

To be submitted for  
publication (after  
slight revision)--  
probably to "Ecology"

Original: Fish Division  
cc: Mr. Ruhl  
Dr. D. S. Caswell  
Dr. Eschmeyer  
Mr. Clark

INSTITUTE FOR FISHERIES RESEARCH  
DIVISION OF FISHERIES  
MICHIGAN DEPARTMENT OF CONSERVATION  
COOPERATING WITH THE  
UNIVERSITY OF MICHIGAN

ALBERT S. HAZZARD, PH.D.  
DIRECTOR

May 16, 1938

ADDRESS  
UNIVERSITY MUSEUMS  
ANN ARBOR, MICHIGAN

REPORT NO. 474

ANALYSIS OF THE POPULATIONS OF FISH  
IN THE WATERS OF THE MASON GAME FARM, MASON, MICHIGAN

by

R. W. Eschmeyer and O. H. Clark

The waters of the Mason Game Farm consist of an artificial pond eight and one-half acres in area and two small streams which converge before flowing into the pond. The farm is used by the Department of Conservation to rear game birds and the pond is used in connection with the raising of waterfowl.

In the fall of 1937 the pond was drained to facilitate repair of some of the pens, and if possible, to eradicate the goldfish which had become abundant. Fishing was poor and the abundance of goldfish, as well as some other fish unsuited for angling, was considered a possible cause for the scarcity of desirable fishes. After the pond had been drained, the fish in a section of each of the two streams were killed by poisoning and were collected.

This discussion represents a study of the fish which were present in the two streams and in the pond. According to the Game Farm personnel, the streams had been seined little or none for bait minnows and the pond had been fished very little in recent years. Each of the waters was presumably supporting a maximum crop at the time of the poisoning. Since

the fish had ready access to each of the three different waters, it might be assumed that each species chose the type of habitat best suited to it. There is a possibility, of course, that because of competition some of the fish may not have selected their most desirable habitats.

In addition to a comparison of the populations in the three waters, data were obtained on the total number, kind and weight of fish in the two streams at the time of the original poisoning and again forty days after that date. The second study was made to determine what number and species had re-entered the sections from which the fish had been removed.

The fish were preserved in formalin and were studied after preservation. They were weighed on a Welch balance by species but not by individuals. References to the literature on the ecology and life history of the several species have been limited to a very few publications, for even a brief reference to the literature on the subject would involve some pages of discussion. Each of the two streams and the pond and the populations present in each water at the time of the study are considered separately.

#### Big Mud Creek

The portion of Big Mud Creek which was studied includes an 850 foot section of the stream just above the confluence of this creek and Little Mud Creek. The section has an area of 0.15 acres at relatively low water level and an average width of about 7.5 feet. It is a slow moving stream with numerous pools. The bottom is chiefly of sand and gravel. At the time the fish were removed, the water was at low level. The flow was approximately 60 gallons per minute, determined by placing a temporary dam in the stream and passing all water over it in pails for a period of about 10 minutes. The upper portion (about half) of the stream section flows through an open pasture and in this area considerable aquatic vegetation is present. The lower half flows through timber and is devoid of

vegetation. When the stream was examined (September 30 and October 1, 1937), the water was relatively clear and the name given this stream seemed to be decidedly misleading.

Trout were planted in this creek and in Little Mud Creek each year from 1921 to 1926. A total of 4,000 brook trout, 48,000 rainbow trout and 35,000 brown trout were introduced chiefly as fry. The stocking was unsuccessful. Summer temperatures are not available, but the streams are very probably too warm to support trout.

On the morning of September 30 a seine was placed across the stream at the outlet of Little Mud Creek and another was placed at the upper end of the 850 foot section (see map). About 0.3 pound of powdered derris root (5% rotenone content) was mixed with water and placed in the stream at the upper net. The stream was impounded for a few minutes where the poison was introduced. After the fish showed decided distress in the temporary pool, the water was released. All fish in the section were very probably killed, since no live specimens could be found later and since forms such as bullheads, which are more resistant to derris root than are most species, were found to be dead.

Efforts were made to pick up every fish on the day of the poisoning and on the succeeding day. Some fish undoubtedly were not recovered even though numerous collecting trips up and down stream were made, but a very large percentage of the fish was obtained. It is believed that those which were picked up represent fully 90 per cent of the total population.

A total of 3,872 fish, representing 13 species, was collected. Darters, because of their small size and failure to float after being killed, were probably less thoroughly collected than were the other species. The fish had a total weight of 11,305 grams or 24.9 pounds. The number of fish of each species, the percentage of the entire population represented by each species, and the total weight by species are listed in Table 1.

Table 1

Species, Weight and Number of Fish Taken  
 From a 850 Foot Section of Big Mud Creek  
 On September 30 and October 1, 1937, and  
 From the Same Section on November 9, 1937

Species	Taken Sept. 30 and Oct. 1			Taken Nov. 9		
	Number	Per Cent	Total Weight (Grams)	Number	Per Cent	Total Weight (Grams)
White sucker	19	0.5	143	3	1.5	56
Goldfish	1	...	1	1	0.5	2
Black-nosed dace	346	8.9	858	8	3.9	28
Creek chub	1,158	29.9	6,490	74	36.3	506
Golden shiner	2	0.1	3	...	...	...
Common shiner	26	0.7	213	14	6.9	15
Blunt-nosed minnow	618	16.0	638	34	16.7	66
Stone roller minnow	321	8.3	1,294	...	...	...
Yellow bullhead	42	1.1	194	3	1.5	11
Mud minnow	399	10.3	572	51	25.0	69
Mud pickerel	15	0.4	342	7	3.4	205
Johnny darter	922	23.8	548	6	2.9	9
Pumpkinseed	3	0.1	9	3	1.5	5
Totals	3,872	100.1	11,305	204	100.1	972

Almost a third of the fish were creek chubs (Semotilus a. atromaculatus); Johnny darters (Boleosoma nigrum nigrum) were second in abundance, and blunt-nosed minnows (Hyborhynchus notatus) were third. Mud minnows (Umbra limi), black-nosed dace (Rhinichthys atratutus melegris) and stone-roller minnows (Campostoma anomalum pullum) were each represented by between 300 and 400 specimens. The other seven species were present in relatively small numbers.

On November 9th, 40 days after the original poisoning, the same area was poisoned in a similar way except that several times the original amount of derris root was used, since the stream had a somewhat greater flow at this time. Again all fish were very probably killed and almost all were collected. Two hundred and four specimens having a total weight of 972 grams were collected. The data, by species, are recorded in Table 1.

Some species obviously migrated into the area much more than did the others. Of the six most common species, creek chubs and mud minnows represented a greater proportion of the total percentage than they had at the time of the original poisoning; the percentage of blunt-nosed minnows was approximately the same as previously, and the percentage of black-nosed dace, stone-roller minnows and Johnny darters decidedly declined. Stone-rollers showed no movement into the area and Johnny darters, which were well represented originally, were almost entirely absent at the second poisoning. A study of Table 1 suggests that certain species (creek chubs and mud minnows) have wide movements at this time of year and that others (stone-rollers and Johnny darters) are very local within the stream.

For three species, the fish taken at the time of the second poisoning had a larger average size than those killed on September 30th. Black-nosed dace had increased in average weight from 2.5 grams to 3.5 grams, creek chubs from 5.6 grams to 6.8 grams, and blunt-nosed minnows from 1.0 gram to 1.9 grams. Mud minnows had a similar average weight each time. Whether

the larger specimens tended to migrate more than the smaller ones, or whether the difference in weight may be attributed to growth during the forty day period, could not be determined.

#### Little Mud Creek

The section of Little Mud Creek which was used for the fish population study differs decidedly from the portion of Big Mud Creek mentioned above. The water is more rapid in Little Mud, pools are few, vegetation is absent and the bottom is sand, covered in a few areas by a thin layer of organic soil. On September 30th the water temperature was 54° Fahrenheit at 9:30 a.m. (air 68°), compared with 69° for Big Mud at 3:00 p.m. (air 81°). Temperatures were not taken at identical times, but Little Mud Creek was undoubtedly the cooler. By the same method used for Big Mud Creek, the flow at the time of the study was calculated as being about 50 gallons per minute. The average width was approximately 4 $\frac{1}{4}$  feet. The portion of the stream which was studied consisted of the lower 1,150 feet having an area of 0.9 acres, all of which flows through a wooded area and is generally shaded.

Methods of obtaining the population were identical with those used for Big Mud Creek. The two studies were made at the same time and equal amounts of derris root were used.

In the original population study 987 fish weighing a total of 2,691 grams (5.9 pounds) were taken. The fish (see Table 2) were primarily creek chubs and mud minnows. Black-nosed dace and Johnny darters each represented about ten per cent of the population. Brook lampreys (Entosphenus lamottenii), mud pickerel (Esox vermiculatus) and stone-roller minnows comprised the remainder of the population.

Table 2

Species, Weight and Number of Fish Taken  
 From a 1,100 Foot Section of Little Mud Creek  
 On September 30 and October 1, 1937, and From  
 the Same Section on November 9, 1937.

Species	Taken Sept. 30 and Oct. 1			Taken Nov. 9		
	Number	Per Cent	Total Weight (Grams)	Number	Per Cent	Total Weight (Grams)
Brook lamprey	26	2.6	108	...	...	...
White sucker	...	...	...	1	1.1	27
Black-nosed dace	102	10.3	311	4	4.2	19
Creek chub	419	42.5	1,613	76	80.0	558
Common shiner	...	...	...	3	3.2	10
Blunt-nosed minnow	...	...	...	1	1.1	3
Stone roller minnow	3	0.3	9	...	...	...
Mud minnow	333	33.7	432	8	8.4	25
Mud pickerel	10	1.0	120	1	1.1	15
Johnny darter	94	9.5	98	...	...	...
Common sunfish	...	...	...	1	1.1	4
Totals	987	99.9	2,691	95	100.2	661

When the fish were poisoned 40 days later, 95 specimens having a total of 661 grams were recovered. Eighty per cent of these fish were creek chubs. Mud minnows comprised 8.4 per cent of the population. Six other species were taken. As in Big Mud Creek, the creek chubs comprised a greater percentage of the total population on the second study than they did on the first examination. Mud minnows, however, were relatively fewer at the time of the second poisoning. As in the other stream, Johnny darters and stone-roller minnows showed little or no movement into the area during the 40 day period.

Four species, white suckers (Catostomus c. commersonii), common shiners (Notropis cornutus frontalis), blunt-nosed minnows and pumpkinseeds (Eupomotis gibbosus), were present in very limited numbers in the second study but were not taken in the original examination.

Twenty-six brook lampreys were recovered after the poisoning on September 30th. All except one of these were taken on the second day (October 1) and some were still alive, though incapacitated, when collected. Many of these lampreys may have remained in the bottom and the actual percentage of the lamprey population represented by those collected is not known. Since none were taken in the second poisoning, which was more concentrated than the first, all may have been killed in the September 30th poisoning.

Originally the creek chubs had an average weight of 3.8 grams; those taken 40 days later averaged 7.3 grams. Mud minnows originally weighed 1.3 grams each, but the eight specimens taken 40 days later averaged 3.1 grams each. It seems that the larger fish tend to migrate more than the smaller ones, since these very large differences can hardly be attributed entirely to growth.



Comparison of the Two Stream Populations

The two populations were taken from streams which differed ecologically as indicated above. In Table 3 the two populations are compared on a per acre basis. The larger, slower, warmer stream, with vegetation in a portion of it, contained 13 species, compared with 7 species in Little Mud Creek; it also contained about  $2\frac{1}{2}$  times the number of fish per unit of area as were found in the smaller stream. In pounds of fish per acre, the larger stream was decidedly the more productive, since the two streams contained 166.2 pounds per acre and 65.9 pounds per acre respectively.

An examination of Table 3 shows a decided difference in the fish fauna of the two streams. Seven species: white suckers, goldfish (Carassius auratus), common shiners, yellow bullheads (Ameiurus natalis natalis) and pumpkinseeds, were present only in the larger, slower stream. One species, the brook lamprey, was found in the smaller stream only. Of the fish common to both streams, mud minnows were more abundant (per unit of area) in Little Mud Creek, and mud pickerel were about equally distributed in both. The other species were more abundant in Big Mud Creek. The blunt-nosed minnow apparently showed extreme preference for Big Mud Creek, since it was abundant there but entirely absent in Little Mud Creek. Stone-rollers were common in the larger stream, but rare in the smaller one. The lower limits of the two streams were only a few feet apart, near the point where Little Mud Creek empties into Big Mud Creek, and the fish had ready access to either stream.

Comparisons were made of the average size of fish of five species common to the two streams, and these fish were also placed in one-inch size groups. For four of these species (see Table 4) the fish in the larger stream had a larger average size; black-nosed dace, however, were the larger, on the average, in the smaller stream. Mud minnows had about

Table 3

Number of Fish Per Acre in Big Mud Creek and  
Little Mud Creek in the Sections From Which the  
Fish Were Removed, September 30 and October 1, 1937.

Species	Number	
	Big Mud Creek	Little Mud Creek
Brook lamprey	...	289
White sucker	127	...
Goldfish	7	...
Black-nosed dace	2318	1132
Creek chub	7759	4651
Common shiner	174	...
Golden shiner	13	...
Blunt-nosed minnow	4141	...
Stone roller minnow	2151	33
Yellow bullhead	281	...
Mud minnow	2673	3696
Mud pickerel	101	111
Johnny darter	6177	1043
Pumpkinseed	20	...
Total	25,942	10,955

Table 4  
 Comparison of the Sizes of Fish of  
 Each Species Common to Both Streams,  
 One Inch Groups

Species	Stream	Ave. Wt. (Grams)	Number in each one inch size group							
			1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
Black-nosed dace	B.M.C.	2.5	73	270	3	...	...	...	...	...
	L.M.C.	3.0	2	96	4	...	...	...	...	...
Creek chub	B.M.C.	5.6	634	127	191	133	50	11	11	1
	L.M.C.	3.8	209	46	131	32	...	1	...	...
Stone roller minnow	B.M.C.	4.0	51	138	116	15	1	...	...	...
	L.M.C.	3.0	1	1	1	...	...	...	...	...
Mud minnow	B.M.C.	1.4	309	63	26	1	...	...	...	...
	L.M.C.	1.3	278	35	18	2	...	...	...	...
Mud pickerel	B.M.C.	22.8	...	...	...	...	9	5	1	...
	L.M.C.	12.0	...	...	...	..5	5	...	...	...

the same average size in each stream. Creek chubs and mud pickerel were decidedly larger in Big Mud Creek than in Little Mud Creek. It is improbable that for any of these species the young primarily inhabited one stream and the adults another; such condition is not evident at least from an examination of the size groups (Table 4). No attempt was made to determine the rate of growth of the fish in these streams.

#### Mason Game Farm Pond

The Mason Game Farm Pond was formed by impounding Big Mud Creek. Its upper end is about six hundred feet below the sections of streams discussed in the preceding pages. The pond was originally created to supply water power for operating a small saw mill. Extensive silting has occurred during the many years that the pond has been in existence and the water is now very shallow. Fully a third of the pond has a depth of about a foot or less, and the greatest depth, at the dam, is only about 6 or 7 feet. The average depth is probably not over 3 feet. Vegetation is sparse and consists primarily of yellow pond lilies. Numerous stumps are present in the upper end of this  $8\frac{1}{2}$  acre pond.

Dr. D. L. Caswell, superintendent of the Game Farm, provides the following information regarding the pond, the angling and the stocking of fish:

"According to Roy Hunt, the pond at the Game Farm is about 75 years old. Before 1918 the pond was considered a good fishing place, offering catches of bluegills, sunfish, bullheads and pike (northern). In the spring of 1918 the dam was washed out leaving the pond dry except for the stream running across the bottom. In the fall of 1918 the dam was rebuilt. About 1920-1922, two plantings of fingerling smallmouth bass were made (quantity unknown). A few years later Hunt recalls having seen some large bass, whereas, before the planting was made he does not recall having seen any bass.

"About 1926, according to Hunt, 34 goldfish were planted; 30 gold ones and 4 black ones, which are supposed to have been secured from the St. Clair River by nets."

.....

"It is my understanding that since 1929 the boards in the dam once gave way and allowed the pond to drain. At that time, it is said, the stream below was literally golden with gold fish."

According to Harry Ruhl, Chief of the Game Division of the Michigan Department of Conservation, fishing was good until 1918 and bluegills (Helioperca macrochira) were dominant in the catch but after the pond was restored in 1918 fishing was poor and bullheads were dominant in the catch. The bluegills probably went downstream when the dam broke in 1918 and failed to become re-established later. The bass referred to above may have gone downstream at the later break. No bluegills or bass were seen when the pond was drained in 1937. An examination of the fish (in 1937) suggested that angling would probably have been uneventful so far as taking fish of catchable size was concerned for very few fish of desirable species or desirable size were present.

Only two species were taken in the pond which were not also present in the stream above. These were black crappies (Pomoxis sparoides), which were not abundant in the pond, and long-eared sunfish (Xenotis megalotis peltastes), which were too small to be of catchable size. Small non-trout streams contain few species which are desirable for angling, or contain only the young or stunted individuals of these species, and when such streams are impounded, stocking to introduce desirable fish is obviously necessary unless these have access from connecting waters.

No accurate account can be given of the number of fish which were present in the pond when it was drained in 1937. Many remained in or on the muddy bottom and many passed down stream. A large number of goldfish were removed by some of the several thousand spectators who came in response

to a news release indicating that the pond was to be drained and that goldfish would no longer be obtainable from this source after the draining. About 200 gallons of fish were definitely accounted for and these represented only a portion of the total population.

General observation suggests that the pond was decidedly over-populated, for an examination of the fish and of the scales of some of them indicated that the suckers, goldfish and sunfish were stunted. Black crappies were of a relatively large size, but only about a hundred were seen. Small crappies were not in evidence, suggesting that this species may possibly have become extinct in the pond within a few years. Some bullheads were of catchable size, but their abundance cannot be estimated because of the possibility that many may have remained in the muddy bottom. Sunfish were generally too small to be of value, and the other species were worthless for angling.

After most of the water had been drained from the pond, a bag seine was placed in the spillway to catch the fish which had become concentrated at the dam. Twenty gallon of fish obtained by this method included twelve species. This sample was not representative for many goldfish and some bullheads and crappie had been removed. With the exception of these three species, the relative abundance of fish of each kind in the sample may possibly have been representative of the abundance of these species in the pond.

The species taken in the 20 gallon sample, and the number and percentage of each are given in Table 5.

#### Comparison of the Pond and the Stream Populations

A comparison cannot be made of the pounds per acre in the streams and in the pond because complete data on the latter are not available. Some species which had ready access to the pond and the two streams showed decided preference for one or the other of these waters. How much of this

Table 5

Number and Percentage of Fish From Mason Game Farm Pond  
in a 20 Gallon Sample, September 30, 1937

<u>Species</u>	<u>Number</u>	<u>Per Cent of Total Sample</u>
White sucker	787	10
Goldfish	56	1
Creek Chub	310	4
Common shiner	260	3
Golden shiner	619	8
Blunt-nosed minnow	4,276	57
Yellow bullhead	52	1
Mud minnow	28	...
Mud pickerel	8	...
Black crappie	1	...
Long-eared sunfish	20	...
Pumpkinseed	169	2
Sunfish (young of the year)*	918	12
<hr/>		
Total	7,504	98
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\* Both long-eared and pumpkinseed, perhaps also hybrids of the two.  
Not sorted by species.

was due to population pressure cannot be determined. An examination of tables 1, 2 and 5 suggests that white suckers showed a decided preference for the pond as did also the goldfish. Creek chubs, on the contrary, were much more common in the streams, where they were the most abundant of any species, than in the sample from the pond where they represented only four per cent of the fish. Common shiners and golden shiners (Notemigonus crysoleucas auratus) showed a preference for the pond. Black-nosed dace were found only in the streams. Blunt-nosed minnows comprised over half of the fish in the sample from the pond. They were also prominent in Big Mud Creek, but were absent in Little Mud Creek. Stone-roller minnows and Johnny darters showed very decided preference for the slow running water of Big Mud Creek.

The bullheads taken in the creek were all small; adults were found only in the pond. Mud pickerel were not especially abundant in any of the three waters but were most common, in proportion, in Little Mud Creek. Crappies and sunfish were primarily confined to the impounded water and lampreys were taken only in the smaller stream.

In general the habitats in which the fish were found <sup>were</sup> in accord with the habitats of the several species as indicated by several authors and as recorded in Table 6. The common shiner was relatively more abundant in the pond, although Hubbs and Cooper (1936) indicate its preferred habitat to be creeks with clear water. The yellow bullhead, reported by Forbes and Richardson (1920) to prefer streams in Illinois, showed decided preference for the impounded water. Mud minnows, reported by Adams and Hankinson (1928) to prefer sluggish creeks in abundant vegetation also were present in Little Mud Creek, a moderately fast stream with no vegetation. Descriptions of the habitats are mostly of a general nature and close comparisons cannot be made except possibly for the black-nosed dace. Traver (1929) indicates that this fish inhabits rapid waters in small creeks. The fish was common in Little Mud Creek, ~~and~~ in the larger stream it apparently was



Table 6  
Habitats of the Species Found  
in the Mason Game Farm Waters as Indicated  
By the Authorities Listed

Species	Habitat	Authority
Brook lamprey	Streams exclusively	Gage
White sucker	Varied	Adams & Hankinson
Goldfish	Lakes and rivers, sluggish water	Hubbs and Cooper
Black-nosed dace	Rapid waters in small creeks	Traver
Creek chub	Small creeks, moderate to rapid water	Hubbs and Cooper
Golden shiner	Lakes, ponds and streams	Hubbs and Cooper
Common shiner	Creeks, clear water	Hubbs and Cooper
Blunt-nosed minnow	Lakes and sluggish streams, sandy shoal	Hubbs and Cooper
Stone roller	Creeks, gravelly areas	Hubbs and Cooper
Yellow bullhead	Creeks, lowland lakes	Forbes and Richardson
Mud minnow	Sluggish creeks, in abundant vegetation	Adams and Hankinson
Mud pickerel	Creeks, also ponds and small rivers	Forbes and Richardson
Johnny darter	Typically creeks and small brooks	Forbes and Richardson
Pumpkinseed	Ponds, small rivers	Forbes and Richardson
Long-eared sunfish	Chiefly streams	Forbes and Richardson
Black crappie	Varied, lakes in preference to streams	Forbes and Richardson

much more abundant in the upper, narrow, faster portion than in the lower area where the creek is wider and slower.

#### Bait Minnows

The problem of obtaining bait minnows is becoming increasingly acute as the angling pressure increases and as the removal of forage fish for bait from fishing waters becomes more and more discouraged because of the value of these species as food for the game fish. This study was made to determine how many fish were being supported by the two streams and to note changes in the population where the water is impounded. The larger stream carried about 4,000 fish in the section studied, and the smaller stream less than a thousand; per linear foot of stream these represent 4.6 and 0.9 fish respectively.

The fish which might be regarded as bait minnows (white suckers, black-nosed dace, creek chubs, common shiners, golden shiners, blunt-nosed minnows, stone-roller minnows and mud minnows) totaled 2,889 and 857 respectively for Big Mud Creek and Little Mud Creek in the sections studied. Some of the specimens were too small for use as bait minnows. Others, especially creek chubs, were considerably larger than the ordinary bait minnow size. If it be assumed that these fish had a value of one cent each as bait, the standing crop for the sections of the two streams was worth \$28.39 and \$8.57 respectively. The value per acre was about \$192 and \$95 respectively or considerably higher in value than most farm crops. If some of these were removed periodically, the value per year might be much greater for more fish would probably have survived and growth would perhaps have been more rapid. It might be added that, in view of the finding that creek chubs tended to move into an area soon after the fish were removed, it may be possible by rather heavy removal of these fish, to harvest a considerable portion of the fish which grew on the

neighbor's property unless he also harvested bait minnows from his area.

The number of forage fish in the pond could not be determined, but was undoubtedly many times the number originally present in the stream. The study suggests that some impoundment of the water would be especially desirable if small, warm streams of this type were to be used to raise forage fish. Observations suggest, too, that shaded portions of the stream are decidedly less productive of forage fish than are those portions which are run through open pasture.

INSTITUTE FOR FISHERIES RESEARCH

By R. W. Eschmeyer and  
O. H. Clark

Acknowledgment

The writers wish to thank Dr. A. S. Hazzard for valuable suggestions in preparing the manuscript, Dr. C. J. D. Brown, John Greenbank and Dr. D. S. Caswell and his associates at the Game Farm for assistance in the field, and Walter Crowe for help in identification of the species.

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Fig. 1. Riffles in Big Mud Creek in pasture



Fig. 2. Pool in Big Mud Creek in pasture



Fig. 3. Big Mud Creek in wooded section



Fig. 4. Little Mud Creek



Fig. 5. Game Farm Pond, after draining



Fig. 6. View of pond bottom from dam

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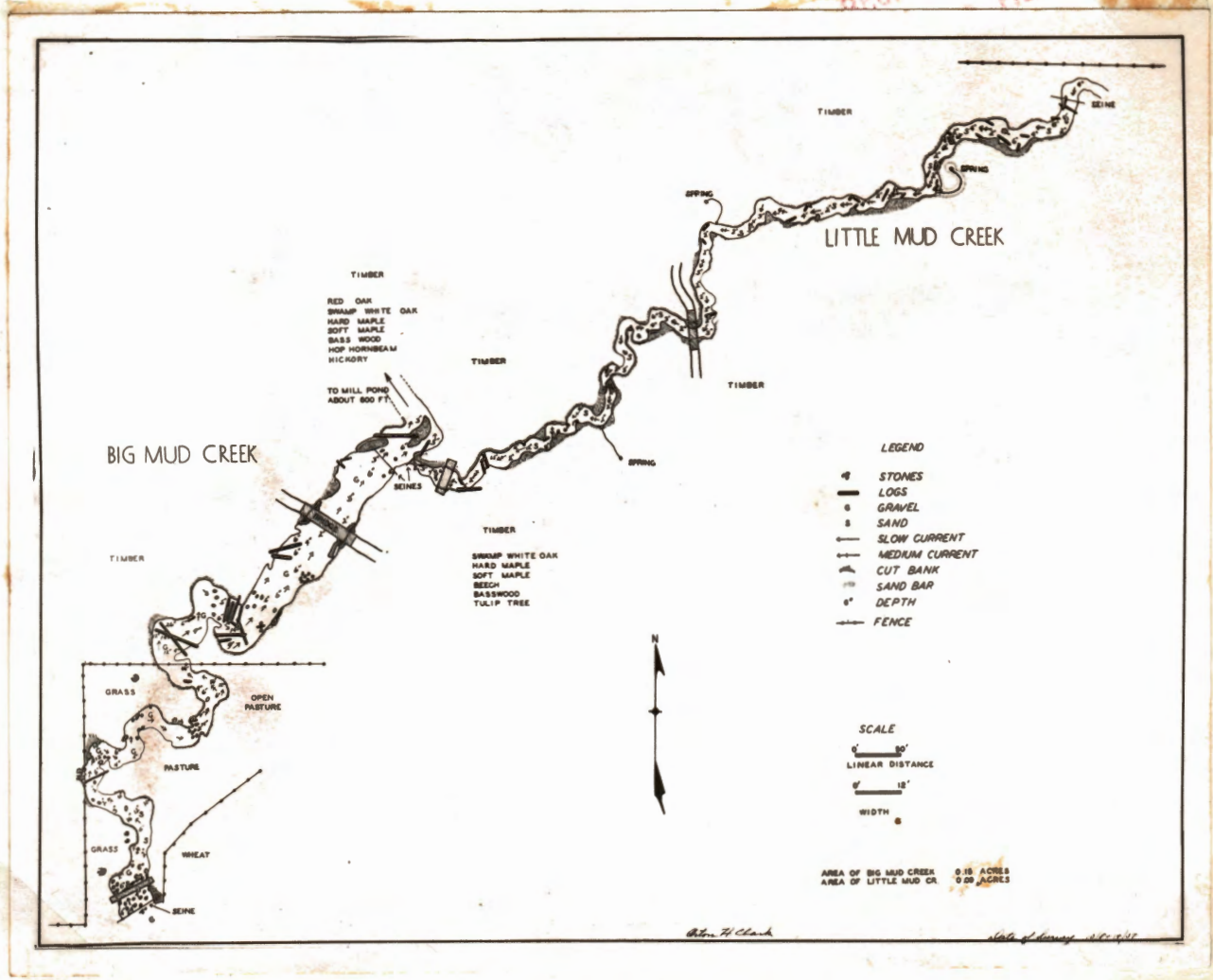


Fig. 7. Map of the sections of Big Mud Creek and Little Mud Creek from which the fish were removed.

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ALBERT S. HAZZARD, PH.D.  
DIRECTOR

May 23, 1938

ADDRESS  
UNIVERSITY MUSEUMS  
ANN ARBOR, MICHIGAN

APPENDIX TO REPORT NO. 474

On May 12th, 61 adult male bluegills and 42 adult female bluegills were planted in the Game Farm Pond. These were obtained in Third Sister Lake near Ann Arbor -- by seining.

An examination of the pond in April indicated that a few goldfish at least were present. Whether these came down Big Mud Creek from some water suitable for goldfish farther up stream or whether they survived in the mud while the pond was dry is not known, but it is certain that goldfish are now present in the pond.

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By R. W. Eschmeyer  
Assistant Aquatic Biologist