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FINAL REPORT ON THE SUCCESS OF RATES AND RATIOS IN KENTUCKY FARM PONDS

by

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ABSTRACT

A series of ponds was stocked with the following rates: 30:400, 50:500, 80:500, and 100:500 (largemouth bass fry: fingerling bluegill) per acre and 100:30, 100:50, and 100:70 (largemouth bass fry: adult bluegill) per acre in 1952, 1953, 1954, and 1955. In addition a series of ponds was stocked with the following rates in 1953, 1955, and 1956: 50:300, and 50:600 (largemouth bass fry: fingerling shellcracker) per acre and 50:300 + 400, and 50:600 + 400 (largemouth bass fry: shellcracker fingerlings + Gambusia) per acre. Each pond was investigated annually to determine the degree of success of these rates as evidenced by the percentage of balanced ponds.

Little difference in percentage of success was found among the following bass-bluegill rates: 80:500, 100:500, 100:30, 100:50, and 100:70. These differences appeared to be influenced by environmental factors.

The most successful bass-shellcracker rate could not be determined. There were indications that the shellcracker does not provide sufficient forage to promote good bass growth in most ponds. However, very few ponds became overpopulated with shellcrackers.

The most serious problem encountered was the invasion of ponds by wildfish and the subsequent overpopulation of forage.

INTRODUCTION

Accepted stocking rates and ratios successful in other areas, have failed to produce satisfactory results in Kentucky ponds. In November of 1951, the Department of Fish and Wildlife Resources initiated a project, as part of the Federal Aid to Fisheries program, designed to aid in establishing more successful rates and ratios for Kentucky farm ponds.

The project was divided into 2 phases. The first phase, was completed in 1953 and the findings were published in 1955 by Smith, Kirkwood, and Hall. A brief history of Kentucky's farm pond program was presented in this report and will not be repeated here but will be used in reference.

The first phase and part of the second phase of the project were under the leadership of William A. Smith, Jr. The author of the present report became project leader on March 1, 1956.

The second phase of the project consisted of investigations to determine the success of various rates and ratios of largemouth bass,

Micropterus salmoides, and bluegill, Lepomis macrochirus, and of largemouth bass and shellcracker (red-ear), Lepomis microlophus, in Kentucky farm ponds. To accomplish this, a series of bass-bluegill combinations were stocked in each of the following years: 1952, 1953, 1954, and 1955. A series of bass-shellcracker combinations were stocked in 1953, 1955, and 1956. Each pond was investigated once each year (a few exceptions will be discussed later) from the time of stocking until the termination of the project in April, 1958.

In this report data collected from investigations of the bass-bluegill series will be presented separately from data collected from the bass-shellcracker investigations.

MATERIALS AND METHODS

Selection of Rates

The rates and ratios listed below were selected in the following manner: Meetings were held by Kentucky fishery personnel and personnel from other states and several rates were suggested; several rates that had been successful in Kentucky and other states were examined; rates that had been successfully used by the U. S. Fish & Wildlife Service were examined and recorded, and data collected during the first phase of the project was evaluated. After analysis and evaluation of the data from these sources the following rates were selected.

Rate			Ratio (Approx.)
Largemouth bass fry	:	Fingerling bluegill	
30	:	400	1:13
50	:	500	1:10
80	:	500	1:6
100	:	500	1:5
Largemouth bass fry	:	Adult bluegill	
100	:	30	3:1
100	:	50	2:1
100	:	70	1½:1

Data collected during the first phase of the project revealed that many marginal ponds tend to become overpopulated with bluegill when stocked with this species. It was suggested that this type of pond might be more successful if stocked with bass-shellcracker combinations. The following combinations were then added to the study:

Rate			Ratio
Largemouth bass fry	:	Shellcracker fingerling	
50	:	300	1:6
50	:	600	1:12
50	:	300 + 400 Gambusia	
50	:	600 + 400 Gambusia	

Past results indicated that shellcracker did not produce sufficient forage during the first summer to promote the desired growth of bass, therefore, mosquito fish, Gambusia affinis, was thereafter added to 1/2 the ponds stocked in order to supplement the bass food supply. All rates were stocked on a per acre basis.

Soils Region Division

The state was divided into 6 major soils regions, Fig. 1, and the designated rates were distributed throughout these regions.

These regions are:

1. Jackson Purchase: The Purchase consists of that portion of Kentucky lying west of the Tennessee River. Here most of the soils are derived from loess which ranges from 2 to 20 feet in thickness, and if unlimed are moderately to strongly acidic. They are low in phosphates but not as much so as the other soils outside of the Bluegrass area.

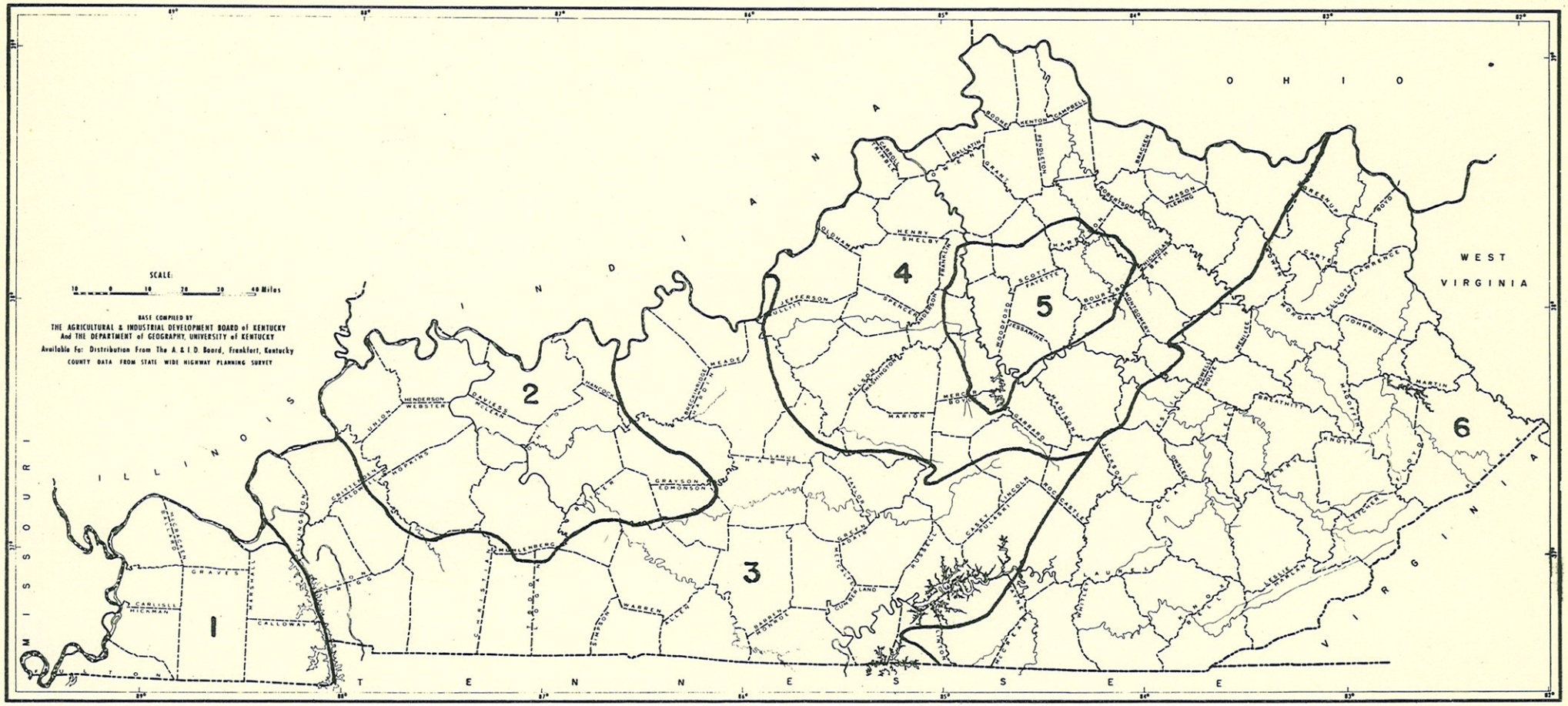
2. Western Coalfields: In this region the upland soils are derived from sandstone and shale. They are low in phosphates and usually moderately to strongly acidic. Considerable loess has been deposited in that part of the area adjacent to the Ohio River, but this and the overflow area contain few farm ponds.

3. Pennyroyal: The soils of this region are derived from sandstone, shales and limestone, either singly or in various combinations. All are slightly to strongly acidic and low in phosphates. The topography is generally sloping to hilly.

4. Outer Bluegrass: In this region the topography is rolling to hilly. The soil is derived from limestone and calcareous shales, with the latter predominating in the outer sections. The majority of the soils range from slightly to moderately acidic.

5. Inner Bluegrass: This region is well known for its productive soils derived from phosphatic limestone. Topographically it consists of gently rolling upland.

Fig. 1. MAJOR PHYSICAL DIVISIONS OF KENTUCKY



Legend

1. Jackson Purchase
2. Western Coalfields
3. Pennyroyal
4. Outer Bluegrass
5. Inner Bluegrass
6. Eastern Coalfields

6. Eastern Coalfields: This region is typified by rugged and partly mountainous topography with very little bottom land. The soils are derived from sandstone and some shales. The greater portion of the area is in forest and not suitable for agriculture. Very few farm ponds are located in this section, most of them being confined to a few southern counties.

Selection of Ponds

The ponds for the 1952 series were selected directly from stocking applications received by the Department in 1951. This method proved to be unsatisfactory because of errors in size estimations by owners or conservation officers, who collected this data, and because many ponds were found to be inaccessable. It was decided that all ponds to be stocked in 1953 and thereafter would first be inspected by project personnel.

Ponds were selected during the fall and winter preceeding each stocking series. Each month all new stocking applications were examined and ponds over 1/2 acre were recorded along with names and addresses of owners. Conservation officers, in the counties where the ponds were located, were contacted and a meeting was arranged between project personnel and the pond owners.

The purpose of the meeting was explained to the pond owner and permission was obtained to use the pond for experimental purposes. The pond was then inspected to see if it satisfied the following conditions: It must contain no fish, either being newly constructed or renovated; it must be classified as manageable or marginal (see classification of ponds); it must be between 1/2 and 15 acres in size (later reduced to 8 acres) as measured by pacing to the nearest 0.1 acre; it must be fairly easy to seine; it must be readily accessable.

If the pond or ponds were found satisfactory, the inspecting party explained to the owner that the pond would be placed on a special stocking list and that fishery personnel would bring the fish directly to the pond instead of to a centrally located spot in the county as was the usual procedure on regular stocking deliveries. The location of the pond and other pertinent information was recorded and a crude map of directions to the pond was drawn. This map was found to be very valuable in locating ponds later, especially when the C. O. was not available.

After all ponds had been selected, the locations were classified as to soils regions and the stocking rates were distributed among the six regions.

Classification of Ponds

Manageable Ponds

1. Adequate depth for continuous growth and carry-over of fish through periods of low rainfall (depends on water supply).
2. A relatively stable water level.
3. Moderate to nonexistent overflow of water from pond.
4. Absence of large areas of extremely shallow water.
5. Clear water except following extremely heavy rains.

Marginal Ponds

1. Inadequate depth for continuous growth of bass and bluegill during moderately dry periods.
2. Widely-fluctuating water level.
3. Subject to heavy overflow of water during winter and early spring, resulting in an excessive loss of nutrients and adult fish.
4. Extensive areas of shallow water that hamper predator control of forage species and promote growth of emergent weeds.
5. Moderate siltation resulting in retardation of bass and bluegill growth, bass reproduction not being greatly affected.

Unmanageable Ponds

1. Inadequate depth for carry-over of the bass-bluegill population during prolonged periods of little or no rainfall.
2. Extreme water level fluctuation such that bluegill and/or bass growth is severely retarded for prolonged periods.
3. Pond subject to heavy overflow of water during major portion of growing season, resulting in severe loss of adult fishes and nutrients.
4. Major areas of pond consisting of water too shallow for efficient control of emergent and submergent weeds.
5. Extreme siltation resulting in severely retarded growth of bass and bluegill and greatly curtailed or suspended bass reproduction.

Stocking

All ponds were stocked with bass-bluegill combinations in the spring, except the 1952 series, of which 50% were stocked with bluegill in the fall and bass the following spring. Bluegill were stocked in March and April and bass were stocked in May of the same year. All fish were hand counted and delivered directly to the pond by fishery personnel.

Bluegill stocked in the spring as fingerlings were 2-3 inches in length and those stocked as adults were 4-6 inches. Bass were stocked as advanced fry (about 1" in length).

Bass-shellcracker combinations were stocked in the same way, except that only fingerling shellcracker were used, and they were stocked in the fall (October thru December). Bass fry were stocked the following spring. Gambusia were added to the ponds at approximately the same time as the shellcracker.

Bluegill and shellcracker stock for the 1952, 1953, and 1954 series were obtained from the U. S. Fish and Wildlife Service Hatchery at Corning, Arkansas, and from private ponds. Bass were obtained from state-owned hatcheries except in 1953, when they were secured from a Michigan hatchery. Stock for the 1955 and 1956 series were obtained from the U. S. Fish and Wildlife Service Hatchery at Frankfort, Ky. Gambusia were raised by project personnel in private ponds near Louisville, Ky.

At the time of each stocking, the level of the pond was recorded. Also, any defects, such as leaks or spillway damage, that had occurred since the original inspection were noted.

Collection of Data

The collection of field data began about the second week in June or just after the bluegill started spawning and ended around September 30. Ponds in the 1954, 1955, and 1956 series were test-seined the first (initial) summer following stocking. In this way the presence of adult fishes, other than those stocked, that had entered the pond from the watershed or drainage area would usually be detected. This first summer's test seining could not be done in 1952 and 1953 because of the time needed for other phases of the project.

Investigations were conducted each year by two field teams, consisting of a biologist and field assistant each. Populations were examined with a 1/4 inch mesh, 30' x 6', minnow seine; a small mesh fry seine, 8' x 4', made of bobbinet cloth, and a $1\frac{1}{4}$ inch mesh seine, 75' x 10' (this seine was not used in the 1956 and 1957 seasons except to collect scale samples for the growth study). In each pond, 3 hauls, averaging 40 feet of shoreline in length, were made with the 30 foot seine; 5 hauls, averaging 10 feet of shoreline, were made with the fry seine, and 2 hauls, averaging 100 feet of shoreline, were made with the 75 foot seine. The length of these seine hauls varied somewhat because of the size and topography of the ponds. Numbers and size groups for each species in each seine haul were recorded and the pond was classified as balanced, overpopulated with bluegill, or overpopulated with bass at that time. Other pertinent information that might aid in population analysis was also recorded. Figure 2, shows the type of form used to record this data.

It is generally agreed that there are many degrees of balance and unbalance in ponds and no definite combinations of numbers can be set to designate this degree of balance. In these investigations, however, the range of numbers generally found in balanced ponds was between 6 and 25 intermediate bluegills and 2 or more young-of-the-year bass per drag of the 30 foot seine. In the fry seine the range was between 50 and 1000 fry bluegill per drag. Bluegill between 2 and 5 inches long were classified as intermediates and fry bluegill refers to any bluegill 1 inch or less.

Ponds were classified as balanced when an adequate number of young bass and young bluegill, along with a moderate number of intermediate bluegill, were found to be present as evidenced by the seine hauls.

Ponds were classified as being overpopulated with bluegill when either adequate bass or bluegill young were not captured by the seines and an over-abundance of intermediate bluegill were present.

Ponds were classified as being overpopulated with bass when the series failed to capture an adequate number of intermediate bluegill (this is normally due to an over-predation by bass) and therefore there were inadequate replacement of adults which were lost by natural causes.

If the investigators were unable to classify the population as either balanced or unbalanced, the pond was placed in an undetermined category. If a pond could not be classified after two consecutive yearly checks it was discontinued as an experimental pond.

Figure 2. Front Side of Field Data Form

Department of Fish and Wildlife Resources, Frankfort, Kentucky
Farm Pond Investigation
Project F-3-

File No. _____

Soils Group_____ County _____ Size _____ Ratio _____

Name _____ Address _____

Color of Pond _____ Cause _____

Seechi disk reading _____ins. Time _____ Weather Con'd. _____

Present status: Manageable _____ Marginal _____ Unmanageable _____

Reason _____

Present size _____ Present water level _____

Fishing: Good _____ Poor _____ Fishing Effort _____

Species, Number, Length or Weight of Fish Caught _____

_____

Weeds _____

_____

Other influencing factors _____

_____

_____

Analysis of Population:

Bluegill Spawn: Heavy _____ Medium _____ Light _____ Absent _____

Conditions of Adult Blg. _____ No. of Intermediates _____

Bass Spawn: Heavy _____ Medium _____ Light _____ Absent _____

Condition of Adult Bass _____

State of Balance _____ Disposition _____

Reason _____ Scale Sampling _____

Recommendations _____

Remarks _____

_____

Date Checked _____ Investigators _____

Ponds that failed to yield any pertinent information at the time of investigation, or failed to show promise of yielding any such information, were discontinued and were not checked thereafter.

During the first three years of investigation scale samples were collected by the investigators at the time the ponds were test seined, that is, the ponds were visited only one time. During the last two years of investigation, scale samples were collected during August and and September after test seining had been completed.

Scales were taken from a key area on the left side just below the origin of the dorsal fin on all fishes. If ponds were sampled during 2 consecutive years, scales were taken from the right side of the fish the second year in an effort to avoid collecting regenerated scales. Samples were collected from key ponds in every soils regions. All ponds sampled had been stocked two years or longer.

Growth determinations for bluegill were made by using the following formula, Kirkwood, 1956:

$$Lx = Sx \left(\frac{Lt - 0.74}{St}\right) + 0.74$$

Growth determinations for bass were made assuming a direct proportional linear body-scale regression having an intercept of 0.0.

BASS-BLUEGILL INVESTIGATIONS

Rate Distribution

A total of 514 ponds were stocked with bass-bluegill combinations during the 5 year investigation, Table 1. Twenty-four of these ponds were stocked with various rates that were later discontinued. The remaining 490 ponds were all stocked on the 7 rates described earlier in this report.

No ponds were selected from the Jackson Purchase region in 1954, because of the distance of this region from the central office. In 1955 ponds were selected from this region again in order to get a maximum number of ponds.

History of the 1952 Series

In this series 89 ponds were stocked. About 1/2 of these ponds were stocked with bluegill in the fall of 1951 and bass the following spring. The other 1/2 were stocked with both bass and bluegill in the spring of 1952. A history of this series is shown in Table 2.

Table 1. Rate Distribution of Bass-Bluegill Ponds

Soils Regions	Series	Rates 30:400	50:500	80:500	100:500	100:30	100:50	100:70	Totals
Outer Bluegrass	52	1	4	-	1	4	6	4	20
	53	4	6	3	4	7	7	4	35
	54	7	4	5	4	5	5	5	35
	55	12	14	10	11	11	15	12	85
Inner Bluegrass	52	1	1	1	-	5	-	6	14
	53	1	1	-	1	1	1	3	8
	54	3	1	2	3	2	1	3	15
	55	2	1	1	2	4	2	1	13
Eastern Coalfields	52	-	4	3	1	5	6	6	25
	53	-	1	1	1	5	5	3	16
	54	3	2	2	3	3	4	3	20
	55	5	6	5	5	4	5	5	35
Western Coalfields	52	1	-	1	1	-	-	-	3
	53	1	1	2	1	1	-	-	6
	54	2	2	2	1	2	2	2	13
	55	3	4	4	5	3	3	3	25
Pennyroyal	52	3	-	5	6	2	2	1	19
	53	2	-	4	3	1	-	1	11
	54	2	2	3	3	3	2	2	17
	55	8	7	10	10	6	10	9	60
Jackson Purchase	52	1	1	-	1	-	-	1	4
	53	-	-	-	-	-	1	1	2
	54	-	-	-	-	-	-	-	0
	55	1	2	1	-	2	2	1	9
All Regions	52	7	10	10	10	16	14	18	85
	53	8	9	10	10	15	14	12	78
	54	17	11	14	14	15	14	15	100
	55	31	34	31	33	30	37	31	227
Totals		63	64	65	67	76	79	76	490

Table 2. History of the 1952 Series

Status in 1953, 89 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	3 (60%)	7 (64%)	1 (100%)	11 (65%)
Overpop. Blg.	1 (20%)	4 (36%)	-	5 (29%)
Overpop. Bass	1 (20%)	-	-	1 (6%)
Not checked			11	11
Undetermined			10	10
Discontinued*			-	-
Totals:	5	11	22	38

* No ponds were discontinued in 1953.

Status in 1954, 89 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	7 (64%)	3 (38%)	1 (17%)	11 (44%)
Overpop. Blg.	3 (27%)	4 (50%)	1 (17%)	8 (32%)
Overpop. Bass	1 (9%)	1 (13%)	4 (67%)	6 (24%)
Not checked			2	2
Undetermined			2	2
Discontinued			60	60
Totals:	11	8	70	89

Status in 1955, 29 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	1 (25%)	4 (50%)	2 (50%)	7 (44%)
Overpop. Blg.	3 (75%)	3 (38%)	-	6 (38%)
Overpop. Bass	-	1 (13%)	2 (50%)	3 (19%)
Not checked			2	2
Discontinued			11	11
Totals:	4	8	17	29

Status in 1956, 18 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	3 (38%)	3 (50%)	-	6 (43%)
Overpop. Blg.	4 (50%)	2 (33%)	-	6 (43%)
Overpop. Bass	1 (13%)	1 (17%)	-	2 (14%)
Discontinued			4	4
Totals:	8	6	4	18

Status in 1957, 14 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	-	3 (50%)	1 (33%)	4 (31%)
Overpop. Blg.	3 (75%)	1 (17%)	1 (33%)	5 (39%)
Overpop. Bass	1 (25%)	2 (33%)	1 (33%)	4 (31%)
Undetermined			1	1
Totals	4	6	4	14

In the following tables of histories, the ponds are classified into three groups--manageable, marginal, and unclassified. The unclassified category contains those ponds (either manabeable or marginal) from which data was collected but could not be accurately compared with the data collected from the other manageable and marginal ponds. These unclassified ponds were extremely weedy, had very little shallow area (not enough for adequate bluegill reproduction) or were larger or smaller than was reported in the original write-up sheet, therefore, not accurately stocked.

The ponds listed as "not checked", were ponds that the investigators were unable to visit because of impassable roads or barriers, or in one or two cases were overlooked when the summer work schedule was planned. These ponds were investigated the following year, if possible, and if they were found to be inaccessable again they were discontinued as experimental ponds.

History of the 1953 Series

The 1953 series contained 98 ponds, Table 3. Several ponds in this series and the following series were discontinued primarily because of fish kills or renovation at the owner's request. For this reason the total figures are sometimes different than those in the table heading.

During 1953, and again in 1954, the whole state was affected by a severe drought. Many ponds went dry and almost all became lower than usual. As a result the bass failed to spawn in many ponds at the end of the first year. However, the ponds were not necessarily overpopulated and were placed in the undetermined category. In 1955 these ponds again filled to normal levels and many contained balanced populations.

History of the 1954 Series

The 1954 series contained 100 ponds. The history of this series is shown in Table 4.

Table 3. History of the 1953 Series

Status in 1954, 98 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	4 (80%)	5 (42%)	-	9 (45%)
Overpop. Blg.	-	6 (50%)	1 (33%)	7 (35%)
Overpop. Bass	1 (20%)	1 (8%)	2 (67%)	4 (20%)
Not checked			1	1
Undetermined			26	26
Discontinued			52	52
Totals	5	12	82	99*

*1 pond was discontinued after data compiled.

Status in 1955, 46 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	7 (47%)	4 (50%)	2 (40%)	13 (46%)
Overpop. Blg.	5 (33%)	3 (38%)	2 (40%)	10 (36%)
Overpop. Bass	3 (20%)	1 (12%)	1 (20%)	5 (18%)
Not checked			4	4
Undetermined			2	2
Discontinued			17	17
Totals	15	8	28	51*

*5 ponds were discontinued after data compiled.

Status in 1956, 29 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	9 (64%)	2 (25%)	3 (100%)	14 (56%)
Overpop. Blg.	4 (29%)	5 (62%)	-	9 (36%)
Overpop. Bass	1 (7%)	1 (12%)	-	2 (8%)
Discontinued			6	6
Totals	14	8	9	31*

* 2 ponds were discontinued after data compiled.

Status in 1957, 23 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	6 (46%)	5 (62%)	2 (100%)	13 (57%)
Overpop. Blg.	5 (39%)	3 (37%)	-	8 (34%)
Overpop. Bass	2 (15%)	-	-	2 (8%)
Discontinued			1	1
Totals	13	8	3	24*

* 1 pond discontinued after data compiled.

Table 4. History of the 1954 Series

Status in 1955, 100 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	8 (42%)	12 (71%)	3 (60%)	23 (56%)
Overpop. Blg.	4 (21%)	4 (24%)	1 (20%)	9 (22%)
Overpop. Bass	7 (37%)	1 (6%)	1 (20%)	9 (22%)
Not checked			3	3
Undetermined			11	11
Discontinued			50	50
Totals	19	17	69	105*

*5 ponds were discontinued after data compiled.

Status in 1956, 50 ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	14 (64%)	8 (62%)	2 (50%)	24 (62%)
Overpop. Blg.	4 (18%)	3 (23%)	2 (50%)	9 (23%)
Overpop. Bass	4 (18%)	2 (15%)	-	6 (15%)
Undetermined			4	4
Discontinued			9	9
Totals	22	13	17	52*

*2 ponds were discontinued after data compiled.

Status in 1957, 41 ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	12 (52%)	2 (18%)	1 (25%)	15 (40%)
Overpop. Blg.	3 (13%)	6 (55%)	2 (50%)	11 (29%)
Overpop. Bass	8 (35%)	3 (27%)	1 (25%)	12 (32%)
Undetermined			2	2
Discontinued			3	3
Totals	23	11	9	43*

*2 ponds were discontinued after data compiled.

History of the 1955 Series

This series was the largest of the four. An intensive effort was made by each member of the project to secure for the study as many ponds as possible. As a result 227 ponds were selected from the six soils regions. It should be emphasized that this series of ponds is the only series that was not adversly affected by extremes in climatic conditions. The history of this series is shown in Table 5.

Table 5. History of the 1955 Series

Status in 1956, 227 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	32 (55%)	13 (32%)	5 (33%)	50 (44%)
Overpop. Blg.	21 (36%)	23 (56%)	5 (33%)	49 (43%)
Overpop. Bass	5 (9%)	5 (12%)	5 (33%)	15 (13%)
Not checked			2	2
Undetermined			12	12
Discontinued			100	100
Totals	58	41	129	228*

* 1 pond was discontinued after data compiled.

Status in 1957, 127 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	35 (60%)	15 (37%)	6 (33%)	56 (48%)
Overpop. Blg.	19 (33%)	20 (49%)	5 (28%)	44 (38%)
Overpop. Bass	4 (7%)	6 (15%)	7 (39%)	17 (15%)
Undetermined			3	3
Discontinued			10	10
Totals	58	41	31	130*

* 3 ponds were discontinued after data compiled.

Success of Rates

The success of the seven rates in manageable and marginal ponds combined is shown in Table 6, success being relative to the percentage of balanced ponds. All four series (1952, 1953, 1954 and 1955) are combined to show success at the end of the first and second years. Success for ponds 3 years old excludes the 1955 series, which was not yet 3 years old at the termination of the project. Success for ponds 4 years old includes only the 1952 and 1953 series and success for ponds 5 years old includes only the 1952 series.

For all ponds the most successful rates were 100:50 (Ratio, 2:1) which was 64% successful at the end of the first year after stocking and 56% successful at the end of the second year after stocking, and 80:500 (Ratio 1:6) which was 58% successful the first year and 69% successful the second year.

The success of each rate in manageable ponds is shown in Table 7. The rates with the highest percentage of success for this type of pond were also 100:50 (72%, first and 73%, second year) and 80:500 (56%, first and 71%, second year).

Table 6. Success of Rates for all Series of Manageable and Marginal Ponds (combined) at the End of the First, Second, Third, Fourth and Fifth Year After Stocking.

Status	Rates 30:400	50:500	80:500	100:500	100:30	100:50	100:70	Totals
First Year								
Balanced	8 (32%)	9 (43%)	14 (58%)	10 (39%)	11 (52%)	20 (64%)	12 (60%)	84 (50%)
Overpop. Blg.	17 (68%)	12 (57%)	8 (33%)	10 (39%)	4 (19%)	9 (29%)	3 (15%)	63 (37%)
Overpop. Bass	-	-	2 (8%)	6 (23%)	6 (29%)	2 (6%)	5 (25%)	21 (12%)
Totals	25	21	24	26	21	31	20	168
Second Year								
Balanced	7 (32%)	7 (39%)	18 (69%)	16 (64%)	11 (50%)	20 (56%)	14 (56%)	93 (53%)
Overpop.Blg.	15 (68%)	8 (44%)	5 (19%)	7 (28%)	7 (32%)	11 (31%)	7 (28%)	60 (35%)
Overpop.Bass	-	3 (17%)	3 (12%)	2 (8%)	4 (18%)	5 (14%)	4 (16%)	21 (12%)
Totals	22	18	26	25	22	36	25	174
Third Year								
Balanced	4 (57%)	3 (60%)	3 (30%)	3 (33%)	8 (67%)	3 (37%)	6 (35%)	30 (44%)
Overpop.Blg.	3 (43%)	1 (20%)	4 (40%)	5 (56%)	-	2 (25%)	9 (53%)	24 (35%)
Overpop.Bass	-	1 (20%)	3 (30%)	1 (11%)	4 (33%)	3 (37%)	2 (12%)	14 (21%)
Totals	7	5	10	9	12	8	17	68
Fourth Year								
Balanced	2 (67%)	1 (25%)	1 (25%)	1 (33%)	5 (71%)	3 (60%)	4 (44%)	17 (49%)
Overpop.Blg.	1 (33%)	2 (50%)	2 (50%)	2 (67%)	1 (14%)	2 (40%)	4 (44%)	14 (40%)
Overpop.Bass	-	1 (25%)	1 (25%)	-	1 (14%)	-	1 (11%)	4 (11%)
Totals	3	4	4	3	7	5	9	35
Fifth Year								
Balanced	-	-	2 (100%)	1 (100%)	-	-	-	3 (30%)
Overpop.Blg.	-	1 (50%)	-	-	1 (50%)	-	2 (67%)	4 (40%)
Overpop.Bass	-	1 (50%)	-	-	1 (50%)	-	1 (33%)	3 (30%)
Totals	-	2	2	1	2	-	3	10

Table 7. Success of Rates for all Series (combined) in Manageable Ponds at the End of the First, Second, Third, Fourth, and Fifth Year After Stocking

Status	30:400	50:500	80:500	100:500	100:30	100:50	100:70	Totals
First Year								
Balanced	3 (25%)	6 (67%)	5 (56%)	5 (39%)	7 (58%)	13 (72%)	8 (57%)	47 (54%)
Overpop.Blg.	9 (75%)	3 (33%)	4 (44%)	4 (31%)	1 (8%)	3 (17%)	2 (14%)	26 (30%)
Overpop.Bass	-	-	-	4 (31%)	4 (33%)	2 (11%)	4 (29%)	14 (16%)
Totals	12	9	9	13	12	18	14	87
Second Year								
Balanced	5 (45%)	3 (37%)	12 (71%)	11 (69%)	7 (47%)	16 (73%)	9 (53%)	63 (59%)
Overpop.Blg.	6 (54%)	2 (25%)	4 (24%)	5 (31%)	5 (33%)	4 (18%)	5 (29%)	31 (29%)
Overpop.Bass	-	3 (37%)	1 (6%)	-	3 (20%)	2 (9%)	3 (18%)	12 (11%)
Totals	11	8	17	16	15	22	17	106
Third Year								
Balanced	4 (57%)	2 (50%)	1 (33%)	-	7 (70%)	2 (67%)	6 (60%)	22 (54%)
Overpop.Blg.	3 (43%)	1 (25%)	-	3 (75%)	-	-	3 (30%)	10 (24%)
Overpop.Bass	-	1 (25%)	2 (67%)	1 (25%)	3 (30%)	1 (33%)	1 (10%)	9 (22%)
Totals	7	4	3	4	10	3	10	41
Fourth Year								
Balanced	-	-	1 (50%)	-	4 (67%)	1 (100%)	3 (37%)	9 (43%)
Overpop.Blg.	1 (100%)	1 (50%)	1 (50%)	1 (100%)	1 (17%)	-	4 (50%)	9 (43%)
Overpop.Bass	-	1 (50%)	-	-	1 (17%)	-	1 (12%)	3 (14%)
Totals	1	2	2	1	6	1	8	21
Fifth Year								
Balanced	-	-	-	-	-	-	-	0
Overpop.Blg.	-	1 (100%)	-	-	-	-	2 (67%)	3 (75%)
Overpop.Bass	-	-	-	-	-	-	1 (33%)	1 (25%)
Totals	-	1	-	-	-	-	3	4

Rate success for marginal ponds is shown in Table 8. The rates with the highest percentage of success for this type of pond were 100:70 (Ratio $1\frac{1}{2}$:1) which was 67% successful in the first year and 62% successful the second year, and 80:500 which was 60% and 67% successful for the first and second year investigations.

The success of the different rates for the 1954 series is shown in Table 9. The rates of 80:500 and 100:70 were the most successful in this series, however the number of ponds included in this analysis is admittedly small.

The success of rates in the 1955 series is shown in Table 10. In this series there appears to be little difference in the degree of success of 80:500, 100:500, 100:30, 100:50, and 100:70. A comparison of the success of rates in manageable and marginal ponds is shown in Table 11.

Table 12 shown the success in each soils region for the first three years. All four series are combined in this table. It is regretable that there were not enough ponds in each soils region to determine individual rate success for that region.

The status of the ponds stocked with the various rates is shown in Tables 13, 14, 15, 16, 17, 18, and 19.

Although the above tables depict certain rates to be more successful than other, the author believes that because of the differences in watersheds and immediate environment, the differences in percentages of success among the following rates, 80:500, 100:500, 100:30, 100:50, and 100:70, is not great enough to justify any major changes in stocking policies of this state based only on the above data.

Growth Rates of Bluegill

Tables 20 and 21 show the growth rates of bluegill sampled in 1954 and 1955 from balanced and overpopulated ponds. All ponds sampled in 1954 were from the 1952 series and the ponds sampled in 1955 were from 1952 and 1953 series. There appears to be no significant differences between the growth of bluegill from balanced ponds, and bluegill from overpopulated ponds.

A comparison of average weights, Table 22, also failed to show any significant difference in weights between bluegill from overpopulated ponds and bluegill of corresponding lengths from balanced ponds. This apparent lack of difference in length and weight between bluegill from these two types of populations was probably due to inadequate sampling from ponds that had been overpopulated for two years or more.

Table 8. Success of Rates for all Series (combined) in Marginal Ponds at the End of the First, Second, Third, Fourth, and Fifth Year After Stocking.

First Year

Status	30:400	50:500	80:500	100:500	100:30	100:50	100:70	Totals
Balanced	5 (38%)	3 (25%)	9 (60%)	5 (39%)	4 (44%)	7 (54%)	4 (67%)	37 (46%)
Overpop.Blg.	8 (61%)	9 (75%)	4 (27%)	6 (46%)	3 (33%)	6 (46%)	1 (17%)	37 (46%)
Overpop.Bass	-	-	2 (13%)	2 (15%)	2 (22%)	-	1 (17%)	7 (9%)
Totals	13	12	15	13	9	13	6	81

Second Year

Balanced	2 (18%)	4 (31%)	6 (67%)	5 (56%)	4 (57%)	4 (31%)	5 (62%)	30 (43%)
Overpop.Blg.	9 (82%)	8 (62%)	1 (11%)	2 (22%)	2 (29%)	6 (46%)	2 (25%)	30 (43%)
Overpop.Bass	-	1 (8%)	2 (22%)	2 (22%)	1 (14%)	3 (23%)	1 (12%)	10 (14%)
Totals	11	13	9	9	7	13	8	70

Third Year

Balanced	-	1 (100%)	2 (29%)	3 (60%)	1 (50%)	1 (20%)	-	8 (30%)
Overpop.Blg.	-	-	4 (57%)	2 (40%)	-	2 (40%)	6 (86%)	14 (52%)
Overpop.Bass	-	-	1 (14%)	-	1 (50%)	2 (40%)	1 (14%)	5 (18%)
Totals	-	1	7	5	2	5	7	27

Fourth Year

Balanced	2 (100%)	1 (50%)	-	1 (50%)	1 (100%)	2 (50%)	1 (100%)	8 (57%)
Overpop.Blg.	-	1 (50%)	1 (50%)	1 (50%)	-	2 (50%)	-	5 (36%)
Overpop.Bass	-	-	1 (50%)	-	-	-	-	1 (7%)
Totals	2	2	2	2	1	4	1	14

Fifth Year

Balanced	-	-	2 (100%)	1 (100%)	-	-	-	3 (50%)
Overpop.Blg.	-	-	-	-	1 (50%)	-	-	1 (17%)
Overpop.Bass	-	1 (100%)	-	-	1 (50%)	-	-	2 (33%)
Totals		1	2	1	2	-	-	6

Table 9. Success of Rates for the 1954 Series in Manageable and Marginal Ponds (combined) at the End of the First, Second, and Third Year After Stocking

First Year

Status	30:400	50:500	80:500	100:500	100:30	100:50	100:70	Totals
Balanced	2 (25%)	2 (100%)	4 (100%)	3 (75%)	2 (50%)	2 (40%)	5 (56%)	20 (55%)
Overpop.Blg.	6 (75%)	-	-	1 (25%)	2 (50%)	1 (20%)	4 (44%)	14 (39%)
Overpop.Bass	-	-	-	-	-	2 (40%)	-	2 (6%)
Totals	8	2	4	4	4	5	9	36

Second Year

Balanced	3 (50%)	1 (50%)	5 (83%)	2 (50%)	2 (67%)	2 (40%)	7 (78%)	22 (63%)
Overpop.Blg.	3 (50%)	-	1 (17%)	1 (25%)	-	1 (20%)	2 (22%)	8 (23%)
Overpop.Bass	-	1 (50%)	-	1 (25%)	1 (33%)	2 (40%)	-	5 (14%)
Totals	6	2	6	4	3	5	9	35

Third Year

Balanced	3 (75%)	1 (50%)	2 (40%)	1 (20%)	3 (50%)	1 (33%)	3 (33%)	14 (41%)
Overpop.Blg.	1 (25%)	-	1 (20%)	3 (60%)	-	2 (67%)	4 (44%)	11 (32%)
Overpop.Bass	-	1 (50%)	2 (40%)	1 (20%)	3 (50%)	-	2 (22%)	9 (27%)
Totals	4	2	5	5	6	3	9	34

Table 10. Success of Rates for the 1955 Series in Manageable and Marginal Ponds (combined) at the End of the First and Second Year After Stocking.

Status	Rates 30:400	50:500	80:500	100:500	100:30	100:50	100:70	Totals
First Year								
Balanced	4 (29%)	5 (33%)	6 (40%)	4 (27%)	6 (55%)	15 (71%)	5 (62%)	45 (46%)
Overpop.Blg.	10 (71%)	10 (67%)	7 (47%)	7 (47%)	2 (18%)	6 (29%)	2 (25%)	44 (44%)
Overpop.Bass	-	-	2 (13%)	4 (27%)	3 (27%)	-	1 (12%)	10 (10%)
Totals	14	15	15	15	11	21	8	99
Second Year								
Balanced	3 (27%)	5 (31%)	10 (67%)	11 (65%)	5 (56%)	11 (52%)	5 (50%)	50 (51%)
Overpop.Blg.	8 (73%)	8 (50%)	4 (27%)	5 (29%)	3 (33%)	7 (33%)	4 (40%)	39 (39%)
Overpop.Bass	-	3 (19%)	1 (7%)	1 (6%)	1 (11%)	3 (14%)	1 (10%)	10 (10%)
Totals	11	16	15	17	9	21	10	99

Table 11. Success of Rates for the 1955 Series in Manageable and Marginal Ponds at the End of the First and Second Year After Stocking

Status	Rates 30:400	50:500	80:500	100:500	100:30	100:50	100:70	Totals
First Year, Manageable Ponds								
Balanced	2 (22%)	4 (67%)	4 (50%)	3 (33%)	5 (62%)	10 (83%)	4 (67%)	32 (55%)
Overpop.Blg.	7 (78%)	2 (33%)	4 (50%)	3 (33%)	1 (12%)	2 (17%)	2 (33%)	21 (36%)
Overpop.Bass	-	-	-	3 (33%)	2 (25%)	-	-	5 (9%)
Totals	9	6	8	9	8	12	6	58
Second Year, Manageable Ponds								
Balanced	2 (50%)	2 (40%)	7 (64%)	7 (70%)	4 (57%)	10 (67%)	3 (50%)	35 (60%)
Overpop.Blg.	2 (50%)	1 (20%)	4 (36%)	3 (30%)	2 (29%)	4 (27%)	3 (50%)	19 (33%)
Overpop.Bass	-	2 (40%)	-	-	1 (14%)	1 (7%)	-	4 (7%)
Totals	4	5	11	10	7	15	6	58
First Year, Marginal Ponds								
Balanced	2 (40%)	1 (11%)	2 (29%)	1 (17%)	1 (33%)	5 (56%)	1 (50%)	13 (32%)
Overpop.Blg.	3 (60%)	8 (89%)	3 (43%)	4 (67%)	1 (33%)	4 (44%)	-	23 (56%)
Overpop.Bass	-	-	2 (29%)	1 (17%)	1 (33%)	-	1 (50%)	5 (12%)
Totals	5	9	7	6	3	9	2	41
Second Year, Marginal Ponds								
Balanced	1 (14%)	3 (27%)	3 (75%)	4 (57%)	1 (50%)	1 (17%)	2 (50%)	15 (37%)
Overpop.Blg.	6 (86%)	7 (64%)	-	2 (29%)	1 (50%)	3 (50%)	1 (25%)	20 (49%)
Overpop.Bass		1 9%)	1 (25%)	1 (14%)	-	2 (33%)	1 (25%)	6 (15%)
Totals	7	11	4	7	2	6	4	41

Table 12. Status of Ponds in Each Soils Region for all Series (Manageable) and Marginal Ponds (combined) at the End of the First, Second and Third Year After Stocking.

Status	Outer Bluegrass	Inner Bluegrass	Eastern Coalfields	Western Coalfields	Pennyroyal	Jackson Purchase	Totals
First Year							
Balanced	8 (36%)	3 (75%)	14 (61%)	6 (55%)	13 (59%)	3 (60%)	47 (54%)
Overpop.Blg.	11 (50%)	1 (25%)	2 (9%)	4 (36%)	7 (32%)	1 (20%)	26 (30%)
Overpop.Bass	3 (14%)	-	7 (30%)	1 (9%)	2 (9%)	1 (20%)	14 (16%)
Totals	22	4	23	11	22	5	87
Second Year							
Balanced	13 (50%)	3 (30%)	19 (68%)	11 (79%)	15 (62%)	2 (50%)	63 (59%)
Overpop.Blg.	13 (50%)	7 (70%)	4 (14%)	2 (14%)	5 (21%)	-	31 (29%)
Overpop.Bass	-	-	5 (18%)	1 (7%)	4 (17%)	2 (50%)	12 (11%)
Totals	26	10	28	14	24	4	106
Third Year							
Balanced	5 (45%)	-	6 (43%)	7 (87%)	2 (50%)	2 (100%)	22 (54%)
Overpop.Blg.	4 (36%)	2 (100%)	3 (21%)	-	1 (25%)	-	10 (24%)
Overpop.Bass	2 (18%)	-	5 (36%)	1 (12%)	1 (25%)	-	9 (22%)
Totals	11	2	14	8	4	2	41

Table 13. Status of Ponds Stocked at a Rate of 30:400, for the 1952, 1953, 1954, and 1955 Series at the End of the First, Second, and Third Years After Stocking

	Status	Series 1952	1953	1954	1955	Totals
	First Year					
Man.	Balanced	-	1	-	2	3
	Overpop.Blg.	-	-	2	7	9
	Overpop.Bass	-	-	-	-	0
Mar.	Balanced	-	1	2	2	5
	Overpop.Blg.	-	1	4	3	8
	Overpop.Bass	-	-	-	-	
	Totals	-	3	8	14	25
	Second Year					
Man.	Balanced	-	1	2	2	5
	Overpop.Blg.	-	2	2	2	6
	Overpop.Bass	-	-	-	-	0
Mar.	Balanced	-	-	1	1	2
	Overpop.Blg.	1	1	1	6	9
	Overpop.Bass	-	-	-	-	0
	Totals	1	4	6	11	22
	Third Year					
Man.	Balanced	-	-	3		3
	Overpop.Blg.	-	1	1		2
	Overpop.Bass	-	-	-		0
Mar.	Balanced	-	2	-		2
	Overpop.Blg.	-	-	-		0
	Overpop.Bass	-	-	-		0
	Totals	-	3	4		7

Table 14. Status of Ponds, Stocked at a Rate of 50:500, for the 1952, 1953, 1954, and 1955 Series at the End of the First, Second, and Third Years After Stocking

	Status	Series 1952	1953	1954	1955	Totals
	First Year					
Man.	Balanced	-	-	2	4	6
Man.	Overpop.Blg.	1	-	-	2	3
Man.	Overpop.Bass	-	-	-	-	0
Mar.	Balanced	1	-	-	1	2
Mar.	Overpop.Blg.	1	1	-	8	10
Mar.	Overpop.Bass	-	-	-	-	0
	Totals	3	1	2	15	21
	Second Year					
Man.	Balanced	-	-	1	2	3
Man.	Overpop.Blg.	1	-	-	1	2
Man.	Overpop.Bass	-	-	1	2	3
Mar.	Balanced	-	1	-	3	4
Mar.	Overpop.Blg.	1	-	-	7	8
Mar.	Overpop.Bass	-	-	-	1	1
	Totals	2	1	2	16	21
	Third Year					
Man.	Balanced	-	1	1		2
Man.	Overpop.Blg.	1	-	-		1
Man.	Overpop.Bass	-	-	1		1
Mar.	Balanced	1	-	-		1
Mar.	Overpop.Blg.	-	-	-		0
Mar.	Overpop.Bass	-	-	-		0
	Totals	2	1	2		5

Table 15. Status of Ponds, Stocked at a Rate of 80:500, for the 1952, 1953, 1954, and 1955 Series at the End of the First, Second, and Third Years After Stocking

	Status	Series 1952	1953	1954	1955	Totals
				First Year		
Man.	Balanced	-	-	1	4	5
	Overpop.Blg.	-	-	-	4	4
	Overpop.Bass	-	-	-	-	0
Mar.	Balanced	3	1	3	2	9
	Overpop.Blg.	-	1	-	3	4
	Overpop.Bass	-	-	-	2	2
	Totals	3	2	4	15	24
				Second Year		
Man.	Balanced	2	-	3	7	12
	Overpop.Blg.	-	-	-	4	4
	Overpop.Bass	-	-	1	-	1
Mar.	Balanced	1	-	2	3	6
	Overpop.Blg.	-	1	-	-	1
	Overpop.Bass	1	-	-	1	2
	Totals	4	1	6	15	26
				Third Year		
Man.	Balanced	-	-	1		1
	Overpop.Blg.	-	-	-		0
	Overpop.Bass	-	-	2		2
Mar.	Balanced	-	1	1		2
	Overpop.Blg.	2	1	1		4
	Overpop.Bass	1	-	-		1
	Totals	3	2	5		10

Table 16. Status of Ponds, Stocked at a Rate of 100:500, for the 1952, 1953, 1954, and 1955 Series at the End of the First, Second, and Third Years After Stocking

	Status	Series 1952	1953	1954	1955	Totals
	First Year					
Man.	Balanced	1	-	1	3	5
	Overpop.Blg.	-	-	1	3	4
	Overpop.Bass	1	-	-	3	4
Mar.	Balanced	1	2	2	1	6
	Overpop.Blg.	-	1	-	4	5
	Overpop.Bass	-	-	-	1	1
	Totals	3	3	4	15	25
	Second Year					
Man.	Balanced	2	-	2	7	11
	Overpop.Blg.	1	-	1	3	5
	Overpop.Bass	-	-	-	-	0
Mar.	Balanced	-	1	-	4	5
	Overpop.Blg.	-	-	-	2	2
	Overpop.Bass	-	-	1	1	2
	Totals	3	1	4	17	25
	Third Year					
Man.	Balanced	-	-	-		0
	Overpop.Blg.	-	-	2		2
	Overpop.Bass	-	-	1		1
Mar.	Balanced	2	-	1		3
	Overpop.Blg.	1	1	1		3
	Overpop.Bass	-	-	-		0
	Totals	3	1	5		9

Table 17. Status of Ponds, Stocked at a Rate of 100:30, for the 1952, 1953, 1954, and 1955 Series at the End of the First, Second, and Third Years After Stocking

	Status	Series 1952	1953	1954	1955	Totals
	First Year					
Man.	Balanced	1	-	1	5	7
	Overpop.Blg.	-	-	-	1	1
	Overpop.Bass	-	1	1	2	4
Mar.	Balanced	-	2	1	1	4
	Overpop.Blg.	1	1	-	1	3
	Overpop.Bass	-	-	1	1	2
	Totals	2	4	4	11	21
	Second Year					
Man.	Balanced	-	3	-	4	7
	Overpop.Blg.	-	3	-	2	5
	Overpop.Bass	-	1	1	1	3
Mar.	Balanced	1	-	2	1	4
	Overpop.Blg.	1	-	-	1	2
	Overpop.Bass	-	1	-	-	1
	Totals	2	8	3	9	22
	Third Year					
Man.	Balanced	-	4	3		7
	Overpop.Blg.	-	-	-		0
	Overpop.Bass	-	1	2		3
Mar.	Balanced	1	-	-		1
	Overpop.Blg.	-	-	-		0
	Overpop.Bass	-	-	1		1
	Totals	1	5	6		12

Table 18. Status of Ponds, Stocked at a Rate of 100:50, for the 1952, 1953, 1954, and 1955 Series at the End of the First, Second, and Third Years After Stocking

	Status	Series 1952	1953	1954	1955	Totals
	First Year					
Man.	Balanced	-	2	1	10	13
	Overpop.Blg.	-	-	1	2	3
	Overpop.Bass	-	-	2	-	2
Mar.	Balanced	2	-	1	5	8
	Overpop.Blg.	1	1	-	4	6
	Overpop.Bass	-	-	-	-	0
	Totals	3	3	5	21	32
	Second Year					
Man.	Balanced	1	3	2	10	16
	Overpop.Blg.	-	-	-	4	4
	Overpop.Bass	-	-	1	1	2
Mar.	Balanced	1	2	-	1	4
	Overpop.Blg.	1	1	1	3	6
	Overpop.Bass	-	-	1	2	3
	Totals	3	6	5	21	35
	Third Year					
Man.	Balanced	-	1	1		2
	Overpop.Blg.	-	-	-		0
	Overpop.Bass	-	-	1		1
Mar.	Balanced	-	1	-		1
	Overpop.Blg.	-	2	-		2
	Overpop.Bass	-	1	1		2
	Totals	0	5	3		8

Table 19. Status of Ponds, Stocked at a Rate of 100:70, for the 1952, 1953, 1954, and 1955 Series at the End of the First, Second, and Third Years After Stocking

	Status	Series 1952	1953	1954	1955	Totals
	First Year					
Man.	Balanced	1	1	2	4	8
	Overpop.Blg.	-	-	-	2	2
	Overpop.Bass	-	-	4	-	4
Mar.	Balanced	-	-	3	1	4
	Overpop.Blg.	1	-	-	-	1
	Overpop.Bass	-	-	-	1	1
	Totals	2	1	9	8	20
	Second Year					
Man.	Balanced	2	-	4	3	9
	Overpop.Blg.	1	-	1	3	5
	Overpop.Bass	1	2	-	-	3
Mar.	Balanced	-	-	3	2	5
	Overpop.Blg.	-	-	1	1	2
	Overpop.Bass	-	-	-	1	1
	Totals	4	2	9	10	25
	Third Year					
Man.	Balanced	1	2	3		6
	Overpop.Blg.	2	1	-		3
	Overpop.Bass	-	-	1		1
Mar.	Balanced	-	-	-		0
	Overpop.Blg.	-	2	4		6
	Overpop.Bass	-	-	1		1
	Totals	3	5	9		17

Table 20. Corrected Growth Rates for 842 Bluegill Sampled in 1954 and 1955 from 33 Ponds with Balanced Populations

Age Group	Total Number	Average Total Length (Inches)	Calculated Total Length (Inches) at Time of Annulus Formation				
			I	II	III	IV	V
0	123	2.3					
I	292	4.4	2.8				
II	238	5.6	2.8	4.9			
III	107	6.2	2.8	4.6	5.8		
IV	63	6.5	2.2	4.0	5.2	6.2	
V	19	6.3	1.5	3.3	4.4	5.4	6.2
Average Length			2.7	4.6	5.4	6.0	6.2
Increment of Growth			2.7	1.9	0.8	0.6	0.2
Total Number			719	427	189	82	19

Table 21. Corrected Growth Rate for 495 Bluegill Sampled in 1954 and 1955 from 30 Ponds Overpopulated with Bluegill

Age Group	Total Number	Average Total Length (Inches)	Calculated Total Length (Inches) at Time of Annulus Formation		
			I	II	III
0	32	2.5			
I	214	4.0	2.7		
II	236	5.6	2.7	4.8	
III	13	6.0	2.2	4.2	5.5
Average Length			2.7	4.8	5.5
Increment of Growth			2.7	2.1	0.7
Total Number			463	249	13

Table 22. Comparison of Average Lengths (Inches) and Average Weights (Pounds) of Bluegill Sampled in 1955 from Balanced and Overpopulated Bluegill Ponds

Age Group	Balanced Ponds			Overpopulated Ponds		
	No.	T.L.	Wt.	No.	T.L.	Wt.
I	292	4.4	0.07	214	4.0	0.05
II	238	5.7	0.14	236	5.6	0.14
III	107	6.2	0.17	13	6.0	0.17

Table 20 reveals that bluegill from balanced ponds reached a length of 2.7 inches at the time of the formation of the first annulus. By the time the fourth annulus had been laid down they were 6 inches long.

The growth rates of bluegill sampled in 1956 are shown in Tables 23 and 24. A total of 1,576 bluegills were sampled from 18 balanced ponds and 1,829 bluegills were sampled from 10 overpopulated ponds. All ponds sampled had been stocked for at least two years.

It appears from Tables 23 and 24 that bluegill grow at approximately the same rate in balanced and unbalanced ponds, however, when individual ponds from the same soils region are compared, some differences can be detected. Table 25 reveals that bluegill growth in age groups II and III was much slower in overpopulated ponds. In one overpopulated pond bluegill failed to reach a length of 6 inches at the end of their fourth year of life.

A comparison of average weight and average total lengths of bluegill sampled in 1956 is shown in Table 26. The bluegill in age group I and II from overpopulated ponds grew very little after the first and second annuli had been formed and as a result these fish weighed considerably less than fish of corresponding age groups from balanced ponds.

Table 23. Corrected Growth Rates for 1,576 Bluegill Sampled in 1956 from 18 Ponds With Balanced Populations

Age Group	Total Number	Average Total Length (Inches)	Calculated Total Length (Inches) at Time of Annulus Formation				
			I	II	III	IV	V
0	810	2.0					
I	306	4.4	2.7				
II	326	5.9	2.7	4.9			
III	124	6.5	2.5	4.6	5.9		
IV	4	7.5	3.5	4.9	6.2	7.0	
V	6	7.5	2.8	4.7	5.8	6.6	7.1
Average Length			2.7	4.8	5.9	6.8	7.1
Increment of Growth			2.7	2.1	1.1	0.9	0.3
Total Number.			766	460	134	10	6

Table 24. Corrected Growth Rates for 1,829 Bluegill Sampled in 1956 from 10 Ponds Overpopulated with Bluegill

Age Group	Total Number	Average Total Length (Inches)	Calculated Total Length (Inches) at Time of Annulus Formation				
			I	II	III	IV	V
0	446	2.1					
I	589	3.7	2.7				
II	527	5.0	2.7	4.3			
III	256	6.4	2.6	4.7	6.1		
IV	9	7.3	2.4	5.0	6.0	6.8	
V	2	7.4	2.4	4.3	5.4	6.4	6.9
Average Length			2.7	4.4	6.1	6.7	6.9
Increment of Growth			2.7	1.7	1.7	0.6	0.2
Total Number			1383	794	267	11	2

Table 25. Comparison of Growth Rates of Bluegill Sampled in 1956 from Individual Ponds

Number Bluegill	Pond Status	Calculated Total Length (Inches) at Time of Annulus Formation			
		I	II	III	IV
E. Coalfields					
71	Balanced	2.3	5.0	-	-
80	Overpop.Blg.	2.2	3.5	3.9	-
W. Coalfields					
107	Balanced	3.0	5.4	6.2	7.0
55	Overpop.Blg.	2.5	4.5	5.8	6.7
Pennyroyal					
178	Balanced	2.7	4.6	5.9	-
334	Overpop.Blg.	2.7	4.6	5.3	5.9
O. Bluegrass					
125	Balanced	2.3	4.1	6.3	-
129	Overpop.Blg.	2.3	4.0	5.6	-

Table 26. Comparison of Average Total Lengths (Inches) and Average Weights (Pounds) of Bluegill Sampled in 1956 from Balanced and Overpopulated Bluegill Ponds

Age Group	Balanced Ponds			Overpopulated Ponds		
	No.	T.L.	Wt.	No.	T.L.	Wt.
I	306	4.4	0.07	589	3.7	0.04
II	326	5.9	0.15	527	5.0	0.08
III	124	6.5	0.20	256	6.4	0.19
IV	4	7.5	0.31	9	7.3	0.32
V	6	7.5	0.42	2	7.4	0.36

Growth rates for bluegill sampled in 1957 are shown in Table 27. All ponds were from the 1955 series and only balanced ponds were sampled.

Table 27. Corrected Growth Rates for 740 Bluegill Sampled in 1957 from 17 Balanced Ponds

Age Group	Total Number	Average Total Length (Inches)	Calculated Total Length (Inches) at Time of Annulus Formation		
			I	II	III
0	452	2.7			
I	211	5.6	3.1		
II	58	6.0	2.7	4.9	
III	19	7.0	3.0	5.1	6.3
Average Length			3.0	4.9	6.3
Increment of Growth			3.0	1.9	1.4
Total Number			288	77	19

A comparison of length and weights, Table 28, shows that bluegill sampled in 1957 grew at a slightly faster rate and weighed slightly more than bluegill sampled in 1955 and 1956.

Table 28. Comparison of Average Total Lengths (Inches) and Average Weights (Pounds) of Bluegill Sampled from Balanced Ponds in 1955, 1956, and 1957

Age Group	1955			1956			1957		
	No.	T.L.	Wt.	No.	T.L.	Wt.	No.	T.L.	Wt.
I	292	4.4	0.07	306	4.4	0.07	211	5.6	0.08
II	238	5.7	0.14	326	5.9	0.15	58	6.0	0.16
III	107	6.2	0.17	124	6.5	0.20	19	7.0	0.26

Growth rates for largemouth bass collected in 1955, 1956, and 1957, are shown in Tables 29, 30, 31. Table 32 shows the comparison of growth for these years. Both balanced ponds and those overpopulated with bluegill were used for the 1955 and 1956 studies. In the 1957 study only balanced ponds were used. From this data it appears that the average largemouth bass reached a length of 10 inches at the formation of the second annulus. This did not hold true for first year growth in all newly stocked ponds. In some ponds the bass reached a length of 10" or more at the end of the first year after stocking.

Other Influencing Factors

As is shown in Figure 2, data concerning water transparency, aquatic weeds, fishing pressure, etc., was collected during the investigations. Although it was not possible to correlate any of these factors with the success of the various rates, many are worth examining.

No correlation could be found between the size of the bluegill stocked and the amount of bluegill spawn in the first year. In some instances, bluegill stocked as fingerlings produced as much or more spawn as bluegill stocked as adults produced in comparable ponds. At other times fish stocked as adults produced more spawn than fingerling stocked fish. From observation it appeared that the amount of spawn produced probably depended more on the environment than it did on the size of the bluegills that were stocked. It was also found that bluegill stocked as fingerlings reproduced at approximately the same time during the first year as the adult stocked fish.

In many ponds the bass did not always reproduce after 1 year's growth, but stocking rates seemed to have little effect. If the pond was fertile and clear and the bluegills did not become overpopulated during the first summer, the stocked bass usually reproduced after 1 year's growth.

Very little data was collected concerning the percentage of harvestable fish in balanced and unbalanced ponds. It was planned to drain or pump dry a series of ponds for this purpose in 1953 and 1954, but due to the drouth the pond owners needed all available water. Also the cost of renting equipment to pump dry the ponds that could not be drained was prohibitive, therefore, this phase of the project was discontinued in late 1953.

A total of 4 ponds were drained, however, in the fall and winter of 1953. The 4 ponds were stocked on 2 adult rates, 100 fry bass to 30 adult bluegill, and 100 fry bass to 40 adult bluegill, and 2 fingerling rates, 100 fry bass to 1000 fingerling bluegill and 135 fry bass to 134 fingerling bluegill. The analysis of the population from

Table 29. Growth Rates for 448 Largemouth Bass Collected in 1955 from 81 Ponds

Age Group	Total Number	Average Total Length (Inches)	Calculated total length (Inches) at Time of Annulus Formation	
			I	II
0	22	6.0		
I	337	8.4	6.7	
II	89	11.0	6.6	10.0
Average Length			6.7	10.0
Increment of Growth			6.7	3.3
Total Number			426	89

Table 30. Growth Rates for 311 Largemouth Bass Collected in 1956 from 28 Ponds

Age Group	Total Number	Average Total Length (Inches)	Calculated Total Length (Inches) at Time of Annulus Formation		
			I	II	III
0	109	3.4			
I	128	7.3	5.2		
II	64	11.7	4.1	10.1	
III	10	13.2	4.3	7.1	10.6
Average Length			4.8	9.7	10.6
Increment of Growth			4.8	4.9	0.9
Total Number			202	74	10

Table 31. Growth Rates of 125 Largemouth Bass Collected in 1957 from 17 Ponds

Age Group	Total Number	Average Total Length (Inches)	Calculated Total Length (Inches) at Time of Annulus Formation	
			I	II
0	26	4.8		
I	74	9.7	5.6	
II	25	12.0	7.0	10.4
Average Length			6.0	10.4
Increment of Growth			6.0	4.4
Total Number			99	25

Table 32. Comparison of Growth Rates of Largemouth Bass Collected in 1955, 1956, and 1957

Year Collected	Average Length (Inches) at Time of Annulus Formation		
	I	II	III
1955	6.7	10.0	-
1956	4.8	9.7	10.6
1957	6.0	10.4	-
Average	6.1	9.9	10.6

these 4 ponds is shown in Table 33. In this study harvestable fish included bass 8 inches or more in length and bluegill 5 or more inches long. The percentages of harvestable fish from the adult stocked ponds were 13.3% and 7.3% and the percentage of harvestable fish from the fingerling stocked ponds amounted to 58.3% and 48.9%.

During the annual investigations the amount of aquatic vegetation for each pond was recorded. Although no correlation between balance and weed growth was found, the data did point out the fact that bass invariably reproduced in ponds with dense growths of pond weed, Potamogeton sp., regardless of the numbers of bluegill present.

Water level fluctuation was found to be a problem in many ponds. In some areas, ponds got very low each summer and overflowed freely in the winter and spring. In most cases the investigators were able to get this information from the owners, but in some instances ponds probably overflowed about which nothing was known. Some of the ponds that overflowed freely were found to be overpopulated with bluegill during one investigation and were found to be balanced the following year. Undoubtedly many fish and nutrients were lost over the spillway.

Very little correlation was found between balance and fishing pressure. Very few owners fished or let the public fish their ponds heavily and some allowed no fishing. The only real problem created by fishing was that some owners caught most of the bass in their pond before they had spawned for the first time.

Many owners were dissatisfied with shellcracker because they did not bite as readily as bluegill. Some of this dissatisfaction may be dispelled as they learn more about angling for these fish.

Discontinuance of Ponds

After investigations had begun in 1953 it was evident that nothing of value could be gained by keeping certain ponds on an experimental basis. In 1954 it was decided to discontinue studying any pond from which reliable data could not be procured. Ponds were discontinued because of the following reasons:

1. Dry or very low. Includes ponds that went completely dry or became low enough that fish survival was in doubt.

2. Wildfish. Included green sunfish, Lepomis cyanellus, bullheads, Ictalurus sp., and a few miscellaneous species that entered the pond from ponds on the watershed or from ponds or streams below.

Table 33. Analysis of Data from Ponds Drained in 1953

	Pond A	Pond B	Pond C*	Pond D
Location	P	O.B.	P	E.C.
Rate	100:30	100:40	100:1000	134:134
Size (Acres)	1.08	1.00	0.27	0.30
Bass:				
No. Stocked	101	100	27	40
Size of Fish	1½"	2"	1½"	1"
Date Stocked	6-22-53	6-25-53	6-19-53	5-21-53
Bluegill:				
No. Stocked	33	40	270	40
Size of Fish	6"	5"- 6"	3"	3"
Date Stocked	4-23-53	4-15-53	4-24-53	3-13-53
Date Drained	11-18-53	11-12-53	12-3-53	12-12-53
Bass:				
No. Recovered**	95	46	24	23
% of Recovery	94%	46%	89%	58%
Weight Per Acre	18.8	9.5	31.1	15.1
Bluegill				
No. Recovered**	20	23	154	23
% of Recovery	61%	58%	57%	58%
Weight Per Acre	20.2	118.1	122.3	14.5
Total Wt. Per Acre	39.0	127.6	153.4	29.6
% of Harvestable Fish	13.3%	7.3%	58.3%	48.9%

* This pond was fertilized

**Fish that were stocked initially

3. Errors in stocking. Many ponds were found to be smaller than originally reported. This pertains mostly to the 1952 series where the applications were pulled directly from the departmental files and the ponds were not investigated by project personnel. In one or two cases the owner had two ponds or more and the wrong pond was stocked.

4. Other fish. This includes any bass or bluegill, other than those stocked experimentally, crappie, Pomoxis sp., channel catfish, Ictulurus puntatus, or minnows that were added by well meaning owners or friends, or that entered the pond from the watershed. It was not always possible to tell which fish were added and which entered from the watershed.

5. No population. A few ponds had fish kills from oxygen depletion, or the population was depleted because of crop spraying, or because of organic pollution from septic tanks.

6. Renovated. The owners became dissatisfied and wanted the population removed.

7. Physically unsuited. Many ponds were lost due to heavy silting or by livestock trampling the banks and dam. A few owners placed barbed wire on trees in their ponds to keep out poachers and thus made seining difficult. In some ponds weeds became such a problem that seining was prohibited.

8. Rates discontinued. A few ponds were stocked with rates other than the original series. These were later discontinued at the suggestion of the U. S. Fish and Wildlife Service.

9. Inaccessable. The investigators were unable to check a number of ponds because of the impassability of roads or because of the erection of barriers, such as, fences or crops, by the owners.

The number of ponds that were discontinued each year from 1954 thru 1957 is shown in tables 34, 35, 36, and 37. The effects of the drought is reflected in the number of dry ponds listed here.

Table 34. Ponds Discontinued in 1954

Reasons for Discontinuance	1952	1953	1954	Totals
Dry or very low	13	16	11	40
Wildfish	7	11	5	23
Errors in stocking	10	5	1	16
Other fish	5	6	8	19
No population	1	3	2	6
Renovation	1	1	1	3
Physically unsuited	13	3	3	19
Rates discontinued	1	6	-	7
Inaccessable	9	1	-	10
Totals	60	52	31	143

Table 35. Ponds Discontinued in 1955

Reasons for Discontinuance	1952	1953	1954	1955	Totals
Dry or very low	1	-	3	29	33
Wildfish	3	2	4	29	38
Errors in stocking	4	8	2	5	19
Other fish	1	-	1	18	20
No population	-	2	-	1	3
Physically unsuited	2	3	9	6	20
Rates discontinued	-	2	-	-	2
Totals	11	17	19	88	135

Table 36. Ponds Discontinued in 1956

Reasons for Discontinuance	1952	1953	1954	1955	Totals
Dry or very low	1	2	2	3	8
Wildfish	-	-	2	4	6
Errors in stocking	-	1	1	-	2
Other fish	-	-	1	5	6
No population	-	1	-	2	3
Renovation	3	1	1	-	5
Physically unsuited	-	1	1	1	3
Inaccessable	-	-	1	-	1
Totals	4	6	9	15	34

Table 37. Ponds Discontinued in 1957

Reasons for Discontinuance	Series 1952	1953	1954	1955	Totals
Dry or very low	-	-	-	1	1
Wildfish	-	1	-	1	2
Other fish	-	-	-	2	2
Renovation	-	-	3	4	7
Physically unsuited	-	-	-	2	2
Totals	-	1	3	10	14

Table 38 shows the total number of ponds that were discontinued from 1954 thru 1957. A total of 326 or 64.3% of the total number stocked were discontinued. The invasion of the ponds by other fish (including wildfish) was the primary reason that ponds were discontinued during this investigation.

The number of ponds that were discontinued in each soils region is shown in Table 39. In the Bluegrass region of the state the most serious problem was other fish entering the pond. In the Pennyroyal the most serious problems encountered were the inability of ponds to hold water and the heavy siltation. Better cover crops and less cultivation would prevent much of the siltation.

BASS-SHELLCRACKER INVESTIGATIONS

Rate Distribution of Bass-Shellcracker Ponds.

A total of 89 ponds were stocked with bass-shellcracker combinations in 1953, 1955, and 1956. Only 5 ponds were stocked in 1953 and these failed to yield any reliable data. They were discontinued after the 1955 field investigation. The distribution of the remaining 84 ponds is shown in Table 40.

Table 38. Ponds Discontinued from 1954 thru 1957 (combined)

Reasons for Discontinuance*	Series 1952	1953	1954	1955	Totals
Dry or very low	15 (16.9%)	18 (18.4%)	16 (16.0%)	33 (14.5%)	82 (16.0%)
Wildfish	10 (11.2%)	14 (14.3%)	11 (11.0%)	34 (15.0%)	69 (13.4%)
Errors in stocking	14 (15.7%)	14 (14.3%)	4 (4.0%)	5 (2.2%)	37 (7.2%)
Other Fish	6 (6.7%)	6 (6.1%)	10 (10.0%)	25 (11.0%)	47 (9.1%)
No population	1 (1.1%)	6 (6.1%)	2 (2.0%)	3 (1.3%)	12 (2.3%)
Renovated	4 (4.5%)	2 (2.0%)	5 (5.0%)	4 (1.8%)	15 (2.9%)
Physically unsuited	15 (16.9%)	7 (7.1%)	13 (13.0%)	9 (4.0%)	44 (8.6%)
Rates Discontinued	1 (1.1%)	8 (8.2%)	-	-	9 (1.8%)
Inaccessable	9 (10.1%)	1 (1.0%)	1 (1.0%)	-	11 (2.1%)
Total Discontinued	75 (84.3%)	77 (78.6%)	62 (62.0%)	113 (49.8%)	326 (63.4%)
Total Stocked	89	98	100	227	514

Table 39. Ponds Discontinued from 1954 thru 1957, all Series (combined), for each Soils Region

Reasons for Discontinuance	O.B.	I.B.	E.C.	W.C.	P.	J.P.	Totals
Dry or low	33 (17.6%)	6 (12.5%)	13 (12.7%)	5 (10.4%)	24 (21.2%)	1 (6.2%)	82 (16.0%)
Wildfish	34 (18.2%)	7 (14.6%)	4 (3.9%)	8 (16.7%)	11 (9.7%)	5 (31.2%)	69 (13.4%)
Errors in Stocking	13 (7.0%)	4 (8.3%)	7 (6.9%)	4 (8.3%)	9 (8.0%)	-	37 (7.2%)
Other fish	23 (12.3%)	7 (14.6%)	9 (8.8%)	2 (4.2%)	5 (4.4%)	1 (6.2%)	47 (9.1%)
No population	6 (3.2%)	1 (2.1%)	1 (1.0%)	-	4 (3.5%)	-	12 (2.3%)
Renovated	4 (2.1%)	3 (6.2%)	3 (2.9%)	1 (2.1%)	4 (3.5%)	-	15 (2.9%)
Physically unsuited	10 (5.3%)	8 (16.7%)	6 (5.9%)	3 (6.2%)	15 (13.3%)	2 (12.5%)	44 (8.6%)
Rates Discontinued	1 (0.5%)	-	4 (3.9%)	1 (2.1%)	2 (1.8%)	1 (6.2%)	9 (1.8%)
Inaccessable	4 (2.1%)	1 (2.1%)	4 (3.9%)	1 (2.1%)	-	1 (6.2%)	11 (2.1%)
Total Discontinued	128 (68.3%)	37 (77.1%)	51 (50.0%)	25 (52.1%)	74 (65.5%)	11 (68.8%)	326 (63.4%)
Total Stocked	187	48	102	48	113	16	514

Table 40. Distribution of Bass-Shellcracker Ponds

Soils Regions	Series	Rates 50:300	50:600	50:300:400	50:600:400	Totals
Outer Bluegrass	55	8	8	3	3	22
	56	4	4	3	4	15
Inner Bluegrass	55	-	-	1	1	2
	56	1	1	1	1	4
Eastern Coalfields	55	-	-	1	-	1
	56	-	-	-	-	0
Western Coalfields	55	3	3	2	2	10
	56	-	-	-	-	0
Pennyroyal	55	7	6	3	4	20
	56	-	-	-	-	0
Jackson Purchase	55	4	3	1	2	10
	56	-	-	-	-	0
Totals		27	25	15	17	84

History of the 1955 series

When the ponds for the 1955 bass-bluegill series were selected in the fall of 1954, many marginal ponds were selected for the 1955 bass-shellcracker series. Approximately 75% of these were old marginal ponds that had been rotenoned and were ready for restocking. The other 25% were new, manageable ponds that were stocked with shellcracker at the request of the owners.

A total of 65 ponds were stocked in this series, Table 41. All of the ponds were stocked with shellcracker in the fall and winter of 1954. In a few cases the ponds were frozen over and the fish were stocked through a hole in the ice. It is known that the shellcrackers did not survive in 3 ponds that were stocked in this manner.

History of the 1956 series

In the 1956 series ponds were selected from the Bluegrass region of the state only. Six old ponds, 2 of which were marginal and 4 manageable, and 13 new ponds, of which 9 were manageable and 4 were marginal were selected for this series. All were stocked in the fall of 1955. A history of this series is shown in Table 42.

Table 41. History of the 1955 Series

Status in 1956, 65 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	2 (29%)	4 (44%)	1 (100%)	7 (41%)
Overpop.Shc.	- -	1 (11%)	-	1 (6%)
Overpop.Bass	5 (71%)	4 (44%)	-	9 (53%)
Not checked			1	1
Undetermined			6	6
Discontinued			41	41
Totals	7	9	49	65

Status in 1957, 24 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	6 (50%)	2 (22%)	-	8 (38%)
Overpop.Shc	-	2 (22%)	-	2 (10%)
Overpop.Bass	6 (50%)	5 (56%)	-	11 (52%)
Undetermined			1	1
Discontinued			2	2
Totals	12	9	3	24

Table 42. History of the 1956 Series

Status in 1957, 19 Ponds

Status	Manageable	Marginal	Unclassified	Totals
Balanced	1 (50%)	-	-	1 (25%)
Overpop.Shc	1 (50%)	-	-	1 (25%)
Overpop.Bass	-	-	2 (100%)	2 (50%)
Undetermined			2	2
Discontinued			13	13
Totals	2	-	17	19

Success of Rates

The success of the 4 rates in manageable and marginal ponds for the 1955 series is shown in Tables 43 and 44. There are not enough ponds represented here to determine which rate was the more successful, but his table does reveal that shellcracker do not provide enough forage for bass. Very few ponds became overpopulated with shellcracker. In manageable ponds there were no ponds overpopulated with shellcracker, and in marginal ponds less than 25% became overpopulated (Table 43). Bass became overpopulated in a large percentage of both type ponds.

Table 43. Success of Rates for the 1955 Series in Manageable and Marginal Ponds at the end of the first and second years after stocking

	Rates				
Status	50:300	50:600	50:300:400	50:600:400	Totals
First Year, Manageable Ponds					
Balanced	-	2 (50%)	-	-	2 (29%)
Overpop.Shc.	-	-	-	-	0
Overpop.Bass	2 (100%)	2 (50%)	-	1 (100%)	5 (71%)
Totals	2	4	-	1	7
Second Year Manageable Ponds					
Balanced	2 (67%)	4 (67%)	-	-	6 (50%)
Overpop.Shc.	-	-	-	-	0
Overpop.Bass	1 (33%)	2 (33%)	1 (100%)	2 (100%)	6 (50%)
Totals	3	6	1	2	12
First Year, Marginal Ponds					
Balanced	3 (75%)	-	-	1 (50%)	4 (44%)
Overpop.Shc.	-	1 (33%)	-	-	1 (11%)
Overpop.Bass	1 (25%)	2 (67%)	-	1 (50%)	4 (44%)
Totals	4	3	-	2	9
Second Year, Marginal Ponds					
Balanced	-	-	1 (100%)	1 (50%)	2 (22%)
Overpop.Shc.	1 (33%)	1 (33%)	-	-	2 (22%)
Overpop.Bass	2 (67%)	2 (67%)	-	1 (50%)	5 (56%)
Totals	3	3	1	2	9

Table 44. Success of Rates for the 1955 Series in Manageable and Marginal Ponds (combined) at the End of the First and Second Years After Stocking

Status	50:300	50:600	50:300:400	50:600:400	Totals
		First Year Investigations			
Balanced	3 (50%)	2 (29%)	-	1 (33%)	6 (38%)
Overpop.Shc.	-	1 (14%)	-	-	1 (6%)
Overpop.Bass	3 (50%)	4 (57%)	-	2 (67%)	9 (56%)
Totals	6	7	-	3	16
		Second Year Investigations			
Balanced	2 (33%)	4 (44%)	1 (50%)	1 (25%)	8 (38%)
Overpop.Shc.	1 (17%)	1 (11%)	-	-	2 (10%)
Overpop.Bass	3 (50%)	4 (44%)	1 (50%)	3 (75%)	11 (52%)
Totals	6	9	2	4	21

In some of the ponds stocked with Gambusia and shellcrackers, the bass grew very fast and were in excellent condition at the end of the first year. These bass produced very heavy spawns which failed to maintain this good growth because most of the Gambusia had disappeared and the shellcrackers failed to produce the required amount of forage.

Discontinuance of Ponds

Ponds were discontinued from the bass-shellcracker series for many of the same reasons that the bass-bluegill ponds were discontinued, Table 45.

Table 45. Ponds Discontinued in 1955, 1956, and 1957 (combined)

Reason for Discontinuance	Series 1955	1956	Totals
Dry or very low	1 (1.5%)	-	1 (1.2%)
Wildfish	20 (30.8%)	8 (42.1%)	28 (33.3%)
Other fish	17 (26.2%)	6 (31.6%)	23 (27.4%)
Errors in Stocking	1 (1.5%)	1 (5.3%)	2 (2.4%)
Physically unsuited	3 (4.6%)	-	3 (3.6%)
No population	1 (1.5%)	-	1 (1.2%)
Total discontinued	43 (66.2%)	15 (78.9%)	58 (69.0%)
Total stocked	65	19	84

Wildfish and the addition of other fish were the primary reasons that ponds were discontinued. Many of the ponds in the 1955 and 1956 series were old ponds that had been treated with rotenone to eliminate the populations. A complete kill was not affected in many of these ponds. Wet seasons prevailed during the years 1955 and 1956, and for that reason only 1 pond went dry in the two series.

DISCUSSION

It is unfortunate that so many rates were selected for this study. Table 6 shows that only 168 of the 514 ponds stocked with bass-bluegill combinations produced comparable data. Twenty-four ponds for each of the seven rates tested might have been in adequate sample, however, these rates were stocked in ponds which were located in six different soils regions, distributed throughout the state. This represents 4 ponds for each rate per soils region. Discontinuance of ponds did not result in equal distribution among the seven rates, therefore, some regions were left without representation for some rates.

Individual ponds were not always representative of the average pond in the soils region in which they were located. Actually, some ponds located in one soil region were more typical of ponds in other regions. This was especially true along the border of the regions since the change of soil types from one region to another is not abrupt but very gradual. In many of the so-called infertile areas progressive farmers had improved their land to such an extent that their ponds were more fertile than some ponds in the most fertile areas of the state.

It was planned to stock the experimental ponds at the same time that ponds were being stocked on the regular state-wide stocking program, but this was not possible. Vehicles and personnel were not available. As a result most of the experimental stocking was delayed until after the regular deliveries had been made. This most seriously affected the shellcrackers that were stocked in 1955, because some of them had to be stocked in sub-freezing temperatures. It is known that shellcrackers did not survive in 3 ponds stocked at this time and undoubtedly many more perished in other ponds.

Another stocking problem was the presence of bluegill, and sometimes green sunfish, in some of the shellcracker brood ponds in the hatcheries. It was almost impossible to separate these fishes completely due to the time involved.

Many owners did not want their ponds stocked with rates that had few bass. It was found that many times the owners stocked additional bass in ponds so stocked. In other instances, owners were reluctant to cooperate after their ponds had been stocked on rates that had few bass.

Many problems encountered during these investigations were due to the differences in soils regions. In the Eastern Coalfields region a large majority of the ponds have little shallow area for bluegill spawning grounds. Bass are able to spawn readily in the deeper waters and many ponds in this region tend to become overpopulated with bass, due to the lack of forage. It is suggested that ponds in this region be so constructed that adequate spawning areas will be present after impoundment. Fertilization would help to provide increased production of forage.

In other areas of the state, especially in the Bluegrass region, a large majority of the ponds have too much shallow area. The bluegill in ponds in these areas spawn too successfully and the ponds tend to become overpopulated with bluegills. To alleviate this overproduction of forage and subsequent overpopulation of bluegill was the primary reason that the bass shellcracker rates were investigated. The results of these studies were inconclusive, however, and more investigation of these combinations are needed. It is suggested that at the present time, ponds in the Bluegrass region be stocked with adequate numbers of bass to help keep the heavy forage population under control. In the construction of new ponds, extensive shallow areas should be avoided.

It is regrettable that so many ponds had to be discontinued during this investigation. However, much information was obtained about what factors need to be taken into account in planning a study of this type or in establishing stocking policies.

Many owners added 3 or 4 adult bass or adult bluegill to their ponds, since they had little or no idea of the reproductive potential of these fish. They couldn't understand why adding just 3 or 4 fish would make any difference. Although the investigators did explain to the owner when the ponds were selected that it was imperative that the ponds be devoid of fish life when they were stocked experimentally, this point wasn't stressed sufficiently, nor fully explained. It would probably have been profitable to take a little time and explain to the owners why 3 or 4 additional fish did ruin the experiment.

The sizes of the ponds, as reported by conservation officers, were sometimes as much as 100% wrong. It will do little good to establish specific rates for certain areas if this deplorable, inaccurate reporting continues.

It was found during the first phase of the study that ponds less than 1/2 acre seldom produced balanced populations. It would seem advisable that some restrictions be placed on the size of ponds to be stocked and especially on ponds to be renovated by state personnel. This should encourage the building of larger and better constructed ponds.

Other fish entering the ponds from the drainage areas was the cause of many ponds being discontinued during the study. This could have been alleviated, somewhat, if the areas above and below the ponds had been investigated fully, but the investigators did not have time to do this. It was suggested that each pond be rotenoned in the fall, prior to stocking the following spring, but this would not have helped because over 95% of the ponds used in this investigation were new ponds that were built in the summer preceeding stocking. Therefore, they did not fill with water until late fall and winter. It appears that most of the fish that entered did so in the winter and early spring when there is an abundance of rainfall. It might have helped to rotenone the ponds about 1 month before stocking, but this would have been difficult because of the heavy rains at this time of year. A barrier would have prevented the invasion of wildfish from below the spillway in many cases.

Another factor causing the discontinuance of many ponds was the use of these ponds by livestock. Since most of the farm ponds in this state are constructed for the purpose of providing water for livestock and irrigation and not for fish production, very few are fenced. In this investigation a great many ponds, which were manageable when they were selected, became marginal or completely unmanageable, because of the presence of large numbers of livestock roiling the water and trampling the banks during the summer. The investigators always inquired as to what extent livestock would use the ponds, and if the expected use of the ponds by livestock was considered excessive, the pond was rejected. But this could not always be foreseen by the owners. This was especially true in 1953 and 1954 when many streams dried up and the livestock had to water out of ponds.

As had been mentioned before the largest percentage of ponds in this investigation were new ponds. It would have been difficult to get ponds for experimental purposes if new ponds hadn't been selected, because most of the owners wanted their ponds stocked immediately after filling. It was advantageous to select new ponds because they supposedly did not have fish populations, but there were alo disadvantages in using this type of pond. It was not always possible to tell if the ponds were going to hold water and as a result there was a large number of ponds that went dry. Some of the ponds were very infertile the first year after impoundment and did not support a representative fish population.

CONCLUSIONS AND RECOMMENDATIONS

In these investigations the most successful rates for all types of ponds were 100 fry bass to 50 adult bluegill and 80 fry bass to 500 fingerling bluegill per acre. Although these rates were found to have the highest percentage of success, it is believed that the difference in percentage of success among any of the following rates 80:500, 100:500, 100:30, 100:50, and 100:70 is not great enough to justify any major change in stocking policy based only on this data above. It is recommended that a rate be selected that provides for the fisherman the greatest percentage of harvestable fish. The very limited amount of research done on this subject during these investigations indicates that fingerling stocked ponds produce the highest percentage of harvestable fish. More investigation is needed however, to determine what combinations are best suited for this purpose.

In the Eastern Coalfields region ponds tend to become overpopulated with bass due to the lack of forage which in turn is due to the lack of suitable spawning areas. Fertilization would greatly aid fish production in terms of pounds of fish in many ponds in this region, and should aid in the production of sufficient forage for bass also.

In the Bluegrass regions there is a tendency for ponds to become overpopulated with bluegill because in most ponds bluegill spawning areas are too extensive. New stocking rates that provide enough bass (a minimum of 100 per acre) to control this heavy forage population is recommended.

Wildfish entering ponds is also a serious problem. In many ponds barriers would prevent the invasion of wildfish.

During the selection of ponds by project personnel it was found that in many cases the size of the ponds, as reported on the stocking application, was incorrect, sometimes as much as 100%. Undoubtedly some of this error was due to ponds not being measured. Results of earlier investigations demonstrated that ponds below 1/2 acre in size seldom produced balanced populations. It is therefore recommended that no ponds be stocked or renovated by state personnel that are less than 1/2 acre in size, except in unusual cases, such as, properly fertilized ponds, or ponds that were constructed primarily for fishing. This would not only put the state-wide farm pond program on a sound biological and economical basis, but would save time for the man in the field, who inspects ponds to be stocked, since he would not have to measure ponds that were plainly evident to be less than 1/2 acre in size.

It was found that many potentially good fish ponds were ruined because large numbers of livestock were allowed free access to all parts of the pond. Owners should be encouraged to fence their ponds and to provide limited watering areas or to provide watering troughs below the dam. This would eliminate trampled fish nests, roiled water, decreased food production, and eroding banks and quite possibly prolong the life of the pond.

Results of this investigation reveal that in many new ponds the stocked bass failed to reach spawning size in 1 year. Many populations are undoubtedly thrown out of balance because of the removal of the bass, by angling, before the first bass spawn. It is therefore recommended that in new ponds the owner be instructed to refrain from fishing for bass for 2 years from the time the bass are stocked, unless they are absolutely certain the bass have spawned.

There are indications that shellcrackers do not provide enough forage to promote good bass growth in manageable ponds. However, it was also noted that very few ponds stocked with bass-shellcracker combinations became overpopulated with shellcrackers. Since the overpopulation by the forage species seems to be the number one problem in shallow ponds, bass-shellcracker combinations may be the answer in this type of pond. This is definitely worthy of more investigation.

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