AGE AND GROWTH OF THE SMALLMOUTH BASS *MICROPTERUS DOLOMIEUI* LACEPEDE IN ARKANSAS

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ABSTRACT

The age and growth of the smallmouth bass, *Micropterus dolomieui* Lacépède, was studied using the scale method. The bass were collected over a three-year period (1962 through 1964) from 51 locations in 32 streams in three drainages throughout the smallmouth's range in Arkansas and from one location in Missouri. A computer was utilized in determining the mathematical relationship between scale growth and body growth for all specimens used in the study and in comparing the growth of bass collected from the various drainages, streams, and locations in streams. No significant differences in bass growth among the three drainage basins nor among the streams within each basin were detected. Bass growth was found to vary significantly among the various locations within streams indicating that for the bass studied the specific habitat was the important factor influencing growth. A growth summary by location based on the back-calculated lengths of 1145 smallmouth bass is presented. Age composition is also discussed.

INTRODUCTION

Many regional studies of the age and growth of the smallmouth bass are to be found in the literature. The age and growth of Oklahoma smallmouth was studied by Finnell et al. (1956), and Missouri smallmouth bass have been studied by Patriarche and Lowry (1953). A growth summary for Missouri smallmouth appears in Purkett (1958). Little has been published regarding the age and growth of smallmouth bass in Arkansas. This study attempts to fill that void.

METHODS AND MATERIALS

Collection of wild bass

Samples of wild populations of smallmouth bass were collected for general use in this study from 51 locations in 32 streams throughout its range in Arkansas during the years 1962, 1963, and 1964, and from one location in Missouri (Table 1). Additional collections were made in Arkansas for special purposes such as checking for false annuli. Four collecting methods were used: (1) electro-fishing; (2) seining; (3) hook and line fishing; and (4) chemical poisoning (two samples with rotenone and one with phenol).

Each collection is represented by a three-digit sample number to facilitate computer processing of the data. The first digit indicates the river basin in which the collection was taken. Basin 1 is the Arkansas River Basin, basin 2 is the White River Basin, and basin 3 is the Ouachita-Little River Basin. The second digit of the sample number indicates the specific stream from which the collection was taken. The third digit indicates location on a stream.

Freshly collected wild specimens were placed in 10% formalin solution as a temporary preservative. Later the specimens were washed with water and transferred to 35% isopropyl alcohol which was used as the permanent preservative. Large fish were cut on the right side of the abdomen, before being placed in formalin, to insure maximum penetration of the preservative.

Collecting and reading scale samples

Approximately 20 scales were removed from an area just touching the tip of the extended pectoral fin and about five scales below the lateral line of each specimen. This method of scale sampling was closely adhered to in an attempt to obtain uniform and comparable scale samples. Each scale sample was paced in a 2¼ in. by 3½ in. coin envelope. The number of the fish, the collection from which it came, and its standard length were recorded on the envelope. All fish sampled were measured to the nearest millimeter using the fisheries-research method given by Hubbs and Lagler (1947).

The scales were read on a conventional scale reader. Approximately 15 scales from each sample were placed between two glass microscope slides along with a drop of water. The slides were placed in the reader and the number of annuli were determined on one selected scale using the criteria for distinguishing annuli given by Lagler (1952). Measurements to the nearest millimeter were then taken from the focus of the scale, along the primary radius of the scale, to each annulus and to the outer margin of the scale.

Computational Methods

The majority of calculation in this study was done by a computer. All data were therefore first punched on I.B.M. cards. An I.B.M. 7040 computer was programmed to carry out all variance analysis, all calculation of estimated mean squares, and all fitting of scale-length body-length relationship curves to the data. In arriving at the relationships best expressing body length as a function of scale length ten equations ranging from a linear to a 10th degree polynomial were tested by computer for goodness of fit to the data. The equations were tested with the data grouped by collection locations, by streams, and finally by basins to determine what level of combination was possible.

RESULTS

The Arkansas smallmouth bass used in this study were grouped into 25 mm intervals of standard length and tabulated on a length-frequency diagram. The 1454 fish showed a steady progression in length at increasing ages (Table 2). As age increased there was a progressive decrease in rate of growth. On the basis of the number of annuli on their scales none of the smallmouth bass were more than nine years old. Ninety per cent of the bass were under four years of age. Only 139 individuals were four years of age and older. The two year olds were the largest age group, making up 30% of the total sample.

Scale - length body - length relationships

The relationship between the growth in body length and the growth of the scale was found to vary significantly among bass from the various basins, streams and locations. Numerous equations were needed to adequately express the body growth scale growth relationship for all bass used in this study. All of these equations with three exceptions, caused by small sample size, fitted one of two general equation types.

Type	General Equation
1	$L=B_1+B_2S$
2	$L=B_1+B_2S+B_3S^2$

Where: L=the standard length of the fish, $B_1=$ the Y intercept, B_2 and B_3 are constants derived from the data, and S is the scale measurement in millimeters from focus to annulus.

For samples of fewer than five fish the length-scale relationship took the form $L=B_1$ indicating that there were too few fish to establish a trend. This results in the Y intercept B_1 being equal to $\frac{\Sigma L}{N}$ with variation in scale length S having no effect on fish length L.

Confidence intervals, 95% level, were calculated assuming large sample sizes for each body-scale relationship. All showed essentially the same pattern as those plotted for fish from basin 1 and stream 2-10 (Figure 1).

It is interesting to note that in comparing fish of equal size from basin 1 and Calf Creek (which is typical of basin 2) the basin 1 fish have larger scales than the fish from basin 2 (Figure 1). It might be expected that if two equal-length fish have different sized scales the fish having the larger scales would also have fewer scales.

Comparative growth rates of wild bass

For the first three years of growth the analysis of variance test of the nested samples of bass from basins, streams and locations on streams from which multiple collections were taken (Table 3) shows significant differences in growth only among locations on streams. These differences among locations are significant at the 1% level of probability. There were no significant differences in growth among the various streams within basins nor among the three basins.

The analysis of variance results for the fourth, fifth, sixth, seventh and eighth year growth rates were not included. Comparisons of growth rates for fish over three years of age were of doubtful value due to the paucity of fish at these ages.

The estimated mean square percents for basins, streams, locations and residuals for each of the first three years of growth (Table 3) showed that the variation in the growth rates of individual bass from the same locations (the residual term) was responsible for the greatest portion of the differences in growth rates detected, 47%, 48%, and 63%, respectively. The differences in the growth rates of individual fish from the same location increases with increasing age being least the first year and greatest the third year.

A significant portion of the growth rate differences detected was shown to be due to the effect of locations upon the growth rates of fish (Table 3). The amount of differences in growth rate attributable to this source decreases with the increasing age of the fish.

Growth summary based on the back-calculated lengths of all bass collected

The average calculated standard lengths in millimeters as used in fisheries research (Hubbs and Lagler, 1947) for the first eight years of life are presented for bass by location (Table 4). Bass growth at location 2-1-8 (Bull Shoals Reservoir) the only lake sampled for this study was much greater than the growth rate obtained in any stream. Bass from stream 1-4 (Spavinaw Creek) a cold stream, showed relatively slow growth, smallmouth from stream 2-9 (The Buffalo River) a warm stream showed relatively fast growth. A high growth rate was also obtained for bass from location 2-9-2 (a headwater location); the bass population here had been drastically thinned two years before. Bass in many streams, where multiple collections were made such as 1-2 (Little Sugar Creek), 1-9 (Lee Creek), 2-1 (White River), and 2-9 (Buffalo River) showed a gradient in growth rate from slow at headwater locations to increasingly faster at locations progressively further downstream.

DISCUSSION

Validity of the scale method for Arkansas bass

The validity of the scale method for back-calculating the growth of Missouri smallmouth bass was shown by Patriarche and Lowry (1953), and by Purkett (1958). Finnell et al. (1956) found the scale method was applicable to Oklahoma smallmouth bass.

The fish used in this study show a steady progression in length (at capture), for successive ages (Table 2). This substantiates the belief that the annuli laid down by the smallmouth bass in Arkansas are true year marks and indicates that the scale method is valid for aging the fish used in the present study. The range in length of fish within each age group is attributed to differences in growth of individual fish and to differences in the time of year at which the fish were caught.

Many investigators working with various species of fish have found that false annuli occur, particularly during the first year of growth. Sprugel (1953) reported that during some years as many as 90% of the bluegills taken from a new lake possessed scales with false first annuli. This false annulus was attributed to the temporary cessation in growth resulting from the scarcity or absence of an appropriate-size range of food. No false first annuli were found on the scales of the smallmouth investigated in this study. The first check on the bass's scale was a true rather than a false first annulus. This is indicated by the following:

1. The age-length relationship for the bass in this study (Table 2) agrees with the age-length relationship found for known age smallmouth bass.
2. Scales from 24 young of the year bass collected from six locations during the months of November, December, January, February and April show no checks.
3. None of the bass used in a laboratory growth-rate study produced artificial annuli, even though growth was temporarily stopped when the diet of these fish was changed from small to large-sized food.

Body - length scale - length relationships

For the majority of bass used in this study the general equation best expressing the body-scale relationship was either

$L=B_1+B_2S$ or $L=B_1+B_2S+B_3S^2$.

The Y intercept or B_1 values for every equation used were averaged. This average value, an approximation of the size of the average fish at the time of scale formation in the region of the pectoral fin, was 29.93mm. Everhart (1949), using microtechniques, found that the average length of some New York State smallmouth bass having newly formed scales in the pectoral region was approximately 30.0 mm. This very close agreement suggests that the average size at which a smallmouth bass acquires scales in the pectoral region is characteristic of the species.

Eight of the wild bass used in this study were found to have small scales in the pectoral region. The standard lengths of these bass were 40, 37, 39, 41, 43, 33, 36, and 37 millimeters. These fish were undoubtedly smaller when the scales first formed.

No indication of the accuracy of the scale method of fish-length back-calculation was found in the literature. However, confidence intervals calculated for the body-scale relationships used in this study (Figure 1) indicate that a certain amount of error in inherent in this method. A substantial range of fish lengths can be expected from one scale measurement.

Comparative growth rates of wild bass

No significant differences in growth rates were found among either bass collected from the three basins or among bass taken from different streams within each basin. Smallmouth bass growth did vary significantly among locations on the same stream (Table 3). Apparently the specific habitat is the important factor in determining the growth rate of a bass, not the stream or basin in which its habitat is located. Purkett (1958) found that the growth of smallmouth bass often varied more between different locations on the same stream than between different streams.

In many streams such as the White River (2-1) and the Buffalo River (2-9) where multiple collections were made a gradient in the growth rates of bass was found from slow at the headwaters to fast down stream. This gradient in the growth rate can be attributed to many physical and biological factors working in conjunction. Mean water temperature during the growing season is probably one of the important physical factors. Very little temperature information was available for the streams studied. For one stream, the Buffalo River (2-9), a few temperatures were available. On July 31, 1963, a river temperature of 27° C was recorded at Ponca, Arkansas, 122 miles upstream from the mouth. On August 2, 1963, the water temperature at the mouth was recorded as being 32° C (U. S. Army Corps of Engineers, 1964). In his ecological study of smallmouth bass in Illinois Durham (1955) found faster growth in situations having higher mean water temperatures. This trend is supported by data obtained in a laboratory investigation of the growth rate of bass raised at various constant temperatures.

Two physical factors which apparently did not significantly influence the rate of bass growth were soil type and minor growing-season differences. When collection locations were plotted upon a soil map of Arkansas no correlation between fast growth and any particular soil type was evident. The absence of significant growth differences among bass collected from the three basins (Table 3) suggests that the average 10-20 day difference in the length of growing season between basin 1 and basin 3 (USDA, 1941) did not significantly affect the length attained by bass during one growing season.

The only biological factor which seemed to be positively correlated with good growth was abundance of minnows. An abundance of minnows was noted at the time of collection in many locations where high bass growth rates were found later.

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TABLES

Table 1. Smallmouth Bass Collection Locations

ARKANSAS RIVER DRAINAGE

Sample Number	Number of Fish		County	Reference	Township Range Section	Collection date
1-1-1	5	Shoal Creek	*Barry	4 mi. E. of Rocky Comfort	T23N-R28W-Sec. 19	30/06/62
1-2-1	13	Little Sugar Creek	Benton	1.5 mi. NW. of Bella Vista	T21N-R31W-Sec. 35	06/10/62
1-2-2	87	Little Sugar Creek	Benton	3 mi. N. of Bella Vista	T21N-R31W-Sec. 23 & 26	24/07/62
1-3-1	6	Butler Creek	Benton	1/2 mi. N. of Sulphur Springs	T21N-R33W-Sec. 15	29/09/64
1-4-1	34	Spavinaw Creek	Benton	2 mi. S. of Gravette	T20N-R33W-Sec. 24	13/07/62
1-4-2	35	Spavinaw Creek	Benton	6 mi. W. of Decatur	T19N-R34W-Sec. 1	18/07/62
1-5-1	3	Illinois River	Washington	Upstream from Moffitt	T14N-R31W-Sec. 4	06/10/64
1-5-2	3	Illinois River	Washington	At Hgwy. 62 bridge	T15N-R31W-Sec. 8	11/07/62
1-6-1	10	Muddy Fork of Illinois River	Washington	6 mi. N. of Prairie Grove	T16N-R32W-Sec. 14 & 23	07/08/62
1-7-1	5	Clear Creek	Washington	At Savoy	T17N-R31W-Sec. 31 & T17N-R32W-Sec. 36	22/08/62
1-8-1	31	Barren Fork of Illinois River	Washington	At Hgwy. 45 bridge	T14N-R33W-Sec. 22 & 23	19/09/64
1-9-1	14	Lee Creek	Crawford	3.5 mi. NE. Lee Creek	T12N-R31W-Sec. 20	17/07/62
1-9-2	9	Lee Creek	Crawford	Below mouth of Fall Creek	T12N-R31W-Sec. 20	07/05/64
1-10-1	40	Fall Creek	Crawford	3.5 mi. NE. Lee Creek	T12N-R31W-Sec. 17	06/08/62
1-11-1	37	Mulberry River	Johnson	1 mi. down from mouth of Little Mulberry River	T12N-R25W-Sec. 30	13/09/64
1-12-1	34	Illinois Bayou	Pope	2 mi. N. of Scottsville	T10N-R19W-Sec. 28,29 & 32	21/08/64
1-13-1	11	South Fork of Fourche La Fave	Perry	6.5 mi. SE. of Nimrod Dam	T 3N-N19W-Sec. 7, 17, & 18	11 & 25/10/64

* This collection is from Barry County, Missouri. All other collections are from Arkansas.

WHITE RIVER DRAINAGE

Sample Number	Number of Fish		County	Reference	Township Range Section	Collection date
2-1-1	30	White River	Madison	At St. Paul Cemetary	T14N-R26W-Sec. 33	11/08/62 & 9/29/62
2-1-2	5	White River	Madison	1.5 mi. W. of St. Paul	T13N-R26W-Sec. 5 & 6	21/01/64
2-1-3	7	White River	Madison	At Patrick	T14N-R27W-Sec. 31	04/08/62
2-1-4	12	White River	Madison	Downstream from Patrick	T14N-R27W-Sec. 30 & 31	13/06/62
2-1-5	7	White River	Madison	Above ford at Thompson	T15N-R28W-Sec. 34	05/08/62
2-1-6	3	White River	Washington	2 mi. N. of Durham	T15N-R28W-Sec. 18	07/06/63
2-1-7	9	White River	Benton	At Lost Bridge	T20N-R27W-Sec. 19	23/07/63
2-1-8	6	Bull Shoals	Marion	Hgwy. 125 access area	T21N-R17W-Sec. 2	18/11/64
2-2-1	20	Middle Fork of White River	Washington	1 mi. W. of Sulphur City	T15N-R29W-Sec. 16	06/06/63

Table 1. — Continued

WHITE RIVER DRAINAGE (cont.)

Sample Number	Number of Fish		County	Reference	Township Range Section	Collection date
2-3-1	12	West Fork of White River	Washington	1 mi. S. of West Fork	T14N-R30W-Sec. 4 & 9	01/12/62
2-3-2	3	West Fork of White River	Washington	E. of Fayetteville Airport	T15N-R30W-Sec. 3,4, & 9	03/07/62
2-4-1	3	Richland Creek	Washington	1 mi. N. of Tuttle	T16N-R28W-Sec. 20	28/06/62
2-5-1	12	Brush Creek	Washington	Below Hgwy. 45 bridge	T17N-R28W-Sec. 22	09/11/63
2-6-1	9	Henderson Creek	Madison	At Aurora	T15N-R26W-Sec. 1	19/07/63
2-7-1	22	War Eagle Creek	Madison	At Aurora	T15N-R23W-Sec. 2	17/07/63
2-7-2	5	War Eagle Creek	Madison	At ford 2.5 mi. E. of Huntsville	T16N-R26W-Sec. 1	11/07/63
2-7-3	5	War Eagle Creek	Madison	Above Hgwy. 68 bridge	T17N-R25W-Sec. 19, 30, & T17N-R26W-Sec. 25	11/06/63
2-7-4	12	War Eagle Creek	Benton	At War Eagle Mills	T18N-R28W-Sec. 19	29/08/62
2-7-5	9	War Eagle Creek	Washington	8 mi. N. of Goshen	T19N-R28W-Sec. 34	07/03/64
2-8-1	5	Kings River	Madison	At Marble below hgwy. 68	T17N-R24W-Sec. 18	23/08/62
2-9-1	63	Buffalo River	Newton	At Ponca	T16N-R22W-Sec. 30	25/07/62
2-9-2	24	Buffalo River	Newton	At Ponca	T16N-R22W-Sec. 30	03/01/64
2-9-3	21	Buffalo River	Searcy	Below mouth of Calf Creek	T15N-R17W-Sec. 3 & T16N-R17W-Sec. 34	02/02/64
2-9-4	90	Buffalo River	Searcy	At Gilbert	T16N-R16W-Sec. 31	29/08/62
2-9-5	97	Buffalo River	Marion	Above mouth of Rush Creek	T17N-R15W-Sec. 11	28/09/62
2-9-6	50	Buffalo River	Marion	Above its mouth	T18N-R14W-Sec. 35 & 36	27/08/64
2-10-1	167	Calf Creek	Searcy	4 mi. SW. of Gilbert	T15N-R17W-Sec. 3 & 10	22 & 28/08/62
2-11-1	59	Devils Fork of Little Red River	Cleburne	3 mi. N. of Brownsville	T12N-R10W-Sec. 33 & 34	22/08/62
2-12-1	16	Matt Creek	Fulton	7 mi. SW. of Mammoth Springs	T20N-R 6W-Sec. 11 & 12	26/08/64
2-13-1	9	South Fork of Spring River	Fulton	3 mi. N. of Salem	T20N-R 8W-Sec. 10 & 11	25/08/64

OUACHITA AND LITTLE RIVER DRAINAGE

Sample Number	Number of Fish		County	Reference	Township Range Section	Collection date
3-1-1	8	Ouachita River	Polk	4 mi. NE. of Mena	T2S-R30W-Sec. 2	15/08/62
3-2-1	2	Glazypeau Creek	Garland	At Mt. Pine	T2S-R20W-Sec. 8	13/07/63
3-3-1	9	Mill Creek	Montgomery	2 mi. NW. of Caddo Gap	T4S-R25W-Sec. 11	13/07/63
3-4-1	35	Little Missouri River	Pike	3 mi. E. of Athens	T5S-R27W-Sec. 16 & 17	20/08/64
3-5-1	53	Mt. Fork of Little River	Polk	4 mi. NW. of Hatfield	T3S-R32W-Sec. 8	14/08/62
3-6-1	29	Cossatot River	Sevier	4.5 mi. SE. of Gillham	T7S-R30W-Sec. 18 & 19	19/08/64
3-7-1	73	Saline River	Howard	7 mi. NW. of Dierks	T6S-R29W-Sec. 33	20/08/64

Table 2. Length-Frequency Distribution of 1454 Arkansas Smallmouth Bass According to Age Groups and 25-Millimeter Intervals of Standard Length at Capture

Length at Capture in Millimeters	Age Group 0	1	2	3	4	5	6	7	8	9	10	Total fish in size group
0-25												
25-50	41											41
50-75	170											170
75-100	86	16										102
100-125	17	151	9									177
125-150	9	168	78	3								258
150-175		28	197	33								258
175-200			127	87	12	2						228
200-225			26	48	20	13	1					108
225-250				18	24	6	3					51
250-275				2	11	7	3	1				24
275-300					1	7	7	2	1			18
300-325			2			4	3	1	2			12
325-350							1	1	1	1		4
350-375								1	1			2
375-400									1			1
Total fish in age group	323	363	439	191	68	39	18	6	6	1		1454

Table 3. Analysis of Variance and Mean-Square Percents for Growth-Rate Differences Among Smallmouth Bass from Basins, Streams, and Locations within Streams for the First Three Years of Growth.

	S.S.	M.S.	Df	F	Est. M.S. %
First Year Growth for all Fish One Year and Older					
Basins	2317.815	1158.906	2	.914	2.31%
Streams	37999.234	1266.641	30	1.018	7.66
Locations	26131.250	1244.345	21	15.650**	42.65
Residuals	86742.780	79.507	1091		47.38
Second Year Growth for all Fish Two Years and Older					
Basins	2976.546	1488.273	2	2.806	1.49%
Streams	15908.281	530.276	30	.537	15.59
Locations	20744.094	987.813	21	9.380**	34.88
Residuals	75714.890	105.305	719		48.04
Third Year Growth for all Fish Three Years and Older					
Basins	344.652	172.326	2	.526	0.93%
Streams	8518.218	327.624	26	.559	9.72
Locations	8203.957	585.997	14	4.242**	26.00
Residuals	40057.543	138.129	290		63.35

Table 4. Growth Summary of Smallmouth Bass from 32 Arkansas Streams and One Missouri Stream

Average Calculated Standard Length at End of Year - (mm)

Location	1st	2nd	3rd	4th	5th	6th	7th	8th	Total No. of Fish
Basin 1									
1-1-1	57.0	119.3	190.4	255.6					5
1-2-1	60.0	121.4	177.7	222.5	268.8	320.3	371.8	414.6	10
1-2-2	60.8	124.9	193.8	258.8	319.9	375.0			71
1-3-1	60.4	127.2	180.5	237.2	292.2				6
1-4-1	59.9	124.9	189.9	244.9	295.5	345.1	392.3	439.6	34
1-4-2	57.6	120.9	178.6	232.8	283.0	331.7	382.6	421.3	32
1-5-1	82.7	134.2							2
1-5-2	65.9	128.2							3
1-6-1	69.2	145.0	202.8						8
1-7-1	68.2	148.2							5
1-8-1	70.0	137.2	194.2	255.0					31
1-9-1	58.0	114.1	176.4						12
1-9-2	71.5	141.5							9
1-10-1	61.4	131.2	196.4	261.7	308.5				28
1-11-1	68.6	137.7	196.1	259.2					37
1-12-1	70.5	138.1	197.6	265.5					29
1-13-1	71.7	148.0	199.4						10
Basin 2									
2-1-1	48.4	96.8	140.9	187.4	234.9				25
2-1-2	69.2	142.9							5
2-1-3	68.2	140.9	191.4						6
2-1-4	85.3	184.3	284.5						12
2-1-5	64.1	151.1							6
2-1-6									3
2-1-7	93.8	182.8							9
2-1-8	104.7	258.4							5
2-2-1	86.5	170.6	241.5						20
2-3-1	68.9	133.5	190.3	254.9	309.6				6

Underlined figures: less than 9 fish

Table 4. — Continued

Average Calculated Standard Length at End of Year (mm)

Location	1st	2nd	3rd	4th	5th	6th	7th	8th	Total No. of Fish
Basin 2 (continued)									
2-3-2	62.7	127.6	188.6						3
2-4-1									3
2-5-1	74.7	153.6	236.3	330.4	422.9	520.2			11
2-6-1	70.4	141.6	197.7	251.6					9
2-7-1	76.6	157.7	230.3	304.2	375.1	460.9			22
2-7-2	76.8	155.6	195.6						4
2-7-3	83.7	168.6	256.3						5
2-7-4	74.8	160.6							6
2-7-5	72.9	151.4	237.1	311.9					9
2-8-1	63.6	146.4	220.9						4
2-9-1	61.1	134.8	186.7	239.8	331.0				53
2-9-2	85.2	169.7	252.8	330.9					21
2-9-3	79.3	156.3	224.9	295.7	375.1	463.0	547.2	619.03	14
2-9-4	84.2	167.1	234.8	305.6	381.6				59
2-9-5	81.1	169.0	245.7	323.2	396.6	453.0	503.0	552.0	54
2-9-6	90.0	172.3	244.1	311.7	369.5	431.5			31
2-10-1	72.7	159.9	239.1	311.1	396.1				143
2-11-1	72.8	155.7	227.3						52
2-12-1	81.0	165.1	241.5						12
2-13-1	87.1	182.3							9
Basin 3									
3-1-1	49.2	104.3	154.3	212.7	237.7				6
3-2-1									2
3-3-1	81.5	163.0	243.0						9
3-4-1	72.1	145.5	211.4	274.0					29
3-5-1	66.3	141.4	209.6	259.3					46
3-6-1	83.9	164.1	234.9	294.2					28
3-7-1	84.1	168.7	234.2						72

Underlined figures: less than 9 fish

Figure 1. Ninety-five percent confidence belt for body-length scale-length relation (based on large sample size) for bass from Basin 1 and Calf Creek. (X) is the point ($\overline{X}$ $\overline{Y}$), (U) is the upper confidence bound, and (L) is the lower confidence bound.