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Age and growth of the venus clam *Gafrarium tumidum* (Roding) from south-east coast of India

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ABSTRACT

Age and growth of the Venus clam *Gafrarium tumidum* was studied in detail employing four conventional methods and an electronic package ELEFAN – 1. The growth rate obtained by all the methods was more or less similar and comparable with one another. The clam reached a length of 24.4, 31.9 and 37.7 mm at the end of 1st, 2nd and 3rd year of its life. Growth rates of male and female clams were similar and observed to be faster in the first year and then tended to slow down with age. The life span of *Gafrarium tumidum* was estimated to be 3 years.

Introduction

The venus clam *Gafrarium tumidum* belonging to the family Veneridae is one of the commercially important species of bivalves of Gulf of Mannar (GoM). The age and growth of this clam has not been studied so far. For understanding the biology, information on age and growth is inevitable and it gives an insight into age class structure of the stock, changes in the abundance of population, longevity and growth. These are vital to plan the exploitation strategies. In temperate waters, where shellfishes form a fishery and are used as food more commonly than in India, considerable work on the age and growth of clams are available. Studies by Feder and Paul (1974), Kato and Hamai (1975), Wendell *et al.* (1976) and Isla and Gordillo (1996) are the few worth mentioning works on age and growth of clams.

With regard to Indian marine bivalves, the age and growth studies have been done on few species of Veneridae and Donacidae. Studies by Abraham (1953), Nayar (1955), Seshappa (1971), Parulekar *et al*. (1973), Mane (1974) and Harkantra (1975) are some of the earlier works available on bivalves. There is no published account on the age and growth of venus clam *G. tumidum* from India.

In this paper details of the investigations made on the age and growth of this clam collected from Pamban, Gulf of Mannar is described.

Materials and methods

The material was collected from clam bed at Pamban (Latitude 8° 35'- 9° 25' N and Longitude 78° 08' – 79° 30' E.). Random monthly sample of a total of 702 numbers of *G. tumidum* was collected live from the bed up to a depth of 15 cm during the period of investigation (October 2000 to September 2001). The distance between the anterior and posterior extremities of the shell in a direction parallel to the ventral margin measured to the nearest 0.1mm by vernier calipers was taken as the length and used in the studies. The following methods were employed to estimate the age and growth.

Peterson's length frequency method (Peterson,1981) was adopted and the length of the clams were classified into 17 groups with a class interval of 1.9 mm and plotted monthly

and the progressive modes were traced for both the sexes separately. Each year's growth rate was calculated and added to arrive at respective years' growth rates. The Probability plot method (Harding, 1949; Cassie, 1954) of separating the polymodal length frequency distribution has been used to find out the modal lengths of different year classes.

The mathematical model derived by von-Bertalanffy (1938) was used to calculate the length of the clam at a given time and the von-Bertalanffy's growth equation (VBG) was developed. This equation gives a linear relationship between length, at time t and t + x and is expressed as: $L_t = L_\infty (1-e^{-k (t - t_0)})$. Ford Walford graph was constructed for *G. tumidum* by plotting $L_t + 1$ against L_t, where L_t is the length of animal at a specific age (Walford, 1946). From the straight line obtained from the L_t against $L_t + 1$ graph, when intersected by a 45° diagonal from the origin, the L_∞ value was obtained. Growth parameters were estimated using FiSAT-1 software (Gayanilo *et al*., 1996). L_∞, K values and the best fitting curve were estimated.

Results

Length frequency method

Length frequency analysis of male *G. tumidum* showed that fresh recruitments to the population appeared in January '01. The earlier mode during November '00 in 19.5 – 21.3 mm was traced to 34.7 – 36.5 mm group during June '01 recording 15.2 mm growth in 7 months time which showed 26.06 mm growth in the first year. This growth in 25.2 -27.0 mm group during April '01 was traced to 34.7-36.5 mm group in March '02 recording a growth of 8.14 mm for 12 months, which was added to the 1st year growth to become 34.20 mm in the 2nd year. The growth in 32.8-34.6 mm group during January '01 was traced to 34.7-36.5 mm during June'01 recording 1.9 mm in 5 months. Hence, the growth rate for 3rd year was 4.56 mm, which was added to the second year growth to obtain 38.76 mm during 3rd year.

In the case of females of *G. tumidum*, earlier modes in 11.9-13.7 mm size group during January '01 were traced to 34.7-36.5 mm during December '01 recording 22.8 mm growth in 11 months period, which showed a growth of 24.87 mm in the first year. This growth in 23.5-25.1 mm group during January '01 was traced to 32.8-34.6 mm during next January recording 9.5 mm growth. This was added to the first year growth to become 34.37 mm in the 2nd year end. This growth in 32.8-34.6 mm during January was traced to 34.7-36.5mm group during June recording 1.9 mm in 5 months period. Hence, the growth rate for 3rd year was 4.56 mm, which was added to the second year growth to obtain 38.93 mm at the end of 3rd year.

Months mode curve

Growth curves for both the sexes were plotted (Fig. 1 a,b.). Growth in second and third

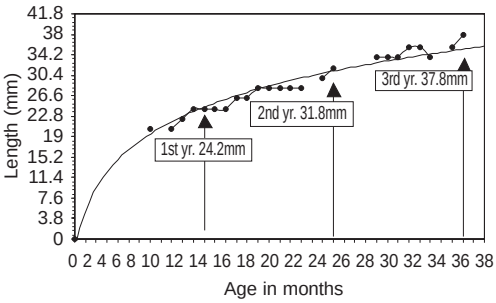

Fig. 1a. Growth of *G. tumidum* based on scatter diagram of months mode (Male)

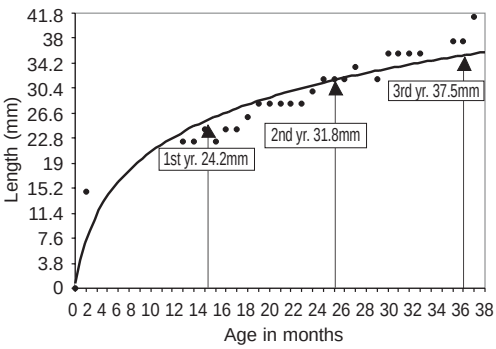

Fig. 1b. Growth of *G. tumidum* based on scatter diagram of months mode (Female)

years were estimated approximately because of the clumping of modes in the higher size groups due to slow growth rates. The average growth rate for the first year for male was 26.06 mm, which got reduced to 8.1 and 4.6 mm respectively in the second and third years and for females the growth rate for the first year was 24.9 mm, which got reduced to 9.5 and 4.6 mm in the second and third years. Hence, from the estimates made separately for males and females of *G. tumidum* it is concluded that the life span of this clam appears to be 3 years.

Probability plot method

Based on the data, the males of *G. tumidum* showed a growth of 24.39 mm in the first year, 31.99 mm in the second and 37.69 mm in the third year and for females it was 24.39 mm in the first year, 31.8 mm in the second and 37.12 mm in the third year (Fig. 2 a,b).

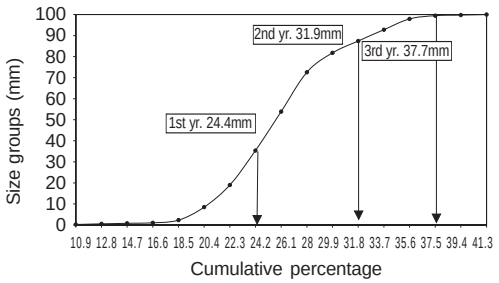

Fig. 2a. Probability plot showing length attained by *G. tumidum* (Male) in different years

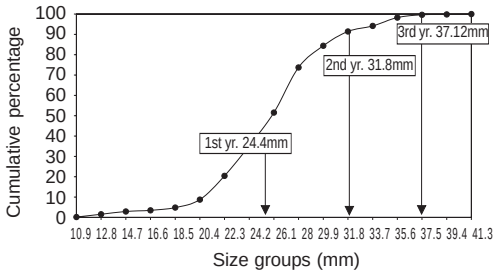

Fig. 2b. Probability plot showing length attained by *G. tumidum* (Female) in different years

von-Bertalanffy's equation

von-Bertalanffy's equation for growth in *G. tumidum* may be given as:

for males

$$L_t = 54.79\ [\ 1\text{-}e^{0.2877\cdot(t\ +1.0473\cdot)}]$$

for females

$$L_t = 50.666\ [\ 1\text{-}e^{0.3313\ (t\ +0.9819)}]$$

By using this equation, L_∞ was found to be 54.79mm for males and 50.67mm for females, age at the origin of the growth curve was 1.0473 for males and 0.9819 for females and coefficient of katabolism was 0.2877 for males and 0.3313 for females. It is estimated that the clams attained 24.39 mm in the first year, 31.99 and 37.69 mm and 31.80 and 37.1 mm in the second and third years respectively for males and females (Fig. 3a, b.)

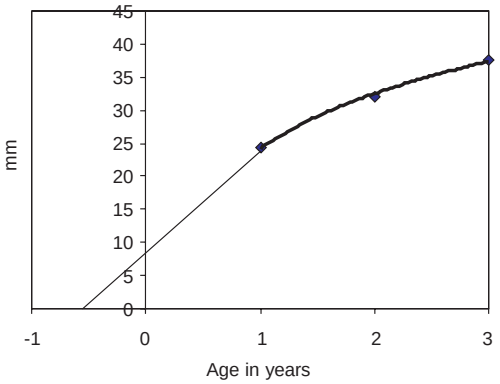

Fig. 3a. Theoretical growth curve fitted with von-Bertalanffy's equation *G. tumidum* (Male)

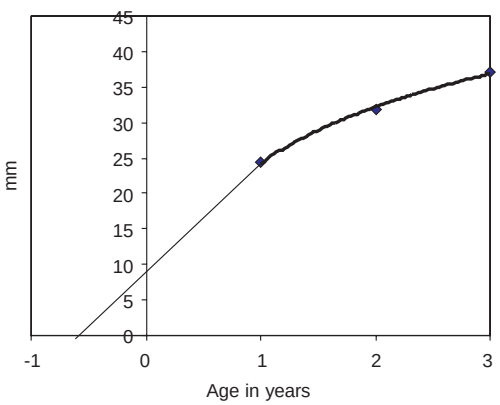

Fig. 3b. Theoretical growth curve fitted with von-Bertalanffy's equation *G. tumidum* (Female)

Ford Walford graph

The straight line obtained from the L_t against $L_t + 1$ graph, when intercepted by a 45° diagonal from the origin, indicated the L value of 55.0 mm for males and 50.5 mm for females of *G. tumidum* (Fig. 4a, b) and the life span appears to be three years.

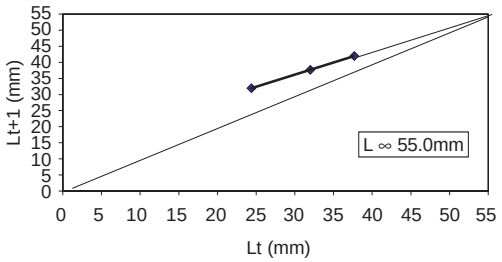

Fig. 4a. Ford-Walford graph (Male)

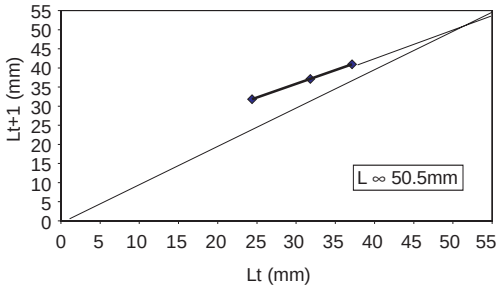

Fig. 4b. Ford-Walford graph (Female)

FiSAT

Using the ELEFAN -1 package, the growth parameters were worked out for male and female *G. tumidum* and presented (Figs. 5 a, b, c, d). The L ∞ for male and female was arrived at as 52.0 and 50.6 mm and 'K' value was 0.359 and 0.320 respectively.

Discussion

The age and growth estimation of *G. tumidum* has been done through several methods so that the outcome of one method will act as a check and control over the other. The results obtained by various methods showed more or less similar growth for the males and females (Table 1 & 2). The growth parameters obtained for *G. tumidum* by various methods are given in Table 3.

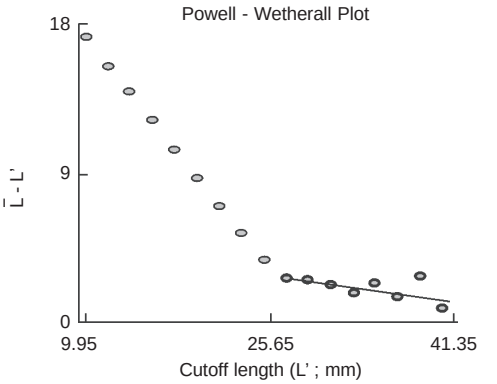

Fig. 5a. Powel-Wetherall Plot for males of *G. tumidum*

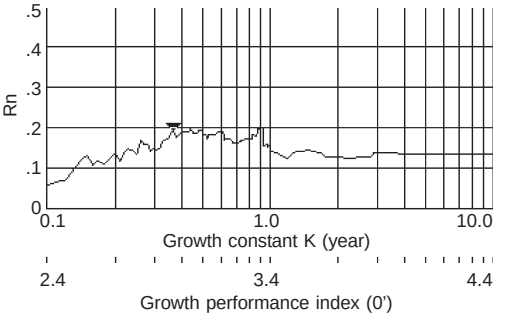

Fig. 5b.Scan of 'K' values for males of *G. tumidum*

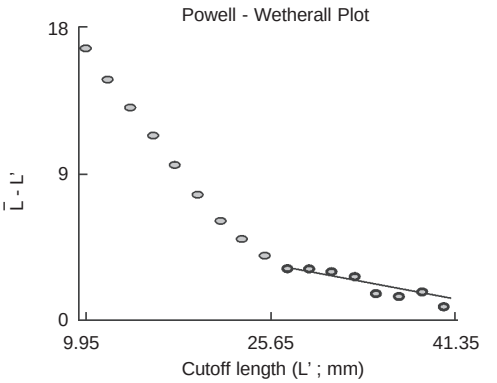

Fig. 5c. Powell - Wetheral Plot for females of *G. tumidum*

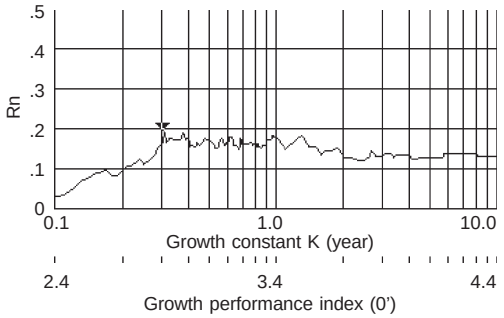

Fig. 5d. Scan of 'K' values females of of *G. tumidum*

Kasinathan (1983) in *Katelysia opima* (26.6; 36.6 and 43.2mm), and Jayabal and Kalyani (1986) in *Meretrix meretrix* (47.0 and 61.5mm) are in conformity with the present results. The findings of John (1980) in *Anadara rhombae*, an arcid clam and on donacid clams like *Donax cuneatus* of Miriya Bay, Ratnagiri (Thalikedkar, 1978); Nayar (1955) and Victor (1985) in *Donax cuneatus* of Mandapam and Madras beaches also correspond with the present results.

TABLE 1: *Growth (mm) obtained by different methods employed for male* G. tumidum

Methods employed	First year	Second year	Third year
Arithmatic probability	24.39	31.99	37.69
von-Bertalanffy's equation	24.387	31.986	37.69
Peterson's method	26.06	34.20	38.76
Months mode curve	24.20	31.80	37.88

TABLE 2: *Growth (mm) obtained by different methods employed for female* G. tumidum

Methods employed	First year	Second year	Third year
Arithmetic probability	24.39	31.80	37.12
von-Bertalanffy's equation	24.391	31.798	37.118
Peterson's method	24.87	34.37	38.93
Months mode curve	24.20	31.80	37.50

TABLE 3: *Growth parameters obtained for* G. tumidum *by various methods*

Method	Sex	L_∞	K	t_o
	Male	54.79	0.2877	1.0473
VBGF	Female	50.67	0.3313	0.9819
	Male	52.0	0.359	-
FiSAT	Female	50.6	0.320	-
	Male	55.0	-	-
Ford Walford	Female	50.50	-	-

In the present observations, *G. tumidum* revealed faster growth rate in the first year of age when compared to the subsequent years. Wilbur and Owen (1964) reported that the decrease in the relative growth with an increase in age is known in bivalves. Brown (1957) stated that specific growth rate declines more and more slowly as the organisms' increase in age. Seshappa (1971) and Harkantra (1975) showed that the young ones exhibit greater growth rate. The observations of Rao (1952), Mane (1976) and Kalyanasundaram and

Taking into consideration the results obtained by various methods of estimation on *G. tumidum*, it can be concluded that the growth rate is faster in the first year of its life and slows down as the age increases. The life span appears to be around three years.

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