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Chalcoela Moths: Pegasus Chalcoela, *Chalcoela pegasalis* Walker and Sooty-Wing Chalcoela, *Chalcoela iphitalis* Walker (Insecta: Lepidoptera: Crambidae)[1]

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The Featured Creatures collection provides in-depth profiles of insects, nematodes, arachnids and other organisms relevant to Florida. These profiles are intended for the use of interested laypersons with some knowledge of biology as well as academic audiences.

Introduction

Chalcoela is a genus of unusual predatory moths that occur across North America and the Caribbean. Pegasus Chalcoela, *Chalcoela pegasalis* (Walker, 1859) (Figure 1) occurs in the southeastern United States and in the Caribbean, while Sooty-wing Chalcoela, *Chalcoela iphitalis* (Walker, 1859) (Figure 2) is more widespread, but has not been found in the peninsular Florida or Georgia, and there are only a few records for the Carolinas. These two closely related species have remarkable and similar life histories, as they are predators of paper wasps such as *Polistes*, which is a feature unique for this subfamily (Solis and Adamski, 1998).

Figure 1. Pegasus Chalcoela, *Chalcoela pegasalis*. Credit: Andrei Sourakov, UF/IFAS

Figure 2. Sooty-wing Chalcoela, *Chalcoela iphitalis*. Credit: Andy Reago and Chrissy McClarren, CC

Synonymy

***Chalcoela pegasalis*:**
Cataclysta pegasalis Walker, 1859
Cataclysta egressalis Walker, 1866
Cataclysta principalis Walker, 1866
Cataclysta robinsonii Grote, 1871
Chalcoela discedalis Möschler, 1890

***Chalcoela iphitalis*:**
Cataclysta iphitalis Walker, 1859
Chalcoela aurifera Zeller, 1872

Distribution

Chalcoela pegasalis was described from Jamaica, is found in Puerto Rico and on the island of Hispaniola. On the continent, *Chalcoela pegasalis* occurs across most of the eastern United States. Common in peninsular Florida, it is recorded as far west as Texas-Louisiana border, and as far north as southern Indiana and Delaware (Wildspecies.ca, 2014; iNaturalist, 2025a).

Chalcoela iphitalis is found throughout the remainder of the United States, as well as in southern Canada and Mexico (iNaturalist, 2025b). The ranges of the two species overlap significantly (Figure 3). Despite their similarity, the two species are genetically distinct (Sourakov and Grishin, unpublished), which probably supports their reproductive isolation in the zone of sympatry.

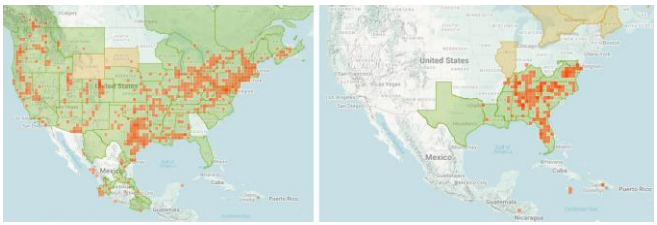

Figure 3. Distributions of *Chalcoela iphitalis* (left) and *Chalcoela pegasalis* (right).
Credit: Maps generated by iNaturalist (2025a, b)

Description

Eggs

The yellow eggs are oval and miniscule, and the chorion is translucent (Figure 4).

Figure 4. Eggs discovered while examining a dead *Chalcoela pegasalis* (Walker) specimen.
Credit: Vera Miskimen, UF/IFAS

Figure 5. Larva of *Chalcoela iphitalis* (Walker).
Credit: Jim McCormac, used with permission

Larvae

Larvae are reclusive, and all instars live inside wasp nest cells. They spin tough webbing that is difficult to tear apart, potentially protecting themselves from attacks by wasps (Buck, 2016).

It takes four weeks for the moths to develop at 22°C (71.6°F) (Nacko and Henderson, 2017), so approximately three weeks are spent in the caterpillar stage. While the caterpillars' means of evading wasp attack are unclear, McCormac (2017) suggests that mature *Chalcoela iphitalis* caterpillars are similar in appearance to the wasp larvae, thereby eluding notice as intruders. However, it remains to be determined whether there is additional chemical crypsis at work, as in the case of predatory Lycaenidae larvae living in ant nests (e.g., Pierce and Dankowicz, 2022).

Nacko and Henderson (2017) described feeding damage to a large mature wasp larva by a small caterpillar of *Chalcoela iphitalis*, and this observation therefore suggests that the moths are predators rather than parasitoids. Thus, even though these moths are frequently portrayed in literature as "parasites," *Chalcoela* moths have apparently turned the table on the predatory wasps and become predators of wasp immatures.

Figure 6. Larva of *Chalcoela iphitalis* (Walker) that develops inside a *Polistes* wasp nest in Ohio.
Credit: Jim McCormac, used with permission

Figure 7. *Polistes* nest after it was parasitized by numerous *Chalcoela pegasalis* (Walker).
Credit: Andrei Sourakov, University of Florida

Figure 8. Cocoon and frass of *Chalcoela pegasalis* (Walker) next to a dead wasp inside the *Polistes* nest.
Credit: Andrei Sourakov, UF/IFAS

Figure 9. Cocoon of *Chalcoela pegasalis* (Walker) extracted from the nest.
Credit: Andrei Sourakov, UF/IFAS

Pupae

Pupation occurs within a tubular cocoon that is spun inside paper wasp nest cells (Figures 8 and 9).

Adults

Adult moths are small and distinctly patterned, with a wingspan of 14 mm–20 mm (~1/2 in–3/4 in). There is little or no sexual dimorphism.

The forewings of *Chalcoela pegasalis* are reddish brown, with a white band of scales on the antemedial and postmedial lines, with the median region between them containing speckled gray scales. The hindwing is speckled gray with a patch of white scales bordering a metallic black strip of scales along the lower median edge of the wing.

While the hindwings of *Chalcoela iphitalis* are similar to those of *Chalcoela pegasalis*, the forewing coloration is quite diagnostic: they are rusty orange with a more extensive speckled gray pattern (Figures 1, 2, 10, and 11).

From the side view, the wings are upturned in live moths, with the hindwings held higher than the forewings (Figures 2 and 12). The hindwing spots likely mimic the eyes of small jumping spiders such as *Habronattus* (Salticidae) (Hill et al., 2019).

Figure 10. *Chalcoela pegasalis* (Walker) specimens and the *Polistes* nest found in Gainesville, Florida, from which they emerged.
Credit: Andrei Sourakov, UF/IFAS

Figure 11. Chalcoela iphitalis (Walker) specimen from Larimer Co., Colorado. Collection of the Florida Museum of Natural History.
Credit: Andrei Sourakov, UF/IFAS

Figure 12. Resting position of *Chalcoela pegasalis* (Walker).
Credit: Andrei Sourakov, UF/IFAS

Figure 13. Hindwing spots of *Chalcoela pegasalis* (Walker) resembling spider eyes.
Credit: Andrei Sourakov, UF/IFAS

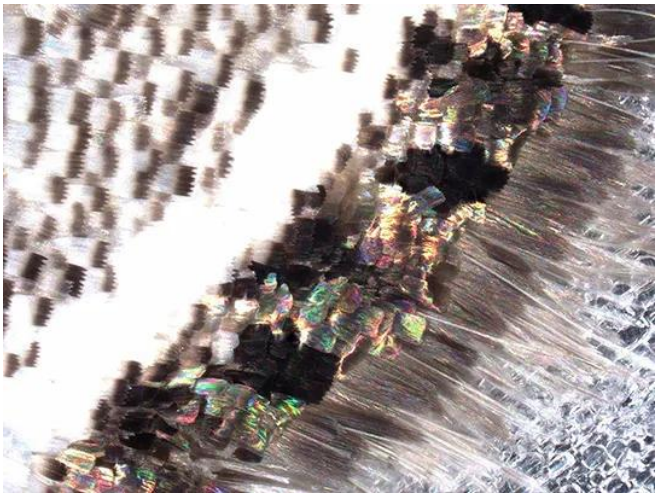

Figure 14. Metallic scales forming shiny hindwing spots of *Chalcoela pegasalis* (Walker).
Credit: Andrei Sourakov, UF/IFAS

Life Cycle

Development time from egg to adult during the warmer seasons of the year is approximately four weeks (Nacko and Henderson, 2017). Multiple generations can occur each year, with larvae overwintering until spring. Adult flight tends to occur from April through October in the United States. Buck (2016) illustrated a nest of *Polistes apachus* infested by *Chalcoela iphitalis*, demonstrating that a cell with a single wasp pupa may result in several moth cocoons. However, Nacko and Henderson (2017) suggest that one moth caterpillar destroys, on average, one immature wasp, and sometimes moves sideways into a neighboring cell if it runs out of food.

Adults typically emerge at night, with mating occurring shortly after emerging into the early morning hours (Nelson, 1966). Moths do not interact with one another beyond the initial mating period. Females lay eggs at night on wasp larvae and pupae (Hodges, 2002). Adults are short-lived, between 7 and 14 days. We did not observe them feeding or drinking in captivity, despite offering them sponges soaked in sugar water.

Main Hosts

Chalcoela larvae do not feed on plants; instead, larvae are generalist feeders on many *Polistes* wasp species. Most host taxa are *Polistes* species native to North America, but the moths have been observed infesting nests of invasive species such as *P. dominulus* (Madden et al., 2010). Female moths have been observed to lay eggs on exposed nests, such as those built on buildings, at a higher rate than concealed nests. Larval *Chalcoela pegasalis* will target larvae and pupae of *Polistes* wasps but ignore eggs (Nelson, 1966).

There are several studies of these predator/prey associations, mostly conducted by wasp researchers. In northern Georgia, for example, 5% of *Polistes metricus*

nests were found to have been attacked by *Chalcoela pegasalis* (Hodges et al., 2003). These authors found that the more advanced the stage of development of the immatures inside a nest, the more likely it is to be infested. According to sources cited in that study, *Chalcoela pegasalis* lays eggs on the larvae or pupae of *Polistes*, and these occurrences are frequent, with around 10% of *Polistes annularis* and *Polistes fuscatus* colonies infested by *Chalcoela pegasalis* in Missouri, for example.

The frequencies of predation by *Chalcoela pegasalis* on *Polistes* nests (*P. crinitus*, *P. dorsalis*, and *P. major*) were studied in Jamaica by Starr and Nelson (2015). On the campus of the University of the West Indies, numerous nests of all three species could be collected from the buildings, all presumably equally exposed to the moths. Despite that, *P. crinitus* colonies experienced predation rates as high as 27%, while *P. dorsalis* nests were infested in 5.6% of cases, and *P. major* only 0.5%, demonstrating that either the wasps have different levels of defense against these moth predators, or that moths preferentially prey on some wasp species over others. Nacko and Henderson (2017) suggest an even higher rate of infestation for *P. bellicosus*, where it can reach as high as 50%.

Chalcoela iphitalis commonly attacks *Polistes metricus* in southern Illinois and in Texas. Madden et al. (2010) report that these moths also attack the invasive European *P. dominulus*. Nacko and Henderson (2017) observed the behavior of adult *Chalcoela iphitalis* in the laboratory and noted that adult wasps frequently display an alarm behavior when sensing moths and chase them away. The moths avoid detection to some extent by being nocturnal and ovipositing near the nest, so neonate caterpillars must locate the host wasps by crawling into the nest.

Minor Hosts

Predation on immatures of *Mischocyttarus flavitarsis* paper wasps by *Chalcoela iphitalis* larvae has been documented by Little (1979) and Nacko and Henderson (2017).

Mischocyttarus mexicanus was observed as a host for *Chalcoela pegasalis* in captivity (personal observation, 2024). One adult moth emerged from a *Mischocyttarus mexicanus* nest with a notably smaller size (6 mm) compared to adults from *Polistes* nests. This low success rate and lack of other documentation of this association points to *Mischocyttarus mexicanus* perhaps being an atypical host in the wild.

Damage

Chalcoela moths typically have a minor impact on *Polistes* wasps, with several notable exceptions where they caused *Polistes* population declines in the Caribbean. There is speculation that *Chalcoela* infestations are a selective pressure that discourages polygyny (founding nests with multiple queens) in *Polistes* species that experience high infestation rates (Starr, 1976).

Heavy infestations of *Chalcoela iphitalis* are correlated with nest decline of *P. exclamans* (Strassmann, 1981). Infestation rates are not significantly different between several of the native and invasive *Polistes* species of North America (Miller et al., 2013). *Chalcoela pegasalis* has a notable history of impacting *Polistes* species in the Caribbean (Starr and Nelson, 2015). There are reports that documented the moth eliminating *Polistes* species from several islands in the Caribbean (Ballou, 1915; Nelson, 1968). Hence, *Chalcoela pegasalis* has been noted as a possible biological control agent of invasive *Polistes* species, specifically in New Zealand (Brown, 2021). The generalist nature of *Chalcoela* as predator of *Polistes* wasps limits the moths' potential as control agents where there are native *Polistes* species that may be negatively affected.

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