

A review of the endemic Hawaiian Drosophilidae and their host plants

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Abstract

The Hawaiian Drosophilidae is one of the best examples of rapid speciation in nature. Nearly 1,000 species of endemic drosophilids have evolved *in situ* in Hawaii since a single colonist arrived over 25 million years ago. A number of mechanisms, including ecological adaptation, sexual selection, and geographic isolation, have been proposed to explain the evolution of this hyperdiverse group of species. Here, we examine the known ecological associations of 326 species of endemic Hawaiian Drosophilidae in light of the phylogenetic relationships of these species. Our analysis suggests that the long-accepted belief of strict ecological specialization in this group does not hold for all taxa. While many species have a primary host plant family, females will also oviposit on non-preferred host plant taxa. Host shifting is fairly common in some groups, especially the *grimshawi* and *modified mouthparts* species groups of *Drosophila*, and the *Scaptomyza* subgenus *Elmomyza*. Associations with types of substrates (bark, leaves, flowers) are more evolutionarily conserved than associations with host plant families. These data not only give us insight into the role ecology has played in the evolution of this large group, but can help in making decisions about the management of rare and endangered host plants and the insects that rely upon them for survival.

Key words: Hawaiian, Drosophilidae, taxonomy

Introduction

The Hawaiian Drosophilidae is a large, morphologically diverse radiation, consisting of perhaps as many as 1,000 species placed in two main lineages, the Hawaiian *Drosophila* and the genus *Scaptomyza* (Kaneshiro, 1997). The Hawaiian *Drosophila* is further divided into a number of species groups: *antopocerus*, *modified tarsus*, *ciliated tarsus* (these three form a single clade, referred to here as the AMC clade), *modified mouthparts*, *picture wing*, and *haleakalae* (Figure 1, after Bonacum, 2001; O'Grady, 2002; Throckmorton, 1966). The genus *Scaptomyza*, which includes both Hawaiian and continental taxa (Bonacum, 2001) is divided into a series of 21 subgenera, ten of which (*Alloscaptomyza*, *Bunostoma*, *Celidosoma*, *Elmomyza*, *Engiscaptomyza*, *Exalloscaptomyza*, *Grimshawomyia*, *Rosenwaldia*, *Tantalia*, and *Titanochaeta*) contain Hawaiian species. The Hawaiian Drosophilidae are also ecologically diverse, utilizing 34 of the 87 families of native flowering plants (Wagner, *et al.*, 1999), as well as various ferns and fungi (Heed, 1968), as larval breeding hosts. In contrast to most continental Drosophilidae, many endemic Hawaiian species are highly host plant specific (Heed, 1968; Montgomery, 1975). Therefore, the persistence of populations or species is intimately linked to that of their breeding hosts. Although factors such as predation by alien wasps are important for some taxa, particularly the *picture wing* species (Carson, 1986; Foote & Carson, 1995), in most cases conservation of the *Drosophila* depends on maintaining sufficient host plant populations for oviposition and larval substrate.