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LIFE HISTORY AND IMMATURE STAGES OF *CHLAMYDASTIS PLATYSPORA* (ELACHISTIDAE)

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ABSTRACT. The natural history of *Chlamydastis platyspora* Meyrick (Elachistidae) is described from the cerrado ecosystem (savanna-like vegetation) in Brasilia, Distrito Federal, Brazil, and also from specimens reared in the laboratory. The larvae are external folivorous feeders restricted to the host plant *Roupala montana* Aubl. (Proteaceae). The life cycle from egg to adult lasts about 4.5 months. In the natural cerrado ecosystem *C. Platyspora* is bivoltine, the first generation occurring from November to April (wet season) and the second from May to October (early dry season to beginning of the wet season). The immature stages are described. Egg, larval head capsules, last larval instar, pupa, and adult male and female are illustrated. Morphological modifications in the mandible of the third instar larva, chaetotaxy of the last larval instar, and male and female genitalia are also described.

Additional key words: Brazil, cerrado, host plant, natural history, *Roupala*, Proteaceae.

Ptilogenes platyspora and *P. amblystoma* were described by Meyrick in 1932 and 1936 respectively. The female type of *P. platyspora* was collected from Araras (São Paulo, Brazil) and deposited in the Naturhistorisches Museum (NM), Vienna, Austria. The type of *P. amblystoma*, also a female, was collected from Rio Grande do Sul, Brazil and deposited in the Institut für Pflanzenschutzforschung, Eberswalde (IP), Germany. Busck (1934) transferred these species to *Chlamydastis* (Elachistidae, Stenomatinae) and Becker (1984) recognized that *C. amblystoma* is a junior synonym of *C. platyspora*.

Besides what is described above, the only information known about *C. platyspora* is that it is restricted to the host plant *Roupala montana* Aubl. (Proteaceae) in the cerrado of Brasilia, Brazil (Diniz & Morais 1995). Therefore, this research constitutes the first study of the natural history of a species in this genus (with 81 described species) (Hogue 1984). The objectives of this study are to describe the immature stages (egg, larva, pupa) of *C. platyspora* and the life cycle in the field. The male genitalia are also described to facilitate identification of adults by future workers.

MATERIALS AND METHODS

The descriptions of immature stages and adult genitalia were based on specimens reared in the laboratory. To obtain eggs, six pupae (three males, and three females) of *C. platyspora* were collected from several plants of *R. montana* in an area of cerrado (sensu stricto Goodland 1971), in the Brasilia University Experimental Farm (Fazenda Água Limpa-FAL) (15°55′S, 47°55′W) in Brasilia, Distrito Federal, Brazil, and maintained in a rearing cage until adult emergence. Leaves of the host plant *R. montana* were supplied with the purpose of simulating natural conditions and to serve as substrate for oviposition. To maintain the swelling turgidity of the leaves, the petioles were immersed in moist cotton. Fresh leaves were supplied every two days.

All observations and measurements were made with a stereomicroscope using an ocular micrometric scale or a millimeter scale paper. The following measurements were taken: eggs (length and width), head capsules of the different instars (distance between the second stemmata), body length of the last instar larva and pupa (from head vertex to end of last abdominal segment), pupal cocoon (length and diameter), and the length of the right wing of the adults.

The mandible of different instar larvae, larval exoskeleton of the last instar, and the adult genitalia were preserved in permanent slides and examined under compound and stereo microscopes. The material was heated in a 10% potassium hydroxide (KOH) solution. The terminology used follows Klots (1970) and Stehr (1987). Camara lucida illustrations were made using a compound microscope (Zeiss ULTRAPHOT III). Voucher specimens were deposited in the Entomological Collection of the Zoology Department of the University of Brasilia, DF, Brazil.

The field study was carried out in an area of approximately 2 ha of cerrado sensu stricto. The life cycle under natural conditions was determined by searching for eggs, larvae, or pupae of *C. platyspora* on 300 to 500 plants of *R. montana* monthly, from November 1999 to October 2000. The behavior of the larvae of *C. platyspora* was monitored twice a week using 15 marked plants on which eggs or larvae were present and followed until the completion of the life cycle.

RESULTS

Description of the immature stages. Egg: pale yellow, transparent, ovoid, flattened, 3.0–4.5 mm length (mean = 3.79 SD = 0.5) and 2.0–2.5 mm width (mean = 2.25 SD = 0.2). Chorion sculptured with fine minute ridges. Egg with changes of coloration from yellow to brown, due to the embryonic development of the larva (Fig. 1A).

Larva: First instar (n = 10), head dark chestnut, body integument greenish yellow with brownish-red transverse stripes; head capsule 0.3–0.5 mm wide (mean = 0.4 SD = 0.1) (Fig. 1B); mandible with five incisive "teeth" and four transverse furrows on the concave oral surface (Fig. 2A). Setae clear yellow, located on large body pinnacles. **Second instar** (n = 4), head, body integument and setae as in the first instar; prothorax with several brownish spots, a yellow stripe in the anterior margin, and a dark chestnut prothoraxic shield. The head capsule is 0.5–0.8 mm wide (mean = 0.63 SD = 0.1) (Fig. 1B). Mandible morphology as in the first instar. **Third instar** (n = 2), head and setae as in previous instars. Body integument with a conspicuous reddish longitudinal lateral spiracular stripe from the prothorax to A10. Head capsule 0.9–1.2 mm wide (Fig. 1B). Morphology of the mandibles as previous instars. **Fourth instar** (n = 2). Head, body integument, and setae as in the third instar. Head capsule 1.2–1.9 mm in width (Fig. 1B). Mandibles lacking "teeth", smooth and bearing a reinforced furrow finishing in a small dorsal lobe above the retinacular seta. Oral surface concave and smooth (Fig. 2B). **Fifth instar** (n = 2). Head and body integument as in the previous instar (Fig. 1C). Body length: 19–20 mm. The integument of the larval cuticle (Fig. 2C), including the pinacula, presents a granular texture when observed under high magnification. Head capsule and anal plate dark brown, with a reticulate texture. Head capsule 2.0–2.3 mm wide (Fig. 1B). Mandibles as in the fourth instar. Hypopharynx with an elongate spinneret and submental pit present. Generation time (egg to adult) of *C. platyspora* in the laboratory lasted 136 days (4.5 months).

Chaetotaxy. Thorax: Prothorax: Three dark chestnut pinacula on prothoracic shield. Three setae of group L (lateral) extended over the anterior-ventral of the spiracular pinacula. **Mesothorax:** A sub dorsal micro seta on a pinaculum in the ante-dorsal edge of the mesothoracic segment. Two dorsal pinacula without setae differ in color, one being ligther than the other. Seta D2 (dorsal) four times the length of D1; SD1 and SD2 (sub dorsal) group on a single pinaculum. **Metathorax:** Setae position similar to that of the mesothorax, differing only by the presence of the dorsal and sub dorsal micro setae. Thoracic legs well developed and tarsal claws with the pre-tarsal setae disposed as cilia (see Stehr 1987:384). **Abdomen:** A1–A5 with a dorsal micro seta and two D setae obliquely placed on a prolonged pinaculum. A6 and A7 with two SD setae and a ventral seta on pinaculum (V), and A6 with a non-sclerotized round area in the posterior part of the pinaculum. A8 with the SD1 seta in the ante-dorsal position to the spiracle and A9 with setae D1 and D2 in separate pinacula. Prolegs on A3–6; crochets uniserial and biordinal disposed in circles (see Stehr 1987:384).

Larval shelters. Larvae of all instars construct shelters by binding together two leaves of the host plant and frass with silk. During larval development at least four of these shelters are constructed. The last instar larva builds a large shelter of leaves where pupation occurs.

Cocoon. The cocoon is dark chestnut, ovoid, with a thick wall composed of frass and silk and an inner layer of silk. Females' cocoons 42–55 mm length (mean = 48 SD = 4.7) and 7–19 mm width (mean = 2.8 SD = 2.8) (n = 11) and the males from 33–47 mm length (mean = 41.2 SD = 5.2), and 11–17 mm width (mean = 14.6 SD = 2.5) (n = 5).

Pupa. Wrinkled texture and variable coloration from clear red brown to dark brown. Female (Fig. 1D) from 18–20 mm length (mean = 19.3 SD = 0.9) (n = 8) and male (Fig. 1E) 16–17 mm (mean = 16.6 SD = 0.5) (n = 5). **Abdomen.** Fifth, sixth and the seventh abdominal segments are immobile; cremaster ventrally rounded, with two short setae on small lateral tubercles.

Adults. The male's wings have the same color and pattern as the female, as described by Meyrick (1932). Male forewing length 13–16 mm (mean = 1.5 SD = 0.13, n = 7) (Fig. 1F) and females 17–21 mm (19 SD = 0.13, n = 10) (Fig. 1G).

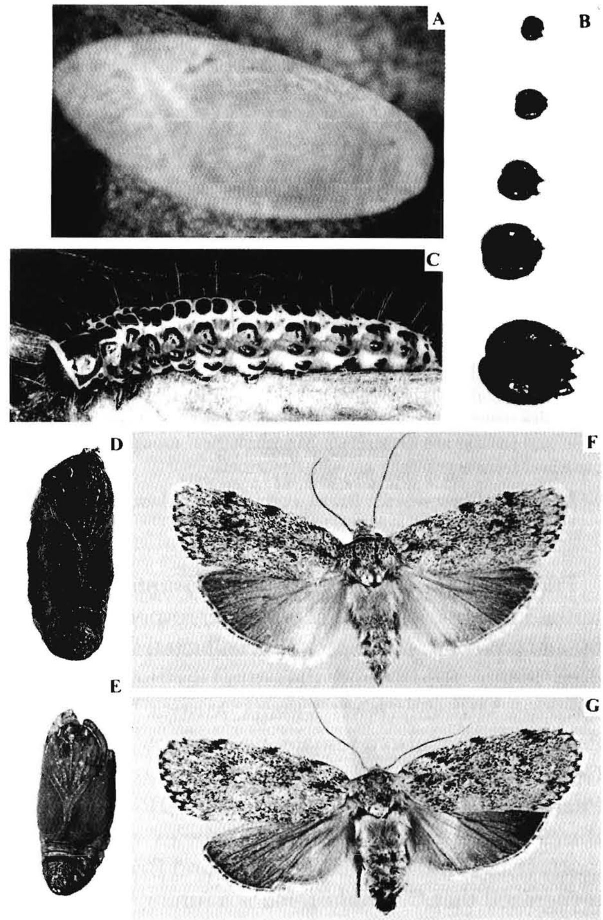

FIG. 1. *Chlamydastis platyspora*. **A,** Egg; **B,** Head capsules from 1st to 5th instars; **C,** Larva of the last instar; **D,** Female pupa; **E,** Male pupa; **F,** Male adult and **G,** Female adult. (Color illustrations can be found at www.unb.br/ib/)

Female genitalia (Fig. 2D). Papillae anales formed into large compressed pads; eighth sternum rectangular, with ante-dorsal rift invaginate forming a pair of round bags, ornamented with numerous fine hooks; posterior apophyses curved close to the base and slightly longer than the anterior; antrum wide sclerotized; seminal ductus bursal short, spinulate; inception of ductus seminalis on anterior part of antrum; corpus bursae elongate, signum plate-like and spinulate.

Male genitalia (Fig. 2E). Uncus curved, with the apex rounded and narrowing from the base; gnathos poorly developed, slightly curved and medially spinose. Costa of the valves with round termination, cuculus thoroughly rounded, with piliform setae on the inner surface, intermixed with setal with palmate apices (Fig. 2F). Vinculum truncate ventrally; juxta developed. Adeagus short, cylindrical and slightly curved; the vesica with an irregularly round cornutus.

Life cycle in the field. Initially, eggs were found in the field on 23 December 1999 (Table 1). The larvae occurred from January to March, and the pupae from April to May. By 19 May 2000 all adults had emerged from their cocoons. Thus, the first generation occurred from December to May, and corresponded with the

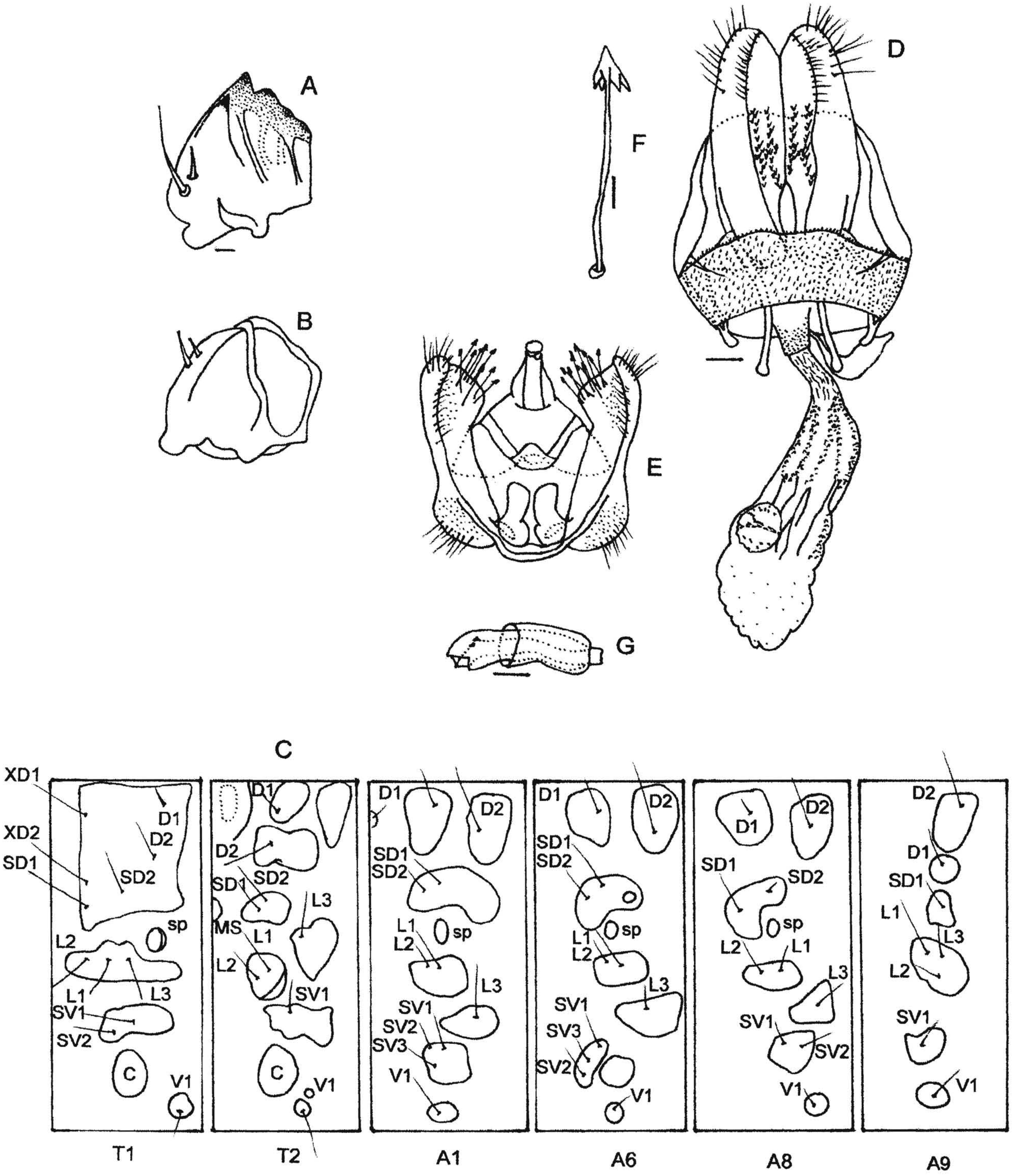

FIG. 2. Structures of the larvae and adults of *Chlamydastis platyspora*. **A,** Mandible of the larvae from 1st to 3rd instars; **B,** Mandible of the larvae of the 4th and 5th instars; **C,** Chaetotaxy of the 5th instar; **D,** Female genitalia; **E,** Male genitalia; **F,** Details of the setae of the cucullus; **G,** Aedeagus. Scale bars represent the following values: **A** and **B,** 35.7 µm; **D and E,** 0.4 mm; **F,** 35.7 µm and **G,** 89 µm.

TABLE 1. Number of plants inspected from November/1999 to October/2000 and the immature stages found.

	Plants examined			Number of immature			
		Plants with immatures					
Months	Total	number	%	Eggs	Larvae	Pupae	Total number of immatures
November	400	0	0	0	0	0	0
December	432	1	0	6	0	0	6
January	486	13	2.7	0	29	0	29
February	550	16	3.0	0	50	0	50
March	408	26	6.3	0	27	0	27
April	341	23	6.7	0	0	33	33
May	400	13	3.4	25	0	19	44
June	400	76	1.0	0	159	0	159
July	300	41	13.7	0	81	0	81
August	300	56	18.7	0	83	0	83
September	300	39	13.0	0	68	0	68
October	300	39	13.0	0	60	1	61
Total	4617	343	7.4	31	557	53	641

period from the middle of the wet season to dry season. The second generation began in early May, the larvae occurred from June to October (Table 1). We observed pupae on 10 October 2000, corresponding to the period between the dry season to wet season.

Behavior of the larvae of *C. platyspora*. In the laboratory, we observed 6 and 25 eggs laid in December 1999 and May 2000, respectively. They were laid singly, on the adaxial surface of the mature leaf of *R. montana*. First larvae were observed on 11 January 2000. After hatching, the larvae moved to another leaf on the same branch, where they fed and built their initial shelter. Frequently, newly hatched larvae remained in small groups from three up to five individuals; however, some larvae remained solitary. Larvae built their shelters by attaching two leaves together with silk or by folding one leaf and incorporating a protecting frass layer intertwined with the silk threads inside. First instar larvae scrape the abaxial leaf surface to the mesophyl. Solitary larvae built shelters in a similar way, but with a single chamber. Later instar larval (3–5) are solitary and built shelters in a similar way as does the first instar, except these lack the inner protective silk layer. In addition, later instar larvae exhibit aposematic colors and, as a reaction to any aggression or disturbance, regurgitate a substantial amount of a greenish liquid. As larvae mature, they built at least four larger shelters, each of them with a thicker wall. The leaves surrounding the shelters become more and more separated in successive shelters due to an increase in size of the larvae. Fourth instar larvae change their feeding habit from scraping the abaxial leaf surface within the shelter to consuming the whole leaf, and foraging outside of the shelter during the day. Fifth instar larvae construct a large cocoon, with thick walls covered with a dense layer of silk, leaves and frass.

DISCUSSION

The flattened egg observed for *C. platyspora* seems to be common among moths. Pertenson (1965) described flattened eggs for two species of moth of the family Tortricidae (*Carpocapsa pomonella* (Linn.) and *Acleris variana* Fern.). Scoble (1995) refers to them (present in Pyralidae moths) as being important in protection against natural enemies because they are unnoticeable on the substrate surface, and cannot be easily seen by predators.

Factors that affect oviposition strategies are numerous; for instance density of predators and parasites (Stamp 1980), host scarcity (Benson et al. 1975, Jones 1977), and flight inhibition caused by adverse climatic conditions (Courtney 1984). The low number of eggs observed in this study does not allow us to discuss the above arguments regarding the oviposition strategies of *C. platyspora* females. However, the host plant (*Roupala montana*) in our study area is very abundant so host plant scarcity was not an issue. Because a high mortality rate of *C. platyspora* larvae was observed in the field, only 53 of 557 reached the pupal stage (Table 1). It can be assumed that for this species, in the cerrado, others factors such as predators, parasites, and adverse climatic conditions play a more important role in controlling the size of larvae populations than the plant resource.

The larval stage was the longest stage of development. Larvae exhibited several different behaviors, such as: construction of shelters, aggregation in the first instar, changes in feeding habits from scraper to cutter, acquisition of aposematic colors from the third instar, and the regurgitation reaction when agitated. The first two behaviors are common among Lepidoptera; for example, see *Omphalocera munroei* Martin (Pyralidae) which builds shelters by tying leaves of *Asimina* spp. (Annonaceae) (Damman 1987).

Variation of the mandible morphology of larvae (Fig. 2A, B) was already observed for other moth species such as *Heterocampa oblique* Packard and *Crinodes besckei* (Hübner) (Notodontidae) (Godfrey et al. 1989). The authors suggested that these mandible morphological variations have two functional purposes: allowing the opening of the egg chorion, and better scraping of the leaf while feeding. The scraping habit is very advantageous for small larvae due to the limitation of the size of the bite relative to leaf thickness. According to Bernays and Chapman (1994), many Lepidoptera feed on mature leaves and in that case, the first instar larvae may not have the size or the necessary strength to pull up pieces of leaf. The morphology of the mandible found in the fourth larva instar (Fig. 2B) is similar to that of other moths as, for example, in species of Saturniidae. This morphology is adapted to cut the mature leaves of the plants, which they usually feed on. The convergences of characters are an indication of the adaptive function (Bernays 1991).

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