



Description of the adult male elongate hemlock scale, *Fiorinia externa* Ferris (Coccoidea: Diaspididae), with notes on the seasonal development of the species on eastern hemlock, *Tsuga canadensis* (L.) Carrieré (Pinaceae), in the southern Appalachian region (U.S.A.).

PARIS LAMBDIN¹, CHRISTOPHER HODGSON² & JEROME GRANT¹

¹Department of Entomology and Plant Pathology, The University of Tennessee, Knoxville, TN 37996. E-mail: plambdin@utk.edu

²Department of Biodiversity and Biological Systematics, The National Museum of Wales, Cathay's Park, Cardiff, CF10 3NP, UK. E-mail: hodgsoncj@Cardiff.ac.uk

Abstract

The adult male of *Fiorinia externa* Ferris is described for the first time. Its morphology agrees with that of previously described adult males in the tribe Diaspidini, and suggests a close affinity to *Pseudaulacaspis*. *F. externa* has two complete overlapping generations per year on the needles of eastern hemlock, *Tsuga canadensis* (L.) Carrieré, in the eastern Tennessee (USA) southern Appalachians. Adult females (both gravid and non-gravid) and first-instar nymphs were the dominant overwintering stages, although all stages apart from the adult males were present throughout the winter months. Adult males began emerging in mid March with emergence peaks in mid April to early May and again in mid to late September.

Key words: relationships, taxonomy, life cycle

Introduction

The Diaspididae is a fairly homogenous group, and generally considered to be the most advanced and specialized family of scale insects (Coccoidea). They form the most speciose family of Coccoidea, with about 2,400 species in 380 genera. Diaspidids are characterized by each stage secreting a detachable cover, all of which are retained and combined to form adult female test. A ventral cover is also present in some species. In addition, the adult females of some genera remain within the cast skin of the 2nd instar and these are described as pupillarial. *Fiorinia* is a pupillarial genus in the subfamily Diaspidinae. It has a worldwide distribution but most species are Oriental; all five species currently known from the USA are introduced.

Fiorinia was placed in its own tribe (Fioriniini) by MacGillivray (1921), whereas Brues & Melander (1932) considered it to be a subfamily (Fioriniinae). Borchsenius (1965) considered this group to be a tribe within the Diaspididae, perhaps most closely related to Chionaspidini. Recently, Morse & Normark (2006) published a phylogenetic analysis of 89 species of armoured scale insects, belonging to 47 genera and five tribes, based on Bayesian and parsimony analyses of 705 base pairs of Elongation Factor 1 α and 660 base pairs of 28S. This analysis included four species of *Fiorinia* (including *F. externa*). The four species formed a clade with *Ichthyaspis ficicola* (Takahashi), sister to three species of *Pseudaulacaspis*. This clade fell within the Diaspidini in both the parsimony and consensus Bayesian phylograms.

The exotic elongate hemlock scale (EHS), *Fiorinia externa* Ferris, is a significant pest of eastern hemlock, *Tsuga canadensis* (L.) Carrieré, throughout the eastern U.S.A, often co-existing with the hemlock woolly adelgid, *Adelges tsugae* Annand (McClure 1980a). The host range of EHS includes species of *Abies*, *Cedrus*,