

STUDIES ON DIMENSIONAL RELATIONSHIPS IN GREEN MUSSEL  
*MYTILUS VIRIDIS* FROM TWO ENVIRONMENTS

Z. A. ANSARI, AYYAPPAN NAIR, S. N. HARKANTRA and A. H. PARULEKAR  
*National Institute of Oceanography, Dona Paula-403 004, Goa*

ABSTRACT

Dimensional relationships between total weight, shell weight, wet meat weight, dry meat weight, length, width and depth in the green mussels collected from the intertidal zone (natural population) and those cultured on ropes hanging in water, were determined. Total weight/length, wet meat weight/length, total weight/depth, wet meat weight/depth and dry meat weight/depth were found to be significantly different in the mussels from the two environments. Depth appears to be a useful parameter for estimating the total weight, meat weight and shell weight. The shell weight/dry meat weight ratio was higher in cultured on ropes than in the naturally occurring mussels. Moisture percent in tissues varied in mussels from the two environments.

Dimensional studies in lamellibranchs reveal that animals coming from different localities have differences in their dimensional ratios (Newcombe, 1950; Durve and Dharma Raja, 1965; Dame, 1972; Seed, 1973). In a recent study on the aquaculture of green mussel, a quantitative estimate of biomass of cultured and natural population was made (Qasim, Parulekar, Harkantra, Ansari and Nair, 1977). The present work gives the relationship between parameters such as weight, length, width and depth in the green mussel, *Mytilus viridis* L. obtained from two different environments. The purpose of this study was to compare the differences in morphological features of mussels in the light of ecological differences in two environments.

Intertidal mussels (naturally occurring) were collected from Velsao Bay and the submerged mussels were taken from the culture ropes suspended in water from a floating raft which was moored about 20 km away from Velsao Bay. A sample constituting 870 specimens from naturally occurring population and 800 specimens of cultured mussels were measured for various dimensions. The animals were brought to the laboratory and measurements taken with the help of a vernier calipers to the nearest 0.1 mm. The weight of each mussel was determined on a monopan electric balance. The mussels were then opened, the tissues were separated from the shell and dried to a constant weight at 60° C. The weights of each shell and the weights of dried tissue were determined.

To study the relationship between a part and the intact organism or between two parts of the same organism over a wide size range a simple allometric equation of the following type has been described by Wilbur and Owen (1954)

$$Y = aX^b$$

where Y is some measure of a part, X is measure of the whole body or another part and a and b are constant and can be estimated from a set of data using least square regression

Table I. Regression equations describing the dimensional relationship in the mussels of the two environments.

Relationship(Y/X)	Tidal level	Regression equation		r <sup>2</sup>	SE
<u>Total weight</u> Length	I	Y = 0.000195	X <sup>2.8577</sup>	0.9041*	0.299
	S	Y = 0.000513	X <sup>2.5001</sup>	0.9861	0.271
<u>Total weight</u> Width	I	Y = 0.000590	X <sup>3.0124</sup>	0.9336	0.322
	S	Y = 0.000822	X <sup>2.8756</sup>	0.9820	0.289
<u>Total weight</u> Depth	I	Y = 0.00388	X <sup>2.8387</sup>	0.9304*	0.304
	S	Y = 0.00563	X <sup>2.6710</sup>	0.9964	0.247
<u>Wet meat weight</u> Length	I	Y = 0.000581	X <sup>2.2878</sup>	0.7370*	0.382
	S	Y = 0.000001	X <sup>3.6422</sup>	0.9653	0.321
<u>Dry meat weight</u> Length	I	Y = 0.000006	X <sup>3.0909</sup>	0.8177	0.457
	S	Y = 0.000109	X <sup>2.2609</sup>	0.9019	0.298
<u>Shell weight</u> Length	I	Y = 0.000138	X <sup>2.7620</sup>	0.9196	0.316
	S	Y = 0.000320	X <sup>2.6810</sup>	0.9312	0.279
<u>Wet meat weight</u> Depth	I	Y = 0.06277	X <sup>1.2519</sup>	0.8298*	0.212
	S	Y = 0.00419	X <sup>2.5081</sup>	0.9946	0.186
<u>Dry meat weight</u> Depth	I	Y = 0.000185	X <sup>3.0280</sup>	0.8172*	0.301
	S	Y = 0.000924	X <sup>2.4324</sup>	0.9852	0.214
<u>Wet meat weight</u> <u>Dry meat weight</u>	I	Y = 0.1305	X <sup>0.9896</sup>	0.5270	0.494
	S	Y = 0.3017	X <sup>0.6524</sup>	0.6561	0.462
<u>Dry meat weight</u> Total weight	I	Y = 0.0662	X <sup>1.1079</sup>	0.9227	0.321
	S	Y = 0.1036	X <sup>0.9135</sup>	0.9115	0.318
<u>Dry meat weight</u> Shell weight	I	Y = 0.1371	X <sup>1.1541</sup>	0.8816	0.346
	S	Y = 0.2129	X <sup>0.8325</sup>	0.8616	0.338
<u>Shell weight</u> Total weight	I	Y = 0.5348	X <sup>0.9581</sup>	0.8622	0.283
	S	Y = 0.4478	X <sup>1.0696</sup>	0.8704	0.215
<u>Wet meat weight</u> Shell weight	I	Y = 0.8597	X <sup>1.0247</sup>	0.9416	0.336
	S	Y = 1.1264	X <sup>0.8666</sup>	0.9612	0.238
<u>Depth</u> Length	I	Y = 0.1763	X <sup>1.2450</sup>	0.8744*	0.304
	S	Y = 0.4184	X <sup>0.9298</sup>	0.9890	0.296

I=Intertidal, S=Submerged

\* Significantly different at 5% level.

technique. This equation was used in the present study and the calculations were carried out on a DCM Microsystem 1101.

Dimensional coefficients for the various relationships are given in Table I. The correlation coefficients of each pair were tested by *t*-test to allow an indirect comparison

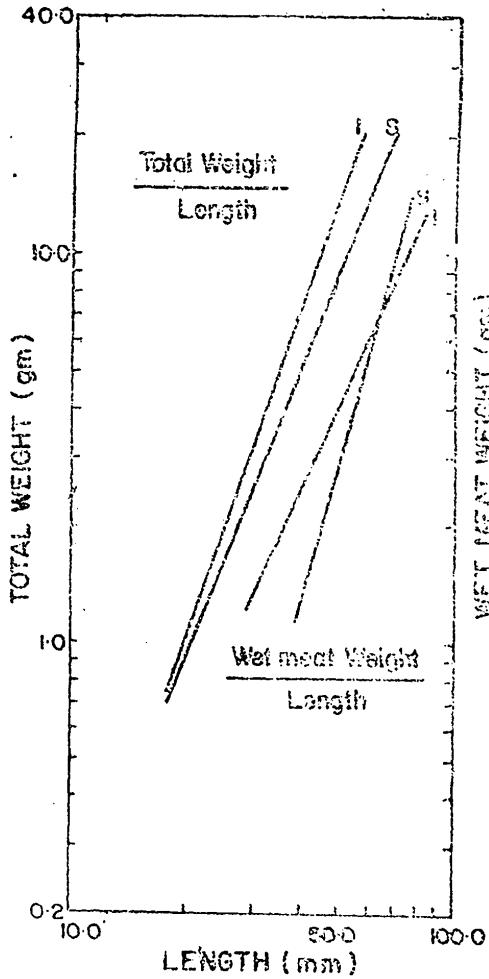


Fig. 1. The fitted lines for total weight/length and wet meat weight/length of intertidal (I) and submerged (S) mussels.

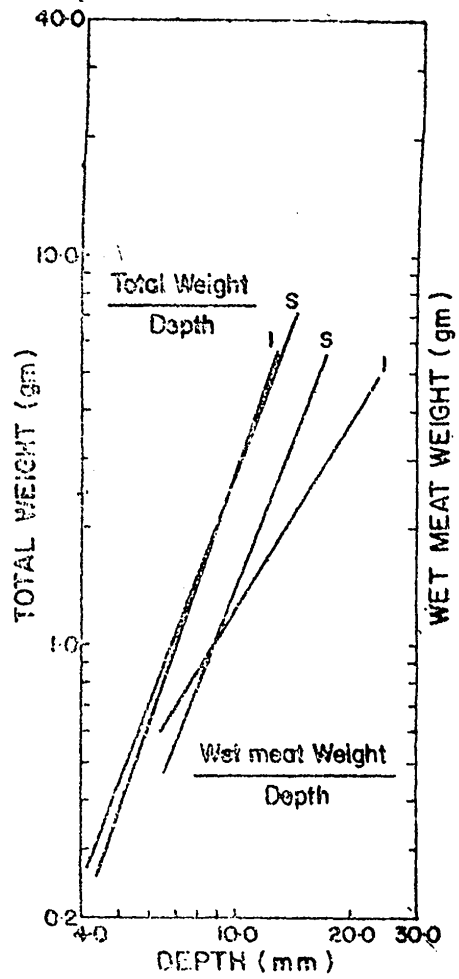


Fig. 2. The fitted lines for total weight/depth and wet meat weight/depth of intertidal (I) and submerged (S) mussels.

of the values for naturally occurring and cultured mussels. The coefficient of determination which gives an estimate of the fitness of the data to the equation used (perfect fit would be  $r^2 = 1$ ) is also in given Table I. The standard error (SE) of each regression coefficient was calculated. Regression lines of the various relationships of naturally occurring and cultured mussels were plotted on a logarithmic scale where it has assumed a more or less linear function (Figs. 1-3).

The relationship of total weight/length, wet meat weight/length, total weight/depth, wet meat weight/depth and dry meat weight/depth were significantly different for the naturally occurring and cultured mussels (Table I). The total weight, wet meat weight and dry meat weight against length, width and depth exhibited exponential growth and their relationships were found to be cubic.

No significant differences were found between naturally occurring and cultured mussels in the remaining relationships of total weight/width, shell weight/total weight,

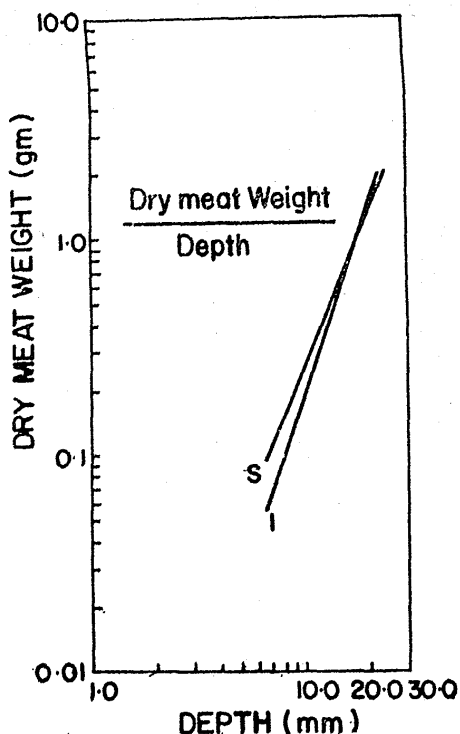


Fig. 3. The fitted lines for dry meat weight/depth of intertidal (I) and submerged (S) mussels.

important in productivity study. The condition index which reflects the seasonal changes in metabolism and growth, has been reported to be higher for cultured mussels than for naturally occurring forms (Qasim, Parulekar, Harkantra, Ansari and Nair, 1977). The ratio of meat weight to total weight was higher in the cultured mussel than in the naturally occurring forms. It indicates that the rate of conversion of energy in terms of soft tissue is greater in the cultured mussels than in those of the intertidal region. From the various relationships it appears that the depth is the most useful parameter to estimate other biomass parameters of total weight, meat weight and shell weight. It is because of high coefficient of determination values in this relationship (Table I). Shaffee and Sundaram (1975) have also found that height (depth in the present study) was the most useful parameter for predicting other biomass parameters in the green mussel from the Madras region.

The wet meat weight/shell weight and dry meat weight/shell weight showed linear relationship and their ratios were higher in the cultured mussels than in the naturally occurring forms. This may be due to the higher shell weight in the former mussels. Rao (1953) found a similar relationship between intertidal and subtidal forms of *M. edulis* and *M. californianus*. He observed that the depositions of calcium in molluscan shell is directly dependent upon the time the animal is kept submerged.

The water percentage in the tissues as calculated from dry meat weight/wet meat weight ratio was 85.0% in the naturally occurring mussels and 83.0% in cultured mussels which is within the reported range of 75.0 to 85.0% (Qasim, Parulekar, Harkantra,

wet meat weight/total weight, dry meat weight/total weight and dry meat weight/shell weight. These relationships exhibited linear growth. The shell weight/dry meat weight ratio was found to be higher in cultured mussels than in the naturally occurring forms.

Dimensional relationships between weights and linear size of bivalves including mussels have been adequately described previously and were found to change when exposed to a variety of environmental factors, both seasonal and regional (Coe and Fox, 1942; Seed, 1968, 1973). The results obtained in the present study indicate disproportionate growth with increasing size and age in the mussels from the two environments. This is due to various factors such as growth rate, population density and degree of exposure as has been reported in the earlier communication by Qasim, Parulekar, Harkantra, Ansari and Nair (1977) and also indicated by Seed (1976).

All the significant relationships in mussels from the two environments were associated with body weight and therefore this parameter is imp-

Ansari and Nair, 1977). Naturally occurring mussels in the intertidal zone appear to retain a higher proportion of water than the cultured mussels in the submerged zone as they remain exposed for long period during the ebb tide. Dame (1972) while working on the American oysters also found a higher percentage of water in the tissues of intertidal oysters than in the subtidal oysters. These quantitative differences in the biological parameters are useful in ecological investigations.

#### ACKNOWLEDGEMENT

We are grateful to Dr. S. Z. Qasim, Director, NIO and Dr. M. J. George, Scientist, for their encouragements. Thanks are also due to Shri S. G. Dalal for help in statistical treatments. We wish to thank Shri S. K. Dharma Raja, Scientist, Central Marine Fisheries Research Institute, Cochin for his invaluable criticism of the manuscript.

#### REFERENCES

- Coe, W. R. and D. L. Fox, 1942. Biology of California sea mussel *Mytilus californianus*. 1. Influence of temperature, food supply, sex and age on the rate of growth. *Journal of Experimental Zoology*, **90**: 1-30.
- Dame, R. F., 1972. Comparison of various allometric relationships in intertidal and subtidal American oysters. *Fishery Bulletin*, **70**: 1121-1126.
- Durve, V. S. and S. K. Dharma Raja, 1965. A study on the dimensional relationship in the clam *Meretrix casta* (Chemnitz) collected from two localities. *Journal of the Marine Biological Association of India*, **7**: 69-79.
- Newcombe, C.V., 1950. An analysis of certain dimensional relationships of the Virginia oyster *Crassostrea virginica* (Gmelin). *American Naturalist*, **84**: 203-204.
- Qasim, S. Z., A. H. Parulekar, S. N. Harkantra, Z. A. Ansari and Ayyappan Nair, 1977. Aquaculture of green mussel, *Mytilus viridis* L. Cultivation on ropes from floating rafts. *Indian Journal of Marine Sciences*, **6**: 15-25.
- Rao, K. P., 1953. Shell weight as a function of intertidal height in a littoral population of pelecypods. *Experimentia*, **9**: 465-466.
- Shaffee, M. S. and K. S. Sundaram, 1975. A comparative study of the length-weight relationships of estuarine and marine mussels, *Mytilus viridis* L. of Madras region. *Symposium on Estuarine Biology, Cochin-Abstract* (1975).
- Seed, R., 1968. Factors influencing shell shape in *Mytilus edulis* L. *Journal of the Marine Biological Association of the United Kingdom*, **48**: 561-584.
- Seed, R., 1973. Absolute and allometric growth in the mussel *Mytilus edulis* (Mollusca, Bivalvia). *Proceedings of the Malacological Society of London*, **40**: 343-357.
- Seed, R., 1976. Ecology. In: *Marine mussels their ecology and physiology*, edited by B.L. Payne, Cambridge University Press, Cambridge. p. 13-60.
- Wilber, K. M. and G. Owen, 1964. Growth. In: *Physiology of Mollusca, Vol. 1*, edited by K. M. Wilbur and C. M. Yonge, Academic Press, New York, p. 211-242.