

Original: Fish Division  
cc: Institute for Fisheries Research  
Education-Game

Dr. Robert C. Ball

INSTITUTE FOR FISHERIES RESEARCH Mr. C. Troy Yoder  
DIVISION OF FISHERIES Mr. Clarence Taube  
MICHIGAN DEPARTMENT OF CONSERVATION Mr. R. S. Marks  
COOPERATING WITH THE  
UNIVERSITY OF MICHIGAN

ALBERT S. HAZZARD, PH.D.  
DIRECTOR

ADDRESS  
UNIVERSITY MUSEUMS ANNEX  
ANN ARBOR, MICHIGAN

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A PROGRESS REPORT FOR 1947 AND 1948 ON THE PRODUCTIVITY-  
STUNTING-SURVIVAL EXPERIMENTS RAN IN HATCHERY PONDS,  
AND PLANS FOR 1949

by

Clarence M. Taube

Stunting of bluegills and of some other fishes is known to occur in a number of Michigan lakes. In an attempt to learn the causes and to find means for correcting this condition, a series of experiments was started in hatchery ponds in the spring of 1946. Additional information these experiments were intended to provide included what combinations of species will give the greatest production per unit of water and whether fast-growing fish experience earlier mortality than fish showing a normal rate of growth. Ponds at the Wolf Lake and Drayton Plains hatcheries and the Almema and Fenton rearing stations were stocked with young bluegills, largemouth bass, and smallmouth bass.

Some of the ponds were stocked with bluegills to produce stunted populations; in time, bass or pike were to be put with the bluegills to reduce the size of these populations and in hope of eradicating the

condition of stunting. Other ponds were stocked for use in the comparative mortality studies and in maximum production studies. The ponds were to be drained in the spring and fall, and the fish weighed, measured, and counted before their return to the water; this procedure was to serve as a periodical inventory providing data on survival, growth, and reproduction for each experiment.

Since the start, various circumstances have altered the original plans for these experiments. Some ponds have been dropped from the program, while the fish populations of other ponds have been moved from their original locations. The comparative mortality study has been abandoned because it is thought that the results of such experiments could have no more than meager application to fisheries management.

This report gives the present status of the investigations, notes data accumulated from the beginning of the program, and outlines plans for the future. Previous Institute reports dealing with the productivity-stunting-survival experiments are No. 1098 and No. 1109. Data on the growth and survival of bluegill fry stocked in hatchery ponds are given in Report No. 763 and have some relation to the current experiments.

During the spring of 1947, the following ponds were drained: Wolf Lake, No. 3, 8, 13, 14, 18, 19, 20, 21, 22 and 23 (the fish from ponds 20 and 21 being moved to Comstock Park (Lydell) ponds 18 and 21, respectively, following this draining); Fenton, No. 2 and 3 (fish combined and moved to Drayton Plains No. 11); and Drayton Plains, No. 7. The four ponds used at the Almena rearing station for this investigation were not drained because the water supply was not adequate at that time to refill them.

During the period of September 30-November 4, 1947, fall draining proceeded on these ponds: Wolf Lake, No. 3, 8, 13, 14, 18, 19, 22, 23; Almena, No. 2, 3, 4, 5; Comstock Park, No. 18 and 21. Pond No. 10 at Wolf Lake, stocked with largemouth bass fry in June, 1947, was not drained because it was thought draining might interfere with a fertilization experiment in an adjacent pond. Pond No. 11 and 9 at Drayton Plains were drained in the fall by the hatchery staff, but No. 7 was not drained.

Pond No. 14 at Wolf Lake was dropped from this experimental series after the 1947 fall draining because too few of the original bluegills remained to make continuation of the experiment worthwhile.

Two tables list numerical data of those ponds that have been in this experimental series at Wolf Lake, Alma, and Comstock Park. In obtaining the length data, random samples of 100, 150 or 200 fish from each population were measured; use of the largest of these numbers henceforth is recommended. Random samples also were weighed to determine the number of fish per pound. The total weight of each population has been obtained at inventory and the total number of fish in most instances has been calculated by using this figure and the number of fish per pound as a basis of calculation.

Although considerable variation in length and weight was evident among the bluegills in the fall of 1947, onset of stunting was shown in only four populations, namely, those of Pond Nos. 8 and 22 at Wolf Lake, No. 5 at Alma, and No. 21 at Comstock Park. The first three ponds are those into which yearlings were introduced in the spring of 1946. It appears certain that stunting of fish in Pond No. 21 occurred early because this population experienced unusually good survival at the beginning. The bluegills of No. 22 appeared near the borderline of normal growth and stunting, whereas in the other three ponds dwarfing was more marked. Dr. W. C. Beckman's data on average length and weight of wild fish in Michigan were employed to determine if stunting had commenced among the experimental fish.

Observations of last fall showed that stunting in bluegills was reflected more clearly by sub-normal weight than by sub-normal length.

The fish of two populations in which it was decided that stunting had begun revealed only little deviation in average length from non-stunted specimens, while deviation in average weight was quite marked. These had an emaciated appearance which rather definitely segregated them from fish showing normal growth. In summary, stunting occurred in all instances within 18 months after yearling bluegills had been stocked at rates intended to result in stunting, and dwarfing of one population took place within 18 months after hatching.

Bluegill populations stocked as yearlings have experienced considerably better survival rates than those stocked as fry. From the time of stocking in the spring of 1946 to the time of draining in the fall of 1947, percentage survival in ponds receiving yearling fish were: No. 8, Wolf Lake, 26 percent; No. 22, Wolf Lake, 46 percent; No. 5, Almena, 47 percent. Percentage survival in ponds receiving fry were: No. 18, Wolf Lake, 0.83 percent; No. 19, Wolf Lake, 2.81 percent; No. 3, Wolf Lake, 8.36 percent; No. 21, Comstock Park, 1.54 percent; No. 18, Comstock Park, 0.7 percent; No. 2, Almena, 11.55 percent; No. 4, Almena, 4.43 percent.

The annual yield of bluegills (adult and young) from the fall of 1946 to the fall of 1947 ranged from a loss of 52.8 pounds per acre in Wolf Lake No. 8 to a gain of 217.4 pounds per acre in Almena No. 2. Excepting No. 8, the populations of all ponds showed a gain in poundage. The annual yield of bass (only fish of original stocking) was 50.6 pounds per acre for smallmouths in Wolf Lake No. 13 and 26.6 pounds per acre for largemouths in Almena No. 3. Of these ponds drained in the spring of 1947, all except one showed overwinter loss; the bluegills of Wolf Lake No. 3 experienced an unexplained gain of 4.7 pounds per acre. (See Table No. 2).

Appreciable numbers of young-of-the-year fish were found in 7 of the 12 bluegill ponds drained in the fall of 1947. Five ponds contained either very few or no young bluegills. Only one of the ponds holding a stunted population, Wolf Lake No. 22, produced young. Besides the other three ponds containing stunted fish, Wolf Lake No. 3 and Almena No. 4 had either very few or no young-of-the-year bluegills when drained. It is not known whether appreciable spawning had not occurred where young did not appear in the fall, or if the spawn and/or fry were eaten by the fish.

As was brought out in Report No. 1098 (Carbine, 1947) it was shown again that sexual maturity among bluegills appears more closely associated with size than age. Six of the populations that produced young in 1947 were stocked as fry in 1946.

An equal poundage of young-of-the-year bluegills was returned to Wolf Lake Pond No. 23 as was removed at draining. No fry were returned to any other pond drained in the fall.

Emerald shiners were stocked by the Wolf Lake Hatchery staff in Pond No. 13, Wolf Lake and Pond No. 3, Almena later in the fall as forage for the bass. The minnows consisted of 480 pounds for each pond, averaging 300 to the pound.

By the spring of 1948 pond space at the Wolf Lake Hatchery was required for other work, mainly experimental propagation of minnows, so in April six ponds were drained there and five of these were dropped from the productivity-stunting-survival series. The usual data were obtained from the fish at the final draining and these, except for Pond No. 10, are included in the accompanying tables. The ponds inventoried were Nos. 3, 8, 10, 13, 19 and 22.

The bluegills from No. 3 were put with those of No. 18 and the bluegills from No. 8 with those of No. 22. Of the bluegills removed from No. 19, a total of 1,974 (individual count) were fin-clipped and stocked in Pond No. 24, which will be opened to public fishing under permit June 25, 1948. No. 22 is the only pond drained this spring that will remain in the program initiated in 1946.

Pond No. 10 held largemouth bass, 7,500 fry having been stocked in June, 1947. On April 7, 1948, there were 14-1/2 pounds of bass, calculated as numbering 2,218 individuals, which averaged 2.6 inches long. In addition there were 25 bass averaging about 6 inches and weighing 3-1/2 pounds. All of these fish were to be stocked in Merkle Lake, Jackson County. This population originally had been intended for use in comparative mortality studies.

The smallmouth bass from Pond No. 13 were stocked in Ransom Lake, Newaygo County as an introduction experiment.

With one exception, comparison of length and weight figures of last fall and this spring showed a less in weight and virtually no increase in length over winter of fish from the ponds inventoried in April, 1948. The exception was Pond No. 3 in which a moderate over-winter growth apparently occurred. The same was true for this pond last year. Presumably this was due to some environmental condition or conditions. Two factors possibly contributing to growth here in late fall and winter are noted: (1) No. 3 being nearer the spring which serves as the main source of the hatchery water supply, the water here remains warmer than that in the other experimental ponds during the onset of cold weather. (2) Gross examinations of the basins has indicated that appreciably more burrowing mayfly nymphs occur in this pond than in the others.

How a protracted period of low temperatures may affect the growth and condition of some fishes was aptly shown by the smallmouth bass from Pond No. 13. Although only 103 fewer bass were recovered this spring than last fall, the population as a group had lost exactly 100 pounds overwinter. This occurred despite an abundance of emerald shiners that were available to the bass as food. It was estimated that about 300 pounds of shiners remained at the last draining. Less of weight overwinter of individual fish was shown from random samples of these bass and of the bluegills from three of the four bluegill ponds drained this spring.

The three ponds of this experimental series at the Drayton Plains Hatchery also were drained in the spring of 1948. These were No. 7, 10 and 11, all of which were dropped from the experiments after this draining. The fish were to be stocked in public waters, excepting green sunfish and pumpkinseed sunfish. The data for these ponds are summarized in Table 3.

Ponds No. 9 and 11 were drained by the hatchery staff in the fall of 1947, and weights and estimated counts taken. The largemouth bass from No. 9 and the bluegills from No. 11 were to have been stocked in the fall, but after they were kept in holding ponds for about a month the bluegills were returned to No. 11 and the bass put into No. 10.

The bluegills of ponds 7 and 11 showed a marked degree of stunting this spring. The state average for Age Group II bluegills is 4.3 inches, but these that were about 22 months old were less than 3 inches long.

Due to difficulties in draining No. 11, an estimated 1,000 bluegills were not recovered and these are not included in the total given in the table.

The sunfish in Pond No. 7 were sorted from the bluegills and weighed separately. It was estimated that the mixture of pumpkinseed and green sunfish consisted of about 95 percent pumpkinseeds.

Appreciation is expressed to Messrs. Henry Hatt, Harold Hughes, Claude Lydell, and personnel of the Wolf Lake, Drayton Plains and Lydell hatcheries for their assistance and cooperation with these experiments. Various members of the Institute staff have helped in handling the fish and collecting data, and their efforts likewise are acknowledged.

#### Plans for 1949

Present intentions are that the ponds remaining in the productivity-stunting-survival experiments will not be drained again until the spring of 1949. At that time a predator species will be put with some populations in an attempt to control stunting. Species combinations may be tried in other ponds to learn which of these combinations are more productive. Possibly brood stock of black crappies, rock bass, and perhaps other species may be put into ponds at the Drayton Plains Hatchery in the spring of 1948 for providing experimental stock for such studies.

It is suggested that in the future when these experimental ponds are inventoried the young fish be sorted and returned to the ponds as soon as possible, if their return is desired. Young-of-the-year stock is especially sensitive to handling and holding in hatchery tanks, and



considerable loss of this class has occurred in the past, presumably mostly due to holding under unnatural conditions. It is planned for next spring that whatever young bluegills will have been produced in ponds where experiments on stunting are progressing, the young will be returned to the ponds after inventory.

While it is thought that worthwhile information on production, survival, and some aspects of stunting has been obtained to date from these experiments, their future value appears to have certain limitations. For this reason additional ponds may be dropped from the program if their experimental value decreases or if more urgent use is found for them.

INSTITUTE FOR FISHERIES RESEARCH

Clarence M. Taube  
Fisheries Biologist I

Approved by: A. S. Hazzard

Typed by: S. E. Putman

Pond	Type of experiment	Pond area (acres)	Rate of stocking per acre	Number stocked	Pounds Fall, 1946
Wolf Lake #13	Productivity (S.M. Bass)	5.15	4,851 <sup>2</sup> / <sub>5,000</sub> (fry)	25,000 6-28-46 <sup>1</sup>	329.5 10-1-46 <sup>1</sup>
Wolf Lake #14	Stunting (B. gills)	3.55	21,887 (fry) 25,000	77,700 6-9-46	73.5 10-3-46
Wolf Lake #18	Stunting (B. gills)	3.83	91,383 (fry) 100,000	350,000 6-17-46	259.0 9-30-46
Wolf Lake #19	Stunting (B. gills)	3.40	51,470 (fry)	175,000 6-19-46	207.0 10-3-46
Wolf Lake #22	Stunting (B. gills)	2.10	100 lbs. (yearlings)	28,130 4-5-46	710.0 10-4-46
Wolf Lake #23	Stunting (B. gills)	4.67	44,111 (fry) 50,000	206,000 6-19-46	610.0 9-26-46
Wolf Lake #3	Stunting (B. gills)	0.85	24,941 (fry) 25,000	21,200 6-19-46	20.0 9-25-46
Wolf Lake #8	Stunting (B. gills)	0.90	200 lbs. (yearlings)	27,100 4-5-46	215.0 9-25-46
Almena #5	Stunting (B. gills)	1.50	150 lbs. (yearlings)	30,500 4-5-46	314.25 10-7-46
Almena #4	Stunting (B. gills)	3.00	150,000 (fry) 150,000	450,000	181.7 10-10-46
Almena #3	Productivity (L.M. bass)	5.50	24,909 (fry) 25,000	137,000 6-10-46	184.2 10-14-46
Almena #2	Productivity (B. gills)	4.00	25,000 (fry)	100,000 6-17-46	248.2 10-15-46
Wolf Lake #21 and Lydell #21	Stunting (B. gills)	2.20 2.64	106,818 (fry) 100,000	235,000 6-19-46	285.0 9-24-46
Wolf Lake #20 and Lydell #18	Stunting (B. gills)	2.34 1.81	132,478 (fry) 150,000	265,000 6-19-46	122.0 9-24-46

1 Dates of stocking and draining.

2 The first figure of this column represents the actual rate of stocking, the second the proposed rate.

3 Rate of survival from fall 1946 to fall, 1947

Table 1

LENGTH, WEIGHT, NUMBER, & PERCENTAGE DATA ON FISH FROM PRODUCTIVITY-STUNTING-SURVIVAL EXPERIMENT  
PONDS AT THE WOLF LAKE & LYDELL HATCHERIES & THE ALMENA REARING STATION

Number of fish	Percent survival	Pounds, spring, 1947	Number of fish	Percent survival	Av. (mean) length (inches)	Pounds, fall, 1947	Number of fish	Percent survival
7,174	28.7	204.0	4,712	65.7	4.78	590.0 9-30-47 <sup>4</sup>	2,765	58.7
2,910	3.8	1.75	69	2.4	3.36	42.5 10-2-47	160 <sup>4</sup>	...
20,610	5.9	89.75	4,905	23.8	3.04	344.75 10-3-47	3,792	77.3
14,530	8.3	61.5 4-28-47	3,568	24.5	3.07	508.5 10-17-47	4,932 <sup>4</sup>	...
24,990	88.8	472.0 4-24-47	18,594	77.5	3.79	564.75 10-14-47	12,952	69.6
63,190	30.7	447.0 4-30-47	41,990	66.4	2.67	1,312.5 10-1-47	28,875	68.8
1,780	8.4	24.0 5-1-47	1,731	97.2	2.88	121.5 11-4-47	1,774 <sup>4</sup>	...
25,499	94.1	90.0 5-1-47	8,109	31.8	2.75	167.5 11-4-47	7,052	86.9
20,260	66.4					455.75 10-16-47	14,584	...
36,400	8.1		The Almena ponds were not drained in the spring of 1947			548.75 10-21-47	19,974	...
10,392	7.6					330.75 10-27-47	3,828	...
13,877	13.9					955.25 10-29-47	11,558	...
81,040	34.5	156.0 4-14-47	40,201	50.0	2.04	453.25 10-22-47	36,260	90.2
6,560	2.5	44.75 4-11-47	2,822	43.0	3.35	139.5 10-23-47	1,855	65.7

<sup>4</sup> Possibly incomplete recovery from these ponds in the spring accounted for greater numbers in the fall.

<sup>5</sup> Incomplete recovery from this pond in the fall accounted for a greater number in the spring.

3

Percent survival, fall to fall.	Av. (mean) length (inches)	Young-of-the-year (pounds)	Young-of-the-year (number)	Pounds, spring, 1948	Number of fish	Percent survival	Av. (mean) length (inches)
38.5 <sup>3</sup> ✓	7.62	...	...	490.0 <sup>1</sup> ✓ 4-6-48	2,721	98.4	7.61
5.5	6.83	231.5	226,407	...	...	...	...
18.4	5.06	186.0	356,450	...	...	...	...
33.9	5.42	14.75	...	201.0 4-1-48	1,997	40.0	5.48
51.8	4.37	209.0	65,626	396.0 4-2-48	9,900	76.4	4.39
45.7	4.25	101.5	65,670	...	...	...	...
99.6	4.65	...	Very few	87.0 4-8-48	1,201	67.7	4.90
27.6	3.50	...	Very few	149.5 4-7-48	7,236 <sup>5</sup> ✓	...	3.46
72.0	3.84	...	None	...	...	...	...
54.9	3.74	...	None	...	...	...	...
36.8	6.08	...	None	...	...	...	...
83.3	5.20	163.0	161,370	...	...	...	...
44.7	2.96	...	None	...	...	...	...
28.3	4.28	91.5	131,260	...	...	...	...

Pond	Type of experiment	Pond area <sup>1</sup> (acres)	Pounds per acre, Fall, 1946	Number fish per pound	Number fish per acre	Pounds per acre, spring, 1947	Number fish per pound
Wolf Lake #13	Productivity (S.M. bass)	5.15	64.0	21.8	1,393	39.6	23.0
Wolf Lake #14	Stunting (B. gills)	3.55	20.7	39.6	819	0.5	39.1
Wolf Lake #18	Stunting (B. gills)	3.83	67.6	79.6	5,382	23.4	54.0
Wolf Lake #19	Stunting (B. gills)	3.40	60.9	70.2	4,273	18.0	57.0
Wolf Lake #22	Stunting (B. gills)	2.10	338.0	35.2	11,900	224.7	39.1
Wolf Lake #23	Stunting (B. gills)	4.67	130.6	103.6	13,531	95.7	105.0
Wolf Lake #3	Stunting (B. gills)	0.85	23.5	89.0	2,094	28.2	71.0
Wolf Lake #8	Stunting (B. gills)	0.90	238.9	118.6	28,332	100.0	90.0
Almena #5	Stunting (B. gills)	1.50	209.5	64.5	13,512	The Almena Ponds were not drained in the spring 1947	
Almena #4	Stunting (B. gills)	3.00	60.6	200.4	12,173		
Almena #3	Productivity (L.M. bass)	5.50	33.5	56.4	1,889		
Almena #2	Productivity (B. gills)	4.00	62.1	55.9	3,469		
Wolf Lake #21 & Lydell #21	Stunting (B. gills)	2.20 2.64	130.9	281.4	36,836	70.9	257.0
Wolf Lake #20 & Lydell #18	Stunting (B. gills)	2.34 1.81	52.1	53.8	2,803	19.1	62.0

- <sup>1</sup> Acreage of Wolf Lake and Almena ponds subject to alteration, pending more accurate calculation from maps now being made.
- <sup>2</sup> Denoting total increase in weight from spring, 1947 to fall, 1947, of fish from original stocking plus weight of any young-of-the-year fish of that species.
- <sup>3</sup> Denoting total increase in weight from fall, 1946 to fall, 1947 of fish from original stocking plus weight of any young-of-the-year fish of that species.
- <sup>4</sup> A gain of 4.7 pounds per acre in this pond, the only instance in which an overwinter gain occurred.

Table 2

RATE OF PRODUCTION PER ACRE IN PRODUCTIVITY-STUNTING-SURVIVAL EXPERIMENT PONDS AT THE  
WOLF LAKE & LYDELL HATCHERIES & THE ALMENA REARING STATION

Number fish per acre	Pounds original fish per acre, fall, 1947	Number fish per pound	Number fish per acre	Pounds blue-gill young per acre	Number blue-gill young per pound	Pounds other organisms per acre
915	114.6	4.6	537	66.3	620	5.0 (B. gills 3 - 6")
19	11.9	3.7	45	65.2	864	0.4 (Perch)
1,280	90.0	11.0	990	48.5	978	...
1,049	149.5	9.7	1,450	4.3	1,600	414.6 (tadpoles and crayfish)
9,025	268.9	22.9	6,167	99.5	...	29.9 (other fish)
8,991	281.0	22.0	6,183	21.7	314	7.5 (crayfish)
2,036	142.9	14.6	2,087	Trace	647	3.8 (crayfish)
9,010	186.1	42.1	7,835	Trace	...	...
	303.8	32.0	9,722	None	...	2.9 (other fish)
	182.9	36.4	6,658	None	...	16.4 (crayfish and tadpoles)
	60.1	12.4	696	...	...	125.0 (tadpoles)
	238.8	12.1	2,889	40.7	990	3.3 (large B. gills)
18,273	171.6	80.0	13,734	None	...	20.3 (L.M. bass)
1,206	77.1	13.3	1,024	50.5	368	21.5 (L.M. bass)
					1,830	2.1 (other fish)
						0.9 (crayfish)
						8.6 (other fish)
						189.6 (tadpoles and crayfish)
						2.8 (large B. gills)
						0.5 (crayfish)
						3.5 (other fish)
						55.6 (crayfish)

Winter loss pounds per acre, fall 1946 - spring 1947	Summer's yield pounds per acre, fall 1947	Annual yield pounds per acre, fall to fall	Pounds per acre, spring 1948	Number fish per pound	Number fish per acre	Winter loss in weight (pounds) per acre of original fish
24.4	75.0 <sup>2</sup>	50.6 <sup>3</sup>	95.1	5.5	528	19.5
20.2	76.6	56.4	...	...	...	...
44.2	115.1	70.9	...	...	...	...
42.9	135.8	92.9	59.1	9.9	587	90.4
113.3	143.7	30.4	188.5	25.0	4,714	80.4
34.9	207.0	172.1	...	...	...	...
(Note 4)	114.7	119.4	102.3	13.8	1,412	40.6
138.9	86.1	-52.8	166.1	48.4	8,040	20.0
...	...	94.3	...	...	...	...
...	...	122.3	...	...	...	...
...	...	26.6	...	...	...	...
...	...	217.4	...	...	...	...
60.0	...	...	...	...	...	...
	115.1	40.7	...	...	...	...
33.0	...	...	...	...	...	...
	108.5	76.1	...	...	...	...

TABLE 3.--LENGTH, WEIGHT, AND NUMBER DATA ON FISH FROM PRODUCTIVITY-STUNTING-SURVIVAL PONDS

AT THE DRAYTON PLAINS HATCHERY

Pond	Type of experiment	Pond area (acres)	Rate of stocking per acre	Number stocked	Pounds, fall, 1946	Number of fish	Pounds, spring, 1947	Number of fish	Av. (mean) length (inches)	Pounds, fall, 1947	Number of fish	Pounds, spring, 1948	Number of fish	Av. (mean) length (inches)
7	Stunting (B. gills)	6.48	25,463 (fry)	165,000 <sup>1</sup> 6-27-46 <sup>1</sup>	227.0	91,731 <sup>2</sup> 10,192	324.0 5-12-47 <sup>1</sup>	107,568 <sup>3</sup>	1.84	Pond not drained		641.75 <sup>2</sup> 129.75 4-22-48 <sup>1</sup>	51,340 <sup>2</sup> 6,487	2.97
11	Stunting (B. gills)	7.72	yearlings numbering 99,025 fish & weighing 106 pounds --	stocked from Fenton No. 2 & 3, spring, 1947										
9 & 10	Survival (L.M. bass)	6.72(9) 7.13(10)	5,000 (fry)	33,750 <sup>4</sup> 6-30-47	...	...	...	...	...	679.5 9-47	40,780	204.5 4-21-48	18,158	2.95
										75.0 10-47	10,125	6.75 4-20-48	776	2.63

<sup>1</sup> Dates of stocking and draining.

<sup>2</sup> The upper figure refers to bluegills, the lower to pumpkinseed and green sunfish.

<sup>3</sup> Evidently some additional fish had been put into this pond since the fall draining, accounting for the increased number; the sunfish and bluegills were counted together.

<sup>4</sup> Stocked in No. 9 and transferred to No. 10, fall, 1947.