

A STUDY OF THE PRODUCTIVITY AND BREEDING HABITS OF THE BLUEGILL, *LEPOMIS PALLIDUS* (MITCH).¹

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The bluegill, *Lepomis pallidus* (Mitch.), one of the most common Centrarchids, has never been studied with regard to the number of young produced in a definite area under natural conditions. The method used was to count the entire number of nests in the lake and to collect and count the embryos in a few typical nests. The average per nest multiplied by the total number of nests gave the approximate number of young produced each year. An attempt was made to determine the total population of bluegills although this was very difficult because of the many varying factors concerned. This work was done during June, July, and August of 1921, 1922, and 1923, with a few observations during the months of March and October. The work was essentially the same for the three summers and was all done on Eagle (Winona) Lake.

Nests.—The nest of the bluegill is like that of the bass and several other Centrarchids. It is made by the male, which, by standing almost vertically over the nest and flipping the tail, brushes the lighter debris aside leaving shells, roots, or gravel for a solid bottom. The nature of the bottom regulates the depth and size of the nest; if the bottom of the nest is made up of thick roots it is always very shallow, never more than three or five centimeters in depth and more often just a clean place on the bottom. If the nest is located in marl it is much deeper with sloping sides, oftentimes 15 centimeters deep. The nests located in marl always have the bottom covered with dead shells and if the shells are thinly distributed the male makes a much deeper cavity in order to get enough shells to form the bottom of the nest. The nests average 28 inches across with some as wide as 36 inches.

The location of the nest is determined by the character of the bottom. As the nesting sites are observed from year to year it seems that the same places are selected again and again with only a little variation. Practically all of the nests are found at the edge of the two meter contour line where the water rapidly becomes deeper so that, when the bluegill is alarmed it may dart rapidly out to deeper water. Only a very few instances were noted where the nests were found at a depth of one half meter or less. They are found rarely in the Potamogetons unless these plants are unusually short and scattered. Nests were never found where the Potamogetons extend to a depth of 12 to 15 feet and are continuous with the spike rushes (*Scirpus americanus*) to the shore line. The bays in the lake are more densely populated than the shallower points.

Nests are almost always found in clusters, only three instances being noted where a single nest was found entirely apart from any

¹ This study was made at the suggestion and under the supervision of Dr. Will Scott, Director of the Indiana University Biological Station, Winona Lake, Indiana.

other nest. This condition of clustered nests is due to the fact that the choice of one individual in the same general strip of favorable territory is naturally the choice of many others. Possibly there also exists a social instinct which causes the males to build nests in groups. These nests were very close together and as many as 120 have been counted in an area 150 feet in length and 15 feet wide.

In late spring and early summer it is very easy to count the nests since the water is very transparent although some of them were found as deep as seven or eight or even ten feet. For the summer of 1921

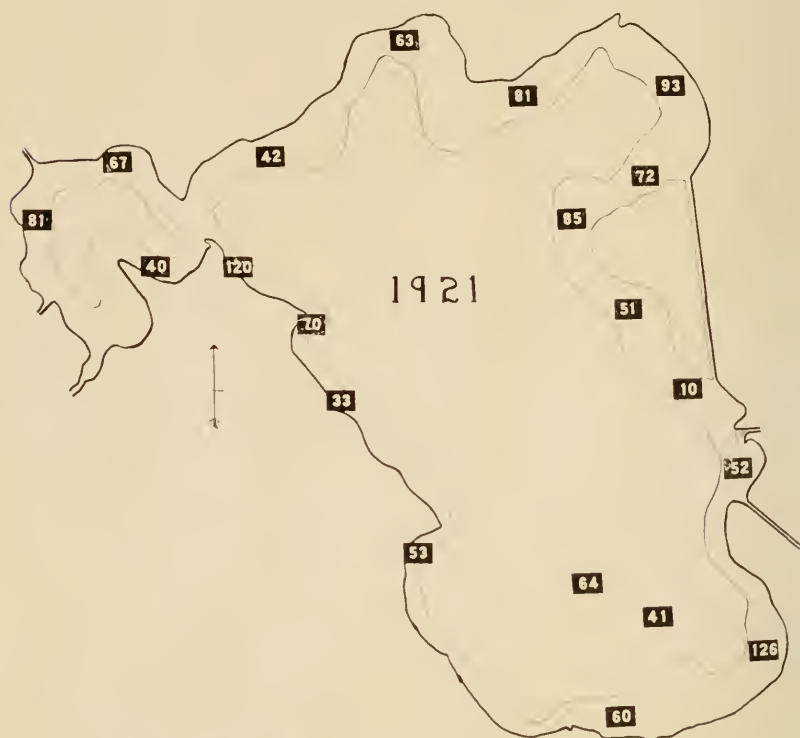


Fig. 1. Map of Eagle (Winona) Lake, showing the number and distribution of bluegill nests in 1921. The numbers indicate the location and number of nests in a group.

a total of 1,395 nests were counted, 1,874 in 1922, and 2,398 for the summer of 1923.

To determine the average number of embryos per nest, four typical nests were carefully collected and counted. The embryos were taken from the nest immediately after they were hatched when most of them still had the yolk sac attached. With the number of occupied nests and an average of the individuals per nest, the approximate number of young produced annually was determined. From the smaller nests the number was obtained by counting them out individually, in the larger nests approximately 1,500 would be counted out, the water filtered off and

their weight taken. The remainder of the nest would be drained and weighed in the same manner and the total number of young in the nest calculated.

From the four nests counted the following figures were obtained: 11,257; 30,374; 80,000; and 224,900, these representing the maximum and minimum sized nests. The average for these four nests is 86,631. According to this average, for the year 1923 in which 2,398 nests were counted, 207,751,138 young bluegills should have been hatched. If a single female laid in each nest this would mean that there are 2,400 mature egg-laying females in the lake. With an equal ratio between



Fig. 2. Same as figure 1, except that it is for 1922.

males and females there should be a total of 4,800 adult bluegills in the lake. This assumption of the equal ratio between males and females is used because in all hook and line catches as well as net catches the sexes were about equally divided. These figures are undoubtedly too low and there may be two plausible explanations. A number of females may lay in a single nest at one time for it is known that an individual male of the sunfish, *Eupomotis gibbosus*, has reared in a single nest two broods laid at different times by two females. While spawning the female darts rapidly to and fro over the nest making it impossible to keep her under observation all the time and to determine whether or not several females are laying in a single nest.

Reigard says that the relation between the sexes of *Eupomotis gibbosus* "may be regarded as promiscuous polygamy." This relationship is probably the same for the bluegill. As soon as the young bluegills have entirely absorbed their yolk sac they begin to leave the nest and within a few days all are gone, unguarded by either parent. Within a very few days the male will be seen hovering over another group of eggs in the same nest. This may happen two or three times during the same summer.

Not only do the females lay in the same nest successively but more than a single female's eggs are in a nest at the same time. This was



Fig. 3. Same as figure 1, except that it is for 1923.

determined in the following manner. A number of females with ripe ovaries were collected, the ovaries were removed and preserved, and from these ovaries one of average size was selected for the determination. The ovary was 3.3 cm. long and 2.3 cm. wide (from a fish 14 cm. in length). The eggs within it were large and fully developed. It was hardened in formalin and the eggs were readily teased apart for counting. In this ovary there were 11,257 eggs. Although there were some ovaries that contained twice as many eggs it hardly seems possible that the 224,900 embryos found in one nest were laid by a single female.

Assuming that the average number of eggs laid per female is 11,257 for the year 1923 there should be 18,467 egg-laying females in

Eagle Lake according to the number of young produced there that year. This would mean that the number of sexually mature fish is about 36,000 providing the numbers of males and females were equal.

At this point arises another question. If there are 18,000 males why have only 2,400 of them constructed nests? There are two possibilities. Either more than one male makes and guards a nest or a large percentage of the males are non-functional. The latter solution seems to be the more plausible of the two. All observations point to the fact that a single male guards the nest, when all of the males are driven off of a bed of nests the same male is always observed to return to the nest previously occupied. One instance where a single nest was observed over an extended period of time proved conclusively that the same male remained over a nest until the embryos had left. At first this male seemed extremely shy and at the first alarm he would dart away and remain some distance from the nest. After continued observations he became less alarmed and within a very short time he would remain quiet on the nest with the writer directly above him. If any attempt was made to disturb the male by reaching the hand down into the water he would dart at it furiously with no sign of alarm.

To determine the population at any one time or to determine the number that reach the adult stage is a very difficult problem due to the many factors involved. The mortality of these young fish is very high, that is from the time of hatching to the self-maintaining stage. The mortality from this stage to maturity is greatly reduced but is still high.

Enemies.—The worst enemy of the young bluegill is the illegal fisherman who fishes before the season opens or nets over the nests; or he who marks the beds and fishes the males off the first of the open season. The capture of a very few males leaves thousands of young fry to fall prey to the young bass, turtles and many other carnivorous forms.

Another serious enemy of the young bluegill is the spawning carp. The carp spawns at a time when the bluegill nesting season is at its height. In the middle of June, 1923, all the nests in one strip along the south shore of the lake were destroyed by the carp as they muddied up the water and uprooted the plants. In this particular instance over 40 nests were destroyed.

Summary.—The nest of *Lepomis pallidus* (Mitch.), the common bluegill, is a saucer-like excavation constructed by the male. Practically all of the nests are found inside of the two-meter contour line, which is the shelf of the lake where the water rapidly becomes deeper. These nests are never found in dense growths of aquatic plants and are always found in clusters.

The accompanying illustrations (figs. 1, 2, and 3) of Eagle Lake, which has an area of a little less than a square mile (556 acres), indicate the location and number of nests found in the years, 1921, 1922, and 1923, respectively. From four typical nests all the embryos were collected and counted, the average per nest was 86,631. From these counts it is estimated that approximately 207,000,000 bluegills were hatched out in Eagle Lake in 1923.

It has been determined that more than one female lays in a single nest, that is the relation between sexes is regarded as "promiscuous polygamy." From counts of eggs in the ovaries and the number of eggs sometimes found in nests, it is concluded that more than one female may lay eggs in a single nest. Repeated observations show that as soon as one brood leaves the nest, other females deposit their eggs in the empty nest.

It was estimated that there were 18,467 egg-laying females in Eagle Lake in 1923, this estimate being taken from the average number of eggs and the total number of young hatched. With an equal ratio there should be about an equal number of males. It is thought that a larger percentage of the males are non-functional since there were only 2,400 nests and probably 18,000 mature males.

Some of the serious enemies of the young bluegills are the illegal fishermen; also many carnivorous forms as young bass, darters and turtles. The spawning carp is another menace.