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Thoracic spiracular gill structure of *Lipsothrix* (Diptera, Limoniidae) in Britain described from scanning electron micrographs

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Abstract

Recent ecological surveys have resulted in rearing examples of the five British members of the genus *Lipsothrix* (Diptera, Limoniidae). These have provided samples for investigating the morphology of their thoracic spiracular gill by the use of scanning electron microscopy. This reveals unique characteristics for the five species available. The differing structures may relate to varying larval habitats. A species identification key for pupae is based on features of the plastron. Information from the juvenile stages supports the placing of *Lipsothrix* in the Limoniinae.

Key words: plastron, saproxylic, aquatic

Introduction

The thoracic spiracular gills of the pupae, often referred to as pupal horns (Fig. 1), of members of the genus *Lipsothrix* (Diptera; Limoniidae) were described in detail first by Hinton (1955) using light microscopy and some transmission electron microscope work. In *Lipsothrix* they achieve the greatest level of complexity of these structures to be found in the family (Hinton, 1967). These remarkable features of the pupae in which plastron structures are also present are found in a number of genera of the limoniids. The gills provide for gaseous exchange between the insect and its environment through fine structures of the plastron in the membrane. They function for both oxygen transfer while submerged and water retention when exposed to air (Hinton, 1955). The plastron lines (Hinton, 1957; p.113) are clearly visible using a scanning electron microscope, marked by rows of punctures (e.g., Fig. 2). Plastrons are found mostly in insect stages associated with well-aerated water but also prone to fluctuating levels (Hinton, 1981).

Later, Hinton (1967) was able to use a scanning electron microscope, then a newly invented machine, and could see more detail in order to better understand the structure (Fig. 18). His diagrammatic reconstruction based on these further observations accords very closely to the image produced by a more sophisticated modern machine (Fig. 17). He regarded the thoracic gills of *Lipsothrix* as the most complex of any such structures that were available for study. Several other

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