Rec. zool. Surv. India, **81** (3 & 4) : 373-380, 1984

LENGTH-WEIGHT RELATIONSHIP IN *CARANGOIDES MALABARICUS* (BL. & SCHN.) AND *ALEPES KALLA* (CUV. & VAL.)*

V. K. VENKATARAMANI AND R. NATARAJAN
Centre of Advanced Study in Marine Biology
Parangipettai 608 502, S. India.

INTRODUCTION

A study of length weight relationships has two purposes (Lecren, 1951), first to establish the mathematical relationship between two variables, length and weight and secondly to know the variations from the expected weight for various length groups. Weight of a fish is a function of its length and it is observed that the length weight relationship could be expressed by the hypothetical cube law, $W=CL^3$ where 'W' represents the weight, 'L' the length and 'C' a constant. This formula could be used only if density and form are constant. LeCren (1951) pointed out that it is better to fit a general parabolic equation of the form W=aLn (which expresses the relation between two factors better than the cubic formula) where 'W' and 'L' represent weight and length of a fish respectively, 'a' a constant equivalent to 'c' and 'n' a constant to be determined empirically, i. e. from the data.

MATERIAL AND METHODS

Presently, in two carangid fishes viz., *C. malabaricus* and *A. kalla*, the length weight relationships have been calculated. Total length was measured from the tip of the snout to vertical through tip of the longest caudal fin lobe ; weight was recorded to the nearest 0.01 milligram. Specimens where the tails are broken, were rejected.

RESULTS AND DISCUSSION

The parabolic equation $W=aL^n$ can be expressed in the logarithmic form as $\log W=\log a+n \log L$ i.e. $Y=a+bx$; where, $a=\log a$; $b=n$; $y=\log n$ and $x=\text{long } L$ which is a linear relation between y and x. This linear equation was fitted separately for males, females and indeterminants in both the species and the estimates of parameters 'a' and 'b' for each category was obtained by the method of least squares. The

*This paper formed part of a thesis submitted by the first author to Annamalai University for the award of Ph. D. degree.

regression equations for males, females and indeterminants of *C. malabaricus* and *A. kalla* are given below.

C. malabaricus

For males : Log W = −4.6642 + 2.8870 Log L ;

For females : Log W = −4.1144 + 2.6348 Log L ;

For indeterminants : Log W = −4.7356 + 2.9239 Log L.

A. kalla

For males : Log W = −5.1033 + 3.0250 Log L ;

For females : Log W = −4.8888 + 2.9288 Log L ;

For indeterminants : Log W = −3.9541 + 2.4411 Log L.

During fish growth, when it does not change form or density, the weight will be proportional to the cube of any linear dimension. According to Hile (1936) and Martin (1949), the value of the exponent 'n' in the parabolic equation usually lies between 2.5 and 4.0. For an ideal fish which maintain the shape throughout without any change, the value of 'n' is equal to 3.0 (Allen, 1938). Generally the value of 'b' is '3' in the length-weight relationship of fishes, but due to changing of specific gravity and shape of the body contour the cube law need not always hold good (Rounsefell & Everhart, 1953). Morphological changes due to age also cause the coefficient of regression of logarithm of weight on logarithm of length, to depart substantially from 3.0.

The regression equations of males, females and indeterminants, of the above two species were subjected to analysis of covariance as done by James (1967), Narasimham (1970) and Mojumder (1971). Significant differences were obtained on comparing the regression equations of males, females and indeterminants of *C. malabaricus* (Tables 1-3). On comparing the regression equations of females and indetermints (Tables 6 & 7), males and females (Tables 8 & 9), significant differences could be noted. Only insignificant differences were obtained on comparing the regression equations of males (Tables 4 & 5) with indeterminants.

Significant differences were obtained on comparing the regression equations of males, females and indeterminants of *A. kalla* (Tables 10-12). Significant differences were also obtained between males and indeterminants (Tables 13-14) and between females and indeterminants (Tables 15-16), while differences between males and females (Tables 17-18) were insignificant.

TABLE 1. Statistics on the length-weight relationship of males, females and indeterminants of *C. malabaricus*.

Sex	N	Sx	Sy	Sx^2	Sy^2	Sxy
Males	250	545 0397	407.4662	1188.9400	670.0242	890.2666
Females	182	396.5735	296.0851	864.7594	486.6015	646.8368
Indeterminants	250	514.3073	319.8573	1059.0504	417.9587	660.9510

N = Number of fish

Sx^2, Sy^2, Sxy = Sum of squares and products

Sx, Sy = Sum of logarithmic values of length and weight respectively

TABLE 2. Regression data for the lenth-weight ralationship of males, females and indeterminants of *C. malabaricus*.

		Sum of squares and products				Errors of Estimate	
Sex	D. F.	x^2	xy	y^2	b	D. F.	S. S.
Males	249	0.6670	1.9256	5.9094	2.8870	248	0.3503
Females	181	0.6356	1.6747	4.9181	2.6348	180	0.5055
Indeterminants	249	1.0025	2.9312	8.7239	2.9239	248	0.1534

D. F. = Degrees of freedom ; b = Regression co-efficient ; S. S. = Sum of squares.

TABLE 3. Test of significance.

Source of variation	D. F.	Sum of squares	Mean squares	Observed F	5% F
Deviation from individual regression within sexes	676	1.0092	0.0015		
Differences between regression	2	0.0352	0.0176	11.7333	3.000
Deviation from total regression	678	1.0444	0.0191		
				Significant	

TABLE 4. Regression data for the length-weight relationship of males and indeterminants of *C. malabaricus*.

		Sum of squares and products				Errors of Estimate	
Sex	D. F.	x^2	xy	y^2	b	D. F.	S. S
Males	249	0.6670	1.9256	5.9094	2.8870	248	0.3503
Indeterminants	249	1.0025	2.9312	8.7239	2.9239	248	0.1534

D. F. = Degrees of freedom ; b = Regression co-efficient ; S. S. = Sum of squares.

TABLE 5. Test of significance.

Source of variation	D. F.	Sum of squares	Mean squares	Observed F	5% F
Deviation from individual regression	496	0.5037	0.0010		
Differences between regression	1	0.0005	0.0005	0.5000	3.000
Deviation from total regression	497	0.5042	0.0016		
				Insignificant	

TABLE 6. Regression data for the length-weight relationship of females and indeterminants of *C. malabaricus.*

		Sum of squares and products				Errors of Estimate	
Sex	D. F.	x^2	xy	y^2	b	D. F.	S. S.
Females	181	0.6356	1.6747	4.9181	2.6348	180	0.5055
Indeterminants	249	1.0025	2.9312	8.7239	2.9239	248	0.1534

D. F. = Degrees of freedom ; b = Regression co-efficient ; S. S. = Sum of squares.

TABLE 7. Test of significance.

Source of variation	D. F.	Sum of squares	Mean square	Observed F	5% F
Deviation from individual regression	428	0.6589	0.0015		
Differences between regression	1	0.0325	0.0325	21.6667	3.000
Deviation from total regression	429	0.6914	0.0340		
				Significant	

TABLE 8. Regression data for the length-weigtht relationship of males and females of *C. malabaricus.*

		Sum of sqares and products				Errors of estimate	
Sex	D. F.	x^2	xy	y^2	b	D. F.	S. S.
Males	249	0,6670	1.9256	5.9094	2.8870	248	0.3503
Females	181	0.6356	1.6747	4.9181	2.6348	180	0.5055

D. F. = Degrees of freedom ; b = Regression co-efficient ; S. S. = Sum of squares.

TABLE 9. Test of significance.

Source of variation	D. F.	Sum of squares	Mean squares	Observed F	5% F
Diviation from individual regression	428	0.8558	0.0020		
Differences between regression	1	0.0207	0.0207	10.35	3.000
Deviation from total regression	429	0.8765	0.0227	Significant	

TABLE 10. Statistics on the length-weight relationship of males, females and indeterminants of *A. kalla*.

Sex	N	Sx	Sy	Sx^2	Sy^2	Sxy
Males	80	171.1297	109.3990	366.2991	151.8196	234.7192
Females	250	536.5012	349.0990	1152.0433	494.7335	751.2452
Indeterminants	132	250.1510	88.7079	475.2592	67.5245	171.0436

N = Number of fish

Sx^2, Sy^2, Sxy = Sum of squares and products

Sx, Sy = Sum of logarithmic values of length and weight respectively

TABLE 11. Regression data for the length-weight relationship of males, females and indeterminants of *A. kalla*.

Sex	D. F.	Sum of squares and products				Errors of Estimate	
		x^2	xy	y^2	b	D. F.	S. S.
Males	79	0.2319	0.7015	2,2178	3.0250	78	0.0958
Females	249	0.7092	2.0771	7.2531	2.9288	248	1.1697
Indeterminants	131	1.2022	2.9347	7.9102	2.4411	130	0.7463

D. F. = Degrees of freedom ; b = Regression co-efficient ; S. S. = Sum of squares.

TABLE 12. Test of significance.

Source of variation	D. F.	Sum of squares	Mean squares	Observed F	5% F
Deviation from individual regression within sexes	456	2.0118	0.0044		
Differences between regression	2	0.1396	0.0698	15.8636	3.000
Deviation from total regression	458	2.1514	0.0742	Significant	

TABLE 13. Regression data for the length-weight relationship of males and indeterminants of *A. kalla*.

Sex	D. F.	Sum of squares and products x^2	xy	y^2	b	Errors of Estimate D. F.	S. S.
Males	79	0.2319	0.7015	2.2178	3.0250	78	0.0958
Indeterminants	131	1.2022	2.9347	7.9102	2.4411	130	0.7463

D. F. = Degrees of freedom ; b = Regression co-efficient ; S. S. = Sum of squares.

TABLE 14. Test of significance.

Source of variation	D. F.	Sum of squares	Mean squares	Observed F	5% F
Deviation from individual regression	208	0.8421	0.0040		
Differences between regression	1	0.0662	0.C662	16.55	3.000
Deviation from total regression	209	0.9083	0.0702	Significant	

TABLE 15. Regression data for the length-weight relationship of females and indeterminants of *A. kalla*.

Sex	D. F.	Sum of squares and products x^2	xy	y^2	b	Errors of estimate D. F.	S. S.
Females	249	0.7092	2.0771	7.2531	2.9288	248	1.1697
Indeterminants	131	1.2022	2.9347	7.9102	2.4411	130	0.7463

D. F. = Degrees of freedom ; b = Regression co-efficient ; S. S. = Sum of squares.

TABLF 16. Test of significance.

Source of variation	D. F.	Sum of squares	Mean squares	Observed F	5% F
Deviation from individual regression	378	1.9160	0.0051		
Difierences between regression	1	0.1061	0.1061	20.8039	3.000
Deviation from total regression	379	2.0221	0.1112		
				Significant	

TABLE 17. Regression data for the length-weight relationship of males and females of *A. kalla*.

Sex	D. F.	Sum of squares and products x^2	xy	y^2	b	Errors of Estimate D. F.	S. S.
Males	79	0.2319	0.7015	2.2178	3.0250	78	0.0958
Females	249	0.7092	2.0771	7.2531	2.9288	248	1.1697

D. F. = Degrees of freedom ; b = Regression co-efficient ; S. S. = Sum of squares.

TABLE 18. Test of significance.

Source of variation	D. F.	Sum of squares	Mean squares	Observed F	5% F
Deviation from individual regression	326	1.2655	0.0039		
Differences between regression	1	0.0016	0.0016	0.41036	3.000
Deviation from total regression	327	1.2671	0.0055		
				Insignificant	

SUMMARY

The length-weight relationships in *C. malabaricus* and *A. kalla* were calculated separately for males, females and indeterminants. Significant differences were obtained on comparing the regression equations for males, females and indeterminants of *C. malabaricus* and *A. kalla.* The regression equations for males and females, females and indeterminants and males and indeterminants of *C. malabaricus* and *A. kalla* was also compared.

ACKNOWLEDGEMENTS

The authors are grateful to Prof. F. Williams, Chairman, Division of Biology and Living resources, School of Atmospheric Sciences, University of Miami, University of Florida and Dr. C. T. Samuel, Dean, Department of Industrial Fisheries, Cochin for their valuable comments. For financial support and facilities, they thank the University Grants Commission, New Delhi and the authorities of Annamalai University.

REFERENCES

ALLEN, K. R. 1938. Some observations on the biology of the trout (*Salmo trutta*) in winder mere. *J. Anim. Ecol.*, **7** : 333-349.

HILE, R. 1936. Age and growth of the Ciso, *Leucichthys artedi* (Le Sueur) in the lakes of the north eastern high lands. Wisconsin. *Bull. U. S. Bur. Fish.*, **48** : 311-317.

JAMES, P. S. B. R. 1967. The ribbon fishes of the family Trichiuridae of India. *Mem. Mar. biol. Ass. India*, **1** P. 1-226.

LE CREN, E. D. 1951. The length-weight relationship and seasonal cycle in gonad weight and condition in the perch. (*Perca fluviatilis*) *J. Anim. Ecol.*, **20** (2) : 201-219.

MARTIN, W. R. 1949. The mechanics of environmental control of the body form in fishes. *Univ. Toronto stud. Biol.,* **58**, *Ont. Fish. Res. Lab.,* 70 p. 1-91.

MOJUMDER, D. 1971. Length-weight relationship in the cat-fish *Tachysurus thalassinus* (Ruppell) *Indian. J. Fish.,* **18** : 179-182.

NARASIMHAM, K. A. 1970. On the length-weight relationship and relative condition in *Trichiurus lepturus* Linnaeus. *Indian. J. Fish.,* **17** : 90-91.

ROUNSEFELL, G. A. AND W. H. EVERHART 1953. *Fishery Science : its method and application.* John Wiley and sons. Inc., N. Y.