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GAMETOGENIC CYCLE OF THE TUBE WORM HYDROIDES DIRAMPHA (POLYCHAETA, SERPULIDAE) FROM LAKE TIMSAH (SUEZ CANAL, EGYPT)

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ABSTRACT

Gametogenic cycle of the tube worm Hydroides dirampha has been investigated in an attempt to find reasons of its abundance in Egyptian water. Stages of sexual maturity in both male and female have also been defined. Six stages were determined in female while only three stages were determined in male.

The breeding season is restricted,spawning occurs between late June and early September. The growth of the coelomic gametes development takes place between 4 to 6 months for completion.The correlation between breeding and temperature is discussed.

INTRODUCTION

The reproductive cycles of many polychaetes were studied by many investigators. Much attention on this respect has been focused on family Syllidae (Potts, 1911; Herpin, 1925; Hausenschild, 1953; Daly, 1975; Schiedges, 1979; Franke, 1980; Heacox, 1980; Garwood, 1982), family Nereidae (Clark & Ruston, 1963; Brafield & Champman, 1967) and family

Spioribidae (De-Silva & Knigh-Jones, 1962; Rothlisberg, 1974; Daly, 1978). Also other species such as Clymenella torguata (Newell, 1951). Glycera dibranchiata (Simpson, 1962) and Arenicol marina (Howie, 1961; Howie & Mc Clenaghan, 1965) have been investigated.

In Egypt, no similar studies have been carried out on Polychaetes except the contribution presented by Ghobashy et al. (1981) on the reproduction potential of Hydroides elegans. This lack of knowledge is probably because of the difficulty of obtaining quantitative samples from habitats in which they are usually most abundant. In Lake-Timsah Hydroides dirampha was found to be extremely common, and this population has provided an excellent opportunity to study its gametogenic cycle in details. It is hoped that this and future investigations on the reproductive biology of this common tube worm would explain the reasons behind its abundance in Egyptian waters.

MATERIAL AND METHODS

The annual cycle of Hydroides dirampha was established by quantitative sampling at a marked station (area 50 m^2) at Lake-Timsah. From October, 1988 to December, 1989, adult specimens were monthly collected. This study was continued at irregular intervals throughout 1990 to check the previous years's observations. About 100 worms of different sizes were examined is each sample.

The total body length was measured to estimate the different sizes of the collected worms. The total length was defined as the distance between the operculum and the posterior end of the worm.

In order to determine the stages of sexual maturity, smears of the coelomic contents were made. These smears were also used to record the total numbers of oocytes in each individual . According to the method proposed by Daly (1978), smears were made by withdrawing the live worm carefully from the tube and putting it on a slide in a small drop of sea water. The coelomic contents were consequently smeared on the side. Each smear was dried by placing the slide on a hot-plate. Slides, with dried smears, were later fixed for 2 minutes in 70 % ethyl alcohol (or methyl), rinsed in distilled water and stained for 2 min. in 1 % toluidine blue or Giemsa solution. Smears were then washed in two changes of distilled water, dehydrated in two changes of acetone, cleared in xylene and mounted in Canada Balsam under a cover-slip. Smears of coelomic contents of males were similarly stained, but some were stained in acetic orcein, rinsed in distilled water, dehydrated in two changes of absolute alcohol and then mounted in Euparal. In case of males the stage of maturation was simply assessed qualitatively after examination of the smears. In case of females, the diameters of 200 oocytes in the smears were recorded by placing in one of a series of 10 um size classes. From this distribution the maximum oocyte diameter, which was used as a measure for maturation, was obtained.

RESULTS

Gametogenic cycle in female:

Females Hydroides dirampha were assigned to one of six stages of sexual maturity, based upon the size distribution of oocytes within a sample of coelomic fluid. The sequence of stages defined below is similar to that used by Olive (1970).

Stage 1. All the coelomic oocytes are less than 50 um in diameter.

Stage 2. The majority of the coelomic oocytes are less than 40 um in diameter, but there are some between 50-80 um in diameter.

Stage 3. The majority of the coelomic oocytes are less than 80 um in diameter, but some greater than 100 um in diameter are present.

Stage 4. The majority of the coelomic oocytes are greater than 100 um in diameter and most of these are full size 120 um in diameter. Large numbers of smaller oocytes less than 80 um in diameter may be observed.

Stage 5. Almost all the coelomic oocytes are fully grown and greater than 100 um in diameter; few, if any, small oocytes less than 80 um remain. The oocytes are packed together and overlaped so as to completely fill the coelomic space.

Stage 6. Spent females. In these there is a small number of full-sized oocytes, but they do not fill the coelomic space and often show signs of degeneration. Variable numbers of smaller oocytes may be present in the coelom together with large numbers of coelomocytes.

The reproductive cycle of female Hydroides dirampha is summarized in Fig. (1). The oocytes are released from the dispersed packets of primary oocytes as small transparent solitary oocytes with a diameter of approximately 20 um. Such oocytes first appear amongest the coelomic contents of the females shortly after the breeding season. In this early stage of oocytes development, the coelomic fluid also contains numerous coelomic corpuscles, but these gradually disappear as the oocytes approach maturity. In late September and October almost 100% of the females have only these small coelomic oocytes and were classified as stage 1: this remains true from late September to march. A small proportion of the females (less than 2%) have in addition, few fully grown oocytes and are recorded as stage 3: it seems most likely that these oocytes represent a small number of unspawned oocytes from the preceding breeding season. During this time the production of young coelomic oocytes continues and the number of small coelomic oocytes increase and reaches its highest number by March.

On late March about 10% of the females were in stage 2: by April more than 70% of the females have reached at least

Stage 3: On May the bulk of the population (70%) had reached at least stage 3: and had at least 2% fully grown oocytes.

The greatest proportion of mature female (i.e. state 4,5) was recorded on June (60%) and breeding had not yet begun at that time (Fig. 2).

Breeding took place during late June, July, August and early September. On August, September and early October most of the females were spent, though during July, August and September no females had immature oocytes.

The data show that the breeding season for this population of Hydroides dirampha is late June, July, August and early September. This is confirmed by the fact that the decline in the proportion of empty or spent animals during the period November-May is due to the gradual appearance of coelomic gametes in the coelom spent and previously immature animals.

The increase in the proportion of empty animals in December was not due to spawning but was the result of a very large collection of immature animals at that time. Although some of the immature individuals may acquire a few coelomic gametocytes prior to the breeding season, the majority of the small females do not achieve reproductive success, as shown in the length frequency histograms for each class of females in May and July (Fig. 3).

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Gametogenic cycle in male:

The sexual maturity of males was assessed according to a three-point scale.

Stage 1: Spermatogonia and primary spermatocytes rosettes only in coelom.

Stage 2: Spermatogonia, primary spermatocytes, secondary spermatocytes and spermatid rosetts in the coelom.

Stage 3: Spermatogonia, spermatocyte, spermatid rosetts and free spermatozoa in the coelom.

In practice the sexual maturity of the population could be assessed by determining the percentage of males with free spermatozoa.

Fig. (4) shows the percentage of males Hydroides dirampha with free spermatozoa. At the end of June almost 100% of the males had free spermatozoa. During the breeding season, the proportion of animals, which retained mature spermatozoa, remained high, suggesting that the animals did not completely shed all the coelomic contents together.

DISCUSSION

The evidence presented so far suggests that Hydriodes dirampha (a) breeds mostly between June-September; (b) Males and females are not completely devoid of gametes after spawning which means that they do not completely shed all coelomic conter together; (c) individual females spawn only one time per a year,

(d) the oocytes grow fairly swiftly, the period between individual spawning being perhaps as long as 6 months.

The obtained data makes it possible to attempt an interpretation of the idea of simple correlation between breeding and temperature. This idea was elaborating by Orton (1920) and has been termed "Orton Rule". But it meets with many exceptions such as in the case of Crepidula fornicata (Chipperfield, 1951); Blennius sp. (Qasim, 1956) and Ostrea edulis (Korringa, 1957). It seems easily to suggest that, in the present work, breeding continues until, the temperature falls to the the same level as it was initiated, since it began, in June and ended in September. This suggestion comes in accordance with that given by De Silva (1967) in which he proposed that the rise in water temperature in spring is the stimulus responsible for initiating breeding. He also proposed that either the fall in sea temperature in autumn, or a decline in food availability might cause the observed cessation of breeding in the autumn and winter. This explains the high increasing in the population densities of the investigated species in Lake-Timsah during spring and summer seasons.

Olive (1970) reported that, the growth and reproduction within cirratulid population becomes very prominent during excess of food supply. On the other hand, Gee (1967) reported that, maturation of gametes in Spirorbis rupestris occurred slowly at 5C° and more rapidly at higher temperature, and breeding season seems to be determined by high temperature as well as unknown factors.

In being a summer breeder, Hydroides dirampha resembles some polychaete species studied previously such as Sterpto-syllis websteri (Garweed, 1982); Cirriformia tentaculata (George, 1964); Spirorbis borealis (Garbarini, 1936), Spirorbis tridentatus and Spirorbis pagienstecheri (De Silva, 1967), S. rupestris (Gee, 1967). On the other hand, some polychaete species were known to breed several years in succession and are called polytelic species according to Clark & Olive (1973). The smaller polytelic such as Polydora spp. and Spirorbis were observed to have similar population structure in a short time scale (Dare & Polk, 1973). Hydroides dirampha seems to belong to such case, since gametogonia were observed in large specimens during the early reproductive cycle while mature gametes were observed in the coelom of smaller individuals.

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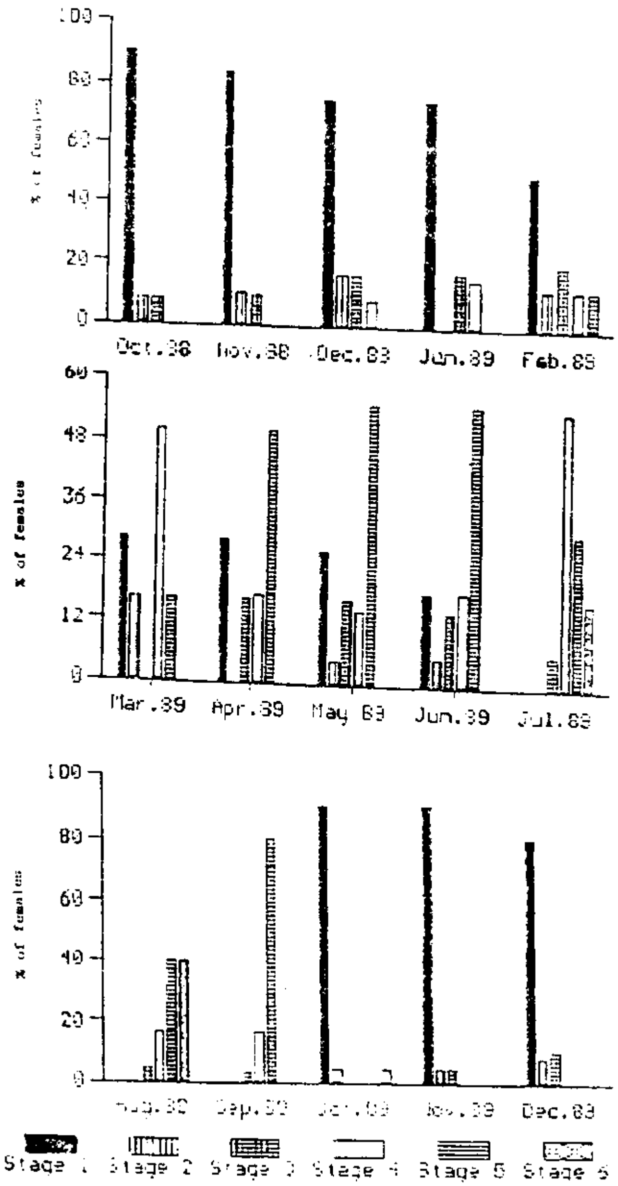

Fig (1) The sexual maturation cycle of females [illegible] [illegible] for definition of sexual maturation stages 1-6. Stage 1, sexually immature, Stages 2 and 3; maturing, Stages 4 and 5, mature gravid females, Stage 6, spent females.

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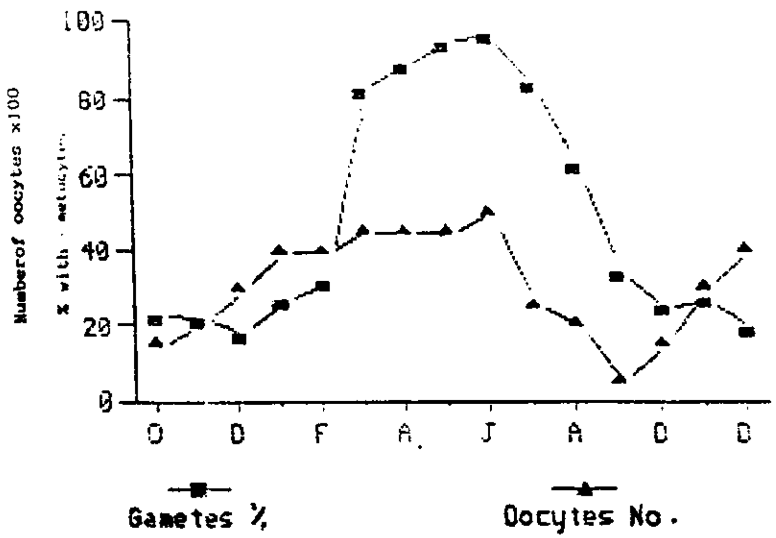

Fig. (2): The proportion of *Hydroides diramphq* with coelomic gametocytes and the number of gametocytes throughout the study period. This class includes both spent and juvenile animals.

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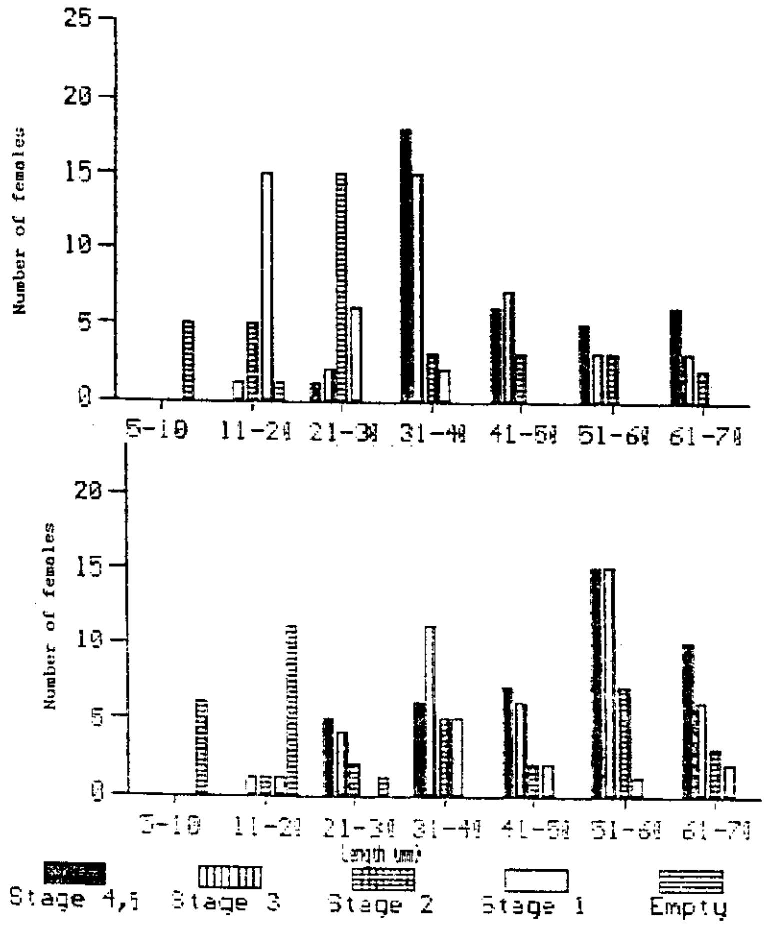

Fig. (3): Length frequency histograms for females at each stage of sexual maturity immediately before the breeding season (May 1989) and immediately after the begining of the breeding season (July 1989).

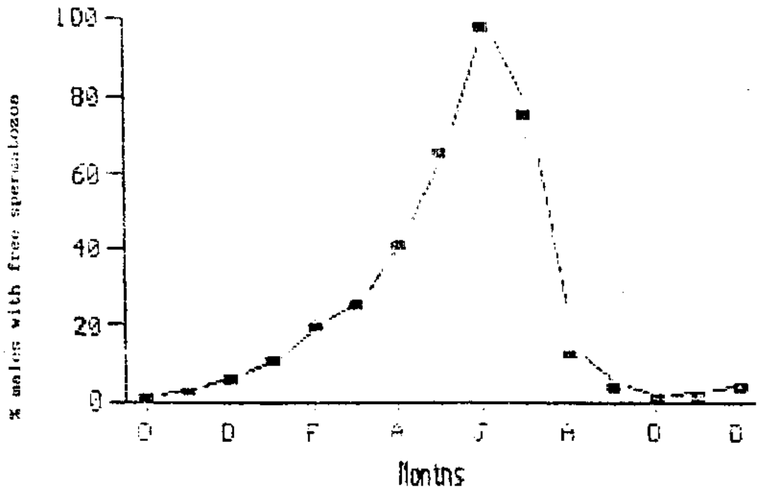

Fig. (4): Percentage of male *Hydroides dirompha* with free spermatozoa in the coelom, spent male animals with small numbers of gametocytes were present in Aug. and Sept.

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الدورة المنسلية فى الدودة الانبوبية المعروفة باسم هايدرويدس ديرامفا (عديدات الاشواك) عائلة سربيوليدى) فى بحيرة التمساح (قناة السويس)

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تم فى هذا البحث دراسة الدورة المنسلية للدودة الانبوبية هايدرويدس ديرامفا فى محاولة لايجاد تعليلات تفسر سبب شيوعها فى المياه المصرية خاصة بحيرة التمساح. ولقد تم خلال هذه الدراسة تحديد مراحل النضوج فى كل من الذكر والانثى حيث تم تحديد ٦ مراحل لنضوج المناسل فى الانثى بينما تم تحديد ثلاث مراحل فقط فى الذكر.

كما تبين ان موسم التكاثر فى هذه الدودة الانبوبية يتم فى فترة محدودة حيث يحدث الاخصاب فى الفترة من اواخر يونيه حتى اوائل سبتمبر. كما اتضح من خلال ما تم الحصول عليه من نتائج وبالمقارنه مع عديدات الاشواك الاخرى ان نضج المناسل فى هايدرويدس ديرامفا سريع نسبيا بحيث يستغرق من ٤ - ٦ شهور. كما تم مناقشة العلاقة بين نضج المناسل ودرجة الحرارة.