Morphometric Measurements as an Index for Estimating Yield of Meat in Shell Fishes, 2. Mussel *(Perna viridis)* and Clam *(Villorita cyprinoides)**

CHINNAMMA GEORGE, G. RAJAGOPALAN UNNITHAN and K. GOPAKUMAR
Central Institute of Fisheries Technology, Cochin - 682 029

Observations (76 nos) on height-length and whole weight-meat weight relations of mussels *(Perna viridis)*, both wild and cultured were made. From the length of mussel the height can be worked out by the equations (logarithmic scale),

1. $y = 0.360 + 0.988\ x$ for wild
2. $y = 0.334 + 1.011\ x$ for cultured,

where x is the length (cm) and y is the height (cms). So also to any height the corresponding meat weight can be obtained by the regression equation.

$\log w = -0.8178 + 1.9769 \log H$ for wild variety (1)

$\log w = -1.3049 + 2.8385 \log H$ for culture-variety (2) where w is the meat weight (g) and H is the height (cm) of the mussel. Fourteen observations on size-weight measurements of clams were made. The yield varied from 8.9 to 13%. The length-height relationship worked out for clams *(Villorita* sp) is $y=0.485+1.005\ x$ for length x and height y.

Now-a-days the popularity of shell fishes, is increasing due to their high delicacy as well as their high food value. Shell dimensions and their inter-relations in bivalve molluscs have been reported by several workers (Weymouth, 1923; Newcombe, 1935, 1936, 1950; Orton, 1926; Quayle, 1952; Rao, 1952; Abraham, 1953; Galtsoff, 1931; Hamai, 1934; 1935; Nair & Nair, 1985, 1986). The study of length-weight relationship is an important tool in fishery biology and according to Le Creen (1951) it is pursued with two objectives, namely (1) to establish a mathematical relationship between two variables, namely the length and the weight; so that if one is known the other could be computed and (2) to know whether variations from the expected weight for the known length groups are indication of fatness, general well-being, gonad development and suitability of environment. The relation between linear dimensions, weight and volume of shell in *Meretrix meretrix* and the probable influence of environmental factors were studied by Hamai (1934). Rao & Nayar (1956) and Nair (1984) studied the rate of growth in the backwater oyster *(Crassostrea madrasensis)* from Adayar estuary and Cochin backwaters respectively. Richards (1946) studied the comparative growth rate in the green mussel *(Mytilus californianus)* and *Mytilus edulis)* from California and Woods Hole respectively. Nayar (1955) made detailed studies on length-weight length-breadth and length-thickness studies in the clam *(Donax cuneatus)*. Hanoka & Shimatzu (1949) made notable contributions to the morphometry of clams. Talikhedkar *et al.* (1976) studied the growth rate in the wedge clam *Donax cuneatus* inhabiting Ratnagiri. Durve & Dharmaraja (1965) noticed the influence of environmen-tal conditions prevailing at the locality influencing the morphometry of *Meretrix casta.*

*Formed part of the Ph.D. thesis of the first author approved by the Cochin University of Science and Technology.

Materials and Methods

Green mussels *(Perna viridis)* collected from the landing places of Calicut and from Central Marine Fisheries Mussel Culture

Centre at Calicut were transported to laboratory in refrigerated van or in iced condition. The material was cleaned free of mud and byssus thread. Their size-weight measurements were taken. In mussels and clams height is the distance between the umbo and the ventral valve margin and length is the maximum distance between the anterior and posterior margin measured parallel with the hinge axis. Clams *(Villorita cyprinoides)* collected from Cochin backwaters were brought to laboratory in live condition. After thorough washing, height and length were taken. With a stainless steel scalpel the muscle was picked up, and the yield was calculated on the basis of whole weight.

Results and Discussion

Table 1 represents the size-weight measurements of mussel *(P. viridis)*. Two categories were tested namely (a) wild and (b)

Table 1. *Size, weight ratios of mussels (Perna viridis)*

(a) Wild

	Height cm	Length cm	Ratio	Whole weight g	Weight of meat g	Ratio
1	10.80	5.0	2.16	61	19	0.31
2	11.10	4.6	2.41	76	16	0.21
3	10.90	4.9	2.22	74	19.5	0.26
4	9.20	4.0	2.30	47	12	0.25
5	9.00	4.0	2.22	38	10	0.26
6	8.90	3.8	2.37	36	9	0.25
7	8.45	3.8	2.22	39	12	0.30
8	8.10	3.5	2.28	27	9	0.33
9	7.80	3.8	2.05	31	10.5	0.33

(b) Cultured

	Height cm	Av.	Length cm	Ratio	Whole weight g	Av.	Meat wt. g	Av.	Ratio
1	9.1	9.1	4.1	2.21					
	9.1		4.0	2.27	135	45	58	19.3	0.429
	9.1		4.0	2.27					
2	8.0		3.7	2.16					
	8.1	8.1	3.7	2.19	109	36.3	45.5	15.2	0.417
	8.1		3.6	2.25					
3	7.6		3.8	2.00					
	7.2	7.6	3.3	2.18	85	28.3	36.5	12.2	0.429
	7.6		3.5	2.17					
4	6.8		3.1	2.19					
	7.1	7.1	3.3	2.15	97	24.3	40.5	10.1	0.417
	7.2		3.1	2.32					
	7.0		3.3	2.12					
5	6.3		2.8	2.25					
	6.9	6.5	3.3	2.09	69	17.3	36.0	9.0	0.521
	6.6		3.0	2.20					
	6.3		3.0	2.10					
6	6.1								
	6.0	6.1			56	14.0	28.0	7.0	0.50
	6.0								
	6.2								

	Height cm	Av.	Whole wt cm	Av.	Weight of meat g	Av.	Ratio
7	5.7 5.9 5.9 5.7 5.7 5.7 5.6 5.7 5.6 5.6 5.6 5.6	5.7	153	12.8	78.0	6.5	0.509
8	5.5 5.5 5.5 5.4 5.4 5.4 5.5 5.5 5.5 5.2 5.5 5.4 5.3 5.3	5.4	151.5	10.8	78.0	5.6	0.515
9	5.1 5.1 5.1 4.9 4.8 4.9	5.0	55	9.2	23.5	3.9	0.427
10	4.5 4.6 4.1 4.5 4.2 3.5	4.4	33.5	6.7	11.5	2.3	0.343
11	3.4 3.0 3.5 3.1 3.1 3.2 2.9 2.0	3.1	27.0	3.0	9.0	1.0	0.333

cultured. The height of the wild variety ranged from 7.8 to 11.1 cm whereas the cultured variety was in the range 2.0 to 9.1 cm.

Given any height the corresponding meat weight can be obtained by the regression equation:

Table 2. *Size-weight measurements of clams (Villorita sp.)*

Height cm	Length cm
3.5	2.5
3.0	2.4
3.1	2.6
2.9	2.4
2.9	2.7
3.3	3.0
4.9	4.3
4.9	4.4
4.7	4.2
3.8	3.6
3.3	2.4
3.5	2.8
2.0	1.8
2.1	1.8

(1)	Whole weight of a lot, kg	3.0
	Meat weight (free of intestines), g.	390
	Meat content, %	13
(2)	Whole weight of a lot, kg	4.995
	Average weight of a clam, g,	10.9
	Meat weight, g.	445
	Meat content, %	8.9
(3)	Whole weight of a lot, kg.	1047
	Meat weight, g.	97.27
	Meat content, %	9.3

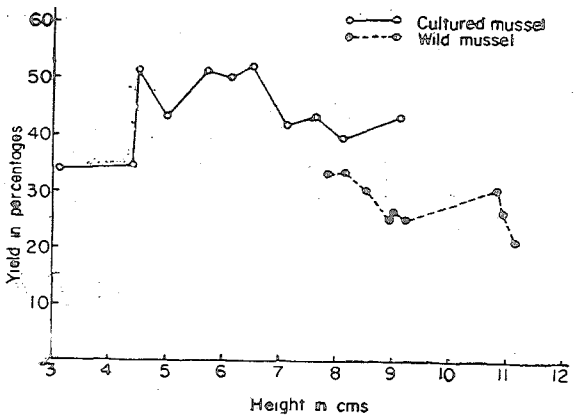

Fig. 1. Yield of *Perna viridis*

log w = -0.8178 + 1.9769 log H for wild (1) and

log w = -1.3049 + 2.8385 log H for cultured (2) where w is the meat weight (g) and H is the height (cm) of the mussel. The correlation coefficients were found to be r = 0.87 and r = 0.78 respectively and were highly significant ($p < 0.01$).

It is observed that the yield percentage $\frac{\text{(ie. meat weight x 100)}}{\text{whole weight}}$ was generally in the range (25,35) for the wild (Fig. 1 and Table 1). There was a marked increase in yield in cultured mussel compared to the wild. This yield percentage was noted to be in the range (34,53.) Also of mussels of medium height (about 5.4 to 6.5 cm) were observed to have the maximum yield of above 50%.

Length-height relationship

For *Perna viridis,* length-height relationship was worked out for wild and cultured categories. The correlation coefficients were found to be (log. scale) r = 0.94, and r = 0.95 for wild and cultured respectively. r values were hgihly significant ($p<0.01$). The regression equations were

(1) $y = 0.36 + 0.99\ x$ for wild

(2) $y = 0.33 + 1.01\ x$ for cultured

where y is the height (cm) and x is the length (cm).

The analysis of covariance shows that the slopes are same and hence the equations were combined as $y = 0.31 + 1.06\ x$. b value is nearly 1 and hence x and y (original values) are directly proportional (Coef. of proportionality = 2.03).

Study was not conducted to examine the age and size of clams. The size-weight measurements of clams are depicted in Table 2 and the data were statistically analysed. The yield vaired from 8.9 to 13%.

The length-height relationship worked out for clams *Villorita* sp. is:

$y = 0.485 + 1.005\ x$ (or $y = 0.49\ x$) for length x and height y. Correlation coefficient r = 0.96 which is highly significant ($p < 0.01$).

Hamai (1934) found that the growth of *M. meretrix* at different localities and also under different substrata is influenced by

temperature, salinty and other parameters of the enviornment. Durve & Dharmaraja (1965) also noticed the influence of environmental conditions prevailling at the locality on the morphometry of *M. casta*. Galtsoff (1931) assigned variations in growth ratios of the pearl oyster *Pinctada* sp. to differences in their origin. Ohba (1959) observed changes in the rate of dimensional relations of shell during definite stages in *Tapes japonica*. Allometric relations of height depth was observed in *Mya arenaria* by Newcombe & Kessler (1936) and Alagarswami (1966).

We are thankful to the Director, Central Institute of Fisheries Technology, Cochin for the facilities provided for this work.

References

Abraham, K. C. (1953) *J. Zool. Soc. India* 5, 163

Alagarswami, K. (1966) *J. Mar. Biol. Ass. India* 8, 56

Durve, V. S. & Dharmaraja, S. K. (1965) *J. mar. Biol. Ass. India*, 7, 69

Galtsoff, P. S. (1931) *Am. Nat.* 65, 423

Hamai, I. (1934) *Sci. Rep. Tohoku. Univ.* 4, 205

Hamai, I. (1935) *Sci. Rep. Tohoku Univ. Fourth Ser.* 9, 339

Hanoka, T. & Shimadzu, T. (1949) *Bull. Japan. Soc. Sci. Fisheries*, 15, 311

Le Creen, C. P. (1951) *J. Anim. Ecol.* 16, 189

Nair, N. Unnikrishnan & Nair, N. Balakrishnan (1985) *Fish. Technol.* 22, 87

Nair, N. Unnikrishnan & Nair, N. Balakrishnan (1986) *Fish. Technol.*, 23 27

Nayar, K. N. (1955) *Indian J. Fish.* 2, 325

Newcombe, C. L. (1935) *Can. J. Res.* 13, 97

Newcombe, C. L. (1936) *Nature*, 137

Newcombe, C. L. (1950) *Amer. Nat.* 84, 203

Newcombe, C. L. & Kessler, H. (1936) *Ecology*, 17, 429

Ohba, S. (1959) *Biol. J. Okayamma Univ.* 5, 13

Orton, J. H. (1926) *J. mar. Biol. Ass. U.K.* 14, 239

Quayle, D. B. (1952) *Proc. Royal Soc. Edin.* 6413, 384

Rao, K. V. (1952) *Proc. Indo-Pacific Fish. Coun. Sec.* ii, 94

Rao, K. V. & Nayar, K. N. (1956) *Indian J. Fish.* 3, 231

Richards, O. W. (1946) *Ecology*, 27, 370

Talikhedkar, P. M., Mane, U. H. & Nagabhushanam, R. (1976) *Indian J. Fish.* 23, 183

Nair, N. Unnikrishnan, (1984) *Studies on Backwater Oyster Crassostrea madrasensis* Preston *Inhabitiug Cochin Harbour.* Ph.D. Thesis, University of Cochin

Weymouth, F. W. (1923) *Bull. Calif. Fish. Game, Fish. Bull.* 7, 1