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Managed fishing experiments conducted at the  
Hillsdale Rearing Ponds during 1946

by

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Most people go fishing for two reasons: first to provide fresh meat for the table and second for the pleasure and relaxation afforded by this popular pastime. Increasing evidence indicates that hook and line fishing has not harmed any lake and that more warm-water fish die of old age and other natural causes each year than are removed by anglers. Because most of our lakes are underfished, we believe that the present restrictive laws should be liberalized to permit fishermen to harvest a bigger crop.

When the Hillsdale Rearing Ponds were made available for experimental work, it was thought that they could best be used to determine the effect of more liberal fishing regulations on a known fish population, under a known fishing pressure. The following additional information could also be determined: (1) to demonstrate to the public that it is not possible to deplete the breeding stock by angling. (2) To determine the production (the crop that is harvested), the standing crop (the number and pounds of fish present), and the carrying capacity

(the maximum number and pounds of fish each pond is capable of supporting) of each of the various ponds. (3) The percentage of the standing crop that can be harvested by anglers. (4) The maximum sustained yield of fish to the anglers over a period of years. (5) If fishing is not improved with legal restrictions removed, techniques more likely to improve fish yields and fishing could and should be devised.

The six ponds at Hillsdale have a total area of 43 acres and vary in size from 1 to 16 acres as follows: Pond No. 1 - 1 acre; Pond No. 2 - 4 acres; Pond No. 3 - 4 acres; Pond No. 4 - 6 acres; Pond No. 5 - 12 acres; Pond No. 6 - 16 acres<sup>1</sup>. The main stream feeding the ponds is spring fed and was a trout stream before the ponds were constructed. This stream is called Beebe Creek by many residents and is a tributary of the St. Joseph River. Beebe Creek is filled with water cress from its source to the head rearing pond. Pond No. 1 also has a fair growth of water cress in the shallow water where the stream enters. Several of the ponds have springs entering along the dykes or in the bottom. Several intermittent tributaries of Beebe Creek enter Pond No. 5. All of the ponds except No. 1 are surrounded by wide dykes and all have seining basins attached to the outlet drain logs. All of the ponds have a rather firm bottom of sand and gravel. The only muck available in each pond is found near the outlet box and in the channels leading from the inlet to the outlet. Several acres of soft muck bottom are present near the outlet of Pond No. 6, and this has accumulated to such an extent that wading in this area when the ponds are being drained is extremely difficult and impossible in some places. Pond No. 1 has a

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↓ These acreages are approximate. Present plans call for a survey of these ponds this winter.

maximum depth at the outlet of approximately 8 feet, while the maximum depth of Pond No. 2 is 11 feet. The maximum depth of all of the other ponds is approximately 10 feet. The slope of the bottom of all ponds is gradual from all dykes to the outlet to facilitate draining operations. The bottom of all ponds is covered with <sup>an</sup> extremely heavy growth of Chara, with scattered patches of waterweed (Anacharis), coontail and water milfoil. All ponds have rather dense patches of cattail around their edges and scattered patches of rushes in the shallow water. Pond No. 6 is about the only pond in which pond weeds (Potamogetan) are to be found. Ponds 4 and 5 have a great many old stumps (with long roots) scattered about the pond bottom.

Pond No. 1 was not used at all during 1946. Pond No. 2 was stocked with legal trout and opened to trout fishing. Ponds 3, 4 and 6 were stocked with legal and undersized largemouth bass and bluegills and opened to fishing. Pond No. 5 was stocked with largemouth bass and bluegill fry.

#### Pond No. 2

Pond No. 2 was the only pond at Hillsdale that was stocked with trout and opened to fishing under the following restrictions for special trout ponds: Open to fishing from April 27 to September 2, 1946. During this period it was unlawful to fish or attempt to fish except with artificial flies only from one hour before sunrise to one hour after sunset each day. The daily limit was two trout of a minimum length of 8 inches. Anglers were required to obtain a permit before starting to fish and to report their catch and the number of hours fished to the creel census clerk. No boats or rafts could be placed or used on the pond. After the season was well under way, it was decided to open the pond to rainbow trout fishing, under the above restrictions, during September, October and November.

Pond No. 2 was stocked with 70 each of brook, brown and rainbow trout on March 28, 1946. None of the fish were marked by tags or by fin-clipping. The age, average length, and weight of each species of trout planted is presented in the following table (this information was obtained from records at the Wolf Lake Hatchery):

Species	Age	Length	Weight
Rainbow trout	26 months	10.0 inches	0.4 pounds
Brown trout	26 months	10.5 inches	0.5 pounds
Brook trout	26 months	12.5 inches	0.8 pounds

A total of 210 trout (52.5 fish per acre) weighing 119 pounds (29.75 pounds per acre) was planted in Pond No. 2. This rate of stocking was similar to that of most of the trout lakes in Michigan, but less than that of other special trout ponds.

During the entire 1946 fishing season 571 anglers fished a total of 826.25 hours on Hillsdale Pond No. 2 (Table 1). The average length of the fishing day was 1.45 hours. A total of 441 (77.2 percent) anglers were unsuccessful. Fishing pressure was extremely heavy on the trout pond with 135.2 anglers per acre fishing 198.2 hours during the regular season and 142.7 anglers per acre fishing 206.6 hours during the entire season. This fishing pressure was much higher than that recorded for other special trout ponds in Michigan. But there is a possibility that not all anglers registered at other trout ponds (where anglers recorded their own fishing trips) while our own creel census men contacted 100 percent of the anglers at Hillsdale. Of the 195 legal fish that were caught in Pond No. 2 during the regular season, only 140 were kept (68 brook, 32 brown and 40 rainbows). Three undersized

Table 1.--Summary of the trout fishing on Hillsdale Pond No. 2 from  
April 27 to December 1, 1946.

	April 27 to Sept. 2 (incl.)	Sept. 3 to December 1	Total for season
Number of anglers	541	30	571
Number anglers taking no fish	419	22	441
Percentage anglers taking no fish	77.4	73.3	77.2
Hours fished	793.00	33.25	826.25
Average length of fishing day (hours)	1.47	1.11	1.45
Total legal fish kept	140	3	143
Total legal fish caught	195	9	204
Catch per hour <sup>1</sup>	0.36	0.30	0.36
Ounces fish caught per hour <sup>2</sup>	1.9	1.2	1.9
Number of brook trout kept	68	0	68
Number of brown trout kept	32	0	32
Number of rainbow trout kept	40	3	43
Number of trout released	58	7	65
Number of legal trout released	55	6 <sup>3</sup>	61
Number of undersized trout released	3	1	4 <sup>4</sup>

<sup>1</sup> Includes the legal trout caught and released.

<sup>2</sup> Based only on fish kept.

<sup>3</sup> Five of these fish were brown trout, species determination not made on the other fish.

<sup>4</sup> Brook trout.

trout (all brooks) were released during the regular season. Only 30 anglers took advantage of the special rainbow trout season which extended from September 3 to December 1. These fishermen caught only three rainbow trout. But, six trout were released by them, and five of these were identified as brown trout.

A total of 80 trout were caught and kept by anglers during the first two weeks of the 1946 trout season. This amounts to 57.1 percent of all the trout that were kept during the regular season (Table 2). Fifty-three of the 80 trout caught during the first two weeks of the season were brook trout, 18 were rainbow trout, and 9 were brown trout. The percentage of unsuccessful fishermen amounted to 65.5 during the first week of the season and 67.8 for the second week. Aside from the week of July 20-26 when 50 percent of the anglers were successful, the first two weeks of the season produced the best fishing. Better than one-third (36.4 percent) of the 140 trout that were kept by anglers during the regular season were taken during the first four days. The trout catch by months is summarized in the following table:

April (4 days)	51 trout	(36.4 percent)
May	43 trout	(30.7 percent)
June	11 trout	(7.9 percent)
July	20 trout	(14.3 percent)
August	15 trout	(10.7 percent)
September (2 days)	0 trout	

The length of the fishing day decreased after the middle of June (Table 2). This probably resulted from the poorer fishing and because fewer trout were left in the pond. The poorer fishing may also be

Table 2.--Weekly summary of the trout fishing on Hillsdale Pond No. 2 from April 27 to September 2, 1946

Weekly period	Number anglers	Unsuccessful anglers		Hours fished	Length of fishing day (hours)	Number fish kept	Percentage caught each week	Brook trout	Brown trout	Rainbow trout	Catch per hour--all species
		Number	Percentage								
April 27 - May 3	145	95	65.5	239.0	1.6	59	42.1	43	6	10	0.25
May 4 - 10	56	38	67.8	90.7	1.6	21	15.0	10	3	8	0.23
11 - 17	54	46	85.2	92.5	1.7	6	4.3	1	2	3	0.06
18 - 24	62	55	88.7	97.5	1.6	5	3.6	2	1	2	0.05
25 - 31	49	46	93.9	67.5	1.4	3	2.1	2	1	0	0.04
June 1 - 7	25	21	84.0	39.7	1.6	6	4.3	1	1	4	0.15
8 - 14	15	13	86.7	29.5	2.0	2	1.4	0	2	0	0.07
15 - 21	2	2	100.0	1.5	0.7	0	...	0	0	0	0.00
22 - 28	14	12	85.7	11.0	0.8	3	2.1	0	3	0	0.27
June 29 - July 5	9	7	77.8	11.2	1.2	4	2.9	4	0	0	0.36
July 6 - 12	11	10	90.9	12.0	1.1	2	1.4	1	0	1	0.17
13 - 19	5	4	80.0	4.0	0.8	1	0.7	0	1	0	0.25
20 - 26	14	7	50.0	17.0	1.2	8	5.7	1	4	3	0.47
July 27 - August 2	12	9	75.0	11.7	1.0	5	3.6	0	2	3	0.43
3 - 9	12	9	75.0	15.2	1.3	4	2.9	3	1	0	0.26
10 - 16	14	10	71.4	12.2	0.9	3	2.1	0	1	2	0.25
17 - 23	16	14	87.5	16.5	1.0	3	2.1	0	2	1	0.18
24 - 30	18	14	77.8	18.5	1.0	4	2.9	0	2	2	0.22
August 31 - September 2 <sup>↓</sup>	8	7	87.5	5.5	0.7	1	0.7	0	0	1	0.18
Totals	541	419	77.4	793.0	1.5	140	...	68	32	40	...

<sup>↓</sup> Only three days

correlated with warmer water which caused the fish to remain in the deeper and colder water of the pond. Fish were seldom seen jumping at the surface after the first of July.

It was expected that the catch and catch per hour of trout would be extremely low during the hottest part of the season, but this was not true. The weekly catch per hour of all species of trout caught during the month of July varied from 0.17 to 0.47 (Table 2). During August the weekly catch per hour either equaled or nearly equaled the catch per hour for the first two weeks of the season. This bears out observations that have been made previously that experienced anglers are able to catch trout during the summer when the warm surface water drives the trout into the deeper, colder water. Experienced anglers either use wet flies and fish deep or do their fishing early in the morning following a cool night when the trout are on or near the surface.

Although all fish taken by anglers were measured and the majority weighed, no correlation was evident between the weight and length of the trout to indicate whether growth had occurred between the time of stocking until capture. The average length and weight of all of the three species of trout that were caught during the regular season is as follows: brook trout - 12 inches and 12 ounces; brown trout - 11.7 inches and 10.4 ounces; rainbow trout 11.2 inches and 9 ounces. The three rainbow trout that were caught during the special rainbow trout season averaged 11.8 inches in length and 13 ounces in weight.

Of the 571 anglers who fished the Hillsdale trout pond during all of 1946, 513 (89.8 percent) were residents of Hillsdale County. Other Michigan residents from the following counties also fished the pond: Lenawee, 28; St. Joseph, 3; Wayne 5; Van Buren, 2; Ingham, 2; Berrien, 1;



Branch, 1; Jackson, 1; and Washtenaw, 1. Altogether 557 (97.5 percent) Michigan residents fished for trout at Hillsdale. Non-residents made up 2.5 percent (14 anglers) of all anglers. Ten of the non-residents were from Ohio and 4 from Indiana.

Anglers removed 96.5 pounds (24.1 pounds per acre) of trout from the Hillsdale pond as follows: brook trout, 50.9 pounds; brown trout, 20.7 pounds; rainbow trout 24.9 pounds (Table 3).

When the Hillsdale pond was stocked with trout we did not know that native brook trout were present in the stream feeding the ponds. Therefore, none of the fish were marked and at the time of draining on October 22 we were unable to tell the wild trout from the hatchery trout. A total of 162 brook trout was present when the pond was drained (Table 3). Therefore it is impossible to compute the percentage of brook trout that were taken by anglers. Anglers caught and kept 46 percent of the brown trout that were planted and 61 percent of the rainbow trout. Of the 68 brook trout caught, it is possible that 64 were planted fish because four trout between 8.75 and 9.0 inches were caught during the summer. Although we do not know what the size range of the planted fish was the average size was 12.5 inches according to the hatchery records.

At the time of draining on October 22, the following fish were taken: brook trout - 52 legal fish (20 pounds) and 110 undersized fish (7 pounds); brown trout 33 fish (32.2 pounds); rainbow trout 20 fish (25.2 pounds). The known mortality from March 28 to October 22 was 7 (10.0 percent) rainbow trout and 5 (7.1 percent) brown trout. This is a very low mortality rate for trout planted in any water. It must be

Table 3.--Comparison of the number, total pounds and pounds per acre of trout stocked in Hillsdale Pond No. 2, with those caught by anglers and those remaining in the pond at the time of draining.

Species	Stocking rate			Anglers catch			Percentage caught by anglers	Draining record			Mortality	
	Number	Pounds	Pounds per acre	Number	Pounds	Pounds per acre		Number	Pounds	Pounds per acre	Number	Percentage
Brook trout	70	56	14.0	68	50.9	12.7	<sup>2</sup> ✓	52 Legal 110 under size	20.0 7.0	5.0 1.7	<sup>2</sup>	<sup>2</sup>
Brown trout	70	35	8.7	32	20.7	5.2	46	33	32.2	8.1	5	7.1
Rainbow trout	70	28	7.0	43 <sup>1</sup> ✓	24.9	6.2	61	20	25.2	6.3	7	10.0
Total	210	119	29.7	143	96.5	24.1	...	...	84.4	21.1	...	...

<sup>1</sup>✓ Includes the 3 trout taken during the special rainbow trout season

<sup>2</sup>✓ See text for explanation

remembered that 65 trout were caught and released by anglers and it is possible that some of these hooked fish might have been injured and failed to survive.

A total of 571 trout fishermen derived a great deal of pleasure out of the Hillsdale pond. This does not represent 571 individual fishermen because it is known that several anglers fished once or twice a week during the season and were therefore recorded many times. It is too bad that the anglers were unable to catch a greater percentage of the planted trout, especially brown trout. From the results of the 1946 creel census it would probably be desirable to allow anglers to take rainbow trout during September, October and November next year also.

Both Ponds No. 1 and 2 will be open to trout fishing in 1947 under the same special trout pond regulations. Pond No. 1 has an area of approximately one acre. It was decided that these ponds should be stocked at the rate of 100 fish per acre for 1947. Therefore, both ponds were stocked with trout on November 19, 1946. No additional brook trout were planted in Pond No. 2, because it is believed that the 162 fish present will be adequate for next year. The number of trout present in these ponds as of November 19, 1946 is presented in Table No. 4.

Ponds 1 and 2 will be drained sometime next spring before opening of the trout season. Data obtained at this time will give the over-winter mortality. This type of information is not available for other special trout ponds which are also stocked in the fall. Some wild brook trout will undoubtedly find their way into Pond No. 1 this winter, but Pond No. 2 is screened and no migration of fish into or out of this pond is possible.

Table 4.--Number, age, length and weight of the trout present in Hillsdale  
Pond No. 1 and 2 on November 19, 1946.

Species	Number	Finclipped	Age (months)	Total weight (pounds)	Size range or average length (inches)
<u>Pond No. 1</u>					
Brook trout	34	Dorsal	22	9.86	9
Brown trout	34	Dorsal	22	9.52	8.9
Rainbow trout	34	Dorsal	22	10.20	9.1
Total	102	...	...	29.58	...
<u>Pond No. 2</u>					
Brook trout	162	No	Unknown	27.00	5 - 12
Brown trout	33	No	34	32.25	10 - 14
	134	Dorsal	22	37.52	8.9
Rainbow trout	19	No	34	24.25	10 - 15
	134	Dorsal	22	40.20	9.1
Total	482	...	...	161.22	...

LARGEMOUTH BASS AND BLUEGILL PONDS

The remaining four ponds (3,4,5 and 6) at Hillsdale were to have been stocked with legal and undersized largemouth bass and bluegills, each at the same rate per acre. By starting out with a known number and poundage of each of the two species, taking an accurate creel census and draining each pond in the fall and again in the spring, it should be possible to evaluate the various regulations in force in Michigan and obtain other pertinent data on the growth, survival and mortality of each species.

In order to keep accurate fishing records for each individual pond (including the trout pond) a system was devised similar to that used by the Game Division at their Rose Lake Experiment Station. All of the ponds were posted with signs of different colors. For example, Pond No. 3 was posted with blue signs; Pond No. 4 with yellow signs, etc. Each sign had the pond number and "Fishing By Permit Only" painted on both sides. The creel census clerk gave each angler a tag (Figure 1) corresponding in color with the signs placed around the particular pond. This tag had the general instructions pertaining to all ponds printed on one side and the special regulations for a particular pond printed on the reverse side. Each angler was asked to fasten this tag in the buttonhole of his shirt or coat. If the angler got tired of fishing on one pond, he had to return to the checking station, turn in his tag and tell the creel census clerk how many hours he had fished and the number of fish caught. The angler was then given a different colored tag and allowed to fish on another pond. Not once during the season did we have any trouble with anglers fishing more than one pond without first reporting in to the checking station. Not one



Figure 1.--Photograph of a tag (actual size) given to all anglers fishing Hillsdale Pond No. 2. Tags of different colors were given to anglers fishing on other ponds. Photo by Flaten.

angler protested during the season about the "red tape" required before allowing him to fish.

Anglers were permitted to fish from one hour before sunrise until one hour after sunset. A small building erected at the parking area (Figure 2) served as a checking station. All gates, other than the one at the main entrance, were closed so that all anglers would have to drive directly to the checking station when entering the area. Fishermen were allowed to use any legal bait. Boats could also be placed on any of the bass-bluegill ponds.

In all ponds existing seasons, sizes and creel limits provided by law for the largemouth bass were to be observed by all fishermen. Rules and regulations pertaining to bluegills were as follows:

Pond No. 3. (Blue signs and tags) No size limit on bluegills but existing creel and season limits provided by law were to be observed.

Pond No. 4. (Yellow signs and tags) No creel limit on bluegills. Existing size and season limits provided by law were to be observed.

Pond No. 5. This pond was not opened to fishing in 1946, but the regulations were to have been as follows: Bluegills of legal length (6 inches) could be taken throughout the year, but existing size and creel limits were to be observed.

Pond No. 6. (Red signs and tags) There were no restrictions as to size, season or creel limits for bluegills in this pond.

To enable the angler to have in possession and to transport undersized or legal bluegills during the closed season and to have more than the legal limit of bluegills, a duplicate creel census card was issued to each angler. This duplicate card would be honored by all conservation officers for a period of two days after the date of issue.



Figure 2.--Creel census checking station located at the Hillsdale  
Managed Fishing Area. Photo by Beckman



Although it would have been desirable to have had equal fishing pressure per acre on all ponds, it was not possible because anglers were allowed to choose the pond or ponds they wanted to fish. If on any one day fishing appeared to be better on one pond, the majority of the anglers fished this pond. This resulted in much higher fishing pressure per acre on some ponds than on others.

All fish caught by anglers were weighed individually when time permitted and in species lots when less time was available. Individual lengths were also obtained when time permitted.

Stocking: The number of fish per acre is not a satisfactory measure of the carrying capacity because it varies greatly. Therefore, all of the fish that were planted in the Hillsdale ponds were weighed, and the rate of stocking was computed on the basis of pounds per acre.

It was rather difficult to arrive at a satisfactory stocking program. Dr. Robert C. Ball, who has been in charge of compiling all of the results of lake poisoning operations and I went over these fish population data. After a great deal of study we decided that the rate of stocking and the ratio of legal and undersized largemouth bass to legal and undersized bluegills that would probably be best to use were as follows: Total stocking rate - 100 pounds per acre; legal bluegills, 60 pounds; undersized bluegills, 5 pounds; legal largemouth bass, 26 pounds; undersized largemouth bass, 9 pounds. This ratio was followed as closely as possible in stocking the Hillsdale Ponds.

All of the fish that were stocked in Hillsdale Ponds 3, 4 and 6 were obtained by netting. Most of the fish were taken in fyke nets although some, especially small bass and bluegills, were taken by seines. Netting operations were first carried on in Oakland County

where all fish captured were held at the Drayton Plains Hatchery until enough were present to justify a trip to Hillsdale. Operations were transferred to Hillsdale County when the mortality of the fish held at Drayton Plains became so great that it was not worthwhile to net any longer. Some fish were obtained from the Wolf Lake Hatchery ponds (Van Buren County) and we received permission to net Wintergreen Lake on the Kellogg Bird Sanctuary (Kalamazoo County). The following lakes were netted to obtain the fish for stocking the Hillsdale Ponds:

Oakland County - Cass, Elisabeth, Crescent, Liggetts, Wildwood, Oakland;  
 Kalamazoo County - Wintergreen Lake; Hillsdale County - Baw Beese, Bass, Boot, Long, Carpenter, Wilson, Cub, Deer, Sand, Pleasant.

The following numbers and pounds of fish were taken in the lakes of each county:

County	Legal bluegills		Undersized bluegills		Legal bass		Undersized bass	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Oakland	936	262.8	494	45.5	35	30.6	38	12.1
Van Buren <sup>↓</sup>	58	24.6	314	19.3	37	38.4	11	2.5
Kalamazoo <sup>2</sup>	178	141.3	48	8.0	55	88.0	4	1.0
Hillsdale	3,903	1,431.6	1,283	45.6	373	427.1	321	62.5
Total	5,075	1,860.3	2,139	118.4	500	584.1	374	78.1

Grand total 8,088 fish weighing 2,640.9 pounds.

↓ Wolf Lake Hatchery Ponds

2 Wintergreen Lake

Netting was started on April 30 and continued until June 18. The first fish were stocked in the ponds on May 8. The first dead fish appeared

on the ponds later that same afternoon. An attempt was made to pick up all dead fish on each pond. On several days approximately 100 pounds of dead fish were collected from the three ponds. The mortality gradually diminished until June 15 and only an occasional dead fish was found from this lake until June 21. After June 21, no dead fish were found on any of the ponds although one trip was made around each pond every day.

The summary of the total stocking, mortality, net stocking and the stocking rate per acre is presented in Table No. 5.

It was originally planned to clip the fins on all legal fish so that the recruitment of undersized fish to legal size could be accurately measured. This marking was not attempted because of the weakness of the first fish planted which had been held at the Drayton Plains Hatchery. It is believed that most of the fish from the Drayton Plains planting died before the fishing season opened. A total of 22.3 percent of the fish captured in nets and held at the Drayton Plains Hatchery died before being shipped to Hillsdale. As the netting season progressed the mortality decreased. Pond No. 6 was the first pond stocked and the total observed mortality amounted to 23.9 percent. Pond No. 3 was the second pond to be stocked and the total observed mortality was 16.1 percent. The observed mortality in Pond No. 4 which was the last pond stocked amounted to only 6.6 percent. Of course we would like to believe that this diminishing mortality was due to increased experience and to other precautionary methods employed as the season progressed. But a mortality of even 6.6 percent is still too high and must reflect to some extent on our method of capturing the fish by fyke nets.

The total observed mortality from the time that netting operations were started amounted to 22.14 percent (this includes the fish that died at Drayton Plains Hatchery). This amounted to a total of 607.2 pounds of fish out of the 2,741.8 pounds collected.

Table 5.--Total planting, recorded mortality, net number and pounds of fish stocked and the rate of stocking per acre for each of the three Hillsdale Ponds.

Pond No. 3 (4 acres)

Stocked - May 28 to June 14

Mortality - May 29 to June 21

	Legal bluegills		Undersized bluegills		Legal largemouth bass		Undersized largemouth bass		Total pounds
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	
Total planting	562	303.1	682	9.5	71	102.2	62	8.1	422.9
Known mortality	103	62.9	57	0.9	4	3.7	4	0.9	68.3
Net stocking	459	240.2	625	8.6	67	98.5	58	7.2	354.6
Rate per acre	114.7	60.1	156.2	2.2	16.7	24.6	14.5	1.8	88.7
Pounds lacking to complete recommended stocking per acre	...	0.0	...	2.8	...	1.4	...	7.2	11.4

Pond No. 4 (6 acres)

Stocked May 31 to June 15

Mortality - June 4 to 21

Total planting	1,091	384.2	250	19.5	64	90.2	107	41.6	535.5
Known mortality	104	30.9	21	2.4	2	1.7	1	0.4	35.4
Net stocking	987	353.3	229	17.1	62	88.5	106	41.2	500.1
Rate per acre	164.5	58.9	38.2	2.8	10.3	14.7	17.7	6.9	83.3
Pounds lacking to complete recommended stocking per acre	...	1.1	...	2.2	...	11.3	...	2.1	16.7

Pond No. 6 (16 acres)

Stocked - May 8 to June 17

Mortality - May 8 to June 14

Total planting	3,422	1,172.9	1,207	89.5	365	391.6	205	28.4	1,682.4
Known mortality	954	327.2	207	18.6	47	52.7	19	4.1	402.6
Net stocking	2,468	845.7	1,000	70.9	318	338.9	186	24.3	1,279.8
Rates per acre	154.2	52.8	62.5	4.4	19.9	21.2	11.6	1.5	79.9
Pounds lacking to complete recommended stocking per acre	...	7.2	...	0.6	...	4.8	...	7.5	20.1

In our first netting operations in Oakland County lakes, all fish captured in nets were transported in 20-gallon cans to the Drayton Plains Hatchery. It was observed at this time that many fish were injured by being squeezed between the wooden hoops of the fyke nets. In addition scales were lost by many fish during the period of collecting and transporting because it was necessary to handle each fish several times. When collection was continued in lakes near the Hillsdale ponds, several handlings of each fish were eliminated. Also, the pump-equipped tank truck used at Hillsdale eliminated the hand aeration necessary at Drayton Plains.

All of the fish that were transferred from the Drayton Plains Hatchery to Hillsdale were dipped in a one percent solution of malachite green just before they were placed in the ponds. After the fifth day of netting at Hillsdale (May 18) all fish were treated with potassium permanganate and salt before they were released in the ponds. It is not known just how much good this treatment accomplished.

Most of the dead fish that were picked up exhibited the characteristic fungus usually found on fish that have been caught in nets. Closer parasitological examination of the dead fish was not made. Many fish were completely covered with a dense fungus growth. Many injuries such as cuts and gashes, not evident at the time of planting, were also observed on the dead fish. Most of these injuries were the result of netting and handling. Many fish that were taken from the middle of May to the middle of June exhibited eroded anal and caudal fins characteristic of bass and bluegills during their spawning period. Undoubtedly some of these injuries incurred at spawning resulted in the death of the fish, because dead fish so marked are commonly found about all of our inland lakes.

All of the legal bluegills taken in our nets and stocked in the Hillsdale ponds were old adults, as evidenced by the average weight.

The bluegills in Pond No. 3 averaged 0.52 pounds each while those in Pond No. 4 averaged 0.36 pounds and Pond No. 6 averaged 0.34 of a pound. Dr. W. C. Beckman of the Institute staff has compiled data on the average length and weight of bluegills of all ages in all Michigan waters from which fish have been collected. From his data we find that the bluegills planted in the Hillsdale ponds were probably between seven and ten years of age (eighth to eleventh summer of life). Ninety percent of the fish used by Beckman in his study were less than six years of age. Therefore it is probable that most of the bluegills that were planted in the Hillsdale ponds were old fish. Most of these fish would probably have died a natural death before being caught by anglers even if we hadn't transferred them to the Hillsdale ponds. Ricker<sup>↓</sup> has found that senile death is an every day occurrence among bluegills and is the most important cause of mortality among bluegills more than five inches in length. He further states that in the bluegill there is a rather indefinite maximum age limit and that senility overtakes the fish over a wide range of ages and sizes. Ricker found that at Shoe Lake (Indiana) as many as 30 to 80 large bluegills die each day. He also found that the annual mortality rate among bluegills of legal size is between 60 and 77 percent. Ricker has concluded that age is probably more important than size in determining the mortality rate of fishes.

The mortality of bluegills could not have been due entirely to old age because fish of the same size and age were taken during the entire

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↓ Ricker, W. E. Natural mortality among Indiana bluegill sunfish.

season. Another probable cause of the death of large numbers of bluegills at Hillsdale may have been the capture of many fish that were spawning or ready to spawn. Bluegills started to spawn shortly after the middle of May and continued through July in 1946. Many male and female bluegills were captured while on the spawning grounds. What effect the capture and transfer, to other waters having lower water temperature, of a female bluegill distended with roe is not known. Many of the dead bluegills that were examined at Hillsdale were ripe females full of mature or nearly mature eggs. It is my belief that the above factor is definitely to be reckoned with in determining mortality.

The mortality figures listed in Table 5 are not complete by any means. Presumably, many dead fish were never recovered. Many scavengers were present in the ponds. Most prominent were crawfish, blue herons, sea gulls, musk turtles, painted turtles, soft-shell turtles, snapping turtles and mink. It is possible, therefore, that many fish that died were eaten before they were quite dead or quickly after they died. Dense growths of cattails were present in certain areas on all ponds. It is entirely possible that many dead fish hidden in weed beds were overlooked. Therefore, it is impossible for us to even guess what the total mortality might have been at Hillsdale.

The original plans called for stocking each pond with 60 pounds of legal bluegills and 26 pounds of legal largemouth bass, 5 pounds of undersized bluegills and 9 pounds of undersized largemouth bass per acre. This stocking rate for legal bass and bluegills was practically fulfilled on each pond after deducting the known mortality. This mortality had dropped off completely, as far as we know, by June 21. Therefore, by the time the ponds were opened to fishing on June 25, we assume that the

number of fish listed in Table 5 was present in each pond. Pond No. 3 was the only pond receiving more than the allotted quota of fish per acre. A total of 60.1 pounds (excess of 0.1 pound) per acre of legal bluegills was planted here. This pond also received 24.6 pounds per acre of legal largemouth bass (short 1.4 pounds per acre). Pond No. 4 was stocked with 58.9 pounds (short 1.1 pounds) of legal bluegills and 14.7 pounds (short 11.3 pounds per acre) of legal largemouth bass. This was the last pond stocked and there were not enough bass available to stock it completely. Pond No. 6 had the highest rate of mortality of the three ponds but was only short 7.2 pounds of legal bluegills and 4.8 pounds of legal bass.

It was extremely difficult to obtain sufficient undersized bass and bluegills during the entire period of netting because of the selectiveness of the fyke nets used. At least 20 attempts were made to obtain small fish by means of seines, but fish of 4 to 5 inches in length still could not be collected in sufficient numbers (Table 5). This was due mainly to lack of sufficient time to do a thorough job and because most of the lakes in Hillsdale County that were seined had very steep drop-offs and fish could not be captured without special seines. Pond No. 4 received the best planting of small bass (shortage of only 2.1 pounds per acre as compared with 7.2 and 7.5 pounds per acre for Ponds 3 and 6). Pond No. 6 received more small bluegills (4.4 pounds per acre stocked and shortage of only 0.6 pounds per acre) than either of the other two ponds. Pond No. 3 was stocked with 2.2 pounds per acre and Pond No. 4 received only 2.8 pounds per acre.

The net stocking per acre fell far short of the 100 pounds per acre. Pond No. 3 received 88.7 pounds per acre, Pond No. 4, 83.3 pounds and Pond No. 6 only 79.9 pounds.



Creel census. It is believed that 100 percent of all anglers who fished the Hillsdale Ponds were contacted by the creel census clerks. Excellent cooperation was received from all fishermen. The creel census system devised appeared to work very satisfactorily. Between 50 and 100 small children who fished the ponds were not recorded on creel census cards because it was felt that they did not concentrate on fishing or else did not fish enough to make it worthwhile to record their fishing. Even the very small children are to be commended for obeying all rules and regulations.

A total of 1,657 anglers fished the three bass-bluegill ponds from June 25 until the ponds were drained in October (Table 6). This does not mean that there were 1,657 different anglers because some people would fish more than one pond. Pond No. 6 was fished by the greatest number of anglers (686), while Pond No. 4 had a total of 495 anglers and Pond No. 3, 476 anglers. These 1,657 anglers spent 2,369.75 hours fishing on the three ponds. The hours of fishing on Pond Nos. 3, 4 and 6 were 633, 659 and 1,077.75 respectively. The average length of the fisherman day was 80 minutes on Ponds No. 3 and 4 and 94 minutes on Pond No. 6. The fishing pressure per acre varied greatly for all ponds. A total of 119 anglers fished 158.25 hours per acre on Pond No. 3, while 82.5 anglers fished 109.83 hours per acre on Pond No. 4 and 42.9 anglers fished 67.36 hours per acre on Pond No. 6. The fishing pressure per acre was about three times as great on Pond No. 3 as it was on Pond No. 6 while the fishing pressure on Pond No. 4 was about twice as heavy as that for Pond No. 6.

A greater percentage of anglers failed to catch fish at the Hillsdale Ponds than is usually found on most natural lakes. The

Table 6.--Summary of the creel census data from Ponds No. 3, 4 and 6 of the Hillsdale Rearing Ponds during 1946.

	Pond No. 3	Pond No. 4	Pond No. 6
Total number of anglers	476	495	686
Fishing pressure - number of anglers per acre	119.0	82.5	42.9
Total hours fished	633.0	659.0	1,077.7
Fishing pressure - number of hours per acre	158.25	109.83	67.36
Average length of fishing day (minutes)	80	80	9.4
Percentage male anglers	84.7	86.5	81.9
Percentage unsuccessful anglers	84.2	85.4	72.7
Total number of fish caught	160	164	517
Total weight of fish caught (pounds)	111.0	88.5	311.2
Average catch per hour	0.25	0.25	0.48
Total number legal bluegills kept	125	141	368
Average catch per hour legal bluegills	0.20	0.21	0.34
Total weight legal bluegills kept (pounds)	75.8	54.4	142.4
Average length legal bluegills (inches)	8.9	7.9	7.6
Average weight legal bluegills (ounces)	9.8	6.1	6.2
Number legal bluegills caught per acre	31.2	23.5	23
Pounds legal bluegills caught per acre	18.9	9.1	9.0
Total number undersized bluegills kept	7	...	10
Total weight undersized bluegills (pounds)	1.0	...	1.2
Average weight undersized bluegills (ounces)	2.2	...	2.0
Average length undersized bluegills (inches)	5.0	...	5.1
Total weight of all bluegills kept (pounds)	76.8	54.4	143.6
Total number of largemouth bass kept	28	23	139
Average catch per hour largemouth bass	0.04	0.04	0.13
Total weight largemouth bass (pounds)	34.2	34.1	167.6
Average length largemouth bass (inches)	13.6	13.5	13.4
Average weight largemouth bass (ounces)	19.5	23.7	19.3
Number largemouth bass caught per acre	7	4	9
Pounds largemouth bass caught per acre	8.5	5.7	10.5

percentage of the total number of fishermen taking no fish amounted to 84.2 percent on Pond No. 3, 85.4 percent on Pond No. 4 and 72.7 percent on Pond No. 6. There are several possible explanations for the high percentage of unsuccessful fishermen. First, the Hillsdale ponds are rather small and shallow in comparison with most natural bodies of water. Most anglers believed that the ponds would be teeming with fish because of the apparent high rate of stocking. (We do not know too much about the number of fish per acre of water in our natural lakes; therefore, the word "apparent" is used when describing the rate of stocking). It is my belief that the anglers who fished at Hillsdale expected to catch a mess of fish in a short period of time, because of the small area, shallow depth and high rate of stocking of the various ponds. This in turn brings up the second explanation, namely the length of each fishing day. The length of the fishing day varied from 80 minutes in Ponds No. 3 and 4 to 94 minutes in Pond No. 6. This is only about half the length of the fishing day in most waters of the state of Michigan. Anglers at Hillsdale quit fishing too soon. They either stopped fishing before they were able to locate a school of fish or else quit before the fish returned to their fishing area after disturbance caused from throwing their lure into the water and by their actual presence in the area. The third explanation of the low percentage of successful fishermen is probably due to the type of fishing practiced by the majority of the anglers. From observations made at Hillsdale it is known that the anglers fishing out of boats made the best catches of fish. Fishermen who waded in the shallow water casting with plugs or flies probably made the next best catches, while the cane-pole produced the poorest catches. It must be mentioned here that the expert

cane-pole angler usually caught fish even while fishing from shore or from docks. Most of the anglers who fished at Hillsdale fished from shore or dock. Therefore, it is necessary to conclude that the majority of the anglers who fished the Hillsdale ponds were novices employing the poorest fishing methods.

The perfectly clear water in the Hillsdale ponds also may have been responsible to some extent for the poor fishing. This factor was recognized early in the season. A load of horse manure was applied to Pond No. 4 on July 1. This manure was immediately effective in turning the water light brown, and visibility was decreased tremendously. Yet fishing in Pond No. 4 did not improve with the decrease in visibility. Therefore, the clear water could not have been entirely responsible for the poor fishing at the Hillsdale ponds.

It is also possible that there were not enough fish present in any of the Hillsdale ponds to make fishing any better. This may be true to some extent, but it must be pointed out that all ponds contained more fish at the time of draining than were removed by anglers. Also, the catch per hour for all ponds was best during September and the ponds were drained in October.

A total of 841 fish weighing 510.7 pounds (19.6 pounds per acre for the 26 acres of water) was taken from the three ponds at Hillsdale as follows: Pond No. 3 - 160 fish weighing 111.0 pounds; Pond No. 4 - 164 fish weighing 88.5 pounds; Pond No. 6 - 517 fish weighing 311.2 pounds (Table 6). The average catch per hour for the entire season amounted to 0.25 fish for Ponds No. 3 and 4 and 0.48 for Pond No. 6. This difference in the average catch per hour is significant and may have been due to any one or all of the following: (1) Longer fishing day

on Pond No. 6. (2) Lighter fishing pressure per acre on Pond No. 6. (3) Pond No. 6 also had a higher percentage of successful anglers. (4) Data are not available on the number of anglers who fished from shore, waded or used boats on each pond but we do know that there were more boats on Pond No. 6 all summer than on any of the other ponds. Observations also indicate that boat fishermen had better catches of fish than all other fishermen. Therefore, it is possible that the type of fishing done by anglers is an important factor in the catch per hour. It is also possible that Pond No. 6 had less available food supply than any of the other ponds, but data are not available on this subject or for any other biological, physical or chemical factors which may have made fish easier to catch in Pond No. 6.

Because none of the fish were fin-clipped it is not possible to determine what the recruitment to the population of legal fish was. Therefore, figures on the percentage of the total number of fish stocked that were taken by anglers cannot be given.

Bluegills were the dominant species in the catch for each of the three ponds. Legal bluegills comprised 78.1 percent (125 fish or 31.2 per acre) in Pond No. 3; 86 percent (141 fish or 23.5 per acre) in Pond No. 4; and 71.2 percent (368 fish or 23 per acre) in Pond No. 6. The total catch of bluegills in Pond No. 3 weighed 75.8 pounds (18.9 pounds per acre); 54.4 pounds (9.1 pounds per acre) for Pond No. 4; and 142.4 pounds (9.0 pounds per acre) for Pond No. 6. The legal bluegills removed from Pond No. 3 averaged 8.9 inches and 9.8 ounces each while those from Pond No. 4 were 7.9 inches and 6.1 ounces and those from Pond No. 6 were 7.6 inches and 6.2 ounces.

Undersized bluegills could be taken only from Ponds No. 3 and 6 according to the regulations set up for Hillsdale. Only 7 fish weighing

one pound (average length of 5.0 inches and weight of 2.2 ounces) were removed from Pond No. 3, while 10 fish weighing 1.2 pounds (average of 5.1 inches and 2.0 ounces) were taken from Pond No. 6. It is not known whether other undersized bluegills were caught and returned to the water, but it is my belief that very few were caught by anglers.

A total of 28 largemouth bass weighing 34.2 pounds (7 fish per acre weighing 8.5 pounds) was removed from Pond No. 3 by anglers during the 1946 fishing season. Pond No. 4 yielded 23 bass weighing 34.1 pounds (4 fish per acre weighing 5.7 pounds) and Pond No. 6 produced 139 bass weighing 167.6 pounds (9 fish per acre weighing 10.5 pounds). The largemouth bass averaged 13.6 inches (19.5 ounces) in Pond No. 3, 13.5 inches (23.7 ounces) in Pond No. 4, and 13.4 inches (19.3 ounces) in Pond No. 6.

The catch per acre of all fish amounted to 27.7 pounds for Pond No. 3, 17.6 pounds for Pond No. 4 and 19.5 pounds for Pond No. 6. This catch per acre is believed to be at least as high as that for natural lakes in Michigan and is probably due to the heavy fishing pressure.

The number of anglers, total hours fished and the number of fish caught in each of Ponds No. 3, 4 and 6 is summarized in Table 7. The fishing pressure on all ponds was extremely heavy during the first two weeks of the fishing season. Of the 476 anglers who fished Pond No. 3 during the entire season, 51.5 percent fished during the first 11 days of the season and caught 51.2 percent of all fish that were caught during the entire season.

Table 7.--Weekly summary of the number of anglers, total hours fished and the total number of fish caught in each of the largemouth bass-bluegill ponds at Hillsdale in 1946.

Period	Pond No. 3			Pond No. 4			Pond No. 6		
	Number of anglers	Total hours fished	Total number of fish caught	Number of anglers	Total hours fished	Total number of fish caught	Number of anglers	Total hours fished	Total number of fish caught
June 25 - 28	138	208.75	67	107	150.25	51	141	208.50	65
June 29 - July 5	107	142.25	15	99	158.50	47	100	150.00	41
July 6-12	41	57.50	6	53	65.25	11	65	88.25	9
13-19	19	18.50	4	32	40.25	1	45	79.95	10
20-26	24	29.00	4	28	40.25	13	18	23.25	6
July 27 -									
August 2	28	29.25	16	41	42.75	8	25	42.75	18
August 3-9	21	27.25	4	34	51.75	3	41	92.75	58
10-16	23	34.75	7	28	36.75	3	46	80.50	41
17-23	20	29.25	3	24	24.25	7	60	88.25	60
24-30	6	3.00	1	10	8.75	0	40	65.50	33
August 31 -									
September 6	11	9.50	0	11	12.00	0	14	20.00	7
September 7-13	3	3.00	5	9	10.00	12	20	29.50	28
14-20	16	17.25	24	3	2.00	1	42	59.25	109
21-27	14	14.25	4	7	5.75	4	28	47.50	31
September 28 -									
October 4	5	9.50	0	5	5.25	0	1	2.00	1
October 5-11	0	0	...	4	5.25	3	0	...	...
Total	476	633.00	160	495	659.00	164	686	1,077.75	517

51.5% anglers first 11 days  
51.2% of fish caught " "

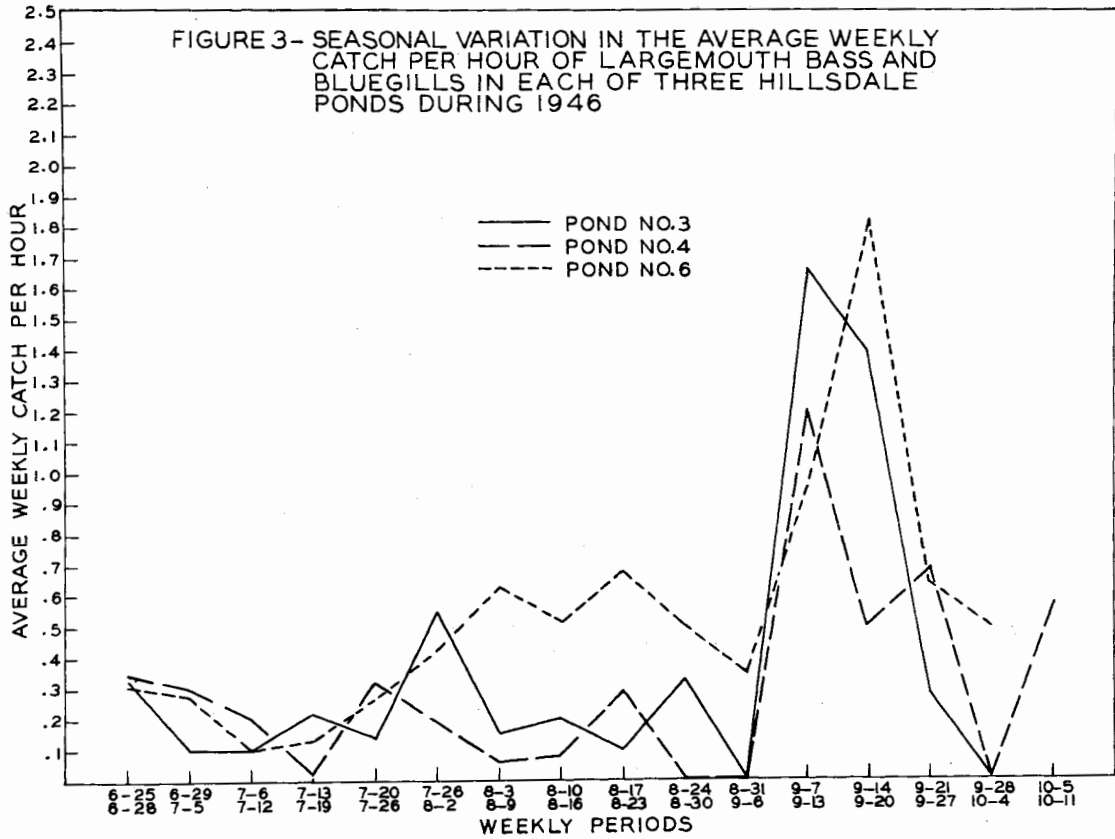
41.6% anglers fished first 11 days  
59.7% of fish caught " "

35.1% anglers fished first 11 days  
20.5% of fish caught " "

On Pond No. 4, 41.6 percent of the total number of anglers fished during the first 11 days of the season and caught 59.7 percent of the fish. Only 35.1 percent of the total number of anglers fished on Pond No. 6 during the first 11 days of the season and caught 20.5 percent of the fish. Pond No. 3 was stocked with large bluegills from Wintergreen Lake. Many of these fish weighed a pound each (at the time of stocking 160 fish weighed 130 pounds). Most of the fishermen concentrated on catching the large bluegills in Pond No. 3 during the first few days of the season which at least partially accounts for the heavy fishing pressure on this pond. Fishing was not very productive on Pond No. 6 during the first few days of the season and therefore anglers preferred to fish on other ponds. As is natural with all fishermen, they tend to concentrate their efforts on a particular hole or lake where the fish are biting. The fact that only 20.5 percent of all of the fish caught during the season were caught during the first 11 days of the season in Pond No. 6 as compared with 51.2 percent for Pond No. 3 and 59.7 percent for Pond No. 4 may be one factor why the catch per hour was greater than that of the other two ponds.

Variation in the average weekly catch per hour of all fish throughout the season is illustrated in Figure 3. Fishing was extremely poor during the first few weeks of the season but improved as the season progressed. The extremely good fishing in each pond from August 31 to September 27 is a phenomenon commonly exhibited in many natural lakes. Bluegills were the dominant species in the catch during this period in all three ponds. No largemouth bass were caught in Pond No. 4 after August 23, and only one bass was caught in Pond No. 3 after August 31.





In Pond No. 6 only 5 bass were caught after August 31, in comparison with the 65 taken during the first two weeks of the season and the 53 taken during the first three weeks of August. The causes of the poor bass fishing and the good bluegill fishing late in the season cannot be answered at present. Perhaps some answers (amount of food present, especially young-of-the-year fish, and water temperatures) might be ascertained in the near future, if these experiments are continued.

Anglers from eleven Michigan counties and five other states fished in the three Hillsdale ponds during 1946. A total of 91.6 percent (1,535) of the anglers were residents of Hillsdale County (Table 8). The next largest group of anglers were from Ohio (39 or 2.3 percent of all anglers). Of the 1,657 anglers who fished the three Hillsdale ponds, 96.4 percent (1,597) were Michigan residents and 3.6 percent (60) were from out of the state.

Recovery of fish at the time the ponds were drained. All of the ponds at Hillsdale were drained during the month of October. The date of the final draining of each pond was as follows: Pond No. 6, October 3; Pond No. 3, October 9; Pond No. 4, October 22. All fish were removed from each pond (except No. 6), sorted according to sizes and species, and were then weighed and counted and returned to the same pond. It was impossible to drain Pond No. 6 completely because the pond bottom immediately in front of the outlet was lower than the outlet pipe. After every effort was made to "flush" the fish through the outlet pipe, it was necessary to close the valve and attempt to estimate the number of fish remaining in the pond. The estimate of one legal and 5,000 young-of-the-year largemouth bass, and 50 legal bluegills is definitely minimal.

Table 8.--Summary of the residence of all anglers fishing the Hillsdale ponds during 1946.

Residence	Pond No. 3	Pond No. 4	Pond No. 6	Total
Bay County	...	...	2	2
Branch County	2	5	...	7
Calhoun County	...	...	1	1
Hillsdale County	444	439	652	1,535
Ingham County	1	7	2	10
Jackson County	3	...	6	9
Kalamazoo County	...	2	...	2
Lenawee County	1	8	...	9
Livingston County	1	...	...	1
Washtenaw County	...	4	2	6
Wayne County	10	4	1	15
Total for Michigan	462	469	666	1,597
Arizona	4	...	...	4
California	...	1	...	1
Indiana	5	3	5	13
Ohio	5	21	13	39
Pennsylvania	...	1	...	1
Unrecorded	...	...	2	2
Total out of state	14	26	20	60
Total	476	495	686	1,657

The summary of the number and pounds of legal and sublegal fish of each species that were removed from each pond at the time of draining is presented in Table 9. For comparison similar figures on stocking and creel census are included in this table.

It is rather difficult to compare the number or weight of legal largemouth bass and bluegills at the time the ponds were drained with the number and weight of those stocked in the pond. It is known that some recruitment to the population of legal fish occurred during the summer, but the number of undersized fish that reached legal size is not known. It was originally planned that all legal bass and bluegills planted in the Hillsdale ponds were to have been fin-clipped so that the recruitment could be measured. Another reason that it is difficult to compare the numbers and pounds of fish stocked in the ponds with those removed at the time of draining is that it is known that natural death occurs daily.

Natural death was not much of a factor in reducing the numbers of largemouth bass in the Hillsdale ponds, and recruitment of undersized to legal sized fish was high. Pond No. 3 was stocked with 67 legal largemouth bass. Anglers removed 28 fish (41.8 percent) and 38 fish remained in the pond at the time of draining. Therefore, it is possible to account for 66 fish, and 67 legal fish were planted. Of course some of the legal fish were undoubtedly derived from the 14 undersized fish (58 fish were planted and only 14 remained at the time of draining) that were planted in this pond. It must also be mentioned at this time that the only food present in the ponds for the largemouth bass were such native food organisms as insects, crayfish and frogs, and the bass and bluegills that were planted. It is reasonable to expect that some legal and

Table 9.--Comparison of the rate of stocking, creel census returns and the number of fish taken from Hillsdale Ponds 3, 4 and 6 at the time of draining - 1946. All weights listed are in pounds.

	Pond No. 3 (4 acres)	Pond No. 4 (6 acres)	Pond No. 6 (16 acres)
<b>Legal Bluegills</b>			
Stocking record - Total number	459	987	2,468
Number per acre	115	164	154
Average weight (pounds)	0.52	0.36	0.34
Total weight	240.25	353.3	845.7
Pounds per acre	60.1	58.9	52.9
Creel census - Total number	125	141	368
Number per acre	31	23	23
Average weight (pounds)	0.61	0.39	0.39
Total weight	75.8	54.4	142.4
Pounds per acre	18.9	9.1	8.9
Draining record - Total number	90	486	538
Number per acre	22	81	34
Average weight (pounds)	0.56	0.39	0.40
Total weight	50.4	189.7	212.9
Pounds per acre	12.6	31.6	13.3
<b>Sublegal bluegills</b>			
Stocking record - Total number	625	229	1,000
Number per acre	156	38	62
Total weight	8.6	17.1	70.9
Pounds per acre	2.1	2.8	4.4
Creel Census - Total number	7	...	10
Total weight	1.0	...	1.2
Draining record - Total number	27	1	8
Total weight	2.6	0.1	0.8
<b>Legal largemouth bass</b>			
Stocking record - Total number	67	62	318
Number per acre	17	10	20
Average weight (pounds)	1.47	1.43	1.07
Total weight	98.5	88.5	338.9
Pounds per acre	24.6	14.7	21.2
Creel Census - Total number	28	23	139
Number per acre	7	4	9
Average weight (pounds)	1.22	1.48	1.21
Total weight	34.2	34.1	167.6
Pounds per acre	8.6	5.7	10.5
Draining record - Total number	38	130	186
Number per acre	9	22	12
Average weight (pounds)	0.97	1.07	0.87
Total weight	37	139.7	161.1
Pounds per acre	9.25	23.3	10.1

Table 9 (Continued)

Sublegal largemouth bass			
Stocking record - Total number	58	106	186
Number per acre	14	18	12
Total weight	7.25	41.25	24.4
Pounds per acre	1.8	6.9	1.5
Draining record - Total number	14	2	33
Number per acre	3	...	2
Total weight	3.7	0.6	7.7
Pounds per acre	0.9	...	0.5

↓<sup>1</sup> 50 adult bluegills (19.7 lbs.) estimated to have been left in pond.

↓<sup>2</sup> 1 largemouth bass (1.0 lbs.) estimated to have been left in pond.

undersized largemouth bass and bluegills were eaten by the larger bass. Each of the ponds at Hillsdale was stocked with at least one bass that weighed between 4 and 5 pounds, plus many 2- and 3-pound fish. Similar figures for Pond No. 4 are as follows: 62 legal largemouth bass planted, 23 (37.1 percent) caught by anglers, 130 removed at draining for a total of 153 legal bass accounted for or a total of 91 more legal fish than were stocked in the pond. Only 104 undersized bass were not accounted for; therefore the recruitment here was extremely high (at least 91 fish) while the loss from predation and natural causes was exceedingly low (no more than 13 fish). The summary for the largemouth bass in Pond No. 6 is as follows: 318 legal fish planted in the pond, 139 (43.7 percent) were caught by anglers and 186 were removed at the time of draining. A total of 325 fish (7 more legal bass than were planted) can be accounted for. Of the 186 undersized bass that were planted, 153 cannot be accounted for. At least seven of these reached legal length during the summer and others among them undoubtedly replaced other legal bass which died of natural causes or of disease.

The known recruitment of undersized to legal largemouth varied in each of the three ponds as follows: Pond No. 3, none (44 not accounted for); Pond No. 4, 91 fish (13 unaccounted for); Pond No. 6, 7 fish (153 unaccounted for). The high percentage of recruitment in Pond No. 4 is partially accounted for because of the large average size of the undersized<sup>fish</sup> at the time of planting. Those in Pond No. 4 averaged 0.39 pounds each while those in Ponds No. 3 and 6 averaged 0.12 and 0.13 pounds each, respectively.

Undersized bluegills could be caught and kept from Ponds No. 3 and 6. Only seven small bluegills were taken from Pond No. 3 and 10

from Pond No. 6. The recruitment of undersized bluegills to the population of legal fish cannot be measured as the bass were in two of the ponds. The number of undersized bluegills present in each pond at the time of draining was as follows: Pond No. 3, 27<sup>fish</sup> (627 stocked); Pond No. 4, 1 fish (229 stocked); and Pond No. 6, 8 fish (1,000 stocked). Natural death and predation by largemouth bass probably accounted for most of this loss, although an unknown number undoubtedly reached legal length during the summer. This is made more complex because of the small number of undersized bluegills that entered the anglers' catch.

Pond No. 4 had the best survival and/or the best recruitment of legal bluegills (Table 9). Besides the undersized bluegills which cannot be accounted for, the following loss of legal bluegills cannot be explained: Pond No. 3, 244 fish (459 stocked); Pond No. 4, 360 fish (987 stocked); and Pond No. 6, 1,562 fish (2,468 fish stocked).

Length measurements were not taken on the bass and bluegills at the time of planting because of the poor condition of most of the fish. But average weights are available because all fish were weighed and counted at the times of planting and draining. The average weights of the fish, as presented in Table 9, are interesting because they give a picture of growth and recruitment unobtainable from other data. Legal bluegills in Pond No. 3 averaged 0.52 pounds each at the time of planting, 0.61 pounds when caught by anglers during the season and 0.56 pounds at the time the pond was drained. Similar figures for the other ponds were: Pond No. 4 - stocking, 0.36 pounds; anglers catch, 0.39 pounds; and draining, 0.39 pounds. Pond No. 6 - stocking, 0.34 pounds; anglers catch, 0.39 pounds; and draining, 0.40 pounds. The increase in the average weight, as evidenced in the anglers catch, may have been due



partly to the growth of the fish. Growth and possibly a light catch of the larger bluegills are probably responsible for the increase in the average weight of the fish at the time of draining in Pond No. 6; growth of smaller fish resulting in recruitment, and mortality of larger fish, for the decrease in average weight for Pond No. 3 bluegills; and recruitment probably accounts for the fact that the average weight of the bluegills in Pond No. 4 was the same at the time of draining as it was for the fish captured by anglers.

Legal largemouth bass in Pond No. 3 averaged 1.47 pounds at the time the pond was stocked, 1.22 pounds each at the time they were caught by anglers, and 0.97 pounds each at the time of draining. In this pond the decrease in the average weight was due to the mortality (probably of the larger fish) and recruitment as the season progressed. In Pond No. 4 the average weight of the bass increased (from 1.43 to 1.48 pounds) from the time of planting until the fish were removed by anglers. This small increase was probably due mainly to growth of the individual fish. The decrease to an average of 1.07 pounds at the time of draining was probably due to the tremendous recruitment that has been discussed in a previous section. The bass in Pond No. 6 also exhibited an increase in the average weight from the time <sup>of</sup> planting until the fish were captured by anglers (from 1.07 to 1.21 pounds) and a heavy decrease in average weight at the time the pond was drained (to 0.87 pounds). The increase in weight exhibited in the anglers catch is probably due entirely to growth while the decrease in weight at the time the pond was drained was probably due to the mortality of the larger bass and recruitment of small fish to legal size.

There were many factors responsible for the unexplainable loss of legal bluegills at the Hillsdale ponds. As was mentioned earlier in this report, there was a tremendous loss of legal bluegills at the time or shortly after the ponds were stocked. It is entirely possible that a large percentage of the legal bluegills unaccounted for at the time of draining actually died and were not recorded before the fishing season opened. Many of these fish may have died and remained on the bottom while others may have been missed in the dense stands of cattails or else were eaten by birds, turtles or crayfish. In the discussion following Table 5, it was mentioned that the figures listed on net stocking in this table could have been too high. Other possible explanations of the loss of fish between the time the ponds were stocked and the time of draining are as follows: (1) Predation by largemouth bass probably accounted for some of the loss of legal and undersized bluegills. (2) It is apparent that natural death occurs daily. A daily trip was made around each pond during the fishing season and dead fish were never observed floating on any pond. But it is possible that birds, turtles, snakes and crayfish could have eaten the fish just before or just after death. The same phenomenon occurs on most of our natural lakes where dead fish are rarely seen. During the week that it took to drain Pond No. 6, it was necessary to walk around the pond a great many times each day, and dead fish were not observed floating on the surface at any time. Yet, when the pond was drained as dry as possible, the writer counted six dead bluegills in various stages of disintegration. It is therefore possible that a great many fish died during the summer and were never observed. (3) There were a number of fish predators present in all of the Hillsdale ponds. Those capable of eating large live fish

were blue herons (three were observed on one pond at least during part of the summer), gulls, and large snapping and leatherback turtles. One snapping turtle of approximately 20 pounds was observed in Pond No. 6 at the time of draining. (4) It was impossible for any of the fish to migrate into or out of any of the Hillsdale ponds because they were tightly screened.

Largemouth bass and bluegills spawned in each of the three ponds that were stocked with legal and undersized fish. A total of 169,619 largemouth bass weighing 1,354.1 pounds and 59,921 bluegills weighing 288.8 pounds were produced in the three ponds (Table 10). In addition to this, 176 largemouth bass weighing 10.1 pounds and 22,312 bluegills weighing 223.1 pounds were raised in Pond No. 5 which had been stocked with the fry of the two species. The total production of young-of-the-year bluegills and largemouth bass in the four Hillsdale ponds amounted to 252,028 fish weighing 1,876.1 pounds.

The production of young bass and bluegills ranged from 48.4 pounds per acre in Pond No. 3 to 76.6 pounds per acre in Pond No. 4 (Table 10). This production was in addition to supporting the legal and undersized bass and bluegills which were present in each pond. Very few young bluegills were produced in Pond No. 6. It is known that bluegills nested in three different places in this pond and that there were over 60 beds in one colony. Largemouth bass usually spawn earlier than bluegills and it is believed that the tremendous numbers of small bass produced kept the numbers of young bluegills down by predation.

The production of young-of-the-year largemouth bass and bluegills is a good example of reproductive potential of these two species in the presence of large numbers of adult fish. It is believed that the

Table 10.--Number and pounds of young-of-the-year bluegills and largemouth bass produced in the Hillsdale ponds in 1946.

	Largemouth bass				Bluegills				Both species	
	Total		Per acre		Total		Per acre		Per acre	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Pond No. 3	4,087	40.9	1,022	10.2	33,944	152.7	8,486	38.2	9,508	48.4
Pond No. 4	44,064	341.5	7,344	56.9	21,477	118.1	3,579	19.7	10,923	76.6
Pond No. 5	176 <sup>↓</sup>	10.1	15	0.8	22,312 <sup>↓</sup>	223.1	1,859	18.6	1,874	19.4
Pond No. 6	121,468	971.7	7,592	60.7	4,500	18.0	281	1.1	7,873	61.8
Total	169,795	1,364.2	...	...	82,233	511.9	...	...	...	...

<sup>↓</sup> Stocked with 100,000 bluegill fry and 1,000 largemouth bass fry

production of young during the summer of 1946 was equally as good, if not better than any previous production at Hillsdale when either bass fry or bluegill fry were stocked in each pond. (Records are not available on the past production of the Hillsdale ponds).

In addition to the largemouth bass and bluegills which were present in each pond at the time of draining, there was an undetermined number and poundage of crayfish, polywogs and Iowa darters in each pond. No effort was made to obtain even an estimate of the number of these forms in any pond containing large fish. But 360 pounds were taken out of Pond No. 5 (30 pounds per acre). Brook trout were present in all of the ponds at Hillsdale as follows: Pond No. 3 - 1 legal trout (3 were also caught by anglers); Pond No. 4 - 1 legal trout; Pond No. 5 - 1 undersized and 5 legal trout; Pond No. 6 - 4 legal trout. Apparently all of the Hillsdale ponds are capable of supporting trout throughout the summer. Pond No. 6 was the only pond containing fish other than bass, bluegills, Iowa darters and trout. In addition to these species, 1 carp, several crappies and golden shiners were taken at the time of draining. Apparently these fish moved into the pond via the outlet stream during the winter of 1945-1946 when the pond was empty.

The standing crop of fish (total number and weight of bass and bluegills only) present in each pond at the time of draining is presented in the following table. These figures are presented at this time because of the importance of such information in indicating the carrying capacity.

Pond	Total Number	Total pounds	Per acre	
			Number	Pounds
Pond No. 3	38,200	287.4	9,550	71.85
Pond No. 4	66,157	789.1	11,026	131.52
Pond No. 6	126,733	1,372.3	7,921	85.79

It is my belief that all of the Hillsdale ponds are capable of supporting more than 100 pounds of fish per acre. Pond No. 4 is not believed to be any more productive than the other ponds. In fact, Ponds No. 5 and 6 should be the most productive ponds at Hillsdale. Ponds No. 3 and 4 are quite similar in the appearance of the water, vegetation and bottom materials. It is too early as yet to draw any conclusions on the carrying capacity of the Hillsdale ponds as several years will be required for this.

In conclusion there are several items of interest that should be mentioned.

(1) Is creel census a measure of the productivity of a body of water? From the preliminary results obtained at Hillsdale it apparently is not. Pond No. 4 had the largest number and the greatest poundage of fish remaining at the time of draining, and yet the catch per hour on this pond was much lower than for Pond No. 6, and the pounds per acre of fish caught was lower than for the other ponds. The fishing pressure was lowest on Pond No. 6, and this pond had the least catch per hour. Pond No. 4 had more unsuccessful anglers than the other two ponds, and yet at the time of draining it contained more fish than the other ponds. The recruitment of undersized fish to the population of legal fish is very important, yet Pond No. 4 which had a high percentage of recruitment had the poorest catch per acre. The type of fishing practiced by most fishermen is extremely important. It is apparent that too many anglers are mere novices at the sport, and their actual presence on a body of water brings the catch per hour down. Many of these anglers would have difficulty in catching a fish <sup>if</sup> it was thrown <sup>^</sup> at them. Better and more efficient methods of catching fish must be

devised if we are to harvest more fish. We do not know how many fish or how many pounds of fish any of our waters are capable of producing nor how many pounds could be harvested. After all, creel census is just one tool that can be used in supplying us with the figures on the number of fish that are actually harvested, and various researches have indicated that this harvest is only a small fraction of the total crop that could be harvested.

(2) In the past, warm-water fish hatcheries have been described as great factories for producing fish. The per acre production of 48.4, 61.8 and 76.6 pounds of young largemouth bass and bluegills in ponds that were heavily fished is a good example of just what can be produced in the presence of large numbers of adult fish. That this also occurs in many natural lakes has been proven by our seining operations during past years. This production is equally as good as that obtained in hatchery rearing ponds in past years when the ponds were stocked with the fry of only one species of fish. The young-of-the-year bass are capable of eating large numbers of young-of-the-year bluegills and bass and yet it was possible to obtain very high production figures of both species in the Hillsdale ponds in 1946.

(3) Despite the fact that there was no creel limit on legal bluegills in two of the Hillsdale ponds, not one angler took more than 15 bluegills from either pond. Also, only 17 undersized bluegills were kept by anglers from the two ponds on which size limits had been removed. It is doubtful whether size and creel limits if removed from all lakes would make a great deal of difference one way or another in the total production of fish. Most fishermen will take no more fish than they can use. Likewise fish that are smaller than the legal limit are

not attractive to most anglers who claim that there is not enough meat on one small bluegill to make it worthwhile to clean them.

(4) A total of 2,228 anglers fished the Hillsdale ponds during 1946 as follows: 571 fished the trout pond; and 1,657 fished the bass-bluegill ponds. This indicates that the experiments were quite popular and justify their continuance.

The Hillsdale ponds are open to fishing during the winter of 1946-1947. The number of fish present in each pond as of the first of November, 1946, is presented in Table 11.

All of the ponds at Hillsdale will be drained soon after the ice goes out next spring. Plans call for restocking all of the ponds with a full quota of legal and undersized bluegills and largemouth bass (100 pounds per acre) as soon as draining operations have been completed.

It is recommended that each pond should be stocked with legal and undersized bluegills and largemouth bass to bring the total stocking to 100 pounds per acre. This figure of 100 pounds per acre does not include the young fish of 1946 which are now present in each pond. This recommended stocking is necessary in order that we may compare the 1947 survival and creel census with that of 1946. Trap nets should be used to capture the fish needed for 1947. The following number (see table below) of pounds of fish will be required to stock each pond as recommended. These figures are based upon poundage of fish present in each pond after the fall draining and will be subject to some revision after the ponds are drained this coming spring because the growth (if any), over-winter mortality and the number of fish that may be caught by ice fishermen is not known at present.



Table 11.--Record of the number and pounds of fish stocked in the Hillsdale ponds in the fall of 1946.

Pond	Largemouth bass						Bluegills					
	Legal		Undersize		Young of year		Legal		Undersize		Young of year	
	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds	Number	Pounds
Pond No. 3	38	37.0	14	3.7	7,957	70.9	90	50.4	27	2.6	33,944	152.7
Pond No. 4	130	139.7	2	0.6	36,614	283.7	486	189.7	1	0.1	21,477	118.1
Pond No. 5	...	...	...	...	2,691	26.1	...	...	...	...	11,487	114.8
Pond No. 6	220	179.6	42	10.7	116,468	931.7	848	308.1	25	3.2	15,325	126.2
Total	388	356.3	58	15.0	163,730	1,312.4	1,424	548.2	53	5.9	82,233	511.8

Pond Number	Largemouth bass		Bluegills	
	Legal	Undersized	Legal	Undersized
3	67	32	190	18
4	17	53	170	30
5	312	108	720	60
6	236	133	652	87
Total	632	326	1,732	195

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INSTITUTE FOR FISHERIES RESEARCH

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Figure 4.--Sign at the main entrance to the Hillsdale Managed Fishing Area. The anglers in the picture are just starting to fish on Pond No. 6. Photo by Beckman from a Kodachrome slide.



Figure 5.--Two Hillsdale residents display the fish they caught in pond No. 6 on August 6, 1946. The 10 largemouth bass weighed 9.7 pounds and the 13 bluegills 4.4 pounds. Photo by L. B. Hoodmaker.



Figure 6.--The barefoot boy on the right caught this 20.5 inch,  
4 pound largemouth bass while plug casting in Pond No. 6  
at the Hillsdale Managed Fishing Area. Photo by  
L. B. Hoodmaker.