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THE UNUSUAL NATURAL HISTORY OF THE CUBAN ENDEMIC SKIPPER *CHIOIDES MARMOROSA* (LEPIDOPTERA: HESPERIIDAE)

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Abstract: The False Locust tree, *Hebestigma cubense* (Kunth) Urb. (Fabaceae), is recorded as host-plant of the Cuban endemic skipper *Chioides marmorosa* (Herrich-Schäffer, 1865) (Lepidoptera: Hesperiidae: Eudaminae). Their last instar larva and pupa are described for the first time and other new data on the natural history of this rare skipper are also given (parasitoids, predators, larval diapause, larval shelter, sex ratio). The common name false locust's skipper (hespérido del frijolillo, in Spanish) is proposed for the species.
Key words: Lepidoptera, Hesperiidae, Eudaminae, larvae, pupae, larval diapause, parasitoids, Fabaceae, *Hebestigma*, Cuba.

La inusitada historia natural del hespérido endémico de Cuba *Chioides marmorosa* (Lepidoptera: Hesperiidae)
Resumen: Se registra al frijolillo, *Hebestigma cubense* (Kunth) Urb. (Fabaceae), como planta hospedera de *Chioides marmorosa* (Herrich-Schäffer, 1865) (Lepidoptera: Hesperiidae: Eudaminae). Se describen por vez primera la larva del último estadio y la pupa; además, se aportan otros datos nuevos sobre la historia natural (parasitoides, depredadores, diapausa larval, refugio larval, proporción sexual) de este raro lepidóptero endémico de Cuba. Se propone para esta especie el nombre común de hespérido del frijolillo (False Locust's skipper, en inglés).
Palabras clave: Lepidoptera, Hesperiidae, Eudaminae, larvas, pupa, diapausa larval, parasitoides, Fabaceae, *Hebestigma*, Cuba.

Introduction

The Cuban endemic skipper *Chioides marmorosa* (Herrich-Schäffer, 1865) (Hesperiidae: Eudaminae) (Fig. 1 A) has been sporadically observed and collected in several localities of this Antillean country, but always only few specimens have been recorded in each occasion (Roque-Albelo *et al*., 1995; Núñez, 2004; Warren *et al*., 2013) (Table I). There were no records of the species in the century after its description, so Riley (1975), Alayo & Hernández (1987) and Smith *et al*. (1994) suspected that it was already extinct. However, Roque-Albelo *et al*. (1995) found a specimen presumably collected in 1923 and recorded a small population in a subcoastal locality of northeastern Artemisa province. A decade after, Núñez (2004) recorded the species from the southern slopes of the Guamuhaya Range, central Cuba, and more recently Warren *et al.* (2013) showed records from Soroa, Artemisa province, and Sierra Maestra (*s.l.*), Santiago de Cuba province (Fig. 1 B).

Nevertheless, available information on the natural history of this uncommon skipper is very scarce. On this respect, Gundlach (1881: 171) wrote: "*La he criado de crisálida que estaba entre unas hojas de la Guara* (Cupania americana) [Sapindaceae] *reunidas por un tejido blanco bien espeso*" [I have reared it from a pupa that was between some leaves of Guara (*Cupania americana*), which were joined by a dense white web]. Alayo & Hernández (1987: 102) erroneously stated that Gundlach reared this species on *Cupania americana*, but the German naturalist did not observe the larvae. On the other hand, Roque-Albelo *et al*. (1995) and Núñez (2004) described some aspects of its habitat; the last author also observed an imago feeding on *Erythroxylon havanense* (Erythroxylaceae) and another one displaying territorial behavior.

The False Locust *Hebestigma cubense* (Fig. 1 C), which in Cuba is commonly known as "Frijolillo", "Cucharillo", "Guamá piñón" or "Jurabaina", in dependence of the locality, belongs to a monotypic genus and is widespread in the Cuban karstic areas (R. Oviedo, pers. comunic., December 2014). The only insects recorded as pest of this legume are the moths *Eulepidotis striaepuncta* (Herrich- Schäffer, 1868) (Noctuidae) and *Leucophobetron argentiflua* (Geyer, 1827) (Limacodidae) (Bruner *et al*., 1975).

In this contribution, *H. cubense* is recorded as host plant of *C. marmorosa*, and new biological data are also given on this rare Cuban endemic skipper. In a next paper (L. F. de Armas & R. Núñez Águila, in preparation), the complete life-history will be described.

Material and methods

On September 4, 2014, in an open area of the semideciduos forest near Ariguanabo river, 100 m east of La Quintica, San Antonio de los Baños town (22º 53' N – 82º 30' W; 210 m a.s.l.), Artemisa province, about 30 larvae of an undetermined skipper were observed on the leaves and branches (0.2–2.5 m above the soil) of several shrubs of *Hebestigma cubense* (Kunth) Urb. (Fabaceae). The shrubs and trees were in an area of approximately 1 800 m^2, at the sides of a narrow sideway ("vereda"), in an anthropized area (Fig. 1 D), similar to those described by Roque-Albelo *et al*. (1995) and Núñez (2004).

On November 10, 2014, ten larvae of the last instar were collected and moved to the laboratory, situated 500 m away, to obtain pupae and adults, under uncontrolled temperature and humidity. On January 17, 2015 a male emerged and the species was identified as *C. marmorosa*. On February and March, 2015, several pupae were moved to the laboratory for determining the sex of the adults, but most of them were later liberated in the area of study.

Table I. Records of *Chioides marmorosa* by sex and locality. The localities are given from east to west. Provinces are in small capital letters. (C): specimen collected; (O): specimen observed.

Localities	Specimens	Date and Reference
La Gran Piedra, SANTIAGO DE CUBA	1 ♀ (C)	Unknown date (Warren *et al*., 2013)
Guama, SANTIAGO DE CUBA (19.59N-76.5W)[a]	1♀ (C)	Unknown date (Warren *et al*., 2013)
Sierra Maestra (20ºN-76.44W), SANTIAGO DE CUBA	1 ♂ (C)	Unknown date (Warren *et al*., 2013)
Holguín, HOLGUÍN (no other data)	1♂ (C)	Unknown date (Riley, 1975; Roque-Albelo *et al*., 1995)
Río Caballero, Trinidad, SANCTI SPÍRITUS	1♀, 1♂ (C)[b] 2 (O)	March and April, 2002 (Núñez, 2004)
Cojimar, La Habana	1♀,1♂ (C)	186? (Herrich- Schäffer, 1865)
Playa Banes, Bauta, ARTEMISA	1 ♂ (C)	187? (Gundlach, 1881)
San Antonio de los Baños, ARTEMISA	3♀♀, 11♂♂[c] 1(O)	January 17 to April 4, 2015 **(This paper)**
Río Guajaibón, Mariel, ARTEMISA	2♂♂, 4♂♂ (C); Several (O)	April and May1993; and September 1994 (Roque-Albelo *et al*., 1995)
Soroa, Candelaria, ARTEMISA	1♀,1♂ (C)	April 1995 (Warren *et al*., 2013)
Viñales, PINAR DEL RÍO	1♀[d] (C)	September 24, 2011 (Barro & Núñez, 2011)
Undetermined	1♂ (C)	January1923 (Roque-Albelo *et al*., 1995)
Undetermined	1♂ (C)	Unknown date (Roque-Albelo *et al*., 1995)

[a] 2 km NW Boca de Dos Rios, Guama, Santiago de Cuba province (not Guantanamo as it was cited).
[b] Núñez (2004) did not identify the sexes, but we examined those specimens.
[c] From pupae reared in the laboratory.
[d] Barro & Núñez (2011) recorded this species from Viñales, but they did not mention the examined material.

Since February 24 to March 12, the area of study was visited day-to-day for observation of the eggs and first instars. Measurements of the larval shelters were taken with a vernier caliper (error: ± 0.05 mm), as indicated in Fig. 1 E). Data on temperature were taken from the meteorological station of La Sabana, San Antonio de los Baños, which is 5.5 Km south of the study area.

The following materials are deposited in the entomological collections of the Institute of Ecology and Systematics (IES), Havana: six adults (2♀♀, 4♂♂), three larvae preserved in 95% ethanol, pupal exuviae, larval shelters, and parasitoids.

Results and discussion

Host plant (Fig. 1 C). Except two, the 30 observed larvae were found on the foliage or branches of *H. cubense*, at not more than 3.0 m height. The only exceptions were two larvae that were found on leaves of Yaya (*Oxandra lanceolata*) and *Bahuinia* sp., respectively, but those plants were in direct contact with shrubs of *H. cubense* and did not showed damages in their leaves. No larvae or its silky shelters were observed on other plants.

The young plants were almost completely defoliate or severely affected by the feeding activity of the larvae (Fig. 1 F).

Despite the Guara (*Cupania americana*) is an abundant plant in the study area, neither larvae nor old larval shelters of *C. marmorosa* were detected on it. We suspect that the pupa found by Gundlach (1881) between the leaves of this plant was an accidental event.

Imagoes (Fig. 1 A). In the laboratory, three females and 11 males emerged between January 17 and April 4, always in the morning (06:40–11:30 am), but predominantly before 07:00 am. In that period nine adults emerged in the field from pupae that were monitored. Female: male ratio of the adults obtained during the present study was 1: 3.6. On the other hand, 14 (58%) of the 24 specimens collected since 1860 to 2012 were males (Table I). It is obvious that in this species the males are more abundant than females.

On January, February and March, imagoes were observed while they were sucking on inflorescences of *Hebestigma cubense* and *Wedelia calycina* (Asteraceae).

Last instar larva (Fig. 2 A–C). During the laboratory observations, it was detected that larvae feeding exclusively on the night, after 19:00 hr.

Although the precise duration of the last instar was not determined, in most of the observed specimens it was longer than three months.

Description. Total length 25–28 mm; head width 3.6 mm. Head black, with two lateroanterior reddish brown spots anterior to the stemmata; approximately rounded in fontal view, densely tuberculate and sparse long hairlike whitish setae; dorsal half of T1 black, ventral half pale purplish brown, spiracle brown; thoracic legs pale orange, darker toward the apex; body, including T2-T3 pale green with a lateroventral broad pale yellowish band on each side, dark green viscera showing through in a narrow mid-dorsal stripe from T3 to A9; two yellowish orange stripes running subdorsally from T3 to A9; spiracles pale orangish brown; entire body sparsely covered with whitish tiny spatulate setae, longest around anal plate.

Larval diapause. Once was defoliate the branch or the small shrub, most of the larvae of *C. marmorosa* remained into their respective shelters during more than five weeks, without feeding. This suggests the existence of at least a short-term larval diapause or dormancy due to lack of food. Summer diapause has been previously mentioned for several tropical Lepidoptera (Masaki, 1980; Delinger, 1986) but only for members of Hesperiinae among the Hesperiidae. The reviewed literature informs its occurrence among species of *Hesperia* and *Ochlodes* in temperate North America (Scott, 1986; James, 2009), whereas in the tropics the data only suggests that it could occurs in some Indian and Australian species (Larsen, 2005; Franklin, 2011).

Two larvae of the last instar that were without feeding during 25 days, because the small shrub was defoliate by them, were experimentally transferred to other neighboring plant of the same species but with fresh leaves. On that night, the two larvae started to feeding, and two week later they pupate.

On December 11, other two larvae of last instar were left without food, because they defoliate the entire plant. One of them died on January 9, but the other one remained into its silky shelter until January 24, 2015 (43 days without feeding). Then, few days after the growing of young leaves, the larva

fed again until defoliate it. In this occasion, as the rachis at which stayed the silky shelter was in menace to come off from the plant, the larvae firmly fixed it with silk to the tree stalk, a behavior observed in other larvae, too (Fig. 2 D).

On February 10 an old rachis with two silky shelters was found on the litter, under a shrub that was monitored since January 10; obviously, that rachis comes off prior to this date. Of those two larvae, one of them was died, perhaps by inanition. The alive larva (last instar) was moved to the laboratory and immediately it accepted fresh leaves; it pupates on March 15.

We suggest that this diapause mechanism probably occurs only at highly seasonal places of Cuba whit well marked dry and rainy seasons. In others areas, such as Gran Piedra, the rains are more distributed across the year so probably there are more suitable environmental conditions and is unnecessary to slowdown metabolism.

Larval shelter (Fig. 1 E–F, 2 D–G, 3 A). Although Gundlach (1881) do not described the shelter made by the larvae of *C. marmorosa*, he pointed out that the pupa was found among leaves "joined by a white and dense web". Most of the larvae of the last instar observed by us in the field were into a cocoon or whitish case of thick silk usually protected by a leaflet around it (Fig. 2 D, G). The cocoon looks like a slightly flattened cylinder with one of the narrower sides swollen at the middle like a belly resembling the shelters made by some bagworm moths (Psychidae). The shelter has a major aperture for the larval access (Fig. 1 E, 2 E, G), whereas it ends in a small irregular hole perhaps utilized for elimination of fecal waste and, also, avoiding water accumulation. Heavily silky cocoons are also constructed by the larvae of *Hesperia* skippers, Hesperiinae, in North America by accumulating silk threads around the blades of their hosts grasses (James, 2009). The larval shelter do not corresponds with those described by Greeney & Jones (2003) and Greeney (2009) for Hesperiidae, since the only common pattern is the silky case being the leaves externally attached in several different ways.

Sometimes the silky shelter was stuck to the leaflet, the rachis or the branch (Fig. 1 F, 2 D–G); but in three occasions it was found firmly fixed, lengthways, to a branch (Fig. 3 A). As the silky shelter is fixed, immovable, for feeding the larva abandons it and, once fed, returns to the shelter.

Although some larvae of *C. marmorosa* stayed into its respective silky shelter (Fig. 2 F), most of them covered the cocoon with part of a leaflet. In an occasion, two-amalgamated silky shelters, one behind the other, were observed.

Most of the silky shelters were initially protected for cuffs of the leave made by the larvae (Fig. 1 F, 2 D, G), but when food was scarce then the vegetal wrapping the silky shelter was eating by them.

Measurements of 20 shelters (last instar) are as follows: length = 26.0–37.7 (mean = 32.1, standard deviation = 3.2), width = 7.2–11.4 (mean = 9.3, standard deviation = 1.4), height = 8.1–14.2 (mean = 10.5, standard deviation = 1.7).

Larvae of the first instar make a very different shelter. They cut almost entirely a semicircular slice (3–4 mm long) of the leaflet border, bend it and then they fix the slice with silk threads (Fig. 3 B–C). In this task they may employ four to five hours. Approximately 24 hours later, they make a second shelter of 7–9 mm.

Larvae of the second and third instar make a larger but similar shelter (Fig. 3 D). Nevertheless, larvae of the fourth instar make shelters that greatly resembles those of the last instar but smaller, create by juncture of two or three leaflets. In this last case, the shelter is internally covered by a fine silky layer.

Pupa (Fig. 3 E–G). Total length 18.2 mm; maximum width 5.6 mm. Stout with blunt rounded head, swollen toward the middle; all orange brown colored except the dark amber head; thoracic spiracle large, darker; dorsum, venter of abdomen and head with relatively large, sparse, pale orange setae, more dense on head. After adult emerges, the pupal exuvia remains into the silky cocoon.

The pupal phase was of 18–35 days (n = 8). The shorter periods happened on March, in direct relationship with higher temperature (mean = 25.1–25.7 ºC) than on January and February (mean = 20.2–22.5 ºC).

Eggs (Fig. 3 H–L). Oviposition was detected since the last half of February to April 20, always on the back of very young leaves, near to the border. They were whitish, globoid, 15-to 18-costate, having a diameter of 0.88–0.90 mm, and a similar height (n = 15). Incubation period was of 3–4 days (n = 35).

As a rule, a single egg (rarely two or three) was deposited on each leaflet. Also, several unfertile eggs were observed. At least on 2015, the oviposition happened on the same plants and even in occasions on the same branches than on 2014. Since February 24 to March 25, oviposition occurred every day. Since April 15 to 18, oviposition occurred on the only shrub having tender leaves.

Roque-Albelo *et al*. (1995) suggested that *C. marmorosa* is at least bivoltine, but that "it may well prove to be continuously brooded". Our observations strongly suggests that this is an univoltine species, because larvae of the first instar need very fresh leaves for feeding and such source (in *H. cubense*) is only available during the first months of the year. Non eggs were observed on well-developed leaflets (larger than 120 mm); on the other hand, when leaves are very old (mainly on December and January), the larvae of last instar do not eat them and then become in diapause.

Parasitoids and predators. On November 28, a larval shelter containing in its interior cocoons of a micro-wasp was detected (Fig. 3 M). On December 11, from those cocoons emerged 13 hymenopterans belonging to an undetermined species of Eulophidae (Chalcidoidea). Two other larval shelters, with several old similar cocoons, were observed on December 6 and January 26, respectively.

On March and April, several eggs were attacked by parasitoid wasps (Chalcidoidea: Encyrtidae) (Fig. 3 J–K, N). At least in a case, incubation of the parasitoid was nine days.

In the field, some of the eggs were eaten by the ant *Monomorium floricola* (Jerdon, 1851) (Fig. 3 L), which has been recorded as an important butterfly egg predator (GISD, 2010). Also, at least in a case an immature thrips (Thysanoptera) was detected on the leaflet from which the egg disappeared.

These two undetermined species of Chalcidoidea and the ant *M. floricola* are the first natural enemies recorded for *Chioides marmorosa*.

Immature mortality. Since November 10 to February 10, five died larvae of the last instar were observed in the field, each into its respective silky shelter. Also, three larvae died by wasp parasitoids. In this interval, two larvae died in the laboratory by unknown causes. In total, approximately 30% of the observed larvae dead.

Data on the natural enemies of the first instars are limited, but at least since February 24 to March 25, approximately 95% of the eggs and larvae of the first and second instars undergo damage or disappeared in the field, mostly by the action of predators and parasitoids (Fig. 3 I–L, N).

Sympatric skippers. In the same period and area of study, ten species of Hesperiidae were flying: *Atalopedes m. mesogramma* (Latreille, 1819), C*horanthus radians* (Lucas, 1857), *Cymaenes tripunctus* (Herrich-Schäffer 1865), *Ephyriades b. brunnea* (Herrich-Schäffer 1865), *Panoquina lucas* (Fabricius, 1893), *Polites b. baracoa* (Lucas, 1857), *Synapte malitiosa* (Herrich-Schäffer 1865)**,** *Urbanus dorantes santiago* (Lucas, 1857), *Urbanus proteus domingo* (Scudder, 1872) and *Wallengrenia otho misera* (Lucas 1857). The most abundant and frequent of those species were *C. radians* and *U. d. santiago*.

Conservation status. Although *C. marmorosa* is widely distributed in Cuba (Roque-Albelo *et al*., 1995; Núñez, 2004; Warren *et al*., 2013) (Fig. 1 B), it is evident that its local populations are small. According with the available data, during the last 150 years only 24 adults were collected and a few ones observed (but not collected) in at least 10 localities belonging to six provinces (Table I). The causes of this low population density seem to be in relation with: (1) the feeding behavior of the larva (likely monophagous and relatively sedentary), (2) life cycle that under certain environmental conditions may be of approximately four months, and (3) the effects of the natural enemies (predators and parasitoids).

Conversely to several butterfly larvae, those of *C. marmorosa*, at least the last instar, do not venture to look for other leaves when the nearest ones lack, with independence of the relative availability of other plants. As a consequence, probably some larvae die by inanition.

Certainly, our knowledge on the natural history of this skipper is unsatisfactory and new field observations are needed for a correct evaluation of the selective pressures on its global population. Neither Barro & Núñez (2011) nor Amaro (2012) included it as a threatened taxon.

Common name. As this species seems to be exclusively associates with the False Locust (*Hebestigma cubense*), we propose to name it from now on as False Locust's skipper (*Hespérido del Frijolillo*, in Spanish). At least in Spanish a common name was lacking, whereas its Englisn name, Cuban Longtail, refers to its endemic and tailed nature, but not to its natural history.

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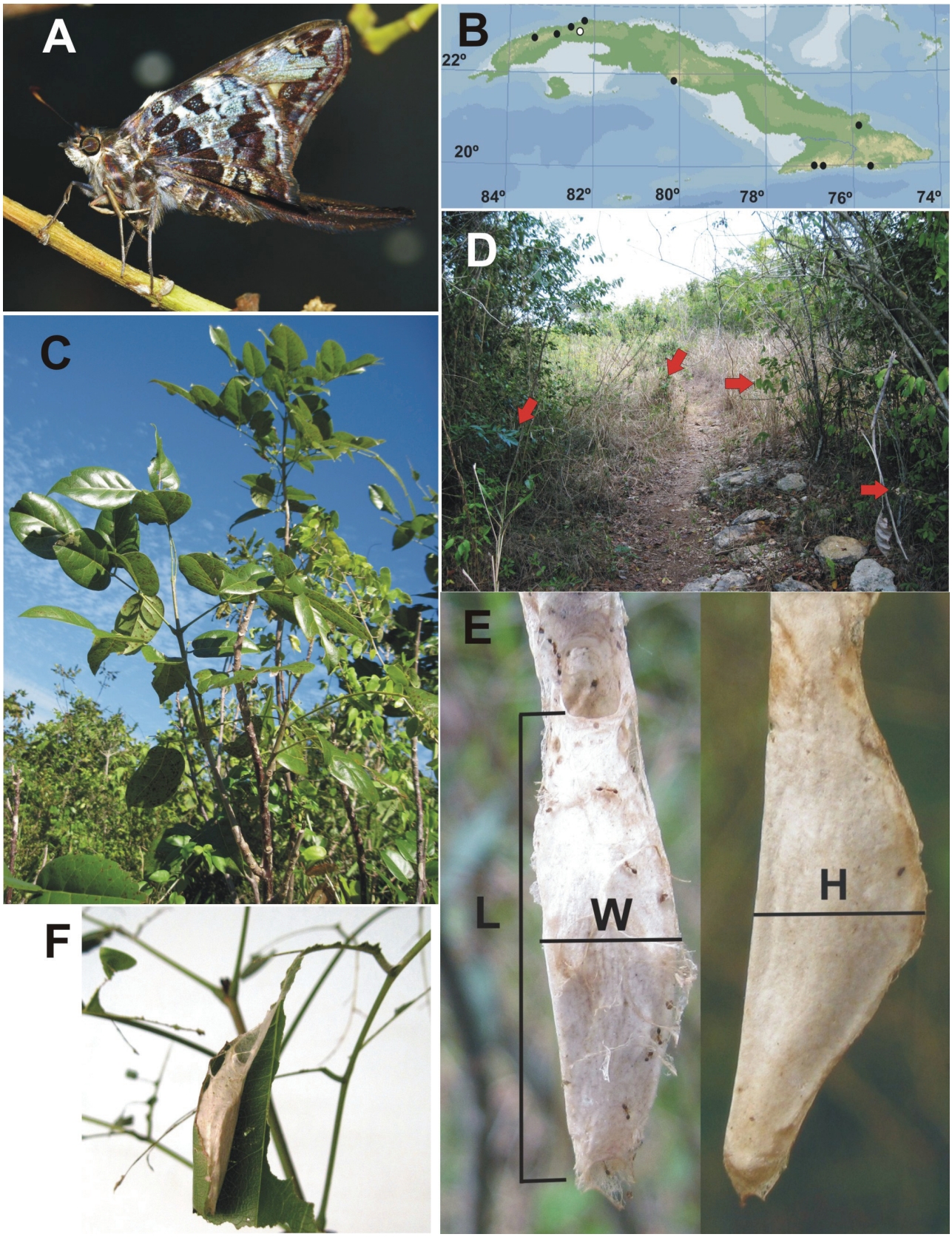

Fig. 1. A, imago of *Chiodes marmorosa* raised in the laboratory. **B**, localities (circles) from which *C. marmorosa* has been recorded (the white circle indicates the study area). **C**, *Hebestigma cubense*, details of a young tree. **D**, partial view of the area of study, San Antonio de los Baños, Artemisa; arrows indicate some of the shrubs having larvae of *C. marmorosa*. **E–F**, silky shelters made by last instar larvae: **E**, frontal and lateral views showing how measurements were taken (H, height; L, length; W, width); **F**, involved in a leaflet that has been partly eaten by the proper larva (note that the young shrub has been defoliate by the larva).

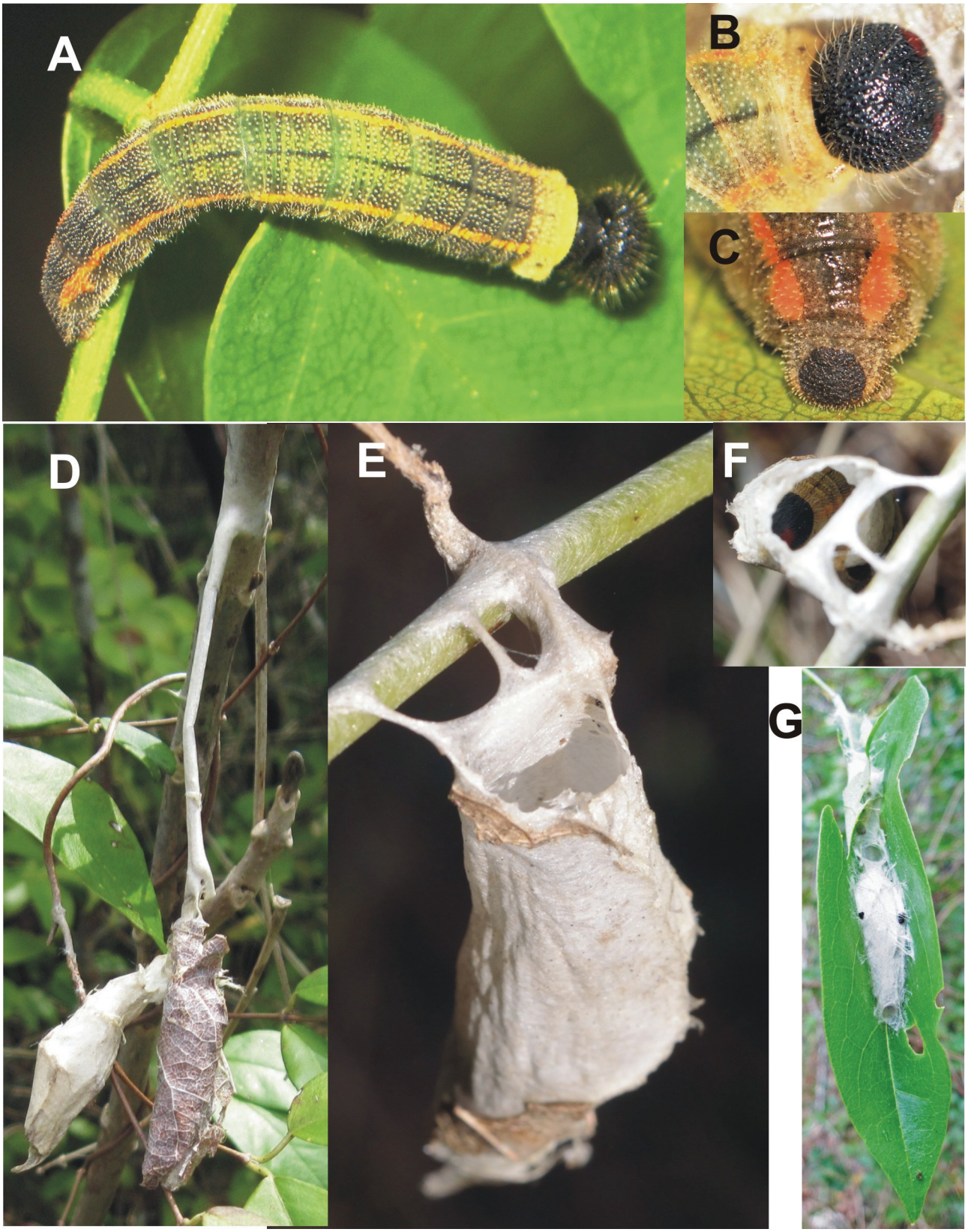

Fig. 2. *Chioides marmorosa*. **A–C**, last instar larva, dorsal aspect: **A**, habitus; **B**, detail of the head and first thoracic segments; **C**, detail of the last segments. **D–G**, last instar shelters: **D**, two cocoons on a died rachis that they firmly fixed with silk to the trunk, avoiding to fall on the soil; **E–F**, cocoon fixed to a rachis (**E**), showing the larva on its interior (**F**); **G**, cocoon made along the central nerve of a leaflet.

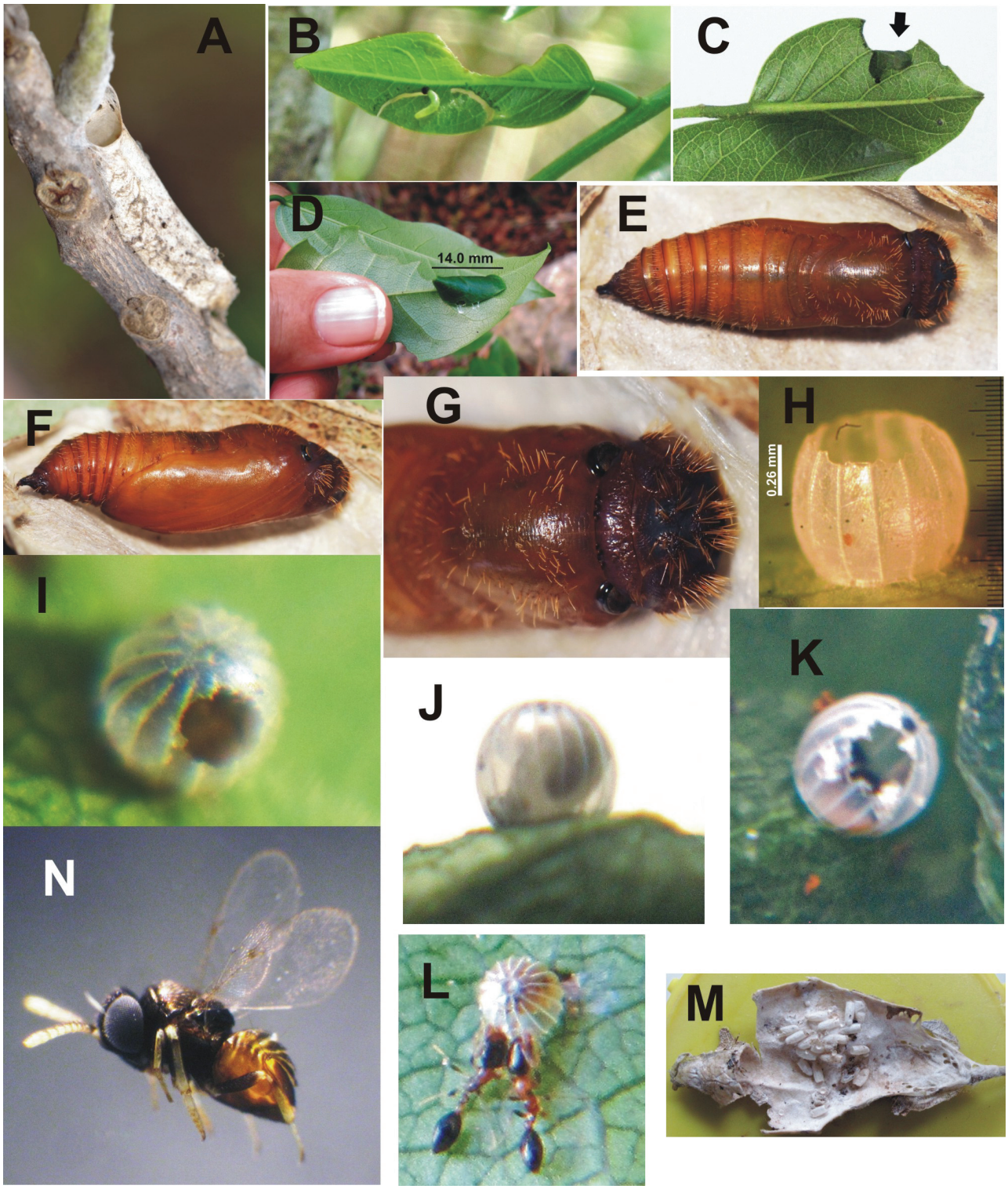

Fig. 3. *Chioides marmorosa.* **A**, cocoon of last instar larva lengthwise fixed to a branch. **B**, first instar larva cutting its shelter on a young leaflet. **C–D**, shelters of first (**C**) and second (**D**) instar larvae. **E–G**, pupa in dorsal (**E**) and lateral aspects; **G**, detail of the anterior part, dorsal aspect. **H–L**, eggs: **H**, after eclosion; **I**, partially eaten by ants; **J**, with an embryo of an encyrtid wasp (parasitoid); the same egg after eclosion of the encyrtid wasp; **L**, predated by workers of the ant *Monomorium floricola* (April 17, 2015, 16:10 hr). **M**, cocoons of an eulophid wasp, parasitoid of the last instar larva. **N**, imago of the encyrtid wasp that parasites the eggs.