

AN UNUSUAL NEW *NAPAEA* METALMARK FROM SONORA, MEXICO (LEPIDOPTERA: RIODINIDAE)

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ABSTRACT.— A new species, *Napaea danforthi* n. sp., is described from one male and one female from southeastern Sonora, Mexico, collected in March 1998. Its placement in *Napaea* is somewhat tentative, due to extensive differences between it and other *Napaea* species, and due to its overall similarity to a fossil metalmark species known from Dominican amber (estimated to be at least 25 million years old). Limited known details of the species' biology are presented.

RESUMEN.— Se describe *Napaea danforthi* sp. n. a partir de un macho y una hembra del sur-este del estado de Sonora, México, agarrados en marzo, 1998. El puesto genérico de la especie nueva está tentativa, por diferencias extensivas entre su mismo y otras especies de *Napaea*, y la gran similitud entre la especie nueva y un fósil de un riodinido en ambarino Dominicano (mas de 25 millón de años de edad). Se presentan algunas notas biológicas muy breves de la especie nueva.

KEY WORDS: *Baronia*, behavior, biogeography, Bromeliaceae, Central America, *Cremna*, Dominican amber, *Eunogyra*, *Eucorna*, fossils, *Hermathena*, *Hyphilaria*, *Ithomiola*, Moraceae, *Napaea danforthi* n.sp., Orchidaceae, paleoendemism, Sterculiaceae, *Teratophthalma*, *Voltinia*.

While photographing butterflies in Sonora, Mexico, on 20 March 1996, Douglas W. Danforth (of Bisbee, Arizona), observed an unusual metalmark flying along the dry banks of the creek at Lo de Campo, a narrow canyon about a mile from the junction of Hwy 16 on the road to San Javier in Municipio San Javier. Both observed individuals were making repeated stops, landing in bare areas and on rocks (where they would bask for a few moments before resuming flight), and were flying closer to the edge of the forest than to the water. According to Danforth (pers. comm., 1998), their flight was very similar to the flight of a *Phycodes* or *Chlosyne* (Nymphalidae: Melitaeini), for which they were initially mistaken, and near the ground, never above two feet. When one of these individuals made a brief stop, Danforth was lucky enough to get a photograph, while the butterfly rested with its wings held flat against a rock (Fig. 1).

The identity of this unfamiliar metalmark eluded Danforth, so he sent the photo to James P. Brock (Tucson, Arizona), an expert on the butterflies of the region. Since Brock was also unfamiliar with this species, he sent the photo to the senior author, when it was determined to be a new species, possibly in the genus *Napaea*. Efforts in 1997 by the senior author and the research group at the "Alfonso L. Herrera" Museo de Zoología, Facultad de Ciencias, Universidad Nacional Autónoma de México (UNAM), in Mexico City (especially Jorge Llorente-B., Armando Luis-M., and Isabel Vargas-M.), resulted in collecting permits for several individuals to collaborate in the study of the butterfly fauna of the northwestern Mexican states of Sonora, Sinaloa, Chihuahua, Durango, and Zacatecas. While the butterfly fauna of these states is still poorly known, the goal of this international collaboration is the eventual production of state faunal surveys giving distributional and phenological data for all species, similar to the compilations recently published by this group (Luis et al., 1991 [for Oaxaca]; Vargas et al., 1994 [Guerrero], 1996 [Jalisco]; Warren et al., 1998 [Colima]).

In March 1998, James P. Brock, Ray E. Stanford, and Sanford A. Upson, accompanied by the junior author and Evi Buckner as photographers, spent several days along Hwy 16 in southeastern Sonora in search of new data for the Sonora state list, and in search of the undetermined species that D. Danforth had photographed two years earlier. On 17 March, late in the morning near Tepoca, in Municipio Yécora, about 50 km southeast of Lo de Campo along

Hwy 16, Brock encountered an individual of this species. He observed it sitting at a moist patch of sand along the permanent creek where the group was working, with its wings just slightly opened, before it was collected. Two days later, on 19 March, the group returned to the canyon where the specimen was collected, and resumed their intensive search for this species. During mid-afternoon, the junior author observed an individual of this species slowly fly to a moist patch of sand along the creek, and begin to sip moisture from the ground, while slowly opening and closing its wings. Moments after the junior author photographed the butterfly (Fig. 4), it was collected by R. E. Stanford. Luckily, Brock collected a male (Fig. 2-3), which has been designated the holotype, and Stanford collected a female (Fig. 5-6), designated the allotype. This remarkable new species is described below.

Napaea danforthi A. D. Warren & Opler, n. sp.

Diagnosis.— Immediately distinguished from all other metalmarks by prominent forewing subapical band of 4 white spots, single white apical forewing spot, and submarginal band of red-orange lines, being repeated on the hindwing. Very dark median ventral forewing in both sexes is also diagnostic. It is the largest metalmark known to occur in the region, with the exception of *Emesis mandana furor* Butler & Druce, 1872, a species it cannot be mistaken with.

Description.— MALE (Fig. 2-3). Forewing length (base to apex): 18.7mm. Upperside: *Head:* Vertex covered in flattened pale, gray-brown scales, rounded urchin-like structure behind each antenna covered with flattened shiny black scales and black hair-like scales. Front densely covered with long pale, gray-brown scales near vertex, shorter scales between eyes; symmetrical white stripes on frons below junction with antenna to eye, at lower edge of frons. Eyes globose, naked. Labial palpi slightly upturned, densely covered with flattened pale brown and whitish (esp. ventrally) scales. First segment very short, not protruding beyond base of eye, second segment very long, scales with 3-4 shallow apical "teeth". third segment short, distal tip scaled and fairly pointed. Antennae with tip of club naked, brown-tan, club and shaft covered with flattened iridescent black scales, a few flattened white scales at base of each shaft segment; ventrally, white scales cover basal half of each shaft segment; shaft with 17 segments. *Thorax:* Broad, black, covered dorsally with both flattened and hair-like pale brown scales, and ventrally with

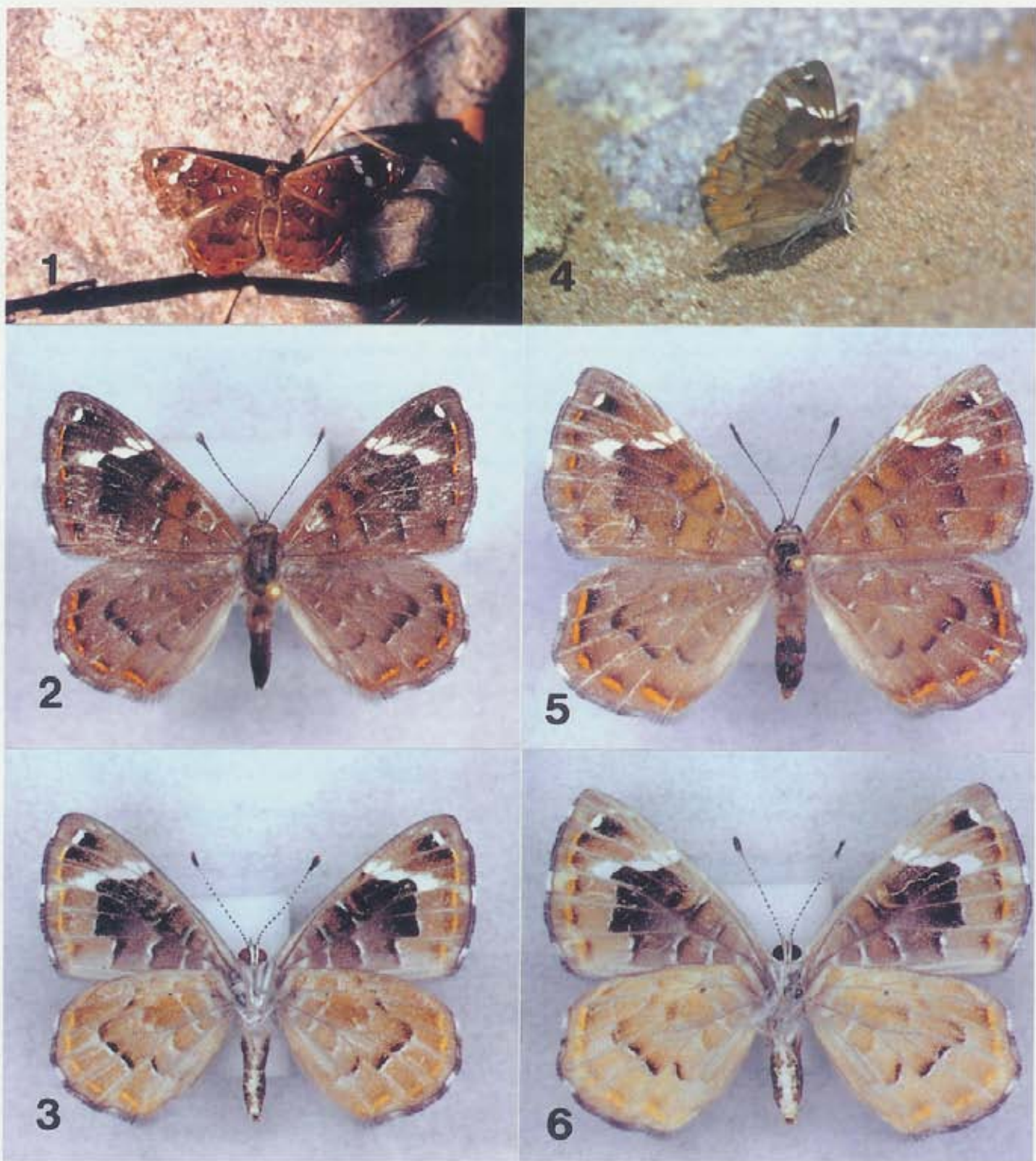


Fig. 1-6. Adults of *Napaea danforthi*. 1) Basking male, at Lo de Campo, Mpio. San Javier, Sonora, Mexico, on 20 Mar 1996; Photo by Douglas W. Danforth. 2) Dorsal and 3) ventral views of holotype male taken at Tepoca, Mpio. Yécora, Sonora, Mexico, on 17 Mar 1998, by James P. Brock. 4) Female on moist sand at Tepoca, Sonora, on 19 Mar 1998; photo by Paul A. Opler. 5) Dorsal and 6) ventral views of same female (allotype), collected by Ray E. Stanford on 19 Mar 1998.

sparse covering of long hair-like scales, a total covering of short, toothed, white scales (as described above), and some short, dull brown scales on the prothorax. *Legs*: Prothoracic legs greatly reduced, with three functional segments, fourth distal segment a vestigial knob; all densely covered in long, white, hair-like scales. Mesothoracic and metathoracic legs similar, tibiae with about five terminal spines, and other scattered short spines on inside surface. Four to six longitudinal rows of short spines on five segments below tibiae to paired terminal claw. *Abdomen*: scale cover and coloration as on thorax, with whitish scales ventrally and dark scales dorsally. *Forewing*: Fringe mainly of elongate dark brown scales, each divided into 3-4 fine teeth at tip; three areas of white scales between veins R 4+5 and M1, M3 and Cu1, and Cu2. Dorsal ground reddish brown on basal 1/3, blackish brown on median 1/3, paler outer 1/3. A few hair-like scales restricted to base. Tiny white marks at base of discal cell, postbasal space Cu2-2A, and antemedian in space Cu2-2A. Subapical band of 4 irregular white spots. Small apical white spot. Submarginal line of red-orange spots. Submarginal line of red-orange dashes between veins. Ventral surface paler (except pronounced dark brown median area), with pattern elements more distinct, except for red-orange submarginal band. *Hindwing*: Ground tan-brown. Long hair-like scales covering entire surface. Five ill-defined tiny white marks on basal 1/3. Irregular, incomplete black line with few white scales externally. Submarginal band of red-orange dashes between veins. Ventral surface paler, with pattern elements more distinct, except for red-orange submarginal band. *Genitalia* (Fig. 8-10): Tegumen broad, bulbed somewhat, well sclerotized throughout. Uncus more-or-less divided into two lobes, about as long as they are wide, sparseley covered with colorless hairs; well sclerotized. Gnathos bifurcate, very well sclerotized, not visible in ventral view of genitalia. Vinculum quite broad where it overlaps anterior part of gnathos, skinny elsewhere, to short, poorly developed saccus. Valves short, prominent lateral ridge comprising lower 1/5 of valve, most obvious anterior of cucullus; cucullus terminates in short, sharp point. Ampulla edge irregular; valve widened slightly at costa. Colorless hairs sparsely distributed along ampulla, cucullus tip and lateral ridge. Penis rather short, quite broad throughout; distal 1/4 terminating in sharp point ventrally, with large vesica dorsally, which is apparently not eversible (we did not force the issue since it is a unique specimen). End of vesica with 16 well sclerotized cornuti, arranged in two roughly equal parallel rows, ranging from very short (nearly imperceptible) to long, arranged in sequential order. Juxta quite broad, deep, and well sclerotized, easily seen in lateral view protruding from base of valve.

FEMALE (Fig. 5-6). Forewing length 19.9mm. Generally, as male with following exceptions: Dark scales on frons slightly paler. Prothoracic tibiae well developed, pretarsi with terminal claw. Meso- and metathoracic legs much better developed than prothoracic legs, with spining patterns as in male. Forewing more rounded at outer margin and barely perceptible indentation below apex. Shape of hindwing with somewhat squarish appearance. Ground above and on ventral hindwing paler than male. *Genitalia* (Fig. 7): Corpus bursae large, oblong, with slight indication of two weakly formed signa at distal end near junction with long, membranous ductus bursae. Lamella antevaginalis very well sclerotized, in asymmetrical, clockwise twisted point, terminating just before antrum in sharp point. Lamella postvaginalis composed of two nearly symmetrical, egg-shaped knobs, the left knob partly obscured by membranes leading to lamella antevaginalis. Papillae anales well developed, lightly sclerotized, sparsely covered in long thin hairs.

Types.- Holotype male (Fig. 2-3) with the following labels: white (printed) MEXICO: SONORA: / Mpio. Yécora: / Tepoca / 17-III-1998 / J. P. Brock; white (printed and handprinted) Genitalia Vial / # 98-30 / Andrew D. Warren; red (printed and handprinted) HOLOTYPE / *Napaea danforthi* / A. D. Warren & Opler. Allotype female (Figs. 5-6) with the following labels: white (printed) MEXICO: SONORA: / Mpio. Yécora: / Tepoca / 19-III-1998 / R. E. Stanford; white (printed and handprinted) Genitalia vial / # 98-32 / Andrew D. Warren; red (printed and handprinted) ALLOTYPE / *Napaea danforthi* / A. D. Warren &

Opler.

Deposition of Types.- The type pair is deposited in the "Alfonso L. Herrera" Museo de Zoología, in the Facultad de Ciencias at UNAM, in Mexico City.

Type Locality.- The two types are from the vicinity of Tepoca, Municipio Yécora, in southeastern Sonora state. Flowing through the small town of Tepoca is the Río Techomoa, which empties into the Río Chico and Río Yaqui to the southwest in Municipio Rosario. The types were taken in a canyon accessed from Hwy 16, less than one mile to the west of Tepoca at W 28°26.392', N 109°15.419'. There is a small, permanent stream flowing through the canyon where the types were collected. We were unable to determine the name of this stream or the exact elevation of the area, but it is apparently between 750-900m. (Local names for towns, creeks, and even mountain ranges in this part of Mexico often differ from names on maps, which themselves at times are not consistent). This site is very similar in overall topology to the area at Lo de Campo where this species was first observed, in that it is a small permanent stream, with very steep canyon walls and dense, deciduous thorn-scrub forest on the north-facing and south-facing sides of the canyon. Lo de Campo, however, has a large number of Montezuma bald-cypress (*Taxodium* sp., Taxodiaceae) which are absent at the Tepoca site. A species of *Ficus* (Moraceae) and *Guazuma unifolia* (Sterculiaceae) are the dominant trees along the stream at the Tepoca site.

Distribution.- To date, known only from two nearby, similar localities in south-eastern Sonora, Mexico, in Municipios San Javier and Yécora. We expect that this species will be found in similar canyons in the region, but it is impossible to speculate how widespread this species may be or if it is likely to occur in surrounding states, until its host is discovered and its life cycle is studied.

Flight Period.- Thus far, this species has been observed only between 17-20 March. The area where this species is known from has been informally studied by various lepidopterists for many years, primarily between May and October, yet this species has not been found in that period. It is tempting to speculate that there is only one annual flight, but additional fieldwork and rearing studies are needed to document the phenology of this species.

Hosts.- Unknown. Since Bromeliaceae and Orchidaceae are the only known hosts for *Napaea* species (DeVries, 1997:141; Harvey, 1987; 152-53 & citations within), it is possible that a species in these families found at the Tepoca site is the host of *N. danforthi*. According to D. Danforth (pers. comm., 1998), there is one species of *Oncidium* (Orchidaceae) and a *Tillandsia* species (Bromeliaceae) which are fairly common at the Tepoca site, growing together as epiphytes in trees above the creek and above canyon walls. There is also at least one species of terrestrial bromeliad, probably in the genus *Bromelia*, in the canyon. Future lepidopterists in the area should start a host search for this species by studying these plants.

Etymology.- This new species is named for its initial discoverer, Douglas W. Danforth.

Remarks.- The higher classification of the Riodinidae, while imperfectly known, was studied by Harvey (1987). His studies placed the genus *Napaea* Hübner, [1819], with eight other genera in a group "incertae sedis" within the Riodininae (including *Hyphilaria* Hübner, [1819], *Volinia* Stichel, 1910, *Hermathena* Hewitson, 1874, *Ithomiola* C. Felder & R. Felder, 1865, *Teratophthalma* Stichel, 1900, *Cremna* Doubleday, 1847, *Eunogyra* Westwood, 1851, and *Eucorna* Strand, 1932). These nine genera, while all possessing five radial veins in the forewing, are not united by any single defining character (some genera in the Mesosemiini and Eurybiini also have five radial veins in the forewing), and as noted by Harvey (1987), do not form a monophyletic group.

Apparently, there is no known shared, derived character uniting the species currently placed in *Napaea* (D. J. Harvey, pers. comm., 1998), and therefore it is possible that *Napaea* is already a paraphyle

tic genus. The description of this new species certainly does not help clarify the relationships between *Napaea* species. We have tentatively placed this species into *Napaea*, noting that it differs in several ways from *Napaea eucharila* (Bates) [Type species of *Napaea*] and *Napaea umbra* (Boisduval), the only *Napaea* species it has been compared with (see below). No other species currently placed in *Napaea*, or any other genus, appear to share more superficial wing characters with *N. danforthi* than *N. eucharila* and *N. umbra*. A thorough revisionary study of the group to determine the best generic placement for this new species is beyond the scope of this paper, and we leave the subject to future workers on the group.

Already being a potentially paraphyletic genus, we present a brief comparison of *Napaea danforthi* to *N. eucharila* and *N. umbra*, to justify its tentative placement in *Napaea* (*Napaea umbra* may actually represent a species complex; our comparison is based only on northwest Mexican material). Similarities between *N. danforthi* and *N. eucharila* + *umbra* include prominent white apical spots on forewings, postmedian line of black or white dashes (all wings), and marginal band of black, orange or white dashes (all wings). All species (especially females) have a similar boxy shape to the hindwing, being better expressed in male *N. danforthi* than in either male *N. eucharila* or male *N. umbra*. Other basic wing pattern elements that differ between *N. danforthi* and *N. eucharila* + *umbra* include the more rounded forewing costa on *N. eucharila* and *N. umbra* than on *N. danforthi*, and unique band of four white forewing spots on *N. danforthi* not seen on *N. eucharila* or *N. umbra*. The thorax and abdomen of *N. danforthi* are noticeably broader than in either *N. eucharila* or *N. umbra* in both sexes. Labial palpi on *N. danforthi* differ from those on *N. eucharila* + *umbra* (which are similar) in the sizes of the second and third segments. On *N. danforthi*, the second segment is shorter than on *N. eucharila* or *N. umbra*, while the third segment on *N. danforthi* is considerably longer than on either *N. eucharila* or *N. umbra*.

The male and female genitalia of *N. danforthi* are considerably different than those of *N. umbra*, so different that in some cases we were unable to homologize certain characters with confidence. Genitalia of no other *Napaea* have been examined in our study, so we know nothing of the variation in genitalia between *Napaea* species. However, genitalia are so different between *N. danforthi* and *N. umbra* that it would not surprise us if future workers on the group place the former in another genus, especially once details of its larval and pupal morphology are known and compared to other *Napaea* species. Harvey (1987:23) noted that the pupae of *Napaea eucharila* were unique among pupae of 64 Riodinidae species studied in having the spiracle on A7 recessed in a deep pit, and proposed this as a possible synapomorphy for *Napaea*. Brévington (1992) noted that this character was also found in *Napaea beltiana* (Bates) but not in *Cremna thasus* (Stoll), strengthening Harvey's hypothesis that this character may be diagnostic.

In many ways, this species closely resembles a fossil riodinid known from Dominican amber estimated to be about 25 million years old. Robert K. Robbins and Donald J. Harvey (pers. comm., 1998) have examined five specimens of the fossil riodinid, one of which is owned by the Smithsonian Institution. A specimen of the fossil riodinid from a private Italian collection was illustrated by DeVries (1997:142). Robbins forwarded photographic slides showing details of certain morphological features of the specimen housed at the Smithsonian Institution. These slides clearly showed details of the head in lateral view, showing precise details of the palpi, as well as details of leg morphology and basal wing venation. The fossil we indirectly examined was a female, as indicated by its developed prothoracic tibiae without spines, which were not distinguishable from the prothoracic tibiae of *N. danforthi* in any way. Meso- and

metathoracic legs were easily examined in the fossil. All segments were of similar size, and spining patterns (not all tibial spines could be seen in the fossil) as seen on *N. danforthi*. The tarsi were especially similar in having the first segment quite elongated, followed by four shorter segments. The eyes and labial palpi of the fossil species are identical to eyes and palpi on *N. danforthi*, in every observable character (the head of the fossil could not be seen in dorsal view). Basal wing venation does not appear to differ between the fossil species and *N. danforthi*. Overall wing pattern, although somewhat difficult to interpret for the fossil species, appears to be quite similar to that seen on *N. danforthi*. The transverse row of four white spots basal of the forewing apex unique to *N. danforthi* (among living species) is represented on the fossil species, all spots being similar in their placement, perhaps only slightly smaller in size. The forewing apical spot is not clearly observable on the fossil, but the submarginal row of light-colored dashes along the forewing margin is as on *N. danforthi*. The median part of forewing apparently has more pale areas on the fossil species than on *N. danforthi* (this may be artificial, since wing pigmentation undoubtedly is quite faded on the fossil). Exact shape of forewing costa or outer margin on fossil could not be deciphered. The hindwing shape is apparently more irregular along outer margin on the fossil than on *N. danforthi*, with submarginal spot band composed of large, rounded spots, not dashes as on forewing of both species. Most observable differences between *N. danforthi* and the fossil species are less apparent than differences between *N. danforthi* and *N. eucharila* or *N. umbra* — another reason why we have been conservative in its generic placement.

If our hypothesis that *Napaea danforthi* and the fossil species are closely related is true, *N. danforthi* is one of several Mexican paleoendemic butterfly species, along with *Baronia brevicornis* Salvin, 1893, the best known example (Llorente & Luis, 1993). A close relationship between *N. danforthi* and the fossil species also has significant biogeographic implications, providing further evidence that the Greater Antilles were formerly fused with Central America, since no members of Harvey's "incertae sedis" group are known to occur in the Caribbean today. Pre-historic tectonic vicariance is a more parsimonious explanation for the modern-day distribution of the "incertae sedis" metalmarks in Central and South America than repeated over water dispersal from the Caribbean to the mainland (see Liebherr, 1988).

ACKNOWLEDGMENTS

First we would like to thank Jorge Llorente-B., Armando Luis-M., and Isabel Vargas-F. (MZFC), and SEMARNAP. (both Mexico City) for assistance in obtaining collecting permits for J. P. Brock, R. E. Stanford, and S. A. Upson. Without close support from Mexico City, this project would not have been possible. We thank Douglas Danforth for being in the right place in the right time, and James Brock for sending Danforth's original photo to us for determination. Robert K. Robbins (Smithsonian Institution) kindly sent us detailed slides of a fossil metalmark specimen for comparison with the new species, and provided thoughtful comments on this manuscript. We thank James S. Miller and David Grimaldi (American Museum of Natural History, New York) for sharing information on the fossil specimens with us, and Donald J. Harvey (Smithsonian Institution) and David H. Ahrenholz (St. Paul, Minn.) for sending information on riodinid higher classification and providing comments on the manuscript. We also thank Boris C. Kondratieff (Colorado State University) for providing laboratory space and use of camera lucida.

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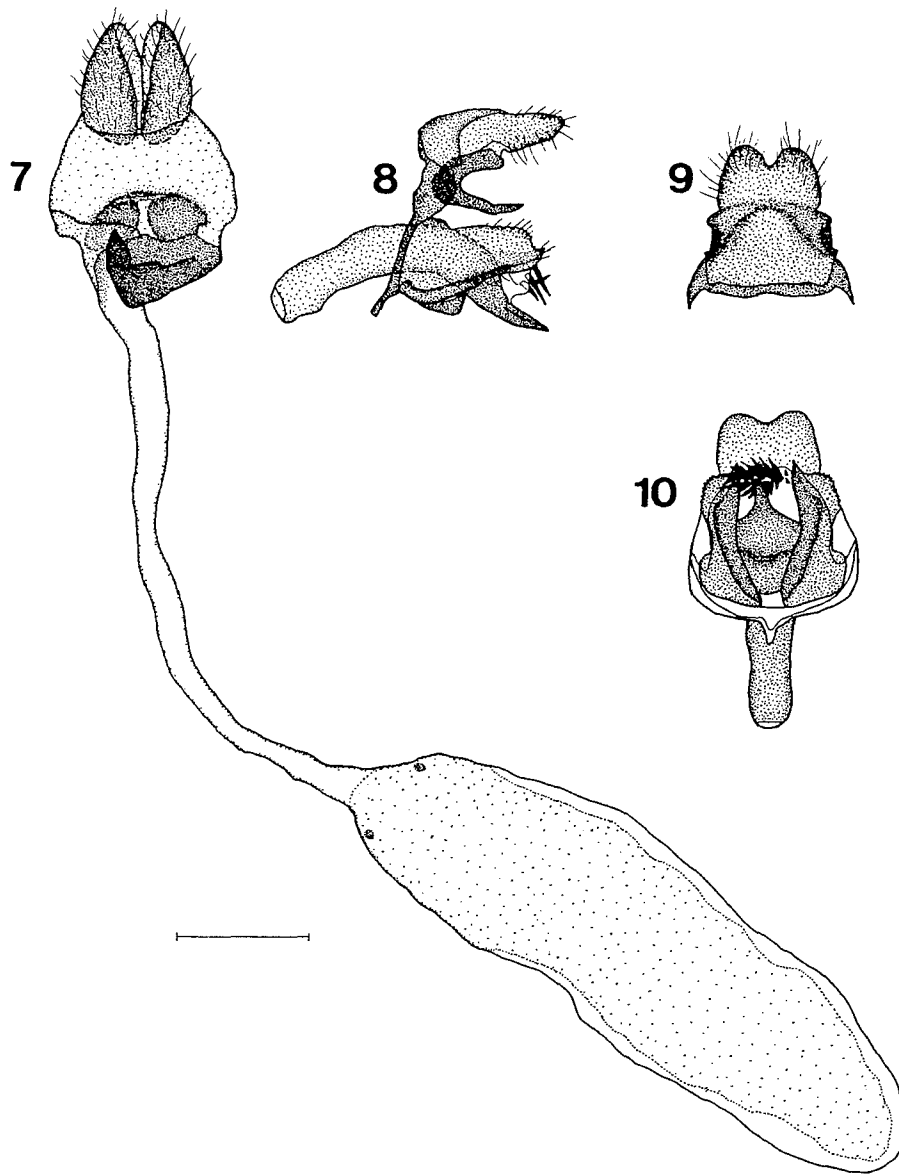


Fig. 7-10. Genitalia of *Napaea danforthi*. 7) Female genitalia in ventral view. Data as for Fig. 4-6; A. D. Warren Genitalia Vial # 98-32. 8) Male genitalia in left lateral view. 9) dorsal (showing uncus, tegumen and top of vinculum only), and 10) ventral views (hairs on valvae and uncus not shown, and saccus and vinculum not stippled in ventral view). Data as for Fig. 2-3; A. D. Warren Genitalia Vial # 98-30. Scale = 1.0mm.

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