

# Euphydryas anicia cloudcrofti (Sacramento Mountains Checkerspot Butterfly)

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Steve Cary,

## Taxonomy

- **Class:** INSECTA
- **Order:** LEPIDOPTERA
- **Family:** NYMPHALIDAE
- **Genus:** Euphydryas
- **Scientific Name:** *Euphydryas anicia cloudcrofti* (Ferris and R. Holland, 1980)
- **Common Name:** Sacramento Mountains Checkerspot Butterfly
- **Synonyms:** *Occidryas anicia* ssp. *cloudcrofti* Ferris and R. Holland, 1980
- **Taxonomic Name Source:** Ferris, C. D. and R. W. Holland. 1980. Two new subspecies of *Occidryas anicia* (Doubleday) from New Mexico. *Bulletin of the Allyn Museum*. 57:1-9.

## Agency Status

- **NMDGF:**
- **Federal Status:**
- **BLM Sensitive:**
- **USFS:**
- **IUCN Red List:** [Critically Endangered](#)
- **Nature Serve Global:** [T1](#)
- **NHNM State:** S1
- **NM Endemic:** YES

## Description

Sacramento Mountains Checkerspot adults are medium-sized butterflies with a wingspan of around 5cm (2 inches) (USFWS 2009). They have yellow-orange clubbed antennae and reduced forelegs which are orange (Glassberg 2017). They can be recognized by their black body, orange antennae, and characteristic checkerspot patterning on the wings in dark brown, red, orange, and white with black spots and lines (Ferris and Holland 1980). Additionally, a circle of yellowish hairs can be found at the base of the abdomen. The females are larger than males and have more rounded abdomens. In females pale markings are evident on the distal hind wings of the females but generally subdued in males (Center for Biological Diversity 2021). Eggs are yellow to reddish brown. The caterpillars start their lives blackish-brown, small, and lacking hairs. As the caterpillars progress through successive instars, they become woolly and black with long orange and black bristles. The caterpillars are between 0.5 and 1 cm long, and can also be identified by the white with orange and black spots along the caterpillar. Pupae are mostly white with black and orange spotting.

## Habitat and Ecology

This taxon occurs in open meadows, drainages, and grasslands in upper montane and subalpine coniferous forest, with less than 5% canopy cover, at elevations between 2,400 and 2,750 metres (McIntyre 2010, Pittenger and Yori 2003). Occupied habitats also support communities of New Mexico penstemon (*Penstemon neomexicanus*), orange sneezeweed (*Hymenoxys hoopseii*), valerian (*Valerian* spp.), arrowleaf groundsel (*Senecio triangularis*), figwort (*Scrophularia montana*), scarlet gilia (*Ipomopsis aggregata*), milkweed (*Asclepias* spp.), Arizona cliff rose (*Rosa woodsii*), and Wheeler's wallflower (*Erysimum capitatum*) (USFWS 2001). The primary larval host, New Mexico penstemon (*Penstemon neomexicanus*), is also a regional endemic, though the distribution of the butterfly is far more restricted than that of its host. This plant is an early successional, stress-tolerant perennial that grows well on disturbed, well-drained, sandy to rocky loam soils (USFWS *et al.* 2004). Historically it was reportedly common and relatively abundant in the Sacramento, Sierra Blanca, and Capitan Mountains (Pittenger and Yori, 2003). All suitable habitat patches contained sufficient abundance of the host plant, and abundance of the host plant is dependent on soil disturbance, often caused by pocket gophers (Pittenger and Yori 2003, McIntyre 2010). More recently, populations of New Mexico penstemon in the Sacramento Mountains seem to be declining relative to populations in neighboring mountains ranges.

The Sacramento Mountain Checkerspot is univoltine. The adult flight period lasts from June to mid-July, with peak flight typically in early July (McIntyre 2010). Individual adults typically live up to 14 days (USFWS *et al.* 2004). Adults show an overwhelming preference for nectaring on orange sneezeweed (McIntyre 2010). At the onset of the summer rainy season, eggs are laid in masses of 20-100 on the underside of New Mexico penstemon (Pittenger and Yori 2003). Occasionally, if New Mexico penstemon is not available, tobacco root (*Valerian edulis*) may be used as a host plant as well (McIntyre 2010). Female butterflies may lay 2 or 3 sets of eggs, but 99% of all eggs laid may not survive to adulthood (Ehrlich and Hanski 2004). Female butterflies prefer to lay eggs on larger host plants, in dense patches (McIntyre 2010). Eggs hatch about 14 days later and the larvae are gregarious, and weave silken tents around the leaves of the host plant (USFWS *et al.* 2004). During the 4th or 5th instar, larvae will overwinter in leaf litter, thatches of bunchgrass, under rocks, or under bark. It has been reported that larvae can remain in diapause for more than a year if environmental conditions are not ideal (USFWS *et al.* 2004). However, it is more likely they come out of diapause, feed, and then forgo pupation to enter a second diapause. This has been observed in captivity. If conditions are suitable, they emerge from diapause in April to finish their larval development. They typically pupate from late May to mid-June (McIntyre 2010).

Larvae are known to be attacked by a *Cotesia* parasitoid wasp, which was first observed in three wild collected larvae in October of 2006 (Ryan and Milligan 2008). Pittenger and Yori (2003) also observed several post diapause larvae in Pumphouse Canyon infected with what later was identified as a *Cotesia* species.

## Geographic Range:

The Sacramento Mountains Checkerspot Butterfly (*Eupydryas anicia cloudcrofti*) occurs within an 85 km<sup>2</sup> area in the Sacramento Mountains of southeastern New Mexico, USA (USFWS 2001). While the historical extent of the range is not known, routine collection by lepidopterists in the mountain range from the 1980s to present has not revealed this species outside the suggested area (Ferris and Holland 1980, Cary and Holland 1992, USFWS *et al.* 2004). This subspecies is the most isolated of all *E. anicia* subspecies, with the closest sister taxa in the Chuska and Sangre de Cristo Mountains of northeastern and northern New Mexico respectively (Ferris and Holland 1980).

Historically, this butterfly has been recorded in 15 general localities (USFWS 2001). In 2010 the butterfly was known from 13 major mountain meadow drainages (McIntyre 2010), all within a 9.64 km radius of the village of Cloudcroft, New Mexico (USFWS *et al.* 2004). Other meadows with suitable habitats exist nearby, yet for unknown reasons,

butterflies have never been observed in these areas. In 1983 and 1984, carbaryl pesticides were sprayed using aerial application, over 240,900 acres in the Sacramento Mountains at elevations between 6,000 and 11,000 feet, to control an outbreak of Western Spruce Budworm (Bennett and Linnea 1985). Most of the inhabited areas and waterways, including the area around the Village of Cloudcroft as well as some of the other meadows where the butterflies are found, were instead sprayed with *Bacillus thuringiensis* (B.t.). This has been suggested as one reason the apparent range of the sub-species is restricted to areas within several kilometres of the Village of Cloudcroft.

In 2004, 1,096 hectares (10.96 km<sup>2</sup>) of suitable habitat was reported for this sub-species, though only 798 ha (7.98 km<sup>2</sup>) was occupied by the butterfly (USFWS 2004). Of the occupied habitat, 484 ha (4.84 km<sup>2</sup>) was on Forest Service lands and 314 ha (3.14 km<sup>2</sup>) was on private land (USFWS 2004). At that time, the range spanned from the border of the Mescalero Apache Nation's lands in the north to Cox Canyon in the south, and from Bailey Canyon in the west to Spud Patch Canyon in the east (USFWS 2004). By 2021, only two historic localities were found to be occupied. Two larval tents were found at one of these sites in 2021. In 2022, adults were recorded at only one historic locality, in two adjacent sites. In 2023 and 2024, no adults or larvae were found in the field, despite ample surveys at both recently occupied sites and historical sites.

## Conservation Considerations:

The Sacramento Mountains Checkerspot Butterfly has been petitioned for listing under the Endangered Species Act (ESA) three times, most recently in 2021 (Suckling 1999, Rosmarino and Greenwald 2007, Center for Biological Diversity 2021). In response to the first petition, the USFWS proposed listing the sub-species as Endangered on September 6, 2001 (USFWS 2001). The USFWS subsequently withdrew the species from the candidate list, citing that the threats to the butterfly were reduced (USFWS 2004). Listing was again denied in response to the second petition because [it] continues to persist within the same general localities (USFWS 2009). The USFWS insisted they would monitor and encourage the conservation of the subspecies (USFWS 2009), but threats and population declines continued. In January 2022, in response to the most recent petition, the USFWS again proposed the subspecies for listing as Endangered (USFWS 2022) and in January of 2023, the proposed rule to add the species to the List of Endangered and Threatened Wildlife was finalized (USFWS 2023).

This butterfly was considered a species of concern by the U.S. Fish and Wildlife Service, and was managed under a 2004 Conservation Plan for the Sacramento Mountains Checkerspot Butterfly (USFWS *et al.* 2004). When this subspecies was first petitioned for listing under the ESA, Otero County passed a county-wide resolution to preserve natural resources and protect threatened and endangered species, including the Sacramento Mountains Checkerspot. As part of this resolution, land subdivisions are required to consider the effects of planned development on the butterfly within their plans (Otero County 2005). This ordinance also requires surveys for butterfly and host plants if development is to occur in suitable habitat. If the butterfly is found occupying the site, a plan to mitigate the impacts of development and a plan to restore habitat is necessary. This and other conservation actions were implemented as part of the 2004 conservation plan, which was designed to coordinate and implement conservation actions, including managing unoccupied and occupied habitat on both public and private lands, to mitigate the threats to the species and stop the decline (USFWS *et al.* 2004).

Despite the protections in place for this species, population declines continue. As metapopulation dynamics are likely critical to the long-term survival of this subspecies, maintaining suitable habitat at occupied, as well as unoccupied habitat patches, and maintaining connectivity between habitat patches is critical, so that extirpated subpopulations can eventually become recolonized (Pittenger and Yori 2003). An *ex situ* population of this subspecies was established at the Albuquerque BioPark in 2022.

## Threats:

The main threats to this species are habitat loss, fragmentation, and degradation due to climate change, residential and commercial development, grazing, recreational use, invasive species, fire suppression (Center for Biological Diversity 2021) and inbreeding depression. While development and large-scale changes to forest ecosystems due to grazing and fire suppression have historically been considered the greatest threat to this species, drought caused in part by climate change has been the most consequential threat more recently. The Southwest U.S. saw its driest 22-year period from 2000 to 2021 since at least 800 CE (the time period used in previous climatic reconstructions) (Williams *et al.* 2022) and droughts are projected to become more prolonged, severe, and common in the region under future climate change scenarios (USGCRP 2018). Drought conditions over the last few years have severely limited food and nectar resources (Hughes 2020) and environmental stochasticity, especially variation in host quantity, quality, and phenology, is the major cause of *Euphydryas* extinction, particularly in small populations (Ehrlich & Murphy 1987). In addition, as this species relies on just one larval host plant, it is more vulnerable to habitat changes. Hostplant breadth is a crucial determinant of extinction proneness; for example, *Euphydryas chalcedona* feed on a wide variety of perennial host plants and suffer fewer documented local extirpations, while *E. editha* exhibits narrow host tolerance of annual host plants and appears more prone to local extinctions (Ehrlich & Murphy 1987). Other climate change related impacts are less well understood, though some butterflies respond to climate changes by shifting to higher elevations or latitudes (Rödder *et al.* 2021, Forister *et al.* 2010). This is not an option for this subspecies as there are no higher elevation habitats to shift to. Phenological mismatch with the host plant or nectar sources is also a potential consequence of climate warming (Singer and Parmesan 2010). In 2021 and 2022, adults emerged before their hostplants fully flowered and adults brought into captivity in 2021 were reportedly so emaciated they drank nectar for 30 minutes (R. Ryan pers. comm. 2021). Other changes to plant communities within the butterfly habitat, which may be the result of climate warming or other disturbance, include the loss of Apache blackberry, which may have acted as shelter for the butterflies during hailstorms (R. Ryan pers. comm. 2021).

Residential and commercial development historically contributed substantially to habitat loss, degradation and fragmentation and remains a threat to this species. All occupied habitats have been recorded from within 9 km of the village of Cloudcroft, New Mexico, which is surrounded on all sides by the Lincoln National Forest (Pittenger and Yori 2003). Cloudcroft was expanded in 2001, by 33 ha, under the Townsite Act of 1958 (USFWS 2004). Though the stated primary purpose for the expansion was to build subdivisions, the town experienced little growth in the ensuing years, and few residential homes have been built. From 2001 to 2005, eight to 10 homes were constructed per year in butterfly habitats (USFWS *et al.* 2004). As part of the 33 ha (0.33 km<sup>2</sup>) land transfer, the town applied to turn 22 acres into a sports field, eight acres into a greenbelt, and eight acres into a wastewater plant (USFWS *et al.* 2004). Three acres of this land consisted of butterfly habitat (USFWS *et al.* 2004). Such development may cause direct mortality of butterflies, destroy meadow habitats through loss of host plant and nectar sources, and contribute to increased fragmentation of habitat patches. For example, one locality (called the "House Plot") was lost when a yard was paved over to form a parking lot (R. Ryan pers. comm. 2021).

Another major threat to this sub-species is the potential occurrence of catastrophic wildfire. Fire suppression has been a key component of forest management in this region since the early 1900s, resulting in dense conifer growth and increased fuel loads (Kaufmann *et al.* 1998). At least nine large fires have burned over 34,000 acres of land in the Sacramento Mountains in the last 50 years (Kaufmann *et al.* 1998), though none have impacted occupied butterfly habitat since 1916 (USFWS *et al.* 2004). The impacts of fire on this species may depend on the intensity and size of the fire, as well as seasonal timing (USFWS *et al.* 2004). For example, if a small amount of meadow habitat was burnt, but adjacent forests were cleared, larval host and nectar plants may benefit from the disturbance caused by the fire, and butterflies may be able to disperse more readily between meadows. Such disturbances are necessary to support the metapopulation dynamics of this sub-species, where small, discrete sub-populations rely on regular recolonization from neighboring patches. However, if a fire that was too hot or too widespread were to burn in the area, direct impacts may include mortality of adults, pupae, larvae, or eggs, depending on the time of year, and indirect effects might include loss of host plants and nectar sources. The impacts of land use on fire intensity and spread may also be consequential. For example, grazing may temper a fire, as grazed meadows carry less fuel load, but the presence of

some invasive grasses which are more abundant in grazed areas, such as Kentucky blue grass (*Poa pratensis*), may cause fire to burn deeper and hotter, due to the formation of mats (USFWS *et al.* 2004).

Recreational disturbance is also a threat to this species. The meadow habitats are attractive areas for recreational activities such as camping, hunting, hiking, mountain biking, and off-highway vehicle (OHV) use. Fourteen campgrounds in the National Forest overlap with butterfly habitat, with varying levels of disturbance. Though attempts have been made to minimize impacts on the butterfly, the sub-species is no longer found in any National Forest campgrounds. In addition, dispersed camping is allowed within 91 meters of roads (U.S. Forest Service 2021), which may be detrimental to butterflies because of trampling and habitat disturbance. For example, butterflies at the "Silver Springs" locality may have been extirpated by campers who mowed the lawn around their RV (R. Ryan pers. comm. 2021). Off-highway vehicle use also likely adversely impacts butterflies, as eggs and larvae may be trampled, host and nectar plants disturbed, adults covered in dust, and soil and hydrological impacts may have lasting habitat disturbing effects (USFWS *et al.* 2004). Direct mortality may be particularly high during certain times of year when butterflies congregate on open ground to thermoregulate, as is seen in other members of this genus, such as in the late spring when post-diapause larvae cluster on open soil to warm up, or in the summer when adults use roads and trails for the same purpose (Osborne and Redak 2000).

Grazing, by cattle historically and stray horses and elk currently, has also been suggested as a threat to this species. Though some argue grazing has no impact on this species and may even be beneficial due to decreased fire potential (fuel loads), there is some evidence overgrazing may be harmful. This is especially true during dry years, when the drought tolerant host, *Penstemon neomexicanus*, is among the only green forage. Hughes (2020) reported that poor environmental conditions across the range of the species, due to drought and sparse, heavily grazed penstemon, may be responsible for the lack of adult observations. Grazing also directly degrades the habitat by reducing the health and abundance of host plants (by as much as 60% in some studies) (McIntyre 2010), and promotes the spread of invasive species, which outcompete host plants and change the composition of vegetation communities (Souther *et al.* 2019). A marked increase in Sleepy Grass, which is not eaten by ungulates, has been observed, taking over the meadows and outcompeting nectar plants (R. Ryan pers. obs.). Grazing not only limits host plant availability and degrades habitat, but causes direct mortality of caterpillars and eggs as well. For example, mortality of post-diapause larvae may be higher due to trampling (Pittenger and Yori 2003). In addition, cattle, horses, and elk have been observed eating caterpillar tents and eggs as they graze on the host plants and cattle and horses defecate on larval tents, effectively smothering the caterpillars (R. Ryan pers. obs.). Pesticide use has also likely adversely impacted this subspecies across its known range. For example, in 1983 and 1984 during peak flight of the checkerspot, carbaryl pesticides were sprayed using aerial application over 240,900 acres in the Sacramento Mountains at elevations between 6,000 and 11,000 feet, to control an outbreak of Western Spruce Budworm (Bennett and Linnea 1985). Most of the inhabited areas and waterways, including the area around the Village of Cloudcroft as well as some of the other meadows where the butterflies are found, were instead sprayed with *Bacillus thuringiensis* (Bt). In another example, in 2007, the Village of Cloudcroft again sprayed *Bt* var. *kurstaki*, which targets lepidopterans, to control a Janet fir looper (*Nepytia janetae*) outbreak (Holland 2007). Lastly, inbreeding depression is an increasing threat to this species. Inbreeding depression results when slightly deleterious alleles accumulate in a small population, reducing the likelihood of population persistence (Hedrick 1994, Lynch *et al.* 1995). The accumulation of deleterious alleles and reduction in heterozygosity have been shown to reduce survival rates at several important life stages in checkerspots, including those that have an effect on population stability and persistence, even after just one generation of mating between full-siblings (Saccheri *et al.* 1998, Nieminen *et al.* 2001). Nieminen *et al.* (2001) also suggests that inbreeding depression may pose an even greater problem in populations currently experiencing rapid habitat fragmentation but with minimal inbreeding in the past. A reduction in fitness resulting from the loss of genetic diversity significantly increases the risk of extinction when populations are subject to environmental stress. Saccheri *et al.* (1998) found that microclimatic conditions combined with inbreeding caused the extinction of a checkerspot population in Finland, while Singer and Ehrlich (1979) found a combination of drought, fragmented habitat, and low dispersal rates contributed to the extinction of several checkerspot populations in California. Historically, the Sacramento Mountains Checkerspot metapopulation was shown

to have considerable allelic richness compared to other checkerspot butterfly populations reported (Ryan and Milligan 2013). However, more recently, it has suffered from extreme heterozygote deficiency, suggesting high levels of local inbreeding and/or hidden population structure. In addition, mean movement rates suggest a low rate of movement between subpopulations (Ryan and Milligan 2013).

## Population:

This butterfly has experienced ongoing declines since population monitoring began in the late 1990s. Over the last 10 years the decline accelerated, with very low numbers observed in the last four years, despite expanded survey effort by the US Forest Service (Hughes 2020) and other groups. In 1999, a survey team from the US Forest Service established 10 stationary reference plots for adults and 10 reference plots for pre-diapause larval tents. Adult and larval sites overlapped or were in closely adjacent segments of the same meadow. Adults and larvae initially occurred in all 10 areas. In 1999, 139 larval tents were counted across all 10 plots. In later years, increasingly fewer tents were counted, and by 2018 zero larval tents could be found in the legacy plots.

Therefore, in 2018 the Forest Service survey team expanded the survey effort, by dividing all meadow areas throughout the entire known and reported potential range into a comprehensive system of patches (small meadows or more typically, segments of larger meadow systems). From 2018 through 2021, circular plots were dispersed throughout meadow patches containing the legacy sites (i.e., subplots within and around legacy plots) and additional meadow patches throughout the historic range. Still, no tents were located in legacy plots or newly created subplots. Three tents were detected opportunistically, one in 2018 and one (at one patch, not encompassing a legacy site) in 2021.

Adults were counted at the 10 legacy sites starting in 2000, when the count numbered more than 700. Adult legacy survey counts were zero as of 2014 and 2015. Recognizing that Sacramento Mountain checkerspot adults were too rare to be enumerated within the legacy plots, the Forest Service adopted double observer sampling at the level of whole patches (small meadows or segments of larger meadow systems) as of 2019.

In 2021, adult emergence was detected on June 17, 2021 (two males) in a period of exceptional drought in New Mexico that preceded the onset of monsoonal rains. Six males were observed on June 22. These adults appeared to be food-plant limited. Only one cluster of orange sneezeweed, the preferred adult nectar source, in the immediate vicinity had any blooms, and that cluster had constant use by other butterfly species, nectar feeding along with this species. Other sneezeweed clusters were not in flower and many appeared near wilt point.

In 2022, 12 adults were detected in one meadow. At a second meadow that was known to be occupied in 2021, no adult butterflies were observed. The number of volunteers looking for butterflies in 2022 was expanded, with near daily survey attempts throughout the flight period. While it is unlikely all remaining mature individuals were counted during these surveys, given the small size of the extant range, and the time spent looking, it is unlikely there were many butterflies missed.

In 2023 and 2024, despite expanded search efforts across the range of the species, no butterflies were found.

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## More Information

