

Observations on reproduction and growth of *Sabella spallanzanii* (Polychaeta, Sabellidae) in the Mediterranean Sea

Adriana GIANGRANDE & Angela PETRAROLI

Dipartimento di Biologia
Università di Lecce
73100 Lecce, Italy

ABSTRACT

A year of observations on a population of *Sabella spallanzanii* is reported. *In situ* measurements of tube length and correlation of this parameter to other variables such as worm length and biomass gave indications on growth-rate. Reproduction was followed by monthly samples and examination of gonad maturation. Sex ratio and minimal size at reproduction were also investigated. In the Mediterranean Sea *S. spallanzanii* showed a fast growth-rate and reproduced during February. Oogenesis is of extraovarian type and eggs reach 250 μm . The presence of protandric hermaphroditism is indicated.

RÉSUMÉ

Observations sur la reproduction et la croissance de *Sabella spallanzanii* (Polychaeta, Sabellidae) en Méditerranée

Des observations sur la reproduction d'une population de *Sabella spallanzanii* ont été faites pendant une année. La longueur des tubes a été évaluée par des mesures directes des individus dans leur habitat naturel. Une corrélation entre la longueur de tube, la longueur du ver et la biomasse a pu être démontrée. A partir de ces corrélations, il est possible d'avoir une indication sur la croissance du ver. Des échantillons ont été récoltés tous les mois pour suivre la reproduction des individus. La taille minimale des vers à la reproduction et leur sex-ratio ont été calculés. La ponte de *S. spallanzanii* a lieu au cours de l'hiver en Méditerranée. La taille ovocytaire maximale observée a été de 250 μm . Néanmoins les premiers stades de la gamétogénèse n'ont pas été observés et des observations complémentaires sont nécessaires. L'espèce présente un hermaphroditisme protérandrique.

INTRODUCTION

Sabella spallanzanii (Gmelin, 1791) is one of the most "popular" Mediterranean polychaetes. It has been used as an experimental animal in numerous studies, but almost always under the generic name of *Spirographis*.

Recently PERKINS and KNIGHT-JONES (1991) synonymized *Spirographis spallanzanii* Viviani with *Sabella*

penicillus Linnaeus, but suggested to suppress *penicillus* and other synonyms to stabilize the name *spallanzanii*.

They pointed out that the correct name for the species, *penicillus*, has frequently been used incorrectly for *Sabella pavonina* Savigny typical of northern Europe.

Sabella spallanzanii is common along the Italian coast. It can be found in the open sea from 1 to 30 m depth, as well as in shallow hard bottom areas of harbours, where it reaches high densities. Probably the open sea and the harbour forms belong to different ecotypes because their behaviour and resistance under laboratory conditions are different.

Despite its wide distribution, and its frequent use in physiological studies (IVANOV, 1908; FOX, 1938; KIORTSIS & MORAITOU, 1965; PARRINELLO & RINDONE, 1981), its reproduction and life-cycle are poorly known (MCEUEN *et al.*, 1983).

The role of coelomocytes in the maturation of germinal products in some specimens from Naples, which surely belonged to *Sabella spallanzanii*, was studied by DALES (1961). While the electron microscopical investigation on sperm of the species incorrectly referred as *Sabella penicillum* by GRAEBNER and KRYVI (1973), should probably be referred to *Sabella pavonina*.

The present paper deals with a year of observations on *in situ* growth and reproduction of a Mediterranean harbour population of *Sabella spallanzanii*.

MATERIALS AND METHODS

The study was conducted at the Mar Grande of Taranto (Gulf of Taranto, Ionian Sea) along an artificial, vertical cliff. The individuals of *Sabella spallanzanii* were distributed in patches. One group measured 2 m deep and 9 m wide, and was chosen to follow individual growth. *In situ* measurements of tube length were done by Scuba divers for about one year. Tubes were measured within an area of 400 cm², using a plastic square to delimitate the surface. The tube length was correlated with other features of the worm.

Biomass was estimated as dry weight by drying individuals at 65°C for 24 h. Various sized specimens were collected monthly from the dense patch under study and from adjacent zones. Size at maturation and sex ratio were determined. Coelomic fluid was analyzed in the laboratory to examine for sexual maturation.

Specimens were fixed in 5 % glutaraldehyde buffered to pH 7.4 and post-fixed for one hour in 4 % osmium tetroxide for histological studies. For light microscopy, 1 µm thick sections were cut with a glass knife. Thin sections were cut on an ultramicrotome with a diamond knife for electron microscopy.

The temperature cycle was typical of Mediterranean confined environments with a range of 11 °-29 °C. Salinity values were stable at approximately 38 P.S.U.

RESULTS

DENSITY, GROWTH AND BIOMETRY. — Individuals of *Sabella spallanzanii* were located within a suspension feeder community typical of Mediterranean eutrophic zones such as harbours (TURSI *et al.*, 1985). At the beginning of the study in May 1991, only small individuals were present within the patch, and the density was about 300 ind. m⁻². The mean tube length in July 1991 was 10 cm (Fig. 1a). In April 1992 it was 18 cm, and in August 1992 it reached 20 cm in length (Fig. 1b), with a density of about 150 ind. m⁻².

The tube length was correlated with the length of the worm (Fig. 2a), biomass (Fig. 2b) and the number of setigers (Fig. 2c). Biomass was estimated at 60 g. m⁻², and 75 g. m⁻² in July 1991 and August 1992, respectively.

The crown of *Sabella spallanzanii* is asymmetric, with one involute lobe having an arrangement of spiralled radioles, but spiralization is absent in small individuals (KNIGHT-JONES *et al.*, 1991). Correlation of number of spirals with length showed that worms up to 9 cm in length do not show any spiralling, whereas large specimens from 30 to 40 cm in length have up to 4 secondary spirals (Fig. 2d). The ratio of body length to crown increases with increasing body length, from 1.5 to 4.7, as observed for other species (GIANGRANDE, 1991).

REPRODUCTION

As observed by DALES (1961), germinal products in sexually mature specimens are found in the coelomic cavity. No germinal products were observed in the coelom from May to July 1991. The content of the coelom was

bright orange or brown and had a rich creamy consistency due to the presence of large coelomocytes. These cells measure up to 70 μm in diameter. The peritoneum appeared hypertrophic in July, 1991. The early stages of

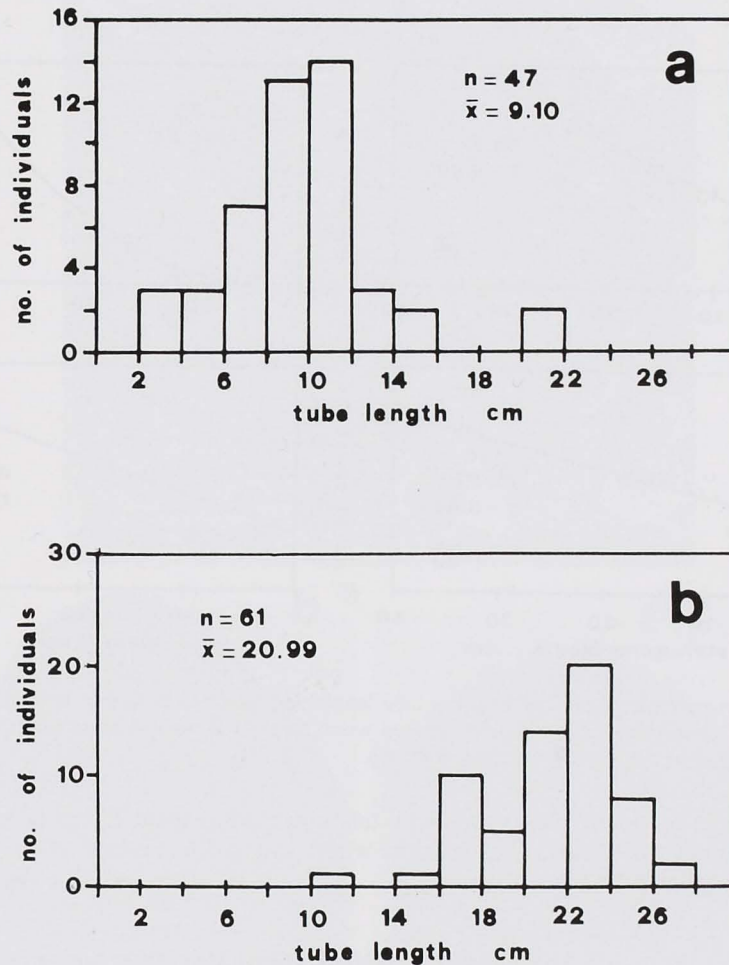


FIG. 1. — *Sabella spallanzanii*. a: Frequency histograms of tube length in July, 1991; b: Frequency histograms of tube length in August, 1992.

germinal products were probably present in August and September, but samples relative to this period were not obtained. Germinal products were well developed in October, 1991, when eggs measured about 100 μm . They reached about 200 μm in December, 1991, and males contained spermatids predominantly at an early stage of maturation. Eggs had completed vitellogenesis and measured 250 μm in January, 1992, (Fig. 3a), and ripe spermatozoa (Fig. 3b-c) together with late spermatid stages were present in the males. Spawning occurred in February. Some females still retained a few eggs surrounded by a large number of coelomocytes in March. The coelom of the worms was once again full of coelomocytes in April, 1992, and no germinal products were present. As observed by DALES (1961) the quantity of coelomocytes decreased as oocytes matured.

SEX RATIO

The minimal size at maturation was computed as 15 cm in length. Specimens from 15 to 20 cm long were all males; females occurred only in specimens greater than 20 cm long. The sex ratio was of 1 : 1 in individuals from 25 to 30 cm. However, males represented more than 80% of the reproductive population when all sized worm were considered.

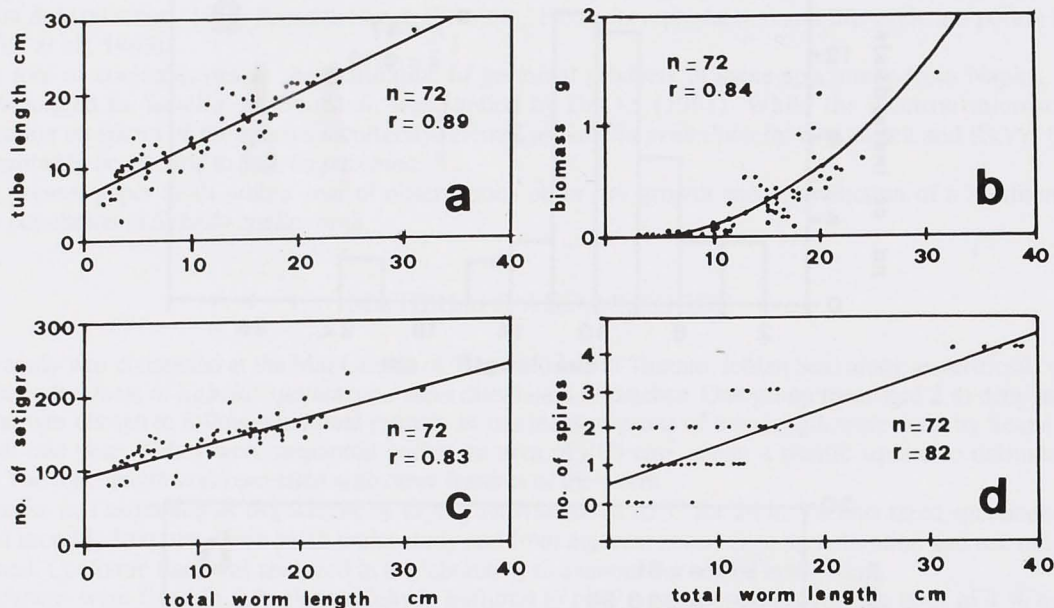


FIG. 2. — *Sabella spallanzanii*. a: Correlation between tube length and total worm length; b: Correlation between worm length and biomass (Dry weight); c: Correlation between worm length and number of setigers; d: Correlation between worm length and number of spirals of the branchial crown.

Individuals from the patch under observation with tubes measuring about 15 cm in length were all males. During the period of study no females were present within this patch. Females were found among larger individuals collected from adjacent zones.

DISCUSSION AND CONCLUSION

Sabella spallanzanii is characterized by a rapid growth rate. Tube length doubled in 10 months. In the laboratory, it has been reared using many different food sources, and it can be hypothesized that it can feed also on particulate organic matter. Size distribution within the patch suggested that it could be the product of a single recruitment episode. The biomass computed per square meter was quite large, even though mortality seemed to be very high during the period of observation, since the density decreased from 300 to 150 ind. m⁻².

Spiralization of the radioles represents a growth strategy in large-sized sabellids. In this way they can obtain an efficient respiratory and feeding surface without elongation of the crown, diminishing the risk from predation. Correlation of the number of spirals with body length is important taxonomically, since one of the features used to distinguish *Spirographis* from *Sabella* was the presence of spiralization in the crown.

Reproduction in *Sabella spallanzanii* seems to be synchronized among individuals. According to DALES (1961), spawning occurs in winter. However, samples relative to this first year were not adequate to investigate the entire gametogenic cycle, especially concerning the appearance of the early stages of germinal development. Data of the present work suggests that gametogenesis begins in summer. During the gametogenesis, coelomocytes were observed to decrease in number, especially in females. After spawning the number of coelomocytes increases

rapidly and by spring fill the coelomic cavity. DALES (1961) reported that coelomic cells are organized as storage

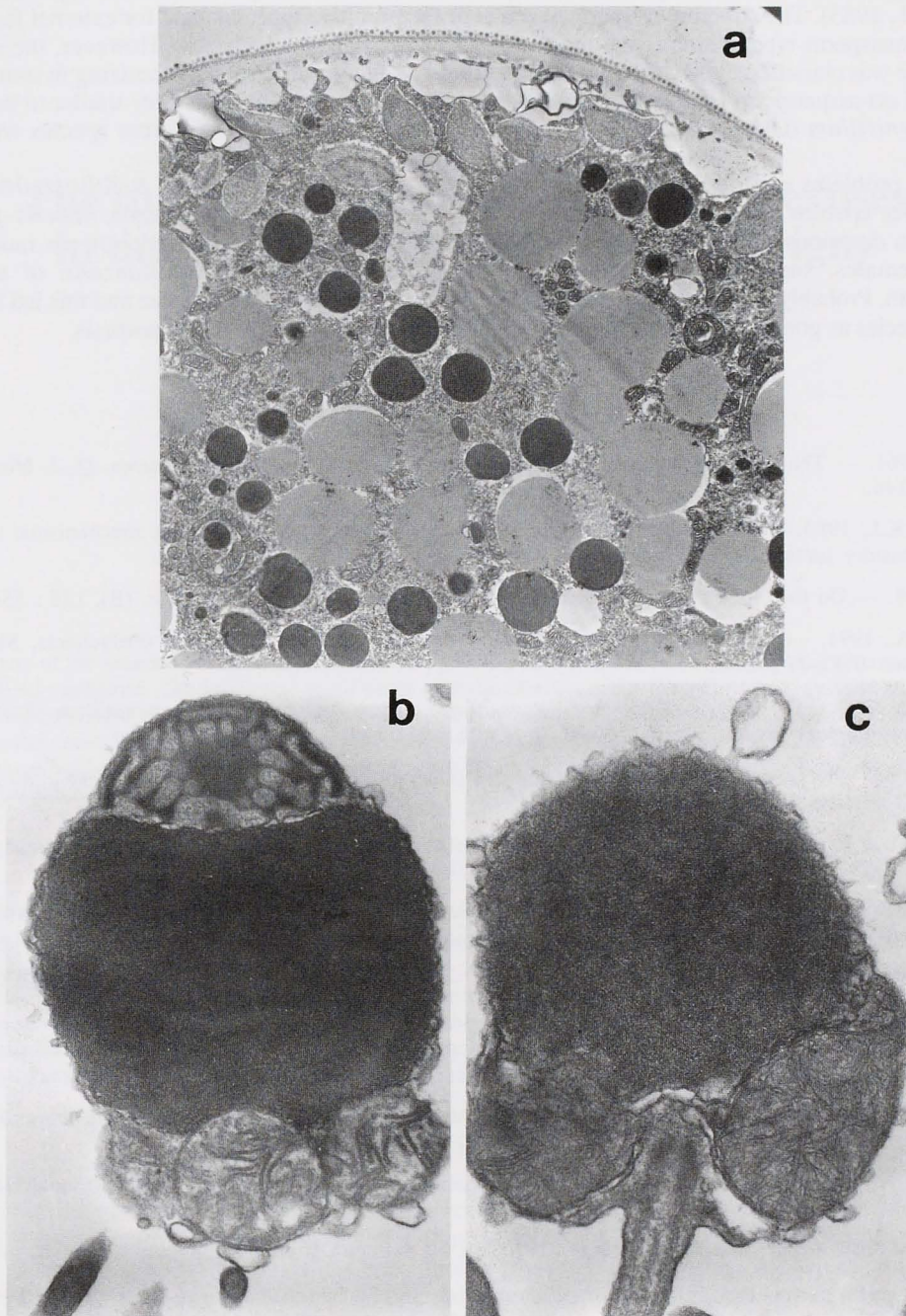


FIG. 3. — *Sabella spallanzanii*. a: Electron micrograph of a section through cortex of ripe egg, showing numerous yolk bodies, magnification 91,000; b-c: Electron micrograph through heads of ripe spermatozoa, magnification 52,000.

centres for the maturation of gametes. Coelomocytes are derived from the peritoneum as small actively phagocytic cells. Large coelomocytes eventually rupture and liberate their inclusions into the coelomic fluid to be taken up by

younger cells or by gametes. The oogenesis therefore is of the extraovarian type and is classified by ECKELBARGER (1983) as "with numerous amoebocytes".

The mature egg diameter is 250 μm ; therefore a lecithotrophic development can be hypothesized. Even though the egg diameter does not agree with that of other sabellids having a broadcaster reproductive pattern (McEuen *et al.*, 1983). The structure of spermatozoa is of the primitive type, adapted for external fertilization. It is of the ect-aquasperm type, which is the most common type among polychaetes. However, the sabellid ect-aquasperm type was classified by JAMIESON & ROUSE (1989) as neo-aquasperm, hypothesizing in some sabellids a re-evolution of ect-aquasperm from ent-aquasperm type. The sperm morphology is very similar to that described for *Sabella penicillum* (GRAEBNER & KRYVI, 1973), but this is probably a different species from *Sabella spallanzanii*.

Due to the problems existing in the taxonomy of *Sabella spallanzanii* (PERKINS & KNIGHT-JONES, 1991), some difficulties arise in comparing present data to other previous works. For example, *Sabella penicillus* is reported to be a dioecious species (McEuen, *et al.*, 1983), but current data, i.e. deviation in sex ratio from 1 : 1 and size of females, supports the hypothesis for the presence in *Sabella spallanzanii* of a protandric hermaphroditism. Probably the individuals examined by DALES (1961) were of large size and this led the author to consider the species as gonochoric. Further investigations are needed to confirm this hypothesis.

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