DESCRIPTION OF EARLY STAGES OF *CHORINEA LICURSIS* (FABRICIUS) (RIODINIDAE)

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Abstract - The early stages of *Chorinea licursis* (Fabricius, 1775) are described and illustrated. Larvae feed on *Maytenus ilicifolia* (Celastraceae). We compare the fifth instar and pupa of *C. licursis* to closely related species, and provide observations on wing color variation in adult *Chorinea*.

Key words: *Maytenus*, Celastraceae, egg, larva, pupa, riodinid butterfly, *Ancyluris*, *Rhetus*, *Necyria*, *Chorinea octauius*

The genus *Chorinea* Gray, 1832 ranges from Central America to southern South America in association with forest habitats from sea level to over 1,000 m elevation (*e.g.*, DeVries 1997, Emery *et al.* 2006), and is currently thought to include eight species (Callaghan & Lamas 2004). These butterflies are distinct among riodinids by having transparent wings outlined with black and with variable, brightly colored marks at the base of the hindwing tails (Seitz 1917). General natural history accounts from South America suggest that adult *Chorinea* are rare, infrequently encountered forest butterflies (Ebert 1969) that often fly at the tree-top level, and when doing so, can be mistaken for large wasps (Biezanko *et al*. 1978, Brown 1992), while in Central America, DeVries (1997) reported aggregations of 5-10 *C. octauius* (Saunders, 1859) males in forest light gaps perching under leaves 5 m above the ground.

Larvae of *Chorinea* are reported to feed on members of the Celastraceae (Biezanko *et al*. 1978, DeVries 1997), and although some members of this plant family contain secondary compounds (*e.g.*, terpenoids and polyphenolic compounds in *Maytenus*; Campos *et al*. 1997, Avilla *et al*. 2000), it is unknown whether *Chorinea* butterflies sequester such chemicals as a defense. Biezanko *et al*. (1974, 1978) listed *Maytenus ilicifolius* (*sic*), *M. spinosus*, and *M. gonoclada* (Celastraceae) and *Ilex paraguaiensis* (Aquifoliaceae) for *Chorinea licursis* (Fabricius, 1775), and DeVries *et al*. (1994) reported *C. octauius* (Fabricius, 1787) (as *C. faunus* (Fabricius, 1775)) feeding on *Prionostemma aspera* (Celastraceae).

Despite the fact that immature stages of *Chorinea licursis* have been found previously (Biezanko *et al*. 1974, 1978), they have never been described in any detail. Accordingly, here we describe and illustrate eggs, first and fifth instars, and pupa of *C. licursis* from Curitiba, Paraná, Brazil. We also present comparative information on the immature stages *C. octauius* from Costa Rica, close relatives in the genera *Ancyluris* Hübner, 1819, *Rhetus* Swainson, 1829 and *Necyria* Westwood, 1851, and provide color photographs of larvae and pupae of these species for the first time.

MATERIAL AND METHODS

At our study site in Curitiba, Paraná, Brazil, adult *C. licursis* are usually found from March to June. Local habitat conditions fit the Cfb category in the Köppen climate classification (uniform precipitation distribution, often overcast weather, cool summers due to cloud cover). Here the average yearly temperature is 16.5°C (ranging from 24.4 to 12.7°C, and ground frost occurs more than five times per year), and the site has an annual rainfall of about 1460 mm (Maack 1981).

Egg clusters, first and fifth instars, and pupae were collected concomitantly in March, 2007. Larvae were reared indoors, under artificial conditions, and thus stadia durations reported here may not correspond with natural life-cycle durations. All development times and photographs of early stages correspond to siblings obtained from a single egg cluster. Adults illustrated here were obtained from larvae of various ages (and egg clusters) collected on the same day. Most illustrations were prepared using a Leica ® DFC500 camera coupled to a Leica ® MZ 16 stereomicroscope and Syncroscopy ® Automontage Pro ® 5.03.0040 software. Some photographs were taken with a Nikon Coolpix 5700 digital camera. Comparative photographs of *Ancyluris*, *Rhetus* and *Necyria* early stages were taken in the field with a 35mm film camera using Kodachrome 64 or Ektachrome 400 film.

Preserved fifth instars and a pupa of *A. inca inca* (Saunders, 1850), as well as photographs of *A. i. inca*, *R. arcius castigatus* Stichel, 1909 and *N. duellona beltiana* Hewitson, 1810, were available for comparison with *C. licursis*. A Leica ® MZ 16 stereomicroscope was used to study preserved specimens. Ethanol-preserved early stages of *C. licursis* and comparative material are in the DeVries collection at the University of New Orleans. Adult *C. licursis* have been deposited in the collection of Departamento de Zoologia, Universidade Federal do Paraná, Brazil.

Abbreviations used here are: T for thoracic segments, followed by the segment number (T1, T2, T3); A for abdominal segments, followed by the segment number (A1, A2, etc).

RESULTS

Egg. (Fig. 1A-B) One cluster of eggs collected 26 March, 2007. Pale pink, finely sculptured, compressed dorsoventrally, ca. 0.75 mm in diameter (n=5 eggs). Laid in clusters on the underside of the host plant leaves (154 eggs, n=1 cluster). Females lay multiple clusters of eggs on the same individual host plant.

First instar. (Fig. 1C-D) Approximate duration: 16 days. Head black with long, barbed, setae. Body mostly pale yellow; prothoracic shield and anal plate slightly darker than the general background color; two brown dorsolateral stripes that extend from T3 (faded on T2) to A8-9; dorsum white on anterior and posterior regions, and also between the brown dorsolateral stripes on A3-4; body setae barbed; dorsal setae approximately three times as long as body height, and even longer on prothoracic shield and anal plate. Thoracic legs dark brown.

Second instar. (Fig. 1E) Approximate duration: 10 days. Similar to fifth instar in general coloration and structure, except for the following: prothoracic shield and anal plate completely brown; dorsolateral brown line interrupted by a white

Figure 1 – *Chorinea licursis* early stages. A, egg cluster. B, detail of egg. C, First instar; on top left, note characteristic leaf damage caused by larvae scraping the leaf surface. D, first instar. E, second instar. F, fifth instar. G and H, larval shelter. I, pupa, dorsal view; inset: dorsal view of a different individual showing dorsolateral spots on A1 and A4-6. J, pupa, ventral view; inset: detail of a dorsolateral tubercule showing setae. All photographs by Olaf Mielke.

Figure 2 – Fifth instar larvae and pupae of Riodinini. A and B, larva and pupa of *Ancyluris inca inca*. C and D, larva and pupa of *Rhetus arcius castigatus*. E, larva of *Chorinea octauius*. F, larva of *Necyria duellona beltiana*. All photographs by Phil DeVries except *Necyria duellona beltiana*, photographed by Isidro Chacón and used here with permission.

line on A3-5, one single orange spot per segment on remaining segments; long, lateral setae of thoracic segments brown (not visible in Fig. 1 E).

Third and fourth instars. Approximate duration: 15 and 11 days, respectively. Similar to fifth instar in general coloration and structure, except for the following: prothoracic shield and anal plate mostly brown, but white at midline; the long, lateral setae of thoracic segments brown.

Fifth instar. (Fig. 1F) Approximate duration: 9 days. Body length at maturity: 2-2.2 cm (n=10). Head black; all setae with accuminate tips; primary setae long, with barbs on shaft; many short, thick, white, barbed, secondary setae in the frontal and stemmatal regions; cusp edge of mandible conspicuously dentate. Body ground color white, lateral edges of T1 with a brown tinge; anal plate white at midline, brown laterally. Dorsal side of the body with sparse, short, white, barbed setae, and completely covered with short, thick, spiculate setae of three colors: white, dark brown, and orange, the latter two more densely spiculate than the white setae. The spatial arrangement of spiculate setae produces the dorsal color pattern of the body, which is lost when the setae are removed (as seen in Fig. 1F). Dorsal color pattern mostly white, with two wide, broken, brown stripes interspersed with dark orange markings in most body segments (no orange spots present on T1 or anal plate); dorsolateral brown line partially interrupted by a white “saddle” on A3-5 that obliterates the orange markings; one pair of orange spots on T2-3, two pairs on A1-2, two pairs on A6-7, one pair on A8. Long, white, acuminate, barbed setae outline the body, projecting over the head, lateral and posterior portions of the body. Ventral surface of body white, with barbed and filiform setae; thoracic legs dark brown; proleg crochets tri- to tetra-ordinal, organized in three bands except for last pair which has two bands of crochets.

Pupa. (Fig. 1I-J) Approximate duration: 11 days. Background color yellow or yellow-green, somewhat translucent dorsally on the thorax. Eye, antennal, and leg regions sometimes solid yellow, sometimes with a dark brown tinge. Thorax with two broad, diffuse, broken, pale purple dorsolateral lines that extend to the abdominal segments; thin black stripe on thoracic midline; a black spot laterally on T1; dorsal edge of wing pad with a black outline. A3-7 with a series of broad, pale purple spots at midline and dorsolaterally; a pair of dorsolateral spots may be present or absent on A1 and A4-6 (see Fig. 1I and inset). Two series of scoli; dorsolateral series present on abdominal segments 1-8, those on segments 1-7 with black tips; ventrolateral series present on abdominal segments 4-8, monochromatic yellow; scoli setae are transparent and have a thin shaft that terminates in a broad disk (see inset in Fig. 1J). Cremaster broad, with dorsal black markings that follow the sequence of the black-tipped dorsolateral scoli.

Host plant. *Maytenus ilicifolia* (Celastraceae), "espinheira santa." This is a common, evergreen shrub in Southern Brazil that is known for its secondary chemical compounds, and it is widely used for a variety of ethno-medicinal purposes (Oliveira *et al.* 1991, Campos *et al*. 1997, Avilla *et al*. 2000).

Larval behavior and parasitoids. The following observations were made based on one cluster of 154 eggs (Fig. 1A). Newly hatched larvae do not eat the entire chorion, only the region surrounding the micropyle. First and second instars scrape the ventral surface of the tough leaves of *Maytenus ilicifolius* and produce a characteristic damage (Fig. 1C, top left). During the third stadium, larvae start making silk shelters in the concavity on the top of a leaf (Fig. 1G-H) that are built by spinning large quantities of silk to which plant debris is attached. From the third instar on larvae rest inside the shelter when not feeding, and forcefully propel feces out of the shelter. From the fourth instar on, larvae feed from the edge of the leaf. Upon molting larvae of all instars fed on the cast skins, but not the head capsules. Larvae pupated inside the shelter.

Comparison of early stages to related species. *Chorinea* is considered to be closely related to *Ancyluris*, *Rhetus* and *Necyria* (Callaghan 1995, DeVries 1997), and adults share the presence of hindwing tails with *Ancyluris* and *Rhetus*. DeVries (1997) noted the similarity between immatures of *C. octauius*, *A. inca inca* (Saunders, 1850), *R. arcius castigatus* and *N. duellona beltiana*.

Mature larvae and pupae of *C. licursis* and *A. inca inca* share several macro and microscopic characteristics, but differ in others (Fig. 1 and 2A-B). In both species the mature larva is white with dark head and paired, dark dorsal markings, all of which are produced by short, thick spiculate setae. Paired dorsal clusters of long, round-tipped setae are present dorsally on thoracic segments T2-3 and abdominal A1-8 in *A. inca inca*, but not in *C. licursis*. Short, plumose, basally multi-branched setae are interspersed within the dark dorsal markings in *A. inca inca*, but not *C. licursis*. In general, setae that outline the body are longer and denser in *A. inca inca* than in *C. licursis*, and in *A. inca inca* these setae are slightly rounded at tip, something that is especially noticeable in the shorter setae at the anterior edge of T1. The pupae of *A. inca inca* and *C. licursis* have the same general color, shape and organization of tubercules (including the setae that terminate in a disk), but the dorsolateral tubercules are longer in *A. inca inca* (Fig. 2B).

Comparison of the immature stages of *C. licursis* with photographs of those of *C. octauius*, *R. arcius castigatus* and *N. duellona beltiana* (Fig. 2) also revealed similarities and differences, the most important of which are given here. In all species the general larval color pattern is produced by short spiculate setae that obscure most of the background cuticular color, except for *N. duellona beltiana* where the dark background shows through the sparse spiculate setae. Although variable in size and color, a dorsal, abdominal "saddle" is present in all species. Paired dorsal clusters of long, round-tipped setae on T2-3 and A1-8 are present in *A. inca inca*, *R. arcius castigatus* and *N. duellona beltiana* (shorter and more numerous in *N. duellona beltiana* than in *A. inca inca* and *R. arcius castigatus*), but do not occur in *C. licursis* and *C. octauius*. The ventrolateral fringe of long setae varies among species of the same genus (compare *C. licursis* Fig. 1F, and *C. octauius* Fig. 2E) and also among genera. In *R. arcius castigatus* these setae form discrete, long, white tufts inserted within a cluster of short, red, spiculate setae, contrasting with the dark color of the body (except for T2, where the long setae are dark). Despite the differences in overall appearance, larvae of *C. licursis* and *C. octauius* show pattern variations of the same three colors: white, dark brown, and orange. The pupae of all studied species (including *N. duellona beltiana*, not illustrated) have the same *gestalt* — they are yellow, yellow-green, or green, with black-tipped tubercules of variable length, and bear transparent setae with a thin shaft terminating in a broad disk.

Adult color and behavior in *Chorinea*. Forty adults were obtained from early stages collected on the same plant, but did not necessarily belong to the same cluster of eggs. Considerable variation was found in these specimens with respect to the size of the transparent region near the hindwing apex, and the presence, size, and color of spots at the hindwing tornus. This variation was not associated with sex. Figure 3 shows nine individuals that differ markedly, corroborating the suggestion of Seitz (1917) that color variation at the tornus may occur in many *Chorinea* species. The function of such color variation is unknown, but it may play a role in mating behavior, or perhaps function as targets to deflect attacks by predators (*e.g.*, Blest 1957, DeVries 2002, Hill & Vaca 2004). In *C. octauius* DeVries (1997) noted that when they are handled, freshly eclosed males often extrude a small, bright-yellow bladder from the lateral portion of the second thoracic segment, and suggested that this could potentially be a defensive gland, or function to disseminate pheromones. However, virtually nothing is known of the defensive or mating biology of this distinctive Neotropical butterfly genus.

Summary. By comparing *Chorinea* early stages with those of *Ancyluris*, *Rhetus,* and *Necyria*, this study illustrates the similarity among caterpillars and pupae of these genera. Sadly, this brief report represents the most detailed descriptions available for the early stages of the genus *Chorinea*—the state of affairs for most Neotropical riodinid butterflies. We feel a major step toward understanding these butterflies will be a broader comparative study using adults and early stages for most species of *Chorinea*, *Ancyluris* and *Rhetus*, and one that includes members of their putative close relatives *Cyrenia* Westwood, 1851, *Lyropteryx* Westwood, 1851, and *Necyria*. Finally, here we point to natural history questions regarding potential mating behaviors and defensive traits that will require detailed observations of adults in the field to be resolved. We hope this brief report stimulates additional observations on the biology of *Chorinea* and other Neotropical riodinids.

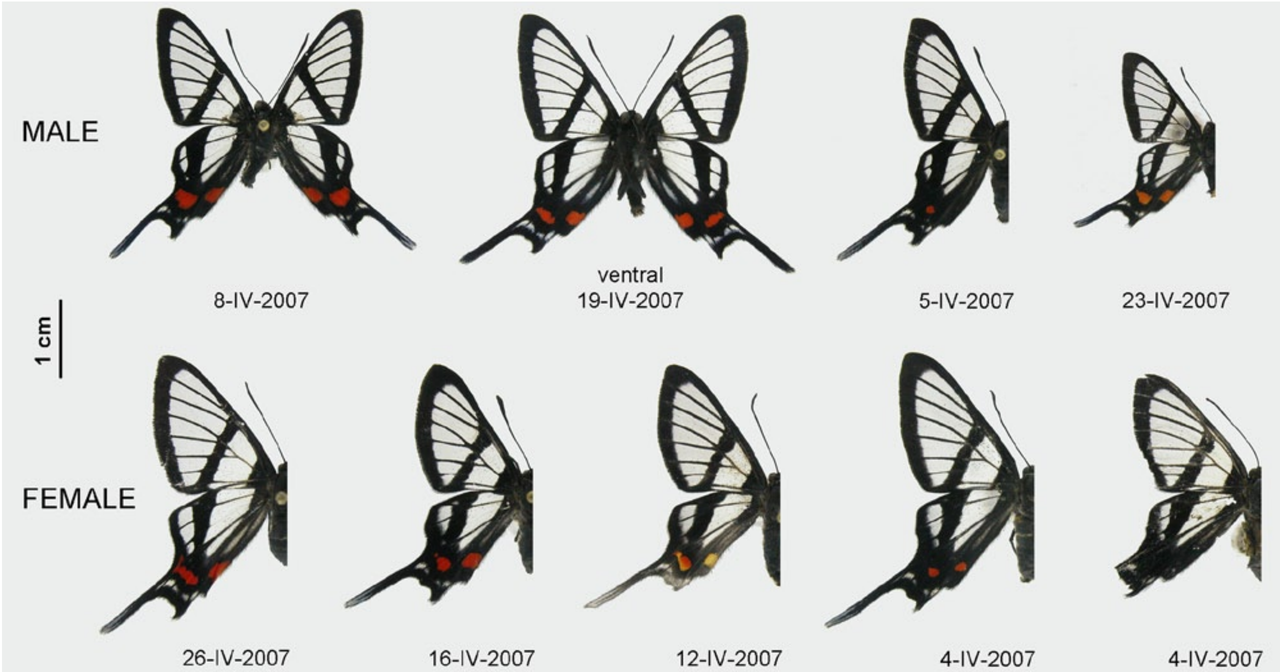

Fig. 3. *Chorinea licursis* adults in dorsal view (except when indicated) showing variation in hindwing tornus color pattern. All specimens are in the collection of Departamento de Zoologia, Universidade Federal do Paraná, Brazil, and dates are provided as means of identification of individual specimens.

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