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# DESCRIPTIONS OF THE IMMATURE STAGES OF *ADELPHA ALALA* (NYMPHALIDAE)

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**Abstract.** Descriptions of the morphology and behavior of the immature stages of *Adelpha alala* are given. *Adelpha alala* does not fit into any of the species groups of *Adelpha* yet recognized. *Viburnum tinoides* var. *venezuelense* (Caprifoliaceae) is its larval host plant, documenting a new host plant family for the genus *Adelpha*.

**Additional key words:** Venezuela, pupa, *Viburnum tinoides*, Caprifoliaceae.

Relationships among the 100 or so species of butterflies included in the genus *Adelpha* Hübner (Nymphalidae) long remained a puzzle for butterfly taxonomists. The traditional approach to butterfly classification, using adult wing pattern characters proved useless in arriving at a satisfying arrangement (see references in Aiello 1984). Recent contributions (Aiello 1984, 1991) follow what seems an appropriate course toward the clarification of taxonomic relationships within the genus, building a consistent picture from characters of early stages and information on life histories. Aiello (1984) proposed that *Adelpha* butterflies can be assigned to at least seven groups based on pupal and larval morphology. Interestingly, while groups I, II and III are rather unorthodox in their larval host plant relationships, using plants from a number of different families, *Adelpha* species in the remaining groups, IV–VII, are reported to use plants of the family Rubiaceae, except for one or two doubtful records, a host-use pattern that in itself is suggestive of a natural grouping; or it may be sympleisiomorphic.

In the following account we describe the early stages of a Venezuelan species, *Adelpha alala* Hewitson, report observations on its behavior, review the phylogenetic position of the species within the genus, and report *Viburnum tinoides* var. *venezuelense* (Killip & Smith) Steyermark (Caprifoliaceae) as the larval host plant, adding a new larval host plant family to those previously recorded for *Adelpha*.

## Materials And Methods

On 10 May 1992, a female *Adelpha alala* was seen flying insistently around a small *Viburnum tinoides* tree in Monterrey, El Valle, near the city of Mérida, Venezuela, at an elevation of about 2350 m. A search

among the foliage produced one egg, recently laid on the under side of a leaf, and three early instars. All were reared to adults (Fig. 1), except a first instar, which died shortly after emerging from the egg. Since then, early stages of the species have been collected and reared on several occasions, allowing the preservation of immatures and adult vouchers.

Larvae and eggs collected in the field were taken to the lab with the leaf and a part of the branch on which they were found. Once in the lab, the branch was anchored in a small glass flask filled with water and placed on a plastic dish covered with an inverted one-liter plastic container. Fresh foliage was provided when necessary, and accumulations of frass and fecula were discarded regularly. Larval and pupal exuviae were saved and pinned with the specimens. Vouchers of the butterfly were deposited in the Museo del Instituto de Zoología Agrícola (MIZA) and vouchers of the plant (*L. D. Otero 66* and *L. D. Otero 203*) in the Herbario de La Facultad de Agronomía (MY) of the Universidad Central de Venezuela, both in Maracay, Edo. Aragua, Venezuela.

## RESULTS

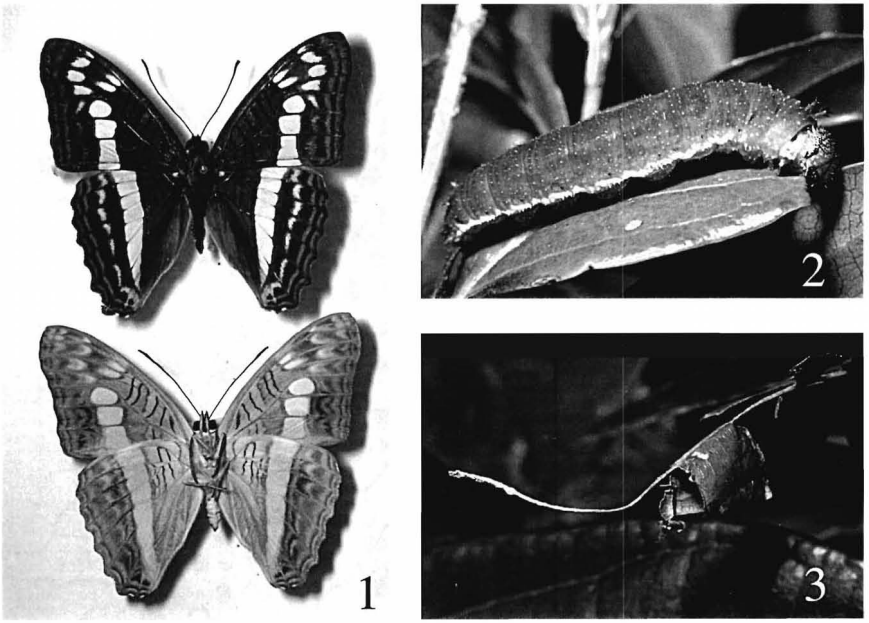
*Viburnum tinoides* is the larval host plant of *Adelpha alala* in Venezuela. The plant, a shrub or small tree commonly known in Venezuela by the name of "Cabo de Hacha," is usually distributed at elevations of 1000 to 3000 m and is a rather common species in forest margins and secondary vegetation in the Mérida area. According to Steyermark (1953), four varieties of *V. tinoides* are the only *Viburnum* occurring in Venezuela; *V. tinoides* var. *venezuelense* (Killip & Smith) Steyermark is the variety commonly encountered in the Mérida area.

### Early Stages

**Egg.** The eggs of *A. alala* are typical of the tribe Limenitidini and closely resemble the egg illustrated in Aiello (1984). They are approximately hemispherical, and are yellowish white in color, but the most characteristic feature is their sculpturing, which consists of concave hexagonal facets joined by their sides and vertices. A sharp pointed structure projects from each vertex. The eggs are laid singly on the under surface of the leaf. The first instar eats an escape hole in the egg, but does not consume the entire shell.

**Larva.** The first instar is dull green and grows to about 5 mm in length. The head capsule is rugose and paler than in later stadia. The second instar shows two colors: a wide, dorsal, greenish yellow stripe divided longitudinally by a thin median line, and a lateral maroon stripe bordered below by a white subspiracular line. The general pattern, with perhaps slight changes in hues, is maintained through the fourth instar and is present still in the recently molted fifth instar. As the fifth instar (Figs. 2, 4) matures, it becomes a rather uniform green, except for the white subspiracular line and a paler green below it. The body is clothed in greenish chalazae.

Compared with the larvae of other *Adelpha* species, *A. alala* displays a rather simple ornamentation. Most body segments are free of scoli or, at most, have clusters of minute spines in place of subdorsal scoli. Segments T2, T3, and A8 bear true scoli, all round in cross section and subdorsal in position. Those of T2 are the largest, and are orange with




FIGS. 1–3. *Adelpha alala*. **1,** Adult, dorsal (above) and ventral (below) (wingspan 48 mm). **2,** Mature larva (30 mm long). **3,** Leaf shelter (leafy portion 8 mm long) constructed by larva on *Viburnum tinoides*.

one black spine at the middle and five radiating black spines at the apex. The scoli of segments T3 and A8 are very small.

**Pupa.** The pupa (Fig. 5) is bone white to straw colored. The dorsal, thoracic (T2) and abdominal (A2) projections are small, with that of A2 slightly larger than that of T2 and ending in a short point directed anteriorad. The small, triangular head horns are directed to the sides. In general form, it is similar to the pupae of *Adelpha justina* (C. & R. Felder) and *A. jordani* Fruhstorfer, although it displays neither the silver markings of the former nor the black markings of the latter. Also unlike the pupa of *A. justina*, which is oriented horizontally (dorsal side down), the pupa of *A. alala* hangs head down as do other *Adelpha* species and most other Nymphalidae. Pupal orientation for *A. jordani* is not known.

**Behavioral Notes.** Characteristic of many nymphalids, *Adelpha* larvae utilize leaf veins to construct resting perches (Moss 1933, Aiello 1984). First instars strip a leaf vein, the midrib in the case of *A. alala*, by eating the surrounding tissue. They then extend the newly exposed perch by adding fecal pellets held in place by silk (see description in Aiello 1984; see Muyshondt and Muyshondt 1979, for perch construction by other nymphalids).

Late first instar and second instar *A. alala* go on to construct elaborate shelters, a behavior not reported previously for any other *Adelpha*. Shelter construction by *A. alala* begins with two opposing cuts, each at, and perpendicular to, the leaf margin, and ending at the midrib. The larva pulls the resulting symmetrical flaps of leaf downward, curving them beneath the leaf, and fastens their proximal edges together with silk to form a tepee-like shelter which opens towards the apex of the leaf (Fig. 3). The larva resides inside the shelter when not feeding, until well into the fourth stadium. Usually, the shelter entrance has a curtain of small pieces of leaf tissue left dangling by the first instar as it fed from the distal end of the leaf.

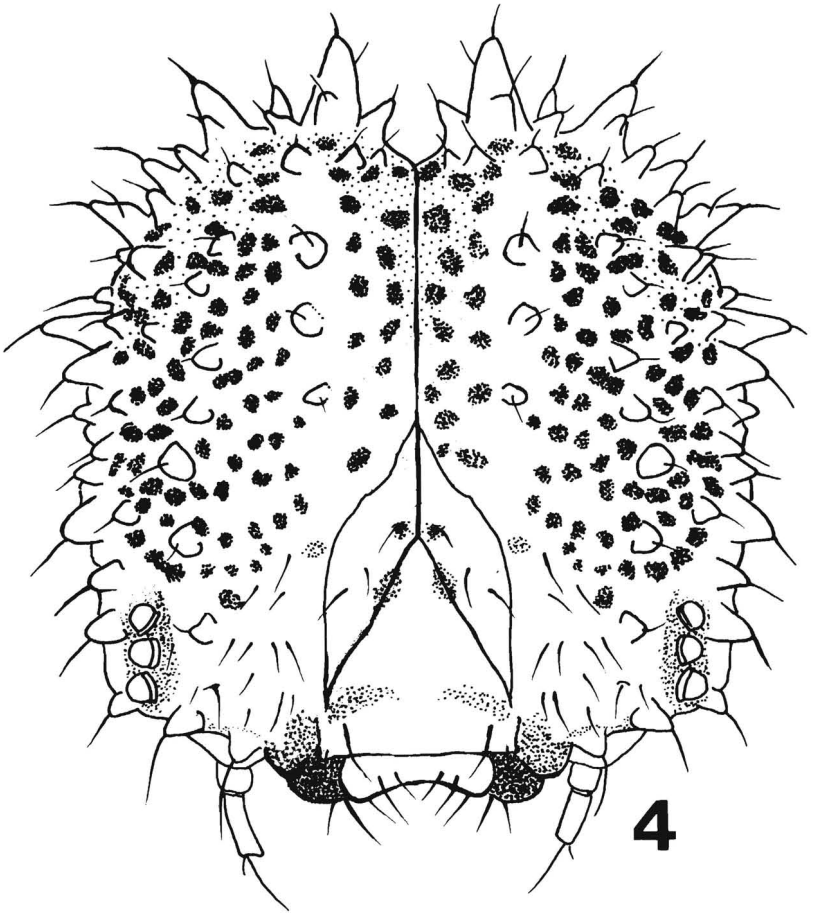



FIG. 4. *Adelpha alala*. Head capsule (3 mm wide) of mature larva.

If the shelter is assumed to play a defensive role, it might be supposed that the earlier the shelter is constructed, the more important its function as a protective structure. In the lab, we have recorded cases in which shelter construction was completed by the second instar, which is most likely what occurs in the field on leaves that have not been perturbed by removal from the plant. In other cases we observed larvae begin shelter construction more than once because their original leaf had decayed. In some cases construction was completed by the third instar. Once finished, the larva crawls into the shelter during periods of inactivity and curls up against the inner walls, a habit that continues into the advanced fourth or early fifth stadium, by which time the head capsule and posterior end of the curled larva begin to protrude from the opening. The shelter is abandoned by the larva either just before molting to the fifth stadium or shortly afterwards, and from then on it lives exposed on leaves. Interestingly, during the final stadium, the larva turns green.

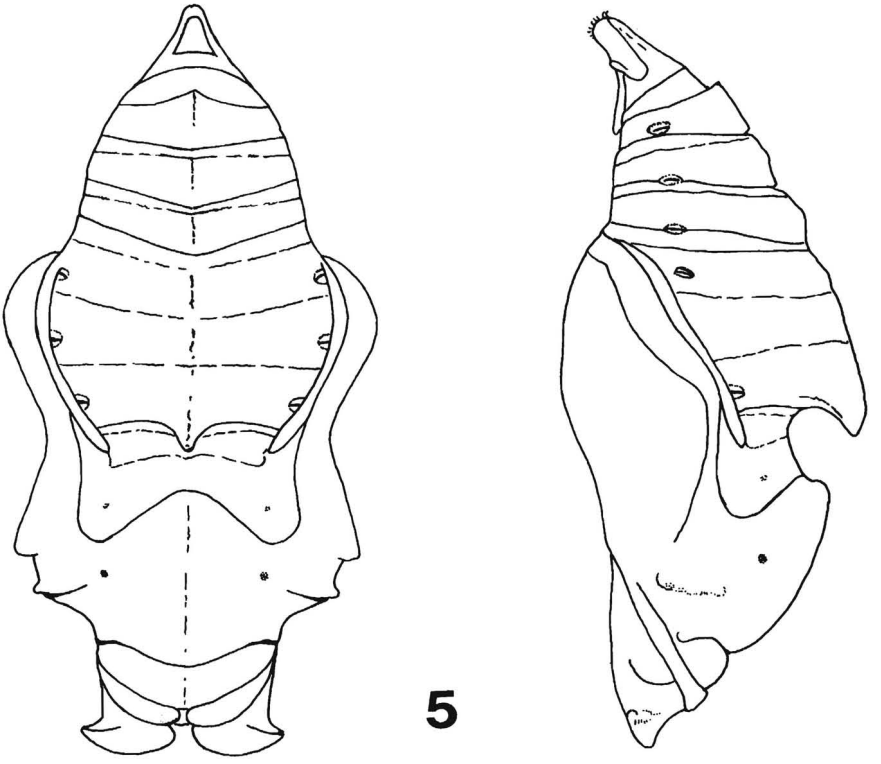



FIG. 5. *Adelpha alala*. **5,** Pupa (2 cm long), dorsal (left) and right side (right).

## DISCUSSION

The larva of *A. alala* differs from larvae of other *Adelpha* species in having greatly reduced body scoli. Larvae of *A. justina* and *A. jordani* have somewhat reduced scoli, but nevertheless do retain those structures on most abdominal segments. In contrast, the larva of *A. alala* lacks scoli on most abdominal segments, and the few scoli that are present (on segments T2, T3, A8) are quite reduced, giving the larva a nearly bare appearance. In general aspect, it does not resemble closely any other *Adelpha* species for which the larva is known.

In addition, the habit of constructing a larval shelter has not been reported for any other *Adelpha* species. In the Old World, however, *Ladoga (Limenitis) camilla* L. (Nymphalidae), and *Ladoga (Limenitis) reducta* Staudinger overwinter within shelters constructed by joining the edges of a leaf together with silk (Carter 1982). Interestingly, the larval host plant of both those species is *Lonicera*, also of the Caprifoliaceae.

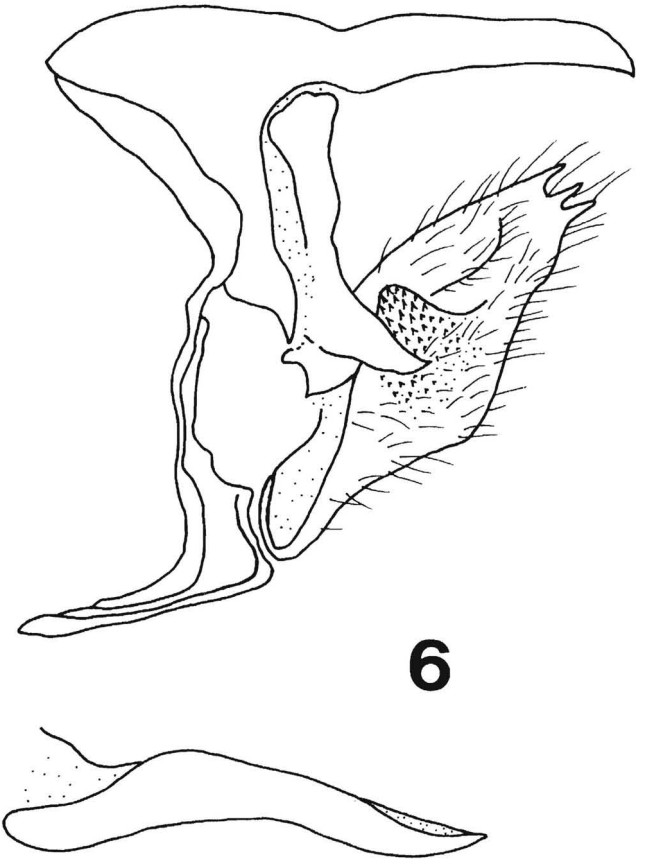



FIG. 6. *Adelpha alala*. Male genitalia.

It is doubtful that *A. alala* belongs to any of the seven *Adelpha* species groups outlined by Aiello (1984). Possibly, it represents an eighth group. As the immatures and larval host plants of more species are discovered, perhaps other *Adelpha* species with larvae similar in form and behavior to that of *A. alala* will reveal themselves. Judging from the genitalia (Fig. 6), other species that potentially belong to the same group as that of *A. alala* may include *A. aricia* Hewitson, *A. corcyra* Hewitson, *A. donysa* Hewitson, *A. pithys* Bates, and *A. tracta* Butler, with which *A. alala* shares: the clunicula broad and not reaching the costal margin; the valve lacking a costal bulge; and the valve apex armed with 1 to 3 large distinct spines. Unfortunately, none of these species has been reared. Genitalic drawings, by Howarth, for more than 70 species of *Adelpha* are included

in an uncompleted manuscript by Forbes (archives of the Museum of Comparative Zoology, Harvard University). Forbes concluded that genitalia were not helpful in classifying *Adelpha* species because they did not agree with the wing patterns.

At present, *Viburnum* is generally considered to belong to the family Caprifoliaceae, order Dipsacales, subclass Asteridae (Takhtajan 1980, Cronquist 1981), although recently the affinities of the genus have been called into question by Donoghue et al. (1992), who, based on chloroplast nucleotide sequences, concluded that the Caprifoliaceae do not form a monophyletic group and that *Viburnum* does not fit with Caprifoliaceae *sensu strictu*. *Viburnum tinoides* var. *venezuelense* represents an addition of both a larval host plant species and a family to the plant associations recorded for *Adelpha* (Aiello 1984, Ackery 1988).

While obvious progress has been made in our understanding of systematic relationships within the genus *Adelpha*, life history information, much of it incomplete, has been reported for only a portion of the approximately 100 species. We urge others to seek the immature stages of additional species and to publish illustrated accounts of their findings. As well, we have only a vague understanding of the relationships between New and Old World members of the tribe Limenitidini. It is possible, for example, that *Adelpha* actually represents several genera, and that some of those genera may be more closely related to Old World genera than to each other. Whether molecular studies will clarify the complex relationships within the Limenitidini remains to be seen, but certainly that approach should be taken by anyone who has access to the appropriate facilities and to fresh subject material.

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