STUDIES ON THE BIOLOGY OF *PARIDES IPHIDAMAS* (PAPILIONINAE: TROIDINI) IN COSTA RICA

ALLEN M. YOUNG
Invertebrate Division, Milwaukee Public Museum, Milwaukee, Wisconsin 53233

The tropical butterfly *Parides iphidamas iphidamas* (Fabricius) occurs, along with several congeners (*arcas mylotes* Bates, *arcas mycale* Goodwin & Salvin, *childrenae* Gray, and *erithalion* Druce) in the Premontane Wet and Lowland Tropical Wet Forest life zones (Holdridge, 1967) on the Caribbean drainage of the Cordillera Central in Costa Rica. It is not uncommon to find butterflies of these *Parides* visiting the same patch of *Cephaelis tomentosa* Aubl (Vahl) (Rubiaceae) flowers each day. At higher elevations in Costa Rica, such as the Montane Wet Forest life zone, generally *P. arcas mylotes* prevails, and although *P. erithalion* and *P. childrenae* are relatively rare in premontane wet forest, they are more abundant in Lowland Tropical Wet Forest.

The life cycle and natural history of *P. arcas mylotes* from Costa Rican Premontane Wet Forest have been reported (Young, 1973). The present paper summarized similar information for *P. iphidamas* at the same locality. Being a very widespread and familar species throughout much of Central America, it is likely that this species has been studied in various places, but data from Costa Rica are not available. Rothschild & Jordan (1906) report that *P. iphidamas iphidamas* ranges from southern Mexico to Panama, and no information is given for the biology of this subspecies and the others. This paper is the second in a series on the biology of *Parides* species in Costa Rica, and it emphasizes differences in early stages and behavior between *P. iphidamas* and *P. arcas mylotes*.

METHODS

Studies were conducted from 10 January through 28 February 1976 on the properties of Compañia Agricola Myristica S.A. (C.A.M.S.A.) and Compañia Agricola Huntro S.A. (C.A.H.S.A.). The two companies have adjacent, extensive land holdings in northeastern Costa Rica. This locality was called "Finca Tirimbina" in Young (1973), and it is ca. 8 km from La Virgen (elev. 220 m), Heredia Province. The region (premontane wet forest) experiences heavy rainfall throughout most of the year and a short, erratic dry period in February and March. Of the land encompassed by both companies (a total of ca. 1500 acres), ca. 60% is still undisturbed primary forest, whereas the remainder is secondary forest and cultivated habitats. Owing, however, to plans to convert most

of the primary and secondary forest habitats into cultivated areas, the habitats of *Parides* are disappearing very fast in this region.

Parides butterflies were studied by searching for adults in a variety of different habitats and recording where they feed and oviposit.

To study the early stages of *P. iphidamas*, several eggs were collected at various times and confined, along with fresh cuttings of the host plant, in clear plastic bags kept tightly shut. The technique is essentially the same used to study *P. arcas mylotes* (Young, 1973). Although *P. iphidamas* has been reared before but incorrectly called *P. arcas mycale* (Young, 1972), the present study focused on the description of the early stages, for comparison with those of *P. arcas mylotes* (Young, 1973). In addition to finding eggs in the wild, two females were confined in separate bags with host plant cuttings to obtain eggs. Both females were caught from the same flower patch and within two weeks of each other during the latter half of January 1976. *Parides* females will generally oviposit readily in captivity, and they can be kept alive on sugar-water solutions for several weeks (Young, 1972). The eggs obtained were reared to the adult stage.

RESULTS

Habitat, Adult Feeding, and Larval Host Plant

Parides iphidamas, in contrast with *P. arcas mylotes* and *P. childrenae*, flies most frequently in open secondary habitats, and along the edges of primary forest. At a flower patch (*Cephaelis tomentosa*) observations of male *Parides* for 3 hr on sunny mornings resulted in the scoring of 8–35 visits of *P. iphidamas* relative to only 3–10 of *P. arcas mylotes* and 1–3 of *P. childrenae*. When *C. tomentosa* is abundantly in bloom in shaded forest, but within a few meters of the forest edge, several species of *Parides* visit the conspicuous red flowers. For example, during the late afternoon of 17 January 1976, six visits by both sexes of *P. iphidamas*, four by *P. arcas mylotes*, and two by *P. childrenae* were scored within 20 min (16:10–16:30 hrs) at a small patch of *C. tomentosa* in an old secondary forest of *Goethalsia meiantha* (Tiliacae) trees.

Other than *C. tomentosa*, *Parides* has not been seen visiting other inflorescences. However, probably other food sources exist. *Cephaelis tomentosa* produces it's large red inflorescences throughtout the year, providing a predictable food source for these and other butterflies, in addition to hummingbirds. However, there is considerable asynchrony of flower production within a patch, such that as some flowers wither following several days of bloom, others come into bloom. A far less abundant nectar source for *Parides* at this locality is *Impatiens sultani*

(Balsaminaceae), which occurs as small patches in heavily shaded forest openings where the ground is almost of mud consistency. The pink or red inflorescences attract *Parides* in mountain forest (Young, 1973), where this plant is very abundant. At lowland tropical wet forest localities, the bright red inflorescences of *Hamelia patens* (Rubiaceae) attract *Parides* species (Young, 1971).

At "Tirimbina," *Parides* butterflies share *C. tomentosa* nectaries with some *Heliconius* species (e.g., *H. hecale* and *H. cydno*). In the absence of precise data from field mark-recapture experiments, it appears that males of *P. iphidamas* and other *Parides* are more predictable visitors than females at a given flower patch on a day-to-day basis. For example, at one small forest edge patch of *C. tomentosa*, the same male *P. iphidamas* visited for six successive days, whereas several different females passed through the patch only one time each during the same period. I have witnessed similar patterns at other patches of *C. tomentosa*. On a given day, the same male would reappear 5–30 times at a flower patch, whereas a female would appear only once or twice.

Whereas *P. arcas mylotes* flies along forest edges (Young, 1973), *P. iphidamas* is more abundant in this ecotonal habitat. All 12 oviposition acts took place at forest edges where the larval host plant, *Aristolochia constricta* (Aristolochiaceae), occurs as large mature vines exposed to direct sunlight most of the day. Oviposition takes place throughout the day in clear weather; generally only one egg is laid, but occasionally two or even three eggs are laid separately on a single visit. The egg is always placed on the ventral side of an older leaf on a mature vine. The larval host plant is very abundant along the edges of primary forest, in forest openings, and in open, secondary habitats. Very small seedlings of this species occur in heavily shaded understory of forest remnants, although mature vines are not common in these places. *Aristolochia constricta is* microsympatric with *A. pilosa*, but the latter is generally rare at this locality, and it is not used as a host plant by *Parides* butterflies.

In a previous study, it was estimated that *Parides* females are capable of producing a few hundred eggs (Young, 1972). But the two females held captive in the present study only produced 22 eggs within a few days. One female, a young adult as judged by the condition of the wings, produced eight eggs between 14 and 16 January 1976, and the second female, judged as middle-aged, produced 14 eggs on 5–6 February 1976. Additional eggs could have been obtained, but one female was sacrificed and the other released. All of the eggs appeared viable in terms of size and coloration.

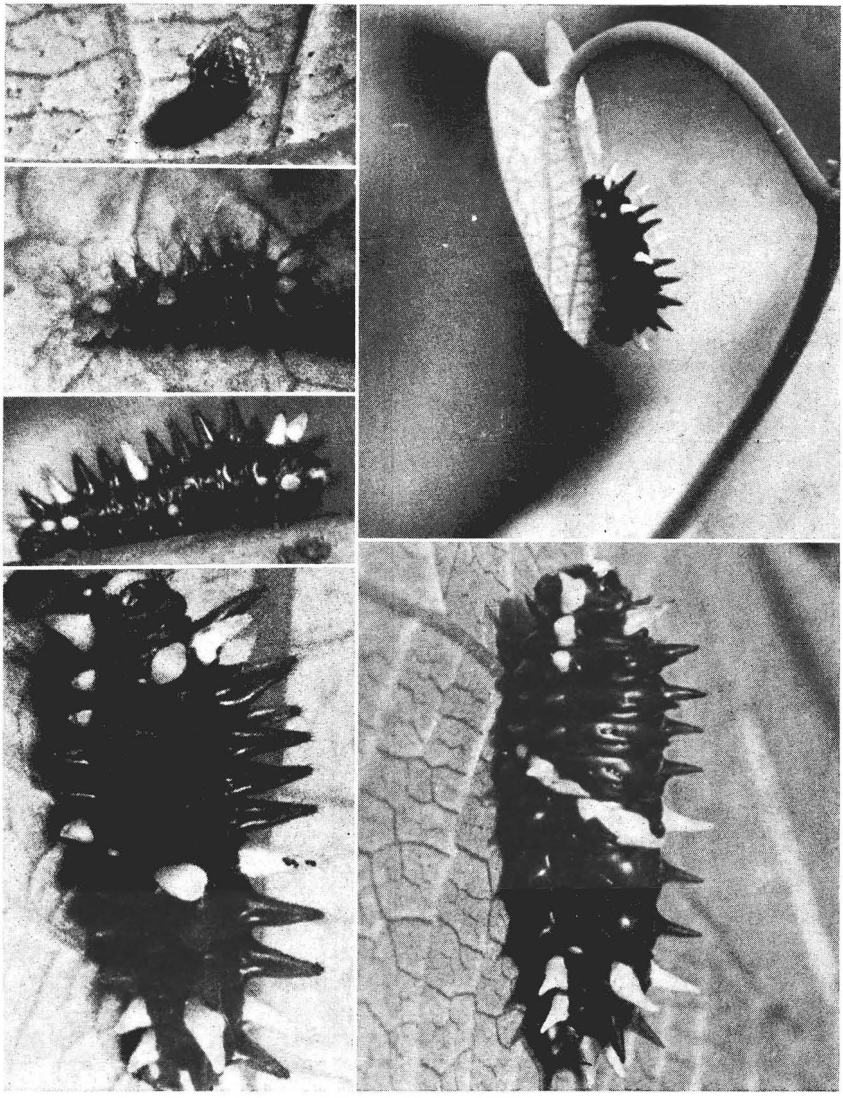

Fig. 1. Early stages of *P. iphidamas*. Left column, top to bottom: egg, first instar, second instar, and third instar caterpillars. Right, top: third instar feeding on *A. constricta* in the wild; right, bottom: fourth instar.

Life Cycle and Behavior of Caterpillars

Egg (Fig. 1). Brown to honey-orange, spherical, clearly visible vertical furrows at 10× magnification, 1.0 mm diameter. Hatches in 6–7 days (13 eggs).

First instar (Fig. 1). Thoracic and abdominal areas rusty-orange, head capsule

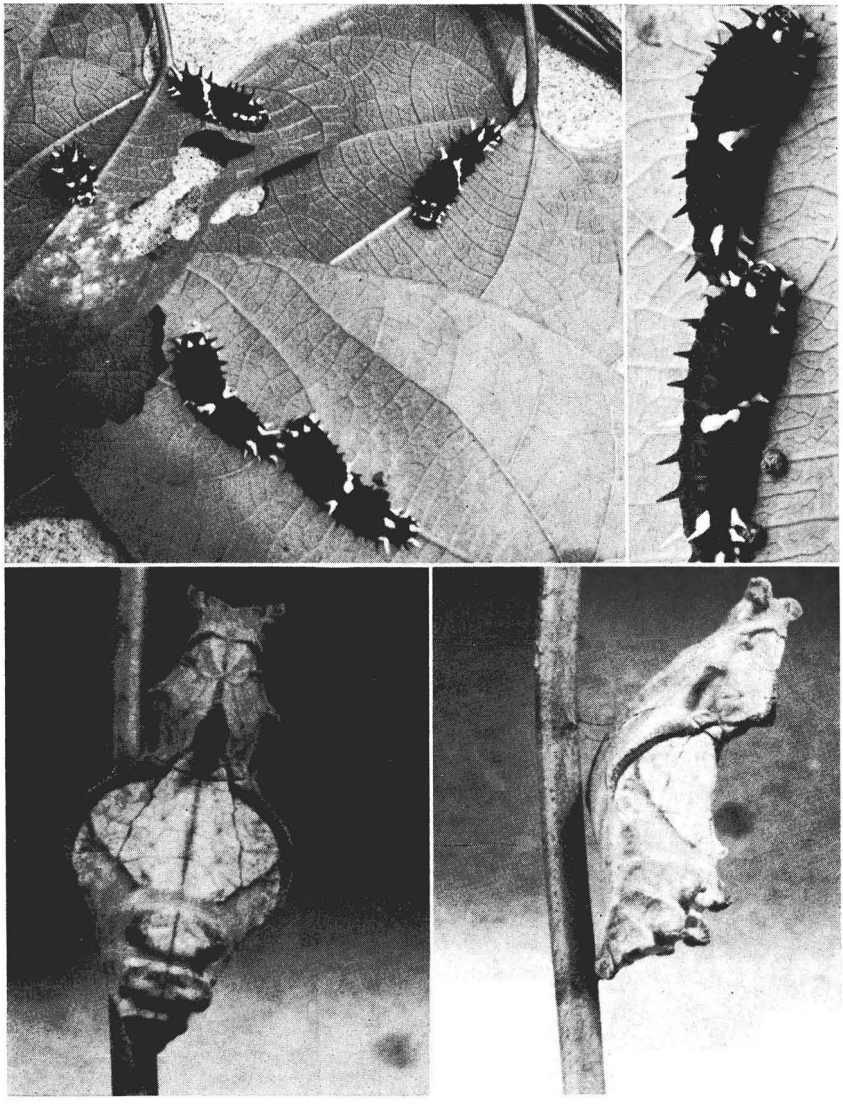

Fig. 2. Top: fifth instar caterpillar. Bottom: frontal and lateral aspects of the pupa.

black. Thoracic and abdominal areas tuberculate. Tubercles white or rusty-orange with latter color replaced by purple in all later instars; otherwise colors and tubercle number and positions the same. Tubercle pattern as follows (all instars): thoracic area bears 3 pairs (dorsal, sub-dorsal, lateral), abdominal area bears 2 pairs (dorsal and lateral). Prothorcic dorsals and sub-dorsals white, laterals rusty-orange; meso- and metathoracic dorsals and laterals white, subdorsals rusty-orange. First abdom-

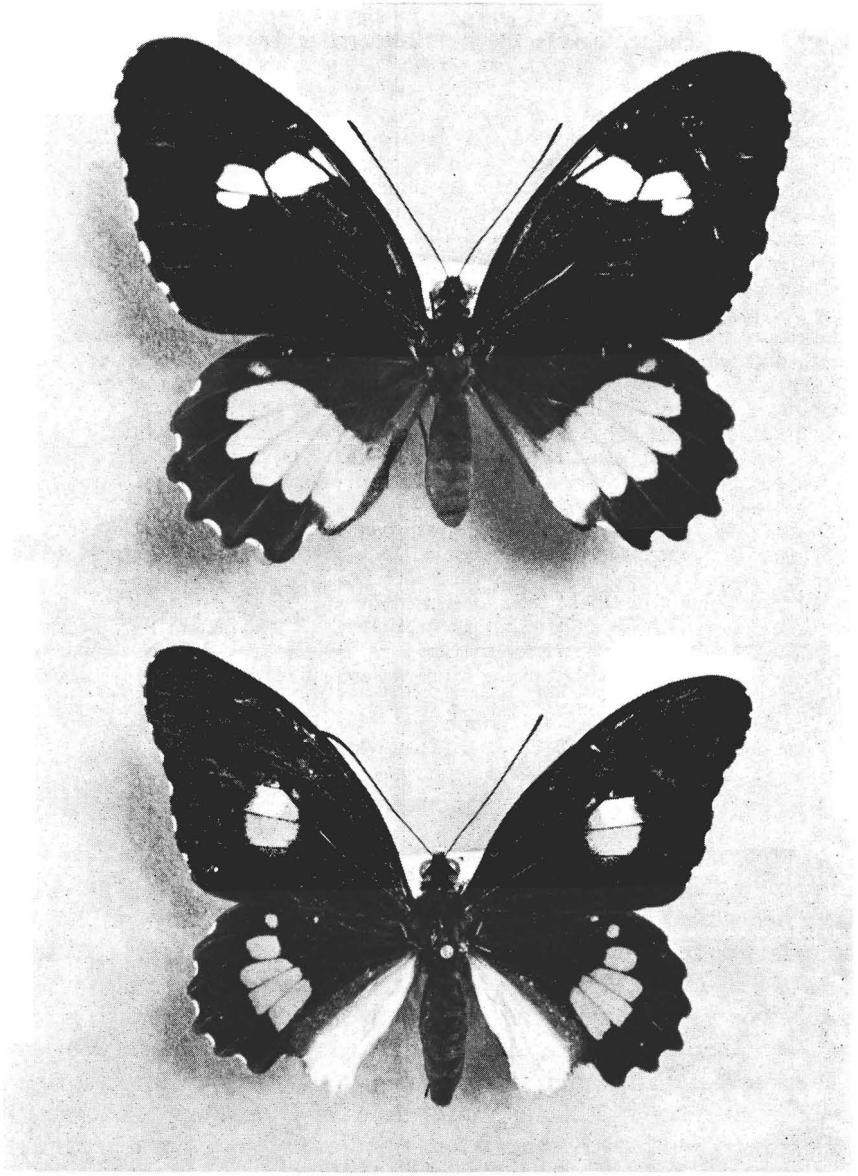

Fig. 3. Adult *P. iphidamas* obtained from laboratory rearing: female above, male below.

inal, both sets rusty-orange, laterals of second abdominal becoming white. Pattern reversed for third abdominal segment. Both sets of fourth and fifth abdominal segments rusty-orange, both white on sixth, only dorsals white on seventh. Both white on eighth and ninth abdominal segments; tubercles of ninth very reduced.

Black setae prominent on tips of all tubercles but disappear in later instars. Grows from 2.5 to 4.0 mm in 5 days; eats egg shell to varying degrees (11 individuals).

Second instar (Fig. 1). As first instar, but with rusty-orange replaced with purple. Prominent white "collar" evident just behind head, present in previous instar but reduced. Body more cylindrical with tubercles shorter relative to thickness of body. Both first and second instars feed on young leaves of host plant in the field and laboratory. Grows from 4.0 to 9.0 mm in 5 days (10 individuals).

Third instar (Fig. 1). Identical in color and form to previous instar. First three instars quickly evert bright yellow osmeteria when disturbed, and this ability diminishes drastically in later instars. First three instars feed from ventral side of young or old leaves in wild. Grows from 9.0 to 23.0 mm in 5 days (8 individuals).

Fourth instar (Fig. 1). Thoracic and abdominal areas cuticle has glossy sheen. One striking color pattern difference retained in fifth instar: white of lateral tubercles of third abdominal segment extends to meet expended white basal area of fourth abdominal segment, giving appearance of thick, broken line connecting the segments. Similar expansion of sub-dorsal tubercle colors on metathoracic area. Grows from 23.0 to 34.0 mm in 5 days (8 individuals).

Fifth instar (Fig. 2). Same as fourth instar. Both fourth and fifth instars eat woody stems of host plant in addition to leaves. Both accept *A. maxima* in the laboratory, but for two tested, both died after feeding several days. Grows from 34.0 to 56.0 mm in 6 days (8 individuals).

Pupa (Fig. 2). Angulate, bluish-green ventrally, yellow-green dorsally; 31.0 mm long, 10.0 mm wide (dorsal-ventral), 15.0 mm thick. Head capsule strongly forked. Darkens to adult colors day prior to eclosion. Lasts 28–31 days (7 individuals). Adult ready for flight 2 hr after eclosion.

Adult (Fig. 3). Good descriptions in Godman & Salvin (1879). Easily distinguished from *P. arcas mylotes* in the wild by marginal dots on wings being white in *P. iphidamas* and red in the former. Females readily identified by presence of variable red spot in cell between veins M_1 and RS ventrally on hindwings; spot always absent in *P. arcas mylotes* examined at this locality.

Total development time 60–63 days (7 individuals).

DISCUSSION

In premontane tropical wet forest regions such as "Tirimbina" and the surrounding area, *P. iphidamas* and *P. arcas mylotes* both exploit *Aristolochia constricta* as a larval host plant. *A. constricta* is by far the most abundant of the four or five species of the genus that occur here. It occurs as large patches in open secondary habitats and as isolated small patches or young single vines in heavily shaded understories of forest remnants that dot the area. Individual vines in forest understory possess thinner leaves than mature vines in open areas, and their leaves are generally darker green. Although four species of *Parides* visit *C. tomentosa* inflorescences in heavily shaded forest understory (old secondary forest) and along forested roads and paths, there is a strong preference for *P. iphidamas* to oviposit on mature vines in open areas, whereas *P. arcas mylotes* oviposits primarily on very small seedlings of *A. constricta* in forest understory. It was noted elsewhere (Young, 1973) that females of *P. arcas mylotes*, presumably mated, make frequent excursions into shaded forest in search of oviposition sites. This is not the case with *P.*

iphidamas. Although females of both species and also those of *P. childrenae*, the latter being a far more elusive species than the other two, may often be found together in the same places, there is a definite preference in *P. iphidamas* for oviposition in open places. In the wild, it is generally easier to follow ovipositing females of *P. iphidamas* than those of *P. arcas mylotes*, and, at least in part, this probably involves a behavioral difference between these species for oviposition site selection. Since *P. arcas* appears to be a species that oviposits in forests, where seedlings and individual vines of the host plant are probably more widely dispersed than in secondary habitats, the females may spend greater amounts of time on a daily basis searching for oviposition sites than do *P. iphidamas* females searching in secondary and forest edge habitats.

Elsewhere (Young, 1973), the developmental time of *P. arcas mylotes* was reported to be ca. 53 days, compared with 60–63 days for *P. iphidamas* in the present study; the host plants were the same in the two studies and rearing conditions very similar. It is expected, however, that an ecological statistic such as developmental time will be very sensitive to subtle environment factors, making comparisons difficult. Certainly the size of adults will be altered by differences in developmental time within and between species. Considerable differences in developmental time occur in *Parides* even when reared under similar conditions (Young, 1972; 1973).

Although caterpillars of *P. iphidamas* and *P. arcas mylotes* are similar in color and size, there are some consistent and useful differences between them that assist in field identification. Since the two species belong to different groups within the genus, differences in early stages are expected. The fourth and fifth instars of *P. arcas mylotes* are colored with a variegated pattern of brownish-purple and velvety black, whereas those of *P. iphidamas* are glossy purple; the caterpillars of *P. arcas mylotes* lack the broken white band of *P. iphidamas* caterpillars. The caterpillar of *P. arcas mylotes* lacks the white coloration of the lateral tubercles of the third abdominal segment that comprises the lower portion of the lateral white band in *P. iphidamas* caterpillars. Furthermore, the caterpillar of *P. arcas mylotes* lacks the white thoracic tubercles of *P. iphidamas* (compare Fig. 3 in Young, 1973 with Fig. 1 in present paper). Other differences occur in the pupa stage for the two species: when placed side by side, it is evident that the pupa of *P. iphidamas* is wider and more greenish-yellow than that of *P. arcas mylotes*, which is narrow and bluish-green.

Aside from the clear differences in the males of *P. iphidamas* and *P.*

arcas mylotes, it is interesting that the males of former species possess a very thick white fold of inner margin on the hindwing. This structure (Fig. 3) is black and reduced in males of *P. arcas mylotes*.

SUMMARY

Various aspects of the biology of the tropical butterfly *Parides iphidamas* were studied at one locality in the premontane tropical wet forest life zone of northeastern Costa Rica. Here, this species occurs with several other of the genus, including the similar-appearing *P. arcas mylotes*. Although both *P. iphidamas* and *P. arcas mylotes* exploit *Aristolochia constricta* (Aristolochiaceae) as a larval host plant, the former species shows a preference to oviposit on mature vines in open secondary habitats and the latter species in forest understory. These species, along with others of the genus, show the same preference to visit *Cephaelis tomentosa* inflorescences in forest understory. Emphasis in interpreting the form and features of early stages is placed on a comparison between *P. iphidamas* and *P. arcas mylotes* caterpillars and pupae for aiding field identifications.

ACKNOWLEDGMENTS

This research was supported by National Science Foundation grant GB-33060. The cooperation of Dr. J. Robert Hunter of C.A.M.S.A. and C.A.H.S.A. with logistical matters and field station facilities is greatly appreciated. I thank Dr. Lee D. Miller (Allyn Museum of Entomology) for confirming the identification of the species.

LITERATURE CITED

GODMAN, F. D. & O. SALVIN. 1879. Biologia Centrali-Americana. Insecta. Lepidoptera-Rhopalocera. Taylor & Francis, London.

HOLDRIDGE, L. R. 1967. Life zone ecology. Tropical Science Center, San Jose, Costa Rica.

ROTHSCHILD, W. & K. JORDAN. 1906. A revision of the American Papilios. Novitates Zool. 8: 27–753.

YOUNG, A. M. 1971. Mimetic associations in natural populations of tropical papilionid butterflies (Lepidoptera: Papilionidae). J. New York Ent. Soc. 79: 210–224.

———. 1972. Breeding success and survivorship in some tropical butterflies. Oikos 23: 318–326.

———. 1973. Notes on the life cycle and natural history of *Parides arcas mylotes* (Papilionidae) in Costa Rican premontane wet forest. Psyche 80: 1–22.