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THE LIFE HISTORY AND BEHAVIOR OF *EUPROSERPINUS EUTERPE* (SPHINGIDAE)

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ABSTRACT. *Euproserpinus euterpe* Hy. Edwards is a small day flying sphinx moth which occurs in southern California. Adults are active from late February to early April. The larval host plant is a primrose in the genus *Camissonia.* Females frequently oviposit on an imported plant, *Erodium.* Larvae from eggs deposited on *Erodium* do not survive, and mistakes in oviposition may contribute to the rarity of the moth. Evidence is also presented which suggests that the type locality for this moth is not San Diego County.

Henry Edwards described *Euproserpinus euterpe* in 1888, based on a single male specimen which had been collected in southern California. Until recently, the only other specimens known were a pair in the Clark collection lacking data; but the female had been in a collection since at least 1888 (Clark, 1919). The observation that no additional specimens had been collected, suggested to some that *euterpe* no longer existed in southern California (Comstock, 1938; Hodges, 1971). Then in 1974, Mr. Chris Henne rediscovered *euterpe*, and collected the first specimens in nearly 90 years. In this paper we discuss the biology of this unique sphingid, and describe the immature stages for the first time. The genus contains two additional species, *E. wiesti* Sperry, and *E. phaeton* Grote & Robinson. Of the three species, *phaeton* is the most commonly collected species, and was the only member of the genus whose biology was known (Comstock & Dammers, 1935).

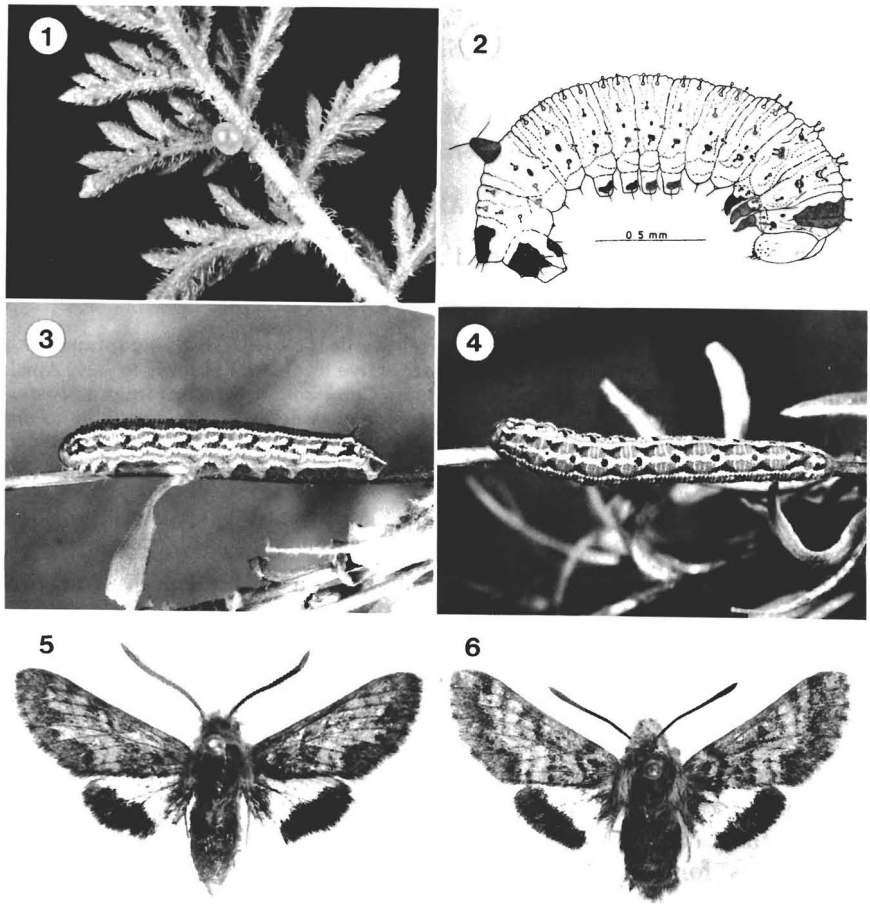
Description of Ova and Larvae

Figs. 1–4

Ova. Light green and oblong, measuring 1.0 by 1.1 mm (Fig. 1).

First Instar. (Fig. 2) **Head:** Black; diameter 0.5 mm. Clypeus white. **Body:** Ground color yellowish-green. Length 4.5 mm; width 0.8 mm. True legs black. Prolegs yellow with anterior black patch. Spiracles black. Scoli are microscopic, black and bulb-shaped. Prothoracic shield black. Anal shield black. Anal horn black; length 0.3 mm.

Second instar. Head: Dark brown; diameter 0.8 mm. Clypeus dark brown. **Body:** Ground color green. Ventral surface green. Subspiracular area and lateral surface of prolegs pink. Dorsal and lateral surface green. Body covered with numerous microscopic black setae. Scoli black. Body length 6.7 mm; width 1.4 mm. True legs black. Prolegs pink. Spiracles black. Prothoracic shield black. Dorsal area proximal to anal horn pink. Anal shield black. Anal horn black; length 0.4 mm.



FIGS. 1–6. **1,** Egg of *E. euterpe* on *Erodium;* **2,** First instar larva of *E. euterpe;* **3,** Lateral view of fifth instar larva; **4,** Dorsal view of fifth instar larva; **5,** Male *E. euterpe;* **6,** Female *E. euterpe.*

Third instar. Head: Dark brown; diameter 1.3 mm. Clypeus dark brown. **Body:** Ground color green and red. Ventral surface green. Subspiracular area and lateral surface of prolegs red. Dorsal and lateral surface green. Partially formed dorsal red band extending from base of horn to head on each side of mid-dorsal area. Mid-dorsal area green. Body covered with numerous microscopic bulb-shaped secondary setae. Body length 12.1 mm; width 2.0 mm. True legs black. Prolegs red. Spiracles red. Prothoracic shield brown. Anal shield black. Posterior area from base of horn to anal shield red. Anal horn black; length 0.4 mm.

Fourth instar. Head: Red; diameter 2.1 mm. Clypeus red. **Body:** Ground color green and red. Ventral surface green. Subspiracular area and lateral surface of prolegs red. Subspiracular white line extending from prothoracic segment to anal prolegs. Subdorsal and supraspiracular area light green. Dorsal rust brown lateral band extending from prothoracic segment to base of anal horn. Mid-dorsal area dark green. Black dot

located dorsal to spiracles on abdominal segments I–VIII. Body covered with numerous microscopic bulb-shaped secondary setae now extending from whitish paniculum. Body length 20.0 mm; width 3.4 mm. True legs green. Prolegs red. Spiracles black. Prothoracic shield red. Anal shield red. Posterior area from base of anal horn to anal shield red. Anal horn red; length 0.6 mm.

Fifth instar. (Figs. 3, 4) **Head:** Dark red; diameter 3.4 mm. Clypeus red. Antenna prominent and cream colored. Adfrontal area light red. **Body:** Ground color green and rust red. Ventral surface grayish-green. Subspiracular area with white line bounded by red on either side and extending length of body. Supraspiracular light green line extending length of body and broken by oblong black spots extending from dorsal edge of spiracles. Pink band dorsal to light green band also extending length of body and partially obstructed by oblong black spots. Subdorsal yellow line extending length of body. Dorsal rust red line extending length of body and interrupted by black V-shaped patch with wide end of patch touching yellow subdorsal line. Mid-dorsal line dark green with black transverse patch on posterior portion of each segment. Body length 32 to 35 mm; width 5 to 6 mm. True legs green. Prolegs red. Spiracles black. Prothoracic shield rust red. Anal shield and horn rust red, length 1.5 mm.

Distribution and Habitat

Presently, the only known population of *Euproserpinus euterpe* exists in Walker Basin, Kern Co., California. Walker Basin is at an elevation of 1470 m, and is surrounded by mountains well over 2000 m in height. The basin is an agricultural area, primarily consisting of cultivated barley fields, pasture for cattle, and fallow fields. From the time of the rediscovery of *euterpe* in 1974, until the spring of 1979, moths were found in one small section of a fallow barley field. The colony was located in the northwest section of the basin, and encompassed about 4000 m^2, on sandy soil. The prominent vegetation during the brief flight period includes *Erodium cicutarium* (L.), *Nemophila menziesii* H. & A., *Chrysothamnus*, assorted grasses, and a small composite.

The plant community surrounding the basin floor is dominated by juniper, oak, sagebrush, or pine, and may limit the distribution of the moth. South of the basin the plant community is oak-grassland, and once over the hills, the elevation drops quickly and conditions become warmer. Near the community of Bodfish, north of Walker Basin, similar habitat was found, but although conditions seemed favorable, no adults were observed.

In March 1979, many adults were encountered at the original colony site. Tuskes examined other locations in the basin as in previous years, and for the first time observed adults in many new locations. Though adults were widespread in fallow fields and pastures, they were uncommon at all but one location.

Adult Behavior and Flight Period

Capture records indicate that adults fly from the last week of February to the first week of April, with the peak period during the second

or third week of March. During the flight season, the weather is unpredictable; rain, strong winds, and occasional snow make conditions difficult. Under usual conditions temperatures seldom rise above 18°C, with lows near or below 0°C. Specimens have been observed and captured under stormy conditions when the high temperature for the day was 6°C (J. Johnson, pers. comm.). The early flight of the moths appears to be related to the development of the host plant. Depending upon the season, *Camissonia* seedlings may be found in late February or early March, but by mid-May the majority of the plants are dried and dead.

Adults fly during the warmer parts of the day, usually between 1000 and 1430 h. In the morning, males and females frequently bask on bare patches of soil, dirt roads, or rodent mounds. The majority of the nectaring was observed in the morning at flowers of *Erodium* and *Nemophila*. As the day progresses, males become active fliers, and are difficult to observe or capture. Nectaring or ovipositing adults fly 5–15 cm above the ground. In general, female *euterpe* appear to be slower fliers than female *phaeton*. As the afternoon winds increase, adult basking locations change to areas protected from the wind, such as in washes, behind knolls, or on the ground among bushes. While basking, the ground color of the moths blends well with that of the soil; only their movement as they are about to fly discloses their location. When disturbed, the moths fly about 60 cm above the ground. This flight behavior, combined with their gray coloration, makes them difficult to follow as the moth may easily be confused with its shadow.

Little variation has been observed in adult specimens. In some individuals the submargin of the forewing is about the same color as the rest of the wing, while in others it is the darkest portion of the wing. Some individuals with dark submarginal areas also have a thin gold postmedial band on the forewing (Figs. 5, 6).

Oviposition and Larval Behavior

An unexpected observation was the large number of mistakes made by the females during oviposition. By following ovipositing females and identifying the plants upon which they deposited eggs, we expected to locate *Camissonia*. But time after time females deposited ova on the imported weed, *Erodium cicutarium*. Eggs were laid one, or occasionally two at a time, on the underside of the leaves or on the stems. Larvae reared on *Erodium* did not feed and died of starvation after three days. First instar larvae have been observed to be rather sessile. Considering these observations, the survival of individuals from ova deposited on *Erodium* seems unlikely. Such oviposition errors may contribute to the scarcity of the moth. If this hypothesis is

correct, the probability of successful oviposition may be related to the distribution, abundance, and height of the host plant in relation to *Erodium* during any given spring. *Erodium cicutarium* was introduced to California by the Spanish, and records indicate that it was well established from San Francisco to Baja California by 1775 (Hendry & Bellue, 1936; Robbins, 1940).

A mature larva was collected on *Camissonia*, 6 April 1974 (E. Walter, pers. comm.) and in 1975 Mr. Henne reared *euterpe* larvae on this same species of *Camissonia*. This plant was later identified as *Camissonia contorta epilobiodes* Munz. (by J. McCaskil, Dept. of Botany, Univ. Calif. Davis). We found that larvae of all instars appear to prefer to feed on flowers, and the new apical growth; first instar larvae seemed to feed exclusively on flowers. The disruptive color pattern of fourth and fifth instar larvae allows them to blend well with the colors of the host plant. After feeding, mature larvae rest on the stems near the base of the plant, an area where their pattern blends especially well with that of the plant (Figs. 3, 4). Pupation occurs in the soil, and the pupation chamber is constructed near the surface, perhaps under rocks or other objects. Although larvae in captivity constructed pupal chambers, all perished in the pre-pupal stage.

Pronounced differences were observed in first instar larvae of *euterpe*, *phaeton*, and *phaeton mojave*. The thoracic shield, anal horn, and patches on the prolegs are heavily sclerotized and dark brown or black in *euterpe* (Fig. 2), but are not sclerotized and green in *phaeton*. First instar setal patterns of *euterpe* and *phaeton* are similar.

Type Locality

In the description of *euterpe*, Edwards (1888) states that the type locality of this moth is near San Diego; however this is almost certainly incorrect. Henry Edwards described many moths and butterflies that he had received from H. K. Morrison, including *euterpe*. Edwards published so many incorrect type localities for the material he had received from Morrison, that Morrison felt compelled to publish a short note in 1883, correcting the errors which Henry Edwards had made. Two of these corrections are of special interest for they are a moth and butterfly from the Kern River, near the present colony of *euterpe*. In addition, the community of Havilah which is located a few miles north of the basin was an active mining town, and served as the county seat until 1874 (Hoover et al., 1966). The same records also indicate access to Havilah and the Kern River was by the wagon road which passed through the Walker Basin. Thus, what is now an out of the way area was once situated along major lines of transportation, and when Morrison traveled to the Kern River to collect *An-*

thocharis morrisonii Hy. Edwards, and *Copaeodes eunus* Hy. Edwards, he would have passed through Walker Basin. Shortly after his publication Morrison died, and thus could not have corrected any later erroneous type localities published by Edwards. Further, scores of *Euproserpinus* from San Diego have been examined but all have been *phaeton*. Comstock (1938), in his effort to locate *euterpe*, suggested that if the type locality was correct, the moth must no longer exist. Based on this information, it is likely that Edwards' type locality for this moth is in fact incorrect, and that the true type locality is in or near Walker Basin.

Because of the small size of the existing colony, *euterpe* was brought to the attention of the Office of Endangered Species and received protection as a threatened species in April of 1980.

Capture Records

1974: 5 ♀♀, CH, Mar. 21; 3 ♀♀, CH, Mar. 22; 2 ♀♀, CL, Mar. 22.

1975: 1 ♂, EW, Feb. 26; 1 ♂, 1 ♀, JJ, Feb. 27; 1 ♂, 1 ♀, JJ, Mar. 29; 2 ♂♂, 1 ♀, EW, Mar. 29; 1 ♀, CH, Mar. 29; 1 ♀, CH, Apr. 2.

1976: 2 ♂♂, MVB, Mar. 17; 1 ♂, 1 ♀, CH, Mar. 17; 1 ♀, CH, Mar. 21.

1977: 1 ♂, CH, Mar. 21; 1 ♀, CH, Apr. 6. 1978: None collected.

1979: 1 ♂, JC, Mar. 18; 1 ♂, 4 ♀♀, PT, Mar. 22; 2 ♂♂, 6 ♀♀, PT, Mar. 23; 1 ♂, 3 ♀♀, PT, Mar. 24; 4 ♂♂, 12 ♀♀, JB, Mar. 24; 1 ♂, 7 ♀♀, JC, Mar. 24; 1 ♂, 5 ♀♀, JC, Mar. 25; 1 ♂, JC, Mar. 29.

Collectors: Chris Henne (CH), Charles Long (CL), Jean Cadiou (JC), Jim Brock (JB), Paul Tuskes (PT), Mike Van Buskirk (MVB), Erich Walter (EW), John Johnson (JJ).

The specimens collected by Henne and Long are deposited in the Los Angeles County Museum of Natural History. Specimens collected by Van Buskirk and the majority of those collected by Tuskes are deposited at the California Academy of Science and the United States National Museum. Preserved larvae have been sent to the Los Angeles County Museum of Natural History.

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BOOK REVIEW

CATALOGO DOS ITHOMIIDAE AMERICANOS (LEPIDOPTERA) by Romualdo Ferreiera d'Almeida. Conselho Nacional de Desenvolvimento Cientifico e Technologico, Curitiba, Parana, Brazil. 405 pp. 1978. No price stated.

and

SUPLEMENTO AO CATALOGO DOS ITHOMIIDAE AMERICANOS (LEPIDOPTERA) DE ROMUALDO FERRIERA D'ALMEIDA (Nymphalidae: Ithomiinae) by Olaf H. H. Mielke & Keith S. Brown, Jr. Consehlo Nacional de Desenvolvimento Cientifico e Technologico, Curitaba, Parana, Brazil. 216 pp. 1979. No price stated.

These two volumes are an absolute necessity for anyone working in the family Ithomiidae (or subfamily Ithomiinae, depending upon your choice). At the time of his death in 1969 d'Almeida had completed the draft of his manuscript catalogue through names and articles published in 1968. Dr. Mielke, d'Almeida's scientific heir, sorted through the numerous manuscripts left to him and selected those for publication. This catalogue is one of them. It is another of d'Almeida's compilations of the literature on neotropical butterflies. The positions I have checked are accurate and complete in so far as he went, with a few exceptions that were caught by Mielke & Brown in their supplement.

The authors of the supplement have been involved in the study of this difficult family for some years. The supplement is a synopsis of their findings through the genus *Hypothryis* Hübner. This extends through p. 118 and covers the Tithorini, Melinaeini, and the Napeogenini, except for *Hyalyris* Bdv. Future work by this energetic team may be expected to complete these revisory studies. The few extended Portuguese notes in the catalogues are easily deciphered by those who do not command the language.

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