



Eulalia picta Kinberg, 1866 – tube builder or specialized predator?

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Abstract: Twenty six specimens of the polychaete *Eulalia picta* were found in fine-grained sand tubes. Material was collected in the Antarctic fjord, Admiralty Bay at the depth of about 100 m. The comparison of tube sediment with the sediment composition at the collection site demonstrated that tubes were created with a high degree of particle selection. Our findings might suggest presence of the tube-building behavior in *E. picta* or show that this species is a highly specialized predator crawling into the tubes of other sessile polychaetes and uses their tubes as protective cases.

Key words: Antarctic, Admiralty Bay, tubes, sediments, Eteoninae, Phyllodocidae.

Introduction

Phyllodocidae are a group of marine polychaetes occurring worldwide, mostly at shelf depths. There are more than 500 species currently described (Pleijel 1991; Rouse and Pleijel 2001; Eklöf *et al.* 2007).

Data on the biology and ecology of Phyllodocidae are very scarce (*e.g.* Emson 1977; Fauchald and Jumars 1979; Lee *et al.* 2004 and references therein). According to current knowledge, it is assumed that all phyllodocids are active predators or scavengers (Rouse and Pleijel 2001; Jumars *et al.* 2015). Their buccal organ is an unarmed eversible pharynx. They actively search for prey, which includes other polychaetes, bivalves or gastropods (Fauchald and Jumars 1979; Rouse and Pleijel 2001). One species is probably hematophagous (Jenkins *et al.* 2002). None of the known phyllodocids is tubicolous. Many other polychaetes construct tubes from sediment particles or from protein secretion encrusted with calcium carbonate. In general the tubicolous species are sessile or discretely motile and most of them are filter or deposit feeders (Rouse and Pleijel 2001). There is still

a considerable lack of research dedicated to the composition and mechanism of tube building in polychaetes (e.g. Gremare 1988; Willems *et al.* 2007; Noffke *et al.* 2009). Nevertheless, it was already demonstrated that the presence of the tube-building behavior may also reflect the character of the feeding mode and other elements of the biology and ecology (Brown and Ellis 1971).

Eulalia picta Kinberg, 1866 is a medium-size Antarctic phyllodocid that occurs on hard and soft bottom (Hartman 1964; Averincev 1972; Pabis and Siciński 2010). All morphological features place this species among other typical members of this family. Characters such as muscular pharynx and numerous well developed parapodia may suggest that this species is an active predator or scavenger. However, it was already demonstrated that such morphological adaptations are not necessarily, evidence of carnivorous behavior. A common European nereidid *Hediste diversicolor* (O.F. Müller 1776), a species with well-developed jaws and an eversible buccal organ, can feed exclusively as a filter-feeder (Rijsgård 1994). Discovery of the larger number of *E. picta* specimens hidden in fine-grained sediment tubes may lead to more than one possible explanation; either this polychaete is able to construct the tubes or it is a highly specialized predator crawling into the tubes of other polychaetes. The analysis of the grain size structure of the tubes was provided in relation to granulometry of adjacent sediments. The possible explanations of these findings are discussed.

Material and methods

Study area. — Admiralty Bay is an Antarctic fjord-like embayment of King George Island (South Shetlands). It consists of the central basin and three inlets (MacKellar Inlet, Martel inlet and Ezcurra Inlet) and covers an area of about 120 km². A large part of the shoreline is covered with glaciers and the basin is influenced by a high rate of glacial disturbance. The amount of suspended matter in the waters of Admiralty Bay varies from about 15 mg dm⁻³ in the central basin to over 100 mg dm⁻³ in the glacial bays (Pęcherzewski 1980, Siciński *et al.* 2011). The bottom sediments are poorly sorted mud and sandy mud (Siciński 2004, Campos *et al.* 2013). The central basin is the deepest part of the bay (maximum depth about 530 m) and is open to the Bransfield Strait (Siciński *et al.* 2011).

Sampling and data analysis. — Samples were collected in the summer season of 2007 in the outlet part of the Ezcurra Inlet, at depths of about 100 m. Material was collected using a van Veen grab (0.1 m²). Four replicate samples were gathered at each of four stations. An additional van Veen grab was collected for granulometric analysis of the bottom sediments at each station. Samples were sieved through 0.5 mm mesh and fixed in a buffered 4% formalin solution.

Ten specimens with complete, well preserved tubes were chosen for grain size analysis of their tubes. All measurements of tube grain size were done under a stereomicroscope Leica 205C.

Results

Amongst 57 collected specimens of *Eulalia picta* 10 were completely hidden in tubes. Sixteen others were covered with remains of the tubes. Another 31 specimens were completely outside of tubes. The tubes were constructed of fine sand ($169.5 \pm 2.4 \mu\text{m}$ grain size) sediment agglutinated with mucus secretion. The secretion layer was thin and semitransparent. Each tube consisted of a single layer of densely packed black and semi-transparent sand grains that almost completely covered the body of the worm. No shell fragments or foraminiferan tests were included. A few larger grains were also attached but no more than 3 or 4 per tube. In the case of the specimens hidden in complete tubes, only a small fragment of the animal was extracted, leaving most of the polychaete inside. Width of the tube was the same along the entire length. Sediment grain size was also similar at a whole length of the tube (Fig. 1).

Sediment structure at four analyzed stations varied from very fine-grained silt ($39.2 \pm 39.2 \mu\text{m}$) at station BIII to fine-grained sand at station BIV ($126.3 \pm 17.6 \mu\text{m}$). Sediments at station BI can be described as very fine-grained sand ($62.3 \pm 17.6 \mu\text{m}$) while at station BII, very coarse-grained silt ($42.2 \pm 16.5 \mu\text{m}$) (Fig. 2). Therefore, the difference between the substrate available at studied site and grains used for construction of tubes show high degree selectivity (only the fine sand particles were used for tube building).



Fig. 1 *Eulalia picta* inside the tube.

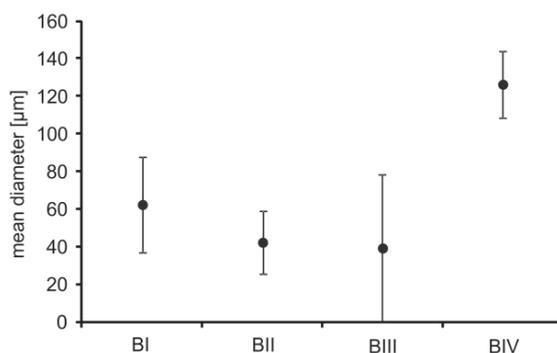


Fig. 2. Mean grain size with standard deviation at four sampling stations.

Discussion

Generally phyllodocids are considered active predators or scavengers, crawling on the bottom surface (Rouse and Plejel 2001; Jumars *et al.* 2015), however like most other polychaete families there are few detailed studies of their biology (*e.g.* Simon 1965; Olive 1975; Emson 1977; Fauchald and Jumars 1979; Jenkins *et al.* 2002; Lee *et al.* 2004). No phyllodocids are reported as tubicolous, although secretion of mucus is characteristic for many members of this family and some of them construct temporary protective cases of mucus that can loosely cover the body of the worm (Ushakov 1974). *Eteone heteropoda* Hartman, 1951 create mucous trails that are adhering sand grains (Simon 1965). Phyllodocids are also known to crawl into the tubes of other polychaetes. In the material from the Admiralty Bay we observed specimens of *Austrophyllum charcoti* (Gravier 1911) inside the tubes of large sabellids (most probably *Perkinsiana littoralis* (Hartman 1967), although the number of such specimens was always very limited. *Perkinsiana* tubes are hard, solid structures and it is easy to crawl into them. *Eulalia picta* was found in thin and delicate mucous tubes. The body of the polychaete perfectly fit into the tube. If they were created by some other sessile tubicolous polychaetes it was probably not so easy to crawl inside them. Hartman-Schröder and Rosenfeldt (1988) already mentioned that *E. picta* can be found in mucus tubes encrusted loosely by sand grains. Nevertheless based on the current observations we cannot speculate about the origin of those tubes.

Our study showed that tubes are constructed of fine sand grains selected from the surrounding bottom sediments. It was demonstrated for some other polychaetes that their ability for selection of particles used for tube building can be quite high, and that they can select the particles smaller or larger than those that dominate in surrounding sediments (Dales 1957; Dufour *et al.* 2008; Noffke

et al. 2009). However, it is worth mentioning that *E. picta* was absent from the near-glacial areas of the Admiralty Bay, where bottom sediments are highly dominated by silt and clay fractions (Siciński 2004; Campos *et al.* 2013). This fact is most probably related to the disturbance caused by a direct inflow of mineral suspension into the areas located in the vicinity of tidewater glaciers that may influence distribution of many animals in polar fjords (Włodarska-Kowalczyk and Pearson 2004; Siciński *et al.* 2011). Nevertheless, it can be also associated with sediment fractions preferred for tube building. Generally, the polychaete community in the outer region of the Ezcurra Inlet is characterized by a much higher number of tube building species (Pabis *et al.* 2015; Pabis and Sobczyk 2015). General morphology and structure of the *E. picta* tubes resembles the tubes of the common Antarctic maldanid *Rhodine intermedia* Arwidsson, 1911 and the owenid *Galathowenia scotiae* (Hartman 1966). Both of those species are also common and abundant in the Admiralty Bay. They dominated at sites that were sampled in our study but were much less abundant in the disturbed inner region of the fjord (Siciński 2004; Pabis and Sobczyk 2015). If that was the origin of the *E. picta* tubes it might prove that this species is highly specialized predator feeding on sessile maldanids or oweniids and uses their tubes as the refugium. The large number of specimens (altogether 26 individuals) that were hidden inside the tubes and earlier observations of Hartman-Schroder and Rosenfeldt (1988) shows that this is not an accidental situation. All tubes looked the same and match the description provided by Hartman-Schroder and Rosenfeldt (1988). The guts of *E. picta* were empty, suggesting carnivorous behaviour. We cannot fully exclude the possibility that *E. picta* is a first known tubicolous phyllocid polychaete, although the current knowledge suggests that this species is highly specialized predator and it is using tubes of other polychaetes which might create temporary protection against other predators.

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