

## THE POPULATION BIOLOGY AND LIFE HISTORY OF *PAPILIO INDRA MARTINI*

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The discovery of a new *Papilio* in a desert locality in which California lepidopterists have collected regularly for over half a century was recently described by the present authors (Emmel & Emmel, 1966). The present paper reports data on the ecology, distribution, and life history of this butterfly, *Papilio indra martini* Emmel & Emmel, obtained from field work in the type locality from 1963 to 1966.

### GENERAL REMARKS

The first clue to the presence of a member of the *Papilio indra* complex in the Providence Mountains (eastern Mojave Desert, San Bernardino County, California) was a single variant specimen in the *P. i. pergamus* series in the collection of the Los Angeles County Museum, bearing the label "Providence Mts., 4-5-34." A few weeks after examining this specimen, we visited the Providence Mountains on March 23-24, 1963, to search for adults or a suitable foodplant of the *Papilio*. On March 23, we climbed to one of the high peaks above Bonanza King Mine Canyon on the eastern slope of the range. At the top, a male *P. i. martini* (as later described in the 1966 paper) was observed landing on rocks, but the treacherous terrain prevented its capture. On the following day, we hiked into Gilroy Canyon, about a mile south of the Bonanza King Mine, to look for possible foodplants. In this canyon we found a number of umbelliferous plants which we suspected to be the foodplant. A search of the plants revealed no immatures.

We were able to return to the area on May 9, 1964. The morning was spent collecting in Bonanza King Mine Canyon, where we found a battered *P. i. martini* female resting on the canyon floor. This prompted us to search for immatures on the plants in Gilroy Canyon; there, the suspected foodplant yielded over sixty *Papilio* eggs. These were placed in sleeves of nylon netting over the foodplants for field rearing.

We returned to the area on June 22 of the same year to collect whatever pupae had been formed in the sleeves. This rearing method proved to be somewhat of a failure: less than a dozen pupae were recovered from the original sixty eggs. Some of the factors leading to the low yield of live pupae were: improper pupation site (as in netting folds), pupal

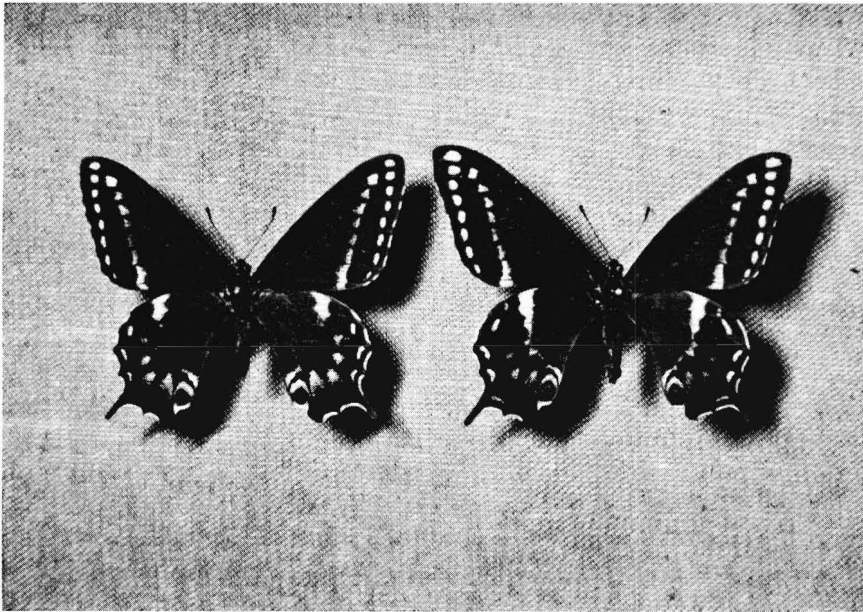


Fig. 7. Dorsal view of a male and female *Papilio indra martini*, reared from larvae collected in the Providence Mountains of California on May 28, 1965. The type specimens previously illustrated (Emmel & Emmel, 1966) had slightly broader bands than this pair.

parasitism, and rodents chewing holes in the sleeves which allowed larvae to escape. A small number of fifth instar larvae were also found in the sleeves. These were taken with us to Donner Pass (7600'), Placer County, California, where they were sleeved out on *Pteryxia terebinthina*, a foodplant of *P. i. indra*. The pupae from these larvae were collected on July 20 when we returned to the Pass.

One of the pupae collected in Gilroy Canyon emerged on July 8, probably within three weeks of pupation, judging from the fact that most pupae were newly-formed when collected on June 22. The remaining pupae emerged in the fall of 1964 and spring of 1965 after several months' refrigeration and subsequent warming at room temperature.

In the spring of 1965 we collected more immatures on May 28, both in Gilroy Canyon and in the south fork of Bonanza King Mine Canyon where more foodplants were found. These were taken back to Stanford University and reared on potted plants of *Tauschia arguta*. Of the resulting pupae, two emerged within 20 days of pupation. The remainder emerged the following spring.

In the spring of 1966, *P. i. martini* was relatively common, after a winter of high rainfall in Southern California. In early April, several lepidopterists collected over a dozen adults and a large number of eggs in the south fork of Bonanza King Mine Canyon. The authors visited the same locality on April 14 to collect two adults and over sixty eggs. These were reared in the laboratory of *Tauschia arguta*; all of the resulting pupae went into diapause. About 20 eggs were sent to David V. McCorkle in Oregon for rearing. Of the pupae obtained by McCorkle, one emerged within several weeks of pupation.

#### DESCRIPTION OF FOODPLANT

The foodplant was identified as *Lomatium parryi* (Wats.) MacBr., using *A California Flora* by Philip Munz. This identification was verified by comparison of our plants with specimens of *L. parryi* in the Dudley Herbarium at Stanford University. The range of this plant includes southern Utah, southern Nevada, extreme northern Arizona, and the eastern deserts of California. It is typically found in rocky areas in the Pinyon-Juniper zone, from 4000 feet to 8500 feet elevation. The plant closely resembles *Lomatium eastwoodae* (C. & R.) MacBr., the foodplant of *P. i. minori* in western Colorado, except that it is much larger, generally about eight to twelve inches in height. In the Providence Mountains it is found in limestone canyons above 4700 feet elevation. Flowering here occurs in March and April, and the leaves remain green into late August. The plant has a strong odor detectable by a human observer, as do the other foodplants of *P. indra* subspecies.

#### HABITAT

The *Lomatium* plants were most common along the canyon bottoms, but were found also in crevices in the canyon walls. The habitat is arid Pinyon-Juniper woodland in the Upper Sonoran Life Zone. This zone extends to the highest peaks of the range, which are over 7000 feet in elevation. The dominant rock is limestone. The topography is one of narrow canyons with steep walls, and precipitous rocky ridges.

#### ADULT HABITS

The observed *P. i. martini* males were either flying about peaks, or "patrolling" the canyons, presumably searching for females. Females were found in the canyon bottoms, often hovering around the *Lomatium* plants to oviposit. No nectar source was observed.

Emergence of adults begins in late March and apparently continues into late April, as evidenced by our dates of capture or observation of

adults and early stages. *P. i. martini* is apparently partially double-brooded, inferred from the emergence of a small percentage of adults several weeks after pupation; it is especially significant that one of these non-diapausing pupae was reared under natural conditions. We have not visited the type locality during the time (July) a second brood would be flying. From field observation, it is known that *P. i. kaibabensis* and *P. i. minori* are double-brooded (Emmel & Emmel, 1967) and that *P. i. indra*, *P. i. pergamus*, and *P. i. fordi* are single-brooded.

#### LARVAL HABITS

First- and second-instar larvae remain near the tips of the leaves of the foodplant, where the eggs are laid. Third-instars generally rest on the petioles, but near the outer part of the leaves. The fourth-instar larvae are found on the petioles near the base of the plant when not feeding. When disturbed, second- through fourth-instar larvae drop readily from the plant. The fifth-instars rest among the petioles at the base of the plant; in this position they are almost always completely hidden, exposing themselves only when feeding. Feeding occurs almost entirely during the daylight hours.

#### DESCRIPTION OF EARLY STAGES

##### *Egg:*

The egg is similar in size and shape to that of *P. i. minori* (see Emmel & Emmel, 1964). The diameter when viewed superiorly is about 1.1 mm. The color is a light cream when first laid, and the egg surface is smooth in texture. The eggs are laid singly, near the tips of the *Lomatium* leaves.

##### *Fourth-Instar Larva:*

Length: 21–25 mm at maturity. Head: Width of head capsule, 2.1–2.2 mm. Shiny jet black, with a small crescent-shaped orange mark at the center.

Body: The pattern in this instar is extremely similar to that of the fourth-instar larva of *P. i. fordi*, and the range of variation in the larvae likewise corresponds (see Comstock & Martin, 1955). The ground color is jet black. There are four longitudinal rows of tubercles. On the third abdominal segment there is a lateral white dot. On the fourth abdominal segment is located a white "saddle" mark, composed of an irregular row of white spots transversely circling the body. A similar transverse row of white spots is found on the eighth abdominal segment. A white spot occurs on the lateral side of the base of each proleg. The larva may or may not have other white spots present. The legs and prolegs are black.

##### *Fifth-Instar Larva:*

Length: 35–40 mm at maturity.

Head: Width of head capsule, 4.0 mm. The head capsule pattern (Figure 5) is very similar to that of *P. i. fordi*. The ground color is black, and the lighter area is a deep orange.

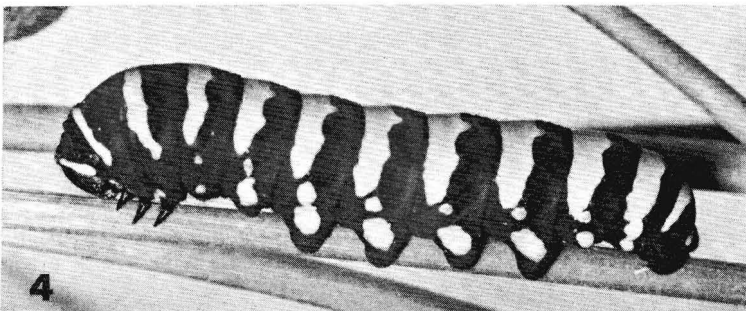
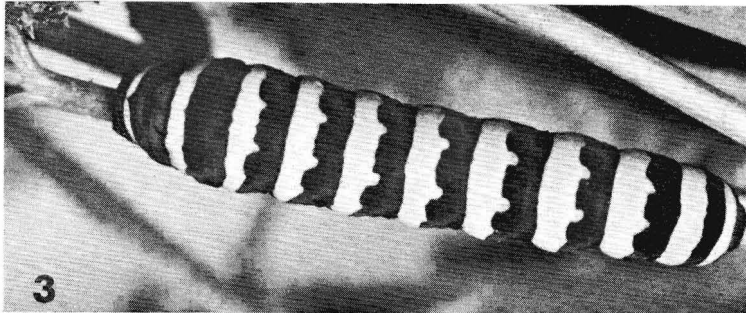
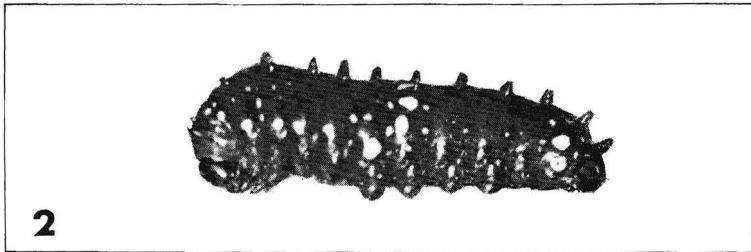
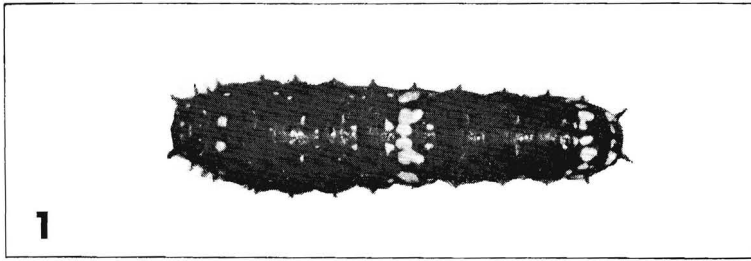


Fig. 1. Fourth-instar larva of *Papilio indra martini*, dorsal aspect.  
Fig. 2. Fourth-instar larva of *P. i. martini*, lateral aspect.  
Fig. 3. Fifth-instar larva of *P. i. martini*, dorsal aspect.  
Fig. 4. Fifth-instar larva of *P. i. martini*, lateral aspect.

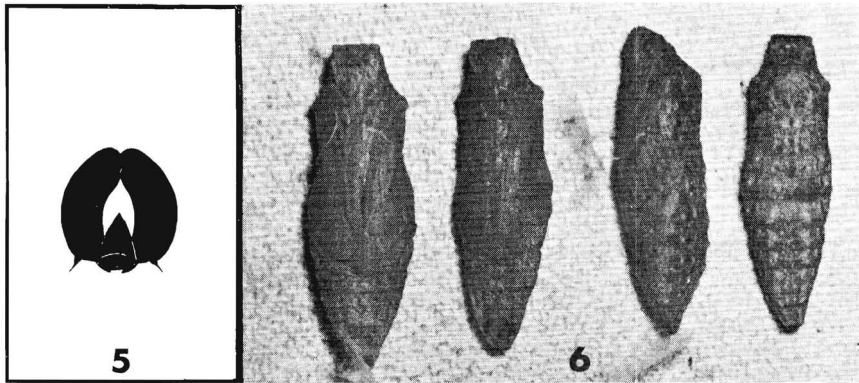


Fig. 5. Head capsule pattern of the fifth-instar larva of *P. i. martini*. Dark areas black, light areas deep orange.

Fig. 6. Pupae of *P. i. martini*. From left to right, ventral aspect (first two), lateral aspect, dorsal aspect.

Body: See Figures 3 and 4. The ground color is black. The first and second thoracic segments each have a narrow transverse *pink* band arching over the anterior half of the segment, ending on either side at the level of the spiracles. The same pattern is found on the succeeding segments; on these the pink band is wider and a pink spot is located laterally at either end of the band; this lateral spot may or may not be connected with the band. Some larvae have salmon-colored, rather than pink, bands. A transverse row of four small, deep ochre yellow dots is located on the posterior edge of each pink band, from the third thoracic segment to the eighth abdominal segment. In some examples these yellow dots are absent. The true legs and prolegs are black; a large white spot is found laterally on each proleg. A white dot is also found ventro-laterally on the first, second, seventh, and eighth abdominal segments; often the thoracic segments have a white dot located ventro-laterally.

The *P. i. martini* last instar larva is distinctive from that of *P. i. fordi* (see figure in Comstock & Martin, 1955), which has *WHITE* transverse bands. The transverse dots which are deep ochre yellow in larvae of *P. i. martini* are lemon yellow in *P. i. fordi* larvae.

#### *Pupa:*

Length: 20.0–28.0 mm. Greatest width at wing cases, 6.8–9.0 mm.

The pupa is morphologically like that of other subspecies of *P. indra*. The ground color varies from a light dull tan, to dull greenish-tan, to dull grayish-tan. The surface is rough, and has scattered marks and splotches of color darker and lighter than the ground color, giving it a vaguely mottled appearance. The wing cases are less mottled and generally darker than the other surfaces, and are often a dull tannish olive green.

#### KNOWN DISTRIBUTION OF THE SUBSPECIES

*P. i. martini* has not been taken in any localities outside of the eastern slope of the Providence Mountains. It will likely be found in the New

York Mountains, on Clark Mountain, and in the Granite Mountains north of Amboy, all in San Bernardino County, California; these adjacent ranges have habitats very similar to those in the Providence Mountains.

#### SUMMARY

The life history and foodplant of *Papilio indra martini* are described from field work in the Providence Mountains, California. The adults differ markedly from *P. i. fordi* adults, yet the ranges of these two subspecies approach within at least 40 miles of each other. The early stages of the two subspecies show a closer affinity, although the body color patterns of the last instar larvae are distinctive. *P. i. martini* apparently has a partial second brood. The food plant is *Lomatium parryi* (Wats.) MacBr. (Umbelliferae). Data on the ecology of the adults and larvae, and known distribution are also given.

#### ACKNOWLEDGMENTS

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