

Seasonal Changes in the Nutritive Value of the Green Mussel, *Mytilus viridis* Linné

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Caloric content, organic carbon and lipids of the green mussel, *M. viridis*, varied in a similar order of magnitude seasonally. Changes in the caloric content of the females and males were closely associated with the spawning cycle. High values were recorded in the prespawning months declining steadily as the spawning progressed. Based on the results obtained on the variations in the nutritive value, suitable periods for harvesting of this shellfish from natural and cultured populations have been suggested.

PRELIMINARY experiments conducted by Qasim and Achari¹ and subsequently by the NIO indicate a vast scope for the culture of shellfish, *Mytilus viridis*, on a commercial scale. However, the success of shellfish culture depends to a large extent on a better understanding of its biology and nutritive value. The present work has been undertaken to study seasonal variations in the caloric content, organic carbon and lipid contents of *M. viridis* with a view to determining the periods of its maximum nutritive value.

Specimens of *M. viridis* were collected at fortnightly intervals from November 1974 to October 1975 from intertidal rocks at Velsao beach. The samples were collected at random and 751 specimens ranging from 7 to 64.5 mm shell length were obtained during the entire period of study. After the gonad examination, the animals were sexed and sorted out as males, females and indeterminate (unsexed) forms. Calories, organic carbon and lipid contents were determined for each category of mussels²⁻⁴. Monthly values give the average of two fortnightly estimations.

Fig. 1 gives the size frequency distribution of the mussels collected. The 18.5 mm mode in December is traceable to 23.5 in January, to 28.5 in February and to 33.5 in March, thus indicating an approximate growth rate of 5 mm/month. The shifts of 28.5 mm mode in December to 33.5 in January and of 33.5 in April to 38.5 in May also confirm this.

Variations in the caloric content showed definite patterns in all the 3 categories studied (Fig. 2). In males, the maximum values were recorded in May, June and July. From July onwards, there was a decline in the caloric content reaching a minimum in April. In females, the peak value was in August followed by a steady decline till April and then there was an increase up to August. In indeterminate forms, peak value was found in July. This decreased to a minimum in January and then increased steadily towards July.

Organic carbon content varied from 22.25 to 37.5% in males, 29.22 to 39.3% in females and 28.96 to 38.29% in indeterminates (Fig. 2). The variations in organic carbon content were nearly similar

to those of caloric content. Lipid content (Fig. 2) varied from 9.88 to 14.47% in males, from 8.33 to 15.72% in females and from 10 to 16.36% in indeterminate forms. In males, high levels of lipid were observed from May to August, corresponding with high caloric content and its decline was similar to that of calories. In females, changes in lipid and caloric content were similar in the 2nd part of the sampling period but from November to February the lipid values were increasing while energy values were decreasing. In indeterminates, the variations in the lipid and caloric contents were similar.

Size frequency distribution of *M. viridis* indicates that the modes do not progress beyond 38.5 mm shell length, though the samples have specimens measuring up to 64.5 mm. Mussels are in great demand in Goa and the minimum marketable size is 60 mm⁵. Nevertheless, mussels even smaller than this size are exploited. In Velsao, it has been observed that the mussels above 35 mm are hand-picked from the intertidal rocks and utilized as food, thus leaving the population with a fairly large proportion of specimens measuring less than 35 mm. The observed growth rate of 8 mm reported by Rao

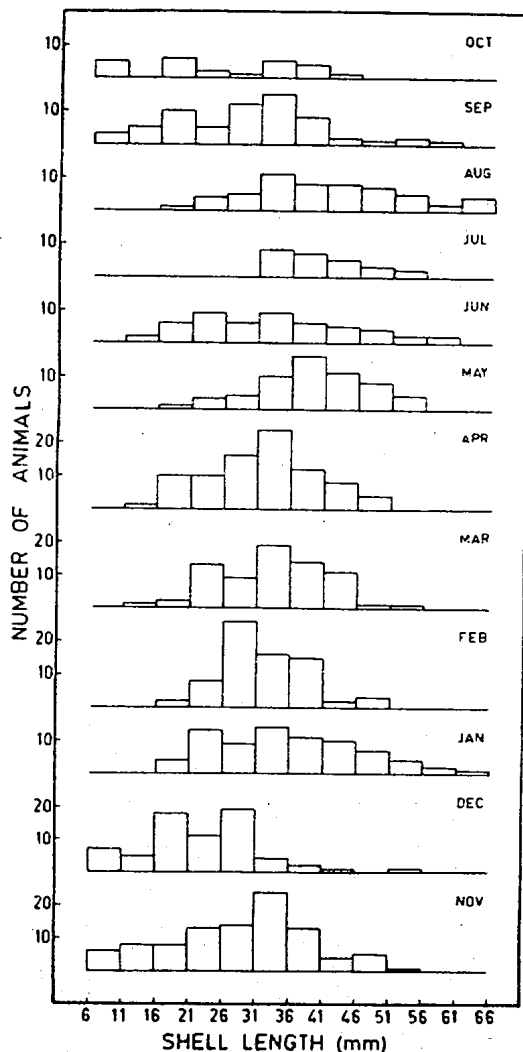


Fig. 1 — Length frequency distribution of *M. viridis*

SHORT COMMUNICATIONS

*et al.*⁵ is for a population of mussels on a moored buoy and for subtidal populations in commercial catches. The mussel population studied at Velsao, however, is intertidal and is exposed during the low tides. These animals would, therefore, have a short potential feeding time and would be more exposed to wave action than those of the subtidal populations. These factors may contribute to the lower growth rates in the Velsao population.

Mean caloric values of *M. viridis* are 3.39, 3.59 and 3.32 kcal g⁻¹ dry weight for males, females and indeterminates respectively. Table 1 gives the comparison of mean and range in caloric and lipid

contents of different bivalves reported from India and elsewhere along with the values obtained in the present study. Caloric values of *M. viridis* are less than those of temperate bivalves and with the exception of *Donax incarnatus* and *D. spiculum* they are similar to those of other tropical bivalves. This is in accordance with the findings of Bogorov¹³ that caloric content of organisms tend to be lower at low latitudes. Changes in caloric contents throughout the year show a definite pattern, attaining maximum values in April-August, in males and females. These changes are related to spawning cycle of this species. The breeding season in *M. viridis* extends from July to April⁶ and hence maximum caloric values in April-August are associated with pre-spawning conditions. Decline in calories as a result of spawning continued in the rest of the months, reaching the minimum towards the end of the spawning season. Variations in caloric content of several organisms have been related to their reproductive cycle¹⁴. This is because the energy accumulated in various organs is diverted towards gonads during maturation and spawning.

The range in the lipid content in *M. viridis* is higher than in other bivalves (Table 1) and its variations are similar to those of caloric content. Seasonal variations in lipid content have been shown in several bivalves and in all the animals variations in total calories are associated with variations in lipid content. Lipids have a higher caloric yield up to 9.37 kcal g⁻¹ in fatty acids¹⁴ and in any animal, such as *M. viridis*, which has higher levels of lipid, changes in lipid content would greatly influence the changes in calories.

Mussels have considerable farming potential as they are sessile, feed at the lower level of food chain and are in demand. Preliminary experiments in this Institute have shown that production can be increased several times by culturing mussels on ropes suspended from rafts, where they are ensured of constant food supply with practically no predation. These factors lead to faster growth and quick fattening. The caloric value of mussels collected from Velsao and transplanted to the raft at Caranzalem showed that mussels of 20-30 mm shell length

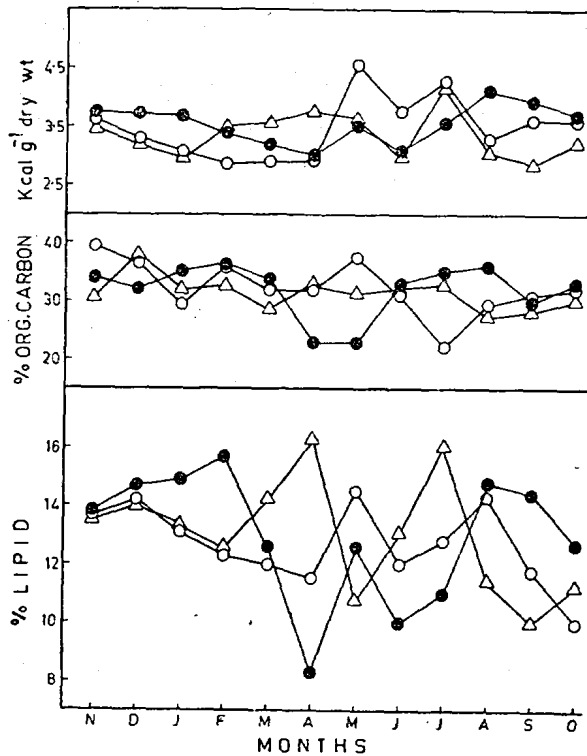


Fig. 2 — Changes in caloric, organic carbon and lipid contents in *M. viridis* [O, males; ●, females; Δ, indeterminates]

TABLE 1 — CALORIC AND LIPID CONTENT IN DIFFERENT BIVALVES

Species	Mean caloric value kcal g ⁻¹ dry wt (range in parentheses)	Mean lipid content % (range in parentheses)	Region	Reference
<i>Mytilus viridis</i>				
Male	3.39 (2.86-4.58)	12.69 (9.88-14.47)	Goa, India	Present work
Female	3.59 (3.05-4.14)	12.95 (8.33-15.72)		
Indeterminate	3.32 (3.01-4.23)	13.09 (10.16-36)		
<i>M. edulis</i>	4.92 (4.61-5.13)	7 (3.9-9.6)	North Wales	Dare and Edwards ⁶
<i>Donax vittatus</i>	4.3-5.5	4.43-10.81	Kames Bay	Ansell ⁷
<i>Abra alba</i>	3.85-4.5	3.26-6.83	Clyde Sea	Ansell ⁸
<i>D. incarnatus</i>	4.46 (4.25-4.53)	4.53 (4.31-4.69)	Cochin	Ansell <i>et al.</i> ⁹
	4.65 (4.43-4.82)	9.23 (7.08-13.16)	Shertallai	
	4.7 (4.62-4.79)	5.14 (4.93-5.27)	Cochin	
<i>D. spiculum</i>	3.78*	8.49	Tondi	Rahaman ¹⁰
<i>Meretrix casta</i>	3.63*	11.51		
<i>Sanguinolaria diphos</i>	3.37*	10.16	Porto Novo	Wafar ¹¹

*Calculated from proximate composition given by the authors using the conversion values of Prosser and Brown¹².

have 4.03 kcal g⁻¹ dry weight 45 days after transplantation. This, compared with the caloric content of the mussels collected from natural beds at Velsao (3.4 kcal g⁻¹ dry weight), is higher and shows that transplanted mussels grown from rafts have a higher nutritive value.

M. viridis attains maximum nutritive value from April to August, which is the best period for harvesting. Dense settlement of spats in the intertidal areas occurs in October-November⁵, and this is the suitable time for collection of spats and their transplantation to culture rafts where the growth rate is considerably enhanced. With the average growth rate of 8 mm/month in subtidal conditions, spats transplanted in October-November will reach the minimum marketable size of 60 mm in July or August during which period the nutritive value would also be high. Further, the water temperature from March to May is high and this will accelerate growth of the mussels, thus allowing them to reach harvestable size in a fairly short time. The ideal time, therefore, to start the culture operations for this shellfish appears to be October or November and the most suitable period of its harvest from April to August.

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