

Studies on Growth & Age of Bivalves from Temperate & Tropical Estuarine Ecosystems

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Comparison of growth progression and age composition of *Abra alba* and *Nuculana minuta* from temperate estuarine ecosystem with *Meretrix casta* and *Paphia malabarica* from tropical estuarine environment, revealed that the annual growth rate in tropical species was 10-12 times more than in temperate species. Natural populations of bivalves had more age groups in the temperate than in the tropical environment. No annual or seasonal growth rings were discernible in tropical bivalves.

The present investigation has been undertaken with a view to comparing growth and age of some common bivalves from temperate waters with those of tropical estuarine waters. Accordingly, observations on population structure, growth and age composition of *Abra alba* (W. Wood) and *Nuculana minuta* (Muller) from the Clyde Sea, southwest coast of Scotland are compared with those on *Meretrix casta* (Chemnitz) and *Paphia malabarica* Chemnitz, from the Mandovi estuary, Goa on the west coast of India. Barnes and Goodley¹, have given an account of the general hydrography of the Clyde Sea. Physiographic and environmental particulars of Mandovi estuary are described by Parulekar and Dwivedi².

Collections were made using a Van Veen grab (0.1 m² area coverage and 0.1 m penetration). However, for bulk sampling an Agassiz dredge lined with a fine mesh screen was used. Samples were examined for size composition, number of age groups and enumeration of growth rings for determining the growth rate. All measurements were taken by a Vernier Calliper, accurate up to 0.1 mm. The size distribution measurements were grouped into 1 mm size interval. The age groups and year classes were estimated from the number of annual or seasonal growth rings as well as from length frequency distribution data. Each growth ring is assumed³ to represent a year class. Comparable data on *M. casta* and *P. malabarica* were taken from published reports⁴⁻⁸.

Size distribution ranged from 1-16 mm and 1-25 mm in *N. minuta* and *A. alba*, respectively. Maximum size class representation, in both the species, was from Kilbrannan Sound (Table 1). *A. alba* seems to have restricted distribution in comparison to *N. minuta*.

Length frequency distribution indicated that *A. alba* population is formed of 4 age groups (Table 1). First age group was characterized by the size range of 5-9 mm; 2nd with 10-13 mm; 3rd with 14-17 mm and 4th above 17 mm. In *N. minuta* there were 7 age groups,

with 1st group at 6-8 mm and the last one above 14 mm size.

Mean size and percentage composition of different age groups from different localities in the Clyde Sea display (Table 1) wide variations. In Loch Long and the Kilbrannan Sound, *A. alba* population had all the 4 age groups as against only 2 age groups in Loch Fyne and Fairli Channel. Both in Loch Long and Kilbrannan Sound, 2 y old specimens were predominant. In other localities, the population was dominated by 1 y old specimens. Mean size distribution pattern was also similar in the populations of Loch Long and the Kilbrannan Sound. In pooled data, the prevalence of different age groups showed a decreasing trend from 0-y class to 3 y class, and is reported⁹ to be a part of the natural distribution. Similarly with *N. minuta* in Loch Long and Loch Fyne, there was a total absence of 0-y specimens. This is explained⁶ as due to the migrations. Oldest (8 y) class specimens were recorded from Loch Long only. The 4 y age group dominated the population. Mean size-wise, all the 3 different populations, showed variations, with minimum and maximum values in Kilbrannan Sound and Loch Long, respectively.

Annual growth rate (Table 1) was varying in different year classes and also in different localities. In both the species, growth was highest in 0-y class and gradually declined with age.

Observations on comparative growth rate and year class composition indicated (Table 2) that there is a great difference between the environmental set-up of the 2 ecosystems. The tropical habitat (Mandovi estuary) falls within the southwest monsoon gyre, with heavy annual rainfall of about 3000 mm. Average annual rainfall in the Clyde Sea area¹ is about 1100 mm, augmented by considerable amount of melting of snow during summer. Thus, both the temperate and tropical estuarine ecosystems receive an appreciable quantum of freshwater inflow.

Table 1—Age and Growth in Temperate Species of Bivalves
[Values represent mean size in mm, and percentage composition is given in parenthesis]

Locality	No. of observations	Age group							Year class								
		I	II	III	IV	V	VI	VII	0	1	2	3	4	5	6	7	8
<i>Nuculana minuta</i>																	
Loch Long	130	—	10.6 (10)	13 (10)	14.2 (23.3)	14.5 (30)	15 (23.4)	15.5 (3.3)	—	3.9	3.6	2.9	2.4	2.3	2.6	0.8	0.4
Loch Fyne	112	—	8.5 (30.3)	9.8 (39.2)	12 (20.8)	13.5 (5.3)	13.5 (4.4)	—	—	3.9	3.1	2.9	2.8	2.1	1.5	1.3	0.4
Kilbrannan Sound	187	7.2 (2.4)	9 (0.5)	10.5 (16.5)	12.5 (34.2)	13.7 (34.2)	14.5 (12.2)	—	—	4.7	4.4	2.6	2.4	1.5	1.4	1.2	0.3
<i>Abra alba</i>																	
Loch Long	603	7.5 (17.5)	12.5 (58.5)	15.7 (22.5)	16.2 (1.5)	—	—	—	5.9	2.6	1.9	1.6	—	—	—	—	—
Loch Fyne	114	6.2 (88.5)	10.5 (11.5)	—	—	—	—	—	6.2	3.9	—	—	—	—	—	—	—
Kilbrannan Sound	129	7.5 (25.5)	11.5 (44.5)	14 (26.5)	18.7 (3.5)	—	—	—	5.4	3.3	2.8	1.9	—	—	—	—	—
Fairli Channel	74	6.5 (80.0)	9 (20.0)	—	—	—	—	—	6.4	1.2	—	—	—	—	—	—	—

Table 2—Comparison of Age and Growth of Bivalves from Temperate and Tropical Estuarine Ecosystems

Characteristics	Temperate		Tropical	
Habitat	Subtidal - Clyde Sea		Subtidal - Mandovi Estuary	
Geographical position	lat. 55-56°N; long 4-5°E		lat. 14-15°N; long 73-74°E	
Annual Precipitation (mm)	1100		3000	
Water temp. (°C) (Annual range)	7-14		23-33	
Species	<i>Abra alba</i>	<i>Nuculana minuta</i>	<i>Meretrix casta</i> *	<i>Paphia malabarica</i> †
Size range (mm)	1-25	1-16	1-55	1-40
Growth rate (mm)	2.3-5.6/y	0.3-4.2/y	2.7/month	4.5/month
Age group	4	8	2	1

*Parulekar *et al.*⁴; †Dwivedi *et al.*⁵

The Mandovi estuary is reported¹⁰ to change from being well mixed during premonsoon (Feb.-May) to stratified in monsoon (June-Sept.). In the Clyde Sea, especially the upper part from which the present set of observations were made, the run-off exceeds evaporation and hence, there is a net annual outflow from the basin¹. Thus, both the ecosystems considered here are essentially estuarine. Other relevant environmental parameter to be considered here, is the annual range of water temperature which is 7°C (7-14°C) for the Clyde Sea and 10°C (23-33°C) for the Mandovi estuary. However, the temperate ecosystem in the Clyde Sea, presents a temperature regime of much lower magnitude than observed in the tropical ecosystem. Another important environmental factor of

direct relevance is the type and composition of sediments. In both the ecosystems, the bottom deposits formed of silt-sand fractions are reportedly similar^{2,6}. The size range of species also show wide differences (Table 2). Tropical species of bivalves have a more wider size range than the temperate. Growth rings in the shell were not discernible in the tropical species and it is due to the lack of well demarcated seasonal variations in temperature regime¹¹.

Number of age groups and year classes in temperate species of bivalves were more than in tropical counterpart. However, annual growth rate in tropical bivalves was many times high. As seen from Table 2, *M. casta* and *P. malabarica*, attain the comparable maximum size of temperate species within few months.

In terms of annual growth, the rate of growth progression in tropical species was many times higher than in the temperate species. Such a wide difference is mainly due to the varying magnitude of temperature regime¹². Under the low temperature regimes, as prevailing in temperate aquatic environment, the growth progression is slow and the population is represented by more number of year classes and age groups¹³. Accordingly, the presence of more number of age groups in the temperate bivalves, reflect on the long life expectancy which is 2-3 times more than in tropical species (Table 2).

The results, of the present investigation, have applied implications, especially in the exploitation of marine living resources through culture fisheries. Due to higher growth rate, early attainment of sexual maturity and protracted breeding behaviour, the tropical species of bivalves⁶ can commercially be exploited, much earlier than their temperate counterparts, and accordingly, the attainment of marketable size takes less time. On the other hand, the temperate species having slower growth rate, longer life span, more number of year classes and short spawning period form time-stable communities¹⁴ representing an overall high biological production on a long term basis.

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References

- 1 Barnes H & Goodley E F W, *Bull Mar Ecol*, 3 (1961) 112.
- 2 Parulekar A H & Dwivedi S N, *Indian J Mar Sci*, 3 (1974) 41.
- 3 Allen J A, *The fauna of the clyde sea; mollusca* (Scottish Mar Biol Assoc, Edinburg) 1962, pp 87.
- 4 Parulekar A H, Dwivedi S N & Dhargalkar V K, *Indian J Mar Sci*, 2 (1973) 112.
- 5 Dwivedi S N, Parulekar A H & Hakkim V M A, in *Proc 3rd All India Estua Biol, Symp*, edited by C V Kurian (Mar Biol Ass India, Cochin) 1973, 113.
- 6 Ansell A D & Parulekar A H, *J Mollusc Stud U K*, 44 (1978) 71.
- 7 Parulekar A H, Dhargalkar V K & Singbal S Y S, *Indian J Mar Sci*, 9 (1980) 89.
- 8 Parulekar A H, Nair A, Ansari Z A & Harkantra S N, *Symp Coastal Aquaculture*, Cochin (1980) 98.
- 9 Ansell A D, *Mar Biol*, 25 (1974) 13.
- 10 Varma K K, Rao L V G & Cherian T, *Indian J Mar Sci*, 4 (1975) 11.
- 11 Bal D V, *Presidential Address - Section on Zoology & Entomology - 42nd Indian Science Cong., Hyderabad* (1951) pp 10.
- 12 Kinne O, *Marine ecology*, Vol 1: *environmental factors*, Part I (Wiley Interscience, London) 1972, pp 675.
- 13 Lockwood A P M, in *Adaptations to environment*, edited by R C Newell (Butterworths, London) 1976, 37.
- 14 Sanders H L, *Am Nat*, 102 (1968) 243.