GROWTH OF THE TUBE WORM *HYDROIDES NORVEGICA* (GUNNERUS) IN THE EAPTERN HARBOUR OF ALEXANDRIA

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ABSTRACT

The growth rate of *Hydroides norcegica* in the eastern harbour of Alexandria was studied and was found about 0.59 mm a day. In the laboratory the effect of surface texture on the growth rate was tested. The growth was found faster on a rough than on a smooth surface. Widening of the tube opening where the branchial crown of the worm usually protrudes was found not proportional to the tube elongation. It was concluded that the prolongation of the tube is a kind of movement performed by these tube worms for searching food of as well as for their own safety.

INTRODUCTION

The serpulid *Hydroides norvegica* (Gunnerus) is cosmopolitan (Beherens, 1968, and Straughan, 1969) and dominates, particularly, in tropical and subtropical waters (Bishop *et al*, 1949). Another serpulid *Pomatoceros triqueter* L. although ranks next to *Hydroides norvegica in abundance attracted* more authors to study its biology (Pyefinch, 1950a).

The serpulid worms live permanently in calcareous tubes secreted by the organisms themselves as the growth proceeds the tubes increase in length. The length of tube was always used in studies of growth rates of tube worms. Because these worm are widely distributed and survive wide range of environments, Bishop *et al.* (949) suggested that their growth rate may vary in different localities. Pyefinch (1950a) reported that unpublished results of Bishop showed that *Hydroides norvegica* tubes attaining a length up to 40 mm in 3 months in the summer in Scotland waters, while Paul (1942) recorded that this length was attained within 3 weeks in Madras Harbour (India). In Cochin Harbour (India). Nair (1967) recorded that the tube length of this species reached 42.3 mm after 88 days from settlement while Beherns (1968) found that it grows about I mm each day in average in the first 4 weeks at theHarzour of Corpus Christi, Texas but later the growth rate diminished.

Studies on fouling organisms in Egyptian waters are rare ; being restricted to observations made in the Eastern Harbour of Alexandria by Banoub (1960) and Megally (1970). The former author stated that tubes of *Hydroïdes norvegica* are numerous and that their highest growth rate was 20 mm/month ; on tube exceeded 40 mm in length. Megally found that *H. norvegica* dominates, annually, between May and October ; the longest tube measured by him was 25 mm.

In the present work the authors, in addition to giving an account on main morphological features of the worms attempt to determine the rate of growth of *H. norvegica* in the Eastern Harbour as well as the effect of the surface texture on growth rate. The relation between the lengh and the diameter of the tube was also investigated in order to throw light on the behaviur of this interesting serpulid.

MATERIALS AND METHODS

In the middle of August, 1972 two perspex plates 20 x 20 x 0.5 cm, one side of each roughened by fine sand paper were immersed in the sea under a raft. Three days after immersion the plates were taken to the laboratory where a number of widely spaced, not clustering, *Hydroidēs norvegica* worms were selected for growth rate studies. Fifty worms were placed on a rough surface of plate that was reimmersed in the sea (plate A), on the second plate (B), 19 and 21 worms were settled on its rough (B_1) and smooth (B_2) sides respectively. Plate B was immersed in a glass tank of 30 x 30 x 60 cm in the laboratory. The water in the tank was continuously aerated and replaced daily by fresh sea water brought directly from the sea. The temperature in the tank was measured each day and never exceeded the in-situ sea temperature by more than 1°C.

Segrove (1941) and Hedly (1956) found in *Pomatoceros triqueter* L. that increease in tube length occurs at anterior end where the branchial crown of the worm protrudes. This was also observed in *H. norvēgica* and was exploited in measuring tube growth. The position of the anterior end of each tube was determined and any subsequent elongation recorded. A divider was used for measuring increase in length and a calibrated micrometer lens for determining width of the tube openings. Measurements were made at least once each weak.

RESULTS

Main morphological features of the worm

Despite the universal spread of *H. norvegica* it has never been described since Fauvel (1927). In this account, in addition to describing the main structures (Fig.1), we shall refer to the difference between what we have observed in worms collected from

Easterm Harbour of Alexandria and that mentioned by Fauvel (1927). Body of the worm is divided into red and white zones and consists of about 100 segments; 7 of them are thoracic. The branchial crown is divided into 2 lobes; Fauvel stated that each lobe consists of 15-20 filaments but we found them 10 filaments only in each. The operculum (Fig. 1 a) is funnel shaped bearing a central crown of 14 divergent horney spines of yellowish colour. Each spine is provided with several long barbs and from each side of it 2 denticles emerge (Fig. 1 b). The barbs were not referred to by Fauvel. There is a pseudooperculm (about 2 mm in length) on the opposite side of the operculum (Fig. 1 c). The thoracic setae (Fig. 1 d) carry one conical dent, not 2 as mentioned by Fauvel, and both blade and fin are provided with fine serrations at one side. According to Fauvel there is another type of thoracic setae, provided with small dents but we did not find such type of setae. The shape of both thoracic and abdominal uncini is similar to that described by Fouvel, but he stated that the dents in the uncini are 7 and 5 in number but we found Them 6 and 4 respect ively (Fig. 1 e).

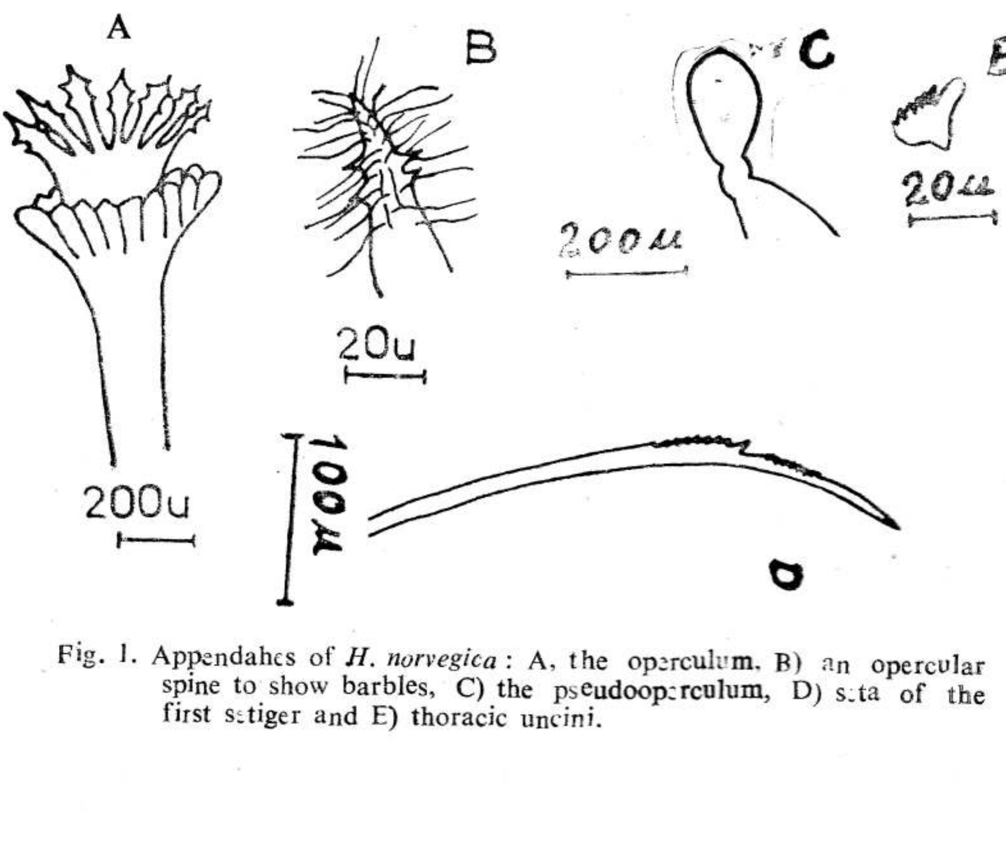

Fig. 1. Appendahes of *H. norvegica* : A, the operculum, B) an opercular spine to show barbles, C) the pseudooperculum, D) seta of the first setiger and E) thoracic uncini.

PATTERN OF GROWTH

Newly attached worms usually have tube diameter of more or less equal width throughout its length. Protursion of the branchial crown always occur from anterior opening at which the tube prolongation was found to proceed. We found that if a shadow pass over the worms, they immediately withdrow their branchial crown inside the tube indicating the presence of high sensitive organs.

Segrove (1941) found the worm tubes are formed of mucous partially impregnated with calcareous material. In *H norvegica* the formation of the tubing occurs as a secretion from tubular glands in the ventral shield (Hedley, 1956) and begins as we observed at certain positions (a, b- b', c in Fig. 2). Further formation appears in between these positions. Fine lines extend across these positions horizontally. These lines cannot be used for age determination, because, although they at first appear clear within a few days they become obliterated due to further deposition of calcareous material

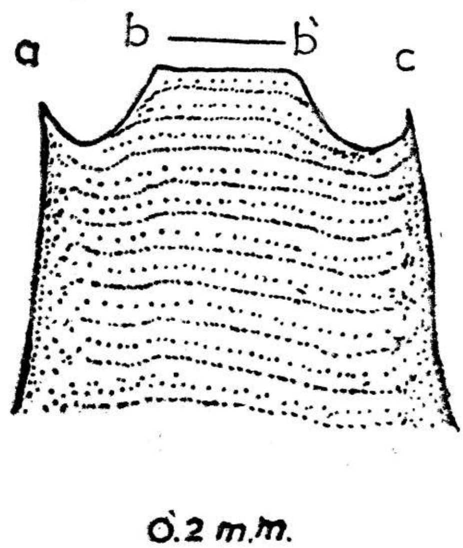

Fig. 2. Upper view of a growing tube to show the positions (a, b-b & c) at which the growth begins. The dotted lines represent growth maks.

and to silt depositions. Ventral tubing is lacking, and the tube thus appears arch shaped in cross section. This is also the case in the other serpulids *Pomatoceros triqueter* (Fauzi, 1931) and *Spirobis corrugatus* Montagu (Gobashy and Selim, unpublished). The cross section, however, is cirular in the case of tubes protrude from the surface.

Occasioally, portions may become separated from the tube. If this occurs in the posterior region no regeneration occurs since the worm usually inhabits the anterior tube region only. If the tube breaks in the anterior region, rebuilding soon begins and a new tube emerges from beneath the old one. In some cases, although no damage was apparent a new tube was seen underneath the old one and the latter soon peeled off. When a whole tube was taken off the worm, although surviving for a few days, it failed to form a new tube.

Growth rate :

The growth curves in Fig. (3) derived from the means of length of the tubes after each increment show that growths on plate B_1 (worms attached to a rough surface in the laboratory) continued longer than those on the other two plates, it lasted for 181 days. From 19 worms originally selected, 8 were still attached to the surface at the end of the measurements.. The longest tube was 96.4 mm long, the shortest 45.2 mm (the average 66.8 mm). On B_2 plate, the tubes failed to grow for more than 111 days, the greatest mean lengh attained was 37.3 mm. Out of the original 21 worms only 3 were still attached, the longest tube reached 39.1 mm, the shortest 35.8 mm. Of those worms left in the sea (Plate A), only two survived for the 91th day after settlement and attained only 52.9 mm and 37.2 mm in length.

Fig. (4) shows the growth rate curves of the tubes. It represents the relation between the specific growth rate, calculated as increase in length per time per length prior to each increase. Growth rate in Plate B_1 was usually higher than in Plate B_2. In both B plates the growth rate was steady compared with that of Plate A. However, in all cases it was high in the starting few weeks and decreased later.

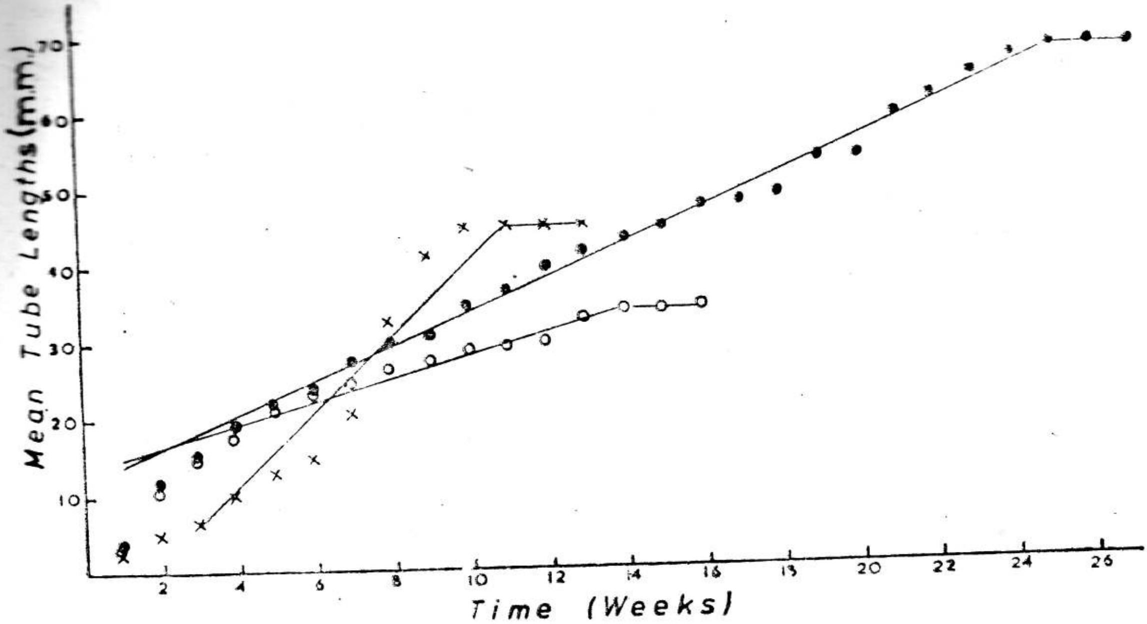

Fig. 3. Growth rate of *H. norvegica* in the sea (X), on a rough ourface (•) in the laboratory and (o) on a smooth surface tn the laboratory.

Calculating the growth rate per day in each case we find in the greatest in Plate A (0.59 mm) followed by B_1 (0.36 mm) and B_2 (0.22 m).

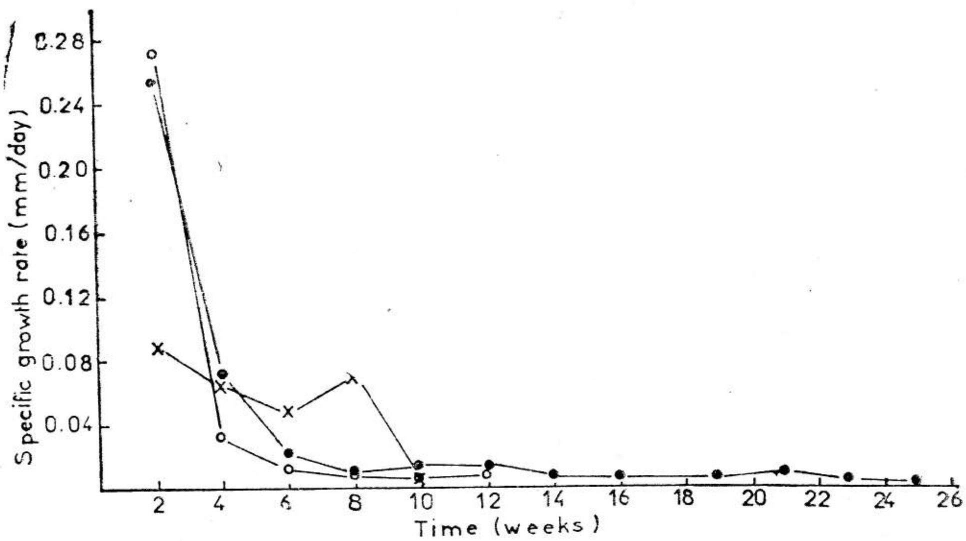

Fig. 4. Specific growth rate of *H. norveoica* calculated as increase in tube length divided by length prior to increase and period of length increase against time. (X) in the sea, (•) rough surface in the leboratory and (o) smooth surface in the laboratory.

Relation between length and width of the anterior opening of the tubes :

The lengths and the diameters of the anterior opening of 203 worm tubes ranged between 2.4 to 96.4 mm long were measured. In (Fig. 5) the abscissa represents the means of the tube lengths, the ordinate the means of the diameters of the rube corresponding to the same length classes.

For recently settled worms, length increase of the tubes were accompanied by remarkable width increases. This continued until the tubes were about 20 mm long the diameter range was 0.2 mm for a tube 2.2 mm long and 0.8 mm for a tube 20.1 mm long. The increase in diameter per millimeter increase in length for the first 20 mm was about 0.4 mm. Between 20 mm in length width increments diminished and growth rate was about 0.003 mm width to each millimeter length increase. Above 30 mm to 60 mm in length the increase in diameter was about 0.011 mm/mm length. For tubes longer than 60 mm. diameter increase was mostly negligible ; rarely exceeding 1.25 mm for any tube opening.

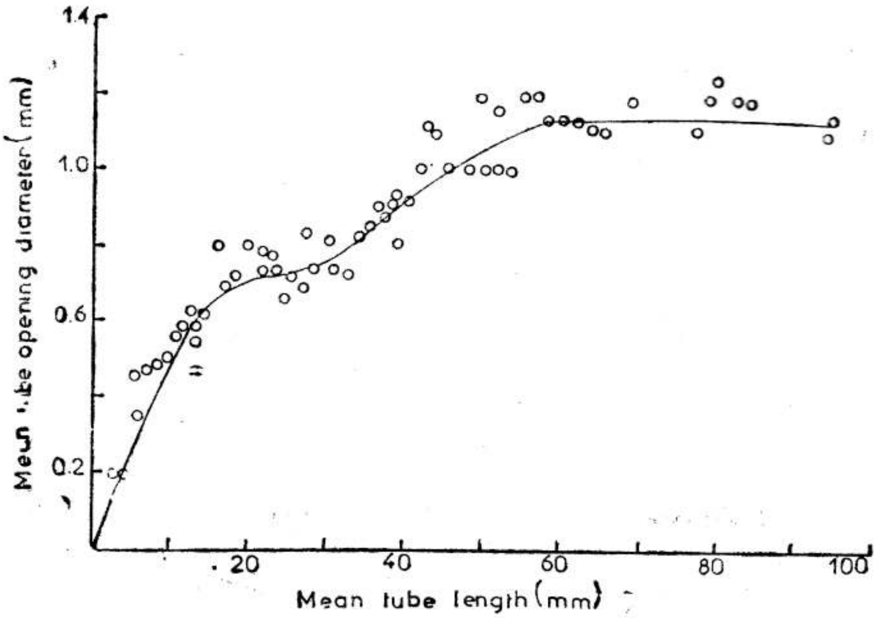

Fig. 5. Relation between tube opening diameter and its length.

DISCUSSION

Structure of worm collected from the Eastern Harbour of Alexandria, being different from that described by Fauvel (1927) points to the importance of studying the structure of this species whenever it occurs. Such difference may have an effect on growth rate and behaviour of *H. norvegica.*

Wisely (1959) and the present authers in a work will be considered later found that larvae of *Hydroides norvegica* prefer to settle on rough surfaces rather than on smooth surfaces. The present study reveals that growth rate of adults on rough surfaces is higher than on smooth surfaces. This suggests that, concerning the effect of surface texture, a relationship occurs between larvae of *H. norvegica* and their adults. Preference of the adults to grow on rough surfaces is possibly due to the strong attachments of tubes to the rough surfaces. Apparently, as sedentary organisms, tube worms must have firm attachment in order to grow fast, This indicates that for fouling organisms firm attachment is important for their growth.

Comparing the growth rate of *H. norvegica* in the Eastern Harbour of Alexandria (0.59 mm/day) with those in other regions we find it lower than in Madras (about 2 mm/day) as found by Paul (1942), higher than in Cochin Harbour; 0,4 mm/day (Nair, 1967) and very near to that observed at Scotland (.5-.6 mm/day) by Pyefinch (1950 b). This suggests that temperautre is not the main factor controlling growth of these worms. The steady rate of growth of the worms on the Plate B_1 for months despite of a wide variation in temperature (26.5°—17 5°C) support this suggestion. Probably, food supply and competition with other foulers have direct relationship with tube prolongation (Pyefinch 1950 b).

In regard to the relationship between tube length and its width at the anterior opening, growth rates appear variable; sometimes both increase, other times the increase in tube length is not accompanied by increase in width. The width of the tube may be considered as a function of worm diameter increase and hence as a function of its growth. Accordingly, we can assume that although tube growth is continuous, worm growth is intermittent and maximum worm growth is almost attained at a tube length of about 60 mm. However, worms could form tubes much longer than 60 mm and additional lengths of the tubes must be for other purposes other than growth. During feeding the worms always protrude their branchial crown from the anterior opening. This presumes the anterior movement of the worm as the tube increases in length. Therefore, although the tube in this serpulid is stationary the worm moves and even when the maximum worm growth is reached the tube growith may continue, i.e. the worm movement continues for the sake of food and safety.

SUMMARY

1.—The serpulid *Hydroides norvegica* (Gunnerus) was observed during growth and tube regeneration; both occur only at the anterior region.

2.—Growth occurs only at dorsal and lateral region of the tube but ventrally tubing is lacking.

3.—Growth rate of *Hydroides norvegica* was studied in the eastern har bour of Alexandria, and was found about 0.59 mm/day.

4.—In the laboratory, the growth rate on a rough surface was found higher (0.36 mm/day) than a smooth surface (0.22 mm/day).

5. Relative to increase in tube length, growth of the anterior opening is variable, the latter does not increase further when the former becomes about 60 mm long.

6.—Increase in tube length, beside its importance for the growth and safety of the worm, constitutes a method of movement performed by this tube worm.

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