SCANNING ELECTRON MICROSCOPY OF THE PROBOSCIDIAL PAPILLAE OF SOME EUROPEAN GLYCERIDAE

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ABSTRACT

The proboscidial papillae are one of the major identification characters in Glyceridae. Due to their small size, light microscopy very often does not show their full details. Therefore, the proboscidial papillae of five European species of the Glyceridae are described using scanning electron microscopy. All five species show typical papillae with species-specific structures. *Glycera tridactyla* can be distinguished from *G. alba* by the size and structure of the respective "fingernail papillae." Thus, the proboscidial papillae provide a reliable character for species identification when studied by scanning electron microscopy.

The Glyceridae comprise about 55 species (Fauchald, 1977). They have a worldwide distribution, mostly on sandy substrates, from the intertidal to the deep sea. The main diagnostic characters for identification of the species are parapodia (shape and number of pre- and postsetal lobes), branchiae (presence or absence), segmental annulations (bi- or triannulate), shape of the aileron, and the structure of proboscidial papillae. However, branchiae and parapodial lobes are not very reliable characters, as branchiae are retractable in some species and the structure and number of parapodial lobes are sometimes difficult to evaluate, especially in smaller specimens. In general, the ailerons and proboscidial papillae appear to be the most reliable characters for identification. The proboscidial papillae are formed by soft epidermal tissue (Bantz and Michel, 1971), which sometimes bears keratinized structures (e.g., in *Glycera alba* and *G. tridactyla*). The papillae appear in different species-specific types and are more or less densely arranged on the proboscis. We studied the proboscidial papillae of five species from the North Sea and the Mediterranean Sea using SEM-techniques to complete the results of earlier authors obtained by light microscopy (Arwidsson, 1899; Voit, 1911; Hartman, 1950; O'Connor, 1987).

MATERIALS AND METHODS

Specimens were collected during two cruises with R/V SENCKENBERG (1987 and 1990) from various stations in the southern North Sea (*Glycera alba*, *G. celtica*, *G. lapidum*, *G. rouxi*) and in the Mediterranean (Licola, Italy) (1966–1968) (*G. tridactyla*, *G. celtica*). They were fixed with 4% seawater-formaldehyde and later transferred to 70% ethanol. For SEM observations, specimens were dehydrated via a graded ethanol series, critical-point dried using CO_2 and subsequently coated with gold-palladium. Observations were performed with a CamScan CS 24 scanning electron microscope.

RESULTS

In *Glycera alba* (O. F. Müller, 1776), the proboscis is densely covered mainly with typical "fingernail papillae" (Fig. 1a–c). Besides these, conical (Fig. 1c) and digitiform papillae (Fig. 1a) are found. The latter two types are randomly distributed and constitute less than 10% of the total number. All types of papillae show a small ciliated pore near the tip.

Glycera tridactyla Schmarda, 1861, closely resembles G. alba in overall appearance. It even shows the same types of proboscidial papillae. The only differences are the shape of the post-chaetal lobes and the type of fingernail-papillae (O'Connor, 1987). The stalk of these papillae is much shorter in G. tridactyla



Figure 1. Scanning electron micrographs of proboscidial papillae. a–c. *Glycera alba*. d. *G. tridac-tyla*. e, f. *G. celtica*. a. "fingernail papillae" and one digitiform papilla (\rightarrow), posterior view, b. fingernail papillae, anterior view. c. one conical papilla (\rightarrow) and some fingernail papillae, posterior view. d. fingernail papillae, posterior view. e. conical papillae, posterior view and f. small, rounded papilla, posterior view.

and the keratinized "nail" shows a slightly different pattern of ridges. While these ridges run almost parallel from bottom to top in G. *alba*, they converge towards the midline in G. *tridactyla* (Fig. 1d). The papillae of G. *tridactyla* also have a ciliated pore at the tip.

In *Glycera celtica* O'Connor, 1987, the papillae are less numerous and consequently less densely arranged than in all other species studied. Two to three types of papillae can be found: 1. Conical papillae with about eight ridges, which are U-shaped at the bottom and V-shaped towards the top of the papillae (Fig. 1e). 2. Smaller, rounded papillae with a variable number of V-shaped ridges (Fig. 1f). 3. An additional small type of papillae without typical structures can be observed.



Figure 2. Scanning electron micrographs of proboscidial papillae, a. d. *Giycera lapidum*, e, f. *G. rouxi*, a, part of proboscis showing arrangement of papillae (\rightarrow : conical papillae), b, elongate, narrow papillae with undulating lamella, posterior view, e, elongate, narrow papillae with undulating lamella, lateral view, d. conical papilla, subtriangular in cross section, posterior view, e, conical papillae, posterior view, e, conical papillae, posterior view, e, conical papillae, posterior view.

They are rare and may represent undifferentiated papillae. In specimens collected in the Mediterranean (Licola, Italy), papillae of type 1 show a higher number of lamellae (ca. 10–15).

In *Glycera lapidum* Quatrefages, 1865, two types of papillae are found (Fig. 2a): 1. Elongate, narrow papillae with an undulating ridge (Fig. 2b), which appears as a crenulated edge in profile (Fig. 2c). 2. Conical papillae, subtriangular in cross section, with a smooth median ridge (Fig. 2d), arranged in at least 10 longitudinal rows on the proboscis (Fig. 2a). Papillae of type 1 are much more numerous than those of type 2.

Glycera rousi Audouin and Milne Edwards, 1833, shows two types of papillae

in similar high density as in G. *alba*: 1. Conical papillae with three U-shaped ridges (Fig. 2e). 2. Rounded papillae with a semicircular ridge (Fig. 2f). All papillae show a small ciliated pore near the tip.

Our investigations show that the anterior and posterior side of the papillae (in relation to the position of the mouth on the everted proboscis) are shaped differently. The anterior side is smooth in all observed species while the posterior side shows characteristic structures like ridges or a keratinized nail as described above.

DISCUSSION

To date, a number of different types of proboscidial papillae have been described and figured for the Glyceridae and Goniadidae by various authors based on light microscopical observations. The histology of the fingernail-papillae in *Glycera convoluta* (syn. *G. tridactyla*) was studied by Bantz and Michel (1971). According to these authors each papilla consists of a small number of cells including one secretory and two to four sensory cells. The latter are connected to a few cilia at the tip of the papilla and are presumed to be mechanoreceptors (Bantz and Michel, 1972). The products of the secretory cell are probably transported to the tip via small internal canals, which are visible by light microscopy. Histoand biochemical investigations are needed to clarify the nature of the secretions and their possible functions.

As glycerids are carnivorous (Ockelmann and Vahl, 1970), a possible function of the papillae might be to secure a firm grip on the prey either by increasing friction and/or by covering the prey with mucus from the secretory cells. During our investigations it was noted that the anterior and posterior side of the papillae (with respect to the mouth opening) are shaped differently. Only the posterior sides carry specialized structures. This has not been described before because the orientation of papillae on prepared microscope slidemounts is accidental and can hardly be influenced during preparation.

Due to the small size of the papillae, the limited depth of field of light microscopy often proves to be insufficient to clarify their detailed structures (Fauchald, 1977), and has therefore led to some misinterpretations by earlier authors. Hartmann-Schröder (1971) for example did not mention the bilobed tip and the ridges on the nail of the fingernail papillae for Glycera alba; for G. rouxi ridges were figured as surrounding the whole papillae in type 1 and several concentric ridges were also figured for papillae of type 2 (Hartmann-Schröder, 1971). For G. celtica papillae of type 1 were described as having "rings," type 2 without any special structures (O'Connor, 1987). Proboscidial papillae of Glycera convoluta Keferstein, 1862, as described by Hartman (1950) based on material collected from California are very specific in bearing a capelike sheath. Thus O'Connor's (1987) view based on material from the NE-Atlantic and the Mediterranean that G. convoluta is synonymous with G. tridactyla needs reexamination. SEM provides a greater depth of field, revealing many small details, which are beyond the resolution of light microscopy. Thus proboscidial papillae studied with SEM provide reliable characters for the identification of Glyceridae species and misconceptions based on light microscopy can be avoided as has also been shown recently by Smith, et al. (1995) for the goniadid Glycinde armigera.

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