Age and Growth of the River Carpsucker, Carpiodes carpio Rafinesque, of Lake Texoma[1]

J. CARL BASS and CARL D. RIGGS, University of Oklahoma, Norman

INTRODUCTION

Data for this study were collected from June 8, until August 6, 1949. The work was part of a biological survey of parts of Lake Texoma conducted by the University of Oklahoma cooperating with the U. S. Army

[1] Part of a thesis submitted in partial fulfillment of the requirements for the M.S. degree at the University of Oklahoma under the direction of Dr. Carl D. Riggs.

Corps of Engineers and the Oklahoma Game and Fish Department. Personnel was headquartered on a barge (68 by 24 feet) which was moved about the lake to the various stations chosen for the survey.

LAKE TEXOMA. Lake Texoma, a 95,000-acre reservoir, is impounded by the Denison Dam which is located on the Red River just below the confluence of the Washita and Red Rivers, Bryan County, Oklahoma, and Grayson County, Texas. More complete descriptions of Lake Texoma are given by the U. S. Department of Interior (1941), the Oklahoma Planning and Resources Board (1946; 1953), and the U. S. Army Corps of Engineers (1948).

THE COLLECTING STATIONS. Eight locations on Lake Texoma were selected as collecting stations. These areas were selected to represent several of the types of aquatic habitats which exist in the lake. They have been designated as "stations" and were numbered chronologically in the order in which they were worked. Approximately one week (± two days) was devoted to collecting at each station.

Station 1 — mouth of Rock Creek on Washita River arm of lake. Water very turbid. Bottom mostly of silt; sand and gravel in some areas of the creek.

Station 2 — Newberry Creek. Water very clear. Coves and the main channel deep with steeply sloping shores and bottoms. Bottom mostly sand and gravel; silt prevalent in some areas.

Station 3 — near upper end of Big Glasses Creek. Water slightly turbid. Bottom mostly sand and gravel with some rocks and silt. Water shallow; slope of bottom gentle.

Station 4 — Cold Spring Creek. Water very clear. Bottom primarily sand. Shore formed of cut sand banks and sand beaches. Depth variable, many shoals, coves and deep areas with steeply sloping bottoms.

Station 5 — just above mouth of Hickory Creek. Water slightly turbid. Bottom clay-silt with mixed soils along the shore. There were shallow flats with sand bottoms, steep cliffs of sandstone, limestone banks and low sloping clay banks.

Station 6 — Buncombe Creek. Water deep and clear. Bottom of deep parts of creek silt; bed rock, boulders and gravel and sand-bottom shoals present.

Station 7 — around Island 2 (second from northwest end) of a chain of islands, approximately 8 miles long, in the Red River arm. Water clear. Shores low; sand beaches. Bottom of sand. Depth varied from shallow shoals and coves on the side toward the Oklahoma mainland, to areas of considerable depth (at least 52 feet) on the Texas side.

Station 8 — Caney Creek. Water deep and clear. Bottom along shore bed-rock and boulders; silt in deeper areas. Steep wooded banks, composed generally of limestone.

MATERIALS AND METHODS

During this study, 615 river carpsuckers were collected. Ten gill nets were used for this collecting. These included: two experimental nets, 125 by 6 feet, and of five 25-foot lengths of ¾-, 1-, 1¼-, 1½-, and 2-inch bar or square mesh; two nets, 210 by 8 feet, and of 1-inch bar mesh; two nets, 210 by 8 feet, and of 1½-inch bar mesh; two nets, 210 by 8 feet, and of 2-inch bar mesh; one net, 210 by 8 feet, and of 2½-inch bar mesh; and one net, 150 by 10 feet, and of 4-inch bar mesh. The nets were weighted to sink, and the addition of supplementary floats was necessary for surface nets. In addition to the gill nets, one fyke net and five seines were used, but they took only three river carpsuckers.

All the nets were in good condition when the netting was started. The experimental nets, the 1½-inch-mesh nets, and the 2-inch-mesh nets were in poor repair by the end of the project, despite regular repairs.

A total of 141 collections was made during the summer: 110 by gill nets, nine with the fyke net, 14 with the bag seine, 5 with common-sense seines and 3 with the small seines and the trawl. River carpsuckers were captured in 84 of the 110 gill-net collections, the number per collection varying from 1 to 57.

Of the 615 river carpsuckers collected, 604 were used in the age and growth computations. Of these, 601 were taken in gill nets, two in the fyke net and one in the bag seine. The 1½-inch-mesh gill nets proved most effective for collecting the greatest numbers of the various species captured, including the river carpsucker. For this reason they were used more often than the other nets, although it was realized that the selectivity of the net for fish of a certain size range would affect the randomness of the sample.

All fish were weighed on direct-reading platform balances calibrated in gram or 25-gram intervals. Measurements of standard-length (from the tip of the snout to a crease in the caudal peduncle formed by flexing the caudal fin) and total-length (from the tip of the snout to the extreme tip of the depressed caudal fin) were made for all fish on a conventional fish-measuring board. Scale samples were taken from the left side of the fish immediately above the lateral line and from an area at the tip of the pectoral fin when the latter was naturally compressed against the side of the body. Scales for each fish were placed in envelopes on which other pertinent data such as sex, date of collection, collection number, and station number were recorded.

The scales were prepared for age and growth determination by soaking them in water for a sufficient time to dissolve the dried mucus and other extraneous material which was clinging to them. They were then wiped with a soft cotton cloth and placed in a temporary water mount between two microscope slides. No attempt was made to make permanent slides, but the scales were saved.

Those scales examined were selected for their symmetry, clearness of markings and average size in relation to the other scales of the sample. Year marks (annuli) were often difficult to identify because of the frequency of false annuli. In many cases the latter were identified by the fact that they were not as definite as the true annuli and by a relative lack of crossing-over of the circuli. Often they were in locations unreasonable for annuli and not comparable to scales of similar size from fish of similar size. No scale samples were discarded as unreadable.

A microprojector, like that described by Van Oosten, Deason, and Jobes (1934), and pictured by Lagler (1950) was used for age determination and scale measurements. The magnified scale images (X 43) were projected on an opal-glass screen. The positions of the annuli and the scale margins were marked on paper strips which were placed over the scale image on the screen. A separate strip was used for each scale; one corner was placed on the focus, its edge bisecting the dorsal margin of the scale. There were no marks or radii in the dorsal field which could be used to locate lines of measurement so the center of the dorsal field was used for consistency. Examination showed that the lateral fields (dorsal and ventral) exhibited less variation of dimensions than the anterior or posterior fields, and that the annuli were better developed in the lateral fields. The dorsal field was used for the sake of consistency, and its selection, rather than the ventral, was arbitrary.

ASSESSMENT OF AGE. The validity of the scale-method of determining the age and calculating the growth-rate of fishes has been proved for many species including several of the suckers (Catostomidae): e. g., Frey and Pedracine (1938) for the bigmouth buffalo *(Ictiobus cyprinellus)*, black buffalo *(I. niger)*, and smallmouth buffalo *(I. bubalus)*; Spoor (1938) for the white sucker *(Catostomus commersonni)*; Eschmeyer, Stroud, and Jones (1944) for the largemouth, black, and smallmouth buffalo, river carpsucker *(Carpiodes carpio)*, *quillback (C. cyprinus)* and golden redhorse *(Moxostoma erythrurum)*; Schoffman (1944) for the smallmouth buffalo; Jenkins (1949) for the river carpsucker; and others. Because of the results of these studies, and because those criteria which may determine the validity of annuli as year marks (summarized by Hile, 1941) could be successfully applied to the river carpsucker, the scale-method was used for age and growth determination of all fish in this study.

The proposals of Hubbs (1944) were followed in assessing the ages of river carpsucker used in this study. Therefore, all fish that had lived past January 1 of their first year of life (but not the second) were considered to be in age-group I if the scales bore 0 or 1 annulus; fish that had lived past January 1 of their second year of life (but not the third) were considered to be in age-group II, if the scales bore 1 or 2 annuli, etc. Whether a fish has lived past January 1 of any given year of life can be determined by the collection date plus the number of annuli and the amount of growth between the latest annulus and the scale margin.

AGE COMPOSITION

LENGTH-FREQUENCY DISTRIBUTION. Within the sample used here the length range of the river carpsucker within each age-group was rather great. The overlap of total-lengths (Table I) between consecutive age-groups was so great that the length-frequency method has almost no value in determining age. It has been stated that length is a poor index of age (Hile, 1936), and this statement appears to be applicable to the river carpsucker in Lake Texoma.

The fact that very few young fish or old, large fish were taken complicates this study of age and growth. No river carpsucker in age-group O was taken, and only two in age-group I. More than half of the fish (327) were in age-group III (Table II). It is very probable that the selectivity of the collecting methods used was responsible to a large degree for the dominance of age-group III and the dearth of age-groups I and II. However, it is almost certainly not the entire explanation. Yearling fish should have been taken by either the fyke net or the smaller meshes of the experimental gill nets, and some of the members of age-groups 0 or I should have been taken in seines had the proper habitats been seined at the right time. A better knowledge of the life history of this species would undoubtedly result in larger collections of the smaller, younger fish. Other workers have failed to capture sufficient numbers of the younger age-groups; e. g., Eschmeyer, Stroud, and Jones (1944) reported failure in taking river carpsucker of age-group 0, but they took several yearlings. In this study, only nineteen river carpsucker of age-group V were taken, and only one in age-group VI (Table II). The collections made with gill nets of larger mesh sizes (2½- and 4-inch mesh) were too few to sample adequately the population of the larger and older fish.

Table I. Length frequency distribution for 604 river carpsucker

Total-length interval	Avg. total-length (mm)	Avg. total-length inches	Age-group						Number of fish
			I	II	III	IV	V	VI	
130-139	130	5.1	1						1
140-149									
150-159									
160-169	167	6.6		1					1
170-179	176	6.9		13	1				14
180-189	186	7.3	1	7					8
190-199	194	7.6		5					5
200-209	203	8.0		18					18
210-219	213	8.4		15	3				18
220-229	226	8.9		14	8				22
230-239	235	9.3		12	10				22
240-249	243	9.6		18	15				33
250-259	255	10.0		16	43	2			61
260-269	264	10.4		8	59				67
270-279	274	10.8		3	43	1			47
280-289	283	11.2		3	34	1			38
290-299	294	11.6			19	3			22
300-309	304	12.0			18	2			20
310-319	315	12.4			15	8	1		24
320-329	325	12.8			20	24			44
330-339	334	13.2			18	22	3		43
340-349	344	13.6			13	26	1		40
350-359	354	13.9			4	18	1		23
360-369	364	14.3			2	10	2		14
370-379	375	14.8			2	1	2		5
380-389	384	15.1				1	2		3
390-399	394	15.5				1	1		2
400-409	400	15.8				2	1		3
410-419	416	16.4					1	1	2
420-429	420	16.6					1		1
430-439	435	17.1					2		2
440-449									
450-459									
460-469	462	18.2					1		1
Totals			2	133	327	122	19	1	604

Table II. Average calculated total-lengths in millimeters, average calculated weights in grams and average increments in calculated total-lengths and weights for each age-group of 604 river carpsucker captured in Lake Texoma, 1949.

Age-group	Year-class	Number of fish	Average calculated total-length (mm.) at end of each year of life					
			1	2	3	4	5	6
I	1948	2	103					
II	1947	133	99	174				
III	1946	327	90	174	240			
IV	1945	122	86	168	237	300		
V	1944	19	74	164	259	313	367	
VI	1943	1	64	125	188	276	338	381
Grand average calculated total-lengths			91	172	240	302	365	381
Equivalent total-lengths in inches			3.6	6.8	9.4	11.9	14.4	15.0
Increments of grand average total-lengths				81	68	62	63	16
Average weights, calculated from grand average total-lengths			4.3	45.1	155.2	364.2	735.9	863.0
Equivalent calculated weights in ounces			0.1	1.6	5.5	12.8	26.0	30.0
Increments of calculated weights in grams				40.7	110.2	209.0	371.7	127.1
Equivalent increments of calculated weights in ounces				1.4	3.9	7.4	13.1	4.5
Number of fish		604	604	602	469	142	20	1

Body-Scale Relationship and Calculation of Growth

Calculations of the total-lengths of the river carpsucker were made, assuming a direct and constant relationship between the scale-length and body-length, by use of the following formula (Van Oosten, 1929):

$$\frac{\text{Length of the scale included in annulus of year x}}{\text{Total-length (focus to margin) of scale}} = \frac{\text{Length of fish at the end of year x}}{\text{Length of fish at time of capture}}$$

Total-lengths for each year of life (length of fish at the end of year X, in formula above) were computed for individual river carpsucker. Averages of these calculated lengths show that the river carpsucker in this sample (Table II; Figure I) reached 3.6 inches at the end of the first year of life, and 6.8, 9.4, 11.9, 14.4, and 15.0 inches during successive years.

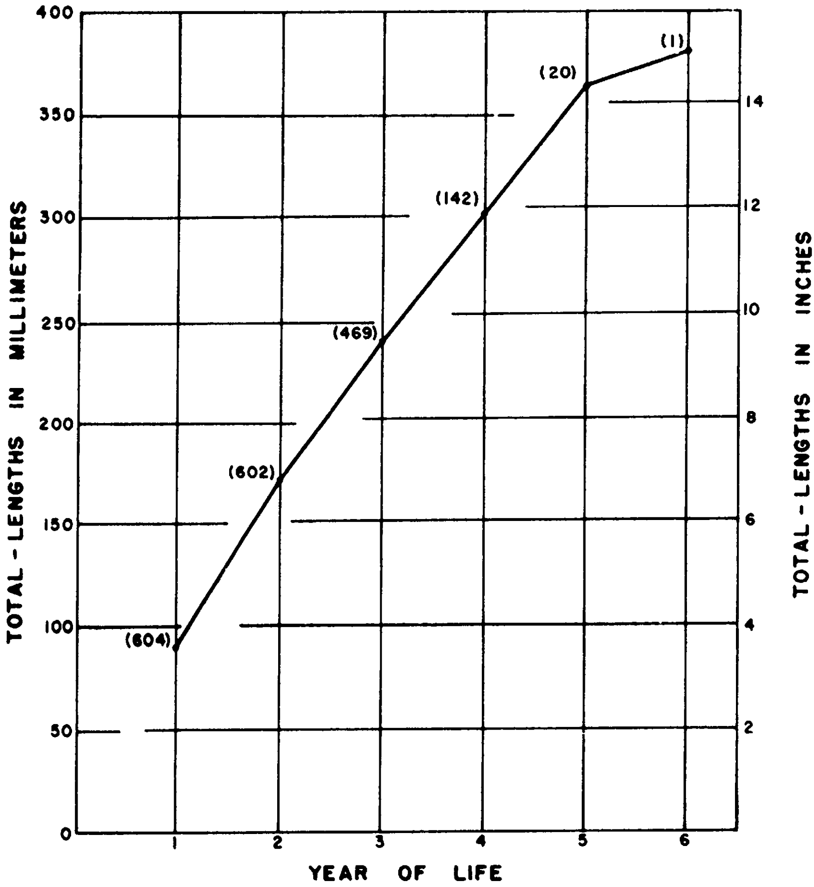

Figure 1. Calculated total-lengths attained by river carpsucker of Lake Texoma at the ends of different years of life. Data for both sexes are combined. Numbers in parentheses indicate the number of fish used in calculations. (Based on data presented in Table VIII).

Calculated total-lengths of the males (Table III; Figure 2) and females (Table IV; Figure 2) were tabulated separately for comparison. Examination of the calculated lengths of each sex show the average calculated total-lengths of the females to be generally greater than those of the males of the same year of life. The average total-lengths of the males at the end of each of the five years of life were 3.6, 6.8, 9.3, 12.0, and 13.5 inches respectively; corresponding averages for the females were 3.7, 7.0, 9.8, 11.9, 13.8, and 15.0 inches.

Lee's phenomenon, an apparent decrease in the calculated growth in the earlier years of life determined from successively older groups of fish, is well demonstrated by the data presented in Tables II, III, and IV. In this sample there is a decrease in the average calculated total-lengths of successively older age groups at the ends of the various years of life for any given year. The decrease is regular for the first and second years; irregular for the later years. No attempt is made to explain the occurrence of this phenomenon in this sample.

In an effort to prove the assumption of the existence of a direct and continuous relationship between the increase of length of the river carpsucker and the annual increment in the dimensions of the scales, a mathematically determined regression line was computed for total-lengths (Figure 3), based on the data on body-scale relationships included in Table V.

Table III. Average calculated total-lengths for each age-group of 316 male river carpsucker collected in Lake Texoma, 1949.

Age-group	Year-class	Number of fish	Average calculated total-length (mm.) at end of each year of life. 1	2	3	4	5
I	1948	1	116				
II	1947	73	96	171			
III	1946	179	91	175	241		
IV	1945	56	86	167	222	306	
V	1944	7	69	146	211	293	342
Grand average calculated total-lengths			91	172	236	304	342
Equivalent total-lengths in inches			3.6	6.8	9.3	12.0	13.5
Increments of grand average calculated total-lengths				81	64	68	38
Equivalent increments in inches				3.2	2.5	2.7	1.5
Number of fish		316	316	315	242	63	7

Table IV. Average calculated total-lengths for each age-group of 245 female river carpsucker collected in Lake Texoma, 1949.

Age-group	Year class	Number of fish	Average calculated total-length (mm.) at end of each year of life					
			1	2	3	4	5	6
I	1948	0						
II	1947	41	104	181				
III	1946	131	91	180	247			
IV	1945	61	91	172	246	302		
V	1944	11	85	154	272	301	351	
VI	1943	1	64	125	188	276	388	381
Grand average calculated total-lengths			93	177	248	301	350	381
Equivalent total-lengths in inches			3.7	7.0	9.8	11.9	13.8	15.0
Increments of grand average total-lengths				84	71	53	49	31
Equivalent increments in inches				3.3	2.8	2.1	1.9	1.2
Number of fish		245	245	245	204	73	12	1

The formula, $L = a + bs$, was employed in calculating points of the regression line, where:

L = total-length of the fish,
s = scale length (focus to margin),
a = a constant to be derived,
b = a constant to be derived.

To obtain the constants, "a" and "b", the two equations below were solved simultaneously;

$$L = Na + b\,s$$
$$LS = a\,s + b\,s^2$$

where: L = summation of empirical total-lengths of the fish,
S = summation of scale-lengths,
S^2 = summation of the squares of scale-lengths,
N = number of fish.

Table V. Body-scale relationship (L/Sc) of 604 river carpsucker collected in Lake Texoma, 1949.

(Data for both sexes combined)

Total-length interval (10 mm.)	Average total-length (mm.)	Average scale-radius (X 43)	Body-Scale relationship (L/Sc)	Number of fish
130-139	130	110	1.1818	1
140-149				
150-159				
160-169	167	141	1.1843	1
170-179	176	159	1.1053	14
180-189	186	160	1.1568	8
190-199	194	168	1.1585	5
200-209	203	173	1.1926	18
210-219	213	180	1.1809	18
220-229	226	193	1.1718	22
230-239	235	199	1.1535	22
240-249	243	204	1.1964	33
250-259	255	217	1.1817	61
260-269	264	225	1.1756	67
270-279	274	230	1.1902	47
280-289	283	236	1.2005	38
290-299	294	247	1.1901	22
300-309	304	256	1.1887	20
310-319	315	277	1.1830	24
320-329	325	270	1.2010	44
330-339	334	276	1.2009	43
340-349	344	283	1.2164	40
350-359	354	289	1.2258	23
360-369	364	305	1.1915	14
370-379	375	324	1.1580	5
380-389	384	307	1.2519	3
390-399	394	341	1.1539	2
400-409	400	292	1.3698	1
410-419	416	371	1.1199	4
420-429	420	384	1.0937	1
430-439	435	358	1.2136	2
440-449				
450-459				
460-469	462	314	1.4713	1
Total				604

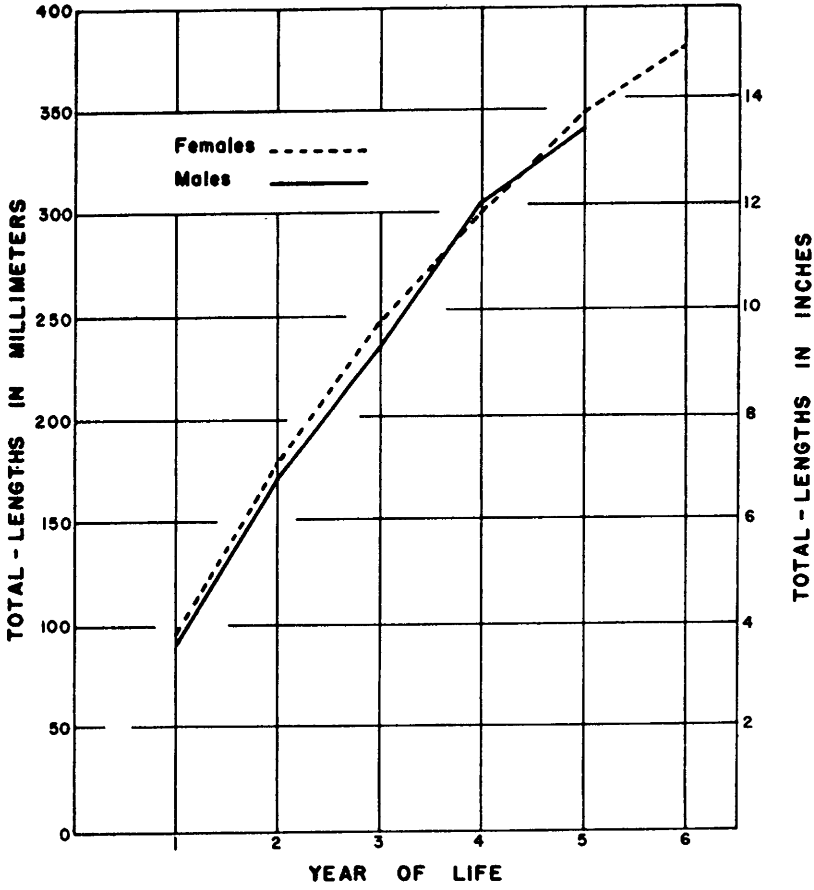

Figure 2. Calculated total-lengths attained by male and female river carpsucker of Lake Texoma at the ends of different years of life. (Based on data presented in Tables IX and X).

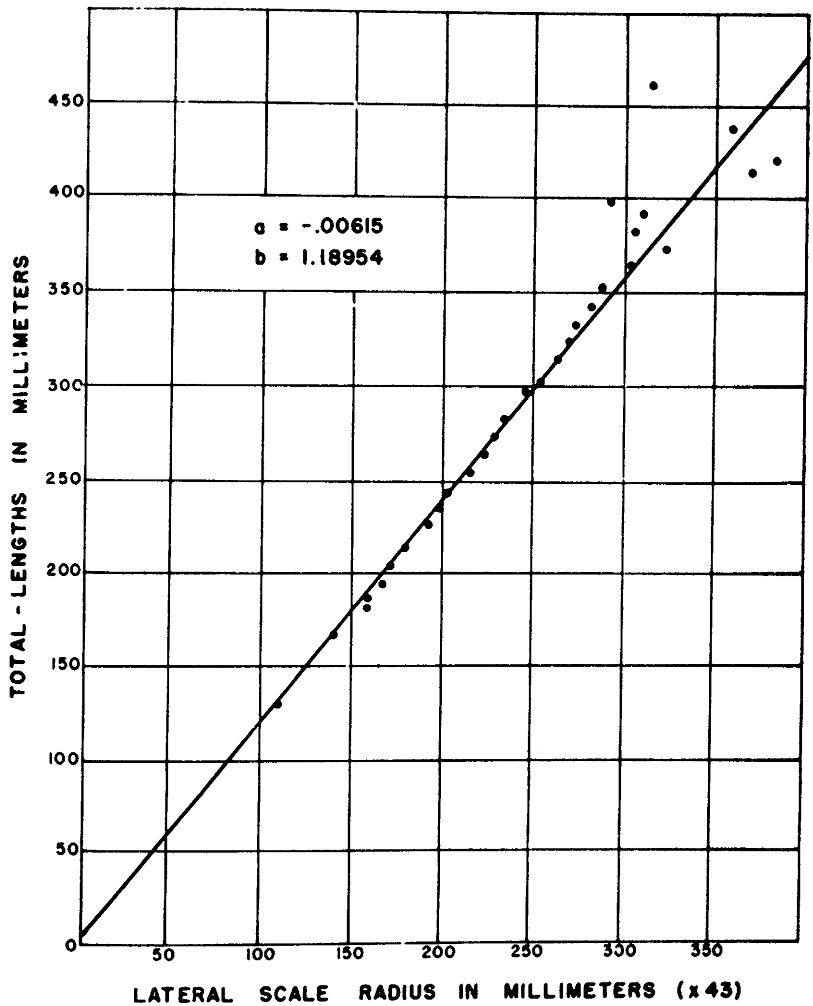

Figure 3. Body-scale relationship of 604 river carpsucker collected in Lake Texoma, 1949.

The regression line for the total-length data fits rather well. The values of the constant "a", (-.00615), and "b", (1.18954), were substituted in the formula, L = a + bs, in calculating the points for the body-scale relationship (Figure 3).

The total-length calculations (Table VI) were tabulated for those river carpsucker collected at each station in an effort to show any effects of relatively good or poor environmental areas of Lake Texoma. Since the numbers of river carpsucker captured at Stations 2, 4, and 8 (Table VI) were quite small, the calculated total-lengths are less apt to represent those of the immediate population than do those of the samples taken at the other stations. Samples collected at the other stations were much

Table VI. Grand average calculated total-lengths for each year of life of river carpsucker collected at each station, Lake Texoma, 1949. Average increments for each year of life included.

Station number	Number of fish	Average calculated total-length (mm.) at end of each year of life					
		1	2	3	4	5	6
1	58	92	164 *(72)	231 (67)	308 (77)		
2	8	94	169 (75)	242 (73)	316 (74)		
3	81	94	180 (86)	244 (64)	307 (63)	329 (22)	
4	20	88	178 (90)	250 (72)	282 (32)	299 (17)	
5	245	87	167 (80)	239 (72)	305 (66)	357 (52)	381 (24)
6	58	97	178 (81)	238 (60)	288 (50)		
7	113	95	180 (85)	249 (69)	303 (54)	385 (82)	
8	21	94	184 (90)	252 (68)	300 (48)		
Weighted grand average calculated total-lengths		91	173	240	303	354	381
Increments of grand average calculated total-lengths			82	67	63	51	27
Number of fish	604	604	602	469	142	20	1

* Numbers in parentheses represent the increment of growth in calculated total-length for the designated year of life at that station.

larger, however, and a comparison of the grand average calculated total-lengths of fish captured at each station (Table VI) indicates that growth in length was better at certain stations than at others. It does not seem, however, that the data are sufficient for any definite conclusions.

Diagrams such as that in Figure 4 are popularly used to indicate the trend of events in the growth history of a species for the various year-classes. However, the use of this method to indicate these phenomena depends upon a more representative sample collected over a period of several years. Figure 4 does show at least part of the growth histories of the six year-classes represented in this sample, and the curves for the first two age-groups illustrate Lee's phenomenon.

LENGTH-WEIGHT RELATIONSHIP. In expressing the length-weight relationship of 604 river carpsucker of Lake Texoma, the formula, $W = CL^n$ (Hile, 1936) was employed, where:

W = weight in grams,
L = total-length in millimeters,
C = a constant to be derived,
n = a constant to be derived.

The logarithmic expression of the relationship of total-length to weight resulted in the equation: $\text{Log } W = -6.64600 + 3.71263 \text{ Log } L$.

Comparison of the calculated weights with the actual weights shows fairly close agreement in those instances where there is a large number of individuals; the deviations are greater in those total-length intervals where the numbers of fish are small (Table VII). The greatest differences are found among the larger fish and probably reflect the greater ranges of lengths and weights among these groups.

The length-weight relationship, as expressed graphically, using total lengths only, does not show the deviations of the calculated weights from the empirical weights as would a logarithmic expression, since the points represent the mean calculated weights for total-length intervals of 10 millimeters (Figure 5).

COEFFICIENT OF CONDITION. The coefficient of condition, C(TL), for total length of the river carpsucker in this sample was determined by using the formula:

$$C(TL) = \frac{100{,}000\ W}{L^3}$$

where:

$C(TL)$ = condition index, using total-lengths,

W = average weights of the fish in the corresponding total-length interval,

L^3 = the cube of the average total-length in an interval.

Total lengths were converted from millimeters to inches and tenths, and the weights were converted from grams to pounds and hundreths. The objective of adjusting the weights is to bring the values to near unity. The mean of the values of C(TL) of this sample of river carpsucker is 45.3, and the range is from 39.2 to 52.4. According to these data (Table VIII) there is no consistent change in the condition of the river carpsucker of Lake Texoma with increasing size or age.

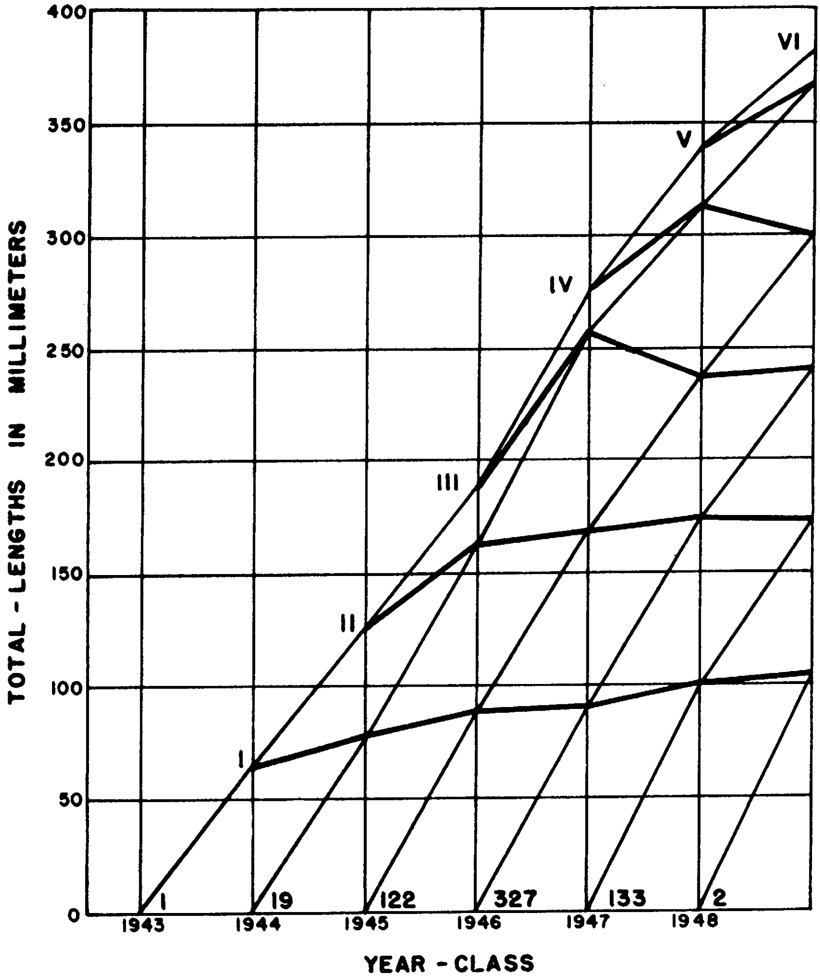

Figure 4. Six-year (1943-1948) growth history of 604 river carpsucker collected in Lake Texoma, 1949. Heavy lines connect calculated total-lengths for different age-groups of the six year-classes. Arabic numerals indicate the numbers of fish used in calculations. (Based on data presented in Table VIII).

Table VII. Length-weight relationship of 604 river carpsucker collected in Lake Texoma, 1949. Data for both sexes combined in 10-millimeter total-length intervals

Total-length interval (10 mm.)	Avg. total-length (mm.)	Equivalent total-length (inches)	Average empirical weight (grams)	Calculated weight in grams	Calculated weight in ounces	Number of fish
130-139	130	5.1	27	15.9	0.6	1
140-149						
150-159						
160-169	167	6.6	60	40.4	1.4	1
170-179	176	6.9	70	49.1	1.7	14
180-189	186	7.3	87	60.2	2.1	8
190-199	194	7.7	98	70.4	2.5	5
200-209	203	8.0	106	83.3	3.0	18
210-219	214	8.5	121	100.4	3.5	18
220-229	226	8.9	152	121.3	4.3	22
230-239	235	9.3	162	143.5	5.1	22
240-249	244	9.6	183	165.0	5.8	33
250-259	255	10.1	207	194.4	6.8	61
260-269	264	10.4	232	221.1	7.8	67
270-279	274	10.8	253	253.8	9.0	47
280-289	283	11.2	280	286.1	10.1	38
290-299	295	11.6	309	329.7	11.6	22
300-309	304	12.0	349	373.2	13.2	20
310-319	315	12.4	380	425.9	15.0	24
320-329	325	12.8	426	478.3	16.9	44
330-339	334	13.2	472	529.4	18.7	43
340-349	344	13.6	492	590.6	20.8	40
350-359	354	13.9	528	656.9	23.2	23
360-369	364	14.3	586	728.5	25.7	14
370-379	375	14.8	640	813.6	28.7	5
380-389	384	15.1	611	888.5	31.4	3
390-399	394	15.5	813	678.5	34.4	2
400-409	400	15.7	780	1034.0	36.5	1
410-419	416	16.4	929	1196.0	41.5	4
420-429	420	16.5	1000	1249.0	43.4	1
430-439	435	17.2	1025	1412.0	49.1	2
440-449						
450-459						
460-469	462	18.2	819	1765.0	62.3	1
Number of fish						604

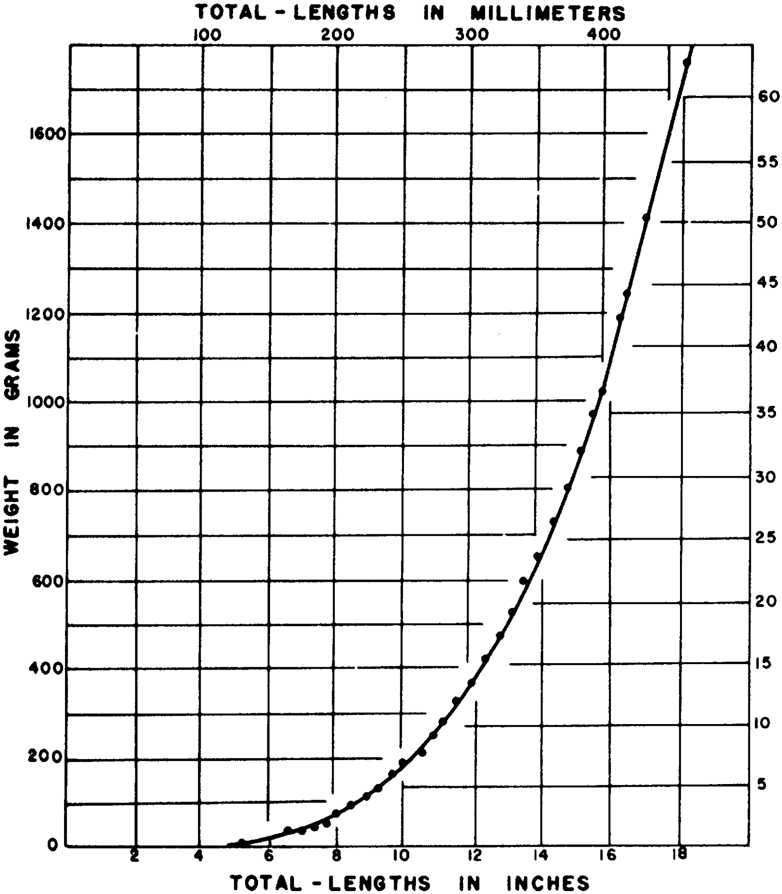

Figure 5. Length-weight relationship of 604 river carpsucker collected in Lake Texoma, 1949.

Table VIII. Coefficient of condition (C) of 604 river carpsucker collected in Lake Texoma, 1949.*

Total-length interval (10 mm.)	Avg. total-length (mm)	Equivalent total-length (inches)	Average weight in grams	Equivalent weight in pounds	Condition index C(TL)	Number of fish
130-139	130	5.1	27	0.06	45.1	1
140-149						
150-159						
160-169	167	6.6	60	0.13	45.3	1
170-179	176	6.9	70	0.15	45.6	14
180-189	186	7.3	87	0.19	48.8	8
190-199	194	7.6	98	0.22	52.4	5
200-209	203	8.0	106	0.23	44.9	18
210-219	214	8.4	121	0.28	47.2	18
220-229	226	8.9	152	0.34	48.2	22
230-239	235	9.3	162	0.36	44.6	22
240-249	244	9.6	183	0.41	46.3	33
250-259	255	10.0	207	0.46	46.0	61
260-269	264	10.4	232	0.51	45.3	67
270-279	274	10.8	253	0.56	44.4	47
280-289	283	11.1	280	0.62	45.3	38
290-299	295	11.6	309	0.68	43.6	22
300-309	304	12.0	349	0.77	44.6	20
310-319	315	12.4	380	0.84	44.0	24
320-329	325	12.8	426	0.94	44.8	44
330-339	334	13.1	472	1.04	46.3	43
340-349	344	13.5	402	1.08	43.9	40
350-359	354	13.9	528	1.16	43.2	23
360-369	364	14.3	586	1.29	44.1	14
370-379	375	14.8	640	1.41	43.5	5
380-389	384	15.1	611	1.35	39.2	3
390-399	394	15.5	813	1.79	48.1	2
400-409	400	15.7	780	1.72	44.4	1
410-419	416	16.4	929	2.05	46.5	4
420-429	420	16.5	1000	2.21	49.2	1
430-439	435	17.1	1025	2.26	45.2	2
440-449						
450-459						
460-469	462	18.2	819	1.81	43.0	1
Number of fish						604

*Based on empirical lengths and weights of all age-groups of both sexes combined and arranged according to averages of 10-millimeter total-length intervals.

SUMMARY

1. Data for this study of the age and growth of the river carpsucker were collected during the summer of 1949 at Lake Texoma, an impoundment of the Red and Washita Rivers.

2. Collections were made at each of eight collecting stations distributed throughout the lake in an attempt to sample different habitats.

3. A total of 615 river carpsucker was collected; 612 in gill nets,

two in a fyke net, and one in a seine.

4. Composition of the sample collected was affected by net selectivity.

5. Ages were determined for 604 river carpsucker by the scale method. Of the 604 fish used, 327 (54 percent) were in age-group III. The maximum age was VI.

6. Lack of small, young fish (age-groups O and I) and large, old fish (age-groups V and VI) complicated the calculation of growth.

7. The body-scale relationship was shown to be expressed by the equation $L = -.00615 + (1.18954) S$.

8. Average calculated total-lengths for fish of age-groups I to VI were 3.6, 6.8, 9.4, 11.9, 14.4, and 15.0 inches respectively.

9. The average calculated total-lengths for female river carpsucker were generally slightly greater than those of males of the same age-groups.

10. Slight differences of doubtful significance exist between the calculated lengths of fish of the same age-groups taken at five of the eight collecting stations.

11. Lee's phenomenon was demonstrated by the calculated total-lengths, but not explained.

12. The length-weight relationship was determined, using the formula $W = CL^n$.

13. Condition factors, C(TL), were determined for the sample of river carpsucker. The mean factor was shown to be 45.3; the range, 39.2 to 52.4. The usual increase in coefficient of condition with age and size was not evident.

Literature Cited

Eschmeyer, R. W., Richard H. Stroud, and Alden M. Jones. 1944. Studies of the population on the shoal areas of a TVA main-stream reservoir. Rept. Reelfoot Lake Biol. Sta. 8: 70-122.

Frey. David G., and Hubert Pedracine. 1938. Growth of the buffalo in Wisconsin lakes and streams. Trans. Wisconsin Acad. Sci., Arts, and Lett: 31: 513-525.

Hile, Ralph. 1936. Age and growth of the cisco, *Leucichthys artedi* (Le Sueur), in the lakes of the Northeastern Highlands, Wisconsin. Bull. U. S. Bur. Fish. 48 (1940): 209-317.

Hile, Ralph. 1941. Age and growth of the rock bass, *Ambloplites rupestris* (Rafinesque) in Nebish Lake, Wisconsin. Trans. Wisconsin Acad. Sci., Arts, and Lett. 33: 189-337.

Hubbs, Carl L. 1944. Terminology of early stages of fishes. Copeia 1943 (4): 260.

Jenkins, Robert Merle. 1949. A biological fishery survey of the Great Salt Plains Reservoir. Master's Thesis, University of Oklahoma, Norman, Oklahoma.

Lagler, Karl F. 1950. Studies in freshwater fishery biology, 3rd. Ed., Edwards Bros., Inc., Ann Arbor, Mich.

Oklahoma Planning and Resources Board. 1946. Oklahoma lakes. Div. of Water Resources.

Oklahoma Planning and Resources Board. 1953. Oklahoma's water resources. Div. of Water Resources.

Schoffman, Robert J. 1944. Age and growth of the smallmouth buffalo in Reelfoot Lake. Rept. Reelfoot Lake Biol. Sta. 8: 3-9.

Spoor, William A. 1938. Age and growth of the sucker, *Catostomus commersonnii* (Lacépède), in Muskellunge Lake, Villas County, Wisconsin. Trans. Wisconsin Acad. Sci., Arts, and Lett. 31: 457-505.

United States Army Corps of Engineers. 1948. Denison Dam and Lake Texoma information pamphlet Red River, Texas and Oklahoma. Tulsa District. Revision of March, 1948 (mimeo.).

United States Department of Interior. 1941. Recreational resources of the Denison Dam and reservoir project Texas and Oklahoma. National Park Service, Oct., 1943.

Van Oosten, John. 1929. Life history of the lake herring, *Leucichthys artedi* (Le Sueur), of Lake Huron as revealed by its scales, with a critique of the scale method. Bull. U.S. Bur. Fish. 44 (1928): 265-428.

Van Oosten, John, H. J. Deason, and F. W. Jobes. 1934. A microprojection machine designed for the study of fish scales. Jour. du Conseil 9(2): 241-248.