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Parafreutreta regalis Cape-ivy gall fly

Parafreutreta regalis is a biological control agent approved in the USA for release against *Cape-ivy*.

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Diptera	Flies
Family	Tephritidae	Fruit flies
Genus	<i>Parafreutreta</i>	
Species	<i>Parafreutreta regalis</i> Munro	Cape-ivy gall fly

DESCRIPTION

Eggs are elliptical, opaque white, and ½ mm long (Fig. 1a). Larvae are cylindrical and up to 4 mm long. They are white, turning yellowish with maturity, and they lack an obvious head capsule (Fig. 1a). Pupae are concealed in a barrel-shaped puparium up to 3½ mm long and pale yellow with dark ends (Fig. 1a). Adults have tan bodies and wings with elaborate brownish-black markings (Fig. 1b,c). Their eyes have a reddish hue, with a multicolor metallic sheen. Males are 3–4 mm long; females are longer due to their ovipositors.

LIFE CYCLE

Females lay eggs in the growing tips of Cape-ivy vines a day or two after emergence. They lay their eggs in tightly packed bundles in a single vine tip or node, depositing an average of 61 eggs during their lifetime. The presence of larvae triggers the formation of a single-chamber gall (Fig. 2a) in the plant tissue surrounding the larvae. Several larvae often live communally within each gall, feeding on galled plant tissue. Larvae develop through three instars. Just prior to pupation, which occurs within galls, a late third-instar larva chews a

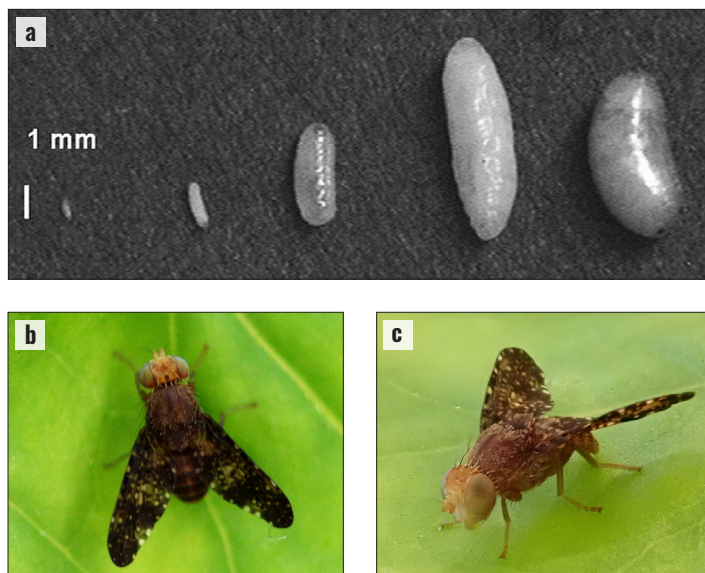


Figure 1. *Parafreutreta regalis* (a) egg, larval instars 1–3, pupa (left to right); (b,c) adult (a: adapted from Balciunas and Mehelis 2010; b,c: S.L. Portman, USDA-ARS Invasive Species & Pollinator Health Research Unit)

passage through the gall wall without puncturing the external cuticle, leaving behind a “window” on the outside of the gall (Fig. 2b). Following pupation, adult flies break through the window (Fig. 2c) and exit the gall head-first. The entire life cycle requires ~50 days under greenhouse conditions and up to three months or more under field conditions. The life cycle timing is also water and temperature dependent, requiring an additional 1–2 weeks during winter and 1–2 weeks less in summer; insect development is delayed by about one week in water-stressed plants. Drought-induced wilting, as is typical at dry sites in summer, reduces fly gall formation and reproduction. Under laboratory conditions, no overwintering or diapause has been observed. It is estimated there could be up to seven field generations a year in southern California, but likely fewer (2–4) in northern California.

DAMAGE

Egg and larval presence causes the formation of a gall (Fig. 2). Galls act as metabolic sinks, diverting resources away from normal plant development. This does not kill existing plants; however, attacked plants are significantly stunted, growing shorter vines, fewer nodes, and smaller leaves.

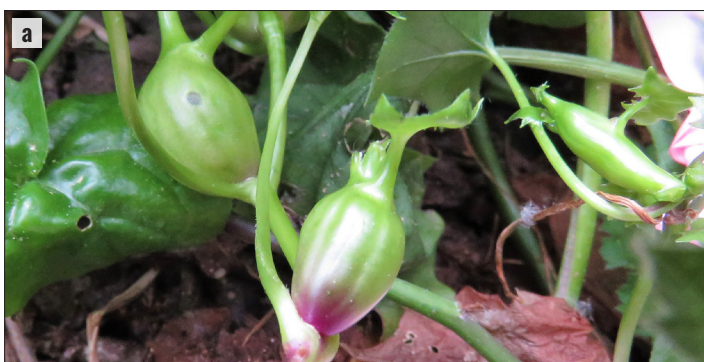


Figure 2. *Parafreutreta regalis* larvae trigger the formation of a gall (a). Late third-instar larvae chew a “window” (b) in the gall wall prior to pupating. After pupation, adults break through the window (c) and exit the gall. (a–c: S.L. Portman, USDA-ARS Invasive Species & Pollinator Health Research Unit)

FIELD IDENTIFICATION

Adult *Parafreutreta regalis* may be observed on Cape-ivy foliage throughout the year. Egg and larval presence causes obvious swollen galls to form in Cape-ivy stems (Fig. 2), and the presence of galls is the easiest way to diagnose the presence of this species. There are 3–4 adults per gall on average, but up to 20 in extremely rare cases.

PREFERRED HABITAT

Due to recent field establishment of the Cape-Ivy gall fly, its habitat preferences are unknown.



Figure 3. *Parafreutreta regalis* distribution in North America (Portman and Moran 2020, Winston et al. 2021)

HISTORY AND CURRENT STATUS

Parafreutreta regalis is native to South Africa. Flies were released in California, USA beginning in 2016. Through 2020, multiple releases were made all along the California coast. Field establishment has been confirmed at five release sites and additional sites are probable (Fig. 3). Gall density has increased 40-fold at some release sites, though it is still too early to determine the fly’s overall abundance and impact on Cape-ivy.

NONTARGET EFFECTS

None reported

Secusio extensa Madagascar fireweed moth

Secusio extensa is a biological control agent approved and released in Hawai’i, USA for control of Madagascar fireweed, *Senecio madagascariensis*, but it quickly spread to Cape-ivy.

SYNONYMS

Galtara extensa Butler

CLASSIFICATION

RANKING	SCIENTIFIC NAME	COMMON NAME
Kingdom	Animalia	Animals
Phylum	Arthropoda	Arthropods
Class	Insecta	Insects
Order	Lepidoptera	Butterflies and moths
Family	Erebidae	Erebid moths
Genus	<i>Secusio</i>	
Species	<i>Secusio extensa</i> (Butler)	Madagascar fireweed moth

DESCRIPTION

Eggs are dome-shaped and less than 1 mm in diameter. They are creamy white at first but turn black one day before larvae hatch (Fig. 4a). There are five larval instars. First instar larvae are translucent white (Fig. 4b), becoming gray with black spots in middle instars (Fig. 4c) and turning black with tan legs by the fifth instar (Fig. 4d). All instars are covered in long hairs. Fifth instar larvae can be up to 26 mm long and spin a light silken cocoon sprinkled with larval hairs in which to pupate (Fig. 4e). Pupae are reddish brown with dark stripes (Fig. 4e). Adults are beige with light brown and white mottling and several small dark spots at the top of their forewings (Fig. 4f). At rest, they hold their wings roof-like

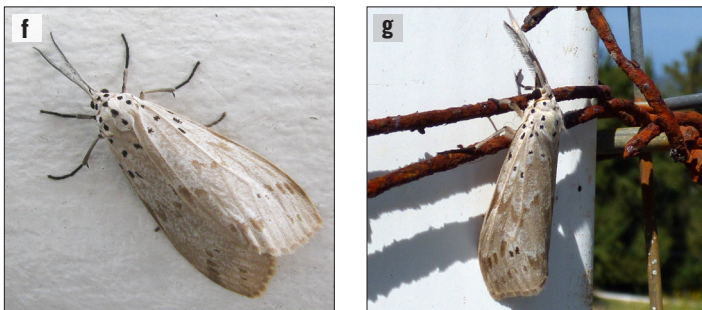
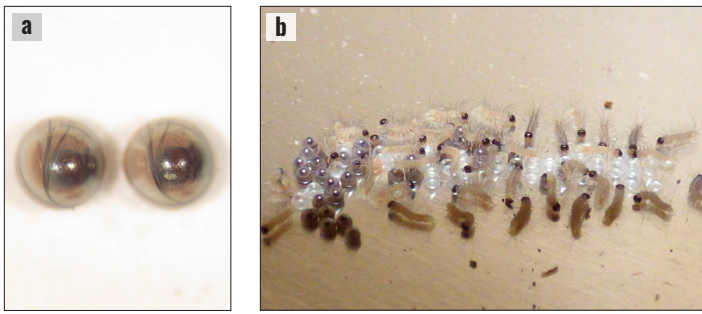


Figure 4. *Secusio extensa* (a) eggs; (b) eggs and early instar larvae; (c) mid-instar larva; (d) fifth instar larva; (e) pupae and silken cocoons; (f,g) adult (a–g: Forest & Kim Starr, Starr Environmental, CC BY 4.0)

over their bodies (**Fig. 4g**). Adults have dark bulging eyes and comb-like antennae.

LIFE CYCLE

This species is continuously brooded, creating frequent overlap of generations. Female adults lay eggs singly, or in groups of up to 62, typically on the undersides leaves. Larvae feed on leaf tissue through all five instars; fifth instar larvae also strip the outer layers of stems. At the end of the fifth instar, larvae spin a light silken cocoon in which to pupate

(**Fig. 4e**). Emerging adults are largely nocturnal. Under laboratory conditions, there are up to nine generations per year.

DAMAGE

Larval feeding (**Fig. 5a**) completely defoliates Cape-ivy (**Fig. 5b**) and sometimes severs flower heads when late instars strip the outer layers off plant stems. Though this may alter seed production, it does not kill established plants. Defoliated



Figure 5. *Secusio extensa* defoliating Cape-ivy (a) leaves and stems; (b) plants (a,b: Forest & Kim Starr, Starr Environmental, CC BY 4.0)

vines re-grow new foliage within a few months of attack.

FIELD IDENTIFICATION

Although adults are typically nocturnal, they may still be observed during the day resting near or on Cape-ivy leaves. Their beige coloring with small dark spots and their comb-like antennae help differentiate them from other moths that might be present in the area. Defoliated Cape-ivy leaves (**Fig. 5a,b**) may indicate Madagascar fire weed moth larvae are present. However, other species may also cause similar feeding damage to Cape-ivy leaves, so observing larvae is the most reliable means for confirming establishment at the site. Larvae are hairy and range from translucent white to gray with black spots to black with tan legs (**Fig. 4b–d**), depending on the stage of development.

PREFERRED HABITAT

Secusio extensa can survive across a wide range of elevations and precipitation regimes and has been found throughout Maui and Hawai'i Island where Cape-ivy is present.

HISTORY AND CURRENT STATUS

Moths were sourced from Madagascar and originally released on Madagascar fireweed, *Senecio madagascariensis*, on Maui and Hawai'i Island in 2013 but quickly spread to Cape-ivy on both islands (**Fig. 6**). It can be found in limited numbers on Madagascar fireweed, but it prefers Cape-ivy, on which the moth is widespread and abundant. Larvae completely defoliate Cape-ivy. Defoliation events do not kill established

Cape-ivy plants, but they give native and more desirable vegetation some time to recover before the smothering Cape-ivy vines push out new foliage. As Cape-ivy vines re-grow, moth populations increase as well.

NONTARGET EFFECTS

In addition to its preferred targets Cape-ivy and Madagascar fireweed, limited feeding has also been observed on the exotic and weedy *Crassocephalum crepidioides* and the exotic but cultivated *Gynura bicolor* in Hawai'i.



Figure 6. *Secusio extensa* distribution on Cape-ivy in the USA (Winston et al. 2021)

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SUGGESTED CITATION

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