingerling trout stocked was relatively low -- only 20- to 26.3% during the first phase of the study and from 11.6 to 40.1% during the second phase of the study. Had it been higher economics of fingerling stocking would have been more favorable. If cost factors alone governed trout stocking less money for equal numbers of fish would have been expended by stocking yearlings. Also size of fish available for harvest was inferior. These of all stocked fingerling trout were smaller than hatchery-reared legal-size fish of the same age.

Natural reproduction is an element of uncertainty in these data. Because all of the trout stocked each year were not marked, there is no way to calculate the percentage of the trout population due to natural reproduction. Natural reproduction must have been low in 1957 because there were relatively few trout in the smaller size classes (Table 3).

Overwinter survival data calculated for the marked trout stocked in 1959 was 18.8 percent as compared to the 26.3 percent overwinter survival for the unmarked trout combined with the marked trout (Table 4). This difference of 7.5 percent (5,741 trout) is probably due to several causes: 1. Overlooking marked fish due to fin regeneration. 2. Basing population data on a small sample as compared to a large sample. 3. Influence of natural reproduction. If the first two factors are discounted, then a maximum of 28 percent of the 1959 year-class of brown trout surviving to April could be due to natural reproduction.

Literature Cited

Brynildson, Oscar M., and Lyle M. Christenson. 1961. Survival, yield, growth and coefficient of condition of hatchery-reared trout stocked in Wisconsin waters. Wis. Cons. Dept. Miscellaneous Research Report No. 3.

Frankenberger, Ludwig. 1960. Applications of a boat-rigged direct-current shocker on lakes and streams in West Central Wisconsin. Prog. Fish Cult. Vol. 22, No. 3, pp. 124-128.

Shetter, D. S. 1948. The electric shocker and its use in Michigan streams. Prog. Fish Cult., Vol. 10, No. 1, pp. 43-47.

7-21-67
ems

Table 1. Brown trout fingerling stocking records for the Lower Willow River, northwestern Wisconsin, for the 1957-1962 period.

Year	Number Stocked	Number Per Pound	Number Marked
1957	77,466	119.7	-
1958	58,000	122.1	-
1959	76,613	85.8	7,668
1960	10,500	70.0	10,500
1961	10,500	65.0	10,500
1962	10,500	29.0	10,500

Table 2. Size distribution of brown trout caught in the Lower Willow River in northwestern Wisconsin during the fall population estimate period.

Size Class (inches)	Fall Estimates 1958	1959	1960	1961	1962	1963
2.5 - 5.4	20,096*	xxx	1,038**	1,078xx	2,485xx	1,904xx
5.5 - 7.4	1,268	674	1,459	926	2,023	835
7.5 - 10.4	5,298	3,185	3,368	931	615	993
10.5 - 12.4	360	400	151	340	400	410
12.5+	150	91	50	91	161	120
Total	27,172	4,350	6,066	3,366	5,684	4,262

* Includes trout stocked in August and September.

xx Natural reproduction.

xxx All stocked trout released.

Table 3. Size distribution of brown trout in the Lower Willow River in northwestern Wisconsin during the Spring population estimate period.

Size Class (inches)	Spring Estimates 1957	1958	1959	1960	1961	1962	1963
2.5 - 5.4	----	9,630	6,391	14,991	638	89	145
5.5 - 7.4	322	4,571	7,208	4,153	755	998	1,398
7.5 -10.4	317	1,264	4,769	2,534	3,183	877	2,173
10.5- 12.4	103	160	2,020	1,324	1,296	691	555
12.5+	144	224	199	130	114	259	367
Total	886	15,849	20,587	23,132	5,986	2,914	4,638
					1,912*	1,224*	4,218*
Grand Total					7,898	4,136	8,856

* Number of marked stocked trout present.

Table 4. The overwinter survival rate and average size in April of brown trout fingerling stocked in the Lower Willow River, northwestern Wisconsin, in the 1958-1963 period.

Year	Number of Survivors	Percent of Survival	Size Range (inches)	Average Size (inches)
1958	15,517	20.0	2.5 - 10.3	5.6
1959	13,599	23.4	2.5 - 7.4	5.7
1960	20,144	26.3	2.5 - 7.4	5.5
1961	1,912	18.2	4.0 - 7.4	5.7
1962	1,224	11.6	2.5 - 9.4	5.4
1963	4,218	40.1	5.0 - 9.4	7.5

Table 5. A comparison of the costs involved in stocking fingerling brown trout and legal-size brown trout in the Willow River in northwestern Wisconsin.

Year	No. of Trout Stocked	Av. Cost of Each Fgl. in August	Cost of Fgl. Stocked Each Yr.	Number of Overwinter Survivors	Cost of Each Surviving Fingerling	Cost of Legal Trout Stocked	Cost of Legal Stocking	Difference Cost Legal/
1957	77,466	.036	$2,788.77	15,519	0.180	.095	$332.50	$2,456.27
1958	58,000	.036	2,088.00	13,599	0.154	.095	332.50	1,755.50
1959	76,613	.036	2,758.06	20,144	0.137	.095	332.50	2,425.56
			$7,634.83				$997.50	$6,637.33

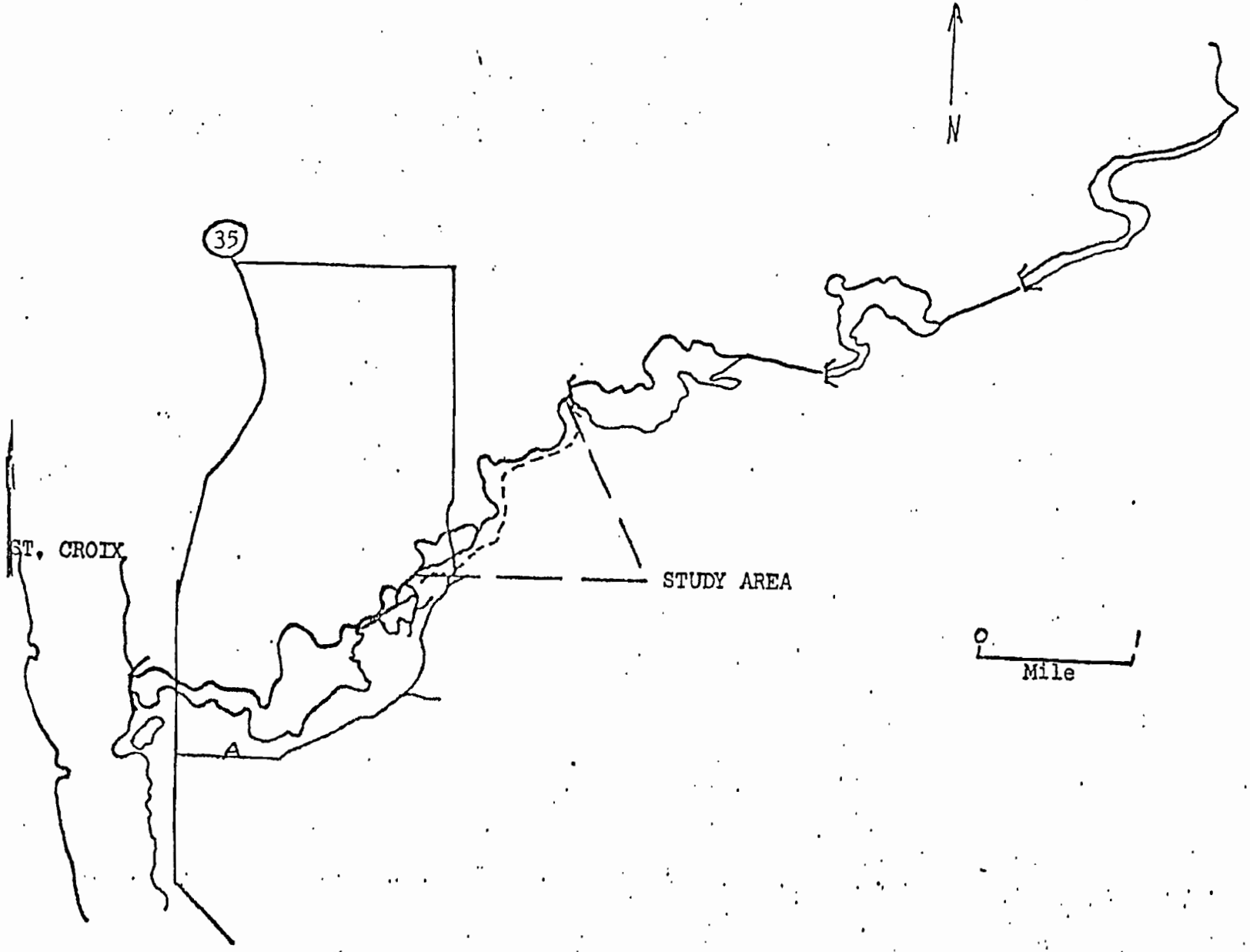

Figure 1. The Lower Willow River in northwestern Wisconsin showing study area

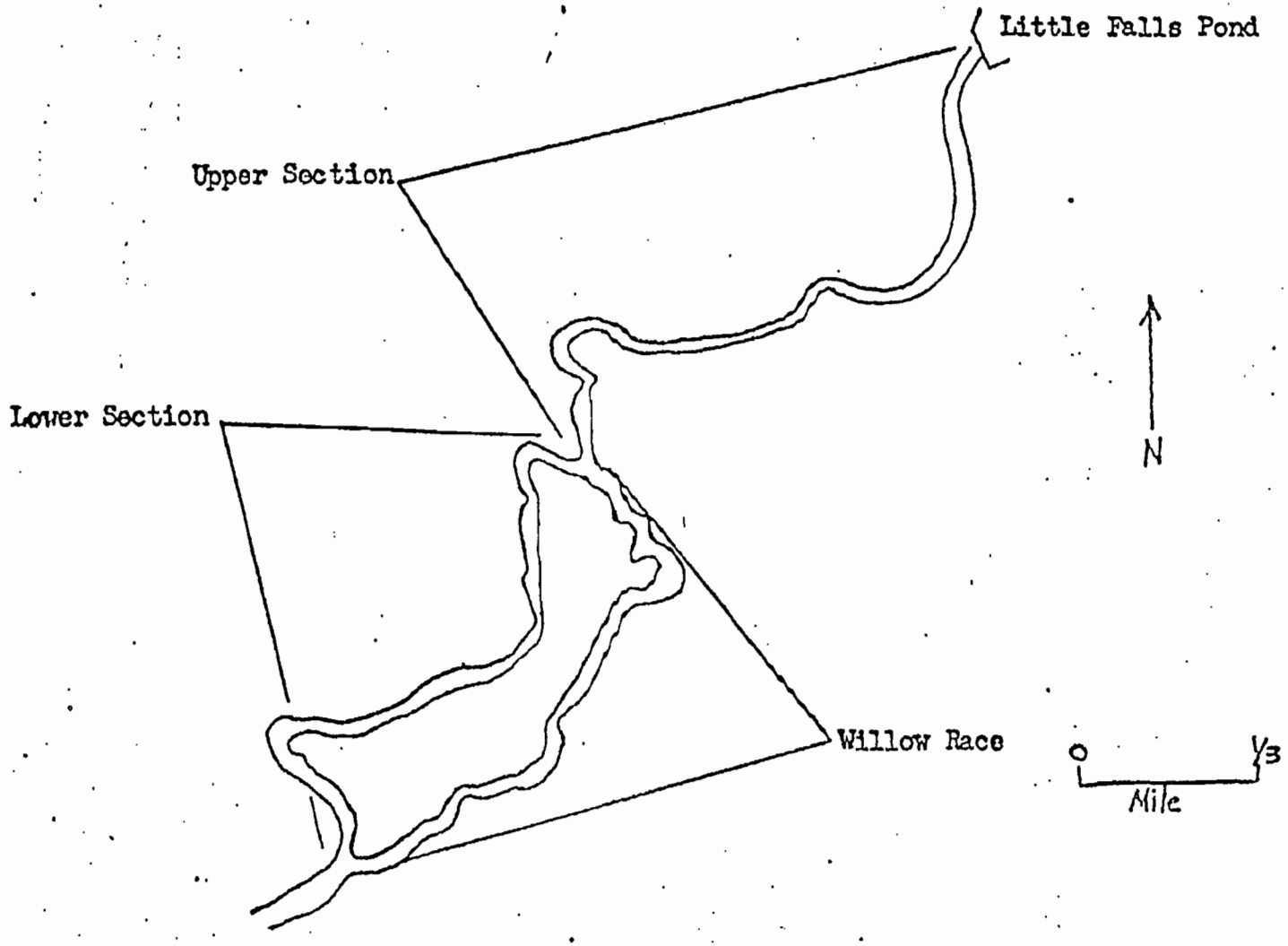

Figure 2. Study Area--Lower Willow River and Race, Northwestern Wisconsin