



<http://dx.doi.org/10.11646/zootaxa.3619.4.1>

<http://zoobank.org/urn:lsid:zoobank.org:pub:3D29B631-A466-42A6-95DD-88BE66F6E3BF>

Development sites and early stages of eleven species of Clusiidae (Diptera) occurring in Europe

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Abstract

Two hundred and ninety-six rearing records of 11 clusiid species (Diptera, Clusiidae) were obtained from 8 tree species in England, Finland, France, Norway, Russia and Scotland, mainly during the period 1994 to 2004. Larvae and puparia were found between annual layers of whitewood (sapwood and heartwood) of wet, decay-softened, dead wood. Levels of host tree specificity were low, most species were reared from 2–4 host trees, maximum 6. The clusiid larva is distinguished by: a small, translucent head skeleton with an obliquely-shaped apex to the artium; a pseudocephalon fixed in an inverted position except for an external, flattened section bearing the antennomaxillary organs; a spherical prothorax with a truncate rim embedded with sensilla and, a wedge-shaped anal segment bearing a pair of conspicuous, sclerotised, red-brown hooks on the inner margins of which are the posterior spiracular plates. Many of these features support a distinctive feeding mechanism, spot-sucking of biofilm coating wet, decaying whitewood. Early stage characters support the results of recent supraspecific taxonomic and systematic investigations, such as the synonymy of *Paraclusia* Czerny under *Clusia* Haliday and the recognition of species groups in *Clusiodes* Coquillett. Based on early stages, supraspecific clusiid taxa are easily recognised but at species level, differences are relatively fine-grained and minor. A key is provided to identify puparia of species reared in this study.

Key words: Druid fly, rearing, host tree, larva, puparium, morphology, head skeleton, pseudocephalon, trophic structures, locomotion, respiration

Introduction

Druid flies or clusiids (Diptera, Clusiidae) are slender, often colourful, higher cyclorrhaphan flies up to 6mm in length and distinguished, among other characters, by the possession of an angular extension on the outer margin of the antennal pedicel and an apico-dorsal arista (Lonsdale and Marshall 2011). North temperate clusiids frequent woodland where adults can be found assembling on dead wood which is the development site of the early stages (Tuomikoski 1933, Roháček 1995, Greve 2005, Lonsdale and Marshall 2011). Over 450 species are known worldwide of which about 30 occur in the Palearctic, with most European species belonging to the primarily north temperate genera *Clusia* Haliday and *Clusiodes* Coquillett (Sasakawa 1998 Lonsdale *et al.* 2010).

The Clusiidae were included in the superfamily Opomyzoidea by McAlpine (1989) however, the validity of this taxon now seems doubtful (Winkler *et al.*, 2009, Lonsdale *et al.*, 2010). In the molecular analyses of Wiegmann *et al.*, (2011), the Clusiidae share a common ancestor with the Pallopteridae + Neurochaetidae, the former of which is not an opomyzoid family. The taxonomy, systematics and phylogenetics of the Clusiidae have been revised in recent years and are now better understood (Lonsdale and Marshall, 2006, 2007, 2008, 2010, Lonsdale *et al.*, 2010). However, as so frequently in the study of Diptera, these advances were made on adult characters without inclusion of early stages.

Although clusiids have often been reared (Tuomikoski 1933, Caloren and Marshall, 1998, Ferrar 1987, Sasakawa 1998), the early stages of many species remain unknown and their larvae and puparia have not been assessed in sufficient detail to enable comparisons between taxa. Furthermore, larval trophic structures are poorly known and understood. For example, the clusiid head skeleton figures of *Clusiodes gentilis* (Collin) (Séguy 1934)