Inferential Evidence of Changes in Growth Rates and Population Densities of Bluegill Sunfish During a 30-year Period[1]

David Weaver
Michigan Department of Natural Resources
Cadillac, Michigan 49601, and

H. E. McReynolds
U. S. Forest Service
633 Wisconsin Avenue, Milwaukee, Wisconsin 53203

Abstract

There are recurring complaints from older fishermen that fish today are fewer and smaller than "when I was a boy." These allegations are difficult for the fishery biologist to either affirm or refute. Few opportunities exist in which reliable fish growth or population data from 1930 or before can be compared with recent studies. Growth data from a 1959-62 study of some lakes in the same general area as Hile's 1929 investigations present some inferential evidence on the subject. It appears that, in some situations at least, growth rates for bluegill sunfish in northeastern Indiana lakes were actually greater in earlier decades. Conversely, there are also insinuative indications that populations in the late 1920's were of lower densities.

Introduction

Fisheries biologists are continually confronted by older fishermen with two related claims which have been difficult to either refute or corroborate. The statements usually take the form of "The fish we catch today aren't as big as we used to catch when I was a boy," or "There were more fish when I was a kid than there are now." Basically, these claims of more and larger fish during the earlier decades of this century have been difficult to evaluate due to the paucity of population and growth data from that era. Fisheries science was at that time in its infancy with most of the studies concerned with natural history and pisciculture rather than age-and-growth, population dynamics, fish physiology, or other later fields of investigation.

One of the earliest comprehensive age-and-growth studies was Ralph Hile's excellent investigation of the lakes of northeastern Indiana during 1926 to 1929 (4). During 1959 to 1962, the Fisheries Research Section of the Indiana Division of Fish and Game conducted studies of four northeastern Indiana lakes. Although these investigations were primarily directed toward an evaluation of liberalized fishing regulations, age-and-growth studies were an integral part of this project.

The authors feel that even though Hile's investigation and the Division of Fish and Game study dealt with different lakes, there is

[1] The 1959-62 data are taken from a Federal Aid in Fish Restoration study (F-4-R) with the approval of the Indiana Division of Fish and Wildlife. Both authors were biologists with the Fisheries Research Section, Indiana Division of Fish and Wildlife, at the time of the study.

a great similarity in climatic, physiographic and edaphic factors. There is an opportunity here to compare growth data from the same geographic region but with a time differential of 30 years. Sufficient comparative growth data existed only for the bluegill, and only Age-group III within this species seemed appropriate for a growth analysis. Difference in measurements used in the two studies necessitated conversion of Hile's data to total length (TL), and lengths of fish in millimeters were used rather than Hile's centimeters.

Discussion

Growth rate changes, even if linear in nature, may be difficult to distinguish over a short period of time (2-6 years), especially if incremental changes are small. Exceptions to this, of course, are those rates affected by catastrophic events (sporadic pollution, winter kill, intense droughts, etc.). We would expect, however, that the ecological changes deriving from gradual cultural impact or natural eutrophication would be of a lower intensity. Even decennial comparisons may not be conclusive; minute growth rate changes of the magnitude of a millimeter per year may go undetected even over a 10-year period.

Dr. Hile's study included specimens from a number of northeastern Indiana lakes, but only three collections of Age-group III fish are of large enough numbers to be fairly reliable. These were the samples from Dewart Lake during August, 1929 (35 fish); Winona Lake, July and August, 1929 (23 fish); and Hyndman Lake, August, 1929 (33 fish). (Author's note: Dr. Hile's summarization table in the Appendix (Table LXXXVII) is in error (4). Age-groups are recorded as one year older than they actually are. Instead, refer to individual lake tables in the body of the paper (Tables XLVI, XLVIII, and LXVI) where the data are correctly recorded.)

There were several reasons for concentrating on Age-group III bluegills. One was Hile's larger and more reliable samples in this age-group. Secondly, the three-year-old bluegills are generally the numerically superior group of those in which the angler is interested. Three-year-olds often fall in a length range of 5.5-7.0 inches, and only the very fast growing two-year-olds reach a length attractive to fishermen. Third, this is the age at which most bluegills spawn for the first time, therefore, the largest percentage of the spawning stock is composed of three-year-old fish.

Hile's fish were measured in an approximation of standard length (SL) from tip of snout to edge of last scale (4) whereas specimens in the present study were measured in total length (tip of snout to depressed tips of caudal fin). This necessitated the use of a conversion factor to adjust Hile's data to total lengths for comparative purposes. Such coefficients have been computed by previous investigators and are available in the literature. Beckman (2) and Carlander and Smith (3) have both presented figures for converting standard length to total length in the size range of Hile's Age-group III specimens. For Michigan bluegills Beckman gives conversion factors of 1.261

(102-163 mm SL) and 1.246 (over 163 mm SL). Carlander and Smith (3) determined conversion coefficients of 1.225 (100-159 mm SL) and 1.205 (160-189 mm SL) for Minnesota bluegills (3). In Table 1 the average lengths for 3-year-old bluegills from the four lakes of the present study are compared with Hile's Age-group III bluegills from Dewart, Winona, and Hyndman lakes. Both the Beckman conversion figures and the ones proposed by Carlander and Smith (3) have been used to adjust Hile's standard lengths to total lengths.

TABLE 1. *A comparison of Age-group III bluegills from 7 northeastern Indiana lakes.*

Investigator	Lake	Date of Collection	Average lengths in millimeters (with conversion to inches and tenths in parentheses)
Original data converted to average total lengths by the Beckman coefficient (average standard length × 1.261 or 1.246 = average total length).			
Hile	Dewart	August, 1929	202 (7.9) total length[1]
"	Winona	July, Aug., 1929	190 (7.5) " "[1]
"	Hyndman	August, 1929	206 (8.1) " "[1]
Original data converted to average total lengths by the Carlander and Smith coefficient (average standard length × 1.225 or 1.205 = average total length).			
Hile	Dewart	August, 1929	193 (7.6) total length
"	Winona	July, Aug., 1929	185 (7.3) " "
"	Hyndman	August, 1929	199 (7.8) " "
Weaver and McReynolds	Long	1959-62 (average)	152 (6.0) total length[1]
"	Sand	1959-62 (average)	162 (6.4) " "[1]
"	Mateer	1959-62 (average)	139 (5.5) " "[1]
"	Still	1959-62 (average)	153 (6.0) " "[1]

[1] Number of fish in sample: Dewart (35); Winona (23); Hyndman (33); Long (110); Sand (123); Mateer (125); Still (88).

A comparison of the data presents an obvious picture of faster growth for the bluegills in Hile's collections. This argument is further strengthened by the larger average size in most of Hile's Age-group IV fish, but the growth differential is less pronounced in these four-year-olds and also in the five-year-old fish. It should be noted that much of Hile's collecting was done by 1⅝ inch mesh gill nets, through which some of the smaller members of Age-group III could presumably escape. This type of selectivity would tend to produce a somewhat greater average length in the age-group than actually existed. Hile's suspicion that selectivity was present in his Age-group III fish is supported by the decline of the growth gap between older age-groups. A study of Hile's three-year-old bluegills shows no average lengths (ranges are not given) smaller than 184 mm after conversion to total length. Only two age-group II fish were taken in gill nets and these were 178 mm TL or greater. All of the other smaller two-year-old bluegills were captured by angling or seining. From these capture data, it seems probable that the lower limit of catchability of Hile's gear has produced an inferior truncation of this age-group. It appears that the smallest bluegills retained by the gear were in the 170-180 mm range (Fig. 1). Therefore, the slower-growing three-year-olds escaped capture, and the average lengths for the groups are inflated. The apparent growth gap between Hile's Age-group II fish and those from the present study is probably real, but with a lower differential than is immediately discernible from the non-annotated figures.

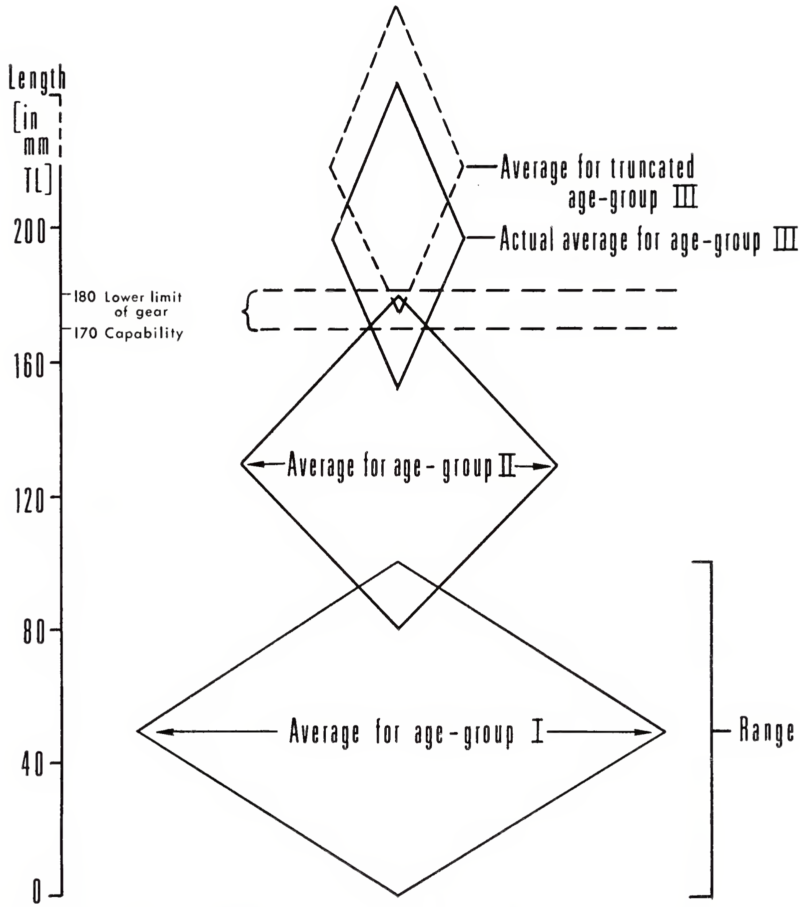

FIGURE 1. *Diagram indicates how truncation of lower end of year-class by year selectivity can produce a year-class average growth rate higher than that which actually exists.*

If we assume that the bluegills, at least in some instances, had a faster growth rate in the latter 1920's than they do have now, this raises some questions about the reasons for such a situation. In this regard—although he was not thinking along these lines—some of Hile's comments are thought-provoking. Dr. Hile states "In several lakes, the results of fishing proved so meager that any attempt at securing a satisfactory sample would be impractical because of the great amount of time required. The gill net used in the summer of 1929 was 160 yards long and had a depth of 12 feet. Yet quite frequently, a set of 5 or 6 hours netted a catch of less than 20 specimens. As an illustration of the scantiness of the catches, it may be cited that Pike Lake was visited 4 days, Spear Lake 3 days, Big Barbee, Little Barbee, and Silver Lakes 2 days, and Kuhn Lake 1 day with the results as indicated in the table." (4).

The total capture for the 14 net/days cited by Dr. Hile was 89 fish of combined species or about 6.4 fish/net/day. It seems almost inconceivable that at present we could set a net of the size of Hile's net and catch only an average of 6 or 7 fish of all species each day. However, in a situation where the paucity of a population is such as Hile infers, it would naturally follow that high growth rates would exist, assuming that the population depressant was *not* food availability. A number of studies have pointed out the increased growth rates stemming from lower population densities. Pirognikoff (5) has attributed the decline in growth of rudd in Russia's Lake Chani to an increasing population density, and Beckman (1) in Michigan has shown that removal of a portion of a rock bass population produced increased growth rates in the remainder.

Literature Cited

1. BECKMAN, WILLIAM C. 1941. Increased growth rate of rock bass, *Ambloplites rupestris* (Rafinesque), following reduction in the density of the population. Trans. Amer. Fish. Soc. **70**:143-148.

2. ———— 1948. The length-weight relationship, factors for conversion between standard and total lengths, and coefficients of condition for seven Michigan fishes. Trans. Amer. Fish. Soc. **75**:237-256.

3. CARLANDER, KENNETH D., and LLOYD L. SMITH, JR. 1945. Some factors to consider in the choice between standard, fork, or total lengths in fishery investigations. Copeia **1**(1945):7-12.

4. HILE, RALPH. 1931. Rate of growth of fishes of Indiana. Invest. of Indiana Lakes # 2. Indiana Dept. of Conserv., Div. Fish and Game, Publ. **107**:9-55.

5. PIROGNIKOFF, P. L. 1927. Materials concerning age and growth rate of rudd (*Rutilus r. lacustris* Pallas) from the Lake Chani. Rep. Ichthy. Lab. in Siberia, Vol. II, No. 5, Krasnoyarsk, 1-17.