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REPORT ON A FISH SURVEY OF THE FORD RIVER SYSTEM (NEAR ESCANABA), AND PRELIMINARY RESULTS OF AN ATTEMPT AT ROUGH-FISH REMOVAL IN THE UPPER HALF OF THE RIVER

By Gerald P. Cooper

A fish survey of the Ford River System was made during the years 1953-1955 by electric shocker (collections at 42 stations--see Fig. 1 and Table 1). This has provided detailed information on the distribution and abundance of different fish species in the drainage system. Generally, this river system would be classified as marginal or only fair trout water. Brook trout are fairly common in the drainage, but are restricted to the headwaters and small tributaries. Most of the main river, plus the lower portions of the larger tributaries, have a large population of minnows, suckers, darters and other non-game fish. In view of the abundance of non-game fish, even in the upper part of the main river, an experimental attempt at rough fish control was undertaken during August of 1955 by poisoning out that section of the river between Channing and Northland. At the time of this poisoning operation, an attempt was made to recover all of the trout which were sacrificed (for a record of the number which were present), and large samples of all other fish were picked up from the poisoned section for a general record of what was there (i.e., to verify the records of

previous shocker samples from this same section). Two months after the poisoning operation, i.e., during October, 1955, five shocker collections were made at stations throughout the poisoned-out section in order to determine either what had survived the poisoning operation or what fish had moved back into the treated area from adjacent untreated waters.

The Ford River enters Little Bay de Noc at a point five miles southwest of the city of Escanaba. The drainage is in Dickinson, Menominee, Delta and Marquette counties. The principal tributaries of the Ford River are Ten Mile Creek, West Branch, North Branch, and Two Mile Creek.

Personnel Involved in the Study

The eight fish collections which were made by shocker during August of 1953 were by Mr. T. M. Stauffer assisted by Ellis Hayden and Buddy Jacob. During October of 1954, 25 additional collections were made by two field crews including Messrs. Stauffer, W. R. Crowe, M. G. Galbraith and G. P. Cooper from the Institute, District Fisheries Supervisors F. Warren, C. F. Long and L. R. Anderson, and Fish Area Biologist T. B. Durling. Finally, the nine fish collections made by shocker during July of 1955 were made by an Institute field party consisting of E. E. Schultz assisted by D. C. McNaught and E. B. Welch.

The rough fish removal work was done by the Lake and Stream Improvement Section, with Messrs. Wayne Tody, Bruce Volmer, Art Feldhauser and Ted Servinski, plus three force-account men participating, and with O. H. Clark observing. Assisting in the poisoning operation and fish pick-up were District Fisheries Supervisor Florin Warren and Messrs. Schultz, McNaught, Welch, Cooper, F. F. Hooper and J. E. Williams from the Institute. District Fisheries Supervisor C. F. Long made a check on the downstream extent of fish mortality following the poisoning.

The shocker collections made during October of 1955, as a recheck on the effectiveness of the poisoning operation, were by Messrs. Warren, Cooper, and W. R. Crowe, assisted by R. M. Bailey of the University of Michigan.

All of the collections taken by electric shocker, and the sample collections of dead fish picked up during the poisoning operation, were sorted by Messrs. Stauffer and Cooper, with considerable help from Dr. Bailey. Dr. Bailey also verified the identifications on at least some specimens of all species taken, on practically all of the lampreys and darters, and on any other fish where there was some special problem in identification. Sample collections for most of the species have been retained in the permanent collection of the Fish Division, Museum of Zoology, University of Michigan.

Fish Fauna of the Ford River System

All collections of live fish were made by D. C. shocker, and all specimens taken are enumerated in the present records. All collections were preserved in formalin and processed in the laboratory. Locality data on the shocker collections are given in Table 1, and the enumeration of all fish in these collections is given in Table 2. The general organization of Table 2 is the listing of localities from the headwaters to the mouth of the Ford River System, starting with headwaters at the top of the table, and ending with the lower portion of the Ford River proper at the bottom of the table. Thus, by an examination of Table 2 and Figure 1, the general distribution of any particular species, in a gradient from headwaters to mouth, is fairly apparent.

The Fish Division of the Museum, in Ann Arbor, has a set of distributional maps for Michigan fishes, based on all collections which have been stored there and which have been cataloged to date. Also, the fish collections made by the late John N. Lowe, mostly from the upper peninsula, have been recently reported upon in a Museum publication by Dr. W. Ralph Taylor. The Lowe collections included four stations on the Ford River System, all on the Ten Mile Creek drainage. There had previously been very little collecting done on the Ford River System, so that the present study makes quite a substantial contribution to the knowledge of fish distribution in the state.

One striking fact concerning the distribution of fish in the upper peninsula is that several species occur only in the Menominee "peninsula," or their distributions do not extend much beyond it. These are species which occur commonly in Wisconsin and which have extended their distribution for only a short way into the upper peninsula. These fish include the hog sucker, hornyhead chub, rosyface shiner, fantail darter and blackside darter. Other items of special interest concerning the fish fauna of the Ford River System are given in the following paragraphs.

The brook trout is fairly common, but is restricted largely to the headwaters of the main river and to the smaller tributaries. The brown trout and rainbow trout are rare.

The smallmouth bass, pumpkinseed sunfish and rock bass are restricted to the lower half of the drainage, largely to the main river itself, and none of them are abundant. The northern pike was recovered during the poisoning operation from the section of the river between Alfred and Northland, but none were taken during the shocker operation. Apparently the pike occurs rarely above Alfred (see Fig. 1).

Three species of lamprey occur in the drainage. The Michigan brook lamprey and the American brook lamprey are abundant in the system; the latter is restricted largely to the headwaters and smaller tributaries. Sea lamprey ammocoetes and newly transformed adults were found along the Ford River proper from Channing down to a point where the river enters Delta County, and a few were found in the lower reaches of some of the tributaries of the main river within this same section; but most of the tributary waters were free of this species. Details on the distribution of the sea lamprey throughout any given drainage system will be important if control measures are applied to the ammocoetes in such waters.

The burbot is an abundant species throughout the entire drainage, both in headwater tributaries and in the lower sections of the system.

The white sucker is abundant throughout the system, but is largely replaced in the lower-most portion of the Ford River by the hog sucker.

The creek chub, blacknose dace, long nose dace, common shiner, mottled sculpin, blackside darter and johnny darter are generally abundant throughout the system. The logperch, fantail darter and hornyhead chub are most abundant in downstream waters.

Poisoning Operation

The section of the Ford River between Channing and Northland was treated on August 10 and 11, 1955 by personnel from the Lake and Stream Improvement Section, using 5 percent emulsifiable rotenone. Some of the details of this poisoning operation are given in Table 3 and Figure 2. This poisoning operation was confined to the main river; the tributaries were not treated. To facilitate this operation, a series of 18 stations (see Fig. 2) were established along the river starting with station No. 1 at the M-95 crossing just south of Channing, and ending with station No. 18 at Northland. Each

station along the river, or along the adjacent county road, was marked by a flag for ready recognition in the field. (It should be noted that this series of 18 stations established for the poisoning operation are entirely different from the 42 fish collecting stations shown on Figure 1.)

Starting at 8 a.m. on August 10, two gallons of 5 percent emulsifiable rotenone were dumped into the river at poisoning station No. 1 (at the M-95 bridge just south of Channing). Later during the day of the 10th, two gallons of rotenone were added to each of stations 2-5 inclusive. During this initial operation a crew of two or three men cruised downstream through each section, to follow the effect of the poison on fish. About one ounce of fluorescein per gallon of rotenone was added for each treatment, giving a bright green color to the solution, and it was expected that the men cruising the stream could follow the rotenone along by detecting this green color. Treatment of the river between stations 1 and 5 on August 10 showed that the downstream dispersal of the poison was much slower than had been anticipated; the result was that most of the day on the 10th was spent at these first five stations. The remaining applications of rotenone were made at several downstream stations along the river (see Table 3) on August 11. A total of 30 1/4 gallons of rotenone was used on the river.

At the time of applying rotenone to the several stations, volume estimates of stream flow were made at stations 2, 6, 13, 17, and 18. These figures on flow are given in Table 3. At station 6, a flow of 5 c.f.s. in the Ford River proper was joined by a flow of 5. c.f.s. from Two Mile Creek. At station 17, a flow of 20 c.f.s. in the

Ford River was joining a flow of 15 c.f.s. from the North Branch. These estimates of stream flow were based on measurements of water depth, determination of current speed and timing floating objects, and making an allowance for bottom friction. The flow figures are therefore only approximate values. The flow estimates are given on Figure 2, along with additional flow figures which are merely interpolations between measured values. When the data on stream flow are examined in conjunction with the records on the amount of rotenone solution added, it is apparent that the upper portion of the river, in the first ten miles or so below Channing, received a much greater concentration of rotenone than did the lower treated portion of the river (between Ralph and Northland). This difference in concentration probably was of considerable significance in the extent of fish kill. A much more complete kill was obtained in the upper section than in the lower section of the treated area, as indicated below.

Daytime water temperatures during these treatments on August 10 and 11 varied between 66° and 72° F., with air temperatures ranging from 70° to 79° F.

The time required for the downstream dispersal of the rotenone and dye, from the point of application to the next station downstream, was surprisingly long. The rotenone and dye added at station 1 at 8 a.m. on August 10 took six hours to reach station 2 (an airline distance of about 3/4 mile); the fluorescein dye added at station 1 could still be detected in the water at station 2. Between stations 12 and 13 (an airline distance of about 2 miles) it took about seven hours on August 11 for the rotenone to travel this distance; the dye could not be detected at station 13, but the presence of rotenone was detected by

fish distress and mortality which started rather abruptly. Between stations 16 and 17 (an airline distance of 4 1/2 miles) it took approximately 17 hours for the effect of the rotenone to travel this distance. Again, the lapse of time was judged on the basis of fish mortality, for the dye could not be detected at station 17.

Mr. Wayne Tody of the Lake and Stream Improvement Section has suggested that the fluorescein dye, as a marker, might have been more effective had it not been mixed in with the rotenone solution ahead of application. His idea is that the dye might remain effective for a greater downstream distance if it is added to the stream just ahead of the rotenone application. This might be tried in some future operation.

The river between stations 1 and 5 was treated on August 10. By (or before) noon on the 11th, the effect of the rotenone had reached station 6 (at the mouth of Two Mile Creek). At a point on the Ford River, about 100 feet above the mouth of Two Mile Creek, a considerable number of dead fish were observed and a considerable number of larval lampreys were observed which were badly distressed and lying around on the stream bottom, but were still not dead. A live box was placed in the stream at this point, and a number of lampreys were put in the box to see if they would eventually die as a delayed effect of the rotenone. This live box was about 1 1/2 feet square, of sheet metal, and was perforated by numerous holes for good circulation. The lampreys were put in this box at noon on August 11, and when examined next at 2 p.m. on August 12, all of them were dead. Prevailing temperatures were: water 69°, air 79°. These test lampreys were preserved and subsequently identified in the Laboratory, as follows:

15 sea lampreys, including one newly transformed adult (6.6") and 14 ammocoetes (3.4"-6.7").

20 American brook lamprey ammocoetes (3.1"-7.5").

6 Michigan brook lamprey ammocoetes (2.7"-5.5").

The effect of applying rotenone solution to the stream between Channing and Northland was followed by cruising much of the length of this entire section. The fish mortality was very heavy from Channing down to the mouth of the North Branch; it was also fairly heavy between the mouth of the North Branch and Northland. Presumably there was very little mortality below Northland. The effect of the rotenone had reached Northland on August 12. On August 15, District Fisheries Supervisor C. F. Long made a check on the Ford River at a point in Section 5 (T. 42 N., R. 26 W.), about one mile downstream from Northland. He reports that, at this point, he saw many live fish in the river, some of them feeding, but he saw no signs of dead fish at all. On the same day Mr. Long also checked the river in Section 9 (T. 42 N., R. 26 W.), about two miles below Northland, and here also he saw no signs of dead fish. It is thus quite certain that this application of rotenone did not affect fish in the river for as much as a mile below the village of Northland.

Immediately after fish were killed by rotenone applications, one to three men cruised downstream from one station to the next, attempting to pick up all dead game fish which were encountered. Time did not permit a complete job, i.e., some sections were cruised and others were not. The extent of this check is indicated by the following figures. The length of the main river from Channing to Northland was measured on county maps (scale 1" to the mile) and found to be about 32 miles. The true figure on actual stream length between these two points may be

considerably greater than 32 miles, in view of the fact that the county maps do not give a true picture of the circuitous course of the stream. The sections of the stream which were cruised for a pick up of dead game fish (see Table 3) make up about 60 percent of the length of the river between Channing and Northland. In other words, the pick up covered about 60 percent of the river. The total numbers of trout, pike and bass which were obtained by cruising the stream are given in Table 4. The total for trout is 230 (189 wild brook trout, 17 fin-clipped hatchery brook trout, and 24 wild brown trout) of which 57 percent were of sublegal size (less than 7"). Where 230 trout were picked up along 60 percent of the treated portion of the river, it is computed by direct proportion that a total of 380 trout were killed, of which 170 (43%) were of legal size. Rechecks on limited stretches of stream showed that the pick up of dead trout was not 100 percent efficient, but the number missed was relatively small. Making allowance for this factor, it seems probable that the total kill of legal-size trout along the 32 miles of river was between 200 and 250, or about 8 per mile.

In addition to the pick up of dead game fish between poisoning stations, large samples of rough fish were picked up and preserved at one-half of the 18 stations (see Table 3). The fish in these collections were identified and enumerated in the laboratory, but the records are not included in this report. Comparison of fish in collections taken by electric shocker during 1953-1955 (see Table 2) with these pick-up collections at the time of poisoning showed very striking uniformity. The two sets of collections had almost exactly the same list of species, and the various species were present in

about the same relative numbers. One difference was that the pike was missed in the earlier shocker collections, whereas the species turned up during the poisoning operation in the lower portion of the stream that was treated.

An actual count of the rough fish killed by the poisoning operation was not attempted. However, based on the large collections which were picked up and enumerated at time of poisoning, it is estimated that rough fish made up over 95 percent of the total fish population by weight.

Shocker Recheck on Fish Surviving, in October, 1955

On October 3 and 4, 1955, five shocker collections were made along the section of the river between Channing and Northland which was treated with rotenone two months earlier. All five of these stations were repeats on fish collection stations (see Figure 1) of the earlier shocker survey. The purpose of these recheck collections was to make a somewhat delayed appraisal of the completeness of the kill resulting from the rotenone applications on August 10 and 11, and also to determine the extent to which fish had already moved back into the poisoned section, either from the tributaries or from upstream and downstream sections of the main river. The results of this resurvey of the river in October are given in Table 5, along with a summary, for comparison, of the collections made prior to the poisoning. At the head of each column in Table 5 is given the poisoning station, corresponding to the records in Table 3 and Figure 2. Immediately below the poisoning stations, in the columns of Table 5, are given the fish collection station numbers corresponding to the records in Table 2 and Figure 1. The amounts of actual shocking time for each collection are also given

in these column headings for Table 5. For example, at fish collection station No. 1, 13 trout were taken in 60 minutes of shocking time in the collection made before poisoning, and 8 trout were taken during the 50 minutes of shocking time in the collection made after the poisoning operation. In the organization of Table 5, emphasis has been placed on grouping species into free-swimming forms, typically slow-swimming (bottom) forms, mud-living forms (lampreys), etc. It seems most logical to assume that the poisoned-out section of the river would be more rapidly repopulated from tributaries by freely swimming forms such as minnows, than by slowly swimming bottom fishes such as darters and cottids. The assumption also is that the mud-living ammocoetes of lampreys would be comparatively slow to repopulate the poisoned-out section of the river, especially when this involves distances of several miles. From the data in Table 5, and from observations made on the stream at the time of poisoning, it is believed that the kill of fish was almost complete from station 1 down to about station 12 (see Figure 2). Slow-swimming fishes such as the darters, cottids, lampreys and the burbot were virtually eliminated at stations 2 and 4, and for some of these species the poison was effective downstream at least to station 14. The almost complete absence of fish, except trout, at station 4 is believed to be most significant. The free-swimming minnows probably repopulated the stream at station 2, coming downstream from the river immediately above station 1. Apparently the rotenone did a fairly complete job in cleaning out the bottom-dwelling lampreys at stations 2 to 4, and for some considerable distance downstream toward station 12. Although the total number of trout taken during the resurvey in October was only 21 fish in about four hours of shocking time, it is believed that this number is of

considerable significance. Especially at station 4, where 410 yards of stream was covered by the shocker on Ocotber 4, 9 of the 10 fish taken at the station were brook trout. All of the 21 trout taken during the resurvey in October were fish of wild origin (hatchery fish had been marked by fin-clipping), and only one of these 21 trout was of legal size. It seems obvious that trout, coming from tributaries, were moving back into this poisoned-out section more rapidly than were most other species, and this fact holds some promise for possible future operations of this type.

It is believed that the August poisoning operation did a fairly complete job of cleaning the fish out of the river from station 1 down to about station 12. Between stations 12 and 18 (down to Northland) the kill was observed (at the time of poisoning) to be heavy, but the resurvey records suggest that a considerable number of fish still survived, especially lamprey ammocoetes.

Survival from Hatchery Plantings of Legal Brook Trout

During May, June and July of 1955 (i.e., prior to the poisoning operation in August), 1800 legal-size, fin-clipped brook trout were planted in the Ford River between Channing and Ralph. Water temperatures during the summer of 1955 were abnormally high, which probably contributed to a lower-than-average survival of these hatchery fish. During the poisoning operation on August 10-11, the pick up of dead game fish indicated a kill of approximately 170 legal-size trout in this section of the river, and based on the comparative numbers of hatchery versus wild fish which were actually recovered (Table 4) it is computed that 25 of these 170 legal brook trout were of hatchery origin. The balance, about 145, were unmarked wild fish. Even if we make a generous allowance for missing legal-size trout during the pick

up of dead game fish, the conclusion seems safe that there were less than 100 legal-size hatchery brook trout in the poisoned-out section of the Ford River, whereas 1800 legal-size trout had been planted in this same section during the previous three months. Some of these planted fish may have entered tributaries prior to the time of poisoning.

Following the poisoning operation on August 10-11 it seemed desirable to replant this treated section of the river with legal-size hatchery trout, to immmediately provide some fishing, and also to encourage the process of trout replacing non-game fish in the poisoned-out section. Thus hatchery plantings of legal-size brook trout were made in the Ford River between Channing and Ralph on August 18, 1955. This was six days after application of the rotenone, and it seemed safe to assume that the stream was no longer toxic to fish. Unfortunately though the weather was very warm, water temperatures were unusually high, and some mortality among these trout planted on August 18 took place. Hatchery records show that 550 legal-size brook trout were planted in this section of the Ford River on August 18. District Fisheries Supervisor Florin Warren reports on an examination which he made at the planting sites on August 19. At one of the plant sites he reports seeing about a dozen live trout and no dead ones, with a water temperature of 67°. At a second planting site he observed 11 dead trout in 1/4 mile of stream, with no live trout seen, and a water temperature of 73°. At a third planting site he saw about a dozen live trout in one pool, but no dead trout, with the water 75°. At the fourth planting site he reports seeing no trout; water 75°.

During the recheck shocker survey made on October 3-4, four of the five collections were made at the same places where hatchery

trout were planted on August 18. The 21 brook trout which were taken during October included only 1 trout of legal size, and no trout of hatchery origin.

Mr. Warren reports some success by anglers fishing for the legal-size brook trout which were planted on August 18, 1955. He states that during late August and early September, some of these fish were caught in the Channing area, but none of them were caught at planting sites farther downstream.

INSTITUTE FOR FISHERIES RESEARCH

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Table 1.

Fish collection stations, Ford River System (1953-55)

Collection	County	T.N.	R.W.	Sec.	Stream	Date	Minutes of shocking time
1	Dickinson	43	30	17	Ford R.	8-11-53	60
2	"	43	30	14	"	"	60
3	"	43	29	18	"	8-12-53	70
4	"	43	29	18	Two Mile Cr.	"	75
5	"	43	29	17, 18	Ford R.	8-13-53	95
6	"	43	29	15	"	"	75
7	"	43	28	7	N. Br. Ford R.	8-17-53	105
8	"	43	28	18	Ford R.	"	90
9	"	43	27	35	Outlet Marsh L.	10-4-54	45
10	"	44	29	29	Camp O Cr.	10-5-54	45
11	"	43, 44	29	6, 31	Two Mile Cr.	"	50
12	"	43	29	11	Turner Cr.	"	45
13	"	44	29	30	Two Mile Cr.	"	65
14	"	43	27	4, 5	N. Br. Ford R.	10-6-54	35
15	"	43	28	23	Hayes Cr.	"	25
16	"	43	28	1	N. Br. Ford R.	"	75
17	"	43	28	1	Trib. of N. Branch Ford R.	"	20
18	Menominee	41	25	20	W. Br. Ford R.	10-7-54	40
19	"	41	26	20	S. Br. of W. Br.	"	15
20	"	41	26	19	Helps Cr.	"	35
21	"	40	26	4	Ten Mile Cr.	"	35
22	"	40	26	11, 12	" " "	10-8-54	70
23	"	39	25	12	" " "	"	55
24	"	40	25	21	" " "	"	45
25	Delta	39	24	8	" " "	"	40
26	Dickinson	43	27	25, 26, 35	N. Br. Ford R.	10-9-54	70
27	"	43	27	35	Ford R.	"	50
28	"	43	28	22	"	"	60
29	"	43	28	26	Stafford Cr.	"	30
30	Marquette	42	26	9	Ford R.	10-10-54	50
31	"	42	26	15	Trib. of Ford R.	"	25
32	Delta	41	24	20	Ford R.	"	60
33	"	41	24	20	Trib. of Ford R.	"	30
34	Menominee	40, 41	25	5 and 34	Unnamed trib. of Ten Mile Creek	7-13-55	27
35	"	41	26	13	West Br. Ford R.	"	26
36	Delta	40	24	10 and 15	Camp Creek	7-21-55	22
37	Marquette	42	25	31	Ford R.	"	62
38	Delta	39	24	23	Ten Mile Creek	7-22-55	33
39	"	39	23	19	Ford R.	"	38
40	"	39	24	11	Ford R.	"	46
41	"	38	23	5	Ford R.	7-23-55	42
42	"	38	23	15	Ford R.	7-22-55	42

Table 2.

Fish in Shocker collections from Ford River System.
Number of specimens taken by shocker at each station.
(Table continued next page)

Stream section and collection number	Brook trout	Brown trout	Rainbow trout	Smallmouth bass	Pumpkin-seed
Headwaters, Ford R.					
F 1	13	...	...	...	...
2	4	...	2	...	...
3	2	3	3	...	...
5	5	4	...	...	...
6	3	...	...	...	...
12 (Turner Cr.)	11	...	...	...	...
8	...	...	...	...	...
Two Mile Cr., and tribs.					
13	11	...	...	...	...
10 (Camp O Cr.)	19	...	...	...	...
11	9	...	...	...	...
4	4	1	...	...	...
Upper-central, Ford R.					
28	4	...	...	...	...
15 (Hayes Cr.)	2	...	...	...	...
29 (Stafford Cr.)	...	...	...	...	...
9 (trib.)	5	...	...	...	...
27	...	...	...	...	...
North Branch, and tribs.					
7	...	...	...	...	...
16	1	...	...	...	...
17 (trib.)	5	...	...	...	...
14	...	...	...	...	...
26	1	...	...	...	...
Lower-central, Ford R.					
30	...	...	...	...	...
31 (trib.)	...	...	...	...	...
37	...	...	...	...	...
32	...	...	...	1	...
33 (trib.)	...	...	...	1	2
36 (Camp Cr.)	...	...	...	...	...
West Branch, and tribs.					
20 (Helps Cr.)	...	...	...	...	...
19 (South Br.)	...	...	...	...	...
35	...	...	...	...	...
18	...	...	...	...	...
Ten Mile Cr., and tribs.					
21	...	...	...	...	...
22	2	...	...	...	...
34 (trib.)	6	...	...	...	...
24	...	...	1	...	...
23	...	...	...	...	...
25	...	...	...	1	...
38	...	...	...	3	...
Lower, Ford R.					
40	...	...	...	...	...
39	...	...	...	...	...
41	...	...	...	...	...
42	...	...	...	5	...

Table 2.
(continued)

Stream section and collection number	Rock bass	Burbot	Hog sucker	White sucker
Headwaters, Ford R.				
F 1	...	15	...	12
2	...	11	...	1
3	...	7	...	10
5	...	23	...	14
6	...	2	...	21
12 (Turner Cr.)	...	...	...	6
8	...	2	...	35
Two Mile Cr., and tribs.				
13	...	6	...	5
10 (Camp O Cr.)	...	...	...	2
11	...	3	...	2
4	...	9	...	3
Upper-central, Ford R.				
28	...	1	...	2
15 (Hayes Cr.)	...	...	...	13
29 (Stafford Cr.)	...	...	...	43
9 (trib.)	...	3	...	...
27	...	16	...	3
North Branch, and tribs.				
7	...	...	...	34
16	...	2	...	18
17 (trib.)	...	8	...	...
14	...	1	...	6
26	...	14	...	18
Lower-central, Ford R.				
30	1	5	...	8
31 (trib.)	...	7	...	...
37	...	20	...	1
32	1	19	2	8
33 (trib.)	...	11	...	11
36 (camp Cr.)	...	8	...	...
West Branch, and tribs.				
20 (Helps Cr.)	...	1	...	60
19 (South Br.)	...	5	...	12
35	1	16	...	3
18	...	4	...	...
Ten Mile Cr., and tribs.				
21	...	9	...	1
22	...	2	...	52
34 (trib.)	...	5	...	13
24	...	3	9	10
23	...	1	9	10
25	...	12	11	21
38	...	3	6	1
Lower, Ford R.				
40	...	1	4	...
39	1	6	1	...
41	4	9	8	...
42	...	2	1	...

Table 2.
(continued)

Stream section and collection number	Mich. brook lamprey [*]	American brook lamprey [*]	Sea lamprey [*]	Mud-minnow	Creek chub
Headwaters, Ford R.					
F 1	...	50 (1)	2	2	7
2	...	52 (11)	...	2	48
3	...	10 (2)	...	...	18
5	3 (1)	11 (5)	2	...	1
6	54 (6)	13 (6)	3	...	32
12 (Turner Cr.)	...	1 (1)	...	...	2
8	37 (10)	9 (3)	6	...	35
Two Mile Cr., and tribs.					
13	...	23 (6)	...	2	8
10 (Camp 0 Cr.)	...	11	...	4	3
11	...	41 (1)	...	...	9
4	1	16	...	...	2
Upper-central, Ford R.					
28	12 (2)	2 (1)	4 (2)	...	17
15 (Hayes Cr.)	...	1 (1)	...	...	17
29 (Stafford Cr.)	4 (3)	...	...	...	109
9 (trib.)	...	12 (1)	...	...	2
27	9 (4)	1 (1)	1 (1)	...	...
North Branch, and tribs.					
7	...	2 (2)	...	14	6
16	4 (2)	3 (1)	...	5	5
17 (trib.)	2	...	...	...	1
14	3	2	...	2	2
26	16 (4)	1	...	1	1
Lower-central, Ford R.					
30	5 (2)	...	3 (1)	...	...
31 (trib.)	...	1	1	...	1
37	3	...	2	...	5
32	1	...	1 (1)	...	...
33 (trib.)	2	...	2	5	5
36 (Camp Cr.)	...	5	...	1	26
West Branch, and tribs.					
20 (Helps Cr.)	...	...	...	...	5
19 (South Br.)	...	...	...	8	...
35	...	...	...	9	7
18	1	...	2	...	...
Ten Mile Cr., and tribs.					
21	9 (4)	52 (14)	...	...	5
22	4 (4)	...	...	12	27
34 (trib.)	...	8	...	4	19
24	22 (7)	...	...	2	3
23	17 (5)	...	...	...	5
25	4 (4)	...	...	...	1
38	2	...	...	3	13
Lower, Ford R.					
40	1	...	...	...	...
39	2	...	...	...	...
41	...	...	...	...	...
42	...	...	...	...	...

[*] For the three species of lampreys, the total of both ammocoetes plus newly transformed adults is given, followed by the number of newly transformed adults given separately in parentheses.

Table 2.
(continued)

Stream section and collection number	Hornyhead chub	Pearl dace	Finescale dace	Redbelly dace
Headwaters, Ford R.				
F 1	...	...	...	...
2	...	...	...	...
3	...	2	...	...
5	...	...	...	...
6	...	...	...	...
12 (Turner Cr.)	...	...	...	...
8	...	...	2	12
Two Mile Cr., and tribs.				
13	...	11	2	2
10 (Camp O Cr.)	...	...	...	2
11	...	...	...	3
4	...	...	...	...
Upper-central, Ford R.				
28	3	1	...	...
15 (Hayes Cr.)	...	...	...	...
29 (Stafford Cr.)	...	7	...	10
9 (trib.)	...	...	...	...
27	...	...	...	3
North Branch, and tribs.				
7	...	17	1	2
16	...	2	...	...
17 (trib.)	...	...	...	...
14	...	1	...	...
26	...	...	...	1
Lower-central, Ford R.				
30	3	...	...	...
31 (trib.)	1	...	...	...
37	1	...	...	...
32	12	...	...	...
33 (trib.)	31	...	...	6
36 (Camp Cr.)	...	24	...	35
West Branch, and tribs.				
20 (Helps Cr.)	...	18	2	36
19 (South Br.)	...	1	4	18
35	...	1	...	1
18	7	...	...	...
Ten Mile Cr., and tribs.				
21	...	...	...	...
22	...	6	...	...
34 (trib.)	...	10	...	15
24	11	...	...	...
23	24	...	...	...
25	15	...	...	...
38	2	3	...	5
Lower, Ford R.				
40	...	...	...	...
39	...	...	...	...
41	1	...	...	...
42	...	...	...	...

Table 2.
(continued)

Stream section and collection number	Blacknose dace	Longnose dace	Rosyface shiner	Common shiner
Headwaters, Ford R.				
F 1	44	14	...	...
2	53	8	...	2
3	24	75	...	...
5	8	117	...	...
6	15	16	...	2
12 (Turner Cr.)	2	...	...	...
8	13	13	...	...
Two Mile Cr., and tribs.				
13	25	...	...	2
10 (Camp O Cr.)	15	...	...	...
11	20	...	...	...
4	2	69	...	...
Upper-central, Ford R.				
28	10	5	...	5
15 (Hayes Cr.)	13	...	...	8
29 (Stafford Cr.)	8	...	...	42
9 (trib.)	...	...	...	...
27	2	2	...	...
North Branch, and tribs.				
7	62	...	...	13
16	42	...	...	1
17 (trib.)	8	...	...	...
14	17	...	...	...
26	12	78	1	1
Lower-central, Ford R.				
30	4	86	...	3
31 (trib.)	6	3	...	...
37	1	12	...	1
32	1	39	...	5
33 (trib.)	...	8	3	44
36 (Camp Cr.)	46	...	...	...
West Branch, and tribs.				
20 (Helps Cr.)	29	...	...	1
19 (South Br.)	8	...	...	1
35	12	3	...	42
18	3	13	...	1
Ten Mile Cr., and tribs.				
21	4	...	...	2
22	89	15	...	34
34 (trib.)	42	6	...	16
24	34	31	...	3
23	32	27	1	35
25	12	60	4	...
38	...	5	...	3
Lower, Ford R.				
40	1	24	...	10
39	...	26	...	...
41	...	15	...	...
42	...	10	...	...

Table 2.
(continued)

Stream section and collection number	Blacknose shiner	Brassy minnow	Fathead minnow	Sculpin C.bairdi
Headwaters, Ford R.				
F 1	...	...	...	12
2	...	...	...	13
3	...	...	...	12
5	...	...	...	13
6	...	...	...	13
12 (Turner Cr.)	...	...	...	...
8	...	...	...	9
Two Mile Cr., and tribs.				
13	...	10	...	20
10 (Camp O Cr.)	...	...	...	7
11	...	...	...	36
4	...	...	...	10
Upper-central, Ford R.				
28	...	...	...	8
15 (Hayes Cr.)	...	...	...	1
29 (Stafford Cr.)	...	...	...	2
9 (trib.)	...	...	...	8
27	...	...	...	1
North Branch, and tribs.				
7	...	...	3	4
16	...	1	...	14
17 (trib.)	...	...	...	12
14	...	...	...	13
26	...	...	...	...
Lower-central, Ford R.				
30	...	...	...	...
31 (trib.)	...	...	...	...
37	...	...	...	...
32	...	...	...	...
33 (trib.)	...	2	...	...
36 (Camp Cr.)	...	3	...	3
West Branch, and tribs.				
20 (Helps Cr.)	...	1	...	...
19 (South Br.)	...	5	...	...
35	1	5	...	...
18	...	...	...	...
Ten Mile Cr., and tribs.				
21	...	1	...	10
22	...	1	...	26
34 (trib.)	...	1	...	12
24	...	...	...	...
23	...	...	...	...
25	...	...	...	...
38	...	...	...	...
Lower, Ford R.				
40	...	...	...	...
39	...	...	...	...
41	...	...	...	...
42	...	...	...	...

Table 2.
(continued)

Stream section and collection number	Brook stickleback	Log perch	Blackside darter	Johnny darter
Headwaters, Ford R.				
F 1	3	...	5	12
2	5	...	12	26
3	1	...	...	11
5	...	...	5	1
6	1	...	14	17
12 (Turner Cr.)	...	...	...	...
8	2	...	24	6
Two Mile Cr., and tribs.				
13	...	...	...	...
10 (Camp O Cr.)	...	...	...	1
11	...	...	...	5
4	...	...	...	...
Upper-central, Ford R.				
28	...	...	16	36
15 (Hayes Cr.)	...	...	2	2
29 (Stafford Cr.)	1	...	...	12
9 (trib.)	...	...	...	9
27	...	...	10	...
North Branch, and tribs.				
7	5	...	...	7
16	...	...	1	10
17 (trib.)	...	...	...	...
14	...	...	1	13
26	...	...	10	5
Lower-central, Ford R.				
30	...	...	15	4
31 (trib.)	...	...	5	...
37	...	...	14	5
32	...	17	5	1
33 (trib.)	...	...	9	39
36 (Camp Cr.)	1	...	2	...
West Branch, and tribs.				
20 (Helps Cr.)	30	...	...	4
19 (South Br.)	1	...	2	...
35	...	...	5	1
18	...	...	5	1
Ten Mile Cr., and tribs.				
21	...	...	...	7
22	...	1	7	11
34 (trib.)	...	...	...	...
24	...	13	12	10
23	...	13	15	10
25	...	10	8	5
38	...	8	4	1
Lower, Ford R.				
40	...	10	7	7
39	...	61	2	1
41	...	10	...	...
42	...	12	...	1

Table 2.
(concluded)

Stream section and collection number	Iowa darter	Fantail darter
Headwaters, Ford R.		
F 1	...	...
2	...	...
3	...	3
5	...	...
6	...	8
12 (Turner Cr.)	...	...
8	...	1
Two Mile Cr., and tribs.		
13	...	...
10 (Camp O Cr.)	...	...
11	...	...
4	...	...
Upper-central, Ford R.		
28	...	...
15 (Hayes Cr.)	...	...
29 (Stafford Cr.)	...	...
9 (trib.)	...	...
27	...	17
North Branch, and tribs.		
7	...	...
16	...	...
17 (trib.)	...	...
14	...	...
26	...	2
Lower-central, Ford R.		
30	...	2
31 (trib.)	...	...
37	...	8
32	...	15
33 (trib.)	1	...
36 (Camp Cr.)	...	...
West Branch, and tribs.		
20 (Helps Cr.)	...	...
19 (South Br.)	...	...
35	...	2
18	...	3
Ten Mile Cr., and tribs.		
21	...	...
22	...	5
34 (trib.)	...	...
24	...	29
23	...	20
25	...	22
38	...	11
Lower, Ford R.		
40	...	28
39	...	24
41	...	12
42	...	54

Table 3

Poisoning and fish pick-up stations on Ford River between Channing and Northland (Dickinson and Marquette counties) August 10-12, 1955

Stations	Location			Emulsifiable rotenone (5%) added		Stream flow on date of poisoning	Pickup of dead game fish made between	Collections of rough fish preserved
	T.N.	R.W.	Section, part. Other	Gals.	Date			
1	43	30	Center of 17, at M-95	2	Aug. 10	...	...	...
2	43	30	Line between 16 and 17	2	" "	2 c.f.s.	1 and 2	At 2
3	43	30	N.E. corner 16	2	" "	...	2 and 3	...
4	43	30	N.W. 1/4 of 14	2	" "	...	3 and 4	At 4
5	43	30	Center of 13	2	" "	...	...	...
6	43	29	N.E. corner of 18. Mouth of Two Mile Creek	1/4	Aug. 11	5 c.f.s. in Ford plus 5 c.f.s. in Two Mile Cr.	1000 feet above 6 to 1000 feet below 6	At 6
7	43	29	N.E. corner of 17	...	...	...	...	...
8	43	29	N. center of 16	2	Aug. 11	...	...	...
9	43	29	N. center of 15	...	...	...	8 and 9	At 9
10	43	29	N. center of 14 At Turner	2	Aug. 11	...	...	...
11	43	29	S.W. corner of 12	...	...	...	10 and 11	...
12	43	28	Center of 18	2	Aug. 11	...	...	At 12
13	43	28	E. side of 20	2	Aug. 11	15 c.f.s.	12 and 13	At 13
14	43	28	N.E. corner of 27. Near Ralph	4	" "	...	13 and 14	At 14
15	43	28	S.E. 1/4 of 35	4	" "	...	14 and 15	...
16	43	27	N. center of 31	4	" "	...	...	...
17	43	27	N.E. corner of 35. At Alfred	...	...	20 c.f.s. in Ford plus 15 c.f.s. in North Branch	...	At 17
18	42	26	N.E. corner of 6. At Northland	...	...	35 c.f.s.	17 and 18	17 to 18, and at 18

Total rotenone added, 30 1/4 gallons. Rotenone contained fluorescein for a tracer.

Pickup of dead game fish was concerned mostly with trout and pike. In some sections, suckers and burbot were also recorded.

Data in this table verified by Wayne Tody of L. & S. I. Section.

Table 4

Dead game fish picked up (between poisoning stations) on Ford River between Channing and Northland, August 11-12, 1955

Station Nos., between	Number of game fish picked up					Number of game fish picked up, by size group				
	Brook trout (wild)	Hatchery brook trout*	Brown trout (wild)	Northern pike	Smallmouth bass	Fingerling 2"-4.9"	Sublegals 5"-6.9"	7"-9.9"	10"-13.9"	Over 14"
1 and 2	62	...	...	...	...	2	33	25	2	...
	...	...	4	...	...	...	2	...	...	2
2 and 3	34	...	...	...	...	...	23	10	1	...
	...	...	2	...	...	...	...	2	...	...
3 and 4	8	...	...	...	...	3	1	3	...	...
	...	...	1	...	...	...	...	...	1	...
6 and 7	9	...	...	...	...	1	6	2	...	...
	...	4	...	...	...	...	...	4	...	...
	...	...	2	...	...	2	...	...	...	...
8 and 9	44	...	...	...	...	2	24	17	1	...
	...	...	11	...	...	2	4	4	...	1
10 and 11	11	...	...	...	...	...	2	8	1	...
	...	...	2	...	...	...	1	1	...	...
12 and 13	16	...	...	...	...	1	10	5	...	...
	...	11	...	...	...	...	3	8	...	...
	...	...	1	...	...	...	1	...	...	...
	...	...	...	1	...	...	...	...	...	1
13 and 14	5	...	...	...	...	...	2	3	...	...
	...	2	...	...	...	...	1	1	...	...
	...	...	1	...	...	...	1	...	...	...
14 and 15**	...	...	...	10	...	...	...	...	...	10
17 and 18	...	...	...	9	...	...	...	2	...	7
	...	...	...	...	4	4	...	...	...	...
Totals	189	17	24	20	4	17	114	95	6	21

*Hatchery trout had been fin-clipped when planted.
**An abundance of suckers and burbot.

Table 5

Fish in shocker collections at five stations on the Ford River between Channing and Northland before and two months after the poisoning operation.

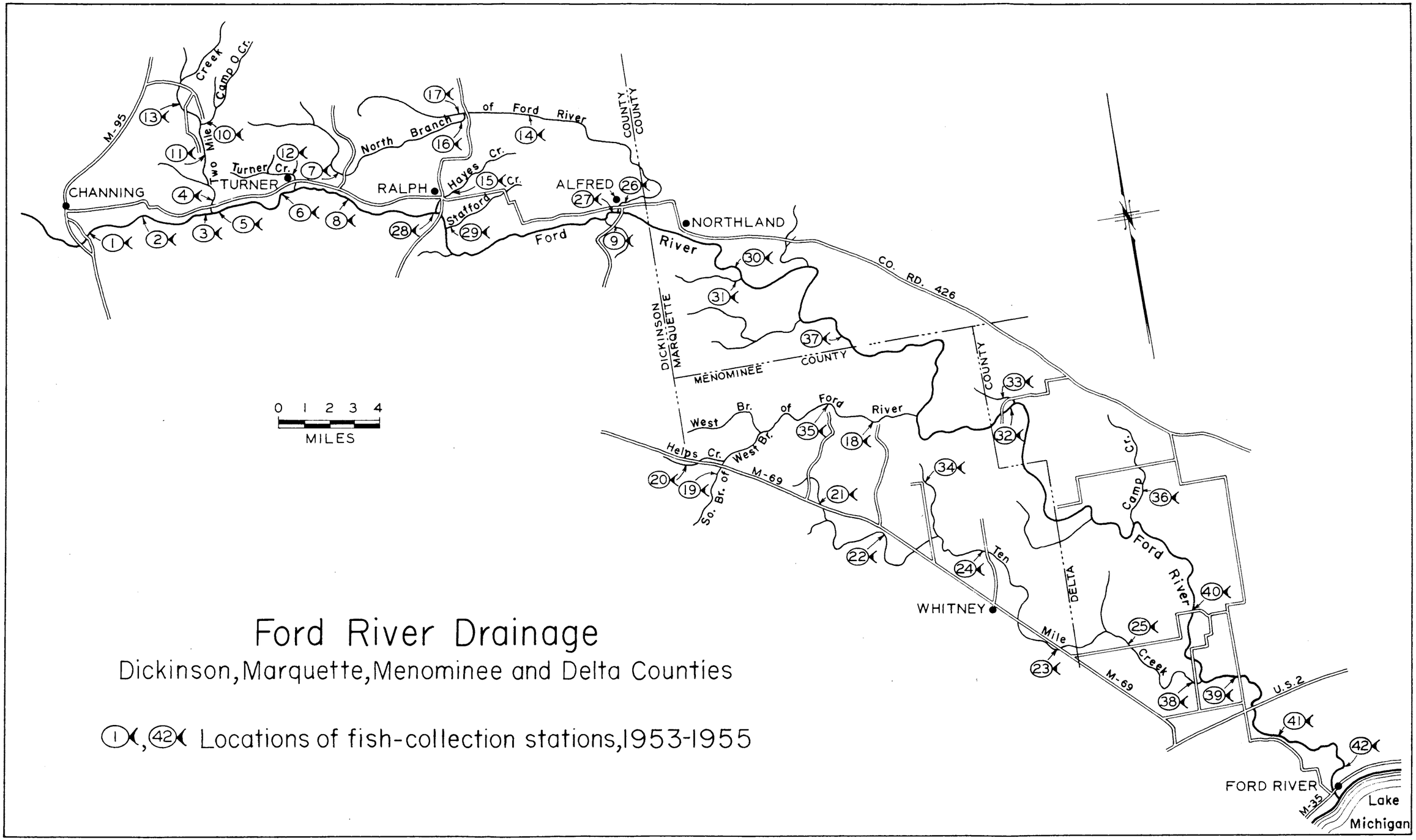
For poisoning stations, see Fig. 2; for fish collection stations, see Fig. 1. Minutes of shocking time for each collection are given in parentheses.

Species	Pois. Sta. 2 Fish Coll. Sta. 1		Pois. Sta. 4 Fish Coll. Sta. 2		Pois. Sta. 12 Fish Coll. Sta. 8		Pois. Sta. 14 Fish Coll. Sta. 28		Pois. Sta. 17 Fish Coll. Sta. 27	
	Before (60 min.)	After (50 min.)	Before (60 min.)	After (85 min.)	Before (90 min.)	After (55 min.)	Before (60 min.)	After (60 min.)	Before (50 min.)	After (80 min.)
Trout (3 species), Mostly brooks	13	8	6	9	...	1	4	3	...	...
Suckers (2 species)	12	2	1	...	35	2	2	19	3	30
Minnows (10 species)	67	54	113	1	75	7	41	32	7	14
Burbot	15	1	11	...	2	...	1	...	16	2
Darters (3 species)	17	...	38	...	31	...	52	...	27	4
Cottids and sticklebacks (2 species)	15	...	18	...	11	...	8	1	1	...
Lampreys (3 species)	52	1	52	...	52	19	18	51	11	58
All, except trout	178	58	233	1	206	28	122	103	65	118

Mostly cottids.

Including sea lampreys at all stations.

Fig. 1

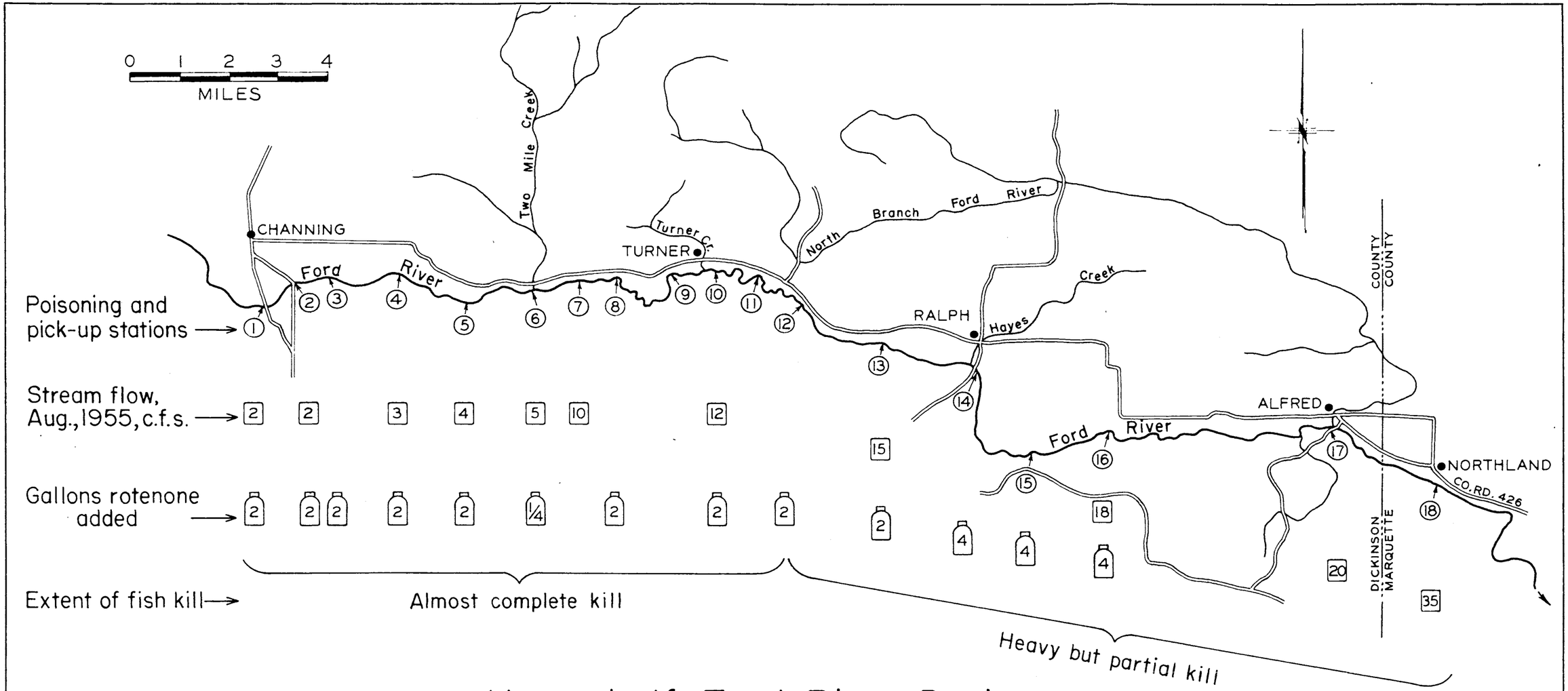


Ford River Drainage

Dickinson, Marquette, Menominee and Delta Counties

(1), (42) Locations of fish-collection stations, 1953-1955

Fig. 2



Upper half Ford River Drainage

Dickinson and Marquette Counties

①, ⑱ – Stations where rotenone was added and where dead fish were recovered, August 10-12, 1955

[2] — Estimated figures on stream flow, c.f.s.

[4] — Gallons of emulsifiable rotenone added