



Drosophila conspicua. Photo: Karl Magnacca.

Terrestrial Invertebrates

Pomace flies

Drosophilidae (Diptera)

Family Includes:

12 Genera

2 Native Genera

12 Introduced Genera

598 Species

566 Endemic Species

32 Introduced Species

GENERAL INFORMATION: The family Drosophilidae contains roughly 4,000 described species, approximately 25 percent of which are endemic to the Hawaiian Islands (Markow and O'Grady 2006). This large radiation accounts for 10 percent of all Hawaiian insects and is the best-studied native Hawaiian lineage. Extensive investigations into the taxonomy, genetics, ecology, and evolutionary biology of Hawaiian Drosophilidae have been made over the past 50 years (Hardy 1965; Spieth 1980).

The Hawaiian Drosophilidae is the oldest lineage of native plants or animals known and is estimated to have colonized the Hawaiian islands about 25 million years ago (Russo et al. 1995). Soon after arriving in the Hawaiian islands, this lineage split into two distinct genera, *Drosophila* and *Scaptomyza* (O'Grady and DeSalle 2008; O'Grady et al. 2011; Lapoint et al. 2013), each of which has diversified extensively in Hawai'i.

The Hawaiian *Drosophila* is divided into the picture wing, modified mouthpart, antopocerus, modified tarsus, ateledrosophila, nudidrosophila, haleakalae, and rustica species groups (O'Grady et al. 2010). Most species are saprophagous and feed on yeasts and fungi present in decaying plant material (Ort et al. 2012). Hawaiian *Drosophila* have evolved a close association with approximately 40 percent of the native Hawaiian plant families, particularly Campanulaceae and Araliaceae, and rely on these hosts to complete their life cycles (Magnacca et al. 2008). *Drosophila* have specialized in two major ways, with species groups showing preference for a specific plant part (e.g., leaves, fruit, flowers, stems, bark, sap flux) of that host plant, and individual species being specific to a given native plant family. This subdivision of available resources is one potential explanation for the large numbers of Hawaiian *Drosophila* species. In addition to fine-scale ecological specialization, most Hawaiian *Drosophila* species also exhibit some degree of sexual dimorphism. Males often use specialized structures, including legs, antennae, mouthparts, and wings in elaborate courtship displays.

The genus *Scaptomyza* is the sister group to the Hawaiian *Drosophila* and were the result of the same original colonization event. *Scaptomyza* is divided into 21 subgenera; ten are endemic to Hawai'i and the remainder are derived from several lineages that escaped from Hawai'i and diversified on the mainland and other island groups (O'Grady and DeSalle 2008; Lapoint et al. 2013). While most members of *Scaptomyza* are classified as saprophages and have developed

close associations with native plant families (Magnacca et al. 2008), there are also some unique taxa that have adapted to be parasites of endemic spiders (subgenus *Titanochaeta*) or herbivores on living plant tissue (subgenera *Scaptomyza* and *Parascaptomyza*).

Leblanc et al. (2009) reported on 32 Drosophilidae species introduced to Hawai'i through human activity. They listed 12 genera (*Amiota*, *Cacoxenus*, *Chymomyza*, *Dettopsomyia*, *Drosophila*, *Hirtodrosophila*, *Leucophenga*, *Mycodrosophila*, *Scaptodrosophila*, *Scaptomyza*, *Stegana*, *Zaprionus*) with non-native species, including mainland relatives of *Drosophila* and *Scaptomyza*. The impact of many of these non-native species is unknown. Only one species, *Drosophila suzukii* (spotted wing *Drosophila*) is known to be an agricultural pest of fruit trees, strawberries, and cane fruits.

DISTRIBUTION: Drosophilidae are ubiquitous in Hawaiian ecosystems. Native species of *Drosophila* and *Scaptomyza* were historically found almost anywhere there are native plants, from close to sea level to above the tree line on the highest volcanoes. The introduction of ants and other alien insects has resulted in considerable range contraction, especially at lower elevations; they are now found primarily in mesic to wet forest between 460 and 1,830 meters (1,500 and 6,000 feet). Introduced taxa are generally found in association with humans or with the fruits of non-native plants and only a few species are regularly encountered in intact native rainforest or mesic forest habitats.

ABUNDANCE: Population sizes differ by species and range from common (hundreds of thousands of breeding individuals) to extremely rare. A total of 15 species of Hawaiian *Drosophila* are currently listed as endangered (treated separately), and at least another 16 species in the picture wing group have not been seen in 40 years, despite regular surveys across the islands. However, five that had been in the latter category have been rediscovered since 2013. Some species show seasonal abundance that may be linked to resource availability (e.g., decomposing leaves), while others undergo unpredictable localized booms due to rare but large breeding resources (e.g., a treefall and associated rotting bark).

LOCATION AND CONDITION OF KEY HABITAT: Species diversity is highest in native-dominated rainforest and mesic forest habitats throughout the Main Hawaiian Islands.

THREATS:

- Habitat loss and degradation. Habitat is lost to fire, conversion for agriculture, logging, and grazing, and disturbed by a suite of non-native ungulates and the introduction of invasive plants.
- Predation. Introduced insect species, particularly *Vespula* wasps and ants, prey on these flies.
- Competition. Introduced saprophagous insects, especially crane flies (Limoniidae: *Libnotes* spp.) and stilt-legged flies (Neriidae), compete with Drosophilidae.

CONSERVATION ACTIONS: The goals of conservation actions are not only to protect current populations and key breeding habitats, but also to establish additional populations, thereby reducing the risk of extinction. In addition to common statewide and island conservation actions, specific management directed toward flies should include the following:

- Conduct surveys to determine the distribution and abundance of known Drosophilidae species and to document and identify new species.

- Preserve, maintain, and restore habitats supporting existing populations.
- Initiate studies on life history, distribution, and critical habitats to better direct conservation measures.

MONITORING: Continue surveys to monitor the status of known populations in order to assess their stability and trends.

RESEARCH PRIORITIES:

- Survey for additional, new populations.
- Survey to determine status of species believed to be extinct.
- Conduct studies to document the biology, habitat requirements, and life history of poorly known native species.

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