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June 29, 1953

Report No. 1378

RESULTS OF A BIOLOGICAL AND PHYSICAL SURVEY OF THE WHITE RIVER DRAINAGE SYSTEM IN NEWAYGO, OCEANA AND MUSKEGON COUNTIES, MICHIGAN

by

Edward E. Schultz

Abstract

A three-man crew, using a D. C. electric shocker, made an extensive biological survey of the White River watershed in Newaygo, Oceana and Muskegon counties. Working from April to August, 1952, study was completed at 92 stations.

Comparison of the results of this survey with records of earlier studies reveals several changes in the fish fauna of the watershed. The most notable difference is the larger number of burbot that appeared in 1952. Rainbow trout have decreased in numbers and are no longer found in many parts of their past extensive range. Brown trout occur in fewer numbers in most streams, but are increasing in the waters above White Cloud.

Evidence afforded by the 1952 survey indicates that the White River below White Cloud is not suitable for trout. They apparently cannot exist there on a year-round basis because of high water temperatures in summer. Of the many tributaries of the White River, some support good populations of trout, usually brook trout. In general, the streams that flow through extensive stretches of

farm land or drain warm lakes do not have trout. Small private dams have been constructed on several of the streams in recent years. In most instances warming of the water as a result of impoundment has made these streams unsuited for trout. On Cleveland Creek spawning grounds have been flooded out by a 16-foot dam.

Hatchery trout have been stocked extensively in the streams of the watershed, and some alterations of stocking procedure are recommended, based on present survey results. In most cases, it is not the release of trout that is in question, but rather the species that should be used. Many brown trout have been planted where the survey indicated conditions suitable for brook trout.

The few beavers present in the watershed were not doing much damage in 1952. However, old beaver dams in the White River above White Cloud that are presently inactive appear to have had a damaging influence. Seven inactive dams were holding water and obstructing fish movement at the time of the survey. On marginal trout water, such as the upper White River, all beaver dams should be broken and the beavers removed.

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RESULTS OF A BIOLOGICAL AND PHYSICAL SURVEY OF THE WHITE RIVER DRAINAGE SYSTEM IN NEWAYGO, OCEANA AND MUSKEGON COUNTIES, MICHIGAN[1]

by

Edward E. Schultz[2]

A survey of the White River and the streams flowing into it was made during the spring and summer of 1952. Using a 230-volt D. C. electric shocker, a three-man crew collected fish, from April 29 to August 22 at 92 stations. Biological and physical data on the watershed were recorded and studied to provide information in anticipation of a watershed improvement program. A supplemental report will follow giving information on stream temperatures and the growth index of trout.

The multiple purposes of the survey included: (a) inventory of some of the biological and physical conditions bearing on game fish production; (b) study of the distribution and general population density of the fish present; (c) collection of information to assist in determining the need for environmental improvement; (d) accumulation of data for use in evaluating the effects of environmental improvement in future years, should an improvement program be undertaken;

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[1] The field work, analysis of data, and preparation of the report were undertaken with Federal Aid to Fish Restoration funds under Dingell-Johnson Project No. F-2-R-1.

[2] Assistants in the field were Douglas Kelty, Alfred Beeton and Gary Hultgren. The author was the field party leader.

(e) acquiring facts about the fish stocking needs of the watershed; and

(f) assembling information of value for future public fishing site acquisition.

Equipment and Methods

The D. C. shocker was used for 89 collections, with all techniques and procedures kept as uniform as possible. Uniformity of procedures enabled a comparison of the fauna of different parts of the watershed. Collection No. 90 was made with an experimental gill net and with hook and line. Collections 84 and 85 were made with an experimental gill net, shocker and angling. Collections from the Hesperia and White Cloud impoundments were made by I. A. Rodeheffer and J. K. Day, using experimental gill nets, bag seine and fishing tackle. All gill nets used were 125 X 6-feet of the experimental type, having five 25-foot sections. The mesh sizes of the sections were 3/4 inch, 1 inch, 1-1/4 inches, 1-1/2 inches and 2 inches, bar measure.

A Fish Collection card and parts of a Stream Summary card were filled out in the field. A 2-1/4 X 3-1/4-inch photograph was made of the stream at each station.

When the shocking equipment was carried in the boat, two positive electrodes were used. Each electrode was manipulated by a man who also carried a scap net for dipping shocked fish. The third man took charge of all other equipment, that is, the boat and its contents. Shocking was started at the lower end of a station and progressed upstream. The men with electrodes usually followed the banks, one on each side of the stream. The procedure was varied in order to shock all good holes and trout cover regardless of their location in the stream. A greater number of fish were captured from a log jam or deep hole if one electrode was placed upstream of the cover while the other was used downstream at the same time.

All fish captured were placed in two tubs in the boat and recorded after the sampling was finished. If the fish in the tubs showed distress, the man pulling the boat would add fresh water from the stream.

In streams too small to float the boat, the generator was located on the bank. A bronze screen placed in the water served as the negative electrode. The positive electrode was at the end of a 200-foot extension cord. With this system one man handled the extension cord, another carried a bucket for the fish and the third operated the electrode and scap net. The wire was uncoiled downstream and shocking started at that point. The wire was coiled up as the shocking proceeded upstream to the generator. Beyond this point the wire was uncoiled as the crew continued up the creek. When the end of the wire had been reached, 400 feet of stream had been covered. In nearly all instances this was an adequate sample.

All fish shocked were captured, if possible. If the bucket could not hold all the fish a tub was placed in the shade near the generator and filled with water, and the fish were emptied into this tub whenever necessary. The data were recorded in the same manner as when two electrodes were used.

A tabular summary of the locations of the stations and conditions affecting collecting is given in Table 1. All tabulations in this report are given in the same order, starting at the station nearest the mouth. The main stream of the White River has been divided into sections marked by the point of entry of the North Branch and two major dams that restrict fish movement. The tributaries of each section follow after the last upstream station of that section, beginning with the tributary farthest downstream.

The column headed "shocking time" refers to the actual length of time that fish were being shocked and collected. The approximate efficiency is given as a compromise guess agreed upon by the three men doing the shocking. The length of

stream shocked is the linear measure, up the center of the stream.

The fish collection records are in Table 3, which gives the numbers of each species of fish taken per hour of shocking for the three-man crew. At most of the stations the number per hour was calculated from the shocking time and the number of fish captured. With all shocker stations based on the same unit of time and effort, a better comparison can be made between different locations. Since the collections from the impoundments were made by several methods, only the actual numbers of fish captured are given for these collections. The size range for each species at each station is given in Table 4. The measurements are total lengths in inches.

Scale samples taken from native trout were studied for age. The average length, and number of fish, for each year-class are shown in Table 5.

Physical features of the environment are summarized in Table 6. The average width was found by measuring the stream, from water's edge to water's edge, in 10 places at intervals of 10 or 20 feet. To find the average depth, groups of three measurements, taken at several points along the stream were used--one depth in the center of the stream and one on either side half-way to shore. These three numbers were added and divided by four, allowing for one zero depth at the water's edge. The pool classification was taken from Embody's outline (1927). Although it was inadequate and unreliable, it was the only method available at that time. By this system sections of the stream are judged on the basis of three qualities--size (length and width), type (depth, cover and vegetation), and frequency (percentage of stream bottom occupied by pools). Each quality is graded from one to three. The lower the number, the better the stream is for trout.

To compare changes in the distribution of fish in the White River drainage, information from past collections has been compiled in Table 7. These records,

on file at the Institute for Fisheries Research in somewhat greater detail, are grouped according to the hears in which the collections were made.

Interest in artificial stocking of the White River has been high, so stocking records from 1933 through 1952 have been compiled in Table 8. This table and the two that follow give the past and present situations involving trout in the White River above the dam at White Cloud. A comparison of collections of brook and brown trout, for the summer of 1952, is given in Table 9, while Table 10 compares the figures of 1952 with those of 1938 and 1926.

Two maps of the White River watershed picture the distribution of trout. All collecting stations are located and numbered on each map. The three species of trout are shown in different colors and the calculated catch-per-hour is given at each station. Hatchery-released trout are not included on the maps or in the tabulations except for Table 8. Hatchery fish were identified by the missing right pelvic fin that had been removed before their release.

Discussion and Recommendations

Using the data presented in the tables, the following conclusions are made for the White River drainage. Over the watershed as a whole, the trend since 1926 appears to be in the direction of slightly warmer water, although even in 1926 it could not be considered as strictly of the cold water type. In many places the brook trout are giving way to brown trout and in some instances even brown trout are not persisting. In 1926 the common fish of the watershed were brook trout, white sucker, creek chub, blacknose dace, common shiner, Johnny darter and northern muddler (Table 7). The results of 1952 indicate that the fish fauna now consists mainly of brook trout, brown trout, white sucker, burbot, creek chub, blacknose dace, mudminnow, northern muddler and American brook

lamprey (Table 3). The greater numbers of burbot and American brook lamprey in the collections of 1952 may be largely a reflection of the greater efficiency of the electric shocker over the seine. However, there is no previous authentic record of burbot in the White River. Although no special study has been made of the fact, it is noteworthy that trout and burbot occurred in the collections in an inverse ratio. That is, where burbot were numerous, few or no trout were found; but where many trout occurred, there were few or no burbot.

Because of the immense size of the White River drainage and the great variety of habitats involved, each area will be considered separately. The streams will be taken up in order as they are arranged in the tables, starting from the mouth and going upstream. In many instances the stream names used were decided upon after consultation with the Geological Survey Division.

The White River from the mouth to the North Branch

(T12N, R16 and 17W)

The section of the White River from White Lake to the mouth of the North Branch is divided into two parts, based on physical characteristics. The lower section is a slow, deep area near the mouth and the upper part is a shallower, more rapid section.

Most of the lower part is surrounded by marsh or swamp. The current is very slow, the river deep and the bottom is all silt. Considerable depth prevented the use of the shocker except on shallow beaches and bars. At the sampling station nearest the mouth an experimental gill net was set from bank to bank but caught no fish, and angling yielded only two common shiners. Observations of fishermen's catches indicated an abundance of rock bass. It is known, from experience and interviews, that there are several spring spawning runs through

this section. The sucker run is the largest, followed in size by the white bass, while walleye and steelhead (rainbow trout) are reported in small numbers.

The upper part of this section of the river differs from the lower in that it is narrower, shallower, swifter and much of the bottom is sand. It was possible to make more collections of fish here because of the greater number of sand bars but still the river was too deep and swift for adequate samples. No trout were captured, and the most common species taken were northern pike, yellow perch, white sucker, redhorse, burbot, Johnny darter, northern muddler and lampreys. Only two larval sea lampreys were captured. The local dipnetters claim that the runs of walleyes and white bass do not go upstream so far as the county-line bridge. Sucker dipnetting is the most common kind of fishing in this section of the river.

Lanford Creek
(T12N, R17W, Secs. 15, 16 and 21)

This is a small, cold stream with brook trout and northern muddlers. The trout were growing at a normal rate, but none of the captured fish had reached two years of age. Because of the large population of brook trout now present, this stream should not be stocked with brown or rainbow trout.

Two local men are planning the construction of a private hatchery and rearing ponds above the road in Section 15. However, when these ponds are in operation they should not have an adverse effect on the stream for trout because temperatures under present conditions are exceptionally low. On July 1, 1952, the air was 86°F., but the water was only 54°F.

Silver Creek
(T12N, R16 and 17W)

Silver Creek has three distinct parts, consisting of a spring-fed portion,

an impoundment and a warm section of stream. The warm portion is made up of over-flow of surface water from the impoundment. The collection below the dam yielded a good number of brook trout, but the tenure of this species in future years is open to question for the following reasons: nearly all the other species of fish present were warm-water fish; the dam was placed across Silver Creek in 1950 and the two subsequent summers have been unusually cool. Various dams have been placed across this creek in the past, and as the collection in 1936 shows, there were no trout below the dam at that time. Instead, yellow perch and pumpkinseeds were taken. It is doubtful that hatchery brook trout could survive here long enough to be taken by fishermen.

Silver Creek pond has had a very short existence as a trout pond. In 1950 and 1951 trout fishing is said to have been good,but in 1952 practically no trout were taken. As the trout fishing went down, the northern pike fishing came up, and in 1952 pike fishing was very good. Experimental gill-netting in this pond yielded only northern pike and white suckers. Crayfish were very abundant.

The temperature of the water flowing into the pond was found to be cool enough for brook trout, but a very slight increase would make it lethal. Although the source of Silver Creek is entirely from springs, several beaver dams near the headwaters undoubtedly serve to warm the water appreciably. Perhaps the removal of these dams and the beavers would permit water of a lower temperature to reach the pond. The greatest depth found in the pond was 8.7 feet, and apparently this is not enough depth to maintain a cold layer of water for trout. Temperatures taken on July 24 were 77° for the air, 73° for the surface water and 68° for water at the bottom. During a hot summer the water temperature would undoubtedly be too high for brook trout. Possibly they would go to the cool inflowing water at the head of the pond.

Legal-size brook trout have been stocked in this pond since its construction. In view of the poor returns reported during 1952, the large number of northern pike present, and the possibility of high water temperatures, it is extremely doubtful that this stocking can be justified.

Silver Creek above the backwaters of the impoundment supports a large number of brook trout. Although there are five beaver dams near the headwaters, this stream does not get too warm for trout. It is well shaded and provides good cover for the fish, but only two of all the trout taken had reached legal size (7 inches). Brown trout should not be planted in this stream.

Unnamed Tributary to White River
(T12N, R17W, Sec. 14)

Although all conditions appeared favorable for trout in this small stream, no trout were taken. It may be that this stream will dry up in some summers. If it is a permanent stream, an attempt to establish trout here would do no harm.

Carlton and Little Carlton Creeks
(T12 and 13N, R17W)

In the opinion of many local fishermen, Carlton Creek is one of the best trout streams in western Michigan. Evidence gathered in 1952 lends weight to their contention. Carlton Creek has a good population of fast-growing brook trout. These trout are found throughout the length of the stream, but burbot now outnumber them at the lower end. The increase in burbot is apparently the only change in fauna since 1928.

According to a temperature survey made on July 2, 1952, Carlton Creek was 68°F. just below its origin in New Era. It warmed slightly and then dropped to 66° for the remainder of its course. All tributary streams flowing into Carlton Creek contained water of a much higher temperature. Temperatures ranged from

74° to 81°. The air temperature was 85°.

Little Carlton Creek, a tributary, had a temperature of 77°. This stream flows into Heitman Lake on the north end and drains it on the south side. It is obviously unsuited for trout as the above temperature shows. The collections did not reveal any game fish, and suckers were uncommon.

Sand Creek and Rochdale Pond
(T12 and 13N, R16 and 17W)

Sand Creek, below the dam which creates Rochdale Pond, is quite warm because of the surface water from the pond. Heavy shade and springs from the dam downstream to the White River probably cool the stream to a temperature suitable for trout. Trout are not very abundant in this part of the creek and few men fish it because of an unstable bottom and dense brush. Almost all the trout taken with the shocker were in the two artificial pools below the spillway. Although the trout were few, the number of burbot was large.

Rochdale Pond has been in existence since early lumbering days, but has been rebuilt several times. The present pond dates from 1913. It has produced fair to good trout fishing so long as local residents can remember. Temperature readings and swimming gave ample evidence of cold water a short distance below the surface. On July 6, 1952, the surface temperature was 74°, while seven feet down the reading was 61°. Because this pond is suitable for brook trout, is easily accessible and many people fish it, it is believed that continued stocking of trout is justified. Browns and rainbows as well as brooks have been released here in the past, but only brook trout were found in 1952.

Sand Creek above Rochdale Pond is a cold, clear stream. Brook trout are very abundant, but are slow growing. Although the situation was not studied in detail, it is believed that the cold water (50° to 60°) and low production of food due to

a sand bottom are largely responsible for slow growth.

Cleveland Creek and Lake Wolverine
(T12N, R16W)

Cleveland Creek can no longer be considered a trout stream. The dam that forms Lake Wolverine has flooded the upper end, including the spawning grounds, and warmed the lower part. Typical fish found below the dam are white suckers, brown bullheads, burbot, bowfins and common shiners. Brook trout have been released in this stream for many years, but present conditions indicate that stocking should cease.

Lake Wolverine, the impoundment on Cleveland Creek, is the private property of William Lidke and Associates. No samples of the fish were taken, but brook and rainbow trout have been planted in the lake. In 1951, 400 rainbow trout from a State hatchery were released here. It is recommended that no further releases be made because this is a private lake and only members of Club Lake Wolverine may fish in it (Membership fee, $850.00).

Lake Wolverine is not shown on the map because it is of recent origin and has not been charted by the State.

Blue Lake Outlet
(T12N, R16W)

In spite of the fact that five brook trout were captured, the mudminnows are probably a better indicator of the characteristics of this stream. The flow of water is small, the stream is wide, and the bottom is muddy.

North Branch of the White River
(T13 and 14N, R15 and 16W)

With the dam at Ferry no longer in operation, the North Branch of the White River is a continuous stream from McLaren Lake to its union with the mainstream.

The fish taken from this river indicate that it is not a brook trout stream. Brown and rainbow trout in medium to small numbers are present below Ferry and for a short distance above. A spring spawning run of rainbow trout is claimed to reach Ferry. However, the warm lakes that furnish the water for the North Branch make the river uninhabitable for trout for most of its length above Ferry. Comparison of the 1928 and 1952 collections does not show any noticeable change in the fauna except for the incursion of large numbers of burbot in the lower end of the stream.

Throughout its history, the three common species of trout have been stocked in the North Branch of the White River. Not enough evidence is available to tell how advantageous the plantings have been, but enough information is at hand (cited above) to warrant cessation of brook trout planting.

Newman Creek
(T13 and 14N, R16W)

Newman Creek starts as drainage from Newman Lake and consequently is too warm for trout for the first few miles. The water was 73° on June 27, 1952. As the stream progresses downstream it becomes cooler and is suitable for trout. Brook trout predominate, with some rainbow and brown trout present. Near the mouth of the creek the species make-up changes. Here brown trout and burbot are about equal in abundance, with some brook and rainbow trout present. Among local anglers this stream is best known for its brown trout.

Knutson Creek
(T13 and 14N, R15 and 16W)

Collections made in Knutson Creek contained some brook and brown trout in the lower part of the drainage. A few brook trout were captured in the headwaters. In the lower part, burbot were as numerous as trout.

Cambers Creek, a tributary, has an abundant supply of slow-growing brook

trout. The connection between the two streams is under-ground and a barrier to fish movement.

Unnamed Tributary to the North Branch of White River (T13N, R16W, Sec. 2)

This is a small, warm, turbid stream draining farmland. It is uninhabitable for any species of trout.

Unnamed Creek in Ferry (T14N, R16W)

The water temperature of this stream was 74° on July 16, 1952, while the air temperature was 78°. The stream bed was silted and there was a large population of mudminnows. These characteristics show that this creek is not suited for trout.

Robinson Creek (T14N, R16 and 17W)

Although Robinson Creek starts as warm run-off from a farm, shade and springs exert sufficient cooling effect to make it a good brook trout stream. One of the land-owners below the road in Section 16 hopes to construct a dam across the stream at some time in the future. Temperature readings of 1952 indicate that such an impoundment would probably warm the water to lethal temperatures and destroy several miles of trout stream below the project. If possible, this construction should be discouraged.

Brook and brown trout were stocked in Robinson Creek before 1948. If stocking is resumed, no more brown trout should be released here.

Swinton and Osborn Creeks (T14 and 15N, R16W)

Two streams, each draining a lake, make up this minor drainage. There is a small, private dam across the stream just below their union. The influence of

this dam is slight because it does not hold much water. It is drained each fall to be refilled in the spring.

A fish collection made here in 1926 yielded brook trout. In 1952 brook trout were still found in both streams while a few brown trout were taken in Osborn Creek. Brown and rainbow trout were found below the point where the two streams unite.

White River from the North Branch to Hesperia Dam (T13 and 14N, R15 and 16W)

Fish collections in the White River from the North Branch to Hesperia revealed that this part of the stream cannot be classed as trout water. White suckers were the most abundant fish, followed by creek chubs, common shiners, blacknose dace, burbot and hog suckers. Smallmouth bass were found, and any development of the river in the way of watershed improvement probably should be in their favor. Brown trout were released in this section in 1945, but it is recommended that no further releases be made.

Two larvae of the sea lamprey were captured in this part of the drainage, making a total of four for the entire watershed. This was the farthest upstream that sea lampreys were found.

Skeel Creek (T12 and 13N, R15W)

Some brook trout were found in the lowest part of Skeel Creek, but they were greatly out-numbered by burbot. Many factors appeared to adversely influence trout in this creek. The two small tributaries that are the source of Skeel Creek consist of warm run-off from open farms. Signs of flood along the banks of the stream and a washed-out bridge on the county-line road indicated extreme fluctuations in water level. This fact was verified by county workers and

residents. The sandy stream bottom is probably poor in the production of food for trout, and spawning areas are rare.

It is well that trout are no longer stocked in this stream. Any improvement of fishing here would have to come from upland improvement at the source.

Cushman Creek
(T13N, R15W)

Although Cushman Creek starts as a warm, muddy stream containing white suckers and creek chubs, dense shade and a few springs have sufficient cooling effect to make it a trout stream at the lower end. It contains brook, brown and rainbow trout and is held in high regard by many anglers. It is said to have a good run of rainbow trout in the spring, being one of the two streams in the drainage that are reported used by migrant rainbows. For year-round fishing it is best known for brown trout, and the 1952 collections showed a large population of this species.

Braton and Dragoa Creeks
(T13N, R14 and 15W)

This drainage is another white sucker and creek chub stream. The few rainbow and single brown trout taken near the mouth probably do not have much significance. All evidence points to a warm, muddy stream that is subject to detrimental high water stages. Possibly brown trout could maintain a foothold if introduced into the stream near the mouth. Seventy-five brown trout were released here in 1945, and the one collected in 1952 was probably a descendent of that group.

The short tributary to Braton Creek in Section 20 is a complete opposite of the rest of the drainage. It is clear and cold and has a large population of brook trout. Although the growth rate of these trout seems slower than average, it should be noted that the sample was taken on May 22, and hence very little growth had been attained in 1952.

Unnamed Tributary to the White River
(T13N, R15W, Secs. 1 and 2)

One brook trout was taken from the creek, but it cannot be considered a trout stream. On July 24, 1952, the water temperature was 74° when the air was only 78°.

White River from Hesperia to the White Cloud Dam
(T13 and 14N, R12, 13 and 14W)

Shetter (1942) concluded that this stretch of the river was marginal trout water. All collections made during 1952 support that conclusion. Complete lack of young trout is in perfect agreement with the added statement by Shetter that there is "little or no reproduction" in this part of the drainage. Undoubtedly, the few trout caught are either wanderers from tributary streams or fish of hatchery origin. The collections make it clear that white suckers, creek chubs and blacknose dace are the dominant fish. The 1926 collections revealed the presence of rainbow trout, and a creel census in 1940 listed 163 rainbow, 142 brook and 141 brown trout as caught that year. The fact that no rainbow trout were taken in any of the streams above the Hesperia Dam by the 1952 survey strongly suggests that they are no longer a part of the fauna.

Brook, brown and rainbow trout have been released here in the past several years. Recently only brown trout have been planted, but if the program is to continue it is recommended that rainbow trout be used. This is based on findings by Shetter and Hazzard (1940), Shetter (1944) and Cooper (1953), that planted rainbow trout give a higher return to the angler than planted brown trout.

A number of temperatures taken on July 21, 1952 showed gradual warming of the river from White Cloud to Hesperia. It should be kept in mind that these readings were taken during relatively cool weather. Starting at White Cloud and going downstream, the temperatures were as follows:

Location	Degrees, Fahrenheit	
	Air	Water
Below White Cloud Dam	82	72
M-37 bridge	85	72
M-20 bridge	84	73
Lutes Bridge	85	74
Aetna Bridge	86	76
Pinchtown Bridge	84	76
Mansfield Bridge	83	77
At head of Hesperia Pond	82	76
Hesperia Pond, surface	84	79
Below Hesperia Dam	83	79

All fish samples taken in the White River, past and present, show that the sea lamprey has not succeeded in passing the Hesperia Dam. Collections below the dam produced only four specimens of the sea lamprey from the drainage. It is also quite evident that the dam at Hesperia is a complete barrier to the upstream movement of all other fish.

Wright's Creek
(T13 and 14N, R14W)

This is a small, warm stream containing a sizeable population of creek chubs, blacknose dace and white suckers. A resident farmer said that there is no sucker run in the spring and that there have been no trout since 1921. The single brook trout taken was undoubtedly a stray and it should be accorded little significance.

The stream bed is nearly free of silt and mud, but there is a lack of cover and shade. Throughout much of its length, Wright's Creek flows through open pasture land.

Martin Creek and East Branch of Heald Creek
(T14 and 15N, R13 and 14W)

Martin Creek originates as the warm surface water from a chain of four small lakes. As a result, much of the upper end of the drainage, where the stream flows through abandoned farm land, is not suitable for trout. However, extensive reforestation done in this area should result in some improvement in the future.

The lower part of Martin Creek is cool enough for brook trout and it supports many of them. A few brown trout are present and are probably the result of heavy plantings in the past. In line with the policy of the Department to keep brook trout waters for brook trout as long as possible, it is recommended that no more brown trout be released in Martin Creek.

The East Branch of Heald Creek is a very cold stream and its union with Martin Creek has a cooling effect on the latter. There have been heavy releases of brown trout in this creek, but examination of the stream leads to the conclusion that it is better suited for brook trout. Nine brown trout were two years of age, and the average length was only 7.7 inches. Therefore, along with Martin Creek, brown trout should no longer be planted in this stream.

Mena Creek
(T14 and 15N, R13 and 14W)

Lake Leda, with a beaver dam at the outlet, supplies the water for Mena Creek. Between this dam and the United States Forest Service dam in Section 6, the creek supports a moderate supply of brook trout. Below the Forest Service dam, known as the "Minnie Creek Sanctuary Dam", there is a dense population of brook trout. Several springs cool the overflow from the dam, and pine stumps and logs furnish good cover. Because of the large number of trout present, there probably is much competition for feed. As Table 5 shows, the growth of trout in this stream is slow.

Mena Creek has had heavy plantings of both brook and brown trout for the last 20 years. The survey of 1952 indicated that the brown trout have been very unsuccessful. In order to insure maintenance of this stream for brook trout, no more brown trout should be planted.

Records of samples taken in 1926 show that rainbow trout were present at that time. In 1952, they were no longer found to be part of the fauna.

DeLong Creek
(T13 and 14N, R13 and 14W)

DeLong Creek is the muddy drainage of many farms near Fremont. There are few springs and almost all of the water comes from shallow lakes, marshes and run-off. Many of the tributary streams are intermittent, and most of the headwater streams are dry during the summer. Records of collections made in 1926 give some evidence that this creek may have been cooler at that time, but no trout were recorded. There were no trout taken in DeLong Creek in 1952.

Coonskin Creek
(T13 and 14N, R13W)

Coonskin Creek flows through several lakes before arriving at the White River. The outlet stream from Blackberry Lake unites with Coonskin Creek in Peterson Lake. The fish collected were typical of a warm-water lake or a slow, warm stream--that is, rock bass, largemouth bass and various sunfishes. Records show that this stream was about the same in 1926. The single brown trout taken in 1952 must have been a stray and is therefore of little significance. Residents claim there is a sizeable run of suckers in the spring, and the samples taken show white suckers present in large numbers.

Beginning in the spring of 1953, spearing of suckers will be legal in Coonskin Creek from the bridge on the south line of Section 32, T14N, R13W, down to the White River. All collections made in Coonskin Creek indicate that suckers are the principle fish. No pike or other large fish were seen or taken in this stream. Therefore, permitting sucker spearing from Robinson Lake to the White River would result in greater utilization of the suckers without endangering any game fish.

The outlet of Blackberry Lake was not so warm as Coonskin Creek, but collections did not yield any game fish. Possibly this stream could be opened to spearing along with Coonskin Creek. However, it probably would not offer very

productive fishing, judging from the lack of sizeable fish in the survey collection.

Temperatures taken on July 21, 1952, in the brushy upper part of Blackberry Lake outlet were 70° for the water and 84° for the air. About one-half mile downstream, in open farm land, the water was 73°. Three water temperatures taken in Coonskin Creek on the same day were 82°. These readings were made below Robinson Lake, and both above and below Peterson Lake.

First Cole Creek
(T14N, R13W)

Although short in length, First Cole Creek is a cold stream. On July 21, 1952, the water was 54° when the air above the water was 76°, but the air away from the stream was 86°.

The growth rate of the brook trout was slow, and the rate for the brown trout was even less. In 1925, only brook trout were found in this stream. Since that time, many thousands of brown trout have been planted here. The coldness of the water and slow growth of the brown trout indicate that this species should not have been planted here. It is suggested that First Cole Creek be left as a brook trout stream.

Second Cole Creek
(T14N, R13W)

Second Cole Creek is another brook trout stream. Maps usually show this creek as draining Blacksmith Lake, but there is no connection and the water comes from springs. The water is cold; it was 63° on July 21, 1952, when the air was 80°.

Rainbow trout were taken in Second Cole Creek in 1926, but brown trout were unknown at that time. Brook trout have been present for many years. Brown trout have been stocked heavily in the last 17 years; 2000 number-one fingerlings were released in 1951. Only one-year-old brown trout were taken in 1952 (probably remnants of the planting). This fact leads to the belief that browns have been

rather unsuccessful in this stream. There is no doubt that Second Cole Creek should be managed for brook trout only.

Rattlesnake Creek
(T13 and 14N, R13W)

Rattlesnake Creek drains two small lakes and as a result has a warm-water fauna. It is well shaded and there is the possibility that it may contain trout downstream from the sampling station. The dense brush prevented the taking of additional samples and would discourage most anglers. The water temperature on July 21, 1952, was 82° while the air was 86°.

White River (above White Cloud) and Flinton, Five Mile, Mullen, and Stratton Creeks
(T13, 14 and 15N, R11 and 12W)

All parts of the White River drainage above the dam at White Cloud are treated much as a unit in this study because they have been handled this way in the past with regard to planting programs and other management measures. A series of temperature readings were made on July 21, 1952, when the air was 83°. Starting below the White Cloud dam and going upstream, the water temperatures were as follows:

Below White Cloud dam	72
Near head of Lake White Cloud	73
Just above Lake White Cloud	71
Two miles north of White Cloud	71
Below site of White River rearing station	70
On Kaiser farm	73
On State land, "The Pool"	71
Above White River Club	70
In Oxford swamp	72

Added to the White River is the water of several tributaries. The temperatures of these streams, also taken on July 21, 1952, were as follows:

Flinton Creek	71
Five Mile Creek	68
Mullen Creek	68
Stratton Creek	71
Lake Webinquaw outlet	79

If Embody's (1927) table for air and water temperatures is applied to the observed temperatures of the upper White River, the conclusion is that this part of the stream is too warm for brook trout and just under the maximum limit for brown and rainbow trout. It should be noted that Embody's table is based on a maximum air temperature of 94°.

A series of water temperatures in the White River at the site of the White River rearing station, taken during July, 1936, showed a high of 84° (Wolf, 1936). This temperature is above the maximum for brook trout and, if continued very long, would have an adverse effect on brown trout. It is apparent that the warm-water condition of the White River is not of recent origin. There is no doubt, however, that some brook trout survive the year round in this part of the stream, but collections of young-of-the-year trout indicate very little successful reproduction. The trout found here probably come mainly from the cool tributaries.

Much of the warming of the river must result from the open land through which it flows. This condition is being remedied somewhat by abandoned farms reverting to brush and trees through natural growth and by tree plantings made by the White River Club and others.

A factor also to be considered is the influence of beaver. Beaver dams cause a warming effect by withholding flow and spreading the water out over a large area. Flooding usually kills many trees and shrubs, thereby eliminating shade and its cooling effects. In three sections (T14N, R12W, Sec. 4 and T15N, R12W, Sec's. 28 and 33) 15 beaver dams were found on the White River. Of these, 8 dams had been broken enough to permit fish movement, but the other 7 were obstructing water flow and fish migration. Active beavers were noticed at just one location, in Section 4 below "The Pool." These animals should be removed. In the future, any beavers that might invade this part of the watershed should be removed

promptly. For the present, all obstructing dams should be opened to permit free flow and to eliminate the backwaters. Such procedure is considered necessary if this part of the river is to be managed for trout fishing, because impoundment only worsens the situation where summer temperatures for trout would be marginal even if there were no dams present.

Review of the history of the White River above White Cloud reveals that in 1926 the only species of trout present was the brook. Many other fish taken at that time were representative of a warm stream. In 1932 one 12-inch brown trout was caught one-half mile below the site of the rearing ponds. This four-year old fish is the first record that could be found of brown trout in the upper White River. The samples taken in 1938 contained many brook trout and nine brown trout. A creel census in 1939 yielded one sublegal brown trout (Shetter, 1940). In 1951 a prize-winning, 31-inch brown trout was taken on a fly. The 1952 survey resulted in a duplication of the species list plus 15 brown trout from the main-stream, including one young-of-the-year fish. It is worthwhile to point out that brown trout have never been intentionally planted in this part of the river.

The numbers of fish shown in Table 10 cannot be compared directly because of the different methods used for collecting. In 1926 the collections were made by scattered seine hauls while those of 1938 were secured by a large crew using the block-and-seine technique. The latter method consisted of blocking off a section of the stream with seines and then using other seines to take the fish. An attempt was made to capture all the fish in the enclosure. Twelve samples were taken in 1938. The use of the shocker in 1952 has been described at the beginning of this report.

The ratio of brook trout to brown trout captured in the upper White River in 1952 was 6:1. However, because the average brown trout was heavier and longer,

the ratio of brook trout to brown trout by weight was only 2:1. Further comparisons of the two fish are in Table 9.

From the evidence presented, several items of importance have emerged. There is no doubt that there are brown trout in the White River above White Cloud and that they are reproducing successfully. However, the number is not large, and in many parts of the mainstream and in some of the tributaries they either are not found at all or are quite rare. On the basis of records from other streams, it can be stated that once brown trout are established in favorable waters they will hold their own without the addition of artificially reared stock. Much of this drainage is still brook trout water and should be retained as such (upper end of the White River in Oxford swamp, Flinton Creek and Five Mile Creek). If the greatest utilization of hatchery fish is to be obtained they must be removed by anglers soon after planting or they are lost. Shetter and Hazzard (1940), Shetter (1944) and Cooper (1953) have shown that planted brook and rainbow trout result in a greater yield to the angler than do brown trout. Therefore, it is recommended that any further releases of hatchery fish, in the White River drainage above White Cloud, should consist of brook or rainbow trout.

List of fishes found in the White River Drainage

Game fish	Scientific name[3]
Brook trout	Salvelinus fontinalis
Brown trout	Salmo trutta
Rainbow trout	Salmo gairdneri
Northern pike	Esox lucius
Yellow perch	Perca flavescens
Smallmouth bass	Micropterus dolomieui
Largemouth bass	Micropterus salmoides
Pumpkinseed	Lepomis gibbosus
Longear sunfish	Lepomis megalotis
Green Sunfish	Lepomis cyanellus
Bluegill	Lepomis macrochirus
Rock bass	Ambloplites rupestris
Black crappie	Pomoxis nigromaculatus
Coarse fish	
White sucker	Catostomus commersoni
Hog sucker	Hypentelium nigricans
Redhorse	Moxostoma spp.
Lake chubsucker	Erimyzon sucetta
Burbot	Lota lota lacustris
Grass pickerel	Esox vermiculatus
Brown bullhead	Ameiurus nebulosus
Yellow bullhead	Ameiurus natalis
Obnoxious fish	
Bowfin	Amia calva
Sea lamprey	Petromyzon marinus
Chestnut lamprey	Ichthyomyzon castaneus
Forage fish	
Creek chub	Semotilus atromaculatus
Pearl dace	Semotilus margarita
Hornyhead chub	Hybopsis biguttata
Blacknose dace	Rhinichthys atratulus
Longnose dace	Rhinichthys cataractae
Redbelly dace	Chrosomus eos
Finescale dace	Chrosomus neogaeus
Common shiner	Notropis cornutus
Blacknose shiner	Notropis heterolepis
Blackchin shiner	Notropis heterodon

[3] All scientific names follow Bailey, 1952 (unpublished check list of the fishes of Michigan).

Forage fish, cont'd.

Mimic shiner	Notropis volucellus
Pugnose shiner	Notropis anogenus
Golden shiner	Notemigonus crysoleucas
Bluntnose minnow	Pimephales notatus
Stoneroller	Campostoma anomalum
Mudminnow	Umbra limi
Banded killifish	Fundulus diaphanus
Johnny darter	Etheostoma nigrum
Iowa darter	Etheostoma exile
Rainbow darter	Etheostoma caeruleum
Least darter	Etheostoma microperca
Blackside darter	Hadropterus maculatus
Logperch	Percina caprodes
Northern muddler	Cottus bairdi
Brook stickleback	Eucalia inconstans
Tadpole madtom	Schilbeodes mollis
American brook lamprey	Lampetra lamottei
Michigan brook lamprey	Ichthyomyzon fossor
Immature lampreys	Ichthyomyzon spp.

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INSTITUTE FOR FISHERIES RESEARCH

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Table 1

Locations of collecting stations and conditions affecting the collecting, White River watershed, 1952

Stream Unit	Station No.	Location Town North	Location Range West	Section	Date Month	Day	Approximate efficiency and influencing factors		Length shocked (feet)	Shocking time (minutes)	Average Width (feet)	Average Depth (inches)
White River	90	12	17	22	Aug.	20	Low	Deep + wide	---	---	80	60
	89	12	17	14	Aug.	19	Low	Very deep	415	20	85	16
	88	12	16	7	Aug.	19	Poor	Very deep	465	38	75	14
	79	12	16	4	Aug.	1	Low	Very deep	505	42	80	22
	87	13	16	33	Aug.	13	Low	One channel only	400	49	14	6
	92	13	16	25	Aug.	22	Low	Very deep	635	36	70	12
Landford Creek	62	12	17	15	July	7	Fair	Weeds near banks	415	26	10	2
Silver Creek, below dam	48	12	17	14	June	19	Fair		600	60	20	5
above dam	49	12	16	19	June	19	Fair		260	35	25	4
Unnamed tributary	65	12	17	14	July	10	High		200	14	3.5	3
Carlton Creek	64	12	17	1+12	July	9	Fair		655	61	30	16
	55	12	17	1	June	26	Fair		580	44	22	6
	54	13	17	21	June	25	Poor	Unsafe bottom	510	26	16	4
	53	13	17	4	June	25	High		408	21	4	115
Little Carlton Creek	57	13	17	24	June	27	Fair	Shocker failing	250	18	14	4
	56	13	17	24	June	26	High		210	14	3.5	2
Sand Creek, below dam	61	12	16	6	July	1	Fair	Large pools	310	62	18	3
above dam	60	12+13	16	32+5	June	30	Fair		650	47	20	3
	63	13	16	30	July	9	Good		245	26	10	5
	58	13	16	7	June	27	High		235	22	2.5	2
Cleveland Creek	52	12	16	9	June	24	Poor	Very wide	575	75	21	5
Blue Lake Outlet	66	12	16	9	July	10	Good	Unsafe bottom	170	31	5	5
White River,	76	13	16	14	July	30	Poor	Swift + deep	730	67	35	18
North Branch	75	13	16	3	July	29	Poor	Swift + wide	730	64	42	12
	72	14	16	34	July	17	Poor	Swift + wide	510	48	37	18
	44	14	16	23	June	9	Poor	Slightly turbid	955	60	15	7
	43	14	15	8	June	9	Fair	Slightly turbid	310	26	14	8
	38	14	15	11	June	4	Good	Weeds abundant	180	28	12	5
Newman Creek	68	13	16	14	July	11	Fair		390	27	12	5
	67	13	16	3+4	July	11	Fair		415	29	10	4
	59	14	16	32	June	27	Fair		435	38	9	4
Knutson Creek	46	13	16	11	June	17	Fair		240	23	15	5
	45	13	15	6	June	17	Good		330	55	6	4
	47	14	15	33	June	17	Good		255	26	5	2
	39	14	15	29+32	June	4	Good		310	24	5	4
Unnamed tributary	73	13	16	2	July	24	Fair		215	26	7	4
Ferry Creek	71	14	16	28	July	16	Good		225	20	7	4
Robinson Creek	69	14	16	16	July	15	Fair		310	26	16	7

Table 1

Locations of collecting stations and conditions affecting the collecting, White River watershed, 1952

Stream Unit	Station No.	Location Town North	Location Range West	Section	Date Month	Date Day	Approximate efficiency and influencing factors		Length shocked (feet)	Shocking time (minutes)	Average Width (feet)	Average Depth (inches)
Swinton Creek	70	14	16	11	July	16	Fair		410	38	11	4
	33	14	16	2+3	May	28	High		310	26	4.5	4
	32	15	16	35	May	28	Good		370	38	8	6
White River, from North Branch to Hosperia	91	13	15	20	Aug.	21	Poor	Deep + swift	325	26	50	16
	83	13	15	16	Aug.	7	Poor	Deep + swift	510	37	80	10
	82	13	15	9	Aug.	7	Poor	Deep + swift	405	28	50	18
	86	13	15	10	Aug.	12	Poor	Deep + swift	430	42	85	10
	81	14	15	35	Aug.	6	Poor	Deep + swift	460	47	73	14
	80	14	15	25	Aug.	6	Poor	Deep + swift	542	66	80	24
Skeel Creek	35	13	15	32	June	2	High		310	33	13	7
	37	12	15	3+10	June	3	Good		285	22	7	6
	36	12	15	10+11	June	3	Good		285	41	8	5
Cushman Creek	40	13	15	22	June	5	Good		456	41	16	7
	51	13	15	26+27	June	23	Fair	Slightly turbid	550	46	14	5
	34	13	15	25+36	May	29	High		285	22	12	5
Braton Creek	41	13	15	11	June	5	Fair	Swift	270	22	15	7
	42	13	15	11+14	June	5	Good		305	29	13	5
	27	13	15	24	May	22	Fair		290	20	10	4
	28	13	14	29	May	22	High		290	24	2.5	2
	29	13	14	20	May	22	High		290	23	5	5
	50	13	14	7	June	23	Good		255	27	5	3

Part III

Table 1

Locations of collecting stations and conditions affecting the collecting, White River watershed, 1952

Stream Unit	Station No.	Location Town North	Location Range West	Section	Date Month	Date Day	Approximate efficiency and influencing factors		Length shocked (feet)	Shocking time (minutes)	Average Width (feet)	Average Depth (inches)
Unnamed tributary	74	13	15	1	July	24	High		485	21	3.5	2
White River, Hesperia	77	14	14	27	July	31	Low	Swift + deep	410	33	42	24
to White Cloud	78	14	14	24	July	31	Low	1 electrode broken	510	37	37	13
	11	14	13	31	May	8	Poor	Wide	1,100	51	85	12
	8	14	13	32	May	5	Low	Deep + wide	720	34	65	18
	15	14	13	34	May	13	Fair	Deep + wide	925	62	55	24
	9	13	12	6	May	6	Low	Shocker failing	530	25	40	16
	6	13	12	5	May	2	Poor	Wide	762	67	45	14
Wright's Creek	26	14	14	32	May	21	Good		310	25	12	5
Martin Creek	12	14	14	22	May	9	Good		482	31	32	7
	19	14	13	6	May	16	Good		170	23	16	6
	13	14	14	2	May	9	Good		525	36	12	6
Mena Creek	10	14	13	6	May	8	Good		506	32	12	6
	31	14	13	3	May	26	High		320	19	5	4
Delong Creek	24	14	13	31	May	20	High		135	20	10	4
Coonskin Creek	25	13	13	5	May	21	Poor	Weeds	506	49	23	6
	14	13	13	10	May	12	High		261	23	15	13
	30	13	13	5	May	23	Good		155	12	6	5
First Cole Creek	20	13	13	33	May	16	High		110	17	9	4
Second Cole Creek	17	14	13	35	May	14	High		128	18	5	4
Rattlesnake Creek	18	13	13	1	May	14	High		175	17	10	3
White River, above	7	14	12	33	May	5	Poor	Wide	645	47	40	14
White Cloud	5	14	12	21	May	2	Fair	Swift	480	47	24	12
	2	14	12	9	Apr.	30	Fair	Deep	740	81	22	10
	21	15	12	33	May	17	Good		425	36	18	10
	23	15	12	28	May	17	Good		310	22	14	4
Hinton Creek	1	14	12	34	Apr.	29	Fair		506	49	12	8
Five Mile Creek	3	14	12	22	May	1	Good		325	20	19	6
Mullen Creek	4	14	12	10	May	1	Good		458	24	12	8
Stratton Creek	22	15	12	25+26	May	17	High		290	18	7	3
	16	15	11	32	May	14	High		145	12	4	4

Table 2

Record of impoundments in the White River watershed

Stream	Name of dam or impoundment	Head, feet	County	Town North	Range West	Section	Owner	When built	Approx. area, acres
Silver Creek	Silver Creek Pond	7	Muskegon	12	17	13+14	Wm. J. Eilers	1950	12
Silver Creek	5 Beaver Dams	---	Muskegon	12	17	19	Beavers	---	---
Sand Creek	Rochdale Pond	10	Muskegon	12	16	5+6	Victor Hugo	1913	18
Cleveland Creek	Lake Wolverine	16	Muskegon	12	16	9+15+16	Wm. G. Lidke	---	90
N. Br. White R.	Ferry Dam (not in use)	6	Oceana	14	16	27	Mich. Pub. Ser. Co.	1871	---
Swinton Creek	---	---	Oceana	14	16	11	Private	---	---
Skeel Creek	---	---	Muskegon	12	15	10	Private		
White River	Hesperia Pond	10	Oceana + Newaygo	14	15	25+30	Consumers Power Co.	1870	50
Mena Creek	Minnie Creek Sanctuary Dam	8	Newaygo	14	13	6	U. S. Forest Service	---	---
Mena Creek	Lake Loda	0.7	Newaygo	14	13	2	Beaver	---	---
White River	Lake White Cloud	17	Newaygo	14	12	4+5	City of White Cloud	1870	35
White River	W. R. trout rearing station (not in use)	2.5	Newaygo	14	12	21	Conservation Dept.	1929	
White River	15 Beaver Dams	---	Newaygo	14+15	12	28+33+4	Beavers	---	---

Table 3

Number of fish caught by shocker, converted to catch per hour, White River watershed

(All figures in parenthesis are the actual numbers of fish caught using techniques other than shocking)

Stream	Station number	Shocking time	Brook trout	Brown trout	Rainbow trout	Northern pike	Yellow perch	Largemouth bass	Pumpkinseed	Longear sunfish	Green sunfish	Bluegill	Rock bass	White sucker	Redhorse	Lake chubsucker	Burbot	Brown bullhead	Yellow bullhead	Bowfin	Creek chub	Blacknose dace	Longnose dace	Redbelly dace	Common shiner	Bluntnose minnow	Mudminnow	Banded killifish	Johnny darter	Blackside darter	Least darter	Rainbow darter	Logperch	Northern muddler	Brook stickleback	American brook lamprey	Michigan brook lamprey	Ichthyomyzon spp.	Other species		
White River,	90	1/	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	(2)	...	...	...	...	...	...	...	...	...	...	...	...			
mouth to	89	20	...	...	...	...	12	...	...	...	...	...	...	...	...	...	30	...	...	...	...	...	...	...	...	...	12	...	3	9	...	...	...	51	...	12	...	9			
North Branch	88	38	...	...	...	8	5	...	...	...	...	...	...	...	3	...	25	...	5	...	...	...	...	...	2	...	22	...	30	...	...	...	...	51	...	5	...	9			
	79	42	...	...	...	3	1	3	...	...	...	...	1	10	44	...	14	...	...	...	10	...	...	...	7	20	...	...	32	6	...	...	3	10	...	3	...	10			
	87	49	...	...	...	1	...	...	...	...	...	...	...	4	...	...	65	...	...	...	...	...	...	...	...	...	...	...	1	...	...	...	...	28	...	1	...	1			
	92	36	...	...	...	...	...	...	...	...	...	...	...	23	10	...	7	...	...	...	108	2	10	...	23	2	...	...	30	5	...	...	...	3	...	20	...	...	Sea lamprey	3	
Landford Cr.	62	26	556	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	46	...	...	...	...			
Silver Cr.	48	60	77	...	...	6	...	...	...	...	...	...	...	9	...	...	20	...	...	...	6	37	...	...	22	...	28	...	7	...	...	6	...	32	5	12	...	...	Mud pickerel	1	
Silver Cr. Pond	84	2/	...	...	...	(6)	...	...	...	...	...	...	...	(23)	...	...	...	...	...	...	...	(2)	...	...	...	...	(35)	...	(12)	...	...	...	...	(2)	(2)	...	...	...			
Silver Cr.	49	35	178	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	...	...	...	...	...	...	...	...	...	...	...	87	2	2	...	...			
Unnamed trib.	65	14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	34	...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	...	...	26	...	...	...			
Carlton Cr.	64	61	37	...	...	...	...	1	...	...	...	...	...	3	...	...	89	...	...	...	1	...	...	...	...	...	8	...	...	...	...	...	...	33	...	17	...	...	Mud pickerel	2	
	55	44	87	...	3	...	...	...	...	...	...	...	...	3	...	...	44	...	...	...	3	25	...	...	...	...	...	...	...	...	...	...	...	10	...	1	...	...	Chestnut lamprey	3	
	54	26	16	...	...	...	...	...	...	...	...	...	...	...	...	7	2	...	...	...	...	...	...	...	...	...	16	...	...	...	...	...	...	159	...	23	...	...			
	53	21	31	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	20	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...			
Little Carlton	57	18	...	...	...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	...	60	63	...	...	...	...	...	...	17	...	...	...	...	...	...	...	...	...			
Cr.	56	14	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	9	...	...	...	...	43	...	...	...	...	...	...	...	...	...	...	...			
Sand Cr.	61	62	17	4	...	...	2	...	...	...	...	...	...	17	...	...	140	...	...	...	1	28	...	...	...	...	1	...	...	...	...	...	...	29	...	8	...	...			
Rochdale Pond	85	2/	(13)	...	...	...	...	...	...	...	...	...	...	(5)	...	...	...	...	...	...	...	(17)	...	...	...	...	(12)	...	...	...	...	...	...	(12)	...	(9)	...	...	Golden shiner	(28)	
Sand Cr.	60	47	209	...	...	...	...	...	...	...	...	...	...	20	...	...	...	...	...	...	...	5	...	...	...	...	10	...	...	...	...	...	...	108	...	5	...	...			
	63	26	203	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	95	...	2	...	...			
	58	22	352	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	9	...	9	...	...			
Cleveland Cr.	52	75	...	...	...	...	2	...	2	...	...	...	...	351	...	2	17	7	...	2	3	14	1	1	50	...	17	...	6	...	...	...	...	12	17	25	...	...	Tadpole madtom	2	
Blue Lake Cr.	66	31	10	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	126	...	...	...	...	...	...	...	6	...	...	...			
North Branch of	76	67	...	...	...	...	...	...	...	...	...	...	...	13	...	1	22	...	...	...	23	16	...	...	...	...	3	...	1	...	...	1	4	22	...	13	...	...	Blacknose shiner	2	
White River	75	64	...	...	...	...	...	...	1	...	...	1	...	25	...	...	35	...	...	...	...	27	98	...	...	17	...	3	...	6	...	...	...	2	38	...	16	...	...	Pearl dace	2	
	72	48	1	...	...	...	...	...	...	...	...	...	...	9	...	...	9	...	...	...	...	14	15	...	...	1	...	...	...	...	...	...	...	19	...	9	...	...	Pearl dace	1	
	44	6●	12	...	...	...	...	...	...	...	...	...	...	16	...	...	...	...	...	...	...	22	72	...	...	1	...	7	...	8	...	...	...	187	...	26	1	5	Iowa darter	1	
	43	26	...	...	...	...	...	...	...	...	...	...	...	28	...	...	...	...	...	...	...	37	25	...	...	...	...	...	...	6	...	...	...	102	...	18	...	...			
	38	28	...	...	...	...	2	2	...	24	90	6	2	...	...	...	...	...	17	...	2	...	...	...	...	...	...	4	9	...	...	9	...	...	...	...	...	...	Green x Longear sunfish	2	
Newman Cr.	68	27	7	...	...	...	...	...	...	...	...	...	...	...	...	...	58	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	...	7	...	...			
	67	29	48	...	...	...	...	...	...	...	...	...	...	8	...	...	4	...	...	...	6	72	...	...	...	...	...	...	...	...	...	...	...	64	...	8	...	...			
	59	38	...	...	...	...	...	...	...	...	...	...	...	9	...	...	...	...	2	...	98	85	...	...	...	...	5	...	...	...	...	...	...	...	...	17	...	...			

1/ Experimental gill net and angling used.
2/ An impoundment, fish taken with experimental gill net, D. C. shocker, bag seine and hook and line.
3/ Collections made by Rodeheffer and Day

Table 3, Cont'd.

Number of fish caught by shocker converted,to catch per hour,
White River watershed

(All figures in parenthesis are the actual numbers of fish
caught using techniques other than shocking)

Stream	Station number	Shocking time	Brook trout	Brown trout	Rainbow trout	Northern pike	Smallmouth bass	Largemouth bass	Pumpkinseed	Rock bass	White sucker	Hog sucker	Redhorse	Burbot	Mud pickerel	Yellow bullhead	Creek chub	Pearl dace	Blacknose dace	Longnose dace	Redbelly dace	Common shiner	Golden shiner	Blunthose minnow	Stoneroller	Mudminnow	Banded killifish	Johnny darter	Blackside darter	Rainbow darter	Logperch	Northern muddler	Brook stickleback	American brook lamprey	Ichthyomyzon spp.	Other species	
Knutson Cr.	46	23	21	5	...	...	...	...	...	...	...	...	...	23	...	...	3	26	26	...	...	...	...	...	...	...	...	...	...	...	26	...	5	...		
	45	55	...	...	...	...	...	...	...	...	3	...	...	2	...	...	44	94	84	...	...	...	...	...	...	25	...	...	...	...	3	...	11	...		
	47	26	240	...	...	...	...	...	...	...	...	...	...	...	...	...	...	16	44	...	...	...	...	...	...	16	...	...	...	...	...	...	...	...		
	39	24	13	...	...	...	...	...	...	...	...	...	...	...	...	...	3	3	70	...	...	...	...	...	...	50	...	...	...	...	125	...	22	...	Blacknose shiner	3
Unnamed trib.	73	26	...	...	...	...	...	5	...	...	18	...	...	2	...	...	37	14	12	...	...	2	...	...	...	18	...	...	...	...	2	...	...	...		
Unnamed trib.	71	20	...	...	...	...	...	...	6	...	...	...	...	...	...	...	72	...	78	...	3	...	...	...	...	207	...	...	...	...	...	6	36	...	Iowa darter	3
Robinson Cr.	69	26	173	...	...	...	...	...	...	...	5	...	...	...	...	...	...	...	...	...	...	...	...	...	...	7	...	...	...	...	37	...	7	...		
Swinton Cr.	70	38	25	2	3	...	...	...	...	...	3	...	...	...	...	...	8	...	35	...	...	...	...	...	...	...	...	...	...	...	196	...	55	...		
	33	26	55	...	...	...	...	...	...	...	...	...	...	...	...	...	78	...	18	...	...	...	...	...	...	2	...	...	...	...	53	...	2	...	Blackchin shiner	5
	32	38	41	2	...	...	...	...	...	...	...	...	...	...	...	...	...	...	6	...	...	...	...	...	...	5	...	...	...	...	81	...	14	...	Yellow perch	2
White River	91	26	...	...	...	...	...	...	...	...	35	9	32	25	...	...	141	...	21	12	...	60	...	2	...	...	...	14	...	5	7	...	...	62	12		
North Branch	83	37	...	...	...	...	...	3	2	...	558	16	34	5	...	...	197	...	39	3	...	110	...	23	...	2	10	18	...	...	6	2	...	2	...	Blacknose shiner	2
to Hesperia	82	28	...	...	...	...	...	...	...	...	32	15	4	28	...	...	92	...	32	2	...	66	...	9	...	...	...	13	2	24	2	...	...	...	2	Sea lamprey	2
	86	42	...	...	...	...	14	...	...	...	14	16	...	6	...	3	59	...	20	87	...	77	...	1	1	...	...	19	4	16	...	...	...	...	...	Sea lamprey	1
	81	47	...	...	...	...	18	1	...	...	36	38	5	10	...	...	175	...	135	5	...	97	...	...	1	...	1	41	4	50	10	...	...	3	...		
	80	66	...	...	...	2	14	2	...	6	16	2	...	29	2	2	6	...	...	...	...	2	1	14	...	...	8	19	6	5	3	...	...	1	3	Lake chubsucker	1
Skeel Creek	35	33	16	...	...	...	...	...	...	...	...	...	...	65	...	...	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	5	...	11	...		
	37	22	3	...	...	...	...	...	...	...	5	...	...	...	...	...	11	...	8	...	...	...	...	...	...	...	...	...	...	...	128	...	8	...		
	36	41	...	...	...	6	...	...	...	...	12	...	...	...	...	...	1	...	...	...	...	...	...	...	...	15	...	...	...	...	53	...	...	...		
Cushman Cr.	40	41	12	64	26	...	...	...	1	...	1	...	...	15	...	3	10	...	...	...	...	...	...	...	...	...	...	...	...	...	7	...	7	...		
	51	46	17	1	1	...	...	...	...	...	...	...	...	1	...	3	43	...	...	...	...	...	...	...	...	7	...	...	...	...	76	...	1	...		
	34	21	...	...	...	...	...	...	...	...	49	...	...	...	...	...	29	...	134	...	...	...	...	...	...	...	...	6	...	...	91	...	...	...		
Braton Cr.	41	22	...	3	8	...	3	...	...	...	11	...	...	19	...	...	11	...	8	14	...	...	...	...	...	...	...	3	11	3	...	...	3	...		
	42	29	...	...	2	...	...	...	...	...	41	4	...	6	...	...	93	...	81	...	...	23	...	...	14	2	...	4	...	...	...	...	...	...	Michigan brook lamprey	8
	27	20	...	...	...	...	...	...	...	...	24	...	...	...	...	3	201	...	237	...	...	54	...	6	...	...	...	48	...	...	...	...	...	...		
	28	24	...	...	...	...	...	...	...	...	...	...	...	...	...	...	98	...	98	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	Blackchin shiner	5
	29	23	216	...	...	...	...	...	...	...	3	...	...	...	...	...	10	...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...		
	50	27	...	...	...	...	...	...	...	...	118	...	...	...	...	...	276	...	334	...	...	20	...	...	9	60	...	102	...	...	...	...	31	...		
Unnamed trib.	74	21	3	...	...	...	...	...	...	...	3	...	...	...	...	...	63	3	63	...	...	...	...	...	...	...	...	...	...	...	...	...	78	...	...	

Table 3, Cont'd.

Number of fish caught by shocker, converted to catch per hour,
White River watershed

(All figures in parenthesis are the actual numbers of fish caught using techniques other than shocking)

Stream	Station number	Shocking time	Brook trout	Brown trout	Northern pike	Yellow perch	Smallmouth bass	Largemouth bass	Pumpkinseed	Longear sunfish	Bluegill	Rock bass	White sucker	Hog sucker	Lake chubsucker	Burbot	Yellow bullhead	Bowfin	Creek chub	Pearl dace	Horyhead chub	Blacknose dace	Longnose dace	Redbelly dace	Common shiner	Mimic shiner	Blunthose minnow	Stoneroller	Mudminnow	Banded killifish	Johnny darter	Blackside darter	Rainbow darter	Northern muddler	Brook stickleback	American brook lamprey	Michigan brook lamprey	Ichthyomyzon spp.
Hesperia Pond	3/	2/	...	...	(2)	(14)	(2)	(40)	(6)	(4)	(11)	(3)	(54)	...	...	...	(11)	(10)	...	...	...	(8)	...	...	...	(1)	(125)	...	...	(31)	(29)	(14)	...	...	...	...	...	...
White River	77	33	...	...	...	...	2	...	...	...	...	...	5	9	...	9	...	2	18	...	...	4	...	...	4	...	9	...	...	...	2	11	25	4	...	11	...	4
Hesperia to	78	37	...	...	...	...	...	...	...	...	...	...	81	13	...	...	...	...	107	3	...	28	2	...	16	...	8	2	2	...	29	3	11	...	...	28	...	16
White Cloud	11	51	1	...	...	...	...	...	...	...	...	...	194	1	...	1	1	...	184	1	...	157	...	...	21	...	...	5	...	...	12	1	1	...	...	7	1	20
	8	34	...	...	...	...	...	...	...	...	...	...	16	2	...	...	...	...	25	...	...	27	...	...	...	...	...	...	...	...	4	2	...	...	...	5	9	7
	15	62	7	5	...	...	...	...	...	...	...	...	10	...	...	7	1	...	16	...	...	9	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	1
	9	25	...	...	...	...	...	...	...	...	...	...	22	...	...	...	...	...	38	...	...	12	2	...	...	...	...	...	...	...	...	...	5	...	...	10	...	26
	6	67	...	...	...	...	2	...	...	...	...	...	22	3	...	5	...	...	55	...	...	16	11	1	10	...	13	4	...	...	2	...	4	...	...	22	1	...
Wright's Cr.	26	25	2	...	...	...	...	...	...	...	...	...	70	...	...	...	...	...	339	4	...	228	...	...	...	...	7	2	...	...	38	...	...	...	...	48	...	...
Martin Cr.	12	31	85	6	...	...	...	...	...	...	...	...	33	...	...	...	...	...	64	21	...	273	...	...	...	...	...	...	...	...	23	...	...	45	...	6	...	...
	19	23	5	26	...	...	...	...	...	...	...	...	...	...	...	13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	42	...	3	...	...
	13	36	3	...	...	...	...	...	...	...	2	...	129	...	...	2	5	...	365	2	85	110	...	...	8	...	...	7	3	...	12	...	...	...	3	10	...	2
Mesa Cr.	10	32	212	2	...	...	...	...	...	...	...	...	2	...	...	...	...	...	120	...	...	145	...	...	...	...	...	...	...	...	...	...	...	38	...	13	...	...
	31	19	32	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	32	...	...	...	...	...	...	...	...	...
Delong Cr.	24	20	...	...	...	...	...	...	...	...	...	...	81	3	6	...	...	...	177	3	...	249	9	...	18	...	9	12	...	...	108	...	...	...	...	9	...	...
Coonskin Cr.	25	49	...	1	...	...	...	4	...	...	1	10	80	1	...	1	16	...	66	...	...	21	...	...	33	...	53	18	...	...	4	1	...	...	...	...	...	...
	14	23	...	...	...	18	...	...	3	50	24	81	290	3	...	...	31	...	31	...	123	...	...	...	68	...	...	3	...	...	...	...	...	...	...	...	...	...
	30	12	...	...	...	...	...	...	...	...	...	...	15	...	...	...	...	...	85	...	...	210	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
First Cole Cr.	20	17	64	247	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	4	...	4	...	...
Second Cole Cr.	17	18	60	87	...	...	...	...	...	...	...	...	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	...	...	7	...	...	...	...
Rattlesnake Cr.	18	17	...	...	...	...	...	...	...	...	...	...	29	...	...	...	...	...	216	...	...	568	...	...	46	...	...	...	...	...	4	...	...	...	...	...	...	...
Lake White Cloud	3/	2/	...	...	(2)	(12)	(3)	...	...	...	...	...	(175)	...	...	...	...	...	(11)	...	...	(2)	...	...	(1)	(25)	(107)	...	...	(2)	(25)	...	...	...	(5)	...	...	...
White River	7	47	8	...	...	...	...	...	...	...	...	...	188	...	...	...	...	...	19	...	...	42	1	...	1	...	...	...	...	...	5	...	...	38	1	5	...	...
Above White	5	47	15	14	...	...	...	...	...	...	...	...	66	...	...	...	...	...	6	...	...	73	1	1	...	...	...	...	...	...	...	...	...	35	...	4	...	...
Cloud	2	81	17	2	...	...	...	...	...	...	...	...	34	...	...	...	...	...	21	73	...	23	...	2	...	...	...	...	1	...	1	...	...	27	...	11	...	...
	21	36	57	2	2	...	...	...	...	...	5	...	20	...	...	...	...	...	3	...	...	2	...	...	...	...	...	...	...	...	...	...	...	50	...	3	...	...
	23	22	41	...	...	...	...	...	...	...	...	...	3	...	...	...	...	...	...	74	...	3	...	5	...	...	...	...	38	...	...	...	...	57	...	...	...	...
Flinton Cr.	1	49	39	1	...	...	...	...	...	...	...	...	35	1	...	...	...	...	60	4	...	63	...	2	...	...	...	...	1	...	2	...	...	10	1	1	...	...
Five Mile Cr.	3	20	138	42	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	93	...	3	...	...
Mullen Cr.	4	24	38	3	...	...	...	...	...	...	...	...	...	...	...	...	...	...	3	...	...	30	...	...	...	...	...	...	3	...	...	...	...	102	...	25	...	...
Stratton Cr.	22	18	13	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	33	...	...	93	...	13	...	...	...	...	47	...	...	...	...	...	7	13	...	...
	16	12	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	160	...	...	...	...	245	...	...	...	...	...	410	...	...	...

Brown bullhead	(123)
Chestnut lamprey	4
Chestnut lamprey	2
Chestnut lamprey	2
Blackchin shiner	2
Brook x brown trout	1
Creek chub x common shiner	6
Black crappie	1
Pugnose shiner	3
Iowa darter	4
Green sunfish	1
Golden shiner	1
Finescale dace	15

2/ An impoundment, fish taken with experimental gill net, D. C. shocker, bag seine and hook and line.

3/ Collections made by Rodeheffer and Day

Table 4

Size range for each species (total length in inches and tenths), summarized by stream drainage units, White River

Stream unit	Brook trout	Brown trout	Rainbow trout	Northern pike	Smallmouth bass	Largemouth bass	White sucker	Burbot
White River	....	....	....	5.8	....	1.8	1.4	2.8
	....	....	....	7.1	....	2.5	7.8	7.6
Landford Cr.	1.1	....	....	....	....	....	....	....
	7.8	....	....	....	....	....	....	....
Silver Cr.	2.1	....	....	3.1	....	....	3.1	1.9
below dam	7.4	....	....	4.7	....	....	5.5	9.6
Silver Cr.	....	....	....	16.1	....	....	2.4	....
impoundment	....	....	....	26.5	....	....	16.3	....
Silver Cr.	1.5	....	....	....	....	....	....	....
above dam	9.6	....	....	....	....	....	....	....
Unnamed tributary	....	....	....	....	....	....	....	2.1
	....	....	....	....	....	....	....	2.9
Carlton Cr.	2.0	....	5.6	....	....	1.3	5.4	2.5
	12.5	....	6.4	....	....	....	19.6	10.0
Little Carlton Cr.	....	....	....	....	....	....	7.7	....
	....	....	....	....	....	....	....	....
Sand Cr. below dam	2.5	2.6	....	....	....	....	1.1	2.2
	8.5	7.4	....	....	....	....	9.5	8.6
Rochdale Pond	4.9	....	....	....	....	....	3.3	....
	11.6	....	....	....	....	....	17.0	....
Sand Cr. above dam	1.4	....	....	....	....	....	....	....
	7.9	....	....	....	....	....	10.5	....
Cleveland Cr.	....	....	....	....	....	....	0.9	2.1
	11.2	....	....	....	....	....	14.8	8.9
Blue Lake outlet	4.6	....	....	....	....	....	....	....
	6.4	....	....	....	....	....	....	....
White River,	4.5	1.7	1.4	....	....	2.6	1.4	3.0
North Branch	7.7	12.6	7.8	....	....	....	16.7	13.5
Newman Cr.	2.3	2.1	1.5	....	....	....	1.2	2.9
	10.8	7.7	8.8	....	....	....	5.9	8.1
Knutson Cr.	1.2	2.0	....	....	....	....	3.0	4.6
	10.3	12.7	....	....	....	....	5.0	10.0
Unnamed tributary	....	....	....	....	....	1.6	1.7	8.4
	....	....	....	....	....	2.1	7.1	....
Ferry Cr.	....	....	....	....	....	....	....	....
	....	....	....	....	....	....	....	....
Robinson Cr.	1.7	....	....	....	....	....	....	....
	14.6	....	....	....	....	....	11.9	....
Swinton Cr.	1.4	7.1	2.2	....	....	....	1.5	....
	11.1	8.7	7.9	....	....	....	5.6	....
White River	....	....	....	6.0	1.8	2.0	1.5	2.6
	....	....	....	7.6	8.4	3.1	5.5	10.6
Skeel Cr.	1.6	....	....	2.9	....	....	2.7	4.3
	9.9	....	....	3.4	....	....	13.2	11.4
Cushman Cr.	2.1	1.4	4.6	....	....	....	2.5	4.7
	10.2	16.8	10.6	....	....	....	10.5	11.6
Braton Cr.	1.4	6.4	5.8	....	2.8	....	1.0	4.8
	9.5	....	7.0	....	....	....	7.9	7.4

Table 4, Cont'd.

Size range for each species (total length in inches and tenths), summarized by stream drainage units, White River

Stream unit	Brook trout	Brown trout	Rainbow trout	Northern pike	Smallmouth bass	Largemouth bass	Bluegill	Rock bass	White sucker	Burbot
Unnamed tributary	5.2	....	....	....	....	....	....	....	3.8	....
	....	....	....	....	....	....	....	....	....	....
White River	3.6	3.1	....	....	2.4	....	....	....	1.1	3.0
	5.6	9.6	....	....	5.7	....	....	....	14.7	10.8
Wright's Cr.	5.2	....	....	....	....	....	....	....	2.4	....
	....	....	....	....	....	....	....	....	8.3	....
Martin Cr.	1.3	5.4	....	....	....	....	5.4	....	2.2	5.3
	9.7	13.9	....	....	....	....	....	....	13.9	7.6
Mena Cr.	1.1	....	....	....	....	....	....	....	3.4	....
	9.6	....	....	....	....	....	....	....	....	....
Delong Cr.	....	....	....	....	....	....	....	....	1.9	....
	....	....	....	....	....	....	....	....	4.9	....
Coonskin Cr.	....	7.9	....	....	....	7.8	3.9	2.8	2.2	10.5
	....	....	....	....	....	8.3	5.1	9.3	12.2	....
First Cole Cr.	1.5	1.3	....	....	....	....	....	....	....	....
	....	....	....	....	....	....	....	....	....	....
Second Cole Cr.	1.0	2.9	....	....	....	....	....	....	3.8	....
	6.9	5.0	....	....	....	....	....	....	....	....
Rattlesnake Cr.	....	....	....	....	....	....	....	....	2.1	....
	....	....	....	....	....	....	....	....	2.9	....
White River	1.2	1.3	....	7.5	....	....	1.9	....	1.9	....
	14.9	19.4	....	....	....	....	2.5	....	15.5	....
Flinton Cr.	4.0	....	....	....	....	....	....	....	2.3	....
	8.0	14.6	....	....	....	....	....	....	13.8	....
Five Mile Cr.	0.9	3.8	....	....	....	....	....	....	....	....
	9.8	8.3	....	....	....	....	....	....	....	....
Mullen Cr.	4.0	....	....	....	....	....	....	....	....	....
	8.6	23.3	....	....	....	....	....	....	....	....
Stratton Cr.	1.2	....	....	....	....	....	....	....	....	....
	5.0	....	....	....	....	....	....	....	....	....

Table 5

Average total length in inches and number of trout in various age classes, summarized by stream drainage units, White River watershed

Species and stream unit	0		I		II		III		IV		V	
	No.	Len.	No.	Len.	No.	Len.	No.	Len.	No.	Len.	No.	Len.
Brook trout												
Landford Cr.	215	2.1	25	5.7	...	...	...	...	...	...	...	...
Silver Cr., below	77	2.8	5	5.9	...	...	...	...	...	...	...	...
Silver Cr., above	82	2.1	21	5.8	1	9.6	...	...	...	...	...	...
Carlton Cr.	56	2.7	67	6.8	5	9.6	2	12.3	...	...	...	...
Sand Cr., below	1	2.5	15	5.8	2	8.3	....	...	...	...	...	...
Rochdale Pond	...	...	9	6.2	2	8.1	1	11.6	...	...	...	...
Sand Cr., above	207	2.3	171	5.0	3	6.7	...	...	...	...	...	...
Cleveland Cr.	...	...	...	...	1	11.2	...	...	...	...	...	...
Blue Lake outlet	...	...	5	5.5	...	...	...	...	...	...	...	...
N. Br. White River	...	...	13	6.3	...	...	...	...	...	...	...	...
Newman Cr.	8	2.7	17	6.1	...	...	1	10.8	...	...	...	...
Knutson Cr.	91	1.9	20	5.4	6	8.5	...	...	...	...	...	...
Robinson Cr.	32	2.6	40	5.8	4	9.4	...	...	1	14.6	...	...
Swinton Cr.	13	2.5	42	5.7	9	8.4	2	10.8	...	...	...	...
Skeel Cr.	1	1.6	8	6.7	1	9.9	...	...	...	...	...	...
Cushman Cr.	7	2.4	13	7.5	1	10.2	...	...	...	...	...	...
Braton Cr.	41	1.8	38	5.7	3	8.3	1	9.5	...	...	...	...
Unnamed tributary	...	...	1	5.2	...	...	...	...	...	...	...	...
White River	...	...	8	4.7	...	...	...	...	...	...	...	...
Wright's Creek	...	...	1	5.2	...	...	...	...	...	...	...	...
Martin Cr.	3	1.4	40	5.8	5	9.3	...	...	...	...	...	...
Mena Cr.	39	1.5	71	5.6	11	7.5	2	9.4	...	...	...	...
First Cole Cr.	11	1.7	5	3.7	...	...	...	...	...	...	...	...
Second Cole Cr.	7	1.4	5	3.7	6	5.8	...	...	...	...	...	...
White River	1	1.2	69	5.5	14	8.1	5	12.7	1	14.0	...	...
Flinton Cr.	...	...	28	4.9	3	7.3	...	...	...	...	...	...
Five Mile Cr.	5	1.2	20	4.2	20	7.2	1	9.8	...	...	...	...
Mullen Cr.	...	...	14	4.9	1	8.6	...	...	...	...	...	...
Stratton Cr.	3	1.2	1	5.0	...	...	...	...	...	...	...	...
Brown trout												
Sand Cr., below	3	3.0	1	7.4	...	...	...	...	...	...	...	...
N. Br. White River	17	3.1	6	7.7	2	11.2	...	...	...	...	...	...
Newman Cr.	18	2.8	7	6.2	...	...	...	...	...	...	...	...
Knutson Cr.	1	2.0	...	...	1	12.7	...	...	...	...	...	...
Swinton Cr.	...	...	1	7.1	...	...	1	8.7	...	...	...	...
Cushman Cr.	5	1.8	28	6.9	8	9.9	1	12.3	1	12.8	1	16.8
Braton Cr.	...	...	1	6.4	...	...	...	...	...	...	...	...
White River	...	...	1	3.1	4	7.7	...	...	...	...	...	...
Martin Cr.	...	...	2	6.3	9	7.7	2	12.6	...	...	...	...
Mena Cr.	...	...	...	...	...	...	1	12.1	...	...	...	...
Coonskin Cr.	...	...	1	7.9	...	...	...	...	...	...	...	...
First Cole Cr.	3	1.6	60	3.4	8	5.9	1	8.3	...	...	...	...
Second Cole Cr.	...	...	26	4.0	...	...	...	...	...	...	...	...
White River	1	1.3	9	5.5	4	10.5	...	...	1	17.8	1	19.4
Flinton Cr.	...	...	...	...	...	...	1	14.6	...	...	...	...
Five Mile Cr.	...	...	12	4.3	2	8.3	...	...	...	...	...	...
Mullen Cr.	All scales regenerated											
Rainbow trout												
Carlton Cr.	...	...	2	6.0	...	...	...	...	...	...	...	...
N. Br. White River	17	2.1	5	6.8	...	...	...	...	...	...	...	...
Newman Cr.	7	1.9	9	5.6	1	8.8	...	...	...	...	...	...
Swinton Cr.	1	2.2	1	7.9	...	...	...	...	...	...	...	...
Cushman Cr.	...	...	18	6.4	1	10.6	...	...	...	...	...	...
Braton Cr.	...	...	3	6.1	2	7.7	1	13.1	...	...	...	...
Brook x Brown Hybrid												
Mena Cr.	...	...	1	4.8	...	...	...	...	...	...	...	...

Table 6

Physical features of the collecting stations
in the White River watershed

Stream unit	Sta. No.	Ave. width feet	Ave. depth in.	Current	Pools				Vegetation	Percent of bottomesoil type				
					Size	Type	Frequency	Cover		Silt	Sand	Gravel	Rubble	Clay
White River	90	80	60	Medium	1	2	1	Fair	Common	100	...	...	...	...
	89	85	16	Medium	2	2	2	Poor	Sparse	10	90	...	...	...
	88	75	14	Medium	2	2	3	Poor	Common	25	75	...	...	...
	79	80	22	Rapid	2	2	2	Poor	Sparse	20	70	...	...	10
	87	14	6	Slow	3	2	2	Good	None	100	...	...	...	...
	92	70	12	Rapid	2	2	2	Poor	Sparse	5	85	10	...	...
Landford Cr.	62	10	2	Medium	3	2	3	Fair	Common	...	100	...	...	...
Silver Cr., below	48	20	5	Medium	3	2	3	Good	Sparse	...	60	40	...	...
Silver Cr., above	49	25	4	Medium	3	2	3	Fair	Sparse	5	75	20	...	...
Unnamed tributary	65	3.5	3	Medium	3	2	3	Fair	None	...	93	2	...	5
Carlton Cr.	64	30	16	Medium	2	2	2	Good	Common	15	85	...	...	...
	55	22	6	Medium	2	2	2	Good	None	15	85	...	...	...
	54	16	4	Medium	3	2	3	Poor	None	70	25	5	...	...
	53	4	1.5	Medium	3	2	3	Poor	None	70	25	5	...	...
Little Carlton Cr.	57	14	4	Medium	3	3	3	Poor	Sparse	20	80	...	...	...
	56	3.5	2	Medium	2	2	3	Poor	None	15	65	...	...	Marl 20
Sand Cr., below	61	18	3	Medium	2	2	3	Poor	Sparse	20	80	...	...	...
Sand Cr., above	60	20	3	Medium	3	3	3	Fair	Common	25	75	...	...	...
	63	10	5	Medium	3	2	3	Good	None	10	90	...	...	...
	58	2.5	2	Medium	3	2	3	Good	Common	15	25	60	...	...
Cleveland Cr.	52	21	5	Medium	3	3	3	Fair	Common	20	75	5	...	...
Blue Lake outlet	66	5	5	Slow	3	2	3	Good	Abundt.	75	25	...	...	...
White River, North Branch	76	35	18	Rapid	3	2	3	Poor	None	5	80	10	...	5
	75	42	12	Rapid	3	2	3	Poor	None	5	85	10	...	...
	72	37	18	Rapid	3	2	3	Fair	None	10	80	...	...	10
	44	15	7	Medium	3	2	3	Poor	Sparse	15	80	5	...	...
	43	14	8	Medium	3	3	3	Fair	None	20	80	...	...	...
	38	12	5	Slow	3	2	3	Poor	Abundt.	40	60	...	...	...

Newman Cr.	68	12	5	Medium	3	3	3	Good	Sparse	5	60	15	...	20
	67	10	4	Medium	3	2	3	Fair	Sparse	15	75	...	...	10
	59	9	4	Medium	3	2	3	Fair	None	50	50	...	...	...
Knutson Cr.	46	15	5	Medium	3	2	3	Fair	None	5	95	...	...	...
	45	6	4	Medium	3	2	3	Poor	Sparse	15	85	...	...	...
	47	5	2	Medium	3	2	3	Fair	None	10	80	10	...	...
	39	5	4	Medium	3	2	3	Fair	None	15	85	...	...	...
Unnamed tributary	73	7	4	Slow	2	2	3	Fair	None	35	55	...	...	10
Ferry Cr.	71	7	4	Slow	3	3	3	Poor	Sparse	80	20	...	...	...
Robinson Cr.	69	16	7	Medium	2	2	2	Good	None	15	85	...	...	...
Swinton Cr.	70	11	4	Medium	3	2	3	Poor	None	10	70	5	5	10
	33	4.5	4	Medium	3	2	3	Fair	None	10	70	20	...	...
	32	8	6	Medium	2	2	3	Fair	None	15	80	5	...	...
White River	91	45	16	Rapid	2	2	2	Fair	Sparse	5	85	10	...	...
to Hesperia	83	80	10	Rapid	2	2	3	Poor	None	15	60	15	10	...
	82	50	18	Rapid	1	2	2	Poor	None	5	60	5	20	10
	86	85	10	Rapid	2	2	3	Poor	Sparse	...	30	20	50	...
	81	73	14	Rapid	2	2	3	Poor	Common	5	40	20	25	10
	80	80	24	Rapid	3	2	3	Poor	Sparse	10	40	...	50	...
Skeel Cr.	35	13	7	Medium	3	2	3	Fair	None	5	95	...	...	...
	37	7	6	Slow	2	2	3	Poor	Sparse	40	60	...	...	...
	36	8	5	Medium	2	2	2	Poor	None	20	60	...	...	20
Cushman Cr.	40	16	7	Rapid	3	2	3	Good	None	5	55	35	5	...
	51	14	5	Medium	3	2	3	Fair	None	5	95	...	...	...
	34	12	5	Slow	2	2	3	Fair	None	40	60	...	...	...
Braton Cr.	41	15	7	Rapid	2	2	3	Fair	Sparse	15	60	...	...	25
	42	13	5	Medium	2	2	3	Poor	Sparse	10	75	...	...	15
	27	10	4	Medium	3	2	3	Poor	Common	30	70	...	...	...
	28	2.5	2	Medium	3	3	3	Poor	Common	35	65	...	...	...
	29	5	5	Medium	2	2	3	Fair	Common	10	90	...	...	...
	50	5	3	Slow	2	2	3	Fair	None	25	70	5	...	...
Unnamed tributary	74	3.5	2	Medium	1	2	3	Good	Common	10	60	15	...	15
White River,	77	42	24	Rapid	1	2	2	Fair	Sparse	10	65	25	...	...
Hesperia to	78	37	13	Rapid	3	2	3	Fair	Sparse	15	65	20	...	...
White Cloud	11	85	12	Medium	3	2	3	Poor	Sparse	20	70	10	...	...
	8	65	18	Medium	2	2	3	Fair	Common	35	60	5	...	...
	15	55	24	Medium	2	2	3	Fair	Sparse	20	75	5	...	...
	9	40	16	Medium	3	2	3	Fair	Common	20	70	10	...	...
	6	45	14	Rapid	3	2	3	Poor	Common	10	40	20	30	...
Wright's Cr.	26	12	5	Medium	3	2	3	Poor	Sparse	10	80	10	...	...
Martin Cr.	12	32	7	Medium	2	2	3	Fair	None	5	50	20	20	5
	19	16	6	Medium	3	2	2	Good	Common	10	90	...	...	...
	13	12	6	Medium	2	2	3	Poor	Common	20	70	5	5	...

Mena Cr.	10	12	6	Rapid	2	2	2	Good	Sparse	10	65	25	...	...
	31	5	4	Medium	2	2	3	Good	None	15	85	...	...	...
Delong Cr.	24	10	4	Slow	2	2	3	Poor	Sparse	40	40	10	10	...
Coonskin Cr.	25	23	6	Medium	3	2	3	Good	Common	30	60	10	...	...
	14	15	13	Medium	3	2	3	Fair	Abundt.	40	60	...	...	...
	30	6	5	Medium	3	2	3	Good	Common	45	50	5	...	...
First Cole Cr.	20	9	4	Rapid	3	2	3	Good	Sparse	...	65	35	...	...
Second Cole Cr.	17	5	4	Rapid	2	2	3	Fair	Common	5	70	25	...	...
Rattlesnake Cr.	18	10	3	Medium	3	2	3	Fair	Sparse	20	70	10	...	...
White River,	7	40	14	Medium	2	2	3	Fair	Sparse	15	80	5	...	...
above White	5	24	12	Rapid	2	2	3	Fair	None	...	35	25	35	5
Cloud	2	22	10	Medium	2	2	3	Poor	Sparse	15	75	10	...	...
	21	18	10	Medium	1	2	2	Good	None	10	90	...	...	...
	23	14	4	Medium	3	2	3	Fair	Sparse	15	85	...	...	...
Flinton Cr.	1	12	8	Rapid	1	2	3	Fair	None	10	65	20	5	...
Five Mile Cr.	3	19	6	Medium	3	2	3	Good	None	15	82	3	...	...
Mullen Cr.	4	12	8	Medium	1	2	3	Poor	Sparse	49	49	2	...	...
Stratton Cr.	22	7	3	Medium	3	2	3	Fair	Common	20	50	20	10	...
	16	4	4	Slow	2	2	2	Poor	Abundt.	30	60	10	...	...

Table 7

Species of fish taken in collections from the White River watershed in 1925, 1926, 1928, 1936 and 1938

Stream unit	Year	Brook trout	Rainbow trout	Yellow perch	Bluegill	Rock bass	White sucker	Hog sucker	Yellow bullhead	Creek chub	Pearl dace	Blacknose dace	Longnose dace	Common shiner	Blacknose shiner	Blackchin shiner	Golden shiner	Bluntnose minnow	Blacknose minnow	Mudminnow	Johnny darter	Iowa darter	Rainbow darter	Least darter	Northern mudder	Brook stickleback	American brook lamprey	Other fish
Silver Cr.	1936			x			x			x		x		x	x	x	x	x			x		x					Pumpkinseed
Carlton Cr.	1928	x																										
N.Br. White R.	1928						x					x									x				x			
Swinton Cr.	1926	x											x															
White River	1926						x	x				x		x				x			x		x					Blackside darter
Hesperia to	1926						x	x		x	x	x	x	x				x			x		x					Blackside darter
White Cloud	1925	x	x				x	x		x		x		x						x	x		x			x		
Martin Cr.	1926						x			x	x	x		x			x		x		x				x	x		Largemouth bass
Mena Cr.	1926	x	x				x					x	x												x			
Delong Cr.	1926		x				x	x		x	x	x		x				x			x							Stoneroller
Coonskin Cr.	1926				x	x	x	x	x	x				x				x			x	x		x				Bluegill x Pumpkinseed
First Cole Cr.	1925	x																							x			
Second Cole Cr.	1926	x	x																						x			
White River	1925	x					x			x		x		x							x				x			
above White	1925	x			x		x			x	x	x	x								x				x			Smallmouth bass
Cloud	1926	x								x	x	x									x				x			
	1926	x		x	x					x									x	x				x	x			
	1938	x			x		x			x	x	x	x	x		x			x	x				x	x	x	Brown trout
Flinton Cr.	1926	x			x		x			x									x	x				x			
Five Mile Cr.	1926	x																										
Mullen Cr.	1926									x	x	x													x			
Stratton Cr.	1926						x			x		x							x									Redbelly dace

Table 8

Number of hatchery-reared trout released in the White River and its tributaries from 1933 through 1952. (Sizes ranged from fingerling to adult).

Stream	Brook trout	Brown trout	Rainbow trout	Period
Silver Creek	47,350	...	...	1933 - 1952
Silver Creek Pond	1,750	...	...	1950 - 1952
Carlton Creek	81,619	...	...	1933 - 1952
Rochdale Pond	9,949	500	4,800	1939 - 1952
Sand Creek	19,000	...	...	1933 - 1939
Cleveland Creek	47,525	...	...	1933 - 1952
Lake Wolverine	...	...	400	1951
N. Br. White River	61,648	17,100	31,500	1934 - 1952
Newman Creek	14,500	20,500	...	1933 - 1947
Knutson Creek	11,750	...	...	1933 - 1938
Robinson Creek	21,550	1,200	...	1935 - 1947
Swinton Creek	10,600	...	...	1933 - 1947
White River below Hesperia	...	200	...	1945
Skeel Creek	19,400	...	...	1934 - 1939
Cushman Creek	30,065	383	...	1933 - 1947
Braton Creek	...	75	...	1945
White River, Hesperia to White Cloud	27,875	187,800	19,000	1933 - 1952
Martin Creek	34,725	141,596	...	1933 - 1952
E. Br. Heald Creek	...	14,250	...	1944 - 1950
Mena Creek	32,425	192,630	...	1933 - 1952
Shotts Creek	...	3,000	...	1951
First Cole Creek	...	142,730	...	1936 - 1951
Second Cole Creek	250	144,230	...	1934 - 1951
White River above White Cloud	260,378	...	...	1933 - 1952
Flinton Creek	26,025	...	...	1933 - 1946
Five Mile Creek	24,750	...	...	1933 - 1946
Mullen Creek	15,450	...	...	1937 - 1946

Table 9

Comparisons between brook trout and brown trout taken in the White River drainage upstream from the dam at White Cloud

Site of collection and species	Station	Shocking time (minutes)	Number of fish	Fish per hour	Pounds of fish	Pounds per hour	Fish per pound	Average length (inches)	Average weight (pounds)
Head of pond	7	47							
Brook trout			6	8	0.93	1.18	6.5	6.9	0.15
Brown trout			0	...	...	...	...	...	...
Below rearing station	5	47							
Brook trout			12	15	0.72	0.92	16.7	5.1	0.06
Brown trout			11	14	0.73	0.94	15.0	5.3	0.07
Kaiser farm	2	81							
Brook trout			23	17	1.94	1.43	11.9	5.5	0.08
Brown trout			3	2	1.53	1.13	2.0	14.3	0.51
White River Club	21	36							
Brook trout			34	57	8.17	13.62	4.2	7.1	0.24
Brown trout			1	2	2.19	3.65	0.5	17.8	2.19
Oxford swamp	23	22							
Brook trout			15	41	2.59	7.05	5.8	6.8	0.17
Brown trout			0	...	...	...	...	...	...
Flinton Creek	1	49							
Brook trout			31	39	1.76	2.16	17.6	5.1	0.06
Brown trout			1	1	1.13	1.38	0.9	14.6	1.13
Five Mile Creek	3	20							
Brook trout			46	138	4.11	12.33	11.2	5.3	0.09
Brown trout			14	42	0.80	2.39	17.6	4.9	0.06
Mullen Creek	4	24							
Brook trout			15	38	0.85	2.12	17.7	5.1	0.06
Brown trout			1	3	4.75	11.88	0.2	23.3	4.75
Stratton Creek	22	18							
Brook trout			4	13	0.05	0.18	75.6	2.2	0.01
Brown trout			0	...	...	...	...	...	...
Stratton Creek	16	12							
Brook trout			0	...	...	...	...	...	...
Brown trout			0	...	...	...	...	...	...
Total		356							
Brook			186	31.3	21.11	3.56	8.8	5.7	0.11
Brown			31	5.2	11.12	1.87	2.8	7.3	0.36

Table 10

Comparison of numbers of fish taken in the mainstream of the White River above the dam at White Cloud in 1926, 1938 and 1952

Year	Brook trout	Brown trout	Northern pike	Smallmouth bass	Bluegill	White sucker	Creek chub	Pearl dace	Blacknose dace	Longnose dace	Redbelly dace	Common shiner	Golden shiner	Mudminnow
1926	55	0	...	3	6	135	44	19	90	1	...	35	...	...
1938	1181	9	...	...	1	799	813	82	4528	61	...	48	4	113
1952	94	15	1	...	3	253	65	126	151	2	10	1	...	29

Year	Johnny darter	Northern muddler	Brook stickleback	American brook lamprey
1926	195	23	...	...
1938	95	181	27	20
1952	5	144	3	28

MAP I

Distribution and abundance of trout as shown by all ages collected with electric shocker in 1952.

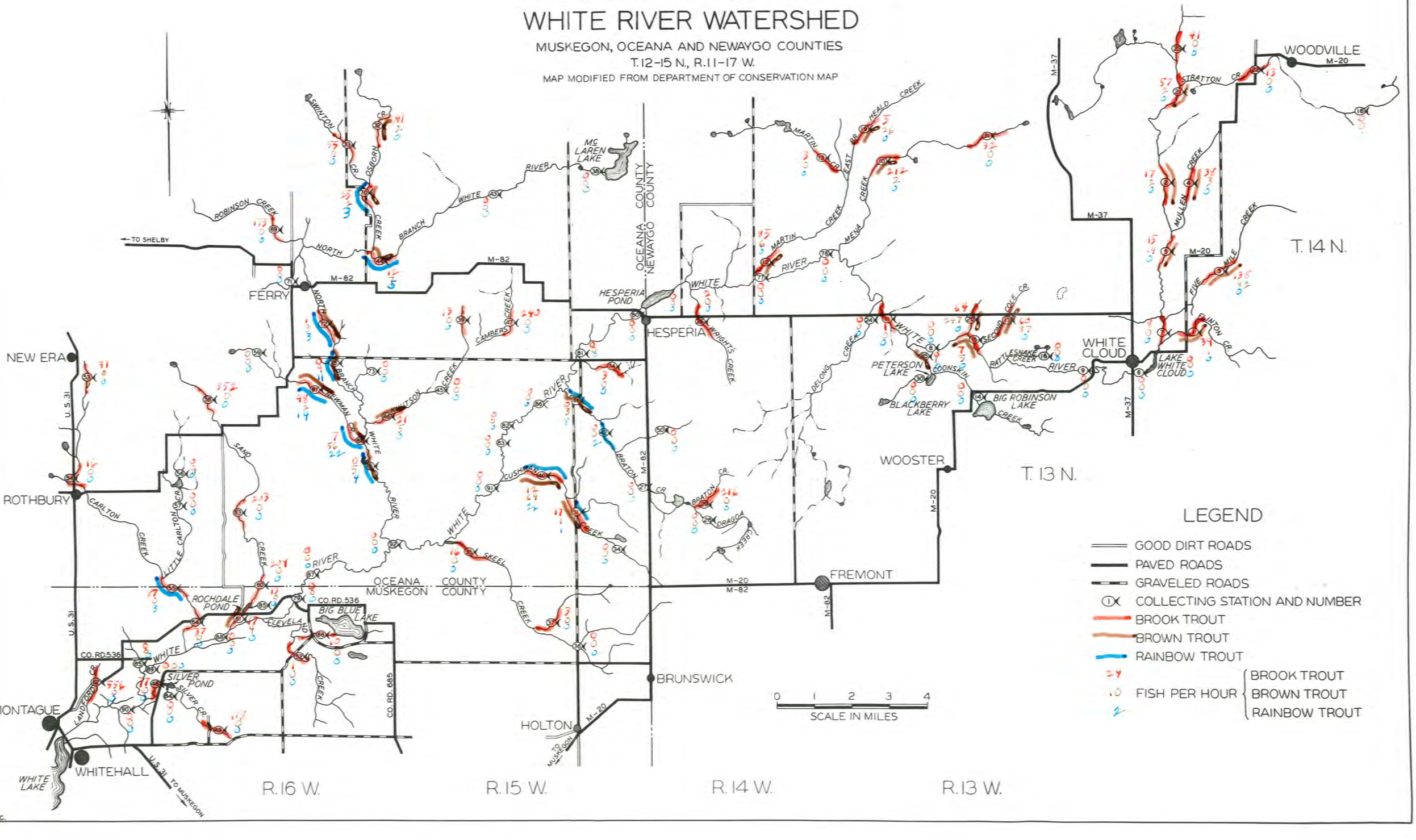
INSTITUTE FOR FISHERIES RESEARCH

WHITE RIVER WATERSHED

MUSKEGON, OCEANA AND NEWAYGO COUNTIES

T. 12-15 N., R. 11-17 W.

MAP MODIFIED FROM DEPARTMENT OF CONSERVATION MAP



LEGEND

- GOOD DIRT ROADS
- PAVED ROADS
- GRAVELED ROADS
- (IX) COLLECTING STATION AND NUMBER
- BROOK TROUT
- BROWN TROUT
- RAINBOW TROUT
- FISH PER HOUR — BROOK TROUT / BROWN TROUT / RAINBOW TROUT

W.L.C.

MAP II

Distribution and abundance of young-of-the-year trout in the 1952 collection taken with electric shocker.

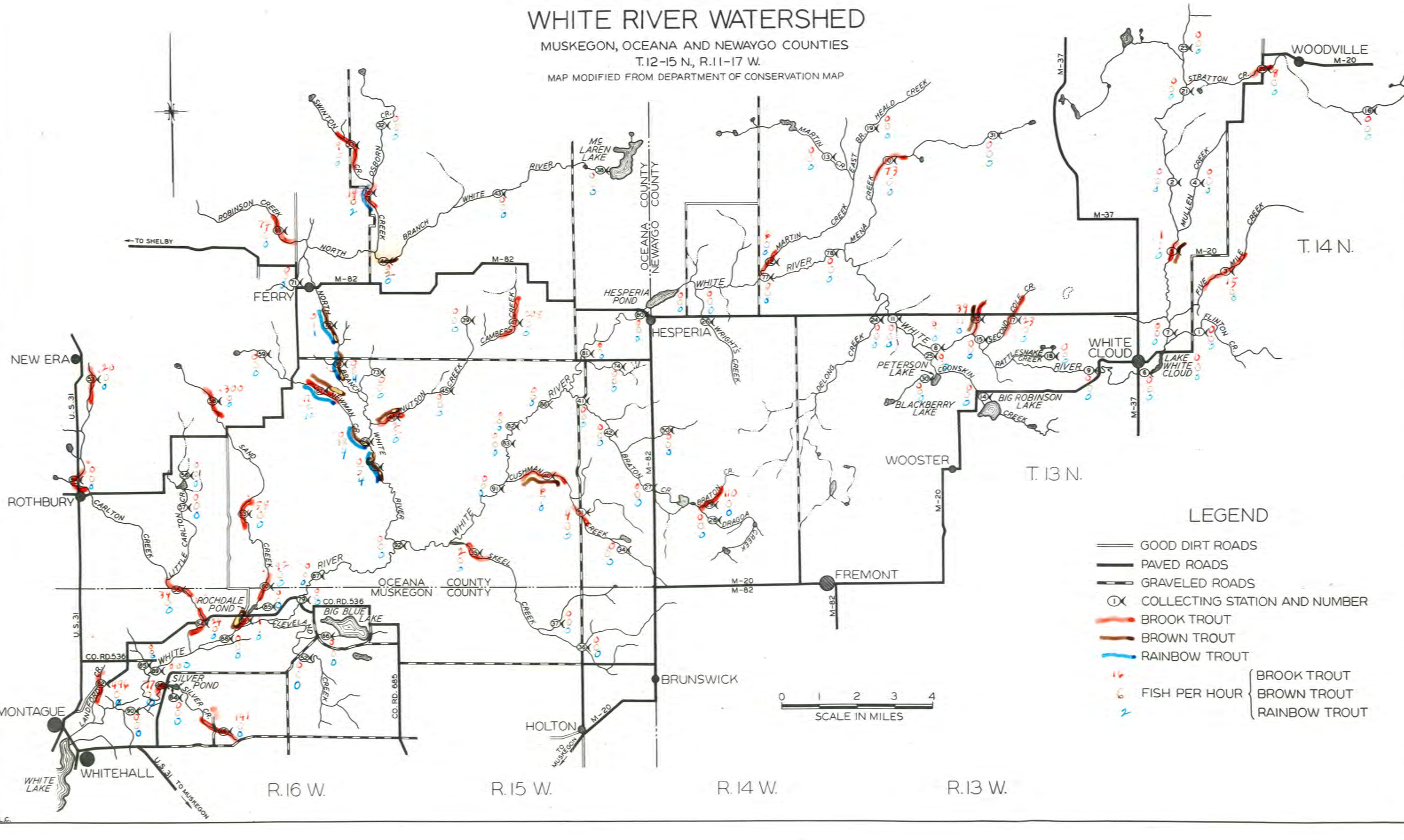
INSTITUTE FOR FISHERIES RESEARCH

WHITE RIVER WATERSHED

MUSKEGON, OCEANA AND NEWAYGO COUNTIES

T. 12-15 N., R. 11-17 W.

MAP MODIFIED FROM DEPARTMENT OF CONSERVATION MAP



LEGEND

- GOOD DIRT ROADS
- PAVED ROADS
- GRAVELED ROADS
- (1X) COLLECTING STATION AND NUMBER
- BROOK TROUT
- BROWN TROUT
- RAINBOW TROUT
- FISH PER HOUR { BROOK TROUT / BROWN TROUT / RAINBOW TROUT }

W.L.C.