The Rate of Growth of Channel Catfish, *Ictalurus punctatus*, in Oklahoma Waters[1]

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During the past five years various agencies and individuals have collected a large amount of data concerning the age and growth of Oklahoma fishes. Much of this information is to be found in the lake management reports of the Oklahoma Game and Fish Department and Fisheries Research Laboratory (3); some is available in recent master's and doctoral theses from the University of Oklahoma and Oklahoma A. and M. College (2, 5, 8), and individual reports published by state fishery workers in pertinent journals (4, 6, 7, 9, 10, 12). Considerable other data have not been published.

In order to consolidate all the available growth data and to provide the Oklahoma fishery worker with standards for use in comparing fish growth, workers at the Fisheries Research Laboratory have undertaken to compile average growth rates for several fishes of this state. In doing so, the various environmental factors which might affect growth are being considered. The channel catfish, *Ictalurus punctatus* (Rafinesque)[2] one of the most abundant and important of the state's game fishes, is the first to be studied.

MATERIALS AND METHODS

The average rate of growth of Oklahoma channel catfish was determined from 4,054 specimens from 62 collections in 50 bodies of water. Names of all the individual bodies of water used in computing the average growth-rate and in the various groupings are not included. For anyone desiring such information, a complete record is on file at the Oklahoma Fisheries Research Laboratory at Norman. The samples were collected over a

[1] Contribution of the Oklahoma Fisheries Research Laboratory, a cooperative unit of the Oklahoma Game and Fish Department and the University of Oklahoma Biological Survey.

[2] The current nomenclature of this species is discussed by Speirs (11).

five-year period, 1948 to 1952, with a variety of methods, including gill-nets of 3/4-inch to 3-inch bar mesh, hoop nets, seines, rotenone, and hook and line. Most of the fish (84 per cent) were taken between May and September. Sixty-five per cent of the total were collected in August.

Age determinations were made by counting growth rings (annuli) on the pectoral or dorsal spine in a manner similar to that described by Sneed (9). The dorsal spine proved more satisfactory for use in aging catfish because the translucent annuli are more distinct and more clearly separated from the alternating opaque areas than in the pectoral spine. Moreover, dorsal spine annuli are usually concentric and entirely within the cross-section area, whereas those on the pectoral spine are elongated and tend to be cut off at the ends. Ages are given as the number of annuli present on the spine. Thus a fish in age-group II would have two annuli plus any amount of additional growth made after the last annulus was formed. All fish taken between January 1 and the time of annulus formation in the spring or early summer were considered to be one year older than the number of distinct annuli would indicate.

Lengths calculated to year-marks or annuli in scaled fishes give a more accurate picture of growth rates than do the average lengths of fish in each age-group. Sneed (9) recently described a method for calculating such growth in channel catfish. Since calculated data were available for only about one-fourth of the total number of specimens, the average size for each age-group is based upon the lengths of the fish at time of capture. The average lengths presented are, therefore, somewhat greater than they would be if calculated to the last annulus.

In the computation of an average growth rate for the entire state, data from all types of waters were combined. Two or more collections were available from 12 lakes, and weighted means were combined to establish the average lengths of age-groups in the individual bodies of water. The simple average was taken to obtain the average length for each age-group from all bodies of water. The data were grouped and the growth analyzed according to different regions of the state, new impoundments, lakes with no apparent reproduction of catfish, lakes with definite stunted populations, ponds, small lakes, large impoundments, rivers, and turbid and clear waters. Sex data were not available for this study, and whether a consistent sex difference exists in the rate of growth of Oklahoma channel catfish is not known. Appelget and Smith (1) found insignificant differences in average calculated lengths of male and female channel catfish from the Upper Mississippi River.

The legal length of channel catfish in Oklahoma is 10 inches, and those exceeding 24 inches may be taken by commercial fishermen.

Average Size of Age-Groups

The grand average length of channel catfish in each of ten age-groups (I-X), together with the number of fish used for each computation, is shown in Table I. The growth trend drawn from these data is presented in Figure 1.

TABLE I

The Average Empirical Total-lengths for the Various Age-groups of Channel Catfish in Oklahoma Waters
(Based on 4,054 specimens from 50 bodies of water)

	Age-group									
	I	II	III	IV	V	VI	VII	VIII	IX	X
Average total-length (inches)	6.83	10.04	12.67	14.91	16.37	17.65	19.94	21.21	24.17	28.20
Number of specimens	613	1,032	857	705	559	166	74	22	20	5

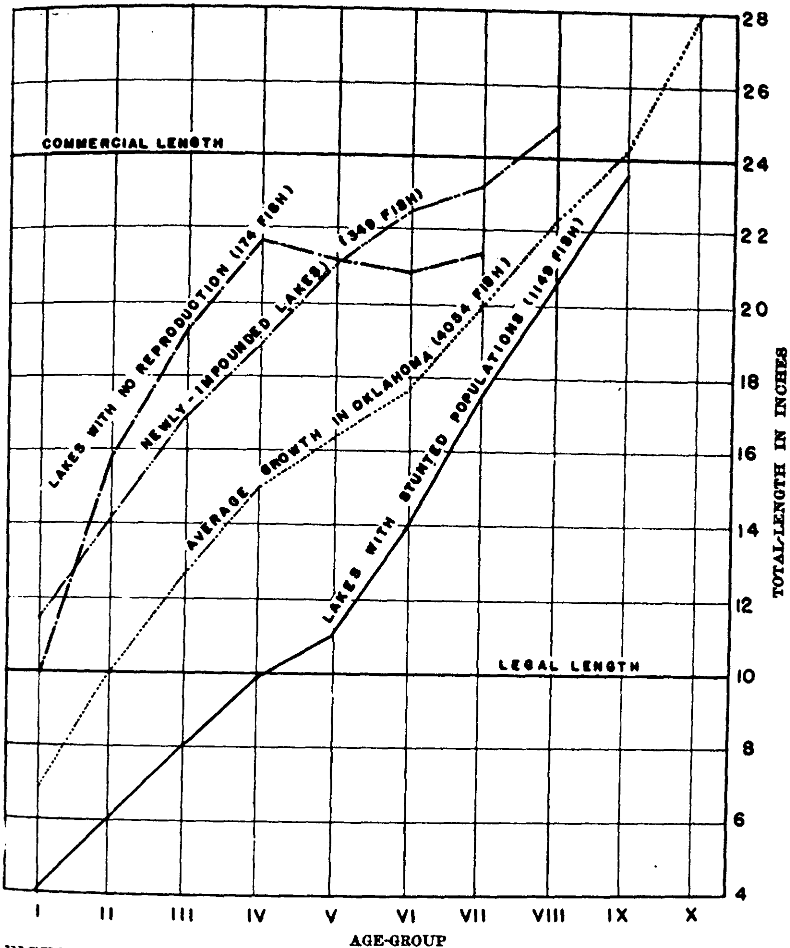

FIGURE 1. Comparison of the Average Growth in Length of Channel Catfish from 50 bodies of Water in Oklahoma with that in 3 New Impoundments, 10 Lakes with no Apparent Channel Catfish Reproduction, and 5 Lakes with Stunted Channel Catfish Populations.

Since age-groups VIII, IX, and X are represented by very few fish, data from them cannot be considered to be representative. The fact that only 47 individuals, or little more than 1 per cent, of the 4,054 specimens used in this study were 8 years old or older would indicate that very few channel catfish reach the age of 8 years in Oklahoma waters or that the collecting methods were selective and failed to take older, larger fish. Based on grand averages (Table I), channel catfish reach legal length during the third summer of life (age-group II), but do not attain commercial length until the 10th summer of life (age-group IX). The latter condition, together with the fact that only 26 of the total were of commercial size, indicates that commercial fishing in Oklahoma is having little or no effect on the sport catch of channel catfish.

Comparable growth data from other states are scarce, that of Appelget and Smith (1) for upper Mississippi River channel catfish being the only major one found in the literature. Comparison (Table II) shows a slightly faster rate of growth by the Oklahoma fish in age-groups I to V, and similar growth in age-groups VI to X. The initial difference may be attributed to a longer growing season in Oklahoma waters than in waters farther north. Calculated growth-rates of Oklahoma catfish (Table II) were based on 1,265 specimens from 10 lakes.

TABLE II

A Comparison of the Growth of Channel Catfish from Oklahoma Waters with Growth in the Upper Mississippi River

Locality and Date	Number of Fish	Average total-length at capture in age-group									
		I	II	III	IV	V	VI	VII	VIII	IX	X
Oklahoma 1948-1952	4,054	6.8	10.0	12.7	14.9	16.4	17.7	19.9	22.2	24.2	28.2
Upper Miss. River 1945-1946	535	—	9.8	11.7	13.7	15.7	18.1	20.9	22.3	24.9	28.0
		Average calculated total-length at end of year of life									
		1	2	3	4	5	6	7	8	9	10
Oklahoma 1949-1952	1,265	4.3	9.0	12.6	14.6	16.6	18.0	21.7	—	—	—
Upper Miss. River 1945-1946	535	2.9	6.3	9.1	11.7	14.2	19.1	21.1	24.0	26.6	28.0

Rate of Growth Under Various Environmental Conditions

Different Regions of the State. According to records from state fish hatcheries at Durant, Bryan County, near the southern border of Oklahoma, and at Byron, Alfalfa County, near the northern edge, fish spawn two to four weeks earlier in the southern part of the state. Knowledge of this difference within the state raised the question of whether the rate of growth of fishes might not be significantly different, also. The state was divided into north and south zones, with the dividing line passing through Oklahoma City. Growth-rate materials from channel catfish were separated on the basis of the two zones, and the averages were obtained for 24 bodies of water in the southern half and 26 in the northern half of the state. Individual lakes with slow or fast growing populations of channel catfish existed in each zone, and comparisons showed no consistent growth-rate differences.

New Impoundments. Data which had been collected during the first and second years of impoundment were utilized from three lakes, each with a surface area of over 2,000 acres (Lake McAlester; Wister and Tenkiller reservoirs) to determine rate of growth in new impoundments. The average rate of growth for channel catfish during the early years of these lakes was very fast (Table III), and far above the state average (Figure 1). The initial effects of impoundment upon the growth of channel catfish in large Oklahoma reservoirs were reported by Jenkins and Leonard (7).

Lakes With No Reproduction of Channel Catfish. Collections from 10 small, clear lakes, all under 100 surface acres, showed that reproduction of channel catfish was apparently not occurring in these waters. In all of these lakes, channel catfish collected were few in number and large in

TABLE III

Comparison of the Growth of Channel Catfish in Oklahoma Waters Under Various Environmental Conditions

Environmental Condition	Number of Waters	Number of Fish	Average Total-Length at Capture in Age-Group									
			I	II	III	IV	V	VI	VII	VIII	IX	X
New impoundments	3	349	11.4	14.2	16.7	18.9	21.2	22.4	23.2	24.7		
Stunted populations	5	1,149	4.2	6.1	7.9	9.9	11.0	14.0	17.5	19.0	23.7	
Ponds (less than 5 acres												
With reproduction	4	142	4.2	6.9	9.1	10.1	11.5	13.6	15.0			
No reproduction	5	23			16.0	19.2	18.7	20.4		21.0	23.7	
Lakes (5-100 acres)												
With reproduction	6	159	5.4	8.1	10.6	14.4	18.0	15.6	17.7	21.5	24.6	25.5
No reproduction	10	174	9.8	15.8	19.4	21.7	21.4	21.1	21.5			30.3
Lakes (100-500 acres)	4	460	5.9	9.4	10.7	12.3	15.1	15.8	20.0	21.8		
Lakes (more than 500 acres)	10	1,304	6.8	9.2	12.3	14.8	17.3	19.6	24.6		22.1	
Rivers	3	294	5.6	8.5	11.5	15.3	17.3	19.9	22.6	25.7	27.0	28.5
Total	50	4,054	6.8	10.0	12.7	14.9	16.4	17.7	19.9	22.2	24.2	28.2

average size. The presence of one-year-old and two-year-old fish in some of these lakes was explained in each case by a record of stocking. The rate of growth displayed by age-groups I through IV was extremely rapid, but beyond age-group IV, little or no increase was evidenced (Table III; Figure 1). The rapid growth exhibited by channel catfish in these lakes was not always accompanied by rapid growth of other species within the same population.

Lakes With Populations of Stunted Channel Catfish. Channel catfish from five large impoundments (Grand, Altus, Okmulgee, Wewoka, and Shawnee lakes) of over 600 surface acres were found to be in very poor condition. In direct contrast to the conditions found in lakes with no reproduction, the population of channel catfish in each of these lakes consisted of a very large number of fish of small average size. The average length at capture in all age-groups was far below average (Table III; Figure 1). In these five lakes, poor growth was found among other species as well as the channel catfish.

Turbid and Clear Waters. Information concerning the relative turbidity of lakes from which collections were made was not available. However, when growth data were separated on the basis of lakes which were known to be usually either clear or very turbid, it was observed that although poor catfish growth was found in some clear waters, the majority of clear lakes showed good growth. On the other hand, in 14 out of 16 definitely turbid lakes, the average rate of growth was below that of the entire state. Above average growth noted in the two exceptions (Lake Overholser and Great Salt Plains Reservoir) may be explained in part by a faster rate of water exchange and consequent closer resemblance to river or ox-bow conditions which afford a more natural habitat for typically stream-dwelling species.

Bodies of Water of Different Size. Growth data were utilized from nine ponds with surface areas less than five acres; 16 lakes from 5 to 100 acres; 4 lakes from 100 to 500 acres; 10 large impoundments with more than 500 acres; and 3 rivers (Table III). In order to show the effects of reproduction upon the growth of fish in similar-sized bodies of water, it was necessary to subdivide the pond and small lake data according to waters with, and those without apparent reproduction.

Environmental factors other than the size of the body of water appear to be responsible for consistent differences in the growth of channel catfish in small and large impoundments. Growth in rivers is somewhat below average in the first four years of life, and above average in succeeding years.

Length-weight Relationship

Data employed in the determination of a length-weight relationship for Oklahoma channel catfish were obtained from 2,891 specimens (Table IV). The collections were made by many different workers using various weighing devices which increased the possibility of inaccurate measurements, especially of smaller specimens. Therefore, data from fish of less than 0.1 pound are not included. The logarithmic expression of the length-weight relationship resulted in the equation:

$$\text{Log } W = -5.2891 + 3.3637 \log L$$

(where W = weight in pounds, and L = total-length in inches.)

Comparison of actual and calculated weights (Table IV; Figure 2) shows reasonably close correspondence between the equation and the empirical data. The greatest differences are found in larger fish and are probably caused by the smaller numbers represented. Examination of the length-weight curve shows that the average channel catfish in Oklahoma waters weighs approximately 0.25 pound when it reaches legal length, and 5.5 pounds when it reaches commercial length.

TABLE IV

Data Employed in the Determination of Length-weight Relationship of Channel Catfish from Oklahoma Waters

LENGTH INTERVAL (INCHES)	NUMBER OF FISH	AVERAGE TOTAL-LENGTH (INCHES)	AVERAGE WEIGHT (POUNDS)	CALCULATED WEIGHT (POUNDS)
7.0- 7.9	373	7.51	0.12	0.11
8.0- 8.9	236	8.43	0.16	0.15
9.0- 9.9	394	9.32	0.23	0.22
10.0-10.9	287	10.53	0.31	0.33
11.0-11.9	244	11.60	0.44	0.46
12.0-12.9	324	12.50	0.58	0.58
13.0-13.9	366	13.59	0.72	0.77
14.0-14.9	25	14.46	0.89	0.95
15.0-15.9	68	15.22	1.00	1.13
16.0-16.9	228	16.46	1.40	1.46
17.0-17.9	101	17.44	1.69	1.78
18.0-18.9	73	18.50	2.09	2.17
19.0-19.9	64	19.32	2.49	2.51
20.0-20.9	15	20.50	3.08	3.07
21.0-21.9	45	21.51	3.69	3.61
22.0-22.9	14	22.20	4.18	4.01
23.0-23.9	11	23.57	5.02	4.91
24.0-24.9	11	24.40	5.65	5.51
25.0-25.9	6	25.50	6.51	6.39
26.0-26.9	2	26.50	7.50	7.28
27.0-27.9	—	—	—	—
28.0-28.9	2	28.50	10.00	9.29
29.0-29.9	—	—	—	—
30.0-30.9	2	30.60	12.00	11.80

The value of the exponent (3.3637) in the logarithmic equation shows that the weight of the channel catfish increases by a power greater than the cube of its length, a condition also found by Appelget and Smith (1) in upper Mississippi River specimens. The average Oklahoma catfish is 15 inches long before it weighs one pound, and beyond that size the weight increases at an accelerated rate in comparison to length. The largest channel catfish in these collections measured 31.5 inches and weighed 13.25 pounds.

DISCUSSION

Comparisons of the various growth rates of channel catfish in Oklahoma waters under varying environmental conditions (Table III) indicates that growth was best in new waters, and in ponds and small lakes where reproduction of this species had apparently not occurred. The poorest growth was exhibited in ponds in which the catfish reproduced, and in some of the larger impoundments where the species was over-populated.

The size of the body of water apparently has little or no effect upon the rate of growth, since good and poor growth rates are found in catfish populations from both small and large bodies of water. Neither was turbidity in itself an absolute criterion of good or poor growth, although better growth was found more often in clear than in turbid waters. Successful reproduction by channel catfish was usually evident in small, muddy bodies of water but never found in small, clear ones. It would appear that in small lakes and ponds better channel catfish angling should result if muddy waters are stocked only initially and clear waters on a periodic replacement basis.

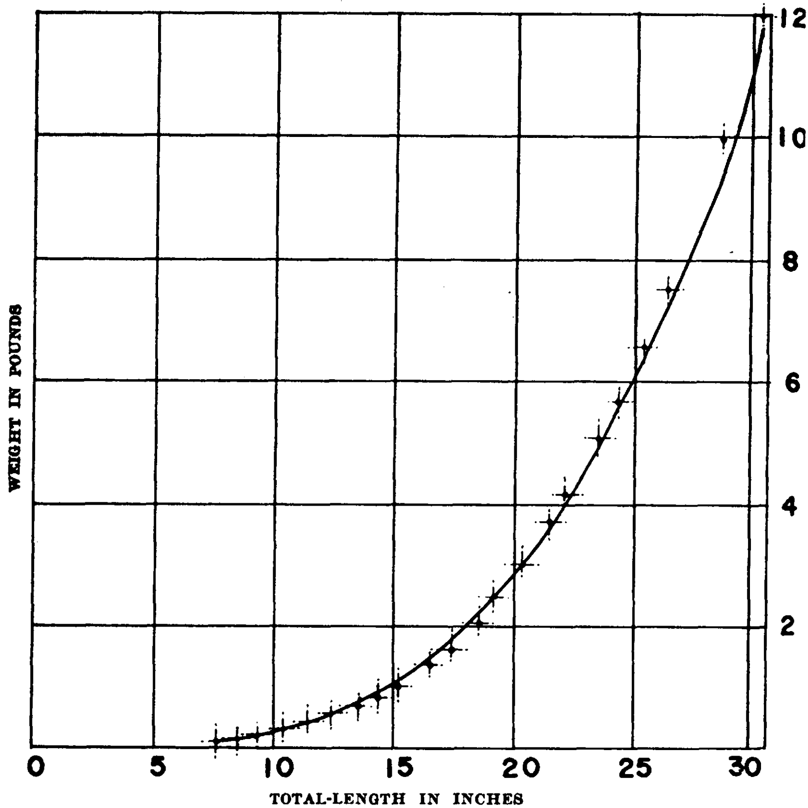

FIGURE 2. Length-weight Relationship of Channel Catfish from Oklahoma Waters. The curve is the graph of the length-weight equation; the dots represent the empirical data.

In lakes of several hundred surface acres, either clear or turbid, reproduction was always evident. The larger lakes with poor growth were generally turbid but, the channel catfish of one clear impoundment of 45,000 acres (Grand Lake) were definitely stunted. In many of the larger lakes with stunted populations, heavy initial and continuous stocking of catfish has usually occurred. Such a practice may have been more detrimental than beneficial, in that it may have tended to hasten over-population and concomitant decline of growth and angling which generally occurs a few years after impoundment. As was recently observed in Tenkiller Reservoir, a new impoundment of the Illinois River, mainstream impoundments nearly always contain a sufficient number of channel catfish for brood stock before inundation. The initial period of both excellent growth and satisfactory angling might be prolonged if additional fish are not planted in new lakes where it has been established by pre-impoundment survey that an ample number were already present.

Acknowledgments

We are indebted to the Oklahoma Game and Fish Department and the University of Oklahoma Biological Survey for use of these data, and to the many persons who aided in their collection. Carl D. Riggs, University of Oklahoma, made helpful suggestions in the preparation of the manuscript.

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