

THE BIOLOGY OF *CALLOPHRYS (INCISALIA)*  
*FOTIS BAYENSIS* (LYCAENIDAE)<sup>1</sup>

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Despite its occurrence in a region which has been explored by lepidopterists for over a century, *Callophrys (Incisalia) fotis bayensis* Brown was not discovered until 1962 (Brown, 1969a). At the present writing, the type locality of this unique butterfly, the San Bruno Mountains in San Mateo County, California, is about to be "developed" for homesites and commercial properties. Although efforts are being made by conservationists to halt this destruction of the natural habitat, it appears unlikely that the San Bruno Mountains will remain unaltered. For this reason, numerous visits have been made to this area over the past four years to record as much of the biology of the butterfly fauna as possible before it is permanently lost to science. Many of the data in this paper were gleaned during these investigations.

Brown (1969b) published a brief description of the larva and habitat of *C. f. bayensis*. Our purpose is to provide additional detailed information on the biology of the insect. Emmel carried out intensive field work in the San Bruno Mountains to document preferred habitat, flight span, and behavior of adults and immatures. Ova were sent to Ferris for rearing and describing of the immature stages. To determine the regional distributions of *bayensis*, Emmel surveyed the San Francisco Bay area from 1968 to 1971 to locate populations of *Callophrys fotis* outside of the type locality.

#### Distribution

The San Bruno Mountains are located on the San Francisco Peninsula at the northern end of San Mateo County, California. The range is approximately four miles long and one to two miles wide, and runs from northwest to southeast. Elevation ranges from sea level at the eastern end on San Francisco Bay to 1314 feet at the highest peak. *Callophrys*

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*fortis bayensis* has been collected in at least six localities in the San Bruno Mountains. These localities are generally situated on north-facing slopes where moisture is conserved and the foodplant grows in abundance.

*C. f. bayensis* has been found in two localities outside of the San Bruno Mountains, both in San Mateo County. One locality is on a north-facing slope near the south end of Milagra Ridge, just north of Sharp Park Road at 400–550 feet elevation. This is about four airline miles southwest of the San Bruno Mountains. Immatures were taken here in April and May 1969, and in May 1970. Only about 50% of the adults from this population are typical *bayensis*; the remainder superficially resemble *C. f. schryverii* Cross, or *C. f. mossii* (H. Edwards).

The other locality, outside of the type locality, is on the northwest flank of Montara Mountain at 900–950 feet elevation, 1.1 air miles south of the Linda Mar School in Pacifica. This area, in the northernmost extension of the Santa Cruz Mountains, is about nine miles from the San Bruno Mountains. Immatures were collected here in April 1969, and adults were taken in March 1970. All specimens from this locality appear to represent typical *bayensis*.

Suitable habitats have not been found south of the Montara Mountain area. To the north of the San Bruno Mountains, two localities which have habitats similar to the type locality have been discovered. These localities, however, apparently do not support populations of *bayensis*, presumably because of limited foodplant biomass. One locality is on the north slope of Twin Peaks in San Francisco at 700–800 feet elevation where a fairly extensive *Sedum spathulifolium* colony grows. In the past, this area may have supported a *bayensis* colony which was exterminated through the gradual destruction of the habitat by housing developments.

The other locality is on a north-facing slope 1.0 air mile west of Yellow Bluff in the Fort Baker Military Reservation, south of Sausalito in Marin County. This area is about seven airline miles from the San Bruno Mountains. While the foodplant is locally abundant here, repeated visits have failed to produce evidence that *bayensis* occurs in the area. Further north in Marin County, a distinct new subspecies of *Callophrys fortis* has been found in a habitat markedly different from that which supports *bayensis*. This new subspecies is being described in a separate paper.

Fig. 1 shows the known distribution of *bayensis*; records of adult and larval collections are given below.

#### Habitat and Foodplant

An excellent description of the climate, geology, and flora of the San Bruno Mountains is provided by McClintock & Knight (1965). The



FIG. 1. Map showing locations where *C. fotis bayensis* occurs. The stippled circles represent the known colonies. SBM = San Bruno Mountains; SP = Sharp Park; M = Montara Mountain.

Milagra Ridge and Montara Mountain localities have a climate and habitat which are very similar to those of the localities in the San Bruno Mountains.

As noted above, *bayensis* is typically found on steep north-facing slopes where its foodplant, *Sedum spathulifolium* Hooker (Crassulaceae), grows abundantly. Representative vegetation on these slopes includes *Rhus diversiloba* Torr. and Gray (Poison Oak), *Berberis pinnata* Lag. (Coast Barberry), *Baccharis pilularis* DC. (Coyote Brush), *Anaphalis margaritacea* (L.) Gray (Pearly Everlasting), *Erigeron glaucus* Ker. (Seaside Daisy), *Dudleya farinosa* (Lindl.) Br. and R., *Arabis blepharophylla* H. and A. (Coast Rock Cress), *Eriogonum latifolium* Sm. (Coast Buckwheat), *Ranunculus californicus* Benth. (California Buttercup), and *Lomatium utriculatum* (Nutt.) C. and R. (Bladder Parsnip).

*Sedum spathulifolium* blooms from April to June. In areas where the

plant is abundant, the bright yellow flowers and red stems form a virtual carpet of color over the rocky ground. These colors are reflected in the cryptic patterns on the third and fourth instar larvae (see larval description below).

#### Field Observations of Adults and Immatures

Emergence of adults takes place primarily during the month of March. A series of adults taken on 15 March 1970 exhibits a complete spectrum between worn and fresh specimens. In some years, a few adults probably emerge as early as late February.

No visits to the habitat of *bayensis* were made earlier than 1030 PST, at which time flight activity appeared to be maximal. It would appear that flight begins at least an hour earlier in the day. No data were obtained on flight activity during the afternoon hours. Adults of both sexes remained in close proximity to the foodplant. Males were much more active than females, often landing repeatedly on small shrubs, and they appeared to exhibit territorial behavior. Several males were noted nectaring at flowers of *Ranunculus californicus*, *Arabis blepharophylla*, and *Lomatium utriculatum*. Females tended to settle on the foodplant where they remained unless disturbed, and then they flew only short distances.

Oviposition takes place in March and early April. In one of the San Bruno Mountains localities, a total of five ova were located on leaf upper-sides of the foodplant. Confined females oviposited freely on both upper-sides and undersides of *Sedum* leaves.

The first and second instar larvae bore into the succulent leaves. By the time the third instar is reached in nature, the *Sedum* plants are beginning to bloom and the larvae generally move up to the flowerheads to feed. In many cases, the larvae fail to locate flowering stalks, and feed through to maturity on the centers of leaf rosettes. Brown (1969b) states that the color of the mature larva depends upon the color of the part of the foodplant on which it feeds; we noted no such relationship. Larvae reared by Ferris on leaves alone displayed three distinct color morphs. In the field, Emmel observed mature larvae of the various color morphs to be randomly distributed with regard to the color of the foodplant parts on which they were feeding. Myrmecophily was never observed in the field studies.

Pupation was not observed in the field, but probably occurs in ground litter under or near the *Sedum* plants. Ecdysis of adults in the laboratory invariably occurred during the early morning hours, usually within an hour of being exposed to the first light of day.

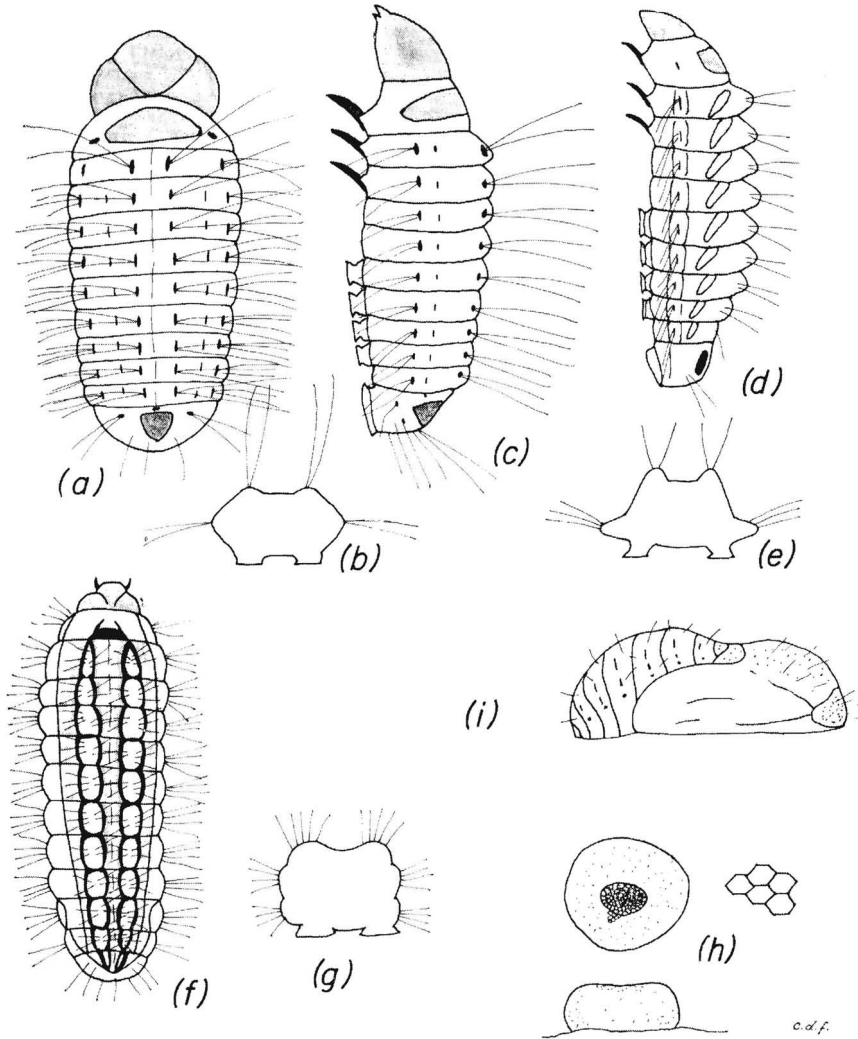


FIG. 2. Larva, ovum, and pupa of *Callophrys fotis bayensis*: a. first instar larva, dorsal view; b. first instar larva, cross-section through middle segment; c. first instar larva, lateral view; d. second instar larva, lateral view; e. second instar larva, cross-section through middle segment; f. third instar larva (mature), dorsal view in normal feeding position; g. third instar larva, cross-section through middle segment; h. ovum, dorsal and lateral views and enlargement of hexagonal cell pattern; i. pupa, lateral view.

## Description of Immature Stages

In March 1970, several females collected by Emmel in the San Bruno Mountains were confined over *Sedum spathulifolium* plants to obtain ova for life history studies. These females were placed in small jars containing several leaf rosettes of the foodplant. The jars were covered with netting and placed under a goose-neck lamp using a 75 watt bulb. The females oviposited freely on the *Sedum*. The ova obtained were sent to Ferris, who reared them on transplanted specimens of *Sedum spathulifolium* and described the immature stages.

**Ovum:** The eggs were pale green oblate spheroids approximately 0.8 mm in diameter. The eggs hatched in five to six days, and turned opaque white prior to emergence of the larvae.

**First instar:** The first instar larvae were pale yellow-green with clear hairs upon emergence from the eggs. They turned somewhat darker prior to moulting. The newly emerged larvae did not eat the egg shells. Stadium one lasted two days and the larvae increased in size from 1 mm to 2 mm.

**Second instar:** In this instar, the larvae were pink with pale hairs. Stadium two lasted three days with growth increase from 2 mm to 3 mm. The mature second stadium larvae varied in color from pale to dark pink.

**Third instar:** Initially, the larvae were a dark cream or straw color with considerable pink mottling, and were covered with short black spines. The larvae remained in the third instar from 9–12 days. Larval length reached 1 cm. In this stage, various color morphs developed. The mature stadium three larvae varied from yellow to cherry red, with greenish mottling. The caterpillars spent 24 to 48 hours in the transformation to the fourth instar. They remained motionless and contracted in length to about 7 to 8 mm before moulting.

**Fourth instar:** The fourth instar larvae exhibited three color morphs from the beginning. Some were yellow, some pale orange, and others cherry red, all with short dark bristles. There were pronounced chevron markings dorsally on the segments, at first in a similar, but darker color than the background. Later, the chevrons were dark cherry red. Some of the yellow larvae had very light or absent chevron markings. This instar lasted about 15 days with growth from 1 cm to 2 cm. A sample of 89 larvae collected in the San Bruno Mountains on 23 May 1971, showed the following numbers of the three principal color morphs: "red," 63 (71%); "yellow," 5 (6%); "light orange" or "intermediate," 21 (24%).

**Pupa:** The fourth stadium larvae spent three days in the prepupal stage. They were motionless during this period and contracted considerably in length. Initially the pupae were pale pink, but turned quickly to pale brown. They exhibited short hairs dorsally. The pupae measured from 0.7 to 0.9 cm in length. Pupation occurred on the earth in the debris at the bottom of the rearing jars.

The transformation from ovum to pupa required an average of 34 days under laboratory conditions of 20° C. and 12 hours of artificial sunlight per day.

The larvae were voracious feeders and were peripatetic. While feeding, they remained relatively motionless and burrowed into the leaves of the hostplant, leaving a large pile of frass behind them. This created some problem with rearing, as the excreta molded quickly, and tended to produce mold on the anal end of the larvae. The first instar larvae fed on the small leaves in the center of the *Sedum* rosette. They appeared in-

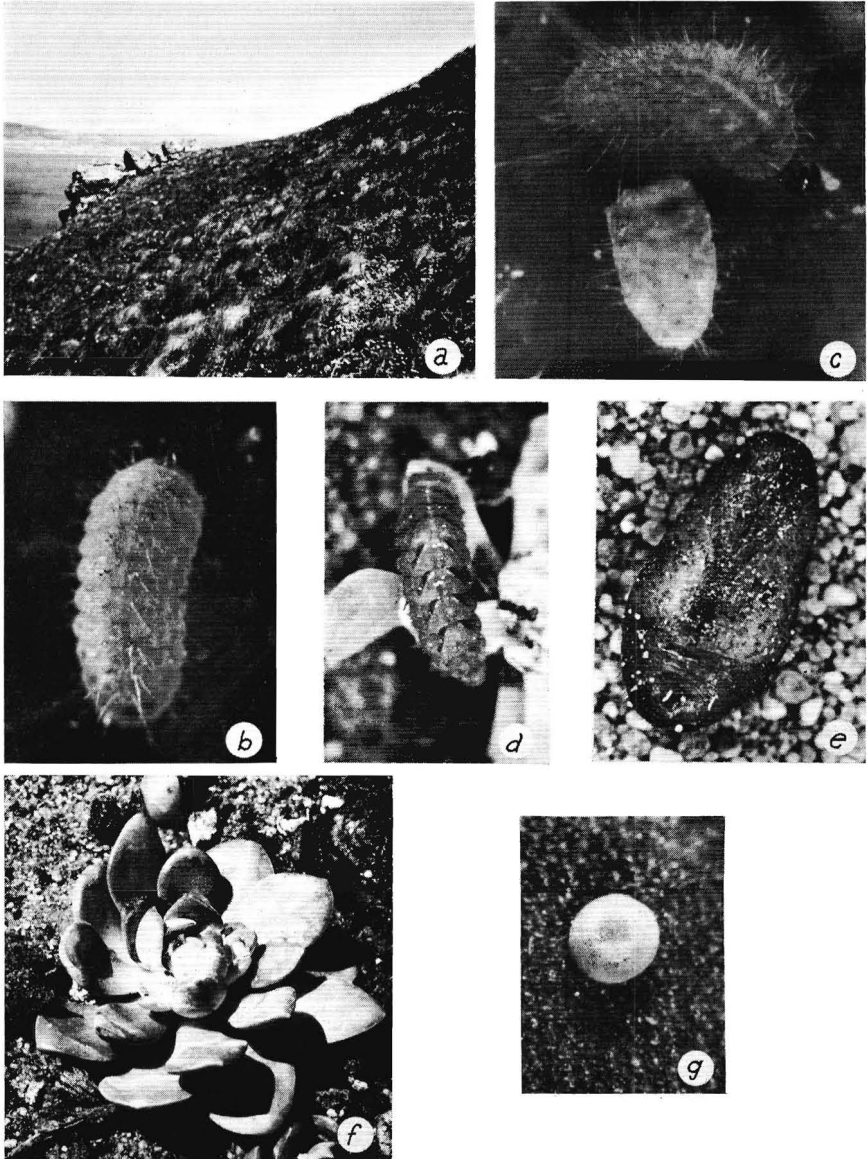


FIG. 3. *Callophrys fotis bayensis*: a. habitat in the San Bruno Mountains, San Mateo Co., California; b. second instar larva preparing to moult; c. new third instar larva, note cast-off skin and black head capsule; d. mature fourth stadium larva; e. pupa; f. young hostplant *Sedum spathulifolium*, the stage when oviposition occurs; g. ovum.

quisitive or pugnacious and reared up their heads whenever an object came near. The third and fourth instar larvae totally devoured the food-plant, both leaves and stems. Prior to each moult, the larvae spun a light silk mat to which they anchored themselves. The cast-off skins were not eaten.

### Distribution Records

CALIFORNIA. **San Mateo Co.:** slope 2 air miles W of Sierra Point, 1000', San Bruno Mts., 1 ♂, 1 ♀, 21-III-69; ravine 1.7 air miles WNW of Sierra Point, 700-800', San Bruno Mts., 5 ova on leaf uppersides of *Sedum spathulifolium*, 13-IV-69; at S end of Milagra Ridge, along and N of Sharp Park Road, 4 second-third instar larvae on flower buds and leaf rosettes of *S. spathulifolium*, 29-IV-69; same locality, 24 third-fourth instar larvae on flowers of *S. spathulifolium*, 14-V-69; same locality, 22 first-third instar larvae on flower buds and leaf rosettes of *S. spathulifolium*, 29-IV-70; on NW flank of Montara Mountain, 1.1 air miles due S of Linda Mar School, 925', 7 second-third instar larvae in centers of leaf rosettes of *S. spathulifolium*, 29-IV-69; same locality, 5 ♂, 1 ♀, 16-III-70; ravine 1.6 air miles WNW of Sierra Point, 800-1000', 15 third-fourth instar larvae on flowers of *S. spathulifolium*, 29-V-69; slope 1.2 air miles ESE of 1314' summit, on NE slope of San Bruno Mts., 850-1000', 24 ♂, 20 ♀, 15-III-70; same locality, ca. 40 third-fourth instar larvae on flowers and leaf rosettes of *S. spathulifolium*, 17-V-70; same locality, 27 ♂, 16 ♀, 28-III-71; same locality, 89 second-fourth instar larvae on flower buds and leaf rosettes of *S. spathulifolium*, 23-V-71; along crest of range 0.7 air mile SE of 1314' summit, San Bruno Mts., 1000-1100', 1 ♂, 28-III-71; same locality, 1 ♂, 2 ♀, 3-IV-71; same locality, 16 second-fourth instar larvae on flower buds and leaves of *S. spathulifolium*, 14-V-71; east-facing slope 0.6 air mile NNE of 1314' summit, 600-650', San Bruno Mts., 15 second-third instar larvae on flower buds and leaves of *S. spathulifolium*, 7-V-71; same locality, 29 third-fourth instar larvae on flowers of *S. spathulifolium*, 31-V-71.

All of the above specimens were collected by J. F. Emmel. The type locality cited by Brown (1969a) is a northwest-facing slope 0.2 air mile west and slightly south of the 1314' summit, 1000-1100', San Bruno Mts.

### LITERATURE CITED

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