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RATE OF GROWTH OF *BANKIAINMQA*[r] "NAffi,- ' ^^ A SHIPWORM FROM THE MADRAS COAST

By N. BALAKRISHNAN NAIR
University of Madras, Extension,, Mdduraf ',.:'•''"- -*

Even though sixty papers have been published on the different aspects of marine boring organisms of India, very little information is available on the rate of growth of Indian shipworms which cause very serious damage to submerged timber all along the sea coasts. The growth of these specialised, wood boring bivalves is directly related to the damage they effect on timber since each shipworm during its lifetime destroys a column of wood of the same dimension as its largest size and it was therefore interesting to make a study of the rate of growth of a local shipworm *Bankia indica*. In the present study four aspects have been taken into consideration namely growth in length of the body, (i.e. increase in length of the burrow) increase in weight of the body, increase in the number of ridges of the shell and growth in length and breadth of the shell valves.

By submerging conditioned test timbers of red-cedar *(Cedrela toona)* off San Thome, Madras, it was possible to obtain a set of shipworms whose age could be estimated with a considerable degree of accuracy. These test timbers having been placed in the sea during the height of the breeding season (June-August) (when the water was swarming with larvae) may safely be assumed to have been attacked within a few days of submergence. Since this teredine *Bankia indica* has been found to subsist mainly on the wood into which it bores Nair (1955) and since its growth in length is proportional to the length of the burrow, the latter may be related to the period of tenancy and therefore the age of the animal. Several test panels of red-cedar were suspended (in the sea during June in sites where the sea water was swarming with larvae.) Each month one of the panels was lifte.d out and the settled borers were studied. The longest specimens were selected since they represent those which were first to enter the wood after it was placed in water, as was done by Miller (1922). In the normal living state each shipworm fills its burrow the length of which therefore, may be treated as the length of the animal and carefully measured throughout its course. The average of the lengths of these would give the average length attained by the earliest settlers during the month in question. In the second month another of the panels was removed and the longest burrows were measured, the average of these will give the average length of *Bankia* settled approximately two months ago. In this way the borers from eight panels were studied from June 18, 1954 to January 23, 1955. The weights of the animals were recorded after drying them between folds of filter paper. The linear dimensions of the shell were measured with a pair of vernier callipers, the very small ones were measured with a micrometer. The dental ridges on the anterior lobe of the shell were counted under a lens. The error in the calculation of the ridges that may arise due to erosion of the ridges by friction or by overgrowth of the shelly material over the ridges are unavoidable and hence has been dealt with as ' negligible for practical purposes' as suggested by Miller (1922). Since by the seventh month the test panels became so riddled by the borers as to become fragile and brittle, observations were limited to a period of 219 days from the time of immersion of the panels.

TABLE 1

Showing measurements of *Bahkia indica* of maximum size groups in respective months from test blocks of *Cedrela toona* submerged in the open sea on 18 June 1954.

	July 5	July 20	August	September	October	November	December	January
Approximate age in days	17	32	68	95	125	165	191	219
Mean length of the burrow in mm.	9	23	142	224	257	274	290	302
Mean wet weight of the animal in gm.	0.2	0.5	0.96	2.12	3.29	3.76	4.56	5.13
Mean height of the shell in mm.	1.77	3.9	7.58	8.09	9.33	9.63	9.88	9.96
Mean length of the shell in mm.	1.78	3.54	6.65	7.64	9.48	9.76	10.12	10.4
Mean number of ridges	16	25	44	55	63	68	71	71
Number of animals examined	20	15	19	21	12	7	5	3
Temperature °C.	28.1	28.4	29.1	28.5	28.6	27.1	26.3	26.4
Salinity. %.	33.3	33.4	33.7	32.8	26.5	27.4	28.5	30.6

The data obtained from the examination of individuals of maximum size groups during each month were averaged as for that month and the figures 1 to 4 show the different readings obtained during the period of the experiment. The data presented in Table I and illustrated in Fig. 1 show the growth in length of the animal, Fig. 2 growth in size of the shell, Fig. 3 increase in the number of ridges and Fig. 4 increase in weight of the animal. From these figures it will be clear that growth is very rapid in the first 90 days and thereafter becomes slackened and the trend indicates the rate of growth becoming negligible at the end of 219 days. This suggests that the growth in length is retarded by the depletion of the woody, material in the panel due to overcrowding. It is possible that if larger volumes of wood had been offered the increase in length would have continued for a longer period than seven months. In the same way, the size of the shell, and the number of ridges, which depends on the size, may have slackened in their growth in a way related to the Retardation in growth in length. In the case of the figure 4 unlike the others the plotted points suggest an almost straight line fit indicating that the increase in weight is directly proportional to time. Therefore, it may be inferred further that growth in weight of the animal after it has ceased to grow in length might probably be due to the accretion of calcareous matter and growth in bulk of the shell which continues unabated throughout the period. This is probably due to the absorption of mineral matter from the sea being independent of the volume of wood and therefore directly proportional to the age of the animal. Within the limits of the "experiment, i.e., using 5'x3£*x4" panels of red-cedar, the rate of growth up to a period of 90 days seems to be a correct representation as growth is not affected by such factors as over-crowding and scarcity of wood during the time.

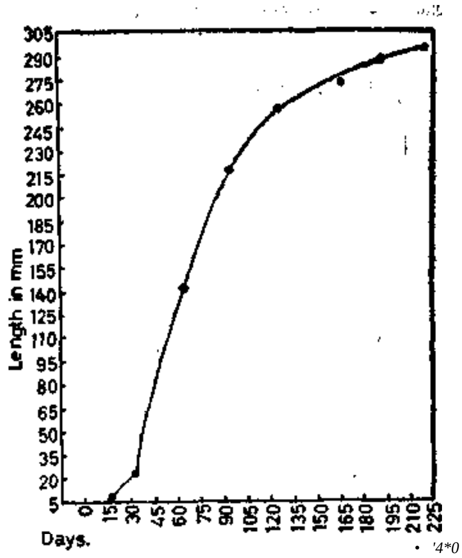

FIG. 1. Curve showing growth in length of the body.

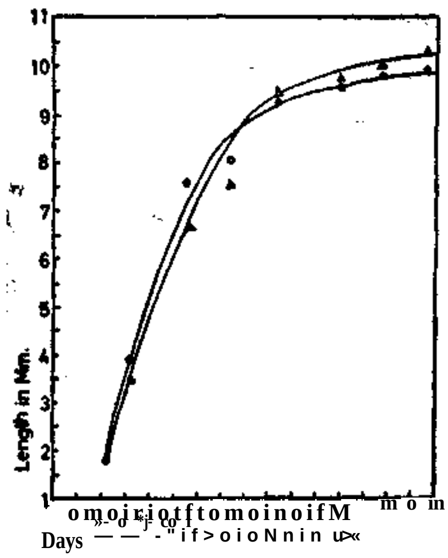

FIG. 2. Curves showing growth of the shell.
Height of shell
Length of shell.

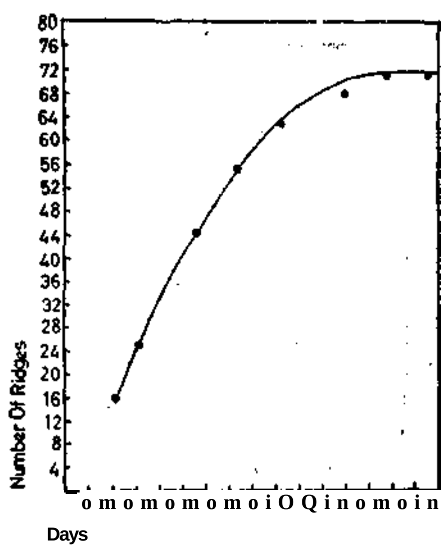

FIG. 3. Curve showing increase in the number of ridges of the shell.

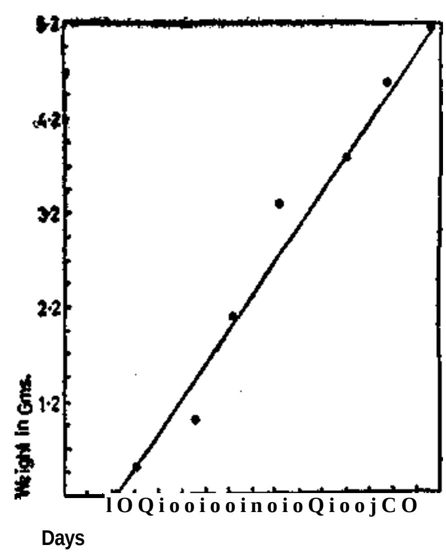

FIG. 4. Graph showing increase in weight of the body.

A comparison of the rate of growth of this tropical borer with that of allied fprms elsewhere will be of interest, *Teredo mvalis* grows to a length of 0.35 to

0.5 mm. in 18 days, 8 to 10 mm. in 33 days, 100 to 120 mm. in 72 days and takes 1 year to reach a length of 250 to 400 mm. in Woods Hole (Grave 1928). In *Bankia gouldi* from North Carolina, the growth as reported by Sigerfoos (1908) is 3 mm. in 12 days, 6 mm. in 16 days, 11 mm. in 20 days, 63 mm. in 30 days and 100 mm. in 36 days. This represents a higher growth rate than what Richards and Clapp (1944) reported for the same species from Florida waters while in the present form tbfr growth in length was 9 mm. in 17 days, 23 mm. in 32 days, **142** mm. in 68 days, **224** mm. in 95 days, 257 mm. in 125 days, 274 mm. in 165 days, 290 mm. in 191 days and 302 mm. in 219 days. Miller (1922) observed in *Teredo navalis* that the rate of growth as measured by the addition of ridges is extremely rapid during the first month (9.3) after which it stops suddenly remaining nearly constant during the next 2 months (3.8-3.6) followed by a further decrease during the fourth month (2.6) and suggested that the decrease is explainable due either to the lowering of temperature or due to the effects of crowding limiting further growth. The present study shows that the growth based on the additions of ridges was rapid in the first 2 months (25 and 19) which was followed by a sharp fall (11) even though the addition of ridges continued until the 6th month after which it remained constant. Kofoid and Miller (1927) found in *Bankia setacea* an average rate of boring of about 4.7 cm. per month in the Pacific area which is slightly higher than the values obtained during the present study (4.3 cm. per month). On the other hand in Friday harbour Johnson & Miller (1935) reported that the largest specimen of *Bankia setacea* measured 3.9 cm. long from a block which had been exposed for 4 months from September to January. The average length of 10 longest specimens was only 2.54 cm. with a rate of growth of about 1 cm. per month. These observations indicate that the rate of boring of the different species in different regions shows great variations. Ralph and Hurley (1952) obtained an ordinary growth curve for *Bankia australis* based on measurements of burrow lengths of (he longest burrow in the block for each month. The curve however showed a deceleration of growth rate in September and November (winter and spring) as noted by Isham *et al* (1951) who have interpreted this as consequent from overcrowding even though for *B. australis* the deviation of the curve was attributed to individual variations. Johnson *et al* (1936) noted a diameter of 3/16 of an inch at the end of 3 months growth of 3 Australian species.

In the present study there was no perceivable correlation between the rate of growth and hydrographic conditions, such as temperature and salinity of the surrounding waters (Table 1) even though in Malpeque Bay, Needier and Needier (1940) noted maximum growth rate in shipworms coinciding with the period of. highest temperature. Salinity was not associated with the seasonal cycle in growth. Isham *et al* (1951) also noticed rapid growth in *Teredo pedicellata* during midsummer at Miami and in panels exposed for more than 2 months the summer growth rate was reduced as a result of overcrowding. In the present study any retardation in growth rate due to overcrowding was noticeable only after a period of about 3 months. It will be seen from the above that there is considerable variation in the rate of growth of the different species of shipworms and even of the same species at different localities and exact comparisons of the rate of growth are very difficult due to lack of sufficient data regarding the factors responsible for the variation of growth of shipworms in the different types of timbers and with age and season.

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