DIMENSIONAL RELATIONSHIPS AND GROWTH OF GREEN MUSSEL *PERNA VIRIDIS* IN KAKINADA BAY

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ABSTRACT

The d!iimeinsikm3!l refcltiioinslhliip of lenigltth to other body measuremente like breadth, thickness, weight, volume eltc. fa *P. viridis* is given. Growth of (he mussels reared din cages kept in the mafanall **bed** lis stodlied. The van Bentelanffy growth eqwattan is flitted Which has the pairaroelteiris **Lcc** = 184.6 mm, K = 0.2512 and t_0 = -1.73 years. Seasonal wtrdaittai in the growth of mussels is observed. First and second quarters accounted for 68.2% of the amnuail increase in length.

INTRODUCTION

For many aspects of growth, ecology and physiology At is desirable to know the relationship between 'these and other body measurements. The relationship of length to 10 body (measurements in the green mussel *Perna viridis* (Linnaeus) collected during 1974-76 from a subtidai bed in 'the Kakinada Bay are given in this paper together with information on age and growth of the: species. Shafee (1978) studied the various afflometrie relationships in this species from Madras.

MATERIAL AND METHODS

The linear measurements were made with vernier calipers to the nearest 0.1 mm. Length was measured from the tip of umbo to the posterior margin of the shell, breadth in 'the greatest dorsoventral direction and thickness from side to side in 'the broadest region when the valves are closed. Ai the weight data over 10 g were recorded to ithe nearest 0.5 g; those below 10 g to the nearest mg. The wet meat was wiped with blotting paper to remove excess moisture before weighing. Volume measurements were made in tap water by the displacement method in an apparatus similar to the one described by Galstoff (1964). All the data were taken in fresh condition within 2-3 h alter collection of mussels except meat volume and meat weight which were studied after preservation in 5% formalin for about 10 days. To study the relationship between length and other body measurements the regression equation of the type Y = a + bX was fitted by the least square technique (Snedecor and Cochran 1967). Where required logarithmic transformation was applied.

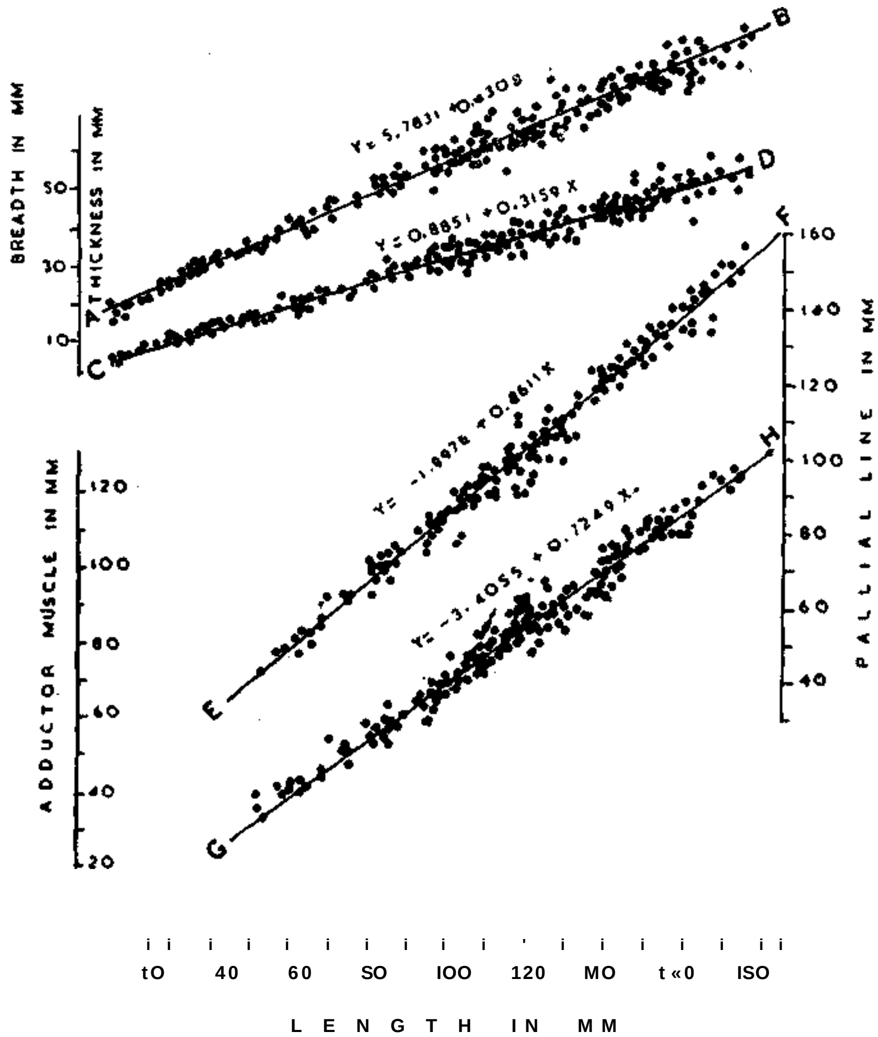
TABLE 1. *The various dimensioned relationships in* Perma viridis.

Parameters	Length range mm	Number	Equation		Wether *b* is signi- ficantly different from 3
Length (X) and total weight (Y)	12-180	249	Log W -3.7889+2.8616 Log L	0.9932	Yes
Length (X) and meat weight (Y)	50-180	207	Log W -4.1572+2.7496 Log L	0.9610	Yes
Length (X) and shell weight (Y)	50-180	207	Log W -4.4538+3.0333 Log L	0.9798	No
Length (X) and total volume (Y)	50-180	207	Log V -3.8575+2.8468 Log L	0.9900	Yes
Length (X) and meat volume (Y)	50-180	207	Log V -3.9309+2.6477 Log L	0.9710	Yes
Length (X) and shell volume (Y)	50-180	207	Log V -4.6414+2.9607 Log L	0.9700	No
Length (X) and thickness (Y)	9-180	286	Y -0.8851+0.3159 X	0.9747	
Length (X) and breadth (Y)	9-180	286	Y -5.7831+0.4308 X	0.9579	
Length (X) and Umbo to posterior margin of paMial lime (Y)	50-180	213	-1.9976+0.8611 X	0.9947	—
Length (X) and Umbo to anterior margin of posterior adductor muscle (Y)	50-180	213	Y = -3.4055+0.7249 X	0.9951	_

•For age-and-growth studies, 7 cages containing a total of 52 mussels were kept on the natural bed where Uhe water depth is over 0.5 m at (the low tide. The mussels were not marked but care was taken to ©insure that the difference in length of the mussels in a given cage is siifneienitly wide to render easy identification of individuals under periodic observation. Onoe in a month the cages were lifted and 'the mussels were measured for length, after oleaninig them of foulers.

DIMENSIONAL RELATIONSHIPS

The various parameters studied and the relationships obtained are given in table 1. Mote of the length against thickness, breadth, distance from umbo to the posterior margin of the pallia! line and from umbo to the anterior margin of posterior adductor muscle showed 'that the general equation Y = a + bX de^ scribes well the growth of these measurements in relation to length (Fig. 1).



FUG. 1. The <Mnieinsdionial Twkttansihi'lps An *P. viridis.* AIB taragtlh amdi fareadltb. CO length-tlhiktasS, BF uoiibo to posteritor fniamgim of paliiai line and OH umlbo to anterior miairgiitt of posterior £idKk»ctar miuscfe.

Plots of weight and volume against length showed 'that the rdationiships aire not linear. Hence after logarithmic transformation of both measurements, the equation was fitted (Figs. 2 and 3). It may be seen that the value of the regression coefficient in Iengith-weighit and length-volume equations varied from 2.6477 to 3.0333. This is in conformity with the observations of Wilber and Owen (1964) that most raioluscs have a slope between 2.5 to 4.5.

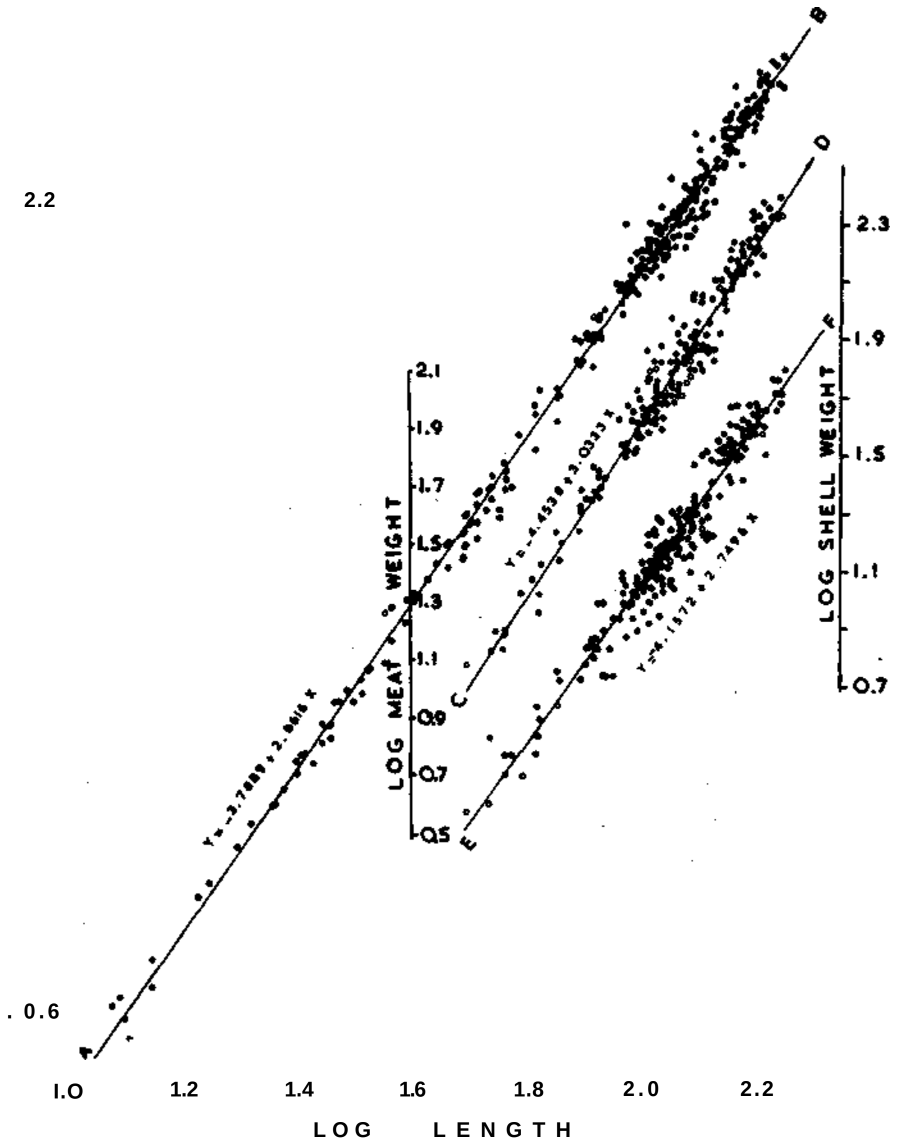


FIG. 2, 'Length-weight nelaitianstodps in *P. viridis.* AiB length-total weight, CO lengith-siheM weight and 'BF length- meat weiight.

Only in the case of length-Kibel weight and lengtJh.-sh.dl volume regression equations, the t test Showed[1] that b is not significantly different from 3, confirm-img that the growth of 'these parameters is isometric (itable 1). The values of Che ooirrdation coefficients (r) between length and the various body proportions studied (table 1) are very close to unity Showing high degjree of correlation.

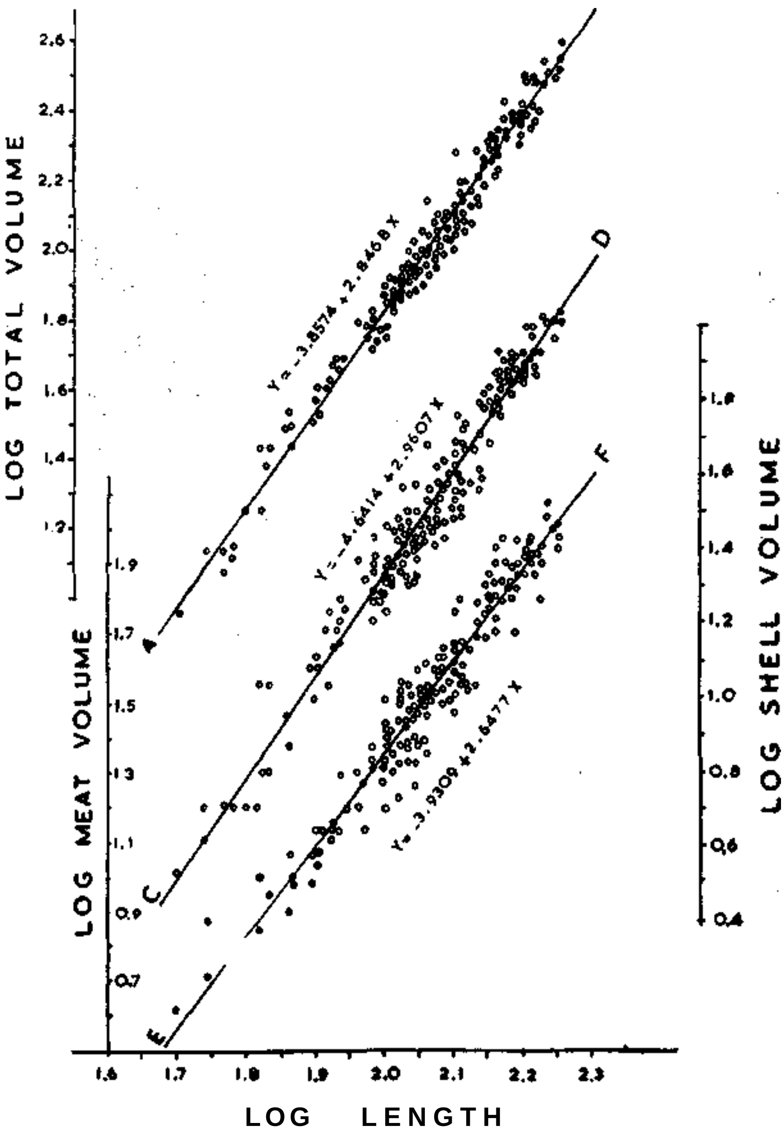


FiG. 3. Length-volume -rdationsihiips in *P. viridis*. A(B lemgtih-*atail volume, CO length-shell volume and EF lefingtUiKmeiait votane.

Rao et ai (1975) and Qasim et ai. (1977) studied the length-total weight relationship in *P. viridis* from Goa. The b values obtained .by them varied from 2.4175 to 2.6648 which are lower compared to 2.8616 obtained by me; Uhafee (1978) used the logarithmic tenisformation for length-breadth ^.and lemgth-thickness relationships.

AGE AND GROWTH

- The average growth in length for 10 mm size groups at quarterly intervals of time for 52 mussels measuring 81-172 mm reared in Cages are given in table 2. The 'monthly average growth of individual mussels during the course of 'an year varied from 0.33 to 2.42 mm depending oh the size of the mussels—the smaller mussels growing faster. There was considerable variation in the growth between mussels of comparable length. •., . ?•....

The age of the'mussels when they were first caged is not-known. In order to 'obtain itfoe length^at-age; Key. 'the von Berita'ianffy growith .equation was fitted. For this purpose 'the Ford-Walford (Ford 1933 and Waifqrd 1946) plot otf. length at time t *f.* 1 was drawn against length at time t (Fig, 4), taking the time interval as one year. From the regression, equation the asymptotic length Loc was daliculated as 184.6 mm. By taking the length of 1-year-old mussels as 91.5 mm (N^rasimham 1980) the lengths .'.at' successive jageis.were caloulated from the Ford-Watford plot. From these data, t_0, the arbitrary origin of the

TABLE 2. *Quarterly average growth in length for* 10 *mm size groups in* Perna viridis. '•- \

Size group	Nos.	28-3-75	3Gr6-75	27-9-75	29-12-75	27-3-76
81-90	7	85.0	94.Q	99.3	101,1	107.7
91-100	3	94.7	101.7	105.3	107.8	114.2
101-110	6	106.0	110.7	113.2	115.5	122.3
111-120	6	115.4	120.2	122.4	123.9	129.0
121-130	6	124.6	128.5	130.9	132,8	136.7
131-140	6	134.7	138.5	140.2	141.7	145.2
141-150	5	145.9	148.9	150.4	151.9	154.3
151-160	6	156.0	158.7	159.9	161.0	163.1
161-170	6	167.0	168:7-.	169.7	17d".4	172.1
171-180	1	172.0	' ' 173.5	174.0	174.5	176.0

growth curve and K, a constant equivalent to l/3cd of cataboilic coefficient were estimated as -1.73 years and 0.2512 respectively. The von Bertalanffy growth equation in *P. vkidis* is written as:

L_t = 184.6 f j.e-0.2512 (^+1.73)1

Where L_t is the length in mm at time t The calculated lengths by the above growth equation at ages 1 to 4 are 91.7, 112.3, 128.3 and 140.8 mm respectively. The length-Jfrequeniy studies on the mussels at Kakiraada made by me (Naxasknham 1980) showed that ith<ey attain an average length of 91.5, 117.0, 129.0 and 135.0 nun when they are (respectively 1 to 4 years old. The length-at-age data airrived by these two methods are similar.

Seasoned variation in growth; The quarterly percentage increase in length (average) in the annual growth for all the 52 mussels is studied. It was observed that during (the II quarter (28-3-75 to 30-6-75) ithe mussels attained a growth rate of 34.3%. The III quarter (30-6-75 to 27-9-75) registered a growth naite of 17.1% whie the growth rate in ithe IV quarter (27-9-75 to 29-12-75) was the lowest, being 14.6%. In the I quarter (29-12-75 to 27-3-76) again the

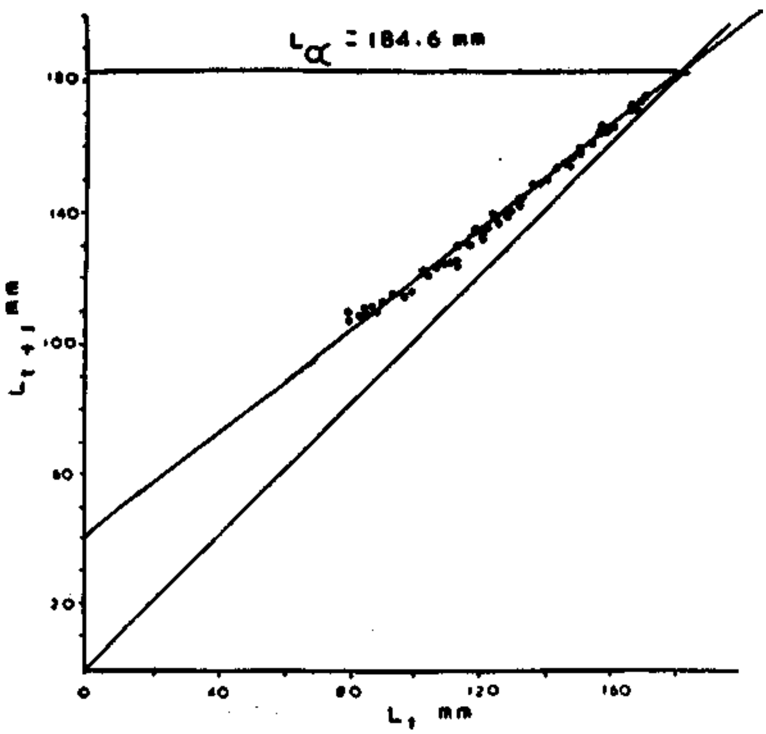


FIG. 4. Bard-Watford plot of cage-grown mussels.

growth was rapid, accounting lor 33.9% of the annual increase. Thus, there is considerable seasonal variation in the growth and the I and II quarters accounted for 68.2% of ithe annual increase in length. This seasonal trend in growtih is manifested in all the size groups of the mussels studied (table 2). The variations observed in the growth of the mussels during different quarters of the year

TABLE 3. *Analysis of variance of quarterly percentage increase in length of mussels on Arcsin transformation.*

Source of variation	d.f.	S.S.	M.S.	F
81-11 Oman group				
Between quarters	3	3139.6	1046.533	77.607
Within quarters	60	809.1	13.485	
Total	63	3948.7		
111-140 mm group				
Between quarters	3	2864.486	954.829	55.3
Within quarters	68	1174.340	17.2697	
Total	71	4038.826		
141-172 mm group				
Between quarters	3	2289.182	763.061	53.496
Within quarters	68	969.950	14.264	
Total	71	3259.132		

were tested by analysis of variance (Snedecor and Cochran 1967). For this purpose the data on the quarterly percentage increase of the length of 52 mussels were used. To make the test more reliable, the percentages were used after Arcsin transformation. As the younger mussels showed faster growth rate than the older mussels, for the .test, (they were divided into 3 length groups comprising 81-110 mm, 111-140 mm and 141-172 mm groups so as to ensure near homogeneity in length of the mussels. The F test showed (Table 3) that ithe differences observed in the growth of the mussels during different quarters are highly significant.

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