Original: Fish Division
cc: Education - Game
Inst. for Fish. Res.
J. A. Scully
C. Long
O. H. Clark
M. G. Galbraith
Marquette Fish. Res. Sta.
Extra

December 4, 1954

REPORT NO. 1434

A BIOLOGICAL AND PHYSICAL SURVEY OF THE CHOCOLAY RIVER DRAINAGE SYSTEM, MARQUETTE COUNTY, MICHIGAN*

By Merle G. Galbraith, Jr.

Abstract

During the summers of 1951, 1952, and 1953, a biological and physical survey was made of streams in the Chocolay River drainage system. The purposes of this survey were to obtain data from which to evaluate conditions for trout, to determine the need for watershed improvement, and to provide basic information for evaluating in subsequent years any improvement work that might be done. The majority of the fish were collected with an alternating current electric shocking machine. Physical and biological characteristics of the stream were noted at the collecting stations, and a temperature survey was made on streams throughout the watershed.

The Chocolay River system drains an area of approximately 94,000 acres of land. The surrounding terrain is characterized by rolling to rugged topography, sandy to gravelly moraines, fairly rich soils, and coniferous to mixed northern hardwood forests.

More than half of the streams were colorless and clear; nine streams varied in color from light to dark brown. In general, the streams were found to have a rapid flow and pools were classified as fair. Cover, as afforded by riffles, boulders, logs and dark water, was good but aquatic vegetation was sparse. Sand and gravel were the chief stream bottom soils.

Two temperature surveys of the watershed streams were made during the afternoon of August 1, 1951, and August 22, 1953. Fifty-eight temperature stations

* Field work, analysis of data and preparation of the report were in part financed with Federal Aid to Fish Restoration funds under Dingell-Johnson Project Number F-2-R-1 and F-2-R-2.

were set up on 23 of the 26 major streams in the watershed. Relatively few streams of the Chocolay attain lethal temperatures for trout. Dorrow and Mud creeks, the lower portion of the East Branch of Mud and Voce creeks, and the upper reaches of both Nelson Creek and the East Branch of Chocolay are the only main tributaries which may at times become excessively warm. Some of the streams in the watershed are very cold. Water temperatures on Silver, Cherry, Cedar, George's, Mattson, Wise Man and Big creeks probably never rise much above 60°, and during the major part of the year likely never reach this temperature. Temperature recordings from 1951 through 1953 by the USFWS thermograph on the Chocolay River below highway M-28 disclosed that water temperatures commonly exceed 60° during June and July but rarely exceed 70°.

Twenty-five species of fish were represented at the 56 stations established on 24 main streams and tributaries. Besides brook, brown, and rainbow trout, game fish collected were northern pike, yellow perch, rock bass, and pumpkinseed. American brook, Michigan brook and sea lampreys were also collected; the American brook was the most widely distributed lamprey.

Trout were collected in all streams studied except Mud Lake outlet and Dorrow and O'Neil creeks. By species, the percentage of trout collected in the watershed were: Brook—58 per cent, rainbow—37 per cent, and brown—5 per cent. Of the brook trout collected, sub-legal trout comprised the majority, and 65 fish or 6.2 per cent were of legal size. Although 20 per cent of the legal trout were attributed to hatchery stock, only 5.4 per cent of the entire collection of brook trout were of hatchery origin. Rainbow trout were collected in 15 of the 24 streams surveyed. Fifty-five or 8.3 per cent of the rainbows were legal size and only 2 of these were assumed to have been of hatchery origin. The most suitable streams for rainbow trout, based on the number of rainbows collected, were the Chocolay and its East and West branches, Nelson, West Branch of the Nelson, Foster, and Big creeks. No lake-run rainbows appeared in the collections.

Brown trout were collected in 8 streams of the system. Streams which appeared to be most suitable for brown trout were Cherry, Silver, and Big creeks. In contrast to the low numbers of legal brooks and rainbows collected, 56 per cent of the brown trout were of legal size, and of these, 75 per cent were hatchery fish. Natural reproduction of brook and rainbow trout in the Chocolay River system appears to be adequate. However, plantings of legal-size brook trout, rather than fingerlings, should be continued. Apparently Kawbawgam and Mud Lakes impose restrictions on the migratory movements of rainbow trout into the waters of Mud Creek and, therefore, it is suggested that legal-size rainbow trout be planted in the lower stretches of Mud Creek. Since the waters of the Chocolay afford good brook and rainbow trout fishing, and because the brown trout is a serious competitor in brook trout waters, it is recommended that plantings of brown trout be discontinued.

Most of the streams of the Chocolay system are not in need of habitat improvement on a watershed basis. However, several streams would likely benefit by such a program, i.e. East Branch of the Chocolay, the East Branch of Mud and Mud creeks, and Nelson and Wilson creeks. Other streams where improvements are recommended on a smaller scale are Massie, George's, Silver, and Voce, ~~and Cherry~~ creeks. Severe bank erosion on the Chocolay, which commonly occurs between the mouth of O'Neil Creek and a point 1/8 of a mile below the Lakewood bridge, should be corrected soon.

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By Merle G. Galbraith, Jr.

During July and August of 1951 and August and September, 1952, a biological and physical survey was made of the Chocolay River drainage system in Marquette County. The purposes of this survey were to obtain data from which to evaluate conditions for trout, to determine whether a watershed improvement program was desirable, and to provide basic information for evaluating in future years any improvement work that might be done. In 1951, a three-man crew** investigated 45 stations. In 1952, another crew*** completed these parts of the survey with 11 additional stations. The larger part of the temperature survey was done in 1953.

The majority of fish collections were taken with a 110-volt, 4.2-ampere portable A.C. shocker; scap nets were used to recover stunned fish. Deep water in the lower Chocolay necessitated the use of a gill net and a seine. The gill net was 125 feet long, composed of five 25-foot sections, one each of the following square-mesh sizes; 3/4-, 1-, 1 1/4-, 1 1/2-, and 2-inch. The seine was 30 feet long and had a bag. The general procedure in shocking was to work all the stream at each collecting station. Where the water was deep, it was sometimes impossible to work the full width of the stream, and in such case only one or both sides were shocked. Shocking efficiency, designated as per cent efficiency

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** R. F. Stinauer, leader; E. H. Bacon, T. M. Stauffer (replacement for Mr. Bacon), and T. B. Durling, assistants.

*** T. M. Stauffer, M. G. Galbraith, and H. E. McReynolds

in Table 1, was estimated by the crew on the apparent stunning effect of the electrical field and the degree of difficulty encountered in shocking and capturing stunned fish at each collection station.

Examination points were generally located 2 or 3 miles apart, except where accessibility was a limiting factor. The areas examined are given in Table 1 and are located immediately upstream from points at which collection symbols are shown on maps in this report. Lengths of stream shocked and stream widths were measured with a 100-foot steel measuring tape. Average stream width was determined by making 10 width measurements spaced 20 feet apart in a 200-foot typical section. Measurements of water depth were made in the middle of the stream and at locations on either side of the midpoint. Depth measurements were taken in the same section as width measurements. Depths were measured to the nearest inch with a yardstick. Surface velocity was determined by averaging the time it took 3 sticks to traverse 100 feet of stream. In Table 5, "sluggish" current is defined as having a flow of less than $\frac{1}{2}$ foot-per-second, and "rapid" as having a velocity greater than this rate. At various fish collecting stations, photographs were taken of typical sections of the stream with one of the crew members holding a board on which a number inscribed in chalk identified the station.

Air and water temperatures were taken with a pocket thermometer at each fish collection station. A separate temperature survey (Table 7) was made during warm weather to determine more accurately whether stream temperatures reached lethal limits for trout.

Water color was expressed as colorless, light brown, or brown, and water clarity recorded as clear, murky (slightly turbid), or muddy (turbid). The pools of a 200-foot stretch of stream at each station were classified according to Embody's tables (1927) with regard to their size, type and frequency. Although the amount of cover afforded fish is considered when classifying pools according to "type", trout cover and vegetation are classified separately in Table 6 because "type" refers only to pools and not to the entire length of

stream composing the station. With a view toward simplification and ease of comparison, pools and vegetation have been recorded in Table 6 as good, fair, or poor. Under the heading of vegetation, good means abundant, fair indicates a moderate amount, and poor means that plants were sparse or absent.

To facilitate the interpretation of biological and physical data, the major tributaries are treated as units separate from the main Chocolay River. Beginning with the main stream, the principal tributaries and the tributaries of the principal tributaries are listed in order progressing upstream. Stations on the streams are listed similarly, progressing from mouth to headwaters, but are not necessarily in numerical sequence. Maps showing the distribution of trout (Figs. 2 & 3) also designate the location of all stations where a biological and physical survey was made.

Game fish collected were anesthetized with urethane and then measured, weighed and scale-sampled. Forage fish were preserved for later identification. Scale samples were taken from the largest of the young-of-the-year trout collected. The larger trout were scale-sampled except when collections were large. In this case, scales were taken only from a representative sample. Lengths of all trout, whether the fish were scale-sampled or not, were recorded on a game-fish list; small trout of doubtful age that had not been scale-sampled were preserved.

During the 1951 collection, scales were removed from an area above the lateral line and below the adipose fin, whereas scales from trout collected in 1952 were removed from below the lateral line just anterior to the anus. This change in procedure in 1952 conforms to the Institute for Fisheries Research Methods Memo #4. Trout scales were impressed on plastic strips and aged with the use of a scale-projection machine. After determining the age of the trout scale-sampled in the field, preserved specimens were aged. Whenever possible, lengths taken in the field were used in recording growth data from preserved fish since preservation caused some shrinkage. Fish for which lengths were recorded but which were not scale-sampled or preserved were assumed to have been of the same age as known-aged fish of similar lengths.

Acknowledgements

I would like to acknowledge the suggestions made by Dr. Frank F. Hooper and Clarence M. Taube, of the Institute for Fisheries Research, in preparation of this report. Also appreciated is assistance from Thomas M. Stauffer; Russell Robertson, Superintendent, Marquette State Fish Hatchery; and A. H. Eichmeier, State Climatologist, United States Department of Commerce Weather Bureau Station at East Lansing, Michigan.

TABLE 1

Record of stations and collecting conditions

Streams and station number	Location	Date	Water level, color, turbidity, etc., and shocker efficiency	Length of stream covered (feet)	Amount of time spent shocking (hours)	Average width and depth
Chocolay River						
39	T47N R24W S6	8-9-51	High, light brown, clear, deep	100	1.00	0.5'-10' (depth)
M1	47-24-6	8-10-51	High, dark brown, clear, deep	125	10.50	0.5'-10' (depth)
51	47-24-8	9-17-52	Low to normal, light brown, clear, <1% (pools too deep to shock)	300 (only along bank)	1.17	51' x 49"
M2	47-24-10	8-17-51	Normal, dark brown, clear	125	17.00	37' x 3.5'
43	47-24-10	8-16-51	Normal, dark brown, clear	100	0.33	37' x 3.5'
43a	47-24-10	9-18-52	Low, very light brown, clear, 30%	580	2.00	3"-3.5' (depth)
53	47-24-14	9-22-52	Low, light brown, clear	480	1.25	39' x 22"
37	47-24-24	8-8-51	High, dark brown, slightly murky, 50%	850	1.17	45' x 20.5"
52	47-24-25	9-17-52	Low, light brown, clear, 5%	500	1.25	46.5' x 24"
36	47-24-36	8-8-51	High, light brown, murky, many ripples and fast water, 10%	1300	1.25	50.7' x 8.8"
35	46-24-1	8-7-51	High, light brown, murky, 20%	1000	0.92	40.3' x 17.4"
34	46-24-14	8-7-51	High, light brown, murky, 25%	700	1.25	25' x 12.3"
Silver Creek						
3	47-24-7	7-17-51	Normal, colorless, clear, 75%	450	0.83	9' x 13"
44	47-25-12	8-27-52	Normal, colorless, clear, deep undercut banks prevented more than 40% shocking efficiency	200	1.50	11.5' x 12"
1	47-25-11	7-17-51	Normal, colorless, clear, 85%	430	1.00	3.7' x 3"
2	47-25-14	7-17-51	Normal, colorless, clear, 60%	380	1.00	4.6' x 5'
Cherry Creek						
5	47-24-8	7-18-51	Normal, colorless, clear, 80%	350	0.50	23' x 20"
4	47-25-13	7-18-51	Normal, colorless, clear, 90%	325	0.58	18' x 1'
George's Creek						
28	47-25-24	8-2-51	Normal, colorless, clear, 60%	480	0.83	8.2' x 6.3"
Cedar Creek						
6	47-24-17	7-18-51	Normal, colorless, clear, 75%	475	0.75	16' x 15"

7	47-24-19	7-19-51	Normal, colorless, clear, 75%	420	0.92	13.5' x 14"
46	47-25-24	8-28-52	Normal, colorless, clear, 30%	250	1.17	30' x 10"
Massie Creek						
45	47-25-24	8-27-52	Normal, colorless, clear, 60%	200	1.00	8.5' x 5"
Big Creek						
8	47-24-16	7-19-51	Normal, colorless, clear, 60%	600	0.75	21.3' x 17.4"
9	47-24-28	7-19-51	Normal, colorless, clear, much overhanging & fallen brush, 50%	400	0.92	22.7' x 14"
10	46-24-5	7-20-51	Normal, colorless, clear, 50%	250	0.92	25' x 9"
11	46-24-5	7-20-51	Normal, colorless, clear, 40%	230	0.75	11' x 9.6"
No Name Trib. to Big Creek						
47	46-24-5	8-28-52	Normal, colorless, clear, 60%	200	1.25	6.5' x 8"
Voce Creek						
33	47-24-27	8-6-51	High, colorless, murky, 80%	240	0.42	5.5' x 7"
Dorrow Creek						
23	47-23-19	7-27-51	High, dark brown, slightly murky, 80%	630	0.58	8.8' x 11.2"
Mud Lake Outlet						
38	47-23-17	8-9-51	High, dark brown, murky, 100%	480	0.50	7.3' x 13.2"
Mud Creek						
24	47-23-21	7-27-51	High, dark brown, slightly murky, 50%	925	1.00	19.5' x 7.5"
27	46-23-9	8-1-51	Normal, colorless, clear, 75%	575	1.08	4' x 7"
Mud Creek, E. Br.						
25	47-23-28	7-30-51	High, dark brown, murky—locally reported as usually dry during hot summers, 90%	480	0.83	10.1' x 3"
26	46-23-9	7-30-51	High, light brown, clear, 80%	240	0.58	5' x .5'
Foster Creek						
12	47-24-35	7-20-51	Normal, colorless, slightly turbid, 75%	300	1.00	9.2' x 9.5"
48	46-24-11	8-29-52	Normal, colorless, clear, 60%	200	1.33	7.5' x 6"
14	46-24-10	7-23-51	Normal, colorless, clear, 80%	300	0.58	4.5' x 11"
O'Neil Creek						
13	47-24-36	7-23-51	Normal, dark brown, slightly murky, 60%	160	0.25	4.7' x 5.8"
Wilson Creek						
22	46-23-7	7-27-51	High, light brown, slightly murky, 50%	480	0.83	9' x 8"
Nelson Creek						
21	46-23-18	7-26-51	Normal, dark brown, clear, 75%	450	0.67	16' x 5.3"
55	46-23-20	9-24-52	Low, light brown, clear, 70%	200	0.67	18' x 10"
20	46-23-28	7-26-51	Normal, dark brown, clear, 75%	380	0.83	13.5' x 8"
40	45-23-16	8-10-51	Normal, dark brown, clear, 95%	280	0.58	3.8' x 3.8"

Nelson Creek, W. Br.						
19	46-23-19	7-26-51	Normal, colorless, clear, 75%	480	0.75	9.2' x 4.4"
Chocolay River, W. Br. (Silver Lead Creek)						
50	46-24-14	9-16-52	Low, colorless, clear, 20%	200	0.75	23' x 7"
16	46-24-22	7-24-51	Normal, colorless, clear, 40%	530	0.92	22' x 16"
41	46-24-21	8-13-51	High, colorless, clear, 80%	425	0.75	15' x 12.7"
54	46-24-31	9-23-52	Low, colorless, clear, 40%	200	1.00	22' x 7"
42	45-25-1	8-13-51	High, colorless, clear, 90%	300	0.33	11' x 18"
Wise Man Creek						
15	46-24-22	7-24-51	Normal, colorless, clear, 50%	400	1.00	5' x 6.3"
No Name, Trib. to Wise Man Cr.						
29	46-24-26	8-2-51	Normal, colorless, clear, 75%	470	0.92	6.5' x 5"
Mattson Creek						
30	46-24-26	8-3-51	Normal, colorless, clear, 80%	480	1.25	6' x 4.7"
Chocolay, E. Br.						
49	46-24-23	9-16-52	Low, colorless, clear, 20%	420	0.83	25.5' x 13"
18	46-24-25, 26	7-25-51	Normal, dark brown, clear, almost all rapids, 30%	950	1.08	27.7' x 8.2"
31	45-24-2	8-3-51	Normal, dark brown, clear—small beaver dams abundant, 60%	750	0.83	11.3' x 14.5"
17	45-24-12	7-25-51	Normal, dark brown, clear, water very dark and deep, 25%	200	0.25	21' x 3'
Sheans Creek						
32	45,46-24-2,35	8-6-51	High, dark brown, slightly turbid, 80%	230	0.42	6.4' x 7"

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[1] Experimental gill net.

[2] 30-foot bag seine.

TABLE 2

Number of fish taken with shocker at each station computed to catch per hour, Chocolay River Drainage, Marquette County, July and August, 1951, and August and September, 1952

Stream drainage unit	Station number	Time spent shocking: (hours)	SPECIES: Brook trout	Brown trout	Rainbow trout	Northern pike	W. sucker	American brook lamprey	Michigan brook lamprey	W. blacknose dace	N. redbelly dace	Central mudminnow	E. mottled sculpin	Brook stickleback
Chocolay River	39	1.00 ↓2				1	1						59	
	M1	10.50 ↓												
	51	1.17						1					15	
	M2	17.00 ↓1				1								
	43	0.33 ↓2												
	43a	2.00				7	1		13			4	10	
	53	1.25										2	18	
	37	1.17		1	14		4	4				1	14	1
	52	1.25			2		1	14	19	1			12	
	36	1.25	2		18			2		2			18	1
	35	0.92	13		34								13	
	34	1.25 ↓3	12		26							1	10	2
Silver Creek	3	0.83	13	14	10								203	
	44	1.50	6	3	1								74	
	1	1.00	31		1									
	2	1.00	80										11	
Cherry Creek	5	0.50	8	82	20	2							54	
	4	0.58	12	28									78	

TABLE 2 (cont.)

Number of fish taken with shocker at each station computed to catch per hour, Chocolay River Drainage, Marquette County, July and August, 1951, and August and September, 1952

Stream drainage unit	Station number	Time spent shocking: (hours)	SPECIES												
			Brook trout	Brown trout	Rainbow trout	Northern pike	W. sucker	American brook lamprey	Michigan brook lamprey	W. blacknose dace	N. redbelly dace	Central mudminnow	E. mottled sculpin	Brook stickleback
George's Creek	28	0.83	42	1									27	
Cedar Creek	6	0.75	39	3	16								89	
	7	0.92	96		15								11	
	46	1.17	39		2								22	
Massie Creek	45	1.00	38										21	
Big Creek (No Name Tributary - Station #47 included)	8	0.75	9	13	24			8					53	
	9	0.92	4	9	21								11	
	10	0.92	40		16								11	
	11	0.75	24		16								24	
	47	1.25	31		8									
Voce Creek	33	0.42	7									10		71
Dorrow Creek	23	0.58					7				2			5
Mud Lake Outlet	38	0.50				4								
Mud Creek	24	1.00	1				1			7		1	5	2
	27	1.08	22				1			2	18	8	4	16

TABLE 2 (cont.)

Number of fish taken with shocker at each station computed to catch per hour, Chocolay River Drainage, Marquette County, July and August, 1951, and August and September, 1952

Stream drainage unit	Station number	Time spent shocking: (hours)	SPECIES												
			Brook trout	Brown trout	Rainbow trout	Northern pike	W. sucker	American brook lamprey	Michigan brook lamprey	W. blacknose dace	N. redbelly dace	Central mudminnow	E. mottled sculpin	Brook stickleback
Mud Creek, E. Br.	25	0.83					2			5	4			4
	26	0.58	7							7	5	2	7	5
Foster Creek	12	1.00	32	1	58			7					9	
	48	1.33	70	1	3			5					17	
	14	0.58	103										12	
O'Neil Creek	13	0.25						4		4			4	
Wilson Creek	22	0.83	4		5					4				1
Nelson Creek	21	0.67	13		54									
	55	0.67	16		39		3			4			19	
	20	0.83	37		7		10			4	2	2	46	4
	40	0.58	64									2		21
Nelson Creek, W. Br.	19	0.75	12		36					4			5	

TABLE 2 (cont.)

Number of fish taken with shocker at each station computed to catch per hour, Chocolay River Drainage, Marquette County, July and August, 1951, and August and September, 1952

Stream drainage unit	Station number	Time spent shocking: (hours)	SPECIES												
			Brook trout	Brown trout	Rainbow trout	Northern pike	W. sucker	American brook lamprey	Michigan brook lamprey	W. blacknose dace	N. redbelly dace	Central mudminnow	E. mottled sculpin	Brook stickleback
Chocolay River, W. Br. (Silver Lead Cr.)	50	0.75	1	1	64								23	
	16	0.92	1		78								3	
	41	0.75	96		89								10	
	54	1.00	58											3
	42	0.33					30			9				3
Wise Man Creek	15	1.00	45		36								3	
No Name Creek, trib. to Wise Man	29	0.92	55		4								7	
Mattson Creek	30	1.25	47		3									
Chocolay River, E. Branch	49	0.83	17		63								23	
	18	1.08			19								3	
	31	0.83	1							63		1		
	17	0.25								28	92			4
Sheans Creek	32	0.42	12							52		10		

[1] Experimental gill net
[2] 30-foot bag seine
[3] 10% of collection accidentally lost

TABLE 3

Size range (total lengths in inches) for brook, brown and rainbow trout and several other species, summarized by stream drainage unit, Chocolay River Drainage System, Marquette County, July and August, 1951, and August and September, 1952 (Average length of trout within parentheses)

Stream drainage unit	SPECIES					
	Brook trout	Rainbow trout	Brown trout	E. mottled sculpin	Brook stickleback	W. blacknose dace
Chocolay River	2.7 6.5 (4.0)	1.4 8.5 (4.1)	13.3	1.0 4.1	1.7 2.2	1.8 2.1
Silver Creek	1.9 10.6 (4.5)	2.0 9.0 (5.7)	5.1 16.2 (7.8)	0.8 4.4		
Cherry Creek	3.5 10.0 (6.3)	3.0 9.9 (5.1)	2.4 16.0 (4.9)	1.1 4.5		
George's Creek	1.8 7.9 (3.5)		9.0	1.4 3.5		
Cedar Creek	1.6 10.3 (3.6)	3.0 9.3 (6.2)	6.0 8.3 (7.1)	1.4 4.4		
Massie Creek	1.8 7.8 (3.5)			1.6 3.1		
Big Creek (No Name Trib. included)	1.8 8.3 (4.5)	1.0 9.7 (4.5)	4.5 19.8 (8.7)	1.4 4.5		
Voce Creek	5.2 10.7 (7.1)				1.0 2.1	
Dorrow Creek					1.2 2.5	
Mud Creek and Mud Lake outlet	2.0 10.6 (5.3)			1.9 4.2	1.0 2.3	1.7 3.2
Mud Creek, E. Branch	2.2 9.7 (6.3)			1.8 4.5	1.2 2.3	1.8 3.9
Foster Creek	1.0 8.0 (4.3)	1.2 8.8 (4.0)	7.7 10.4 (9.0)	0.9 4.3		

TABLE 3 (cont.)

Size range (total lengths in inches) for brook, brown and rainbow trout and several other species, summarized by stream drainage unit, Chocolay River Drainage System, Marquette County, July and August, 1951, and August and September, 1952 (Average length of trout within parentheses)

Stream drainage unit	SPECIES					
	Brook trout	Rainbow trout	Brown trout	E. mottled sculpin	Brook stickleback	W. blacknose dace
O'Neil Creek				3.3		3.8
Wilson Creek	4.4 9.6 (6.7)	1.8 6.1 (4.9)			1.9	1.7 3.6
Nelson Creek	2.2 9.5 (4.6)	1.9 8.9 (4.6)		1.1 4.1	1.4 2.3	1.5 3.9
Nelson Creek, W. Branch	2.7 (5.6) 9.5	1.7 (3.4) 7.8		2.0 3.8		2.4 3.4
Chocolay River, W. Branch	2.0 8.8 (5.3)	1.3 8.8 (4.2)	3.3	1.2 4.3	1.4	2.0 3.5
Wise Man Creek	1.6 (3.0) 6.4	1.1 (1.4) 1.7		1.9 3.5		
No Name, Trib. to Wise Man Cr.	2.4 (4.3) 7.0	3.8 (4.5) 5.5		2.3 3.4		
Mattson Creek	1.5 (5.1) 8.7	3.3 (6.8) 8.7				
Chocolay, E. Br.	2.4 (4.3) 6.6	1.3 (3.4) 6.1		1.1 3.8	2.1	0.7 3.2
Sheans Creek	2.6 (5.3) 7.0					1.9 3.7

Fish Fauna of the Drainage System

Twenty-five species of fish were collected in the Chocolay River drainage. Game fish collected were brook, brown, and rainbow trout, northern pike, yellow perch, rock bass, and pumpkinseed sunfish. Most of the warm-water game fish were collected on the lower part of the main stream. A resident population of northern pike is known to exist in the bayous near the mouth of the river. American brook, Michigan brook and sea lampreys were also found in this system, with the first-named species the most widely distributed. Although the majority of lampreys were found in the main river below Yalmer, it is likely that the American and Michigan brook lampreys are more widely distributed than is indicated by this survey. Only two positively identified sea lamprey larvae were collected; these were taken at Station 52, approximately 1½ miles above the site of the new mechanical weir. Operation of the Burkey Electric Fish Screen since the spring of 1951—located on the Chocolay where M-28 bridges the river—and the characteristically cold water streams of the system probably account for the limited distribution and small numbers of sea lampreys. Of the other fish collected, the following species occurred most frequently, listed in decreasing order of abundance: mottled sculpin, blacknose dace, brook stickleback, mudminnow, white sucker, longnose dace, creek chub, redbelly dace, and burbot. While catch-per-hour was calculated for all species of fish collected in the drainage, only the more common species are listed in Tables 2 & 3.

Of the three species of trout, brook trout were most numerous and widely distributed and brown trout the least common. Fish were collected at a total of 56 stations, representing sample areas on 24 main streams and tributaries. Brook trout were collected at 42 stations in 21 streams, rainbow trout at 31 stations on 14 streams, and brown trout at 13 stations on 6 streams. However, there were some limiting factors which reduced the efficiency of the collecting gear; and, therefore, distribution of trout may not exactly be as shown by the survey results. In particular, dark and deep waters of the Chocolay River at and

below Station 51 prohibited the efficient use of the electric shocker, so a gill net and bag seine were used to obtain a sample of fish. It is thought that neither the net nor the seine was very efficient either, and that trout, based on reports and observations, do inhabit this area. One other point should be made which has an important bearing on the distribution of trout. Rainbow and brown trout are apparently kept out of three areas by natural barriers. Falls on the West and East branches of the Chocolay appear to limit rainbow trout to the lower sections of these streams. In the third area, the Mud Creek drainage system, the combination of Kawbawgam and Mud lakes apparently is a barrier to migrating rainbows.

Common names used herein are in accordance with the Check List of the Fishes of Michigan (Unpublished), revised to February 15, 1952, by Reeve M. Bailey, Curator of Fishes, Museum of Zoology, University of Michigan. Identifications of the majority of fish were verified by W. R. Taylor of the Institute of Fisheries Research and doctoral studeht in ichthyology at the University of Michigan.

List of Fishes in the Chocolay River Drainage System *

Game Fish	Scientific Name *
Brook trout	Salvelinus fontinalis
Brown trout	Salmo trutta
Rainbow trout	Salmo gairdneri
Northern pike	Esox lucius
Yellow perch	Perca flavescens
Pumpkinseed	Lepomis gibbosus
N. rock bass	Ambloplites r. rupestris
Coarse Fish	
White sucker	Catostomus c. commersoni
Eastern burbot	Lota lota lacustris
Brown bullhead	Ameiurus n. nebulosus
Lampreys	
Michigan brook lamprey	Ichthyomyzon fossor
American brook lamprey	Lampetra lamottei
Sea lamprey	Petromyzon marinus
Forage Fish	
N. creek chub	Semotilus a. atromaculatus
W. blacknose dace	Rhinichthys a. meleagris
Longnose dace	Rhinichthys cataractae
N. pearl dace	Semotilus m. nachtriebi
Finescale dace	Chrosomus neogaeus
N. redbelly dace	Chrosomus eos
N. fathead minnow	Pimephales p. promelas
Central mudminnow	Umbra limi
Central Johnny darter	Etheostoma n. nigrum
E. mottled sculpin	Cottus b. bairdi
E. slimy sculpin	Cottus cognatus gracilis
Brook stickleback	Eucalia inconstans

* Names follow Bailey, 1952 (unpublished check list of the fishes of Michigan).

Age and Growth

Young-of-the-year brook trout were found in 18 of the 24 streams examined, and comprised 34.1 per cent of the total brook trout collected. Streams which were known to hold a high percentage of fingerling trout were Cedar and Foster creeks and the West Branch of the Chocolay. Best growth (determined from collections totalling 5 or more fish) was shown by fingerling trout in the West Branch of the Chocolay, Nelson Creek, and the upper reaches of the main stream. Slow growth rates were exhibited by trout from streams with low temperatures—Foster Creek, No Name Tributary to Big Creek, George's Creek, Massie Creek and the headwaters of Cedar Creek.

Yearling and sub-legal trout were collected in 21 main streams and tributaries. This group of fish represented 59.7% of the brook trout taken. Especially poor were growth rates in the following streams: Tributary to Big Creek, Foster, Massie, George's, Silver, and Wise Man creeks and West Branch of the Chocolay.

Legal brook trout amounted to 65 fish or 6.2 per cent of the total brook trout collected. Twenty per cent of these were judged as being of hatchery stock. The average size of legal trout, including hatchery fish, was 8.6 inches. Cedar Creek, a stream which had not been stocked with legal-size trout since 1944, held the highest number of legal brooks, which averaged 9.1 inches. Other streams which contained comparatively large numbers of legal brooks were: Mattson Creek (11 - av. 7.6 inches), Mud Creek (8 - av. 8.9 inches), and Silver Creek (8 - av. 8.4 inches). Of 21 streams containing brook trout, 18 contained legal trout. Streams where shocking did not reveal any legal brook trout were the Chocolay River, Wise Man Creek and E. Branch of the Chocolay. Age composition of legal trout were as follows: Age group I - 1.5 per cent, Age group II - 82.5 per cent, and Age group III - 17.0 per cent.

Excluding the Cherry Creek collections and other streams where trout collected totalled less than 5 fish, fastest growth was made by brook trout of Age group II in Big Creek, Cedar Creek, Mattson Creek and Tributary to Wise Man Creek.

Streams containing slow growing fish were Tributary to Big Creek, Foster, George's and Silver creeks. The sample of brook trout in Age group III was too small to make any valid comparisons among the various streams.

Comparison of Growth of Brook Trout in the Chocolay, Pine and Carp River Watersheds

	Age group			
Stream	0	I	II	III
Chocolay River System	2.5	5.0	6.7	9.9
Pine River System	2.4	5.2	8.0	
Carp River System	2.3	5.8	8.4	

Trout from the Pine and Carp watersheds were collected slightly earlier in the summer than those from the Chocolay watershed. However, it is suspected that the growing season begins later in the Chocolay.

Under this assumption the differences in length of growing seasons for the two watersheds would be small. Because of the biased effect on Age-group-II-fish by the inclusion of hatchery trout, (particularly significant in the Pine River collection) only average lengths from Age-group 0 and I are safely comparable. There appears to be little difference in growth rates of brook trout in their first and second summers from the Chocolay and Pine river watersheds. However, growth of brook trout in their second summer of life collected from the Carp River exceeds those trout taken from the Chocolay River. This, in part, is probably due to warmer stream temperatures in the Carp River watershed.

Rainbow trout were collected in 15 of the 24 streams surveyed. Fifty-five or 8.3 per cent of the rainbows collected (which did not include lake-run rainbows) were of legal size and averaged 8.3 inches. Two of these fish, or 4.1 per cent, (collected on Cherry Creek) were assumed to have been of hatchery origin. Of the legal rainbows, the composition by age groups were: Age group I—5.6 per cent, Age group II—53.7 per cent, and Age group III—40.7 per cent.

Comparatively good growth was displayed by rainbows in the Chocolay, the East and West branches of the Chocolay, Foster, Big and Nelson creeks, and the West Branch of Nelson Creek. In other streams of the drainage system rainbows were few in number.

Samples of rainbow trout from the Pine River drainage were too small to permit a good evaluation of growth rates between streams. However, empirical averages of rainbows taken in the fall of 1952 from the Black River, Mackinac County, were used for comparison with averages for the Pine River drainage. The collection from the Black River consisted of rainbows in Age groups 0 and I and represented growth nearly or entirely completed for the year. Average lengths for rainbows in Age groups 0 and I from the Chocolay drainage were 2.1 and 4.9 inches respectively, whereas those from the Black were 2.9 and 6.3 inches. Growth of rainbows in Age group I for the Chocolay appear somewhat retarded in comparison, but in Age group 0, considering the difference in time of collection, the rate of growth is not appreciably different.

Brown trout were collected in only eight streams of the system. There were no scales for the 13.3-inch brown trout collected at Station 37; therefore, there is no record for this fish in Table 4. The area around this station is noted for its brown trout fishing. Other streams which appear to be among the more suitable for brown trout on the basis of numbers collected were Cherry, Silver and Big creeks.

There is some natural propagation of brown trout in the Chocolay drainage system, but whether browns are produced in significant numbers is not apparent from the results of the survey. Young-of-the-year browns were collected only in Cherry Creek and the West Branch of the Chocolay, and yearlings in Silver, Cherry, Cedar, and Big creeks. The composition of the catch of brown trout by size was in reverse order to that for brooks and rainbows; only two fingerlings were collected and 56 per cent of the collection consisted of legal trout. Of the legal trout, 1.8 per cent were of Age group I, 23 per cent—Age group II,

26 per cent—Age group III, and 5 per cent—Age group IV. Three-fourths of the legal-size browns were of hatchery origin.

Average lengths given in Table 4 were computed by using both hatchery and native trout. Average lengths for trout which would be biased by combining those of hatchery trout are as follows:

Massie Creek - Age group II brook trout
West Br. of Chocolay - Age group II brook trout
Silver Creek - Age group III brook trout; Age group II, III, IV brown trout
Cherry Creek - Age group I, II, III brook trout; Age group II, III, IV brown trout; Age group I, II rainbow
George's Creek - Age group III brown trout
East Br. Chocolay - Age group I brook trout
West Br. Nelson - Age group 0 brook trout
Wilson Creek - Age group III brook trout
Cedar Creek - Age group II brown trout

It is of interest to note that both brook and rainbow trout, when classified according to groups as fingerling, yearlings and sub-legal, and legals, were collected approximately in the same proportion throughout the watershed. Also proportionately similar were the number of brook and rainbow trout collected in each age group. By species, the percentages of trout collected in the Chocolay River system were: brook—58, rainbow—37, brown—5. Total number of trout collected were: brook—1,049, brown—665, and rainbow—99.

Composition (in Per cent) by Size for
Each Species of Trout Collected in the Chocolay Drainage System

	Brook	Rainbow	Brown
Fingerlings	34.1%	34.1%	2.0%
Yearlings and sub-legals	59.7%	58.1%	42.0%
Legal	6.2%	7.8%	56.0%

TABLE 4

Average total lengths in inches and numbers of trout in various age groups, summarized by stream drainage unit, Chocolay River drainage, Marquette County, July and August, 1951, and August and September, 1952

Species and stream drainage unit	Age group					Number of fish				
	0	I	II	III	IV	0	I	II	III	IV
Brook Trout										
Chocolay River	3.2	5.4				20	10			
Silver Creek	2.3	4.9	5.6	9.8		13	43	25	2	
Cherry Creek		5.0	7.1	10.0			5	5	1	
George's Creek	2.2	4.2	5.9			17	12	6		
Cedar Creek	2.4	5.0	7.7	10.4		47	97	15	3	
Massie Creek	2.3	4.6	6.9			20	16	2		
Big Creek	2.2	4.6	6.8			6	53	7		
No Name trib. to Big Creek	2.3	4.2	5.8			7	20	12		
Voce Creek		5.3	10.7				2	1		
Mud Creek	2.3	5.8	8.1	9.6		11	6	4	4	
Mud Creek, E. Br.	2.2	6.6	9.7			1	2	1		
Foster Creek	2.2	4.7	6.3			61	68	18		
Wilson Creek		4.4	6.2	9.6			1	1	1	
Nelson Creek	2.8	5.3	8.3			29	56	3		

TABLE 4 (cont.)

Average total lengths in inches and numbers of trout in various age groups, summarized by stream drainage unit, Chocolay River drainage, Marquette County, July and August, 1951, and August and September, 1952

Species and stream drainage unit	Age group					Number of fish				
	0	I	II	III	IV	0	I	II	III	IV
Nelson Creek, W. Br.	2.8	5.6	8.7			2	5	2		
Chocolay, W. Br.	3.1	5.2	8.3			44	85	2		
Wise Man Creek	2.2	4.6				28	19			
No Name trib. to Wise Man Creek	3.0	5.0	6.9			24	20	7		
Mattson Creek	2.4	5.0	6.9			17	19	21		
Chocolay, E. Br.	3.3	5.6				9	6			
Sheans Creek	3.2	6.7				2	3			
Average	2.5	5.0	6.7	9.9	Total	358	548	132	11	
Wt. average	2.6	5.1	7.4	9.9						
Rainbow Trout										
Chocolay River	2.0	5.5	8.8	13.2		32	66	7	1	
Silver Creek	2.0	4.6	9.0	11.4		1	6	2	1	
Cherry Creek		3.9	9.2				7	2		
Cedar Creek		4.0	6.7	8.0			9	10	9	
Big Creek	1.1	3.8	6.4	8.4		9	33	17	5	

TABLE 4 (cont.)

Average total lengths in inches and numbers of trout in various age groups, summarized by stream drainage unit, Chocolay River drainage, Marquette County, July and August, 1951, and August and September, 1952

Species and stream drainage unit	Age group					Number of fish				
	0	I	II	III	IV	0	I	II	III	IV
No Name trib. to Big Creek		4.1	6.1	7.5			8	1	1	
Foster Creek	1.6	4.7	6.2			16	39	6		
Wilson Creek	1.8	5.9				1	3			
Nelson Creek	2.4	4.8	7.4			12	47	8		
Nelson Creek, W. Br.	1.7	4.9	7.6			14	11	2		
Chocolay, W. Br.	2.5	5.4	7.0	7.7		65	79	19	4	
Wise Man Creek	1.2					36				
No Name trib. to Wise Man Creek		4.2	5.5				3	1		
Mattson Creek		3.3	6.6	8.7			1	1	2	
Chocolay, E. Br.	2.5	4.8				41	27			
Average	2.1	4.9	7.1	8.5		Total 227	339	76	23	
Wt. average	1.9	4.6	7.2	9.3						
Brown Trout										
Silver Creek		5.7	12.7	14.1	15.2		12	1	1	2
Cherry Creek	2.4	5.6	8.2	11.5	16.0	1	21	17	19	1

TABLE 4 (cont.)

Average total lengths in inches and numbers of trout in various age groups, summarized by stream drainage unit, Chocolay River drainage, Marquette County, July and August, 1951, and August and September, 1952

Species and stream drainage unit	Age group						Number of fish				
	0	I	II	III	IV		0	I	II	III	IV
George's Creek				9.0						1	
Cedar Creek		6.0	8.3					1	1		
Big Creek		5.1	8.4	12.9	19.8			7	6	4	1
Foster Creek			7.7	10.4					1	1	
Chocolay, W. Br.	3.3						1				
Average	2.8	5.6	8.4	11.7	16.6	Total	2	41	26	26	4
Wt. average	2.8	5.6	9.1	11.6	17.0						

Stocking Effects

Both brook and brown trout are stocked in streams of the watershed. No rainbows are planted since native lake-run rainbows insure a stock each spring. Generally, brown trout have been stocked only in the lower portion of the Chocolay River, below Station 52, whereas brook trout are stocked in the majority of streams. None of the brown trout were marked in any way for ready identification by the survey crew, and only one plant of brook trout was marked.

It was a matter of judgement as to which troutwere of hatchery origin. Table 5 has been prepared to show the size, number and species of trout stocked at, or within 1½ miles of, each survey station prior to the fish collection date for both 1951 and 1952. A brief history of previous stockings (1944-50) is also given but is not considered of much importance since it is commonly known that winter survival of planted trout is small, especially for brook trout. Based on the lengths, species, and age of these trout and the characteristic pattern of circuli of hatchery-reared trout, the author has made an attempt to distinguish between hatchery and native trout. In the majority of cases, the possibility of hatchery trout being intermixed with native trout in the same collection was eliminated on the basis of size and age alone. Where trout in other collections were of the same age and of similar lengths as those planted prior to the survey, it was decided to treat all fish with lengths which fell within the expected extremes of the average size planted as hatchery trout. If there was a possibility that trout, especially browns, could have been holdovers from previous year plantings—based on age and length—they, too, were considered as hatchery fish.

One case in particular presented a problem. The Marquette State Fish Hatchery rearing ponds and raceways receive their water supply from Cherry Creek and trout escape into the stream from the ponds and raceways. It is more than likely that escaped trout are more numerous downstream from the hatchery where there are no obstructions than upstream where there is a series of dams. All brook trout

collected below and immediately above the hatchery and 45 brown trout were considered to have been hatchery fish. It is the author's feeling that the trout designated as of hatchery origin represent a generous estimate.

Of the total number of brook trout collected, 5.4 per cent were assumed to have been hatchery trout. Excluding the Cherry Creek collections would decrease the percentage for the watershed to 4.4. Hatchery-reared brown trout amounted to 52 per cent of the total collection of this species. This high figure is due to the large number of brown trout taken in Cherry Creek; excluding this part of the collection, the percentage would be 17 per cent. Hatchery trout comprised the following percentages, by species, of legal-size trout collected in the river system: brook—20, brown—75, rainbow—4.1. The percentages given for brown trout are not as reliable as those for brook trout because of the difficulty encountered in distinguishing between hatchery and native trout. The effect on the streams of the watershed from hatchery-escaped rainbows is probably negligible since there is a large spring run of rainbows from Lake Superior each year.

The only plant of marked brook trout was made on August 10, 1951, on the main Chocolay at and above Yalmer and in the East Branch these trout were marked by clipping the right pectoral fin. Unfortunately, survey stations in these areas were either done before this planting or in the following year; hence, no marked trout were collected by either crew. Two plantings of hatchery brook trout in 1952, one each at Stations 49 and 50, approximately two weeks prior to shocking, failed to reveal a single fish which could have been of hatchery origin.

Evidence presented here appears to bear out the findings of repeated investigations in Michigan that trout stocking, particularly in the case of brook trout, results only in a temporary build-up of the population. In certain portions of streams, especially shallow, cold-water streams, where there is a high population of native trout (i.e., Silver, Cedar and Foster creeks), stocking may exert a detrimental effect by increasing competition for a limited food supply.

TABLE 5

Record of recent fish plantings by stream and survey station number and a brief history of previous stocking from 1944 to 1952

Stream and station number	Number, size, and species of fish planted, & date of planting (plantings up to 1½ miles of collecting station) 1951	1952	Brief history of previous stockings (1944-52) by stream drainage unit
Chocolay River			
51		800, 7.9" Brn. trout 6/24/52	- Brook trout and brown trout, legal size,
52		50, 7.9" Brk. trout 5/7/52 & 600 7.9" Brn. trout 6/24/52	- stocked from station 52 to the mouth from 1945-1952. (in 1950 brn. t. averaged 7.6 & 9.7")
36	50, 7.9" Brk. trout 5/9/51		- Stocked with brk. trout 1944-1951
35	75, 7" Brk. trout 8/10/51 175, 7.9" Brk. trout 4/5-4/26/51		- Stocked with brk. trout 1944-1951
34	150, 7", Brk. trout 8/10/51 550, 7.9" Brk. trout 4/5-6/6/51		- Stocked with brk. trout 1944-1951
Silver Creek			
2	3,000 3" Brk. t. (beaver pond) 5/1/51	4,000 2.5 Brk. t. 10/1/52 -USFW	- Silver Creek stocked from 1944-46, 1951-52; heavily stocked with brk. t. in 1945
Cherry Creek			- Stocked with brk. trout 1945-48
Cedar Creek			
7	3,000 3.0" Brk. t. (beaver pond) 5/1/51		- Stocked with brk. t. 1944 and 1951
46	4,000 2.5" Brk. t. 10/1/51		
Big Creek			
9	4,000 2.5" Brk. t. 10/1/51 2,000 3" Brk. t. 5/8/51		- Stocked with brk. t. 1944-46, and 1951
Mud Creek			- Stocked with brk. t. in 1946
Foster Creek			
48 & 14	4,500, 2.5" Brk. t. 10/2/51		- Stocked with brk. t. fingerlings in 1951
Wilson Creek			
22	1,500, 3" Brk. t. 5/8/51		- Stocked with fingerling brk. tr. in 1951

TABLE 5 (cont.)

Record of recent fish plantings by stream and survey station number and a brief history of previous stocking from 1944 to 1952

Stream and station number	Number, size, and species of fish planted, & date of planting (plantings up to 1½ miles of collecting station) 1951	1952	Brief history of previous stockings (1944-52) by stream drainage unit
Nelson Creek			
20	1,000, 3.5" Brk. t. 7/10/51 1,500, 3" Brk. t. 5/7/51		- Stocked with fingerling brk. t. in 1946 and 1951
Nelson Creek, W. Br.			
19			- Stocked with fing. brk. trout in 1946 & 1951 in headwaters
Chocolay, W. Br.			
50		375, 7.3" Brk. tr. 9/3/52 1075, 7.9" Brk. tr. 4/21-6/13/52	
16	150, 7.9" Brk. tr. 4/26-6/6/51		- Stocked with brk. tr. 1945-46, 1948-52
41	3,000, 3.5" Brk. tr. 7/10/51		
Chocolay, E. Br.			
49		375, 7.3" Brk. tr. 9/3/52 1050, 7.9" Brk. tr. 4/21-6/13/52	- Stocked with brk. tr. 1944-1952
18	225, 7" Brk. tr. 8/10/51 425, 7.9" Brk. tr. 4/5-5/9/51		
31	150, 7" Brk. tr. 8/10/51 425, 7.9" Brk. tr. 4/5-5/9/51		
17	200, 7" Brk. tr. 8/10/51 200, 7.9" Brk. tr. 4/5-5/9/51		

Physical Features

The Chocolay River drains an area of approximately 94,000 acres located in the following townships of Marquette County: West Branch, Sands, Forsyth, Chocolay, and Skandia. The surrounding terrain is characterized by rolling to rugged topography, sandy to gravelly moraines, fairly rich soils, and coniferous to mixed northern hardwood forests.

Streams which flow through farming regions of rolling topography are: Voce, Foster, Snake, O'Neil, Nelson, and Wilson creeks, the upper third of Mud Creek, East Branch of the Chocolay, and the Chocolay River between stations 50 and 35. North of Station 52, bottom soil types in the Chocolay are typically sand and silt. Similar in composition were the stream bottoms of tributaries east of US-41 and north of the road to Station 52; exceptions to this pattern are Mud Creek and its East Branch which contain both gravel and sand. Bottom soils of the majority of the other tributaries which lie to the south and west consist predominantly of sand and gravel (see Table 6).

Most of the streams of the watershed are colorless and clear. Those which are murky are the Upper Chocolay, Voce and Dorrow creeks and the lower half of Mud Creek. Streams dark brown to light brown in color were the Chocolay River, East Branch of the Chocolay, the lower section of Mud Creek, East Branch of Mud Creek, and Dorrow, Sheans, Nelson, Wilson, and O'Neil creeks. In general, flow is rapid and pools were classified as fair. Cover afforded by riffles, boulders, logs, and dark water was good but aquatic vegetation was sparse.

Sections of streams surveyed which were exceptionally shallow and lacked adequate pools for trout are located in the upper half of Silver Creek, Massie, East Branch of Mud, West Branch of Nelson and Wise Man creeks, and the area around Station 54 on the W. Branch of the Chocolay. Bank erosion does not present a serious problem along most streams of the watershed. However, on the Chocolay River erosion of high sand banks is common. Beginning one-half mile upstream from Station 36, erosion is progressively worse downstream toward Station 39.

Approximately half the distance from Station 51 to Station 39 there are many cottages on the banks of the river; in some areas the owners have attempted to control bank erosion by installing riprap and cement bulwarks. These structures have only temporarily corrected the condition and are now in immediate need of repair.

It is reported that during years when there are extended warm periods without rain, both Dorrow Creek and the East Branch of Mud Creek (at Station 25) nearly or completely dry up. However, further upstream, on the East Branch of Mud Creek, this condition was not reported by the survey crew. Sources of water for both of these streams are swamps and springs.

TABLE 6. Physical features

Stream and station number	Average width	Average depth	Current	Pool classification	Cover for trout	Vegetation	Percent - bottom soil types: Sand	Gravel	Silt	Clay	Others
Chocolay											
39		0.5-10'	?	poor	good	good	100	...	...	...	...
M1		0.5-10'	?	poor	good	good	100	...	...	...	...
51	51'	49"	rapid	good	good	good	95	...	...	...	5% silt & detritus
M2	37'	3.5'	rapid	fair	good	good	...	...	...	...	100% silty sand
43	37'	3.5'	rapid	fair	good	good	...	...	...	...	100% silty sand
43a		3"-3.5'	sluggish-rapid	fair	fair	fair	...	...	...	...	silty sand and silt
53	39'	22"	rapid	fair	good	good	10	...	15	...	75% silty sand
37	45'	20.5"	rapid	poor	fair	poor	100	...	...	...	...
52	46.5'	2'	rapid	poor-fair	poor	poor	...	...	...	...	-silty sand 70%, fine & coarse gravel covered with silt 30%
36	50.7'	8.8"	rapid	poor	good	poor	10	70	...	...	-20% boulders
35	40.3'	17.4"	rapid	poor	good	poor	50	40	...	...	-10% boulders
34	25'	12.3"	rapid	poor	good	poor	35	60	...	3	2% boulders
Silver Creek											
3	9'	13"	rapid	fair	good	poor	(gravel and sand)				...
44	11.5'	1'	rapid	good	good	fair	90	...	5	...	5% detritus
1	45"	3"	rapid	poor	poor	poor	90	10	...	...	...
2	4.6'	0.5'	rapid	poor-fair	good	poor	10	90	...	...	...
Cherry Creek											
5	23.0'	20"	rapid	poor-fair	good	good	90	10	...	...	...
4	18.0'	1'	rapid	good	fair	fair	90	10	...	...	...
George's Creek											
28	8.2'	6.3"	rapid	poor-fair	good	good	78	22	...	...	...
Cedar Creek											
6	16'	15"	rapid	fair	good	poor	100	...	...	...	...
7	13.5'	14"	rapid	fair	good	good	80	12	7	...	1% boulders
46	30'	10"	sluggish	good	fair	poor	50	...	50	...	...
Hassie Creek											
45	8.5'	5"	rapid	poor	poor-fair	fair	65	35	...	...	...
Big Creek											
8	21.3'	17.4"	rapid	fair-good	good	poor	80	...	...	10	10% silty sand
9	22.7'	14"	rapid	poor-fair	good	good	90	3	...	...	7% silty sand
10	25'	9"	rapid	fair	good	fair	80	20	...	...	...
11	11'	9.6"	rapid	fair	good	fair	90	10	...	...	...
No Name Creek, trib. to Big Creek											
47	6.5'	8"	rapid	fair	good	poor	90	5	...	...	5% silt & detritus
Voce Creek											
33	5.5'	7"	sluggish	fair	fair	poor	70	5	5	20	...
Borrow Creek											
23	8.8'	11.2"	rapid	good	good	fair	70	...	...	...	25% muck 5% detritus
Mud Lake Outlet											
38	7.3'	13.2"	rapid	fair	good	good	...	...	...	...	silt & muck, sand underneath
Mud Creek											
24	19.5'	7.5"	rapid	fair	good	poor	10	80	...	...	10% bed rock
27	4'	7"-	rapid	poor-fair	fair	poor	70	25	5	...	...
Mud Creek, E. Br.											
25	10.1'	3"	rapid	poor	poor	poor	30	65	5	...	...
26	5'	6"	sluggish	poor-fair	poor	poor	40	60	...	...	...
Foster Creek											
12	9.2'	9.5"	rapid	fair-good	good	poor	25	70	3	2	...
48	7.5'	6"	rapid	fair	good	fair	...	...	...	...	sand, silty sand & silt
14	4.5'	11"	sluggish	fair-good	good	poor	70	10	...	...	20% detritus
O'Neil Creek											
13	4.7'	5.8"	rapid	good	good	poor	40	55	...	...	5% boulders
Wilson Creek											
22	9'	8"	rapid	fair	good	fair	70	25	...	...	5% boulders
Nelson Creek											
21	16'	5.3"	rapid	fair	good	fair	10	80	...	...	10% boulders
55	18'	10"	sluggish	poor-fair	poor	poor	15	30	45	...	10% silty sand
20	13.5'	8"	rapid	fair	fair	poor	20	70	...	...	10% boulders & bedrock
40	3.8'	3.8"	rapid	fair	fair	poor	90	10	...	...	...
Nelson Creek, W. Br.											
19	9.2'	4.4"	rapid	poor	good	poor	15	80	...	...	5% boulders
Chocolay River, W. Br.											
50	23'	7"	rapid	poor-fair	poor	poor	...	90	...	...	10% silty sand
16	22'	16"	rapid	fair	good	fair	60	25	...	...	10% silty sand 5% boulde
41	15'	12.7"	rapid	fair	good	good	50	40	10	...	...
54	22'	7"	rapid	poor	good	fair	45	55	...	...	...
42	11'	18"	sluggish	fair	good	good	...	...	...	...	100% silt & muck
Wise Man Creek											
15	5'	6.3"	sluggish	poor	fair	poor	60	35	...	5	...
No Name, trib. to Wise Man Cr.											
29	6.5'	5"	rapid	fair	good	good	90	10	...	...	...
Mattson Creek											
30	6'	4.7"	rapid	fair	good	poor	95	5	...	...	...
Chocolay, E. Br.											
49	25.5'	13"	rapid	fair	poor	poor	...	100	...	...	...
18	27.7'	8.2"	rapid	fair	fair	poor	10	80	...	...	10% boulders
31	11.3'	14.5"	rapid	poor	fair	fair	95	5	...	...	...
17	21'	3'	sluggish	good	fair	good	...	...	...	...	gravel & sand covered with muck
Sheans Creek											
32	6.4'	7"	sluggish	f-g	fair	poor	85	15	...	...	...

Temperature Survey

Routine procedure at fish collection stations included the taking of water and air temperatures. But because of the considerable length of time required to complete a stream survey and the likelihood that cool weather would prevail a goodly share of the time during this period, an independent temperature survey was taken during hot weather. Hence, a temperature series was obtained in the afternoon of August 1, 1951, after a week of higher than normal average summer temperatures. However, this survey was incomplete, and in 1953 another temperature survey was run during the afternoon of August 22. In all, 58 temperature stations were set up on 23 of the 26 major streams in the watershed.

In order to determine which streams or portions thereof might reach temperatures critical for trout, the following material was consulted: stream temperature surveys, temperatures taken in conjunction with fish collections (1951 and 1952), climatological data (U. S. Weather Bureau, 1942 through 1952) recorded at Marquette, Michigan, the nearest temperature recording station, and readings from the USFWS thermograph located on the Chocolay River near temperature Station 4.

Generally, streams of the Chocolay watershed do not reach lethal temperatures for trout. Possible exceptions are Dorrow and Mud creeks, the lower portions of the East Branch of Mud and Voce creeks, and the upper reaches of both Nelson Creek and the East Branch of the Chocolay. At Station 46 on Mud Creek, water temperatures were not excessively warm. Due to insufficient data from this station downstream to Station 45 and because of the small pond, open terrain, and beaver impoundments observed on aerial photographs of this area, this section of stream has been classified as rainbow trout water as temperatures may at times exceed the requirement of brook trout. Although the temperature survey did not show very high temperatures on the East Branch, readings taken in these areas during the biological and physical inventory indicated excessive warming (see Table 8). At fish collection

Station 25, the recorded air temperature was 69° and water 72°, while at fish collection Station 24 on Mud Creek, just below the confluence with the East Branch, the air temperature was 74° and the water 74°. Two beaver ponds have also been observed on aerial photographs of the East Branch near fish collection Station 25, which might account for the warm water temperature at this point. It is not conclusive which of the two streams - Mud Creek or the East Branch of Mud Creek - is the cooler. However, it has been reported that on occasion the East Branch practically dries up, when it would be of little significance in warming Mud Creek.

Both Mud and Kawbawgam lakes serve as warming basins for the waters of Mud Creek, and this stream warms the Chocolay River to some extent. Recently a dam was erected across the outlet of Mud Lake to raise the water level and improve wildfowl habitat. The effect of this structure on temperatures is not certain at this time. Dorrow Creek, which flows into Mud Creek below the outlet of Lake Kawbawgam, may exercise a cooling effect most of the summer months, but this stream also is reported to dry up during hot periods. Voce Creek, another stream which tends to warm, evidently does not receive much ground water between Stations 39 and 38 since it had warmed at the latter station. While this tributary flows through a fairly open area between US-41 and County Road 480, it doesn't seem that it should warm this quickly from lack of shade alone. Between Station 38 and the mouth, Voce Creek receives the outflow from Orchard Lake, which is shallow. Inaccessibility limited the number of stations on Voce Creek to two, which were above the Orchard Lake outlet. Some further investigation might be made near the mouth to ascertain the effect of Voce Creek on temperatures in the Chocolay.

The upper reaches of Nelson Creek, from Stations 60 to 57, flow through open farming country. Although stream temperatures taken during the temperature survey were below the lethal limits for brook trout, water temperatures taken during the biological and physical survey indicated that a serious warming may occur.

Open meadow land and dark and sluggish water were probably the chief causes for the warm water at Station 18 on the East Branch of the Chocolay. At this location,

the stream was very wide as compared with lower sections of the stream. This might have been the result of an old beaver dam which was reported to have had a head of one foot. Below Station 18, however, the stream narrows and water temperatures were lower.

Some of the streams in the watershed are very cold. Water temperatures on Silver, Cherry, Cedar, George's, Mattson, Wise Man and Big creeks probably never go much above 60°, and during the major part of the year never reach this temperature. The effect which Silver, Cherry, Cedar and Big creeks exert on the Chocolay is very pronounced. Between Stations 5 and 6 on the Chocolay, where Big and Cedar creeks empty, there was a drop in water temperature of 10°. Below the mouth of Cherry Creek there was another degree drop in temperature. A temperature of 57° was maintained by the remainder of the Chocolay, at least to Station 2 near the mouth.

Temperature recordings from 1951 through 1953 by the USFWS thermograph on the Chocolay River below highway M-28 disclosed that water temperatures commonly exceeded 60° during June and July. The maximum monthly mean for June, over the three year period, was 62° and during July it was 65°. For short periods during July 1952 and June 1953, water temperatures reached 72° and 70°, respectively. Generally it was during the period of 5:00 P.M. to 9:00 P.M. that high temperatures were registered. It is likely that water temperatures recorded at least on some sections of the drainage system during the survey were several degrees lower than the maximum for the day.

TABLE 7

Temperature survey data on the Chocolay River drainage, August, 1951, and August, 1953

Stream and station number	Location	Date	Time	Air temperature (°F)	Water temperature (°F)
Chocolay River					
T1	T47N R24W S6	8-1-51	2:55PM	63°	62°
↓ T2	47-24-6	8-22-53	↓ 12:45PM	74°	57°
T3	47-24-8	8-1-51	3:00PM	63°	61°
↓ T4	47-24-8	8-22-53	1:20PM	80°	57°
T5	47-24-8	8-22-53	1:20PM	80°	58°
T6	47-24-10	8-22-53	1:35PM	74°	68°
T7	47-24-14	8-22-53	1:50PM	80°	69°
T8	47-24-24	8-1-51	4:55PM	67°	68°
↓ T9	47-24-24	8-22-53	2:50PM	76°	65°
T10	47-24-25	8-22-53	3:45PM	80°	68°
T11	46-24-1	8-22-53	4:05PM	78°	67°
T12	46-24-14	8-22-53	4:00PM	80°	62°
Chocolay, West Branch					
T13	46-24-23	8-22-53	3:58PM	76°	62°
T14	46-24-22	8-22-53	3:55PM	70°	60°
Chocolay, East Branch					
T15	46-24-23	8-22-53	4:00PM	80°	62°
T16	46-24-26	8-22-53	2:50PM	79°	64°
T17	45-24-2	8-22-53	2:19PM	80°	63°
T18	45-24-12	8-22-53	2:10PM	78°	70°
Silver Creek					
T19	47-24-7	8-1-51	2:40PM	62°	56°
T20	47-25-12	8-1-51	2:45PM	68°	53°
T21	47-25-14	8-1-51	3:35PM	66°	49°
Cherry Creek					
T22	47-24-8	8-22-53	1:20PM	80°	54°
T23	47-24-8	8-1-51	6:30PM	66°	54°
↓ T24	47-24-8	8-22-53	2:10PM	79°	55°
T25	47-25-13	8-1-51	4:00PM	68°	49°
George's Creek					
T26	47-25-24	8-1-51	3:15PM	68°	47°
Cedar Creek					
T27	47-24-17	8-1-51	6:00PM	65°	55°
↓ T28	47-24-17	8-22-53	2:15PM	74°	56°
T29	47-24-19	8-1-51	4:20PM	71°	53°
Big Creek					
T30	47-24-16	8-1-51	5:30PM	66°	54°
↓ T31	47-24-16	8-22-53	2:20PM	77°	54°
T32	47-24-33	8-1-51	4:45PM	72°	53°
T33	46-24-5	8-1-51	5:10PM	73°	57°
Tributaries to Big Creek					
T34	47-25-21	8-1-51	4:40PM	69°	70°
T35	46-24-5	8-1-51	5:25PM	72°	52°
T36	46-24-13	8-1-51	5:40PM	73°	56°
Voce Creek					
T37	47-24-22	8-1-51	5:05PM	71°	69°
↓ T38	47-24-22	8-22-53	2:45PM	78°	72°
T39	47-24-27	8-22-53	3:55PM	78°	64°
Dorrow Creek					
T40	T47N R24W S19	8-1-51	4:10PM	64°	64°
↓ T41	47-24-19	8-22-53	2:55PM	77°	70°
Mud Creek					
T42	47-23-17	8-1-51	3:20PM	66°	75°
↓ T43	47-23-17	8-22-53	3:05PM	78°	78°
T44	47-23-21	8-1-51	3:40PM	65°	71°
↓ T45	47-23-21	8-22-53	3:15PM	80°	70°
T46	46-23-9	8-22-53	4:30PM	78°	68°
T47	46-23-16	8-22-53	4:45PM	78°	62°
T48	46-23-16	8-22-53	4:50PM	78°	74°
Mud Creek, East Branch					
T49	46-23-9	8-22-53	4:33PM	79°	60°
T50	46-23-9	8-22-53	4:35PM	78°	60°
Foster Creek					
T51	47-24-35	8-22-53	4:00PM	78°	61°
T52	46-24-10	8-22-53	4:12PM	79°	55°
O'Neil Creek					
T53	46-24-1	8-22-53	4:15PM	78°	60°
Wilson Creek					
T54	46-23-7	8-22-53	4:20PM	76°	66°
T55	46-23-7	8-22-53	5:00PM	80°	64°
Nelson Creek					
T56	46-24-13	8-22-53	5:10PM	80°	67°
T57	46-23-19	8-22-53	5:25PM	71°	64°
T58	46-23-28	8-22-53	5:35PM	77°	68°
T59	46-23-33	8-22-53	5:55PM	75°	68°
T60	45-23-16	8-22-53	2:05PM	78°	62°
Nelson Creek, West Branch					
T61	46-23-19	8-22-53	5:20PM	79°	64°
T62	46-23-29	8-22-53	5:45PM	73°	63°
Wise Man Creek					
T63	46-24-22	8-22-53	3:50PM	79°	55°
Wise Man Creek, No Name tributary to,					
T64	46-24-26	8-22-53	2:50PM	74°	54°
Mattson Creek					
T65	46-24-23	8-22-53	3:05PM	80°	54°
Bushe's Creek					
T66	45-24-11	8-22-53	2:12PM	72°	62°
T67	45-24-10	8-22-53	2:15PM	72°	62°
Sheans Creek					
T68	46-24-35	8-22-53	2:26PM	78°	61°

↓ Indicates same location as station immediately above.
↓ Temperatures of 1953 taken by T. M. Stauffer.

TABLE 6

Temperatures and notes taken at the time
of the biological and physical survey
in 1951 and 1952

Fish collecting station	Date	Time	Temp. Air	Temp. Water	Notes
Chocolay River					
39	8-9-51	3:15 P.M.	66	57	High bank on north side highly eroded.
51	9-17-52	11:00 A.M.	63	50	Bank erosion on west side and east side below bridge.
43	8-16-51	9:00 A.M.	58	60	Open area in jack pine plain
53	9-22-52	3:15 P.M.	58	50	Low and boggy beaver dam at lower half of station
37	8-8-51	3:45 P.M.	72	62	Brushy and scattered hardwoods
52	9-17-52	2:00 P.M.	66	52	Banks covered well, rock dam above area shocked slows stream considerably.
36	8-8-51	9:30 A.M.	69	58	High banks on south side badly eroded.
35	8-7-51	3:45 P.M.	58	58	Many stream improvement structures erected in this area in 1949.
34	8-7-51	11:00 A.M.	54	56	Many stream improvement structures present in the form of deflectors and fish cover.
Silver Creek					
3	7-17-51	4:00 P.M.	64	53	Brushy and open meadow, shoreline undercut.
44	8-27-52	11:00 A.M.	71	49	Boggy with good bank cover, banks undercut.
1	7-17-51	10:30 A.M.	63	54	High banks, sparse bank cover, sand deposits from above.
2	7-17-51	1:40 P.M.	66	48	High banks and marsh, some bank erosion, beaver pond in this vicinity.
Cherry Creek					
5	7-18-51	11:00 A.M.	68	50	Banks stable.
4	7-18-51	9:30 A.M.	64	48	Banks stable.
George's Creek					
28	8-2-51	11:55 A.M.	70	47	Banks stable, wooded.
Cedar Creek					
6	7-18-51	1:30 P.M.	70	54	Shore brushy, beaver dam 1/8 mile below.
7	7-19-51	9:35 A.M.	62	48	Shore brushy, marsh near bridge.
46	8-28-52	10:45 A.M.	73	48	Bank low and muddy - area within beaver pond.
Massie Creek					
45	8-27-52	3:45 P.M.	76	50	Banks 6"-4' high, covered adequately.
Big Creek	7-19-51	11:10 A.M.	63	50	Marshy on one side and fairly brushy - old beaver dam above area and new beaver dam below.
9	7-19-51	2:30 P.M.	60	49	Banks brushy and moderately sloping - high bank.
10	7-20-51	10:15 A.M.	69	49	Dense brush along shore.
11	7-20-51	1:20 P.M.	64	54	Dense brush along shore - old beaver dam.
47	8-28-52	3:45 P.M.	74	52	Banks 6-18" high - well covered.
Voce Creek					
33	8-6-51	4:00 P.M.	61	60	Pastures - cattle grazing, high hardwood canopy.
Dorrow Creek					
23	7-27-51	1:15 P.M.	69	65	Banks brushy & sodded - practically dries up in summer. Beaver working from here up to headwaters.
Mud Lake Outlet					
38	8-9-51	12:15 P.M.	58	64	Boggy and one small beaver dam, poor shade - good pike spawning grounds.
Mud Creek					
24	7-27-51	3:00 P.M.	74	74	Tag alders - moderate shading.
27	8-1-51	10:30 A.M.	71	61	Open meadow in some portions, dense brush in others.
Mud Creek, East Branch					
25	7-30-51	10:00 A.M.	69	72	Partly brushy and open grass lands, dries up in warm summer - beaver dam just below shocking site.
26	7-30-51	2:00 P.M.	73	61	Tag alder, dense brush - beaver reported upstream.
Foster Creek					
12	7-20-51	4:15 P.M.	76	60	Banks brushy & pastured sod
48	8-29-52	1:15 P.M.	58	52	Banks 1-2' high with heavy grass cover.
14	7-23-51	1:00 P.M.	70	55	Open - grasses along shore and moderate amounts of brush - farmland
O'Neil Creek					
13	7-23-51	10:00 A.M.	71	64	Very dense brush - beaver dams upstream.
Wilson Creek					
22	7-27-51	9:00 A.M.	74	62	Dense tag alder & pastured sod - cultivated sandy plain surrounding - beaver dams near headwaters.
Nelson Creek					
21	7-26-51	3:30 P.M.	72	70	Moderate shading - cultivated and wooded sand plain surroundings.
55	9-24-52	11:45 A.M.	55	46	Banks 1-3' - good herbacious cover & sparsely wooded.
20	7-26-51	1:30 P.M.	79	03	Shade - moderate, wooded sand plain - heavy beaver workings reported one mile upstream.
40	8-10-51	1:45 P.M.	69	59	Dense brush and some pastured sod - downstream it flows through and drains swampy area.
Nelson, West Branch					
19	7-26-51	9:50 A.M.	72	64	Very dense brush.
Chocolay, W. Branch					
50	9-16-52	4:30 P.M.	58	53	Banks 1-2' high, good marsh grass & tag alder cover.
16	7-24-51	3:30 P.M.	68	61	Partly shaded - cultivated & wooded plain.
41	8-13-51	10:15 A.M.	60	56	Partly open - tag alder brush
54	9-23-52	4:15 P.M.	50	48	Banks stable - large beaver dam upstream (0.2 mile).
42	8-13-51	5:45 P.M.	70	64	Shore - tamarack bog - open
Wise Man Creek					
15	7-24-51	1:30 P.M.	74	58	Shore dense brush - old beaver dam above shocking area.
Trib. to Wise Man					
29	8-2-51	2:30 P.M.	74	54	Banks low, swampy.
Mattson Creek					
30	8-3-51	9:00 A.M.	51	50	Shore swampy - tag alder & cedar.
Chocolay, E. Branch					
49	9-16-52	11:30 A.M.	55	52	Banks 1-10' high, fair grassy & brushy cover, farming land.
18	7-25-51	4:00 P.M.	78	69	Tag alder moderate, high hardwood canopy - farming & wooded plain.
31	8-3-51	1:30 P.M.	55	60	Dense brush, many old small beaver dams present.
17	7-25-51	2:30 P.M.	78	72	Boggy shore - beaver dam stream flows through open meadow.
Sheans Creek					
32	8-6-51	2:30 P.M.	61	59	Dense brush, scattered trees - beaver dams above area.

Conclusions and Recommendations

Severe bank erosion on the main stream is of common occurrence between a point 1/2 mile above Station 36 to approximately 1/8 mile below Station 39 and should be curtailed as soon as possible. That section of the Chocolay River between Mud and Big creeks is comparatively warm and harbors a population of northern pike. It is believed that Lake Kawbawgam is the source of these fish. Mud Creek, below Lake Kawbawgam, warrants a closer examination before stream improvement recommendations can be made. It is thought that this outlet is responsible for introduction of great quantities of silt into the Chocolay River during heavy run-offs. A warming effect is exerted by the lake as well as the stream, so it is highly questionable whether river temperatures would be lowered by stream improvement between Mud and Big creeks.

Unaccountably high temperatures were recorded by the USFWS thermograph on the Chocolay River approximately 100 yards below the mouth of Cherry Creek. It is recommended that a thorough investigation be made along the Chocolay River between fish collection stations 34 and 51 during hot weather in an attempt to determine the chief causes for the infrequent but high temperatures. In part, these high-water temperatures presumably can be attributed to some or all of the streams which have been shown by the survey to become comparatively warm. Other conditions which might adversely affect water temperatures are the frequent occurrence of exposed pools formed by log-jams and meandering, unshaded portions of the river.

In farming areas and other open stretches on the East Branch of the Chocolay River, Voce, Nelson, Mud, East Branch of Mud and Wilson creeks, bank plantings of trees and shrubs, and erection of fences in pasture areas to prevent damage by cattle, would do much to restore cool temperatures and reduce siltation. It is thought that the removal of old beaver dams on the headwaters of the East Branch of the Chocolay and on Mud Creek would also be of benefit. Removal of unused beaver dams and provision of improvement devices to hasten the flow of water in the East Branch in the vicinity of stations 17 and 31 might also provide spawning grounds for brook trout.

Of some unfavorable influence to the remainder of Nelson Creek, and perhaps also to the Chocolay River, is a portion of Nelson Creek on either side of highway US-41 below Skandia Tower. The stream at this point divides into two channels, both of which lack adequate shade. The rate of flow in these channels is sluggish, and the bottoms are composed of either silt or peat. No investigation was made of this section by the survey crews, but based on observations by the author both in winter and summer, it is suggested that one or the other of the channels be blocked off and that stream deflectors be installed in the open channel to increase the rate of flow.

Streams in need of improvement structures for the creation of pools are Wise Man, East Branch of Mud, Massie, George's and Silver creeks, and the upper third of the Chocolay River. Either the erection of low-head dams or the encouragement of beaver along stretches of Silver Creek, and the headwaters of ~~Cherry~~ and George's creeks is recommended. The pools would raise stream temperatures and consequently would favor better growth rate of trout.

Present Fish Division policy is to withhold planting of brown trout where good brook trout fishing still exists. Several plantings of brown trout have been made in the Chocolay River from 1945 to 1952, but this species is still rather uncommon in the drainage. It is recommended that further plantings of brown trout be discontinued.

Large numbers of rainbows are known to migrate up the Chocolay in the spring. Evidence afforded by fish collections taken throughout the drainage system indicates that natural propagation of this species has been successful and that no supplemental plantings are necessary at present. However, during the fall of 1953, the USFWS installed a mechanical weir on the Chocolay at fish collection Station 37.

Research in the past, both in Michigan and other states, has shown that plantings of fingerling brook trout in streams have given little or no return to fishermen. Most streams in the Chocolay watershed, which have been planted with fingerling brook trout, contain both adequate spawning grounds and many wild brook trout fingerlings

It is advisable, therefore, to discontinue fingerling plants and stock only legal trout.

Maps of the Chocolay River watershed are presented at the end of this report to clarify survey results and management recommendations. Map II classifies the trout waters of the system as to their suitability for the various species. The only streams or portions thereof which were purposely designated as non-trout waters was the section of the Chocolay between the mouths of Mud and Big creeks, Mud Creek between Mud Lake and the Chocolay River, and Dorrow Creek; all other waters left uncolored are those that were not covered by the survey. It is the author's opinion that the first two areas should be classified as non-trout water because of the tendency for excessive warming and abundance of northern pike and other warm-water fish. Dorrow Creek has been classified as non-trout stream because it is warm and sluggish and reportedly dries up at times. There is a remote possibility that trout exist in the headwaters of this stream.

Water temperature was the chief factor in separating rainbow from brook trout water. Waters reputed to be warm in the summer (65°-75°) were designated as rainbow-trout water, whereas all others having cooler temperatures were designated for brook trout. Since investigations were made at stations 2 or 3 miles apart on most streams, boundaries between different types of water represent approximations only.

Absence of rainbow trout above Station 18 on the East Branch of the Chocolay and on the lower stretches of Mud Creek and the East Branch of Mud Creek may be questioned especially since these waters presumably are exposed to runs of rainbow trout. A barrier of bed rock across the East Branch of the Chocolay between station 18 and 31 is reported by L. Erkkila (U.S.F.W.S.) to restrict upstream movement of trout. As for the Mud Creek system, the restrictions are of a slightly different nature. Since there are suitable spawning grounds for rainbow trout in the Mud Creek drainage, and native brook trout successfully inhabit portions of this system, it appears that Kawbawgam and Mud Lakes are the chief limiting factors that restrict the distribution of rainbow trout in this area.

Not since 1946 have there been any hatchery trout planted in Mud Creek. It is recommended that rainbow trout be planted in those parts of this system that are designated as rainbow water on Map II.

Approved by: A. S. Hazzard

Typed by: Norma St.Arnauld

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Merle G. Galbraith, Jr.

Literature Consulted

Bailey, Reeve M.

1952. Check list of fishes of Michigan. (Unpublished) University of Michigan, Museum of Zoology. Revised to February 15, 1952.

Embody, G. C.

1927. An outline of stream study and the development of a stocking policy. Contr. Agricult. Lab., Cornell Univ., 21 pp.

Galbraith, Merle G.

1954. A biological and physical survey of the Pine River watershed, Mackinac and Chippewa counties, Michigan. (Unpublished) Institute for Fisheries Research Report No. 1410. 27 pp.

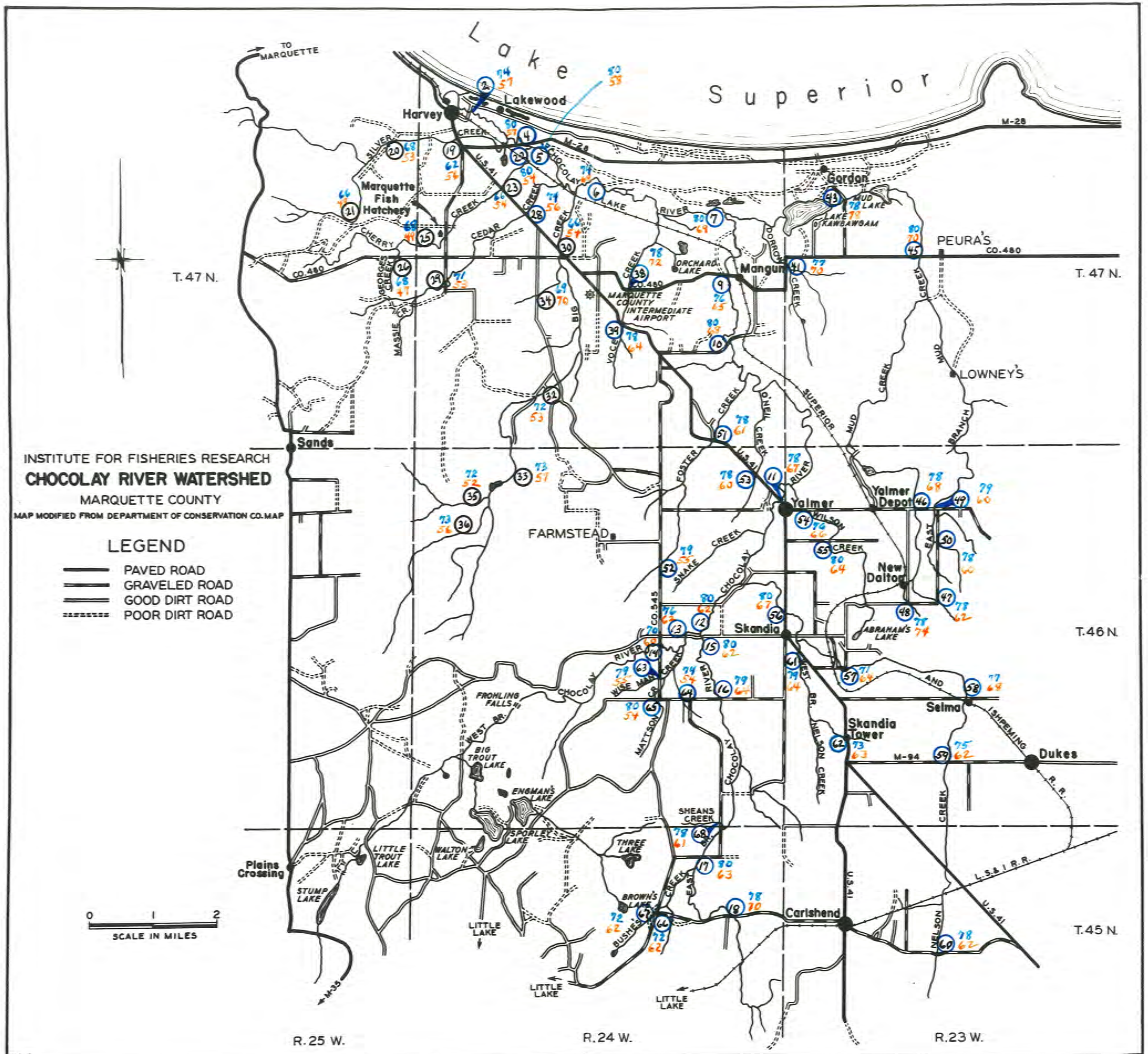
1955. A biological and physical survey of the Carp River drainage system, Mackinac and Chippewa counties, Michigan. (Unpublished) Institute for Fisheries Research Report No. 1433.

Hazzard, Albert S. and C. J. D. Brown

1950. (Revised) Inventory methods. (Mimeographed) Institute for Fisheries Research, 32 pp.

MAP I

Stream temperature survey of the Chocolay River drainage system. Figures in blue are air temperatures, those in red, water temperatures. Black circles are stations surveyed in 1951, whereas red circles indicate stations examined in 1953.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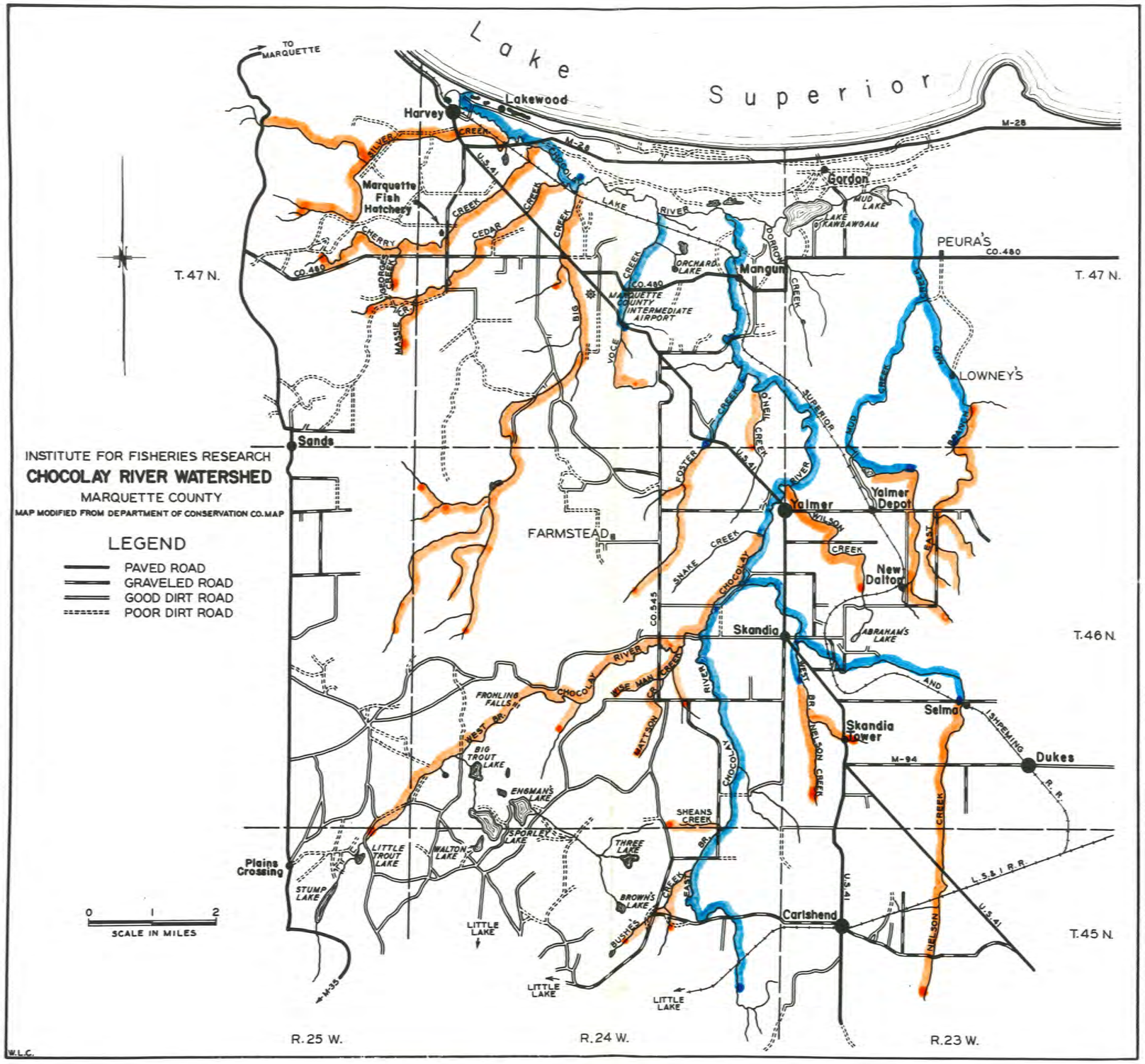
CHOCOLAY RIVER WATERSHED
MARQUETTE COUNTY
MAP MODIFIED FROM DEPARTMENT OF CONSERVATION CO. MAP
LEGEND
PAVED ROAD
GRAVELED ROAD
GOOD DIRT ROAD
POOR DIRT ROAD
SCALE IN MILES
Lake Superior
TO MARQUETTE
Harvey
Lakewood
Marquette Fish Hatchery
Gordon
Mangum
PEURA'S
LOWNEY'S
Sands
FARMSTEAD
Yalmer
Yalmer Depot
New Dalton
Skandia
Selma
Skandia Tower
Dukes
Plains Crossing
Carlshend
MARQUETTE COUNTY INTERMEDIATE AIRPORT
ORCHARD LAKE
MUD LAKE
LAKE KAWBAWGAM
ABRAHAM'S LAKE
FROHLING FALLS
BIG TROUT LAKE
ENGMAN'S LAKE
SPORLEY LAKE
WALTON LAKE
LITTLE TROUT LAKE
STUMP LAKE
THREE LAKE
BROWN'S LAKE
SHEANS CREEK
LITTLE LAKE
CHOCOLAY RIVER
CHERRY CREEK
CEDAR CREEK
SILVER CREEK
BIG CREEK
MASSIE CREEK
GEORGE'S CREEK
VOCE CREEK
DORON CREEK
O'NEIL CREEK
FOSTER CREEK
SNAKE CREEK
WILSON CREEK
EAST BR.
WEST BR.
MATTSON CR.
WISE MAN CR.
NELSON CREEK
MUD CREEK
MUD BRANCH
EAST BRANCH
BUSHES CREEK
M-28
M-94
M-35
U.S. 41
CO. 480
CO. 545
L.S.& I. R.R.
SUPERIOR AND ISHPEMING R.R.
T. 47 N.
T. 46 N.
T. 45 N.
R. 25 W.
R. 24 W.
R. 23 W.
W.L.C.

MAP II

Distribution of trout water. Red indicates brook trout water and blue designates rainbow trout water; all other is non-trout water, except certain headwaters and small tributaries for which insufficient survey data did not permit any designation.



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CHOCOLAY RIVER WATERSHED

MARQUETTE COUNTY

MAP MODIFIED FROM DEPARTMENT OF CONSERVATION CO. MAP

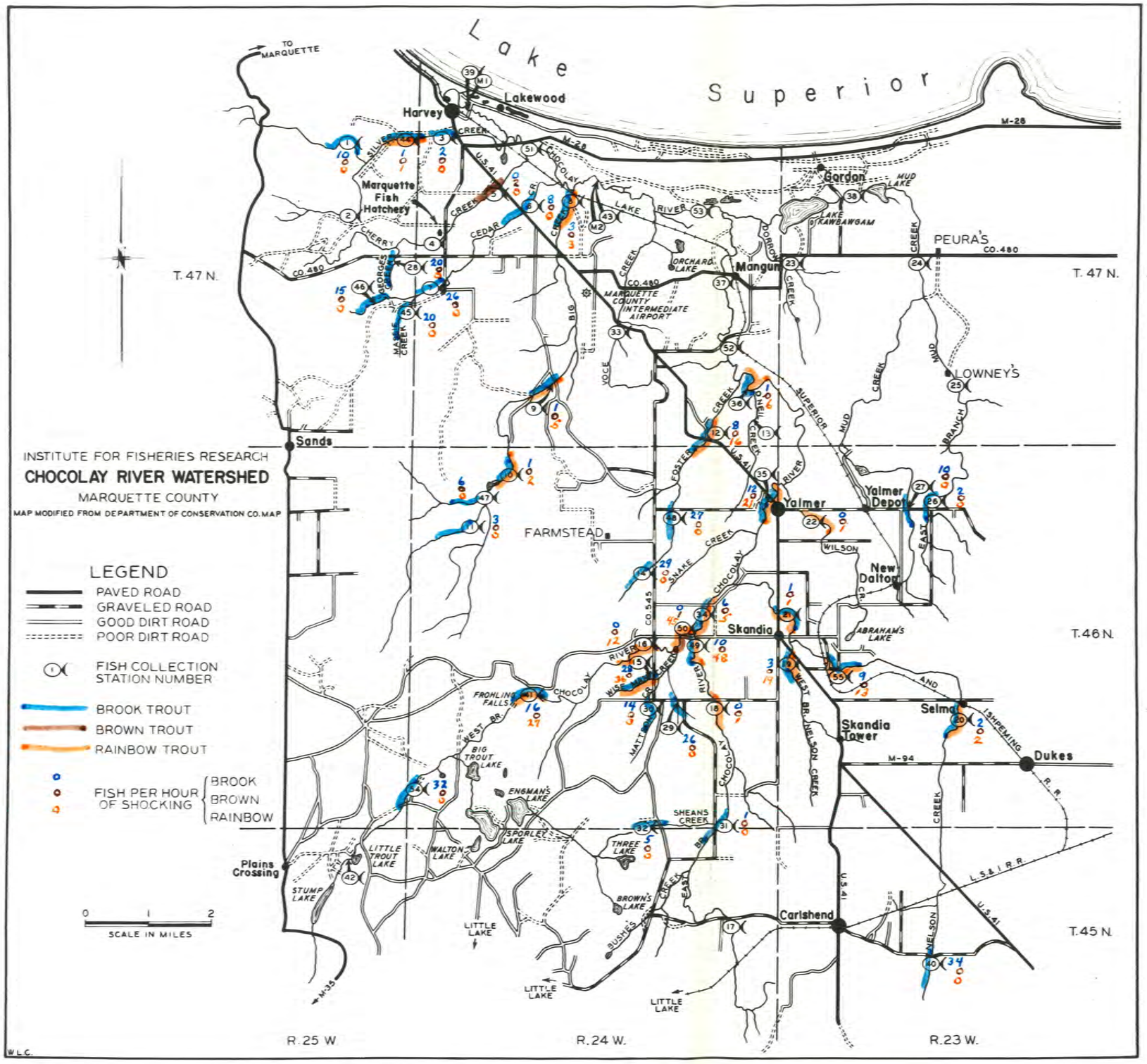
LEGEND

- PAVED ROAD
- GRAVELED ROAD
- GOOD DIRT ROAD
- POOR DIRT ROAD

W.L.C.

MAP III

Distribution and catch-per-hour of young-of-the-year trout.


Lake Superior
TO MARQUETTE
Lakewood
Harvey
Marquette Fish Hatchery
Gordan
MUD LAKE
LAKE KAWBAWGAM
PEURA'S
CO. 480
T. 47 N.
Mangum
ORCHARD LAKE
MARQUETTE COUNTY INTERMEDIATE AIRPORT
LOWNEY'S
Sands
Yalmer
Yalmer Depot
FARMSTEAD
New Dalton
Skandia
ABRAHAM'S LAKE
T. 46 N.
Selma
Skandia Lower
Dukes
FROHLING FALLS
BIG TROUT LAKE
ENGMAN'S LAKE
SPORLEY LAKE
LITTLE TROUT LAKE
WALTON LAKE
THREE LAKE
SHEANS CREEK
Plains Crossing
STUMP LAKE
BROWN'S LAKE
Carlshend
LITTLE LAKE
T. 45 N.
R. 25 W
R. 24 W.
R. 23 W.
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CHOCOLAY RIVER WATERSHED
MARQUETTE COUNTY
MAP MODIFIED FROM DEPARTMENT OF CONSERVATION CO. MAP
LEGEND
PAVED ROAD
GRAVELED ROAD
GOOD DIRT ROAD
POOR DIRT ROAD
FISH COLLECTION STATION NUMBER
BROOK TROUT
BROWN TROUT
RAINBOW TROUT
FISH PER HOUR OF SHOCKING
BROOK
BROWN
RAINBOW
0 1 2
SCALE IN MILES
W.L.C.

MAP IV

Distribution and catch-per-hour of brook, brown, and rainbow trout (all ages).

'NGG'

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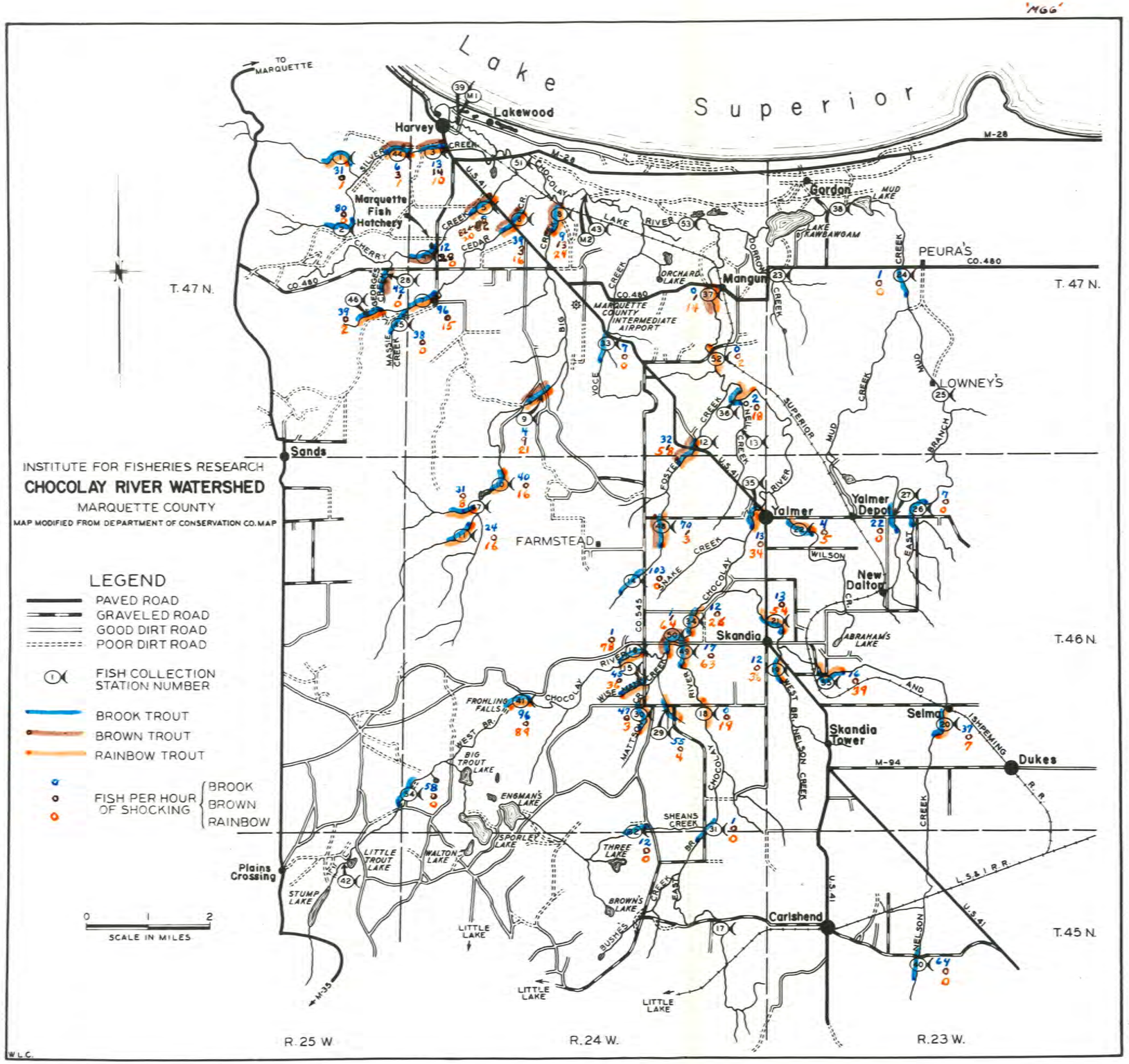
CHOCOLAY RIVER WATERSHED
MARQUETTE COUNTY

MAP MODIFIED FROM DEPARTMENT OF CONSERVATION CO. MAP



LEGEND

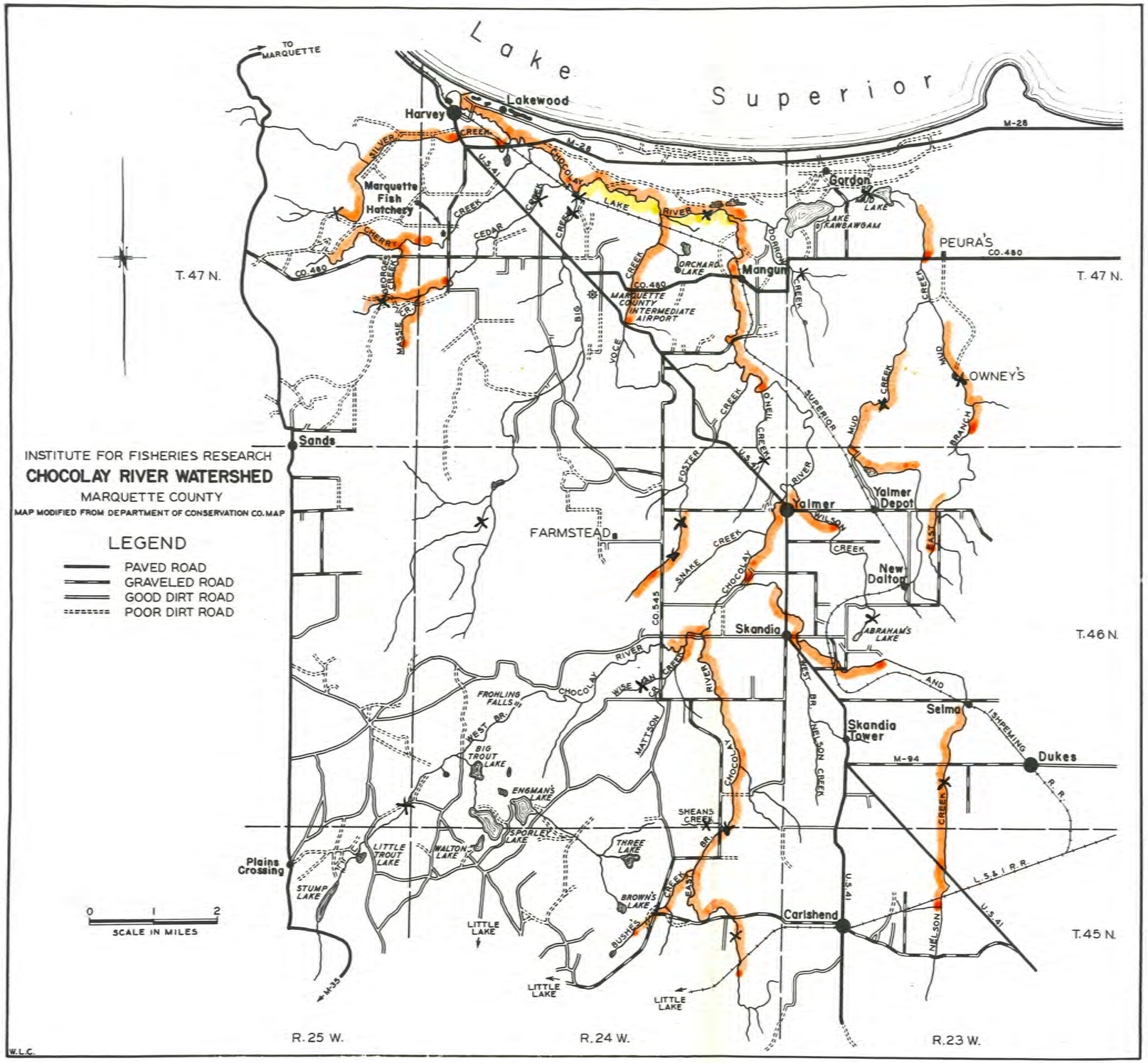
- PAVED ROAD
- GRAVELED ROAD
- GOOD DIRT ROAD
- POOR DIRT ROAD
- FISH COLLECTION STATION NUMBER
- BROOK TROUT
- BROWN TROUT
- RAINBOW TROUT
- FISH PER HOUR OF SHOCKING: BROOK, BROWN, RAINBOW

0 1 2
SCALE IN MILES

W.L.C.

MAP V

Proposed stream improvement and beaver dam locations. Red indicates stream sections where improvement is needed, yellow indicates possible extension of trout water and the capital letter X indicates beaver dams.


Lake Superior
TO MARQUETTE
Lakewood
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SILVER CREEK
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CHERRY CREEK
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Sands
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WILSON CREEK
EAST BR.
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Skandia
ABRAHAM'S LAKE
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WISE CR.
FROHLING FALLS
WEST BR.
BIG TROUT LAKE
ENGMAN'S LAKE
SPORLEY LAKE
MATTSON
Skandia Tower
NELSON CREEK
AND
Selma
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M-94
R.R.
SHEANS CREEK
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T. 45 N.
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CHOCOLAY RIVER WATERSHED
MARQUETTE COUNTY
MAP MODIFIED FROM DEPARTMENT OF CONSERVATION CO. MAP
LEGEND
PAVED ROAD
GRAVELED ROAD
GOOD DIRT ROAD
POOR DIRT ROAD
0 1 2
SCALE IN MILES
R. 25 W.
R. 24 W.
R. 23 W.
W.L.C.