

CAIO RICHARDSONI: ITS IMMATURE STAGES AND NATURAL HISTORY (LEPIDOPTERA: SATURNIIDAE: ARSEURINAE)

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ABSTRACT.— The previously undescribed immature stages of *Caio richardsoni* are described and illustrated in color. Larvae were reared in the field and in the laboratory on *Ceiba pentandra* and *Chorisia sp.* (both Bombacaceae) and underwent five instars.

RESUMEN.— Se describen e ilustran a colores los estadios inmaduros previamente indescritos de *Caio richardsoni*. Las larvas fueron criadas en el campo y en el laboratorio, se alimentaron de *Ceiba pentandra* y *Chorisia sp.* (Bombacaceae ambas) y experimentaron cinco estadios.

KEY WORDS: *Arsenura*, Bombacaceae, chaetotaxy, Costa Rica, Colombia, *Dysdaemonia*, Guerrero, hostplants, Jalisco, larvae, larval behavior, Mesoamerica, Mexico, Neotropical, Oaxaca, pupae, Sonora, *Titaea*.

The American genus *Caio* of the saturniid subfamily Arsenurinae is represented in Mexico by two species (Lemaire, 1980): *Caio championi* (Druce), occurs in humid forest from eastern Mexico south to Colombia while *C. richardsoni* (Druce) is endemic to dry tropical forest of central and western Mexico. With a wingspan of about 130cm, *C. richardsoni* is usually the largest arsenurine in its range. It can be immediately distinguished from the somewhat similar large brownish or grayish *Arsenura polyodonta* Jordan, whose range it partially shares, by its distinct, dark-bordered discal crescent on the forewing. Individual variation produces widely differing morphs. Males and females (Fig. 1, 2) are similar, with the small tail of the hindwing reduced in the female. Both species of *Caio* are variable as eggs, early instars and adults. An almost completely black adult male of *C. richardsoni* was described and illustrated by Beutelspacher (1986). To our knowledge, complete descriptions of their immature stages have not been previously published. The focus of this paper is the biology and immature stages of *C. richardsoni*.

Field observations were made throughout a ten year period, during various seasons at Chamela Research Station in Jalisco by the junior author, and during June through August at widespread other locations by the senior author. Eggs for rearing were obtained by both authors and their colleagues from females attracted to lights and which were allowed to oviposit either within indoor cages made of mosquito netting or in paper bags. Additionally, a mature larva was found while searching for larvae at night in the canopies of large trees of *Ceiba pentandra* (Linnaeus) (Bombacaceae) by illumination with black type ultraviolet light, which causes the larvae to glow. All larvae from Chamela were reared on *C. pentandra*, sleeved in plastic mosquito netting on potted and wild trees, in large groups during early

instars and individually as they reached maturity. Larvae from other locations were reared in small groups in the laboratory on *Chorisia sp.* (Bombacaceae), sleeved indoors on potted foodplant or maintained in terrariums or cages and fed on cut foodplant maintained with stems in water. All stages were measured and recorded on color film, and molted head capsules were collected to identify various instars. Photographs and drawings were made by the senior author. Larval development times were noted in the laboratory but not in the field. Pupation was in damp soil in small plastic pots or in plastic bags with tissue paper. Some pupae were unearthed and maintained in humid terrariums and others remained in the plastic bags with tissue paper until emergence as adults.

Live Material Studied.— Eggs were obtained from four females captured at lights in Mexico in: Sonora, south of Río Yaqui, 4 Aug 1986 by M. J. Smith and K. Hansen; Oaxaca, 90km west of Salina Cruz, el. 25m, 1 Jul 1989 by K. Wolfe, M. Valverde and D. Mullins; Guerrero, 38km north of Atoyac, el. 925m, 15 Jun 1991, by K. Wolfe, S. Smoot and D. Mullins; Jalisco, Chamela, el. 100m, Sep 1982 and 6 Jul 1988 by A. Pescador. Additionally, one mature larva was collected feeding on *C. pentandra* at Chamela, 23 Jul 1985, by A. Pescador.

IMMATURE STAGES

Eggs required 10-12 days to hatch at normal room temperature. Larvae hatched soon after dawn and ate about half of eggshell before wandering away individually. Larvae immediately began to feed when placed on tender new leaves of *Chorisia* or *C. pentandra*. A northern population demonstrated two morphs influenced by light intensity in the first two instars: when reared

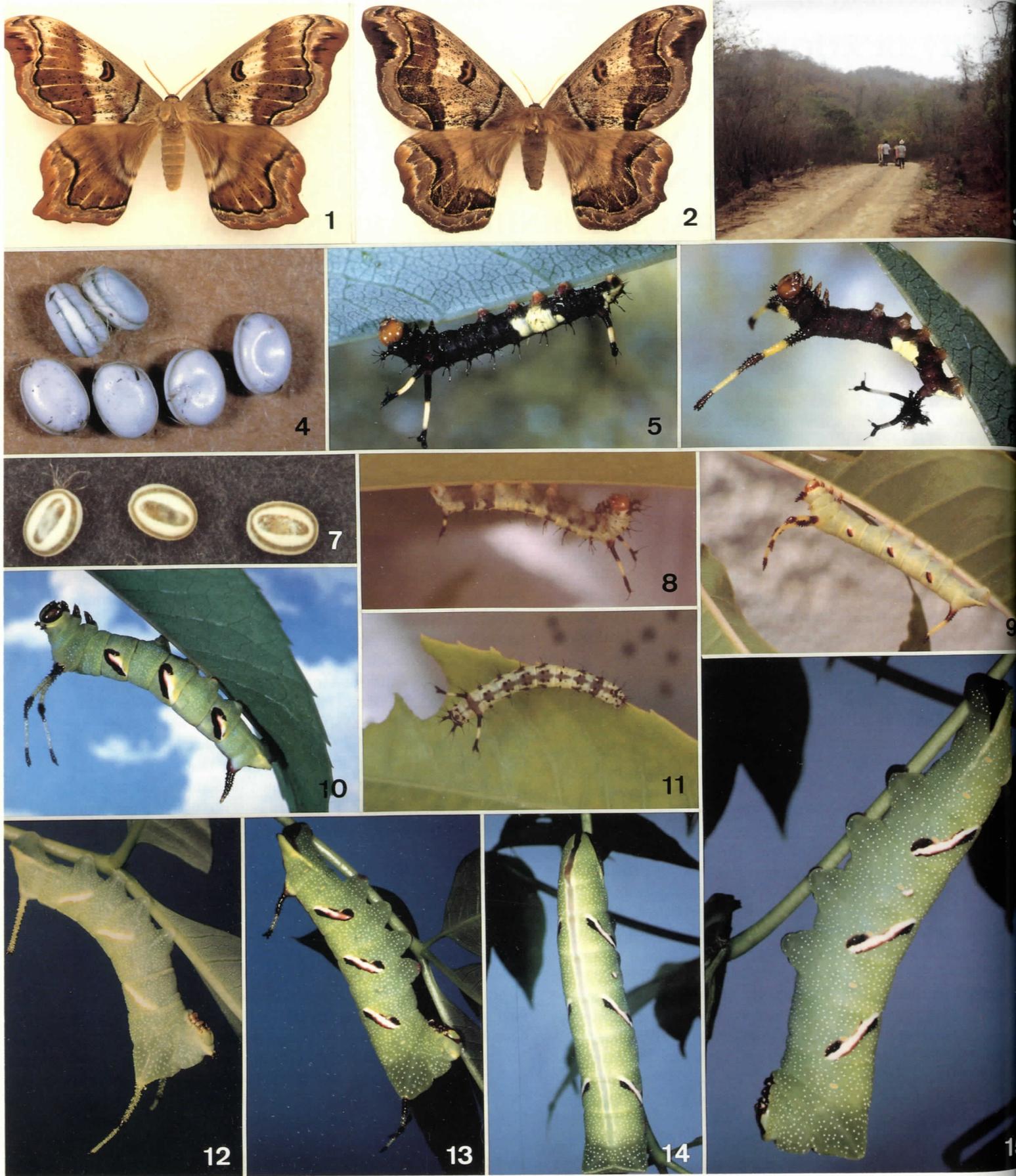


Fig. 1-15. *Caio richardsoni*: 1. Adult ♂; 2. Adult ♀; 3. typical habitat near Huatulco, Oaxaca; 4. undeveloped eggs; 5. 1st instar larva, southern form; 6. 2nd instar, southern form; 7. developed eggs; 8. 1st instar northern form; 9. 2nd instar, northern form; 10. 3rd instar, both forms; 11. 1st instar, northern form; 12. 4th instar, pale morph; 13. 4th instar, typical morph; 14. 5th instar, dorsum; 15. 5th instar, lateral.

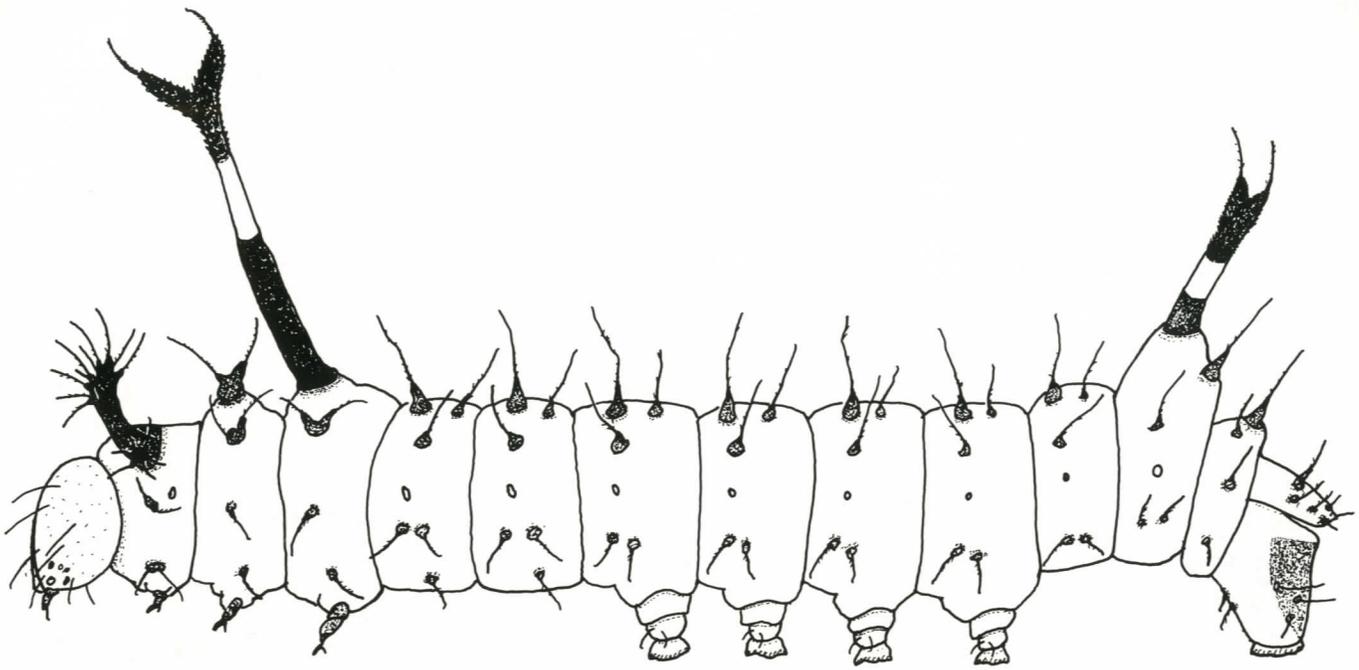


Fig. 16. Schematic view, 1st instar larva of *Caio richardsoni* (greatly enlarged: size = 13mm).

in a brightly lit greenhouse, larvae were pale and without dark markings, but had black heads and black rings and patches when reared under subdued light. Larvae were not gregarious.

Larvae underwent five instars, feeding intermittently day and night, some maturing in as little as 21 days. Minimum instar duration was four days each for instars 1-4 and five days for last instar, after which larvae descended from the foodplant and searched for a place to pupate. Larvae burrowed to a depth of 20cm, the deepest soil provided. Pupation occurred about one week later, and adults of unearthed pupae maintained in a damp aquarium emerged after six weeks. Larvae which pupated in dry plastic bags with tissue paper entered into diapause and remained dormant until water was introduced into the bags, not emerging until at least five to ten days after thorough wetting eight months later, suggesting that pupae of this species will enter diapause if soil is dry.

EGG: 2.4mm long x 2mm wide x 1.8mm thick; when freshly laid, eggs are white with a narrow brown transparent line around the perimeter of both faces (Fig. 4), with an additional transparent "cats-eye" developing in center several days before hatching (Fig. 7). Micropyle dark; eggs were laid flat, either singly or in loose small groups or strings.

LARVA: Measurements in the following descriptions are based upon fully fed larvae and are approximate.

First instar (Figs. 5, 8, 11, 16): 13mm long. **Head:** 1mm wide; reddish brown with short, almost straight, dark brown primary setae. **Body:** **Southern form** (Fig. 5) (Jalisco, Guerrero, Oaxaca): dark reddish brown after hatching soon turning to black with an irregular light green patch saddling parts of abdominal segments 4-6. Dorsal scoli of first thoracic (T1) segment black, 0.51mm long terminating in five branches, each with a stiff, curved black seta; dorsal scoli of T3 segment 2.5mm long, black with a broad yellowish white medial ring, distally bifurcated with a single long seta on each branch. Single dorsal scoli on A8 similar but only about 1.5mm long. All three elongated scoli types minutely but densely thorny, especially on distal third (Fig. 16); remainder of scoli mostly round-topped minutely thorny cones each with a single black long

thorny seta. **Northern form** (Figs. 8, 11) (Sonora): white with black diamonds dorsally, either separated or strung together; integument more or less ringed with irregular black patches. Scoli and larval size as in southern form.

Second instar (Figs. 6, 9): 20mm long. **Head:** 1.5mm wide; dull greenish white, shaded tan on outer border of epicranial suture and more broadly peripherally; surface rough due to numerous pinacula terminating in mostly fine, translucent setae. **Body:** **Southern form** (Fig. 6): color and pattern similar to 1st instar; dorsal scoli on T1 segment 1mm long, black, appearing thorny due to numerous pinacula, each with a minute colorless seta; dorsal scoli on T3 segment 5mm long, tip weakly bifurcated, median knob and slender base black with two broad yellowish white rings between; dorsal scoli on A8 is 3.5mm long, bifurcation of tip reduced, black with white broad median ring; scoli of T3 and A8 are noticeably thorny as in T1; remainder of scoli black, short, smooth and rod shaped, each with a distal minute seta. **Northern form** (Fig. 9): all or mostly greenish white with black irregular dorsal stripe and rings in some individuals; just anterior to spiracles on the A2, A4 and A6 abdominal segments are three short, white diagonal dashes bordered anterodorsally by reddish brown followed by black; size and scoli as in southern form.

Third Instar (Fig. 10): **Head:** 2.4mm wide; color and setae as in 2nd instar. **Body:** 32mm long; most individuals of both forms now marked similarly: pale green with an olive dorsal stripe; integument moderately speckled with white pinacula; spiracles orange; lateral elongated diagonal dashes anterodorsally to spiracles on segments A2, A4 and A6 broadly white, then narrowly purplish brown, both often partially enclosed by a black oval which may also enclose the spiracle; dorsal scoli of segment T1 somewhat reduced, scoli of T3 and A8 similar to 2nd instar; remainder of scoli absent.

Fourth Instar (Fig. 12, 13): **Head:** 3.7mm wide; green, shaded tan and with setae as in 3rd instar, but smoother. **Body:** 58mm long; integument as in 3rd instar; thoracic legs light brown; triangle on paranal lobes dark brown, as in dorsal stripe between 8th dorsal scoli and distal border of anal plate; lateral diagonal dashes on three segments as in 3rd instar; dorsal scoli on T1 greatly reduced, those on T3 and A8 somewhat reduced, the white rings now green; no other scoli present.

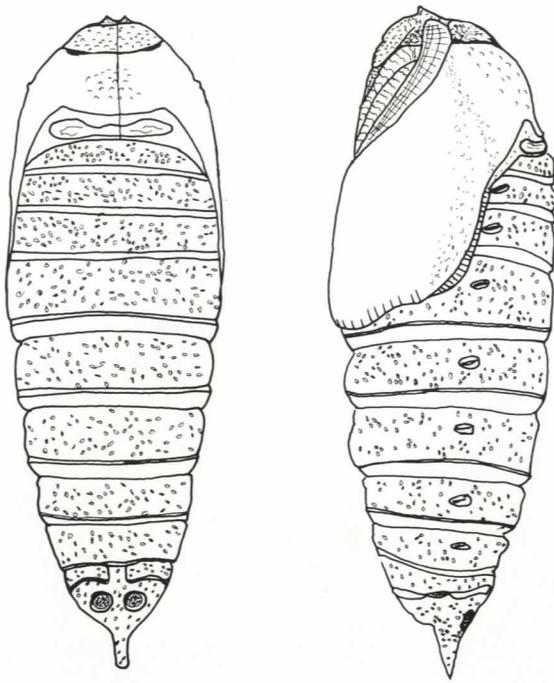


Fig. 17. Pupa of *Caio richardsoni*, dorsal and lateral aspects.

Fifth Instar (Fig. 14, 15): **Head:** 6.3mm wide; green, peripheral and epicranial shading dark brown, reduced and more defined; setae as in 4th instar. **Body:** 90mm long x 14mm wide; integument green, moderately and rather evenly speckled with white pinacula as in 4th instar; 3 lateral diagonal patterns as in 4th instar; spiracles orange; thoracic legs dark brown, base of abdominal prolegs distally black; a distal black triangle on the paranal lobe points forward, dorsally bordered by the white edge of the anal plate; dorsal line broad, olive bordered narrowly white, black on last segment; all scoli absent, a pair of fleshy pyramidal "ears" replace the scoli on swollen segment T3, and slight lumps on segments T1 and A8 marking the locations of the previously prominent scoli on those segments.

PUPA (Fig. 17): ca. 42mm long x 14mm wide; dark reddish brown, smooth, with abdominal surfaces densely pitted; cremaster about 2.5mm long, slender, tip dorsoventrally flattened, rounded and chisel-shaped; dorsum of last segment with two cylindrical pits each about 1.4mm wide x 1.3mm deep, narrowly separated by the mid-dorsum.

NATURAL HISTORY

DISTRIBUTION.— *Caio richardsoni* has been collected in both natural and altered dry tropical forest, at sea level from southern Sonora (M. J. Smith, pers. comm.) to Oaxaca up to at least 1850m across the southern end of the central plateau (Lemaire, 1980), wherever the large and popular *Ceiba* shade tree, its chief hostplant, or other species of Bombacaceae are found.

FLIGHT PERIOD.— This coincides with the beginning of the rainy season in late May or early June through September. Since 10-11 weeks are necessary to complete the life cycle of *C. richardsoni*, it appears that at Chamela, and probably throughout its range, only two broods are possible per year.

HOSTS.— **Wild:** Bombacaceae, including *Ceiba pentandra* (A. Pescador, Jalisco, unpubl. notes; M. J. Smith, Sonora, pers. comm.) **Laboratory:** *Chorisia* sp., *Ceiba pentandra*. Although

larvae accepted and grew well on various species of Bombacaceae, attempts to switch partially grown larvae from *C. pentandra* to a second unidentified species of *Ceiba* resulted in high mortality.

REMARKS.— The immature stages of *Caio championi* are practically indistinguishable from those of *C. richardsoni*, and black southern and white northern forms of first two instars were noted in both species. *Caio championi* feeds on *Bombacopsis quinatum* (Jacq.) (Bombacaceae) in Costa Rica (Janzen, 1985), and has been reared in the laboratory on *Chorisia* sp. (unpubl. notes).

Other genera of Arsenurinae larvae that apparently specialize on Bombacaceae are *Dysdaemonia* (Dias, 1978) and *Titaea* (Peigler, 1993). Some species of *Arsenura* also prefer Bombacaceae while others do not (unpubl. notes).

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