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FISHERIES INVESTIGATIONS CONDUCTED AT DEEP LAKE IN
1942, WITH MANAGEMENT SUGGESTIONS FOR 1943

by

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Deep Lake was poisoned September 12, 1941, and was restocked with rainbow trout, bluegills and smallmouth bass later that year (see Institute for Fisheries Research Report No. 721). Observations were made on Deep Lake at intervals during 1942 to check on the success of the poisoning and the growth and reproduction of the smallmouth bass and bluegills.

The writer wishes to extend his thanks to Messrs. Ben E. Young and James Inglis for permitting the Institute to continue this investigation on Deep Lake. Mr. Young and the caretaker at Deep Lake, Mr. Carl Brendel, should be commended for keeping a record of all of the fish that were removed from Deep Lake by anglers in 1942.

Observations were made at Deep Lake on the following dates in 1942:

April 15 (with Hazzard, Krumholz, Goellner and Brushaber)
April 29 (with Goellner and Beckman)
May 19 (with Shetter)
June 20 (alone)
June 23 (with Krumholz and Allison)
July 27 (with Hazzard and Clark)
August 22 (with Greenbank)
October 8 (with Krumholz)

On each of the dates listed above, observations were made from a boat and by walking around the lake shore. Hook and line fishing was attempted on all of the days that observations were made. Seining was attempted on August 22 and October 8, and two experimental gill nets were set on the latter date.

From observations that have been made to date, we are absolutely certain that the poisoning was a complete success. On July 27 we found

a small school of bluntnosed minnows, some of which were collected on August 22. As these fish were not present previous to the time of the poisoning, it is obvious that they were introduced after the original fish population was removed. The source of these fish is not definitely known, but they could have been introduced as live bait by fishermen or could have accidentally escaped from the live pens that were used to test the toxicity of the water immediately after the poisoning. At no time during the year were nests of species known to inhabit Deep Lake prior to September 12, 1941, found. On July 27, the writer thought that he saw a pumpkinseed sunfish, but could not be certain. On August 22, a total of 257 young of the year bluegills were taken by seining, and another 420 were obtained on October 8. All of these fish were carefully checked by Dr. Carl L. Hubbs, Curator of Fishes at the University of Michigan, Museum of Zoology. He was unable to find anything other than bluegills in these collections.

The smallmouth bass did not spawn during the 1942 season but will probably spawn in 1943. Rainbow trout have never been known to spawn successfully in lakes without suitable inlets or outlets. Some rainbows may attempt to spawn on certain sections of gravel beach at Deep Lake, but it is doubtful whether this spawning would be successful.

Bluegills were first observed spawning on June 20, when rain, wind and cloudy weather prevented the writer from making complete observations. On June 23 and July 27 bluegills were still spawning and complete observations were made on these dates. The number of nests that were found in Deep Lake is presented in Table 1.

Table 1

The Number of Bluegill Nests Found in Deep Lake in 1942.

1. Clean nests									
Colony number	1	2	3	4	14	14a	14b	8	10
June 20	5	2	...	...	...	...	...	...	...
June 23	6	6	...	2	3	8	2	...	6
July 27	9	7	1	2	1	14	...	2	7
2. Nests containing eggs or fry									
June 23	...	5	...	...	...	2	...	...	...
July 27	...	1	...	...	1	...	...	...	...

A total of 47 nests were constructed by the bluegills in 1942. Investigations in previous years provided evidence that spawning did not occur in all nests that were constructed, and that males may spawn more than once during any one season. A total of 100 bluegills were planted in Deep Lake in 1941 and assuming that the sex ratio was even we could expect that 50 males and 50 females were planted. However, we do not know what the mortality was over the first winter. Also, we do not know whether some nests were used more than once during the

season, but in other years some nests were used as many as three times during the same season. The writer believes that between 40 and 50 males were present in Deep Lake during the spawning season. Because it was impossible to make daily observations during the 1942 spawning season, an estimate of the number of bluegill fry that were produced was not obtained. A total of 9 nests were found to contain either eggs or fry on June 23 and July 27. If no other spawning occurred, a total of about 140,000 bluegill fry were present in these 9 nests (An average of 16,000 fry per nest was determined from previous work on Deep Lake).

One of the most striking things that was determined from this investigation was that the bluegills that were taken from Howell Lake and planted in Deep Lake used some of the same nests in the same colonies that were used by the previous inhabitants of Deep Lake in the past. All of the spawning beds constructed in 1942 were located on sand or gravel bottom or a combination of the two. In other years many bluegills built their nests on muck bottoms.

Dead and fungused eggs or fry were not found on any of the nests in 1942.

Most of the bluegills that were found guarding the nests appeared to have a length of greater than five inches. This would indicate that these bluegills that were definitely stunted in Howell Lake, had grown considerably during their sojourn in Deep Lake.

Certain pertinent observations that were made at each of the various trips to Deep Lake are as follows:

April 15. Walked around the lake shore twice. Saw only four dead smallmouth bass and no dead rainbow trout. Many smallmouth bass were observed around the shores of the lake. They appeared sluggish and some were fairly easy to catch with a small dip net (14 were caught in this manner). A sea gull on the lake was having a grand time. We saw it pick up four fish—probably smallmouth bass. The water level was approximately $1\frac{1}{2}$ feet higher than at any time during 1941.

April 29. Did not see any dead fish around the lake. Very few smallmouth bass were found close to shore. Smallmouth bass had not spawned.

May 19. No dead fish or spawning beds were found. The surface water temperature was 61° F. Between 7:30 and 9:30 p.m. trout were jumping all over the surface of the lake. Dr. Shetter and the writer caught 19 rainbow trout, 1 smallmouth bass and 1 adult bluegill in a little over one hour of fishing.

June 20. The first bluegill spawning beds were found on this day.

June 23. Many bluegill beds were found. Rainbow trout were observed near the surface of the lake, and many were jumping at the surface. The temperature of the water at the surface was 72° F.

July 27. Many bluegill beds were in evidence. Many young of the year bluegills were observed in the weed beds close to shore. The largest of these appeared to be about $1\frac{1}{2}$ inches in length. Many smallmouth bass were observed near shore. They appeared lively and were feeding to some extent on frogs that would jump into the water. Eight smallmouth bass were taken on hook and line and were in excellent condition. No rainbow trout were observed.

August 22. No new bluegill beds were found, and most of the old ones were covered with leaves and silt. Saw very few smallmouth bass and no rainbow trout. Young bluegills were very abundant in the shallower water. Mr. Ben Young told me that he had caught a ten-inch smallmouth earlier in the week on worms and spinner.

August 23. According to Mr. Young, a shipment of 1,000 rainbow trout was received at Deep Lake last night. (Received from U. S. Fish and Wildlife Service, Harrison Rearing Ponds). These fish averaged just over two inches in length.

October 8. Young of the year bluegills were very much in evidence in the shallow water. In one short haul (about 10 by 6 feet) of a ten-foot common sense minnow seine, 133 young bluegills were taken. Two experimental gill nets were set in the lake at 2:00 p.m. and were lifted at 7:00 p.m. Twelve rainbow trout were taken in these two nets. Altogether 30 rainbow trout, 7 smallmouth bass and 1 adult bluegill were collected. The bluegill and 19 trout died and were saved for further examination.

It was not always possible to obtain adequate samples of fish for growth computations. A summary of the growth of the rainbow trout and smallmouth bass from the time they were planted in Deep Lake on October 31, 1941 until October 8, 1942 is presented in Table 2.

From October 31, 1941 until April 15, 1942, the smallmouth bass gained an average of only 0.6 of an inch in length. The rainbow trout gained an average of 1.8 inches in length during the period from October 31, 1941 to May 19, 1942. By October 8, 1942 the smallmouth bass averaged 8.7 inches in total length (an increase of 4.3 inches since planting) and the rainbow trout averaged 9.3 inches in total length (an increase of 2.7 inches since planting). It is apparent that the smallmouth bass grew more during the period from April 15 to October 8 (3.7 inches) than did the rainbow trout (0.9 of an inch). Yet the rainbow trout grew faster during the winter than did the smallmouth bass. The smallmouth bass gained an average of 183.2 grams (6.5 ounces) from the time of planting until October 8, 1942. During this same period the rainbow trout gained an average of 61.4 grams (2.2 ounces).

Table 2
Growth of the Fishes in Deep Lake, 1942

Smallmouth Bass						
Date	Number of specimens	Total length in inches			Average weight grams	Average weight ounces
		Minimum	Average	Maximum		
Oct. 31, 1941	*	3.8	4.6	6.2	20.8	0.7
April 15, 1942	14	4.4	5.2	7.6	...	...
May 19, 1942	1	...	4.7	...	23.0	0.75
June 23, 1942	10	6.0	6.3	7.2	...	...
July 27, 1942	8	6.7	7.1	7.5	59.2	2.1
Oct. 8, 1942	7	8.2	8.7	9.6	204.0	7.2

Rainbow Trout						
Oct. 31, 1941	*	5.2	6.6	8.2	54.0	1.9
April 15, 1942	1	...	7.8	...	...	...
April 29, 1942	1	...	7.5	...	...	...
May 19, 1942	19	7.1	8.4	9.4	88.5	3.0
June 23, 1942	1	...	9.7	...	...	...
Oct. 8, 1942	30	8.0	9.3	10.4	115.4	4.1

*A sample of the fish were weighed and measured before planting.

The smallmouth bass were in excellent condition on October 8, 1942. On this same date some of the rainbow trout appeared to be much thinner than lake inhabiting rainbow trout generally are. The coefficient of condition was determined for each of the 30 trout taken on October 8, 1942. The coefficient of condition is an expression of the relationship between the length and the weight of a fish. When the average coefficient of condition is low the chances are that the available food supply is not adequate for the fish present. The average coefficient of condition was 39.10 and ranged from 30.71 to 50.58 (English system after Klak,¹ 1940. According to Klak, the average coefficient of condition of 708 rainbow trout taken from Big Spring Creek in Virginia was 42.45 and ranged from 39.36 to 44.98. It is thought that lake inhabiting rainbow trout would have a higher coefficient of condition than stream fish. However it is apparent that the average coefficient of condition for the Deep Lake rainbow trout is low, but as yet this condition is not serious. The smaller rainbow trout (8 to 9 inches in total length) from Deep Lake were in good condition, while the larger trout (9 to 10.4 inches) were a little thin. It becomes apparent now that more trout should have been removed from Deep Lake during the past summer.

¹Klak, George E. 1940. The condition of brook trout and rainbow trout from four eastern streams. Trans. Am. Fish. Soc., Vol. 70, (1939), pp. 282-289.

Only two adult bluegills were caught during the summer. The original stock of bluegills was obtained from Howell Lake (Livingston County), and all were small and stunted. The two fish that were caught during the summer of 1942 had grown remarkably fast as indicated by an examination of their scales.

On August 22, 1942 a collection of 257 young of the year bluegills was obtained. These fish averaged 37.9 mm. in length and ranged from 21 to 59 mm. On October 8 another collection of 420 young bluegills averaged 34.7 mm. in length and varied from 23 to 59 mm. The young of the year bluegills that were taken on September 12, 1941, when Deep Lake was poisoned averaged 44.7 mm. and ranged from 16 to 65 mm. The lower average size of the bluegills taken on October 8 is probably due to the growth of large numbers of fish that were too small to be taken by seining on August 22. It is also apparent that very little growth occurred after August 22, unless the larger young of the year bluegills were in deeper water and consequently not obtained by our method of seining. The range in size of the fish also indicates that spawning took place over an extended period of time. The fact that the average size of the bluegills taken on October 8, 1942 was somewhat smaller than those taken on September 12, 1941 may be explained by the fact that the October sample was not large enough or else that the larger young of the year bluegills were not obtained by our method of sampling.

Deep Lake is now undoubtedly supporting a larger poundage of fish than before the lake was poisoned. The present fish population is now utilizing every bit of the inhabitable water in Deep Lake. A total of 562.7 pounds of fish was removed from Deep Lake at the time of the poisoning, and the lake was restocked with 505.0 pounds of fish. If we assume that 1500 (one-half of the original planting) rainbow trout and smallmouth bass survived (and there is a possibility that perhaps more than 50 per cent survived) and that the average weights as given in Table 2 are reliable, then these fish would now weigh over 1,050 pounds. Of course this estimate does not include the bluegills, but it is doubtful whether all of the adult and young of the year bluegills would weigh over 70 pounds. This then would give an estimated carrying capacity of Deep Lake at present at well over 1,100 pounds or about twice the poundage at the time of poisoning.

Stomachs were saved from 20 rainbow trout and two smallmouth bass. The results of these examinations will be reported at a later date.

A total of 136 rainbow trout, 3 smallmouth bass and 1 bluegill were removed from Deep Lake by anglers during 1942. Mr. Young reported that 116 rainbow trout were reported caught by the owners of Deep Lake and their friends and neighbors. Members of the Institute removed 20 rainbow trout, 3 smallmouth bass and 1 bluegill. The trout reported by Mr. Young ranged from 8 to 10 $\frac{1}{4}$ inches in length. Those taken by the Institute ranged from 8.0 to 10.4 inches. The smallmouth bass ranged from 6.4 to 7.0 inches and the bluegill was 7.25 inches in length.

Management Suggestions for 1943

1. If possible, the Institute should make further observations on the spawning habits, survival and growth of the Deep Lake fishes. It is recommended that an accurate check be made on the number of nests and the average number of fry per nest for the smallmouth bass.

2. It is extremely important that an accurate record should be kept of all fish that are caught during 1942. Lengths and weights should be recorded for all fish that are caught. This record will be necessary in order to maintain good fishing in future years. Mr. Young has already been provided with a measuring board. A creel census book, with sample pages already filled in, will also be provided. The owners should provide a trustworthy balance. All of the creel census material should be placed at some spot convenient to all fishermen.

3. It is recommended that all bluegill beds should be destroyed during the 1943 spawning season. This would require about one hour of the caretaker's time every two or three days from May 15 until August 15. Probably the best way to destroy the eggs and fry on the nests would be to stir up the bottom material of the nest with ones feet. It is quite important to start to control the bluegills to some extent next year or risk the possibility that the bluegills may become stunted again. Enough bluegills are now present in Deep Lake to ensure good fishing for this species for several years after they reach legal size. Also it will be almost impossible to entirely destroy every nest or every egg on every nest so that some bluegills will undoubtedly survive.

4. No further stocking of fish is recommended in 1943 unless observations, fishing and the creel census indicate that rainbow trout should be planted. The Institute will attempt to watch the trend of the fishing if at all possible.

5. It may be possible to prepare the spring inlet so that trout may spawn there. The writer has already talked to Mr. Young about this, and if needed, further suggestions will be given.

6. It is suggested that about one dozen brush shelters be installed around the lake at depths of 5 to 10 feet. These shelters should be fairly large and constructed to shelter large fish. Besides serving as a hiding place for fish the brush shelter will also harbor some food organisms.

7. Fishermen using Deep Lake should be cautioned against using minnows or other live fish as bait. It is not known whether the few bluntnosed minnows that were found in Deep Lake this past summer will survive. As none of these minnows were collected on October 8, it is believed that the trout and smallmouthed bass may possibly have taken them all. If we find that additional forage fish (other than bluegills) are needed in Deep Lake, steps will be taken to introduce a suitable species.

8. It is recommended that at least 500 each of rainbow trout and smallmouth bass should be removed by angling during the 1943 season. All bluegills of suitable size that are caught should be kept.

9. Scale samples from a good series (50 or more fish) of fish should be saved for rate of growth study. Scale sample envelopes will be furnished by the Institute.

INSTITUTE FOR FISHERIES RESEARCH

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