CONDITION FACTORS AND LENGTH-WEIGHT RELATIONSHIPS OF THE FLATHEAD CATFISH, *PYLODICTIS OLIVARIS* (RAFINESQUE), IN LAKE CARL BLACKWELL

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This report presents condition factors for 432 flathead catfish and length-weight relationships for 224 flathead catfish collected in Lake Carl Blackwell in 16 months, from June 1967 through September 1968. The condition factor (K_{TL}) for flathead catfish varied with total body length. A curvilinear relationship of average K factor and total length gave a better fit than did a linear relationship for fish 20 mm through 519 mm. For fish 519 mm through 879 mm total length, a linear relationship gave a better fit. Females had a larger K_{TL} factor than males, but the K_{TL} varied with season. The greatest K_{TL} values occurred in prespawning females. The average K_{TL} for the 124 female and 90 male fish used for computation of length-weight relationships were 1.30 and 1.25, respectively. The length-weight relationship (logarithmic form) was (Log_{10} W = a + b Log_{10} L): Log W = −5.423 + 3.189 Log L.

METHODS

Condition factors and length-weight relationships were determined for flathead catfish collected in Lake Carl Blackwell in 16 months, from June 1967 through September 1968. The data were stratified to examine the variation in condition factors of fish according to length and month of capture. Comparisons are made between the present findings and pertinent literature.

A description of Lake Carl Blackwell has already been published (1). Most flathead catfish greater than 400 mm were collected by experimental gill nets (76 to 121 mm square mesh), but a few were obtained by the use of electrofishing gear, barrel traps, snag lines, and rotenone cove samples. Flatheads < 400 mm were collected exclusively by electrofishing and rotenone.

The total length (mm) and weight (grams) of the flathead catfish used in this study was usually determined immediately after removal from water. Weights taken in ounces or tenths of pounds were converted to grams.

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RESULTS AND DISCUSSION

Condition Factor

Condition factors (K_{TL}) were computed for 432 flathead catfish collected from June 1967 through September 1968 by the following formula:

$$K = \frac{W \times 10^5}{L^3},$$

where W = weight in grams and L = total length in mm. The average K_{TL} for fish in 20 mm length classes was computed for males, females, and all fish combined (Table 1).

Analyses of variance for linear and curvilinear regressions (2) were computed for the relationship between the average K_{TL} and average total length of flathead catfish in 20 mm length classes from 40 to 519 mm. Both linear and curvilinear regressions were significant ($P < .005$). The curvilinear regression ($K_{TL} = 0.7860 - 0.0002X + 0.000002X^2$, where X = total length in mm) gave a significantly better fit at the 0.05 level than the linear regression ($K_{TL} = 0.6709 + 0.0009X$).

The variation in K_{TL} due to difference in sex was determined by comparing relationships between average K_{TL} and average total length for length classes > 500-519 mm. Although a few of the females

Length Class (mm)	Males		Females		All Fish	
	K_{TL} ±95% C.I.	No.	K_{TL} ±95% C.I.	No.	K_{TL} ±95% C.I.	No.
20-39					2.07 -	1
40-59					0.80 -	1
60-79					0.82±0.81	3
80-99			0.86 -	1	0.71±0.41	3
100-119					0.82 -	1
120-139						
140-159						
160-179					0.83 -	1
180-199						
200-219	0.83 -	1	0.75 -	1	0.79 -	2
220-239						
240-259	0.87±0.14	3	0.96 -	1	0.89±1.05	4
260-279			0.78 -	1	0.78 -	1
280-299						
300-319			0.93	2	0.93 -	2
320-339	0.96 -	1			0.96 -	1
340-359	1.01 -	1		1.01	-	1
360-379	0.92 -	2	0.86 -	1	0.88±0.10	3
380-399	1.17 -	1			1.17 -	1
400-419	1.08 -	1			1.08 -	1
420-439	0.91 -	1			1.05 -	2
440-459			1.09 -	1	1.09 -	1
460-479	0.91 -	1	1.26 -	1	1.09 -	2
480-499	1.16 -	1			1.16 -	1
500-519	1.39 -	1	1.02 -	1	1.24±0.29	4
520-539	1.20±0.10	5	1.23±0.12	7	1.23±0.06	17
540-559	1.26±0.16	3	1.24±0.08	6	1.24±0.04	18
560-579	1.14±0.13	3	1.25±0.19	6	1.22±0.08	16
580-599	1.18±0.10	7	1.25±0.07	8	1.22±0.06	21
600-619	1.22±0.10	11	1.30±0.07	17	1.25±0.05	38
620-639	1.29±0.12	7	1.31±0.05	23	1.30±0.04	38
640-659	1.28±0.08	6	1.30±0.06	12	1.27±0.05	25
660-679	1.34±0.07	13	1.32±0.08	16	1.36±0.05	34
680-699	1.28±0.08	9	1.36±0.06	22	1.34±0.04	36
700-719	1.32±0.08	11	1.40±0.06	15	1.37±0.05	33
720-739	1.32±0.20	5	1.37±0.05	18	1.35±0.04	27
740-759	1.25±0.10	5	1.40±0.06	8	1.37±0.05	21
760-779	1.39±0.11	9	1.38±0.15	8	1.39±0.07	19
780-799	1.39 -	2	1.35±0.13	7	1.37±0.10	11
800-819	1.40±0.53	3	1.50 -	2	1.42±0.15	7
820-839	1.39± -	2	1.44±0.07	4	1.46±0.07	10
840-859	1.42±0.26	4			1.43±0.11	8
860-879	1.51±0.13	5			1.51±0.13	5
880-899			1.35 -	1	1.35±0.04	3
900-919			1.51 -	1	1.37 -	2
920-939	1.25±0.25	3			1.25±0.25	3
940-959	1.33 -	1			1.33 -	1
960-979	1.41 -	1			1.41 -	1
1000-1019	1.52 -	1			1.52 -	1
1100-1119			1.46 -	1	1.46 -	1

TABLE 1. *Average condition factors KTL for flathead catfish in 20 mm length classes.*

were immature, these comparisons were primarly between mature fish. Linear and curvilinear regressions for the relationship between average K_{TL} and average total length of the 18 length classes from 520-539 through 860-879 mm were computed for male flatheads. Similar regressions were computed for females of the length classes from 520-539 through 820-839 mm. The F values of all four regressions were significant ($P < .005$). However, the F values for reduction in variance due to curvilinearity were insignificant ($P > .10$). Therefore, the linear regressions for males ($K_{TL} = 0.742 + 0.00081X$, $r = 0.89$) and females ($K_{TL} = 0.833 + 0.00074X$, $r = 0.93$) were compared by analysis of covariance (3). The F value testing the comparison between regression coefficients (slope) was insignificant ($P > .10$). However, the F value comparing K_{TL} after adjusting for differences in slope between males and females was significant ($P < .005$). Therefore, mature females had a significantly greater average K_{TL} than mature males in the length classes compared (Figure 1). Langemeier (4) found no consistent difference in condition factor between adult male and female flatheads collected from the Missouri River bordering Iowa. However, his sample size of adult flatheads was comparatively small, making any difference in K_{TL} between sexes difficult to determine. The degree of gonadal development in females could also be an important factor in determining whether differences in K_{TL} would exist between the sexes.

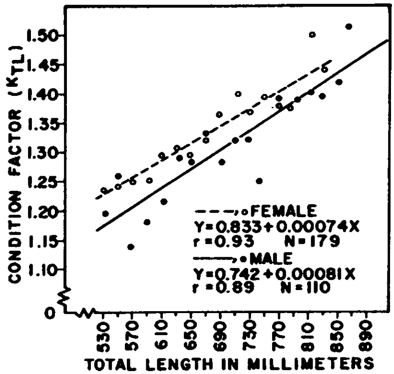

FIGURE 1. Relationships between average condition factor and average length of male and female flathead catfish in 20 mm length classes.

The K_{TL} values of Lake Carl Blackwell flatheads (< 300 mm) were generally less than those reported by Langemeier (4) and Swingle (5) in Alabama. Flathead catfish in Lake Carl Blackwell were similar to values reported for Alabama fish in the 300-500 mm range, but flathead catfish in the length classes > 500 mm in Lake Carl Blackwell had K_{TL} values larger than the Alabama fish. K_{TL} values calculated from

TABLE 2. *Seasonal changes in condition factor (K_{TL}), with 95% confidence intervals, for flathead catfish collected in 1968.*

	Males			Females		
Month	K_{TL}	Length (mm)	Number fish	K_{TL}	Average length (mm)	Number fish
March	1.26±0.22	690	3	1.32±0.08	676	7
April	1.36±0.14	700	6	1.31±0.10	680	7
May	1.37±0.05	690	13	1.37±0.06	681	24
June	1.27±0.07	673	10	1.38±0.06	676	14
July	1.28±0.11	676	5	1.36±0.09	681	15
August	1.25±0.06	692	6	1.33±0.21[a]	670	5
				1.23±0.13[a]	699	6

[a]The first set of values for females in August is for unspawned fish. The second set is for spent fish and includes a fish collected on July 30.

the average Oklahoma length-weight relationship (6) were also consistently less than found in this study for flathead 500 to 1000 mm. Average condition factors and average lengths of flathead catfish in the commercial catch from Eufaula, Fort Gibson, Grand and Texoma reservoirs were 1.33 (647 mm), 1.36 (594 mm), 1.38 (597 mm). and 1.36 (647 mm), respectively (7).

Monthly average condition factors were determined for adult male and female flatheads for the six months from March through August 1968 (Table 2). Because condition factors increased with increasing total length, the monthly means were derived only from samples of adult flatheads between 550 and 880 mm total length. Average K_{TL} values were also determined monthly for flatheads collected from June 1967 through February 1968. Small sample sizes and large variation in average total length made seasonal comparison of K_{TL} values futile for this period.

K_{TL} values of adult females changed with the season. This variation was apparently related to the reproductive cycle. Average K_{TL} values in March and April were 1.32 and 1.31, respectively (Table 2). The average K_{TL} increased to 1.37 in May, corresponding with an increase in gonadal-somatic index (GSI) from 1.1 per cent in April to 4.0 per cent in May (9). Despite increasing GSI values, condition factors for June and July samples were nearly identical at 1.38 and 1.36, respectively. In August K_{TL} values for spent and unspawned females were 1.23 and 1.33, respectively.

Monthly condition factors were also calculated after subtracting the ovary weights from total body weights (subsequently designated as K_{TL}'). The K_{TL}' values for the March, April, and May samples were very similar (1.30-1.31). The effect of gonadal development during June and July was reflected by decreased K_{TL}' values of 1.28 and 1.24, respectively. In August K_{TL}' values for spent females had decreased to 1.22. Evidently, the energy input required to increase gonadal weight and support normal metabolic activities during June and July caused intense catabolic demands on the stored nutrients. This was evident in decreased liver weights (9). Although it was not monitored, the extensive mesenteric adipose tissue may have also been utilized to supply the energy demands for reproduction. Bailey (10) indicated the utilization of both liver and fat reserves prior to and during the spawning period occurred in several species of fishes. The K_{TL} values of the unspawned females in August increased to 1.26. This indicates that the nutrients being reabsorbed from the ovaries may be utilized in the elaboration of body tissues. A statistically significant difference in the liver/body weight relationship between spent and unspawned females occurred in August (9).

Average monthly K_{TL} values for adult males also changed with relation to the reproductive cycle. K_{TL} values in March averaged 1.26, but increased dramatically in April to 1.36. In May K_{TL} values were 1.37, but decreased to 1.27 in June. The average K_{TL} values during July and August were 1.28 and 1.25, respectively. The K_{TL}' value was not calculated for males because GSI values were $< .3\%$.

Feeding activity during the April through July period correlated well with the observed changes in K_{TL} values (11). The percentages of flathead stomachs containing forage fish were greatest during April and May and declined sharply for the June and July samples. Decrease in feeding activity apparently was related to spawning behavior.

Spawning in Eufaula, Fort Gibson, Grand and Texoma reservoirs apparently takes place during June and July (Gary Mensinger, personal communication). Condition factors for flathead catfish in these reservoirs, computed quarterly, were lower in July through September (range 1.25-1.36) than in April through June (range of 1.38-1.44) (12). Lower condition factors for July through September in these reservoirs seems to result from spawning; condition factors of males in Lake Carl Blackwell declined in advance of spawning and remained low through spawning, whereas condition factors of females declined after spawning.

Length-Weight Relationships

Analysis of covariance indicated that adult female flatheads had significantly greater condition factors (K_{TL}) than adult males of the same size (Figure 1). Because of this difference, separate length-weight relationships were computed for males and females using the following formula: W =

cL^n, where W = weight in grams, L = length in millimeters, and c and n were constants. The resulting length-weight relationships were:

$W = 0.000001796\ L^{3.306}$ for 124 females and
$W = 0.000001183\ L^{3.365}$ for 90 males.
The average condition factors (K_{TL}) for the females and males used in these relationships were 1.30 and 1.25, respectively.

The length-weight relationship computed from the length-weight values of all 224 flatheads (males, females and fish for which the sex was not determined) necropsied during this study was: $W = 0.000003763\ L^{3.189}$. The logarithmic form of this relationship ($\text{Log}_{10}\ W = a + b\ \text{Log}_{10}\ L$) was $\text{Log}\ W = -5.423 + 3.189\ \text{Log}\ L$. The regression coefficient (b) of 3.189 for fish of known sex was intermediate to the b values reported by Carlander (12). The b of 3.189 for Carl Blackwell flatheads compared closely with coefficients of 3.176 and 3.181 reported by Langemeier (4) for two sections of the Missouri River. Other b values determined for flatheads from Oklahoma waters were 3.233 for Grand Lake (13) and 3.255 for fish from 21 reservoirs (18). Langemeier (4) and Swingle (5) have noted that length-weight relationships from fish of larger sizes have greater regression coefficients.

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