# THE GROWTH RATES OF FOUR SPECIES OF INTERTIDAL BRYOZOANS IN COCHIN BACKWATERS

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Growth rates of four species of bryozoans viz., *Electra crustulenta* (Pallas), *Electra bengalensis* (Stoliczka), *Alderina arabianensis* Menon and Nair, and *Schizoporella cochinensis* Menon and Nair, are presented in this paper. The growth in the case of all these species was found to be continuous. The growth was slow in the young colonies but a marked acceleration in the rate of growth was evident after 15 days of age in the case of all species except *E. crustulenta*. Comparing the regression co-efficients of the four species, *A. arabianensis* shows the highest co-efficient followed by *E. bengalensis, S. cochinensis* and *E. crustulenta*. This indicates that the growth was more pronounced in the case of *A. arabianensis*. Even though recorded from diverse habitats, the results of growth rates suggest that *E. crustulenta* is more at home in oligohaline and mesohaline waters as may be seen from the greater growth rates in these situations.

## INTRODUCTION

Limited information is available on the growth rates of fouling bryozoans. Edmondson and Ingram (1939) studied the rate of growth of *Bugula neritina* and *Schizoporella unicornis*. According to these authors in the case of *S. unicornis*, "an average growth of one mm per day in diameter of the colony is not unusual for the first month, after which development is less rapid". Friedle (1925) found that *Schizoporella sanguenensis* attained 30,000 zooids in five months. Paul (1942) made some observations at Madras on the growth of *Membranipora* sp. and *Crisia* sp., and noticed vigorous growth. Paul (1942) recorded that *Memberanipora* sp. reached a size of 41 × 40 mm within a period of 34 days and that *Crisia* sp. attained a vertical and horizontal growth of 180 × 100 mm. Mawatari (1951, 1952, 1953) noted the growth rates of *B. neritina, Watersipora cucullata* and *Electra angulata* in the Japanese waters. Based on the findings in *E. angulata,* he concluded that the growth was very fast. Growth rate of *Membranipora* sp. at Visakhapatnam harbour was studied by Ganapati *et al.* (1958) who found that this form attained a dimension of 50 × 50 mm within a period of 30 days. Skerman (1958, 1959) examined the growth rates of *Cryptosula pallasiana, Bugula neritina* and *Bugula flabellata* at the ports of Lyttleton and Auckland, and noticed that spring settling colonies of *C. pallasiana* measured 12 sq. cm. Kawahara (1960) studied the growth, maturation and propagation of *Bugula neritina* in Japanese waters. A few papers exist dealing

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with growth studies of a small number of Bryozoan species under laboratory conditions (Marcus 1926; O'Donoghue 1957; Grave 1930). Apart from these observations, scattered data are available in works on the biology of fouling, about the dimensions attained by colonies of various species (Edmondson and Ingram 1939; Skerman 1958, 1959; see also "Marine Fouling and its Prevention" prepared for Woods Hole Oceanographic Institution, 1952).

During the present investigation, an attempt was made to record the growth rates of four species of bryozoans, viz., *E. crustulenta* Pallas, *E. bengalensis* (Stoliczka), *Alderina arabianensis* Menon and Nair and *Schizoporella cochinensis* Menon and Nair. The data cover a period of 45 days only for each species, by which time the encrusting forms had evenly covered the available space over the surface of the panel.

## Materials and Methods

The bryozoans that settled on glass panels (12×10 cm) were examined regularly and their measurements recorded at three days interval for a period of 45 days. Since the colonies grow more or less in a circular fashion, two measurements across the colony at right angles to each other were taken and the mean value recorded as growth in diameter. From this the area was calculated. Average measurements of two or three largest colonies of approximately the same dimension were recorded. To avoid overcrowding which affects the free spreading of the colonies, the other foulers on the panels were scraped off. The data obtained were supplemented by simultaneous recordings of the growth on panels used for seasonal settlement. The hydrographic data for the period of observation were recorded. Surface temperature was recorded with an ordinary thermometer and salinity was estimated by Knudsen Mohr method.

## Results and Discussion

All the observations were made in the natural conditions and hence the growth rates were studied during the period when the respective species were abundant in the fouling community.

Table I shows the data obtained by the above methods for the four species namely *E. crustulenta, E. bengalensis, A. arabianensis* and *S. cochinensis.* The period of exposure and the available salinity and temperature data when the panels have been examined are also presented. The trend indicates a continuous growth in all the four species during the period of observation (see Figs. 1–4).

Growth was found to be generally slow in the young colonies, but by about 15 days after settlement growth was more rapid. In *E. crustulenta* maximum growth was recorded between 36 and 39 days, in *E. bengalensis* between 18 and 21 days, in *A. arabianensis,* between 24 and 27 days and also between 33 and 36 days and in *S. cochinensis* 30 to 33 days after settlement.

*A. arabianensis* attains sexual maturity as evidenced by the presence of ovicells about 18 days after settlement. Contrary to the condition noticed in other encrusing polyzoans where ovicells develop in zooids from the centre of the colony towards the periphery, in this species the first few ovicells noticed were not in the centre of the colony but were distributed indiscriminately. A brownish hue was characteristic of mature colonies, and the young colonies without ovicells were white in colour with

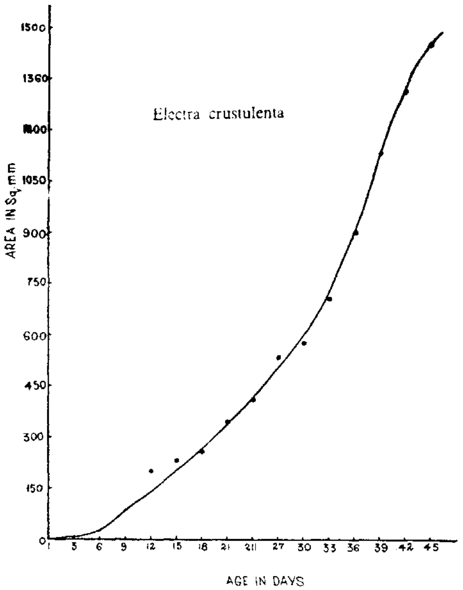


Fig. 1

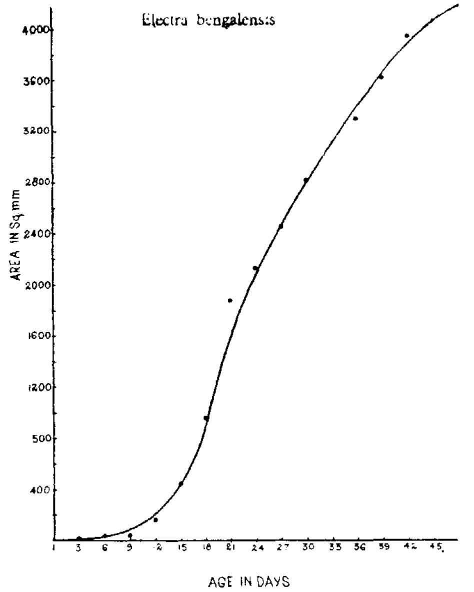


Fig. 2

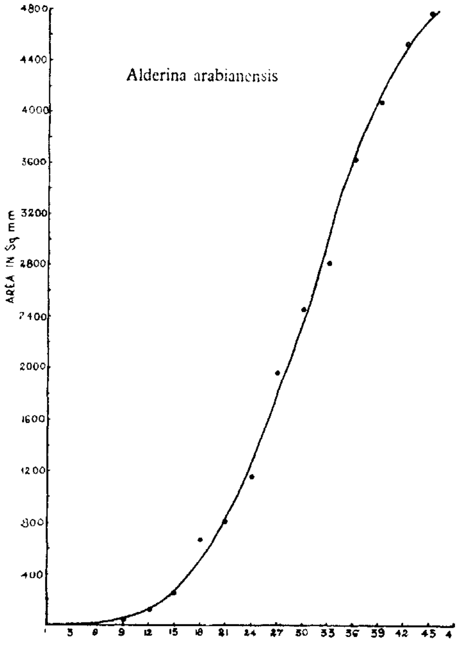


Fig. 3

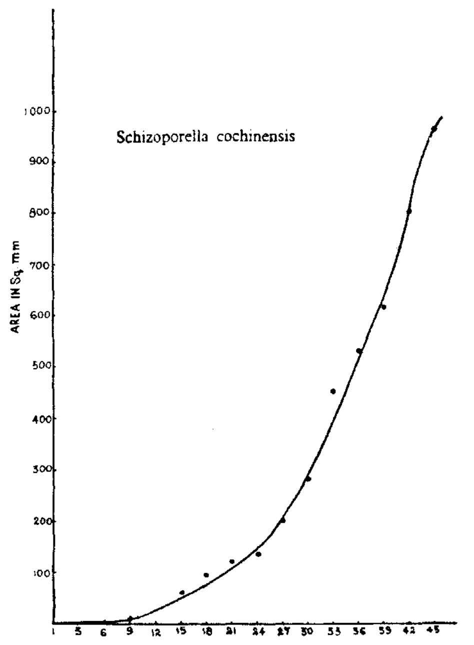


Fig. 4

FIGS. 1–4. The rate of growth of four species of polyzoans. 1, *Electra crustulenta;* 2, *Electra bengalensis;* 3, *Alderina arabianensis;* 4, *Schizoporella cochinensis.*

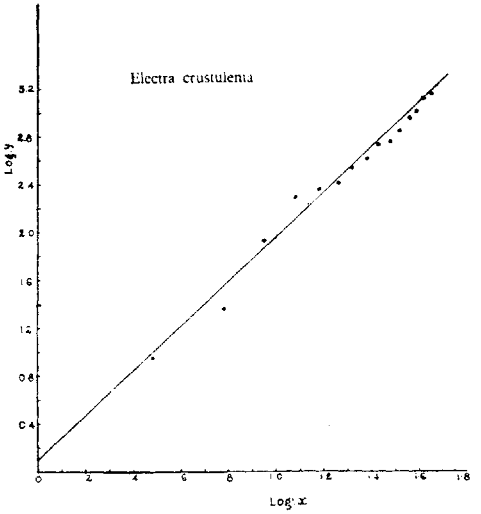


Fig. 5

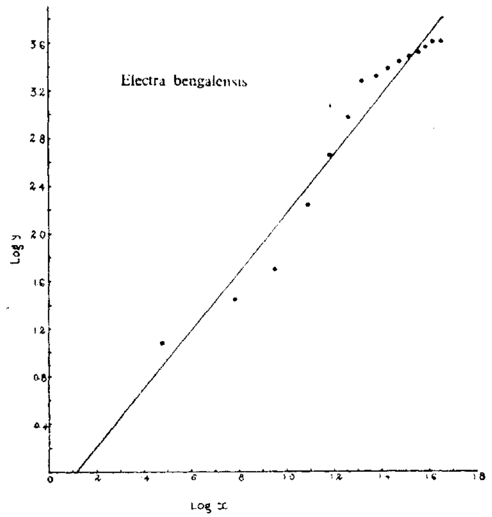


Fig. 6

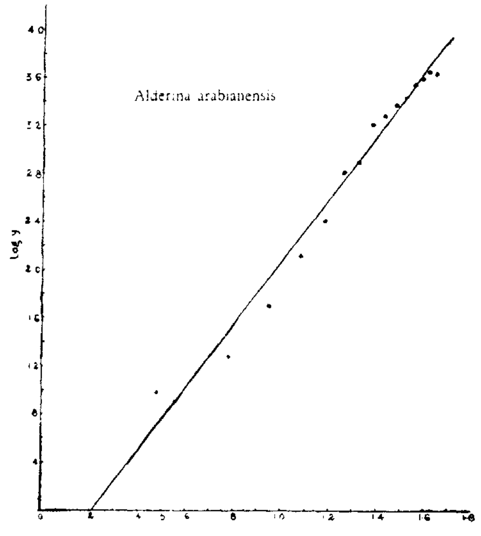


Fig. 7

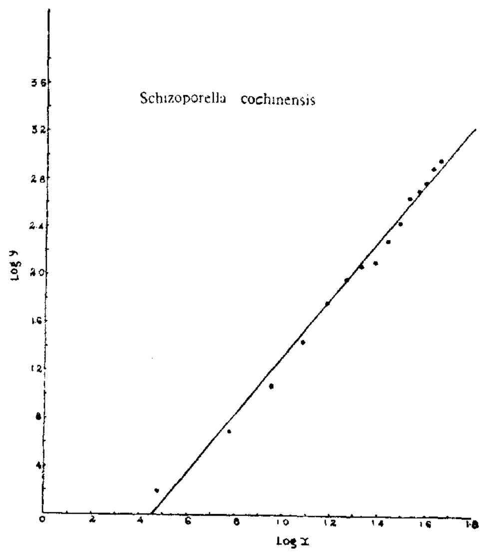


Fig. 8

FIGS. 5–8 : Regression curves showing the rate of growth of four species of polyzoans. 5, *Electra crustulenta* ($Y=0.095+1.852\ X$); 6, *Electra bengalensis* ($Y=-0.302+2.485\ X$); 7, *Alderina arabianensis* ($Y=-0.552+2.612\ X$); 8, *Schizoporella cochinensis* ($Y=-1.131+2.449\ X$).
$x$, days $X=\text{Log}.\ x$ $y$, area, $Y=\text{Log}.\ y$.

a slight brownish flush. Branched spines developed in colonies older than 25 days. These spines appeared as spine-like structures and later elongated to attain bizarre shapes. They developed first in those zooecia situated in the centre of the colony and spread towards the periphery. *S. cochinensis* attained sexual maturity within about

TABLE I

*Maximum size attained by* Electra crustulenta E. bengalensis, Alderina arabianensis *and* Schizoporella cochinensis *each month along with the average of temperature and salinity*

| Species | Average area (sq. mm) | Months | Average temperature (°C) | Average salinity (‰) |
|---|---|---|---|---|
| *E. crustulenta* | 314.3 | June | 28.6 | 26.5 |
| | 707.0 | July | 27.1 | 2.2 |
| | 538.0 | August | 28.4 | 0.58 |
| | 663.0 | September | 27.6 | 1.80 |
| | 616.0 | October | 28.0 | 1.90 |
| | 504.0 | November | 27.8 | 16.70 |
| | 491.7 | December | 27.5 | 29.70 |
| | 380.2 | January | 28.0 | 32.20 |
| *E. bengalensis* | 2740.0 | February | 29.0 | 32.8 |
| | 2213.0 | March | 30.4 | 33.4 |
| | 2828.0 | April | 31.6 | 33.6 |
| | 2601.0 | May | 30.4 | 33.4 |
| *A. arabianensis* | 2464.0 | February | 29.0 | 32.8 |
| | 1964.0 | March | 30.4 | 33.4 |
| | 2127.0 | April | 31.6 | 33.6 |
| | 3020.0 | May | 30.4 | 33.4 |
| *S. cochinensis* | 253.6 | February | 29.0 | 32.8 |
| | 122.7 | March | 30.4 | 33.4 |
| | 260.2 | April | 31.6 | 33.6 |
| | 254.5 | May | 30.4 | 33.4 |

21 days after settlement. By about 45 days, colonies were multi-laminar with nearly 75 per cent of the zooids bearing ovicells.

Equations of the type $y = a \times x^n$ were fitted to the growth data by the principle of least squares. The equation after taking logarithm to the base 10 reduces to straight lines of the four $Y = A \times n \times X$, where $Y = Log.y$, $A = Log.a$, and $X = Log.x$.

The equations for the growth data of the four species are given below :

1. *Electra crustulenta* $Y = 0.095 + 1.852\ X$
2. *Electra bengalensis* $Y = -0.302 + 2.485\ X$
3. *Alderina arabianensis* $Y = -0.552 + 2.612\ X$
4. *Schizoporella cochinensis* $Y = -1.131 + 2.449\ X$

The closeness of the fit of the equation is shown in Figs. 5–8. The growth for the subsequent days can be estimated by substituting the values of $X$ in the corresponding equation. Comparing the regression coefficients of the four species, *A. arabianensis* shows the highest coefficient followed by *E. bengalensis*, *S. cochinensis* and *E. crustulenta* respectively. This indicates that growth is more pronounced in *A. arabianensis*.

Table I shows the maximum growth recorded for *E. crustulenta, E. bengalensis, A. arabianensis* and *S. cochinensis* for different months at Cochin harbour. The data have been compiled from panel records used for the study of settlement of bryozoans in the Cochin harbour. Measurements from about three of the largest colonies from the short-term and long-term panels at different levels from each station have been selected (Menon and Nair, *In press*) and the values presented in the table represent the average of these for the respective months. These data provide an approximate idea of the variations in growth rates in different months for the species concerned. These monthly values need not represent those of individuals of the same age, since their age is dependent on the exact time of settlement on the panels each month. However, they do provide some information regarding the variations in growth rates during the different months. From Table I it is evident that *E. crustulenta* attained a maximum growth of 707 sq. mm during July whereas the same species attained only 380.2 sq. mm in area during January. Even though recorded from all situations, results on the growth rates of this species show that this species is more at home, as evidenced by increased growth, in oligohaline and mesohaline waters.

It would appear from the above discussion that conditions in April and May seem to favour maximum growth for *E. bengalensis, A. arabianensis* and *S. cochinensis.*

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