

Growth parameters in the cultured green mussel *Perna viridis* L. from the Zuari estuary, Goa

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Received 27 April 1992; revised 14 January 1993

Growth parameters for both length and weight were estimated in the raft-grown population of *Perna viridis*. The asymptotic length (L_{∞}) and weight (W_{∞}) were computed to be 85 mm and 34.37 g respectively. Theoretical length and weight computed by applying Von Bertalanffy's equation did not show significant deviation from the observed values. Specific growth rate (SGR) was calculated, by using the values of shell length, varied from 0.74 to 138.52%. SGR maxima was observed during the initial phase of growth implying that it was mainly due to high rate of metabolism. Growth expressed in terms of shell length showed significant positive correlation with chl-*a* and dissolved oxygen (DO) concentration, whereas, salinity showed inverse relationship. In contrast, growth expressed in terms of weight was significantly influenced by chl-*a* and DO. It was also observed that chl-*a* either singly or in combination with particulate organic matter had significant effect on growth.

In bivalves, increase in shell length or weight or both is used to estimate growth. Growth in *Perna viridis* is dependant on the food availability, sheltered waters and salinity gradients¹⁻³ and also known for its variable growth rate between different localities and within the population⁴. Further, the biomass may be increasing at an equal rate, however the growth rate in terms of other morphological parameters may vary due to local environmental conditions prevailing at that time. This paper communicates the growth parameters in raftgrown green mussel, *P. viridis* and its relationship with hydrographical parameters in the Zuari estuary, Goa.

Samples of *P. viridis* were randomly collected from the raft suspended in the Zuari estuary (lat. 15°27'N and long. 73°47'E) at fortnightly interval from October 1987-September 1988. Shell length (length along anterior-posterior axis) of each individual was measured nearest 0.1 mm and weighed. Mussel samples at the time of transplanting were in the size group of 3-8 mm. Sample size at each collection was 25, however each month 50 individuals were examined. Large number of samples could not be collected, since one of the principal purpose behind this study is to examine the commercial viability of mussel farming. In the present study, altogether 574 specimens were studied. From the floating raft (4 × 4 m) 16 ropes were suspen-

ded at 1 m interval. The length of the rope was about 5 m in the water column.

Growth parameters (L_{∞} , K , t_0) were calculated by Ford-Walford^{6,7} and Von Bertalanffy's⁸ growth curves for length (L_t) and weight (W_t) were fitted (Fig. 1). Specific growth rate was calculated⁹ using shell length. Environmental parameters (chlorophyll-*a*, particulate organic carbon, salinity, dissolved oxygen, suspended load) at the raft site were estimated¹⁰ during the time of each collection.

The Von Bertalanffy's growth equation for length (L_t) and weight (W_t) for *P. viridis* were

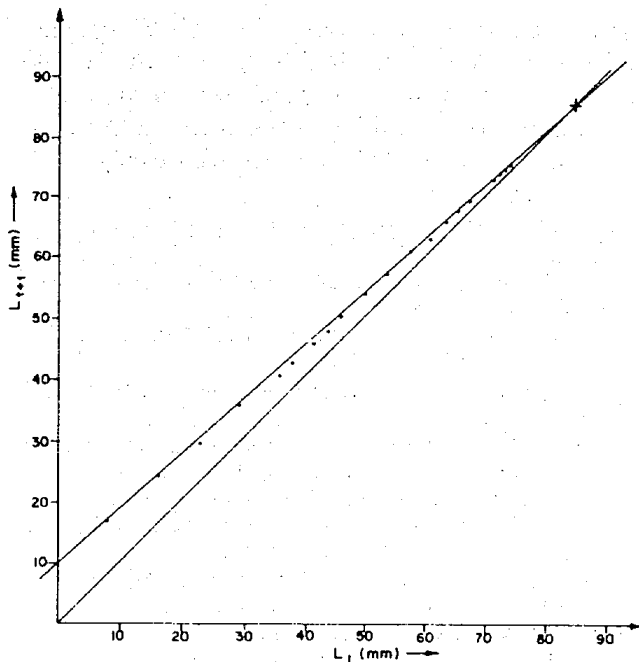
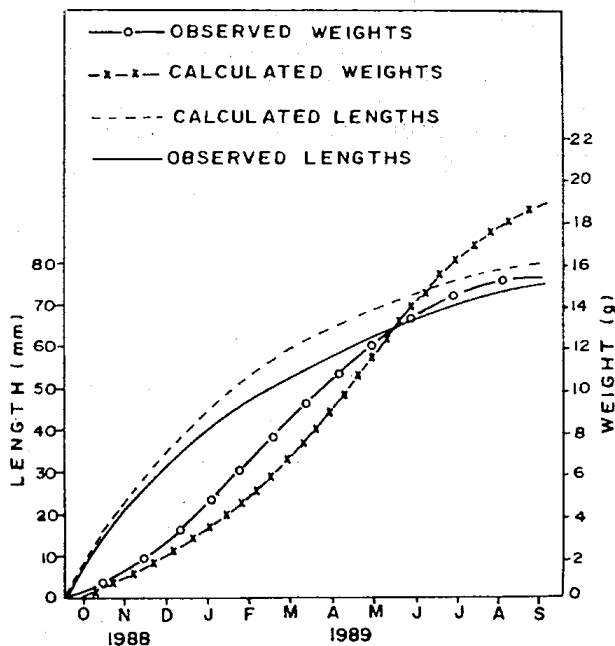
$$L_t = 85[1 - e^{-0.1014(t+0.1153)}]$$

$$W_t = 37.34[1 - e^{-0.0699(t+2.4305)^3}]$$

The theoretical and observed growth curves for length and weight are presented in Fig. 2. The calculated and observed growth curves are in close agreement due to various hydrobiological features which play an important role in influencing the biological productivity and physiology of the mussels.

Specific growth rate (SGR) varied from 0.74 to 138.52%. The SGR values were high in the initial stages (first two months) of growth. Thereafter, the SGR values were < 20% (0.74 to 17.18%) and reaching a low (0.74) value at the end of the study period. This variation of SGR could be due to metabolic activity of the individual mussels, since high values of SGR coincided with high rate of metabolic activity in

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Fig. 1—Ford-Walford plot of *P. viridis*Fig. 2—Growth (length and weight) curves for *P. viridis*

younger mussels. High growth rate was observed in mussels upto a period of 5 months.

Among the environmental parameters, only dissolved oxygen (DO), salinity and chl-*a* showed a significant effect on growth (Table 1). The growth (weight) showed a negative correlation with salinity. Increased growth rate during monsoon season could be due to the fact that reduced salinity may lead to loss of body salts and corresponding hydration of tissue, resulting in body fattening. A significant positive correlation was found between growth, DO and chl-*a*, thus highlighting the importance of these parameters in the growth of raftgrown green mussels.

Length and weight were influenced mostly by chl-*a* when considered as a single independent variable, whereas in combination with particulate organic carbon and DO it showed significant effect, but to a lesser extent on the length of the mussels. However, the weight was influenced significantly by the combined effect of chl-*a* and dissolved oxygen. The positive influence of these parameters on weight resulting in increased growth rate may be explained due to abundance and availability of food. However, in an earlier study¹³, growth was found to be influenced largely by temperature and salinity. Other environmental factors did not show any significant effect on the growth (length and weight) when considered alone or in combination with other environmental factors (Table 1).

Estuarine environment seems to impose an upper size limit on mussels due to prevailing physical and biotic conditions¹¹. Fast growing mussels approach this limit relatively within short duration, whereas, in areas of slow growth this limit may be approached only by older individuals¹¹. However, growth in many bivalves (mussels, oysters and clams) is frequently indeterminate at least over their normal life span and may not therefore cease at any fixed adult size¹². From the predicted values of Von Bertalanffy's parameters it can be said that growth rates in the raftgrown mussels is high and relatively large size mussels can be produced in a short time. In natural population, studies² conducted suggest that the growth is much slower as compared to raftgrown mussel population.

Table 1—Correlation matrix between growth (weight) in *P. viridis* and environmental factors

Parameters	Temp.	Sal.	POC	Chl- <i>a</i>	Susp. load	Total wt
Temp.		0.472†	-0.213	-0.086	-0.312	-0.521†
Sal.			-0.707*	0.286	-0.217	-0.787*
POC				-0.076	0.041	-0.452*
Chl- <i>a</i>					0.140	0.456‡
Susp. load						0.423*

*—Significant at 10%; †—Significant at 5%; ‡—Significant at 1%

A significant effect on growth (length), was observed while correlating with chl-*a*, either singly ($r=0.733$, $P<0.01$) and or in combination with particulate organic carbon and DO ($r=0.888$, $P<0.01$). Earlier studies¹² reported negative correlation of temperature, salinity, DO and suspended load with shell length. This is probably due to some intrinsic factors that influence the physiology of the mussels. The concomitant effect of hydrobiological factors on growth (weight) has significant effect with chl-*a* ($r=0.705$, $P<0.01$) in combination with DO ($r=0.87$, $P<0.01$) exerted significant effect on growth. Other hydrobiological factors did not show any significant effect on growth. Temperature in combination with salinity had significant effect ($r=0.62$, $P<0.01$) on mussels¹². The high value of variance ratio in case of chl-*a* ($F=24.44$, $df=22$, $P<0.01$) indicates that growth is primarily dependant on food availability, generated by primary productivity, and low values of variance ratio in case of other hydrobiological factors may indicate that in a tropical ecosystem, variation in abiotic factors are too wide to explain the actual causes. Eventhough some of the environmental parameters may not be true indicators of predicting growth, however from the regression equation, it does appear that environmental parameters do play a role in influencing the growth of raftgrown

green mussels. The parameters L_{∞} and W_{∞} calculated based on Von Bertalanffy's equation can be used as an important tool to explain growth rate.

Authors are thankful to the Director for facilities. Financial assistance from the Government of Goa is acknowledged.

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