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Author: Nall, Berry

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LARVAL KEY AND LIFE HISTORIES FOR FOUR NORTH AMERICAN *RIFARGIA* SPECIES
(NOTODONTIDAE: HETEROCAMPINAE)

BERRY NALL*

P. O. Box 22, Falcon Heights, TX 78545 *Corresponding Author Email: lb@thenalls.net

AND

DAVID L. WAGNER

Ecology and Evolutionary Biology, University of Connecticut, Storrs, Connecticut 06269

ABSTRACT. The genus *Rifargia* includes four North American species: *R. benitensis* (Blanchard), *R. ditta* (Barnes and McDunnough), *R. subrotata* (Harvey), and a new species, which is the western sister taxon of the latter. All are hackberry (*Celtis*) specialists. We provide images for each species, a larval key, and brief descriptions of the five instars for both of the eastern species (*R. benitensis* and *R. subrotata*).

Additional key words: Life history, *Celtis*, Spiny Hackberry

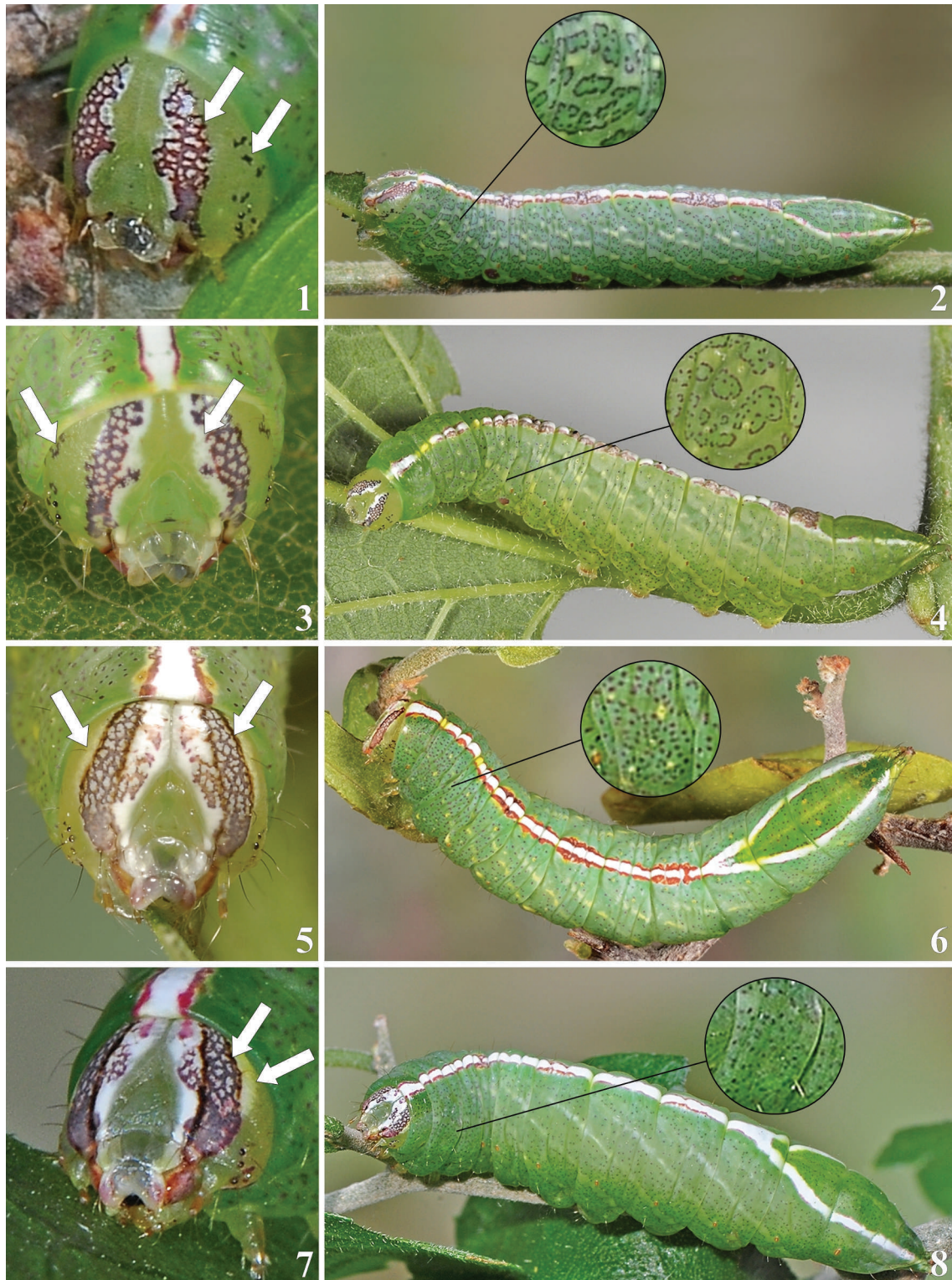
The heterocampine notodontid genus *Rifargia* Walker 1862, as recently re-circumscribed by Becker (2014), includes 11 described species which range from Argentina to New York State. Four species are found north of Mexico: *R. benitensis* (Blanchard), *R. ditta* (Barnes and McDunnough), and *R. subrotata* (Harvey), as well as an undescribed species sister to *subrotata* from Arizona (Miller et al. in prep.). The first two of these form a pair of sister species, with *ditta* being, so far as known, endemic to Arizona and adjacent parts of Mexico; likewise the latter also form a pair of sister species with the n. sp. known from Arizona only. The life history of only one of these, *subrotata* (Wagner 2005), was known prior to our work. Here we provide life history notes, images, and a key to the last instars of the four North American *Rifargia*. More detailed treatments are supplied for the two eastern species, *benitensis* and *subrotata*: all five instars are figured and their life histories briefly compared. While we focus on the eastern pair of taxa, we suspect that our images (Figs. 9–18) could be used gainfully to distinguish early and middle instars of the two Arizonan *Rifargia*, i.e., *subrotata* (Figs. 9, 11, 13, and 15) will closely approximate those for *R. n. sp.*, and our images for *benitensis* (Figs. 10, 12, 14, and 16) will closely approximate those for *R. ditta*.

All four *Rifargia* species have closely similar life histories and larvae. The eggs—bright green, smooth, shiny, and hemispherical—are laid singly on the underside of young growth. There are five larval instars and the pupal stage is believed to overwinter below ground or in duff. The first instars have enormous antler-like scoli on the prothorax, and smaller, less branched scoli on A1–A6, A8, and A10 (Figs. 9, 10). The scoli get

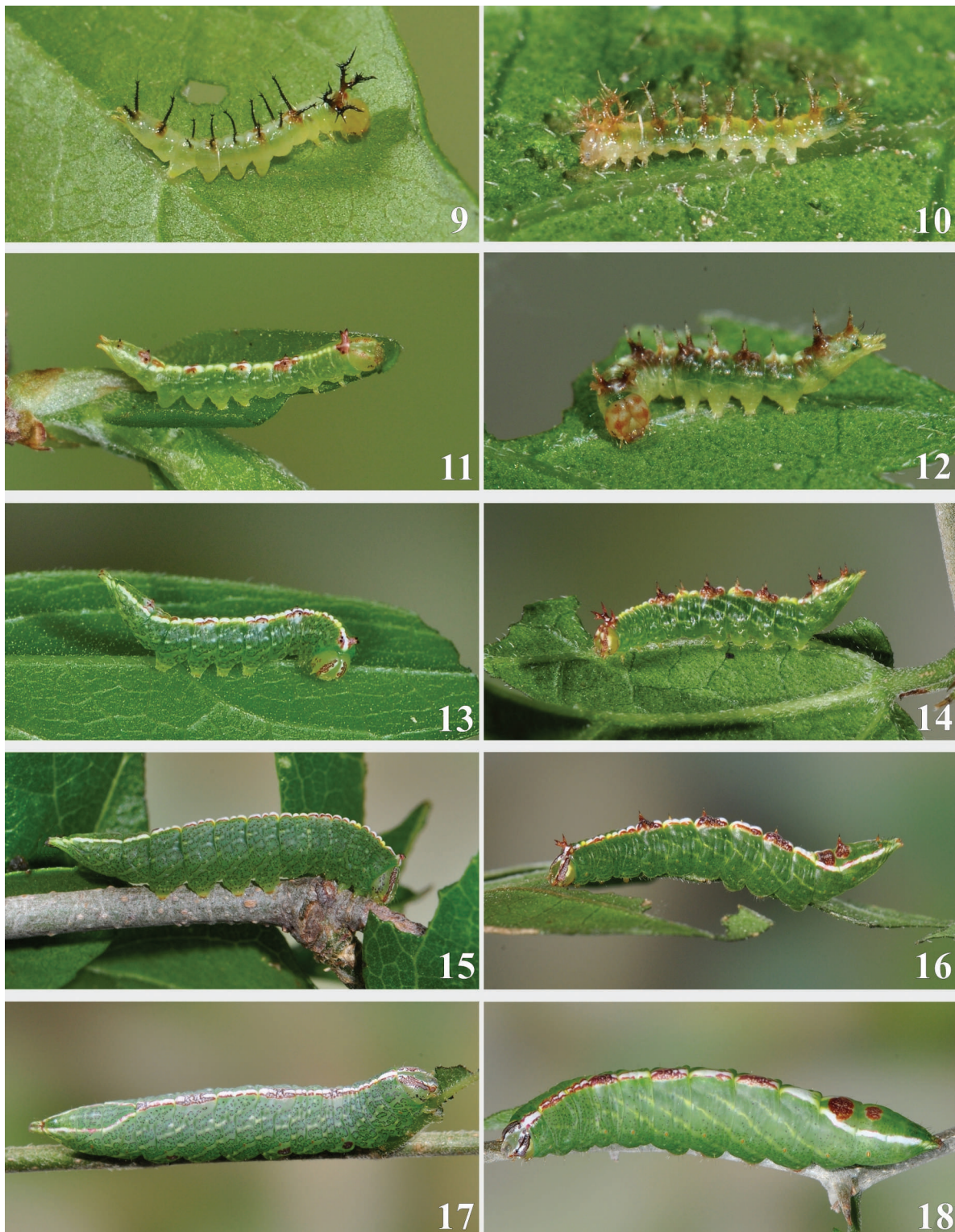
progressively smaller with each molt and are largely absent by the penultimate instar. It is noteworthy that the two eastern species are most easily distinguished in the early instars, and become increasingly similar in later instars, showing the importance of studying the entire life history.

In the last instar all have a lime green ground color and corrugated texture that is most obvious along the dorsal midline (especially in profile); the small head is retracted partway into the prothorax (Figs. 1–8). There is a prominent white middorsal stripe, edged with red, that splits toward the posterior of A6, with the arms carrying to the anal prolegs. The small anal prolegs are held elevated above the substrate in all instars. The trunk is speckled with pale bluish dots which form rings in *subrotata* (Fig. 2) and the n. sp. (Fig. 4), but are more randomly distributed in *ditta* (Fig. 6) and *benitensis* (Fig. 8). There are faint, yellowish, oblique lines that extend from the subdorsum downward toward the prolegs. Primary setae are small and inconspicuous; they do not exude clear defensive secretions as in many heterocampine genera (e.g., *Hyparpax* Hübner, *Oligocentria* Herrich-Schäffer, and *Schizura* Doubleday). The orange spiracles are relatively small.

All four of our species are specialists on *Celtis* and parse out by species group. *R. benitensis* and *R. ditta*, so far as known, feed only on spiny hackberry (*C. pallida*) in the wild; while *R. subrotata* and *R. n. sp.* feed on sugarberries (*C. laevigata*, *C. reticulata*, and related species). At least southward, they are facultatively multivoltine, with generations continuing as long as conditions are favorable for the growth of hackberries, especially in more arid regions. In southeastern Arizona, *R. ditta* can be essentially univoltine, with activity tied to



FIGS. 1–8. Visual key to fifth instar *Rifargia*. **1.** *R. subrotata* head, unlined vertical band and spotted gena emphasized; **2.** *R. subrotata* dorsolateral, inset: blue spots form irregular circles; **3.** *R. n. sp.* head, spotted gena and generous white edging emphasized; **4.** *R. n. sp.* dorsolateral, inset: blue spots form irregular circles (inset from different individual); **5.** *R. ditta* head, elongate creamy spot and edging of red band emphasized; **6.** *R. ditta* dorsolateral, inset: simple blue spots; **7.** *R. benitensis* head, edging of red band and elongate creamy spot highlighted; **8.** *R. benitensis* dorsolateral, inset: simple blue spots.



FIGS. 9–18. *Rifargia subrotata* (left column) and *Rifargia benitensis* (right column). **9.** *R. subrotata* first instar; **10.** *R. benitensis* first instar; **11.** *R. subrotata* second instar; **12.** *R. benitensis* second instar; **13.** *R. subrotata* third instar; **14.** *R. benitensis* third instar; **15.** *R. subrotata* fourth instar; **16.** *R. benitensis* fourth instar; **17.** *R. subrotata* fifth instar; **18.** *R. benitensis* fifth instar.

the monsoon. Below we provide a key and images for the four North American species of *Rifargia*

KEY TO LAST INSTAR NORTH AMERICAN *RIFARGIA*

- 1a Blue spots along sides of thorax forming irregular circles (Figs. 2, 4); vertical red bands on head not edged outwardly with black (Figs. 1, 3); no elongate creamy crescent-shaped spot outside the vertical red band above the eyes; gena with numerous black spots (Figs. 1, 3); on sugarberry and related deciduous hackberries 2
- 1b Blue spots along sides of thorax not forming irregular circles (Figs. 6, 8); vertical red bands on head distinctly edged outwardly with black (Figs. 5, 7); elongate creamy spot outside the vertical red band above the eyes (Fig. 7); gena with or without numerous black spots; on spiny or desert hackberry 3
- 2a Vertical red bands on head not edged inwardly with white or with little white above frons (Fig. 1); known from Rio Grande Valley and Hill Country of South-Central Texas eastward and northward *Rifargia subrotata*
- 2b Vertical red bands on head generously edged inwardly with white above the frons (Fig. 3); known only from southeastern Arizona *Rifargia* n. sp.
- 3a Small yellow spot anterior to spiracle on A1–A3 (just visible in Fig. 6); elongate creamy spot outside the vertical red band above the eyes inconspicuous (Fig. 5); gena sometimes with numerous black spots; southeastern Arizona only *Rifargia ditta*
- 3a No small yellow spot anterior to spiracle on A1–A3; elongate creamy spot outside the vertical red band above the eyes more conspicuous (Fig. 7); gena without numerous black spots; extreme southern Texas from San Patricio County to Brownsville *Rifargia benitensis*

Rifargia benitensis was described from specimens collected in San Benito, Texas, by Andre Blanchard in 1971. This species occurs from San Patricio County (Corpus Christi area) south through Hidalgo and Cameron Counties, into northeastern Mexico. We have been unable to confirm reports of the species from the Hill Country in the vicinity of Austin and San Antonio, southward to Edwards County (specimens from these more inland sites have so far proven to be *R. subrotata*) (Miller et al. in prep.). At times the species is common in the Sabal Palm Sanctuary in Brownsville. It has not yet been collected from south of the Rio Grande (Miller et al. in prep.). We only know it from scrub and palm forests; we have not yet seen it from desert and otherwise more open xeric associations. The moth has a long flight season, from March to at least November, with adult numbers peaking in the fall wet season, from September into October. We found six wild *Rifargia* larvae in the Sabal Palm Sanctuary on hackberry in November 2014. Three *R. benitensis* came from spiny hackberry (*Celtis pallida*), while the three remaining larvae from sugarberry (*Celtis laevigata*) proved to be *R. subrotata*. Ex ova larvae of *benitensis* offered both

species of *Celtis* accepted both. Its sister species, *R. ditta*, is believed to be a strict spiny hackberry specialist.

Larval Description for *Rifargia subrotata*.

First instar (Fig. 9). Head light tan. Body of neonate cream, becoming pale green after feeding. Cream middorsal stripe. On T1, very large antler-like black scoli with primary fork at roughly one-quarter length from body; each branch with irregular bends and sparse secondary spines. Unbranched spinulose black scoli on A1–A6, A8, and A10, terminating in 3 rami, height of abdominal scoli exceeding thickness of body.

Second instar (Fig. 11). Head olive green with green-white vertical bands partly overlaid by mottled red-brown pattern. Body green with sparse dark spots, especially below dorsum; additional pale streaks in subdorsal area where oblique lines appear in later instars. Pale middorsal stripe, occasionally edged with yellow. T1 scoli reduced to short, thick, smooth purplish spines, bifurcated and blackened at tip. Abdominal scoli reduced to purplish setal bumps on A1, A3, A5, A8, and A10.

Third instar (Fig. 13). Head olive green with white vertical bands partly overlaid by mottled purple pattern; dark spots on gena. Body green with small dark spots forming irregular circles. Oblique abdominal lines from subdorsum downward across 2–3 segments to subventer. Dorsum corrugated; white middorsal stripe occasionally broken by yellow or purple spots. T1 spines short, reddish purple, bifurcate, blackened at their apices. Pairs of setal bumps on A1, A3, and A8.

Fourth instar (Fig. 15). Head olive green with white vertical bands partly overlaid by mottled purple pattern; dark spots on gena. Body green with small dark spots forming irregular circles (Fig. 2). Oblique abdominal lines from subdorsum downward across 2–3 segments to subventer. T1 spines nearly absent, red. Dorsum corrugated; sections of white middorsal stripe interrupted with yellow or reddish-purple. Spotting on face and body stronger than previous instar.

Fifth instar (Fig. 17). Head as previous instar. No setal bumps on T1. Body slightly thickened through A2–A6; green, tinted with blue above spiracles; spotting purplish. Occasional irregular large purple spots on body. White dorsal stripe occasionally interrupted by reddish-purple spots, especially on A1, A3, A5, and A7. Larva to 30 mm.

Larval Description for *Rifargia benitensis*.

First instar (Fig. 10). Head pale; occasionally with slightly darker horizontal band across middle. Body of neonate cream; after feeding, dorsum green, occasionally with brown about scoli. On T1, enormous antler-like tan scoli with primary fork at roughly one-

quarter length; each branch serpentine with numerous, long, secondary spines. Unbranched spinulose scoli on A1–A6, A8, and A10, terminating in 3 rami; height of abdominal scoli exceeding thickness of body. Bases and scoli proximally tan; distally clear with dark tips.

Second instar (Fig. 12). Head light tan-green; red-brown splotches yield checkered appearance. Body light green, somewhat darker green dorsally. Abdominal scoli in same positions as first instar, shorter (about half thickness of body) with no rami. T1 scoli shorter, forked, with fewer apical spines. Much-broken pale middorsal stripe broken by reddish-brown scoli on A1, A3, A5, A8, and A10; alternating with paler scoli on A2, A4, and A6.

Third instar (Fig. 14). Head yellowish-green; creamy splotches above frons crossed by vertical reddish-purple bands. Body green with oblique pale yellow abdominal lines from subdorsum downward across 2–3 segments to or through spiracles. Sparse small dark green spots on thorax and in ventral area of abdomen. Scoli in same positions as previous instars, but shorter without rami. T1 scoli antlerlike with three dorsal spines. White and yellow middorsal stripe broken by reddish-brown scoli on A1, A3, A5, A8, and A10. Dorsum corrugated; sections of white middorsal stripe interrupted with, yellow or reddish purple markings.

Fourth instar (Fig. 16). Head yellowish green; white splotches above frons crossed by mottled reddish purple vertical stripes, edged inwardly and outwardly with black. Body green with oblique pale abdominal lines from subdorsum downward across 2–3 segments to or through spiracles. Numerous small dark blue-green spots, most evident on thorax and subventer of abdomen. Scoli in same positions as previous instars, but shorter without rami, and that over A10 much reduced. T1 scoli with three dorsal spines. White middorsal stripe

broken by reddish-brown scoli on A1, A3, A5, A8, and A10. Dorsum corrugated; sections of white middorsal stripe interrupted with, yellow or reddish-purple.

Fifth instar (Fig. 18). Head as previous instar but vertical band with purple and black edging more conspicuous (Fig. 7). Body slightly thickened through A2–A6; oblique pale abdominal lines more conspicuous, running downward across 3 segments to or through spiracles; purplish spotting, largely absent from dorsum of abdominal segments, not forming rings along sides of thorax (Fig. 8) (as in *subrotata*, Fig. 2). No raised scoli. White dorsal stripe often interrupted by reddish-purple spots, especially on A1, A3, A5, and A7. Larva to 32 mm.

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