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TEMPORAL VARIATION IN ANNUAL PRODUCTION OF *TELLINA NOBILIS* AND *TELLINA CUSPIS* IN A TROPICAL ESTUARINE ENVIRONMENT

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ABSTRACT

Secondary production of *Tellina nobilis* and *Tellina cuspis* from Coleroon estuary (Lat.11°21'N; Long.79°50'E), southeast coast of India was investigated between January and December, 1986. The annual secondary production for *T. nobilis* was 5.8553 g/m^2 and for *T. cuspis* 2.2651 g/m^2. The biomass (B) was 5.5281 g/m^2 for the former and 3.06 g/m^2 for the latter. The P/B ratio was 1.0592 and 0.7402 for *T. nobilis* and *T. cuspis* respectively.

Key-Words: Production, biomass, P/B ratio.

INTRODUCTION

Production is of interest as a measure of energy flow through a population and as an indicator of its physiological or nutritional state. Measurement of secondary production is time consuming, but such measurements are necessary to provide flux estimates crucial to understanding ecosystem function (Platt, 1981). Secondary production is defined as the biomass produced by a population in a time interval, regardless whether it survives to the end of the interval (Ricker, 1946). The macrofauna production was calculated as the increment of the biomass between two sampling occasions multiplied by the mean density for the same period (Crisp, 1971).

The analysis of community structure in terms of energy flow through its component species is necessary to interpret observed structural patterns. A better insight might be gained by the use of biomass data rather than numbers. The secondary production studies in tropical (India) waters are very few when compared with the temperate studies. The present study deals with the production of two bivalve species (*Tellina nobilis, T. cuspis*) in the shallow Coleroon estuarine system.

MATERIAL AND METHODS

Samples of *T. nobilis* and *T. cuspis* were collected from Coleroon estuary every month using Peterson's Grab from January to December, 1986. In the laboratory, the length of the bivalves, *T. nobilis* and *T. cuspis* was measured individually with the help of Vernier calipers and tissue dry weight was obtained after removing the shell. The size frequency histograms were drawn in order to separate cohorts. Individuals of overlapping cohorts were separated based on probability paper (Harding, 1949; Cassie, 1954). The bivalves were oven-dried at 65°C for 24 hrs and weighed to the nearest 0.01 mg. The secondary production of each species was estimated using

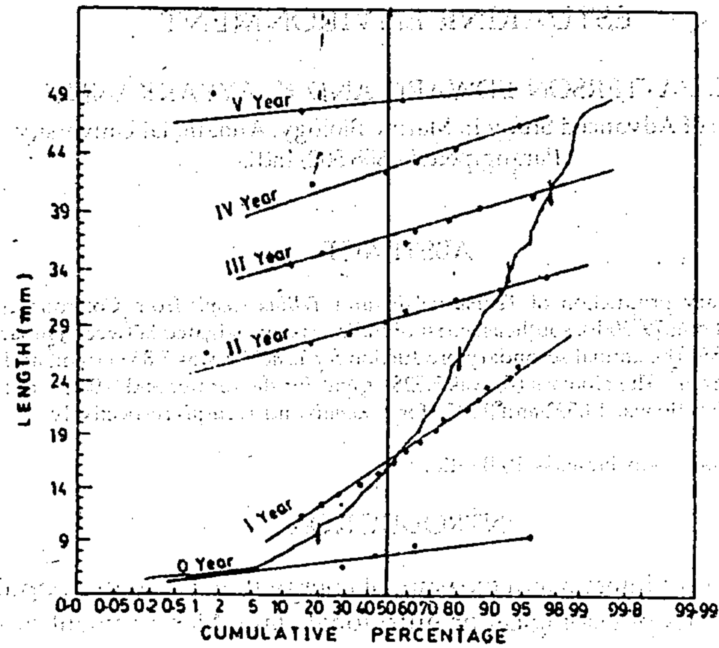

Fig.1. Cumulative percentage curve on probability paper for *Tellina nobilis*

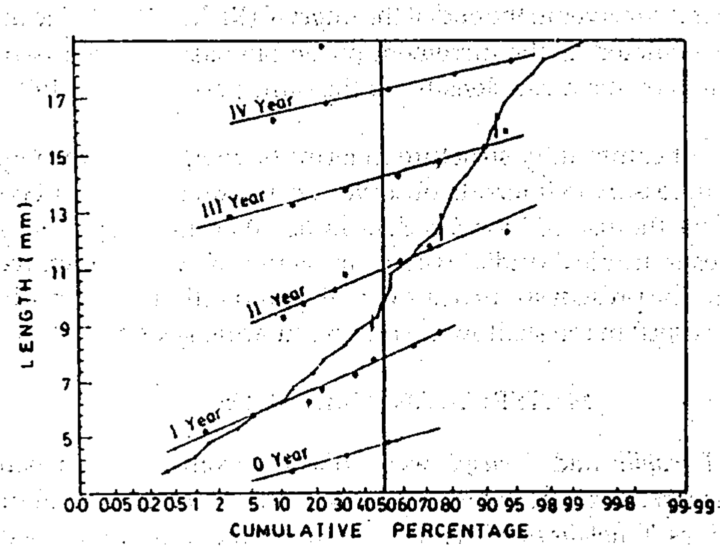

Fig.2. Cumulative percentage curve on probability paper for *Tellina cuspis*

mortality plus residential biomass following the method of Crisp (1971) for stocks with recruitment and age classes separable.

RESULTS AND DISCUSSION

By plotting the cumulative percentages on an arithmetic probability paper against the length and by locating the point of inflection, the polymodal overlapping distribution can be separated into their proportional components, leading to graphic estimates of their respective means and standard deviations. The cumulative percentage of length frequency distribution of *T. nobilis* and *T. cuspis* is shown in the Figs. 1 & 2. In *T. nobilis*, it was found that the first modal value representing the '0' year class had a length of 7.75 mm. The second, third, fourth and fifth modes of 16.75, 29.75, 37.0 and 42.75 mm were represented as the first, second, third and fourth year age groups respectively. The fifth year class displayed a modal length of 48.5 mm and above. The first modal length at 4.7 mm represented '0' year class species of *T. cuspis*. Subsequent modal lengths at 7.9, 11.0, 14.3 and 17.3 mm represented first, second, third and fourth year age groups respectively. The fifth year group was represented by the modal length of 19.6 mm and above.

Growth Rate

The growth is vividly described by Von Bertalanffy's growth equation (Von Bertalanffy 1938) :

$$L_t = L\,[1 - e^{-k(t - t_o)}]$$

where L_t = length at age 't', L = asymptotic length, e = base of Naparian of natural logarithm, k = constant determining the rate of change in length increased, t = age in years and t_o = hypothetical age where length is zero.

To fit this growth equation to the width and length of age data of macrobenthos, the method developed by Ford (1933) and Walford (1946) of plotting L_{t+1} against L_t is used.

The Ford-Walford equation for *T. nobilis* is

$$L_{t+1} = 12.3536 + 0.8432\,L_t$$

and for *T. cuspis*

$$L_{t+1} = 3.6406 + 0.9402\,L_t$$

The Von Bertalanffy's equation describing growth in length for *T. nobilis* was therefore,

$$L_t = 78.7650\,[1 - e^{-0.1706\,(t + 0.6169)}]$$

and for *T. cuspis*

$$L_t = 60.8424\ [1 - e^{-0.0617\,(t\,+\,1.3093)}]$$

PRODUCTION ESTIMATION

Based on the size frequency distributions (Figs. 3 & 4) and probability plot, the year-classes were separated for the two bivalve species. The production estimation was found out for each species for each year-class. The production calculations for all species are given in Tables I and II. *T. nobilis* showed three distinct year-classes with recruitment during October when the minimum number of larger animals were observed. The maximum length in *T. nobilis* (49.5 mm) was found to occur during June. The first year-class (1985 settlement) showed a high production of 3.4621 g/m^2 and a low production was obtained during third year-class (1983 settlement) as 0.6284 g/m^2. The total annual production amounted to 5.8553 g/m^2 and the mean biomass was 5.5281 g/m^2 with P/B of 1.0592.

In *T. cuspis*, there were four distinct year-classes. Adequate numbers of this species was found during January and February. The maximum length observed in this group was 19.9 mm which was noticed in June. The maximum annual production was 0.9449 g/m^2 in third year-class (1984 settlement) followed by 0.6349 g/m^2 in the second year-class (1985 settlement) . The minimum production amounted to 0.3274 g/m^2 during fourth year-class (1983 settlement) . The annual production was therefore 2.2651 g/m^2, the annual mean biomass was 3.06 g/m^2 with P/B of 0.7402.

The molluscs, the second dominating benthic faunal group in Coleroon estuary mainly comprised these two bivalves (*T. nobilis, T. cuspis*) in large numbers. The sand-silt-clay nature of the substratum facilitates their distribution in high densities. The distribution, variations, growth, production and mortality of bivalves were mainly due to the sediment texture (Wigley and McIntyre, 1964), hydrological conditions (Kirkegaard, 1978), and organic carbon (Parulekar, Rajammanickam and Dwivedi, 1975).

The production values of *T. nobilis* (5.8553 g/m^2) and *T. cuspis* (2.2651 g/m^2) were very high when compared with other bivalve production values from temperate waters. Warwick, George and Davies (1978) found out 0.721 g/m^2 in *Donax vittatus*, 0.292 g/m^2 in *Tellina fabula* and 0.616 g/m^2 in *Venus striatula* from the Venus community in Carmarthen Bay. In tropical waters, Ansari, Chatterji and Parulekar (1986) Observed that the production value for *Gafrarium pectinatum* was 3.16 g/m^2 and Yasmin Modassir (1990) noted the production value for *Meretrix casta* as 31.38 g/m^2. These differences in production values may be based on the growth rate, predation, physical conditions or of any genetically determined limits of the respective species.

The annual P/B ratio has been determined for the above species (*T. nobilis* 1.0592 and *T. cuspis* 0.7402). These values were compared with the earlier findings of species

Table I. Annual production for *Tellina nobilis*

Month	Year Class	Number in year class $N(m^{-2})$	Mean Wt. per individual W(mg)	Wt. Increment since previous sample Δ w(mg)	Mean no/m² during period Δ t N/thousands	production increment $N \Delta W gm^{-2}$
Oct	0	88	1.9714	—	—	—
Nov	(1986)	88	2.1667	0.1953	0.088	0.0172
Dec		113	2.2	0.0333	0.1005	9.0033
Jan		188	2.5	0.3	0.1505	0.04S2
Feb		88	2.8	0.3	0.13B	0.0414
Mar		150	3.1426	0.3426	0.119	0.0408
Apr		75	3.625	0.4821	0.1125	0.0542
May		100	4.05	0.425	0.0875	0.0372
Jun		50	4.6	0.5'	0.075	0.0405
Jul		63	6.82	2.22	0.0565	0.1254
Aug		100	9.16	2.34	0.0815	0.1907
Sep		25	10.3	1.14	0.0625	0.0713
					$\sum_{0}^{1}$	0.6672
Oct	1	313	11.256	0.956	0.169	0.1616
Nov	(1985)	400	11.6719	0.4159	0.3565	0,1483
Dec		75	12.2167	0.5448	0.2375	0.1294
Jan		413	12.7	0.4833	0.244	0,1179
Feb		313	13.58	0.88	0.363	0.3194
Mar		275	15.34	1.76	0.294	0.5174
Apr		363	16.2579	0.9179	0.319	0.2928
May		325	17.7455	1.4876	0.344	0.5117
Jun		225	19.7	1.9545	0.275	0.5375
Jul		138	21.975	2.275	0.1815	0.4129
Aug		263	22.6	0.625	0.2005	0.1253
Sep		238	23.35	0.75	0.2505	0.1879
					$\sum_{1\ 1}^{2} N^{1} \Delta W$	3.4621
Oct	II	25	23.7	0.35	0.1315	0.0110
Nov	(1984)	38	24.2	0.5	0.0315	0.0158
Dec		13	25.4	1.2	0.0255	0.0306
Jan		50	27.05	1.65	0.0315	0.0520
Feb		138	29.5429	2.4929	0.094	0.2343
Mar		100	29.6	0.0571	0.119	0.0068
Apr		125	30.0125	0.4125	0.11?5	0.0464
May		50	33.275	3.2625	0.0875	0.2855
Jun		138	33.8	0.525	0.094	0.0494
Jul		75	35.4217	1.6217	0.1065	0.1727
Aug		25	38.9	3.4783	0.05	0.1739
Sep		88	39.24	0.34	0.0565	0.0192
					$\sum_{2\ 2}^{2} N^{11} \Delta W$	1.0976
Oct	III		NIL			
Nov	(1983)		NIL			
Dec			NIL			
Jan			NIL			
Feb		50	39.65	0.41	0.069	0.0283
Mar		63	40.50	0.85	0.0565	0.0480
Apr		63	43.6	3.1	0.063	011953
May		50	46.15	2.55	0.0565	0.1443
Jun		50	49.1	2.95	0.05	0.1480
Jul		13	49.7	0.6	0.0315	0.0189
Aug		25	51.42	1.72	0.019	0.0327
Sep		13	52.1	0.68	0.019	0.0129
					$\sum_{3\ 3}^{4} N^{111} \Delta W$	0.6284
				Total annual production-		**5.8553 gm²**

Table II - Annual production for *Tellina cuspis*

Month	Year Class	Number in year class $N(m^{-2})$	Mean Wt. per individual W(mg)	Wt. Increment since previous sample Δ w(mg)	Mean no/m^2 during perlod Δ t N/thousands	production increment N Δ Wgm^{-2}
Jan	i	173	1.7667	-	-	-
Feb	(1986)	288	1.9870	0.2203	0.2305	0.0508
Mar		225	2.2167	0.2297	0.2565	0.0589
Apr		175	2.5786	0.3169	0.2	0.0724
Jun		150	2.7833	0.2047	0.1625	0.0333
Jul		189	2.8834	0.1001	0.1695	0.0170
Aug		400	2.9656	0.0816	0.2945	0.0240
Nov		100	3.3714	0.4058	0,25	0.1015
					$\sum_{1\ 1}^{2} N^{1} \Delta W$	0.3579
Jan	II	189	3.38	0.2086	0.1445	0.0301
Feb	(1985)	200	4.9563	1.5763	0.1945	0.3066
Mar		200	5.0	0.0437	0.2	0.0087
Apr		163	5.9308	0.9308	0.1815	0.1689
Jun		150	6.3111	0.3803	0.1565	0.0595
Oct		100	6.8	0.4889	0.125	0.0611
					$\sum_{2\ 2}^{3} N^{II} \Delta W$	0.6349
Jan	III	75	8.5333	1.7333	0.0875	0.1517
Feb	(1984)	125	9.1692	0.6349	0.1	0.0635
Mar		88	9.7857	0.6165	0.1065	0.0657
Apr		175	10.59	0.8043	0.1315	0.1058
May		163	11.1429	0.5529	0.169	0.0934
Jun		175	11.5571	0.4142	0.169	0.07
Jul		112	12.2924	0.7353	0.1435	0.1055
Aug		38	12.84	0.5476	0.075	0.0411
Sep		50	13.3111	0.4711	0.044	0.0207
Oct		75	13.796	0.4849	0.0625	0.0303
Nov		38	16.82	3.024	0.0565	0.1709
Dec		88	17.2381	0.4181	0.063	0.0263
					$\sum_{3\ 3}^{4} N^{111} \Delta W$	0.9449
Jan	IV	24	18.127	0.8889	0.056	0.0498
Feb	(1983)	12	18.4334	0.3064	0.018	0.0055
Mar		25	19.384	0.9506	0.0135	0.0128
Apr		37	20.2162	0.8322	0.031	0.0258
Jun		100	21.145	0.9289	0.0685	0.0639
Jul		50	22.426	1.281	0.075	0.0961
Sep		24	24.2944	1.8684	0.0145	0.0271
Dec		12	26.872	2.5776	0.018	0.0464
					$\sum_{4\ 4}^{5} N^{1111} \Delta W$	0.3274
				Total annual production -		**2.2651 gm^2**

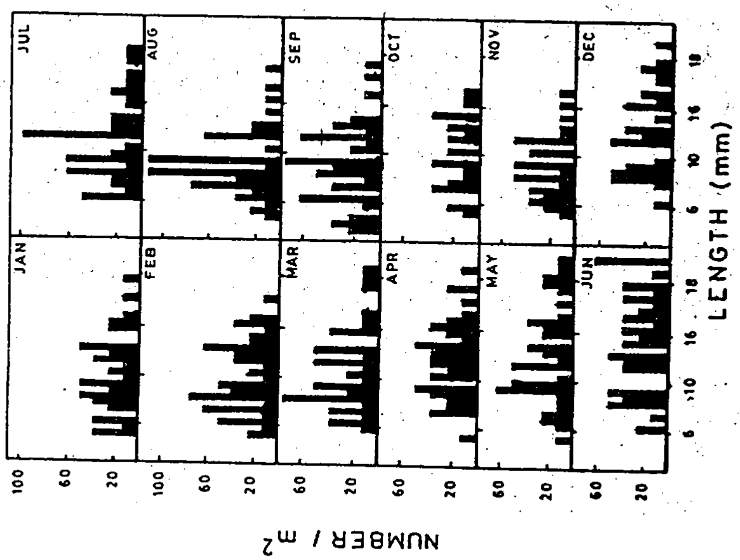

Fig.4: Size frequency histogram for *Tellina cuspis*.

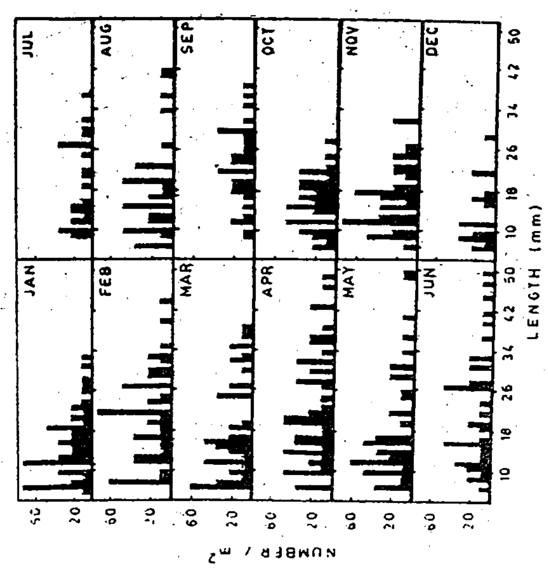

Fig.3. Size frequency histogram for *Tellina nobilis*.

of similar groups of temperate waters. Warwick, George and Davies (1978) observed a P/B ratio of 2.10 for *Donax vittatus*, 0.90 for *Tellina fabula* and 0.41 for *Venus striatula*. Warwick and George (1980) estimated P/B ratio ranging from 0.52 to 1.35 for *Nucula turgida*, *Abra alba*. The highest value was noticed in *Abra alba* and the lowest in *Nucula turgida*. While in tropical waters, it was 4.93 in *G. pectinatum* (Ansari, Chatterji and Parulekar, 1986) and 5.83 in *Donax incarnatus* (Ansell, Mclusky, Stirling and Trevallion, 1978). In Mandovi estuary, Goa, the P/B ratio was 3.4 and the author Yasmin Modassir (1990) suggested that this high value is due to active metabolism and active turnover of the production.

In the present study, in *T. nobilis* the P/B ratio was greater than 1.0 while for other it was below 1.0. Hughes's (1970) studies on bivalves living for over five years, suggested that annual P/B ratios was less than 1.0 for species living 2-3 years. However, Sanders (1956) found ratios of 1.99 and 2.28 for the mollusc *Pandora* sp., and *Yoldia* sp.

From the present study it is inferred that the changes in the production rates and P/B ratio are not only due to a single factor but as a result of various environmental, physical and biological factors. The recorded high production rates of *T. nobilis* and *T. cuspis* showed that these bivalves play an important role in the productivity of this shallow estuarine system and similarly helping to increase the production of fisheries resources.

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