Comparative Age, Growth, and Condition of Channel Catfish from Lake Dardanelle, Arkansas

Thomas M. Freeze[1] and Buford Tatum
Department of Fisheries and Wildlife Management, Arkansas Polytechnic College, Russellville, Arkansas 72801

Abstract

Pectoral spines were collected from 112 channel catfish *Ictalurus punctatus* from Lake Dardanelle, Arkansas, during 1973–1975 for purposes of calculating age and growth of different year classes. A length–weight relationship, determined using the equation log W = –4.3297 + 2.7216 log L, indicated that an average channel catfish from Lake Dardanelle weighs about 165 g when it reaches a harvestable size of 255 mm. Lake Dardanelle channel catfish were characterized by a large first year's growth with greater lengths similar to those from nearby states. Condition factors tended to decrease with increased age.

Introduction

In order to evaluate the ecological effects of the heated water effluent from Arkansas Power and Light Company's nuclear electric generating plant, Arkansas nuclear One, on Lake Dardanelle, it was necessary to establish baseline data on the aquatic fauna prior to the commercial operation of the plant. A ten-year study was initiated in 1973 by Arkansas Polytechnic College with funding from Arkansas Power and Light Company to accomplish that evaluation. While the populations of many organisms were sampled, this paper deals with the age, growth, and condition of Lake Dardanelle channel catfish.

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Description of Study Area

Lake Dardanelle (Fig. 1) is an impoundment of the Arkansas River in west-central Arkansas near the town of Russellville. It is a flow-through reservoir created by the U. S. Army Corps of Engineers as a part of the Arkansas River navigation project. The Arkansas River has its headwaters in the Rocky Mountains of Colorado and flows through Kansas, Oklahoma, and Arkansas before emptying into the Mississippi River approximately 150 km southwest of Memphis, Tennessee. The reservoir has a drainage area of 398,090 km^2, a conservation pool of 13,880 ha, and a shoreline length of 507 km. Completed in 1969, the reservoir is managed primarily for flood control and navigation (McGee 1972).

Materials and Methods

A total of 112 channel catfish spines was collected from Lake Dardanelle during 1973–1975 utilizing gill nets, trammel nets, and rotenone. Total lengths of the fish were recorded in inches, and weights were measured either in grams on dietetic scales or in tenths of pounds on suspension dial scales. All English units of measurements were converted to metric units before computation of data.

Left pectoral spines were disarticulated by means of the procedure outlined by Sneed (1951) and placed in numbered scale envelopes. As the spines were free of all tissue except a thin layer of skin, they received no special treatment or preservation in accordance with DeRoth (1965). The spines were sectioned using a small

[1] Present address: Department of Biological Sciences, Murray State University, Murray, Kentucky 42071.

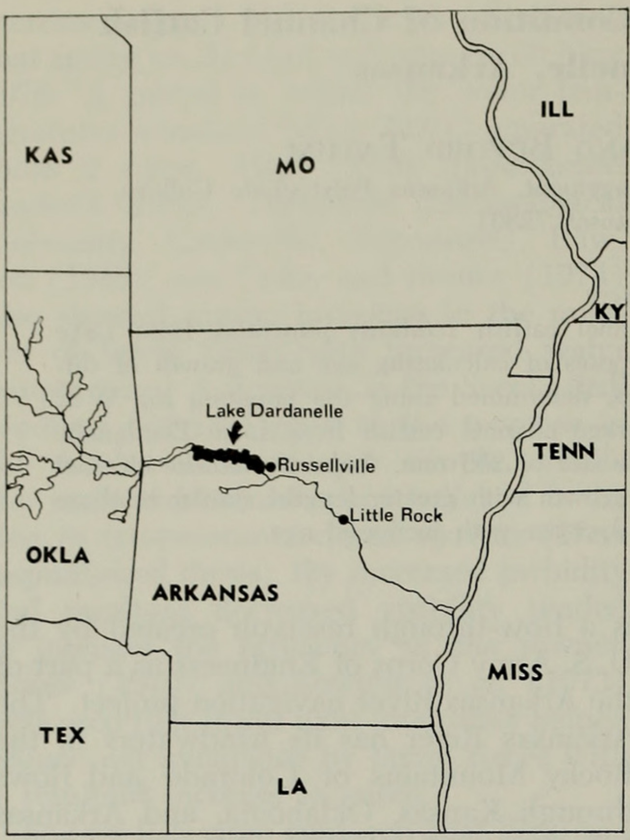

Fig. 1. Location of Lake Dardanelle, an impoundment of the Arkansas River.

power saw on a stationary platform similar to the apparatus of Witt (1961). Unreadable sections were ground by hand on a fine carborundum stone to increase their transparency.

The distal end of the basal recess served as a reference point to ensure consistency in the location of each section (Marzolf 1955, Sneed 1951). That reference point resulted in more readable spine sections and permitted comparisons with previous studies utilizing the same method. One disadvantage in its use is that the body–spine relationship is curvilinear instead of linear (DeRoth 1965).

Approximately one-fourth of the sections were stained with alizarin red S for 3–5 sec before being rinsed with distilled water, but the procedure was discontinued as no apparent advantages in aging the sections were observed.

Spine sections were read with a binocular microscope equipped with an ocular micrometer. Measurements were made from the center of the spine lumen to the annuli and to the edge of the expanded posterior radius.

Measurements of the pectoral spine annuli were used to calculate an average rate of growth utilizing the Dahl–Lea direct proportion method (Carlander 1969). This equation may be stated as:

$$L_n = (S_n)L/S$$

where L_n = length at annulus n, S_n = spine radius at annulus n, S = total spine radius, and L = total body length.

The length–weight relationship was determined using the formula:

$$\text{Log } W = \log a + n \log L$$

where W = weight in grams, L = total length in millimeters, and a and n are empirical constants. The value of the constant n usually is above 3.0 for larger species of catfish such as the channel catfish (Carlander 1969).

The coefficients of condition (K) were computed using the formula:

$$K = 10^5 \times W/L^3$$

where W = weight in grams and L = total length in millimeters. The coefficients provided indexes for comparative analyses of plumpness or well-being of the catfish. Such calculations are based on the premise that the body form of a fish varies with the cube of increasing length provided the shape and specific gravity remain the same (Carlander 1969).

Results and Discussion

The growth of Lake Dardanelle channel catfish, as determined by the Dahl–Lea equation, and the annual lengths for the 1966–1974 year classes are shown in Table 1. The average annual increments decreased gradually from 140 mm the first year to 25 mm the sixth year of life and then gradually increased to 56 mm in the ninth year. The average annual increment for the first year is approximately twice that for any of the following years. While it is normal for channel catfish to attain large percentages of their total lengths during their first 2 years of life, the unusu-

Table 1.—Calculated total lengths (mm) of 112 channel catfish from Lake Dardanelle, Arkansas, 1973–1975

Year class	Number of individuals	Year 1	2	3	4	5	6	7	8	9
1966	5	121	227	292	333	379	406	444	469	533
1967	10	143	229	283	326	374	414	453	482	
1968	13	155	230	277	330	378	427	410		
1969	28	139	207	269	322	385	374			
1970	25	144	215	276	332	348				
1971	14	145	226	289	328					
1972	12	124	195	230						
1973	4	90	163							
1974	1	102								
Average Lengths		140	213	274	328	371	396	432	477	533
Average Annual Increments		140	73	61	54	43	25	36	45	56

ally large first year's growth has resulted in greater lengths of Lake Dardanelle channel catfish than those in several nearby states for their first 4 years of life (Table 2). After the fourth year of life, the growth was approximately equal to or below that of catfish in the other lakes.

All of the studies in Table 2 were conducted on man-made reservoirs. Many of the 16 reservoirs that made up the Oklahoma study are in the same watershed as Lake Dardanelle but are closer to the headwaters of the Arkansas River. Thus, their location relative to the headwaters might result in their being less fertile than Lake Dardanelle. Each of those 16 reservoirs had been impounded more than 4 years and was labeled as old by Finnell and Jenkins (1954), and age was cited by them as the reason for the below average growth of channel catfish as compared to other Oklahoma waters.

The Lake of the Ozarks is farther north than any of the other reservoirs and that may account for the poor growth of channel catfish there. Other environmental factors undiscussed by Marzolf (1951) such as age, turbidity, and extent of reproductive success may also have acted to depress the rate of growth.

Both Norris Lake, in the eastern mountains of Tennessee, and Kentucky Lake, bordering the Jackson Purchase Area of Kentucky, were considerably older than Lake Dardanelle when they were sampled. Those conditions, plus differences in lati-

Table 2.—Calculated total lengths (mm) of channel catfish from Lake Dardanelle, Arkansas, 1973–1975 compared with data from other studies

Location	Number of individuals	Calculated total lengths at end of year 1	2	3	4	5	6	7	8	9
Dardanelle Reservoir	112	140	213	274	328	371	396	432	477	533
16 Oklahoma Reservoirs (Finnell and Jenkins 1954)	3,291	91	178	249	305	363	417	472	531	577
Norris Reservoir, Tenn. (Carroll and Hall 1964)	87	99	175	272	325	373	424	457	541	
Lake of the Ozarks, Mo. (Marzolf 1951)	434	53	109	155	196	234	264	292	330	
Kentucky Lake, Ky. (Matthai 1972)	615	89	188	259	310	356	404	455		

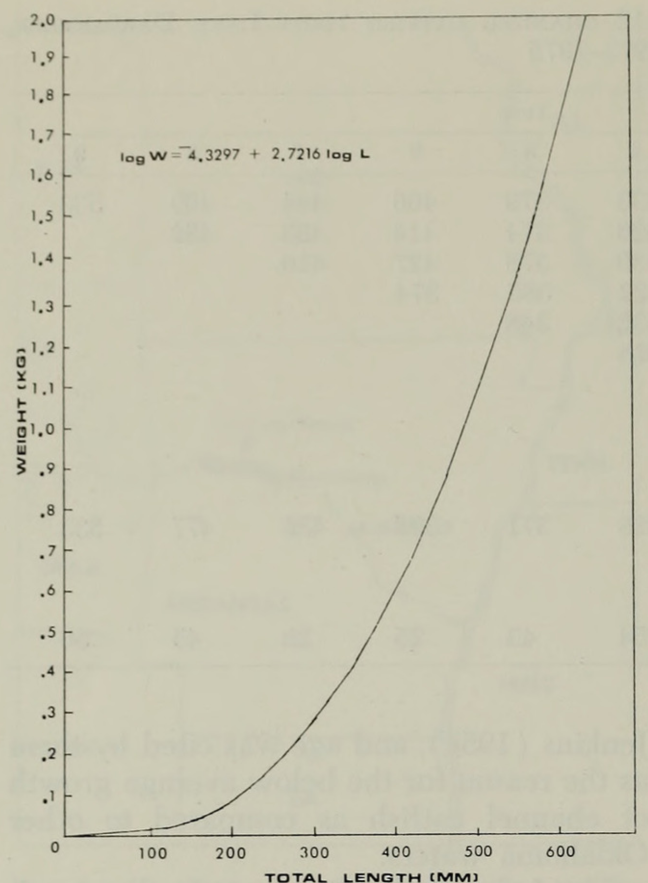

Fig. 2. Length–weight relationship of channel catfish from Lake Dardanelle.

Table 4.—Average condition factors (k) of channel catfish in Lake Dardanelle, Arkansas, for 1973–1975

Age (years)	K
1	1.17
2	1.07
3	0.99
4	0.94
5	0.85
6	0.88
7	0.83
8	0.86
9	0.82

tudes, may account for some of the variations in length attainments. While the channel catfish from Norris Lake came from a balanced population (Finnell and Jenkins 1954), the fish from Kentucky Lake were stunted as evidenced by the retardation in growth reported by Matthai (1972). Also, Lake Dardanelle being a very recently formed body of water, is experiencing what fishery biologists refer to as "peak growing conditions" due to the increased fertility of the water associated with the decay of inundated vegetation.

The length–weight relationship (Fig. 2) was calculated from 112 channel catfish ranging from 102 to 533 mm. This relationship can be expressed by the equation:

$$\text{Log W} = -4.3297 + 2.7216 \log \text{L}.$$

Channel catfish from Lake Dardanelle weighed approximately 165 g upon reaching a harvestable size of 255 mm. At 380 mm, they weighed about 500 g and at 510 mm approximately 1,080 g (Table 3).

Average coefficients of condition (K) for fish from Lake Dardanelle (Table 4) tended to decrease with an increase in age except between the fifth and sixth and between the seventh and eighth years of life. It is believed those discrepancies are due to the small sample size of older fish. The slope in the length–weight regression was less than 3.0 indicating that a decrease in condition should occur with an increase in length as observed here, since length is related to age (Carlander 1969).

In comparison, the average coefficient of condition of channel catfish from Norris Lake was erratic, while that of Kentucky Lake decreased with an increase in age until the third year of life and then increased steadily. Average coefficients of condition for channel catfish were not

Table 3.—Average total lengths (mm) and weights (g) of channel catfish from Lake Dardanelle, Arkansas, 1973–1975

	Age								
	1	2	3	4	5	6	7	8	9
Average length	102	163	230	328	348	374	410	482	533
Average weight	12	46	121	332	358	460	572	963	1,235
No. of individuals	1	4	12	14	25	28	13	10	5

reported by Finnell and Jenkins (1954) or Marzolf (1951).

In conclusion, the channel catfish population of Lake Dardanelle, prior to commercial operation of Arkansas Nuclear One generating plant, exhibited a large first year's growth, other length attainments comparable to studies from nearby states, and condition factors that tended to decrease with an increase in age. In most aspects, the channel catfish of Lake Dardanelle could be considered normal. However, it should be noted that the lengths of Lake Dardanelle catfish may decrease with the natural aging of the reservoir and the resultant decrease in nutrients over an extended period of time.

More recent data on the aquatic fauna of Lake Dardanelle including the channel catfish are being collected by Mr. Buford Tatum.

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