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NOTES ON THE NATURAL HISTORY OF *DOXOCOPA EXCELSA*
(NYMPHALIDAE: APATURINAE) IN TURRIALBA, COSTA RICA

Additional key words: *Astrartes*, *Celtis*, phenology, rarity.

Butterflies of the genus *Doxocopa* Hübner (Apaturinae) are among the least well-known nymphalids of the neotropics. DeVries (1987) records nine species of *Doxocopa* from Costa Rica, but reports hostplant records and partial descriptions of the early stages for only three. A detailed description of the life history has been presented for only one species in the genus, *D. laure* Drury (Muller 1886), and the larva and pupa of *D. cyane burmeisteri* Godman and Salvin were figured by Schreiter (1943).

Doxocopa excelsa (Gillott) is one of the rarest species of *Doxocopa* in Central America; it is known only from El Líbano and Turrialba in Costa Rica, and from Chontales in Nicaragua (DeVries 1987, pers. comm.). The hostplant and early stages of this species have not been recorded previously, although limited life history information was obtained by Andrew King. During his residence in Turrialba, King observed *D. excelsa* only during June and July (also see DeVries 1987) and concluded that it was strongly seasonal in its occurrence.

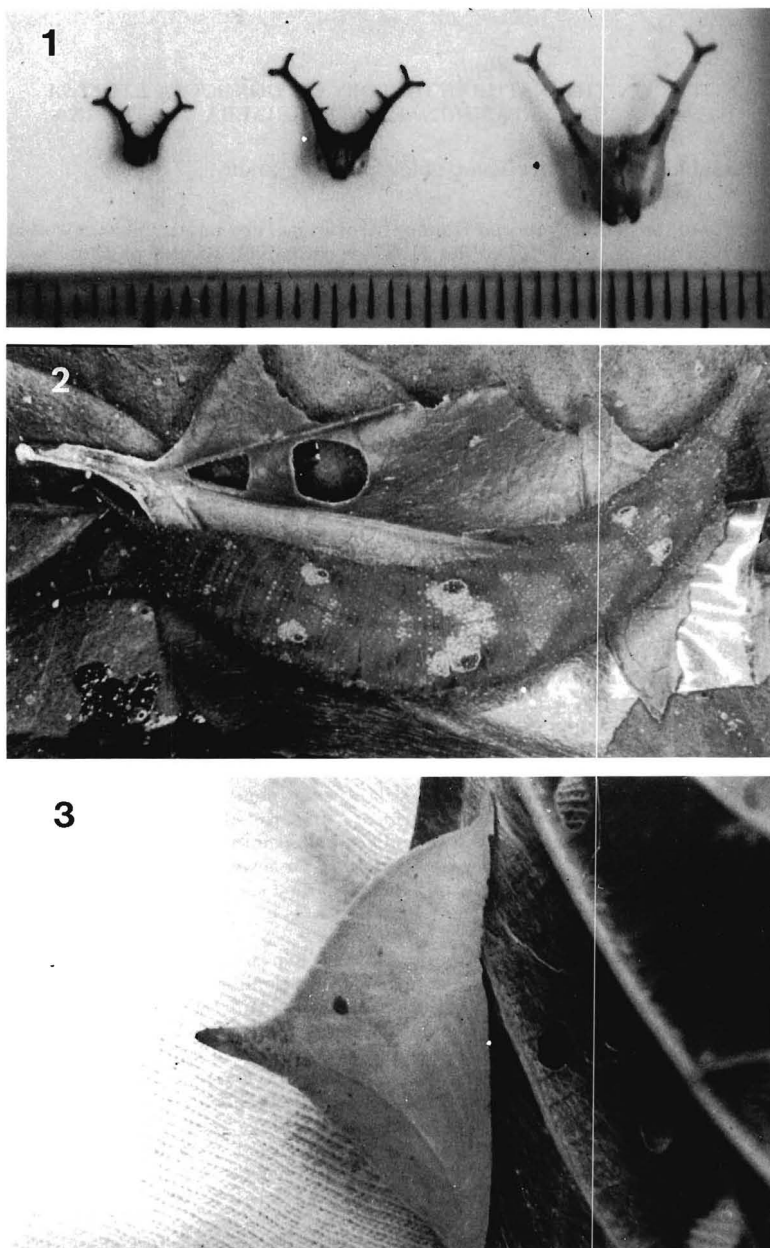
This paper reports the results of studies on *Doxocopa excelsa* conducted at Turrialba, Costa Rica, by the author, and presents descriptions of three larval instars and the pupa. Brief observations are presented on larval behavior, as well as on the biology and ecology of the hostplant and possible relationships to the ecology and population dynamics of the butterfly.

Turrialba is located at 600 m above mean sea level on the Central Volcanic Cordillera of Costa Rica. Mean annual temperature is 22°C and mean annual rainfall 2500 mm. The study was conducted in Los Espaveles, a 20 ha forest fragment located in the canyon of the Reventazón River supporting disturbed primary and secondary vegetation (Salcedo 1986).

Descriptions of the early stages are composite, based on four individuals, three of which were successfully reared to adults. The first larva was found on 7 May 1992. It was 12 mm long and passed through three instars (presumably 3rd, 4th, and 5th) before pupating. The second larva, that apparently had recently moulted into what proved to be its final (5th) instar, was found on 7 September 1993. A third larva was found on 20 October 1993 in what is assumed to be the fourth instar. This larva died soon after being found, possibly from careless handling in the field. The fourth larva was found in its final instar on 6 June 1994.

Third instar. Head capsule 1.7 mm in width, with two stout horns, each approximately 3 mm in length (Fig. 1). Horns with forked tips and two slender, inward pointing branches. Face and front part of horns shiny black; three rather indistinct white marks on the lower face; circular whitish patch around stemmata. Rear part of head and horns shiny dark tan. Body uniform green with rough, warty texture. Two transverse, raised, bright yellow oblong patches on dorsum of segment A4. Tail bifid with the two parts held tightly together as in larvae of other *Doxocopa*. Near end of stadium, two yellow dots increasingly evident on dorsum of each segment, except on segments A3 and A4; particularly conspicuous on segments A2, A5, and A7 at distal edge of segment. Segment A3 with dots at caudal edge of segment adjacent to the yellow oblong patches of segment A4; segment A4 with dots between yellow oblong patches. The third instar moulted four days after its discovery. Total length including bifid tail 15 mm.

Fourth instar. Head capsule width 2.7 mm; horns 4 mm long, forked and branched as in third instar (Fig. 1). Head and horns pale greenish tan posteriorly; sides of the head green, with small white dots. Most of face and front of horns shiny black, frons and clypeus shiny pale grey. Frons lined in black with shiny pale grey triangle covering the adfrontal area on each side, visible as translucent areas in Fig. 1. Inner vertices of triangles connate



FIGS. 1-3. Head capsule, larva, and pupa of *Doxocopa excelsa* from Turrialba, Costa Rica. 1: Head capsules of third, fourth, and fifth instar larvae (from left to right); scale in mm. 2: Final (fifth) instar larva on its hostplant, *Celtis* cf. *iguanaeus*. Larva exhibits typical

at epicranial suture. Body green, markings as described for third instar, but pale yellow; covered with small pale yellow dots evident upon close examination. Markings on segments A3 and A4 as in fourth instar, but yellow; dots on dorsum greatly enlarged on segments A2 and A7, visible but indistinct on other segments. Spiracles surrounded by small pale yellow dot. Total length including bifid tail approximately 34 mm. The fourth instar lasted only four days.

Fifth instar. Head capsule width 4.8 mm; forked horns 6 mm long (Fig. 1). Each horn with single, slender, inward-pointing branch at its middle, with several smaller protuberances below. Body color green, with minute greenish white dots. Series of indistinct dark green to purplish diagonal bands, each starting at lower center of segment and terminating at caudal edge of following segment; dark bluish green dorsal midline. Markings similar to those in previous instar evident on distal edges of segments A2, A4 and A7, in form of an irregular greenish white blotch with a purplish circle in the center of each (Fig. 2). Blotches on A4 largest, those on A7 smallest. Small greenish white dot opposite each blotch on preceding segment (Fig. 2). Total length 47 mm. The fifth instar lasted 8–10 days.

Pupa. Approximately 30 mm long, similar in shape to that of *Doxocopa clothilda* (DeVries 1987:fig. 21), but with segment A5 produced into a short spike (Fig. 3). Same color green as larva, with faint dark green or purplish diagonal stripes, a prominent purplish dot on segment A6, and a smaller dot of the same color on segment T2 (present in first individual reared). Abdominal spike and keel purplish. Cremaster green below, black at pupal attachment to substrate. The pupae wriggled vigorously when molested. The pupal stage lasted 10–12 days.

The first individual (male) emerged on 3 June 1992; the second (female) on 27 September 1993; and the third (female) on 29 June 1994. Voucher specimens (one male, one female, one pupal case, and the head capsules illustrated in Fig. 1) are deposited in the Museo Nacional in San José, Costa Rica.

All larvae were found and reared on shoots of the same individual of the liana *Celtis* cf. *iguanaeus* (Jacq.) Sarg. (Ulmaceae). A voucher specimen of the hostplant is deposited in the Museo Nacional. This large *Celtis* has its crown in the canopy of a secondary forest (approximately 20 years old) that has developed on an abandoned coffee plantation on the upper terrace of the Los Espaveles forest. The shoots upon which larvae were found were about 0.5–3.0 m tall and were produced from the 5–10 cm diameter lower shoots and root system of the plant. *Celtis* is found more commonly at forest edges than within the forest at the Los Espaveles site, though it was formerly abundant in other secondary forests on the CATIE estate (Martín Artavia, pers. comm.). It appears to be relatively light-demanding. In the forest understory, new basal leaf shoots produced in May, June, and July mostly die back by September; I have not observed flowering or fruiting. In contrast, forest-edge plants grow vegetatively, flower, and fruit unimpeded.

As is evident in Fig. 2, larvae of *D. excelsa* are well camouflaged on their *Celtis* host. The first individual was noticed only because of the dark color of the rear of the head capsule in the third instar. Larvae rest on the upper surfaces of leaves with the face flat against the leaf surface (Fig. 2; see also DeVries 1987:fig. 21 for other *Doxocopa* spp. and for identical behavior in larvae of British *Apatura iris*, Thomas & Lewington [1991]). Larvae usually rest towards the leaf tip where they make a silken pad that raises the leaf surface towards the larva, but does not cover it. As the dark color of the rear of the head capsule becomes green in later instars, the camouflage is complete. The white and purplish markings on the body appear to mimic those on mature *Celtis* leaves dotted with epiphylls (Fig. 2).

Reasons for the apparent scarcity of *Doxocopa excelsa* are unclear. The availability of

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cryptic resting position with face (at left of photo) flat against leaf surface. Length of fully extended larva 47 mm. 3: Pupa suspended (cremaster at top) from leaf of hostplant. Pupal length 30 mm.

hostplants would not appear to be limiting. The Turrialba hostplant is widely distributed throughout tropical and subtropical America (see e.g., Croat 1978, Standley 1937). *Celtis* is also the hostplant of *D. cyane* Latreille, which is the most common *Doxocopa* in Costa Rica (DeVries 1987). Competition for the hostplant does not appear to be important. The individual *Celtis* plant which yielded the four larvae has been repeatedly searched since June 1992, and no other larvae of *Doxocopa* spp. have been found, although *D. pavon* Latreille and *D. cyane* also appear to be resident at Turrialba (pers. obs.). The Turrialba *Celtis* is also the hostplant of an *Astraptes* sp. (Hesperiidae: Pyrginae; pers. obs.), whose larvae are found much more frequently than those of *D. excelsa*. However, this *Astraptes* does not seem to represent a serious competitor. During the period of observation of this study, larvae of the hesperiid were never frequent enough to reduce the available foliage significantly, most disappearing while still in first or second instars after inflicting very little damage on the host.

The seasonality of *D. excelsa* at Turrialba (King, cited in DeVries 1987) is as difficult to explain as the insect's scarcity. It is likely, however, that more thorough studies may reveal large population fluctuations, but not seasonally linked presence and absence. The emergence of the male and the second female during the present study coincided with the period predicted from King's observations. On the other hand, the first female reared extends the flight period to September, and the fourth instar larva found in October, had it survived, would have emerged as an adult in November. The only individuals I have seen in nature also unequivocally extend the flight period: a male at a sunny forest edge recorded in the first week of August 1992 and a female seen in the forest understorey on 8 January 1994 at 1100 h, apparently searching for hostplants.

Fluctuations in the abundance of this butterfly may correspond with the annual flushing of tender young shoots of the hostplant. Detailed phenological observations of *Celtis* are required to confirm that flushing is annual, but if young larvae are only able to consume such shoots, this would represent an important limiting factor (cf. Aide & Londoño 1989). As far as adult resources are concerned, the *Mikania* (Compositae) vine mentioned by DeVries (1987) flowers in discrete periods several times a year (pers. obs.), not only during June and July when adult butterflies were observed flying by King.

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