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Cloudless Sulphur *Phoebis sennae* (Linnaeus) (Insecta: Lepidoptera: Pieridae: Coliadinae)[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

The cloudless sulphur, *Phoebis sennae* (Linnaeus), is one of our most common and attractive Florida butterflies and is particularly prominent during its fall southward migration. Its genus name is derived from Phoebe, the sister of Apollo, a god of Greek and Roman mythology (Opler and Krizek 1984). The specific epithet, *sennae,* is for the genus *Senna* to which many of the cloudless sulphur's larval host plants belong.

Figure 1. Lareral view of adult male cloudless sulphur, *Phoebis sennae* (Linnaeus), nectaring at smallfruit beggarticks, *Bidens mitis*.
Credit: Marc Minno

Distribution

The cloudless sulphur is widespread in the southern United States, and it strays northward to Colorado, Nebraska, Iowa, Illinois, Indiana and New Jersey (Minno et al. 2005), and even into Canada (Riotte 1967). It is also found southward through South America to Argentina and in the West Indies (Heppner 2007).

Description

Adults

Wing spans range from 4.8 to 6.5 cm (approximately 1.9 to 2.6 in) (Minno and Minno 1999). Adults are usually bright yellow, but some summer form females are pale yellow or white (Minno and Minno 1999, Opler and Krizek 1984). Females have a narrow black border on the wings and a dark spot in the middle of the front wing. Males are seasonally dimorphic with winter forms being larger and with darker markings ventrally (Opler and Krizek 1984).

Figure 2. Adult female cloudless sulphur, *Phoebis sennae* (Linnaeus), lateral view.
Credit: Marc Minno

Figure 3. Adult female cloudless sulphur, *Phoebis sennae* (Linnaeus), dorsal view.
Credit: Donald Hall, UF/IFAS

Figure 4. Adult female cloudless sulphur, *Phoebis sennae* (Linnaeus), ventral view.
Credit: Donald Hall, UF/IFAS

Figure 5. Adult male cloudless sulphur, *Phoebis sennae* (Linnaeus), dorsal view.
Credit: Donald Hall, UF/IFAS

Figure 6. Adult male cloudless sulphur, *Phoebis sennae* (Linnaeus), ventral view.
Credit: Donald Hall, UF/IFAS

Eggs

The eggs are cream colored when laid but later turn to orange.

Figure 7. Egg of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Jerry Butler, UF/IFAS

Figure 8. First instar larva of the cloudless sulphur, *Phoebis sennae* (Linnaeus), emerging from egg.
Credit: David Almquist

Larvae

The larvae are green with yellow lateral lines and blue patches and transverse bands of tiny blue spots bearing black setae. Larvae that feed predominantly on flowers are yellow with black transverse bands (Minno et al. 2005).

Figure 9. Green larva of the cloudless sulphur, *Phoebis sennae* (Linnaeus). The head is to the left.
Credit: Jerry Butler, UF/IFAS

Figure 10. Green larva of the cloudless sulphur, *Phoebis sennae* (Linnaeus). Head is to the left.
Credit: Marc Minno

Figure 11. Yellowish larva of the cloudless sulphur, *Phoebis sennae* (Linnaeus). Head is to the left.
Credit: UF/IFAS

Figure 12. Yellow larva of the cloudless sulphur, *Phoebis sennae* (Linnaeus). The head is to the left.
Credit: Jerry Butler, UF/IFAS

Pupae

The pupae hang vertically attached to a silk pad by the cremaster and also are supported by a silk girdle. Pupae may be either green or pink with yellow lines (Minno and Minno 1999).

Figure 13. A recently pupated cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Marc Minno

Figure 14. Green and pink pupae of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Marc Minno

Life Cycle and Biology

Cloudless sulphurs may be found in all habitats when migrating, but breed in disturbed open areas where their caterpillar host plants and nectar plants are found. They have relatively long tongues and can reach the nectar of some tubular flowers that some other butterflies cannot (May 1992). Red flowers are preferred (Glassberg et al. 2000). In Florida, they frequently nectar at the red morning-glories, scarlet creeper (*Ipomoea hederifolia*) and cypressvine (*Ipomoea quamoclit*) (Convolvulaceae), and also at scarlet sage, *Salvia coccinea* (Lamiaceae). Males sometimes drink from mud.

Figure 15. An adult female cloudless sulphur, *Phoebis sennae* (Linnaeus), feeding at scarlet sage, *Salvia coccinea*.
Credit: Donald Hall, UF/IFAS

Males patrol for females throughout the day (Cech and Tudor 2005) and especially around nectar plants (May 1985). Rutowski (1983) studied the mating behavior of cloudless sulphurs by tethering reared females to host plants (that were visited by both females and males) with threads and filming the mating sequence. The male initiated courtship by making contact with the female's wings either with his wings or legs. A receptive female usually flicked her wings and then closed them. Unless the female assumed a "mate refusal" posture (open wings and raised abdomen) the male landed beside her with his head pointing in the same direction as hers. The male then inserted the tip of his abdomen between the female's hind wings to couple with her. Throughout this time the male flapped his wings. After coupling, he then attempted to fly off with her, but was prevented from doing so by the tether. In a few cases his attempts to couple were unsuccessful and he moved to the other side of the female and was then usually successful.

Eggs are laid singly on the host plant. Larvae live exposed (no shelter) and feed on foliage, buds and flowers. Development is continuous and none of the immature stages are capable of diapause. Winter form adults probably undergo reproductive diapause (Opler and Krizek 1984).

At night, on dark, cloudy days, and during storms, adult cloudless sulphurs roost singly on leaves. Before settling, they are very choosey of just the right place. An adult preparing to roost makes an erratic flight around a potential tree or shrub, settling briefly at times, then flying about some more, and typically selecting a yellow or reddish leaf within other leaves on which to finally stop. This behavior may help prevent attacks from predators,

such as birds, that may also be perching nearby and watching the activity. Although the adults are brightly colored when flying, they seem to disappear against similarly colored leaves in the shade. The roost site may be low to the ground in shrubs with lots of foliage or high up in the leaves of trees.

Migration and Overwintering

The fall migration of cloudless sulphurs is the easiest to observe butterfly migration in the southeastern United States. On fine days in the fall, in the Southeast, any butterfly watcher driving an east-west road through open country will likely see these bright yellow butterflies crossing the road and can confirm that they are crossing much more frequently from north to south than from south to north. (Monarchs are migrating at the same time, but they generally fly too high to see and are heading for Mexico and hence may miss the Southeast.) During fall, the numbers of cloudless sulphurs crossing an east-west line bisecting the Florida peninsula at the latitude of Gainesville may approach the numbers of monarchs overwintering in clusters at highly localized sites in Mexico (Walker 1991, 2001).

The seasonal migrations of cloudless sulphurs and monarchs are similar in that each species is abandoning large and favorable summer breeding areas that have lethally low winter temperatures for more favorable climates to the south. In the spring, surviving adults head northward and soon repopulate the summer breeding areas. In both species, the northward migration is evidenced by the reappearance each summer in the breeding areas they abandoned the previous fall. In cloudless sulphurs, quantitative comparisons of the fall and spring flights have been made based on the catches of passive flight traps (Walker 1985). These traps are successful because when cloudless sulphurs migrate through open areas, most fly within 3 meters of the ground, and when they encounter a major obstacle, such as a house, they rise and fly over it rather than deviating from their migratory direction. When migrating butterflies strike the central barrier of such a trap and attempt to fly over it, they are deflected into cages that segregate the butterflies that have encountered the barrier on one side from those that have encountered it on the other. In fall, near Gainesville, between 1979 and 1993, flight traps oriented perpendicular to the axis of the Florida peninsula caught, on average, 504 more cloudless sulphurs flying southward than flying northward. In spring, their catch revealed a much smaller migration with 17 more flying northward than flying southward. In both migratory seasons about 90% of the total catch had been flying in the seasonally appropriate direction.

In most years, some cloudless sulphurs probably successfully overwinter as far as 100 miles north of Gainesville, but in exceptionally frigid winters even Gainesville may have temperatures below 20°F that are likely lethal to cloudless sulphurs. The large numbers migrating each fall across the latitude of Gainesville suggest that most overwintering is to the south. Fall and winter observations of butterflies in Florida south of Gainesville suggest that nearly all migrants stop before reaching the latitude of Lake Okeechobee (Lenczewski 1992).

As reported by Walker (2001), the fall migrations of cloudless sulphurs through Gainesville declined sharply between 1984 and 2000. Reduced planting of soybeans and more use of herbicides to control sicklepod in soybean fields may have caused, or at least contributed to, the decline.

In summarizing his own and his associates' research on butterfly migrations in the Southeast US between 1960 and 2000, Walker (2012) made openly accessible the trapping and azimuth data that are the basis of his major papers.

Hosts

Cloudless sulphur caterpillars use various species in the genera *Chamaecrista* and *Senna* in the pea family (Fabaceae) as host plants, including the following.

Native Species

- Florida Keys sensitive pea, *Chamaecrista deeringii*
- Maryland wild sensitive plant, *Senna marilandica*
- narrowpod sensitive pea, *Chamaecrista lineata* var. *keyensis*
- partridge pea, *Chamaecrista fasciculata*
- privet wild sensitive plant, *Senna ligustrina*
- sensitive pea, *Chamaecrista nictitans*
- Chapman's wild sensitive plant, *Senna mexicana* var. *chapmanii*

Introduced Species

- Africa wild sensitive plant, *Senna didymobotrya*
- candlestick plant, *Senna alata*
- coffeeweed (sicklepod), *Senna obtusifolia*
- glossy shower, *Senna surrattensis*
- septicweed, *Senna occidentalis*
- valamuerto, *Senna pendula* var. *glabrata*

Plant names are from Wunderlin et. al (2022) or the USDA PLANTS Database. *Senna pendula* var. *glabrata*, a common cultivated ornamental bush in Florida, is also known as Christmas senna or butterfly bush and is commonly (and erroneously) referred to by the scientific name *Cassia bicapsularis* (now *Senna bicapsularis*). *Senna bicapsularis* is very similar to *Senna pendula*, but is rarely planted in Florida (Isely 1990).

Figure 16. Partridge pea, *Chamaecrista fasciculata*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Donald Hall, UF/IFAS

Figure 17. Sensitive pea, *Chamaecrista nictitans*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Donald Hall, UF/IFAS

Figure 18. Privet wild sensitive plant, *Senna ligustrina*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Deborah Lott, UF/IFAS

Figure 19. Chapman's wild sensitive plant, *Senna mexicana* var. *chapmanii,* a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Donald Hall, UF/IFAS

Figure 20. Candlestick plant, *Senna alata*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Marc Minno

Figure 21. Coffeeweed, *Senna obtusifolia*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Marc Minno

Figure 22. Septic weed, *Senna occidentalis*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Marc Minno

Figure 23. Valamuerto, *Senna pendula* var. *glabrata*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Donald Hall, UF/IFAS

Photographs of *Senna marilandica* and *Senna surrattensis* are available by clicking on the "Photo Gallery" links at the following websites:

Senna marilandica:
http://florida.plantatlas.usf.edu/Plant.aspx?id=905

Senna surrattensis:
http://florida.plantatlas.usf.edu/Plant.aspx?id=1494

Chamaecrista species have extrafloral nectaries on the leaf petioles to attract predacious ants for protection from herbivores. Ants have been observed removing eggs and small larvae of *Phoebis sennae* from *Chamaecrista fasciculata* (Barton 1986).

Senna mexicana, *Senna obtusifolia*, *Senna occidentalis*, *Senna pendula*, *Senna marilandica*, *Senna surrattensis*, and

Senna ligustrina also have extrafloral nectaries on the leaf petioles (Isely 1990, Marazzi et al. 2006) and probably also gain some protection from *Phoebis sennae* larvae and other herbivores.

Fleet and Young (2000) reported protection of *Senna occidentalis* from both the sleepy orange, *Eurema nicippe* (Cramer), and cloudless sulphur by imported fire ants, which are attracted to the plants by extrafloral nectaries. *Senna didymobotrya* has no extrafloral nectaries (Marazzi et al. 2006), and there are conflicting reports regarding the existence of characteristic extrafloral nectaries on *Senna alata*. According to Shumway et al. (2009), *Senna alata* has extrafloral nectaries, but according to Marazzi et al. (2006) it does not. *Senna alata* does produce nectar at its stipules, and ants are attracted to the stipules (Miguel Cid personal communication). Nectar production by stipules is also reported for *Cassia reticulata* Willdenow (Mexzón and Chinchilla 2003).

The extrafloral nectaries of *Chamaecrista* species are cup-shaped with a concave central disc while those of most *Senna* species are bud-shaped or button-shaped and convex.

Figure 24. Extrafloral nectary of sensitive pea, *Chamaecrista nictitans* var. *aspera*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Marc Minno

Figure 25. Extrafloral nectary of Florida Keys sensitive pea, *Chamaecrista deeringiana*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Marc Minno

Figure 26. Extrafloral nectary of narrowpod sensitive pea, *Chamaecrista lineata*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Marc Minno

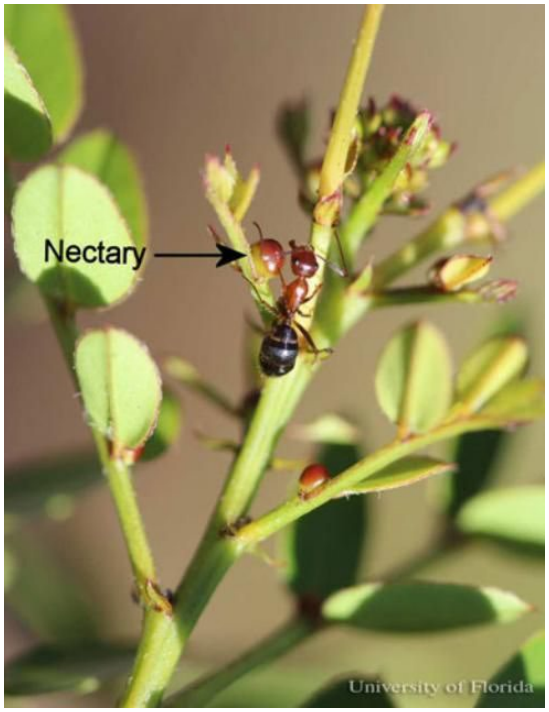

Figure 27. Extrafloral nectary of Chapman's wild sensitive plant, *Senna mexicana* var. *chapmanii*, a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Donald Hall, UF/IFAS

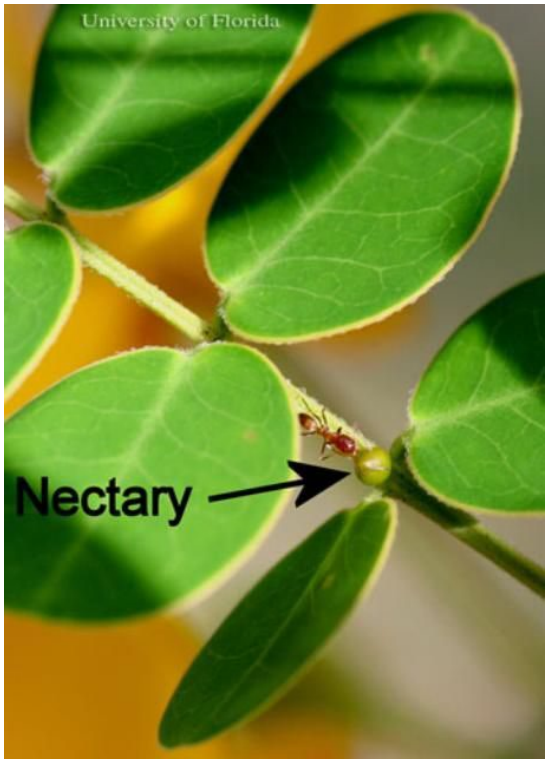

Figure 28. Extrafloral nectary of valamuerto, *Senna pendula* var.*glabrata,* a host of the cloudless sulphur, *Phoebis sennae* (Linnaeus).
Credit: Donald Hall, UF/IFAS

Natural Enemies

The Universal Chalcidoidea Database of the Natural History Museum (London) (https://www.nhm.ac.uk/our-science/data/chalcidoids/database/namedHost.dsml?searchPageURL=indexNamedHost.dsml&HOSTFAMILY=&HOSGENUSqtype=equals&HOSGENUS=Phoebis&HOSSPECIESqtype=equals&HOSSPECIES=sennae) lists the following four species of Chalcididae as parasitoids of *Phoebis sennae*:

- *Brachymeria incerta* Cresson
- *Conura eubule* Cresson (See Sourakov 2012 for photos)
- *Conura transitiva* Walker *Schizomicra tucumana* Blanchard

Kopter et al. (2013) observed the midge *Forcipomyia* (Microhelea) *eriophora* (Williston) (Diptera: Ceratopogonidae) feeding on *Phoebis sennae* larvae.

Larvae fed upon by the midges suffered higher mortality in captivity than occurred in laboratory reared larvae.

Economic Importance

Cloudless sulphur larvae eat the foliage, buds, and flowers of ornamental sennas. If necessary, they can be controlled by hand-picking. Chemical control is neither required nor recommended.

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