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STUDIES ON THE INTERACTIONS OF *MORPHO PELEIDES* (MORPHIDAE) WITH LEGUMINOSAE

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ABSTRACT. The butterfly *Morpho peleides* Kollar is a widespread species throughout tropical America, exploiting several wild genera and species of Leguminosae as larval foodplants. Field studies show that this species feeds on a broad spectrum of wild legumes on a regional basis. This interaction was explored in the laboratory by rearing caterpillars on peanut plants and alfalfa, cultivated legumes. The life cycle is completed successfully on these artificial foodplants, but feeding on alfalfa taken from an expressway led to mass mortality of caterpillars. Apparently the alfalfa was contaminated from some environmental source. In the native habitats of this butterfly, the Leguminosae are both diverse and numerous locally. This suggests that the monophagous feeding habit provides sufficient ecological flexibility for exploiting different genera and species of the family. This is sufficient to maintain breeding populations of *M. peleides* in secondary habitats. Forest-dwelling species of *Morpho* are predicted to be experiencing different types of selection pressures favoring polyphagous feeding.

In the premontane tropical wet forest life zone (Tosi 1969) of north-eastern Costa Rica, a larval foodplant of the butterfly *Morpho peleides* Kollar (Lepidoptera: Morphidae) is the vine *Machaerium* aff. *floribundum* Benth. (Leguminosae). The vine and butterfly occur in stands of mixed primary and secondary tropical wet forest (Fig. 1). It is known that *M. peleides* utilizes several leguminous woody vines and trees as larval foodplants in Costa Rica (Young and Muyschondt 1973) and the species can be reared on commercially available peanut plants both in Costa Rica and Wisconsin (Young 1974). This present paper examines further the feeding habits of *M. peleides* larvae, using eggs obtained from a population in premontane tropical wet forest (rather than from montane forest, as in a previous study), and involves plants not studied previously (Young 1974). The results further support the assumption

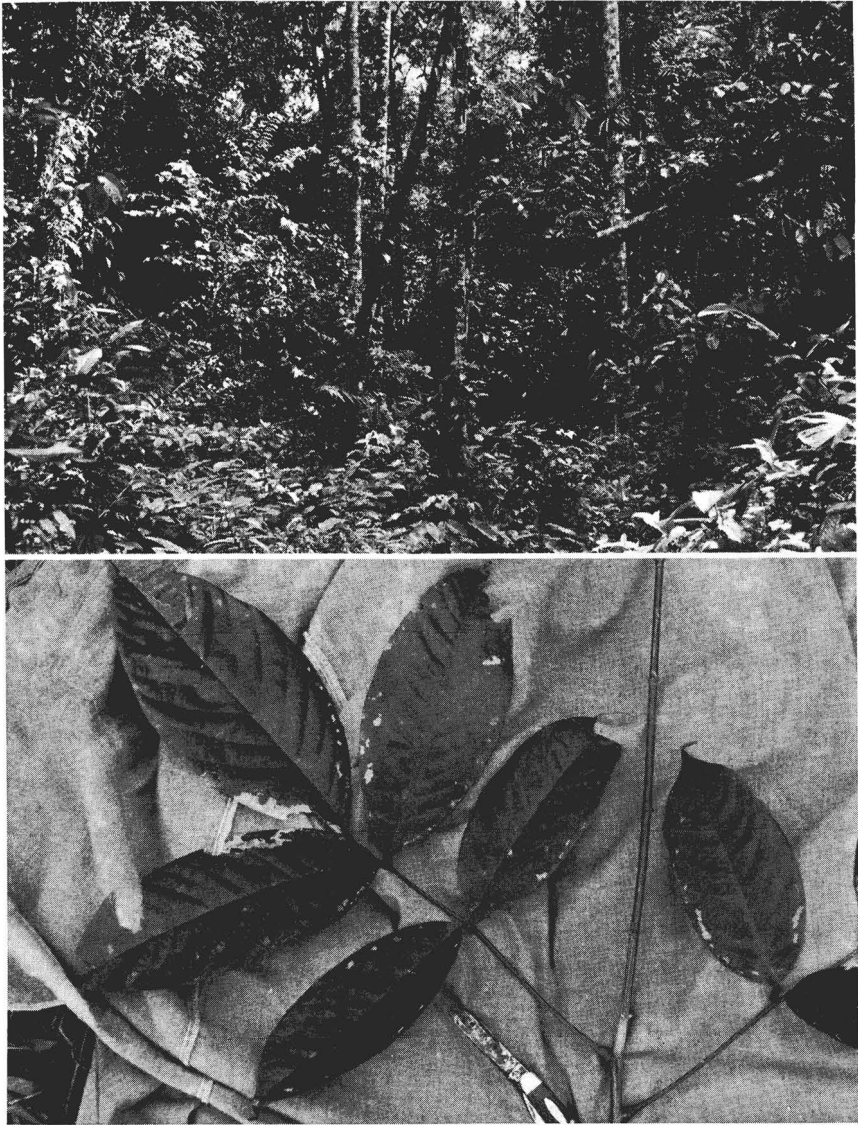


Fig. 1. Above: mixed primary-secondary tropical wet forest habitat of the butterfly *Morpho peleides* at Finca El Tigre, near La Virgen, Heredia Province (Sarapiquí region), Costa Rica. At the spot shown here, *M. peleides* and *M. granadensis* are microsympatric. Below: *Machaerium* aff. *floribundum*, a forest leguminous vine which is a larval food plant of *M. peleides* (and probably *M. granadensis*) in the wild.

that larvae of *M. peleides* are monophagous feeders on many temperate and tropical genera of Leguminosae.

METHODS

A female of *M. peleides* was captured on bait of rotting bananas placed near the edge of a forest habitat (Fig. 1) on February 14, 1977 at "Finca El Tigre," a farm adjacent to "Finca La Tirimbina," a few km from La Virgen, Heredia Province (Sarapiquí region), Costa Rica (220 m elev.). She was placed in a clear plastic bag containing a fresh cutting of *M. aff. floribundum*, and within eight days had produced a total of 40 viable eggs. The female was then preserved, and the eggs were brought to Milwaukee, Wisconsin for rearing. The eggs began to hatch on February 25 in Costa Rica and by the time the morphos arrived in Wisconsin, they were all 1st instar. In Costa Rica these larvae were fed leaves of *Dioclea wilsoni* (Leguminosae) but they were switched to peanuts (*Arachis hypogea* L.—Leguminosae) upon arrival at the Milwaukee Public Museum. The larvae were kept on potted peanut plants placed in a covered glass tank in a laboratory. A growth light was kept over this rearing chamber. The rearing program in Wisconsin extended from March 3 through May 25, 1977 (the date of the late eclosion). Records were kept on body lengths and head capsule widths of all caterpillars. The sources of peanut plants used were (1) Olds Seeds from Madison, Wisconsin and (2) Crop Science Department of North Carolina State University (Raleigh). Near the end of the experiment (April 22), the foodplant was switched to alfalfa (*Medicago sativa* L.—Leguminosae); at this time most of the larvae were in the late 4th instar. The alfalfa plants used were obtained from a farm in Waukesha County, Wisconsin. Later (May 2) the remaining 5th instar larvae (several had pupated) were fed alfalfa collected from the side of an expressway in downtown Milwaukee. Like the peanuts, the alfalfa plants were potted, but this time soil brought in with the plants from the field was used. One 4th instar caterpillar was offered a seedling of *Erythrina crista-galli* L. (Leguminosae) from Brazil. Records were kept on larval survival throughout the study. The adults obtained were kept for further examination.

RESULTS

Both young and older larvae of *M. peleides* fed successfully on peanut and alfalfa leaves in the laboratory, followed by normal eclosion (Fig. 2). In addition, at least the 4th and 5th instar larvae will feed on *Erythrina*. Although some caterpillars feed intermittently throughout the day, the

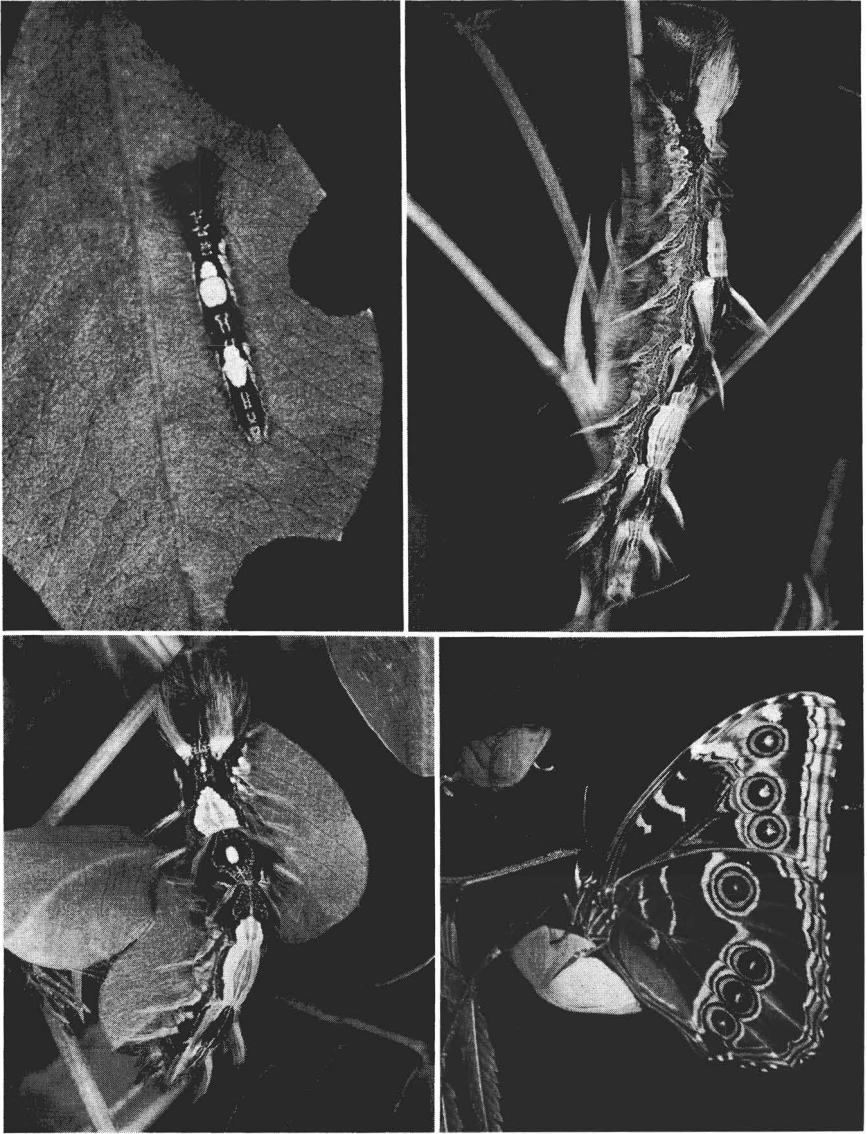


Fig. 2. Right column: second and fourth instar caterpillars of *M. peleides* on peanut leaves at the Milwaukee Public Museum; note eaten areas of leaf in first illustration. Leaf column: fifth instar caterpillar on peanut plant and freshly-enclosed adult clinging to empty pupa case (at Milwaukee Public Museum).

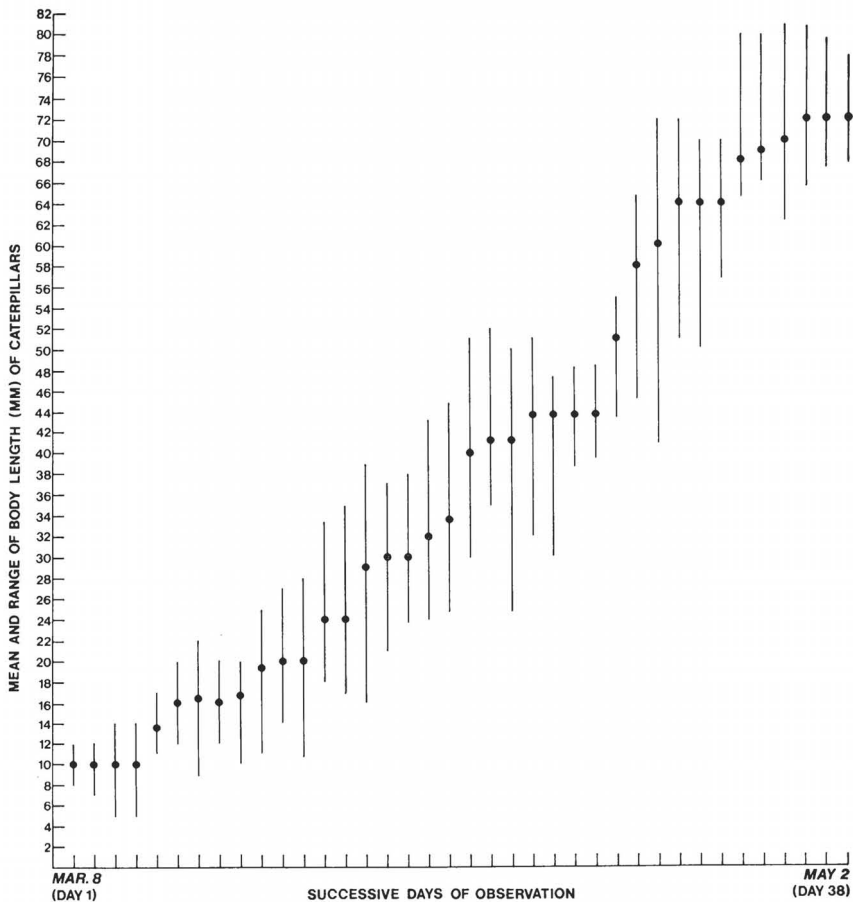


Fig. 3. Growth and size (body length) patterns for *Morpho* caterpillars reared in the laboratory. The vertical lines give the range in body lengths.

greatest amount of feeding occurred in the late afternoon and early morning (e.g., 16:00–19:30 hrs/C.S.T.). Fourth and 5th instar larvae rested on the rims of the pots containing the peanut plants, and they would crawl up the plants to feed. Younger ones rested on leaves and shoots.

Survival both on peanuts and on “farm alfalfa” was 100%. However, larvae fed “expressway alfalfa” showed considerable mortality: between May 4 and May 12, the number of healthy caterpillars dropped from 32 to 13. Very shortly after being fed the expressway alfalfa, many died. Death was preceded by a drastic contraction of body length, and spasmic

TABLE 1. Head capsule size statistics for caterpillars of the tropical butterfly *Morpho peleides*.

Instar	No. measured	Mean head capsule width ($\bar{x} \pm S.D.$)	Range of head capsule widths (mm)
1	17	1.50 \pm 0.08	1.4–1.5
2	34	2.19 \pm 0.09	2.0–2.3
3	33	3.47 \pm 0.18	3.3–3.8
4	31	4.91 \pm 0.11	4.7–5.1
5	11	6.09 \pm 0.45	5.2–6.7

Note—data obtained from molted head capsules at the end of each instar [distorted (crushed) head capsules are not included in the calculations]. All head capsules were collected within 24 hours after each molt.

waves of movements lengthwise. Afflicted caterpillars fell from the plants and wriggled on the bottom of the cage before dying. When attempts were made to replace them on the foodplant, they again lost hold and fell off. Their feces had a reddish-orange component that was quickly absorbed on paper toweling. A few died as prepupae.

Initial signs of the affliction included a larva remaining stationary on the plant, with the anterior half of the body hanging off to one side. Such a state lasted a few days before the larva fell off the plant and died. As a result of this sudden and epidemic-like mortality, only those individuals that had already pupated by May 2 survived to emerge as adults. A total of 12 adults, all males, were obtained. Thus, the mortality was 100% among the 19 individuals that were still larvae on May 4.

Based on a sample of ten randomly chosen larvae, molting is not synchronous. The 5th instar is the longest, and despite changes in the foodplant type, development proceeds without major accelerations or decelerations in the daily pattern of growth (Fig. 3). With the exception of the 1st instar, there is considerable variation in the body length and the magnitude of this variation is about the same for the four instars (Table 1). Excluding a small bias introduced by unequal sample sizes, the range of variation in head capsule width is very low for all instars (Table 1). Body length and head capsule width are used here as estimates of larval size. The total development time of 91 days is broken down as follows: (1) egg = 11 days; (2) caterpillar = 65 days; (3) pupa = 15 days. The right forewing length for the adult male butterflies ranged from 55 to 65 mm ($N = 12$), but the exclusion of two individuals reduced this range to 61–65 mm.

DISCUSSION

The data are useful for discussing (1) feeding behavior of the caterpillars of *M. peleides*, and (2) apparent effects of environmental con-

tamination of a foodplant of an exotic butterfly. The latter was an unexpected outcome of the study.

Morpho accepts peanuts and other legumes, not used as foodplants in the wild, as discussed previously (Young 1974). But to these records I add alfalfa and *Erythrina* as acceptable foodplants of *M. peleides* caterpillars in the laboratory. *Erythrina* is native to the New World tropics (Bailey 1969), although it is not known if it is a natural foodplant of *Morpho*. Greenhouse cultures of this plant are usually infested with herbivorous insects, suggesting few effective defenses operative against such attacks. Alfalfa, a near relative of peanut, is commonly cultivated, and occurs as a weed species along roadsides; it is native to the Old World. As a weed species, alfalfa may possess few defenses against herbivores as energy allocation is likely to be directed toward high reproductive potential (Lewontin 1965). Thus, cultivars such as peanut and alfalfa, weeds such as alfalfa, and ornamentals, such as *Erythrina*, are examples of leguminous plant species with few defenses against herbivores, perhaps making them ideal to serve as food for *Morpho* larvae. It is not known if *Morpho* will oviposit on these plants in the laboratory.

I observed previously that caterpillars of *M. peleides* are primarily "dawn-dusk" feeders in the wild (Young 1972a), and this is also true for laboratory cultures experiencing the Wisconsin dawn-dusk cycle (Young 1974; pers. obs.). Apparently the larvae are programmed with a rhythmicity for peak periods of feeding activity in both tropical and temperate situations. In the wild, 4th and 5th instar caterpillars rest on the trunks of the foodplant where they blend in with the background (Young 1972a), and this behavior explains why they rested on the rims of the pots containing the peanut plants.

Using a larger sample size, Young (1974) estimated the total developmental time for *M. peleides* on peanuts to be about 105 days, or about 14 days longer than the estimate obtained in the present study. Body length of 5th instars in the previous study, was about 73 mm as compared to 70-71 mm in the present study. Several factors may be relevant here: (1) the eggs in the two studies came from different regions. Thus selection pressures could have been different in terms of effects on development time; (2) differences in the foodplant as related to time of the year, and other factors. The discrepancy in the development time is in the length of the larval stage; the egg and pupal stages are the same (Young 1974; pers. obs.). Thus, differences in the foodplant may be involved. Switching to alfalfa (not done in the previous study) might have accelerated development. To test this, eggs will have to be reared entirely on this plant in a future study. The transfer to alfalfa was done

in the fifth instar, the time of greatest food intake. In the previous study, older peanut plants were used, and it may well be that older plants have resistant properties more expressed than younger ones. There is some evidence that the defense systems of peanut plants change with age: in the present study I observed that *Morpho* larvae refuse to eat the first set of leaves of a peanut seedling, eating only shoot and leaf tissue above this point (S. Borkin and A. Young, pers. obs.).

The observed high level of mortality among 5th instar larvae on alfalfa plants taken from the downtown expressway may have been due to a contamination of these particular plants by an industrial or automobile residue. An exotic insect such as *Morpho*, when exposed to a contaminated foodplant, may be expected to encounter such mortality. Since only male adults were reared I presume that all the females died as 5th instar larvae, since *M. peleides* has a sex ratio of unity (Young 1972b, 1973; Young and Muyschondt 1973). Female larval development generally takes longer than that of males. The observed inability of afflicted larvae to grasp the foodplant and feed was very likely due to the contaminant affecting the nervous system. It is not likely that a strain difference affecting feeding ability by morphos exists between the expressway alfalfa and farm alfalfa, since larvae did eat the former and until the time of obvious signs of illness, their feeding behavior appeared normal.

The data indicate that feeding flexibility of *M. peleides* caterpillars is considerable in the sense that it allows this monophagous tropical herbivore to exploit a broad range of genera and species locally. Foodplant records for *M. peleides* from Costa Rica and El Salvador indicate that many different wild Leguminosae are used, and allied South American species exhibit similar behavioral flexibility (Otero 1971; pers. comm.). Secondary forest habitats in the wetter regions of Central America locally support a wealth of leguminous vine, shrub, and tree species, many of which are used by *M. peleides*. It is therefore not surprising that caterpillars will feed successfully on allied legumes not used as natural foodplants, including cultivated forms such as peanuts and alfalfa. On a per unit area basis, secondary habitats in the tropics support large patches of *Mucuna*, *Dioclea*, *Machaerium*, *Inga*, etc. and many patches may occur locally. Thus, in terms of larval foodplants, the environment is very certain or predictable creating selection pressures favoring ecological specialization such as monophagy. As foodplant patches increase in number and size in an area, monophagy is considered an optimal feeding strategy for a herbivore (Levins and MacArthur 1969).

Some species of *Morpho* that live in the canopy of primary tropical forest deposit eggs on different families of trees and woody vines (Otero,

pers. comm.) and these species may be polyphagous. Miller (1968) lists several *Morpho* foodplant families, although the degree to which each species oviposits on more than one family has not been determined. Polyphagy in *Morpho* is adaptive in habitats where individuals of each foodplant species are greatly dispersed over large areas, making it energetically difficult to exploit a single family of foodplants. In forest habitats where each foodplant species is greatly dispersed over large areas, the environment is less certain in terms of a female butterfly locating successfully an individual of that particular plant. As more plants are added to the local foodplant niche, the environment becomes more certain; the incorporation of additional local foodplants implies the evolution of polyphagy, since member genera and species of individual plant families in tropical forests are greatly dispersed over large areas. Thus, although *M. peleides* and its near allies such as *M. achilles* may exhibit considerable feeding flexibility within the Leguminosae, they are monophagous species; polyphagous species of *Morpho* are expected to occur in primary forests. These include such likely candidates as *M. amathonte*, *theseus*, *granadensis*, and *cypris* in the Central American rain forests.

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LITERATURE CITED

- BAILEY, L. H. 1969. Manual of cultivated plants. MacMillan Co., Toronto.
LEVINS, R. & R. MACARTHUR. 1969. An hypothesis to explain the incidence of monophagy. *Ecology* 50: 910-911.

- LEWONTIN, R. C. 1965. Selection for colonizing ability. In *The Genetics of Colonizing Species* (H. G. Baker and G. Stebbins, eds.). Academic Press, New York, pp. 77-94.
- MILLER, L. D. 1968. The higher classification, phylogeny and zoogeography of the Satyridae (Lepidoptera). *Mem. Amer. Entomol. Soc.*, No. 24, 174 pp.
- OTERO, L. S. 1971. Instrucoes para criacao da borboleta "Capitao-do-mato" (*Morpho achillaena*) e outras especies do genero *Morpho* ("Azul-seda", "Boia", "Azulao-branco", "Praia-grande"). *Inst. Brasileiro Desenvolv. Florestal*, Rio de Janeiro, 27 p.
- TOSI, J. A., JR. 1969. Mapa ecologico. Republica de Costa Rica. Centro Cientifico Tropical, San Jose, Costa Rica.
- YOUNG, A. M. 1972a. Adaptive strategies of feeding and predator-avoidance in the larvae of the neotropical butterfly *Morpho peleides limpida* (Lepidoptera: Morphidae). *J. New York Entomol. Soc.* 80: 66-82.
- . 1972b. Community ecology of some tropical rain forest butterflies. *Amer. Midl. Nat.* 87: 146-157.
- . 1973. The comparative ethology and ecology of several species of *Morpho* butterflies in Costa Rica. *Studies Neotrop. Fauna* 8: 17-50.
- . 1974. The rearing of *Morpho peleides* (Morphinae) on peanuts. *J. Lepid. Soc.* 28: 90-99.
- YOUNG, A. M. & A. MUYSHONDT. 1973. The biology of *Morpho peleides* in Central America. *Carib. J. Sci.* 13: 1-49.