

A REVISION OF THE GENUS *BULIA* WALKER (LEPIDOPTERA: NOCTUIDAE)

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ABSTRACT. A phylogenetic revision of the genus *Bulia* Walker is provided and includes a key to species, descriptions, illustrations of adults, both male and female genitalia, and distribution maps. The relationships among the five species of *Bulia* are based on an analysis of 16 characters. The monophyly of *Bulia* is supported by 7 nonhomoplasious synapomorphies. *Arsisca bolinalis* Walker 1866 is proposed as a **new synonym** of *Bulia confirmans* (Walker) 1858 and *Bulia morelosa* Richards 1941 as a **new synonym** of *Bulia similis* Richards 1936. Larval host plants are recorded for the first time for *Bulia confirmans*, on *Jatropha gossypifolia* (L.) (Euphorbiaceae), and for *Bulia mexicana* (Behr), on *Prosopis juliflora* (Sw.) DC. (Fabaceae).

Additional key words: Lepidoptera, Noctuidae, *Bulia*, cladistics, key to species, larval plant hosts, Euphorbiaceae, Fabaceae.

The genus *Bulia* Walker 1858 was first revised by Richards (1936a). In this revision, he described a new species, *B. similis* Richards, designated a neotype for *B. mexicana* (Behr) 1870, and concluded that these two species can only be separated from *B. deducta* (Morrison) 1875 by structures of the male and female genitalia. The maculation of the adult is useless due to the tremendous amount of inter- and intraspecific variability and degrees of sexual dimorphism that these species exhibit. Richards (1936b) described and diagnosed *Bulia* in regards to the *Phoberia-Melipotis-Drasteria-Boryza* group of catocaline genera. A second revision by Richards (1941) incorporated additional material from Mexico and Central America and included two new species, *B. schausi* and *B. morelosa*, and a race of *B. similis* from California (*californica*).

The need for this third revision came about during the curation of the Nearctic Catocalinae at the National Museum of Natural History (USNM) by the senior author. After obtaining specimens from other collections, there was substantially more material available for study, especially from Mexico, than what Richards had seen.

MATERIALS AND METHODS

A total of 2319 specimens were examined. The institutions from which specimens were examined are presented in Table 1.

Material was identified by using the revisions of Richards (1936b, 1941) and by comparing his identified material with the unknown specimens. Richards' material included specimens of *B. deducta* that were compared with the types at The Natural History Museum, London (BMNH), and the types of *B. similis*, *B. mexicana*, *B. schausi*, and *B. morelosa* at the USNM were examined.

After removing the abdomen from the specimen it was placed in a 10% solution of potassium hydroxide (KOH) and heated in a Thermolyne® Type 17600, Dri-Bath for approximately 20 minutes or until the abdomen was soft and the muscles dissolved. The abdomen was descaled and the internal organs removed. The specimen was then identified and the abdomen, with genitalia attached, was placed in a genitalia vial containing glycerin and pinned beneath the specimen.

For specimens that were slide mounted, the abdomen was stained in an aqueous solution of Chlorazol Black E. The male aedeagus was removed from the genitalia and the vesica was inflated using a syringe filled with 99% isopropyl alcohol. The abdominal pelt and the rest of the genitalia were placed in solutions of 40% and 70% ethanol for an hour. The abdomen, genitalia, and aedeagus were then stained in Eosin Y dissolved in 99% isopropyl alcohol until the desired color was achieved. The female genitalia were treated in a similar manner. The genitalia and abdomen were then mounted on a slide using Canada Balsam.

PHYLOGENETICS

The taxa analyzed included 5 species of *Bulia* and two outgroup taxa, *Melipotis jucunda* (Hübner) 1818 (type species of *Melipotis* Hübner 1818) and *Drasteria fumosa* (Strecker) 1898. The outgroups were selected based on the results of Richards (1933, 1936b), who included these genera and *Litocala* Harvey 1875 and *Hypocala* Guenée 1852 as his "group 3" and stated that "This is probably the best defined of all the eremine groups." This group is based on shared characters of the thoracic tympanum (Richards 1933): (1) nodular sclerite shape, (2) pocket I pouched, and (3) pocket IV flanged.

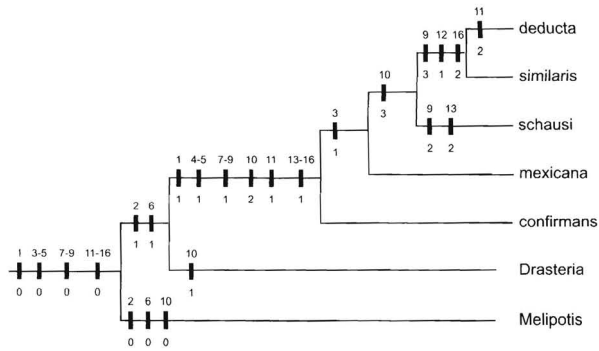


FIG. 1. Cladogram of the species of *Bulia*. Synapomorphies refer to solid black rectangles with character numbers on top and state numbers on bottom. Tree length 25, consistency index (C.I.) 1.00, retention index (R.I.) 1.00.

Characters and states. All characters were run as ordered with their inferred plesiomorphic and apomorphic states shown in Appendix 1. Plesiomorphic states were inferred by outgroup comparison. A total of 16 characters were used including 11 binary and 5 multistate characters (Appendix 1). Data were analyzed using the Hennig86 parsimony program written by Farris (1988, Version 1.5). The command "mhennig*" was used for the data matrix in Appendix 2, and all characters were treated as ordered. The "mhennig*" command constructs several trees, each by a single pass, adding the taxa in a different sequence each time, and then applies branch-swapping to each of the trees, retaining just one tree for each initial one (Lipscomb 1994).

Results. Applying "mhennig" to the data matrix (Appendix 2) resulted in a completely resolved tree with a length of 25, a consistency index (C.I.) of 1.00, and a retention index (R.I.) of 1.00.

The resulting cladogram is shown in Fig. 1 and illustrates the monophyly of *Bulia* based on the following characters: (1) head with an elongate projection from vertex (Fig. 3); (2) eighth tergum mostly membranous, with a narrow X-shaped tergite (Fig. 31); (3) eighth sternum mostly membranous, with a wine glass shaped sternite (Fig. 32); (4) clasper absent from valva (Figs. 34–38); (5) clavus absent from valva (Figs. 34–38); (6) coremata of male arising from base of eighth tergite (Fig. 33); and (7) ventral plate of ostium bursa in female attached to seventh sternum (Figs. 49–53).

Bulia confirmans (Walker) is the most plesiomorphic species for the analyzed characters and occurs in the Caribbean and northern South America; the remaining species of *Bulia* are distributed from the southwestern United States, throughout Mexico to Costa Rica. *Bulia confirmans* is the only species which can be identified without resorting to genitalia and the larvae feed on Euphorbiaceae, while the rest of the

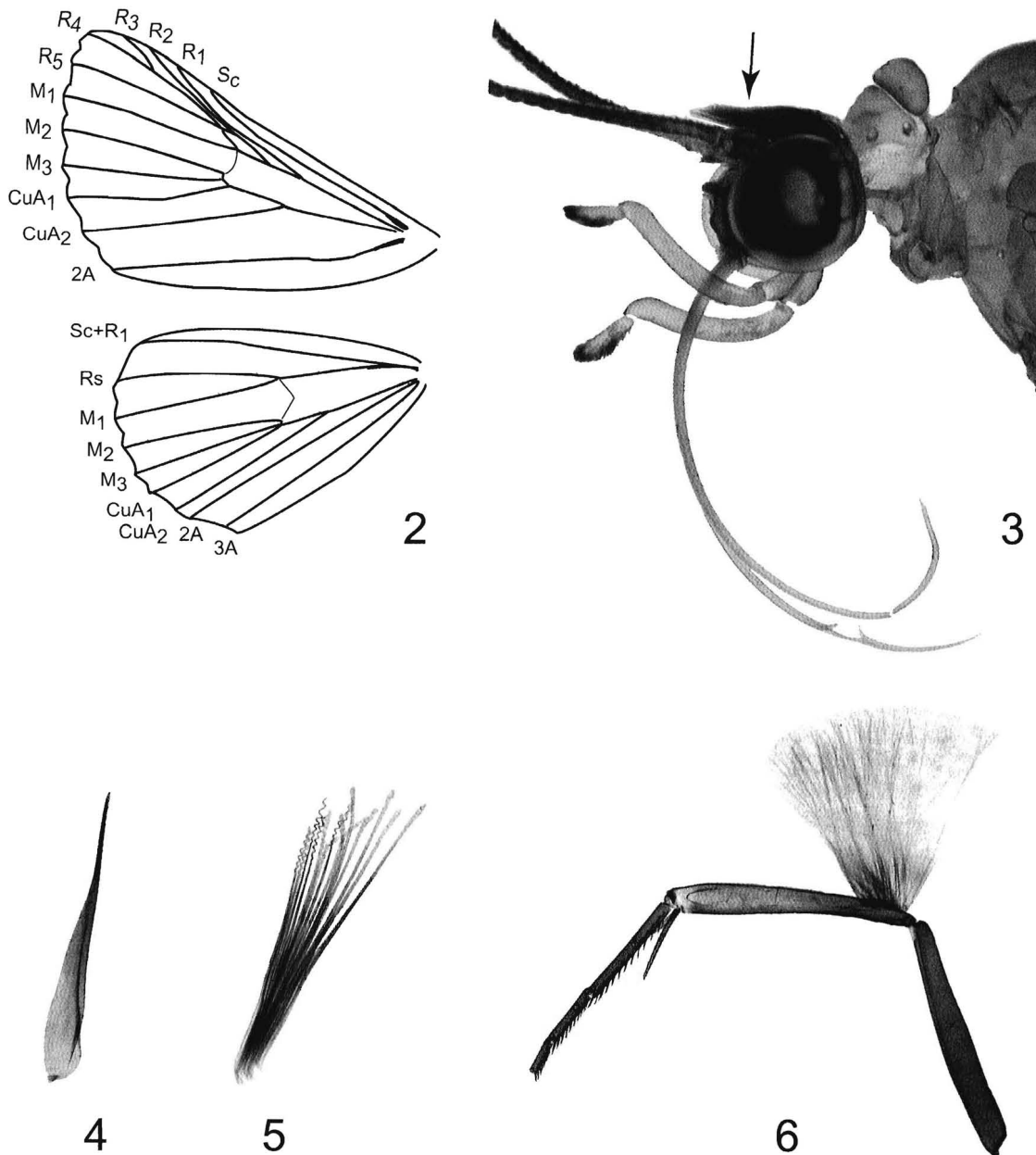
TABLE 1. Acronyms of institutions from which specimens were examined.

AMNH	American Museum of Natural History, New York, New York
BMNH	The Natural History Museum, London
BrM	Bryant Mather, Clinton, Mississippi
CNC	Canadian National Collection, Ottawa, Ontario
INBIO	Instituto Nacional de Biodiversidad, Costa Rica
SDNH	San Diego Natural History Museum, San Diego, California
UCB	Essig Museum of Entomology, University of California, Berkeley, California
UNAM	Instituto de Biología, Universidad Nacional Autónoma de México, México City
USNM	National Museum of Natural History, Washington, D.C.

Bulia species whose host plants are known feed on Fabaceae. *Bulia mexicana* shares the short apex of the sacculus with *B. confirmans* (character 11, state 2). The elongate apex of the sacculus unites *schausi*, *similaris*, and *deducta* (character 11, state 3). Autapomorphies for *B. schausi* include the large costal lobe of sacculus with a slightly bifurcate apex (character 10, state 2) and the vesica containing one large spine (character 14, state 2). The V-shaped dorsal margin of the juxta in the male genitalia is diagnostic for *B. deducta* (character 12, state 2).

LARVAL HOST PLANTS

Three species of *Bulia* have been reared. A single female specimen of *B. confirmans* was reared from a larva that bored into the stem of *Jatropha gossypifolia* (L.) (Euphorbiaceae) from Nueva Esparta, Isla de Margarita, Venezuela. *Jatropha gossypifolia* occurs throughout Mexico, the Caribbean, and South America from Venezuela south to Brazil, Bolivia, and Paraguay. This distribution completely overlaps the known localities of *B. confirmans*. Two other *Bulia* species with known host plants feed on *Prosopis* (Mesquite) (Fabaceae). *Bulia mexicana* was reared on *Prosopis juliflora* (Sw.) DC. from Area de Conservación Guanacaste, Sector Santa Rosa, Estero Naranjo, Guanacaste Province, Costa Rica. *Prosopis juliflora* is distributed from western and southern Mexico through Central America to Venezuela, Colombia, Ecuador, and northern Peru. This distribution overlaps that of the known distribution of *B. mexicana*. *Bulia deducta* (Morrison) was reared from an unknown species of *Prosopis* from the vicinity of Presidio, Presidio County, Texas. There are two species, *Prosopis glandulosa* Torr. and *Prosopis pubescens* Benth., that occur in the Presidio area (Simpson 1988). *Prosopis glandulosa* is the most widely distributed of these two species extending from southern Kansas, west to southern California and southern



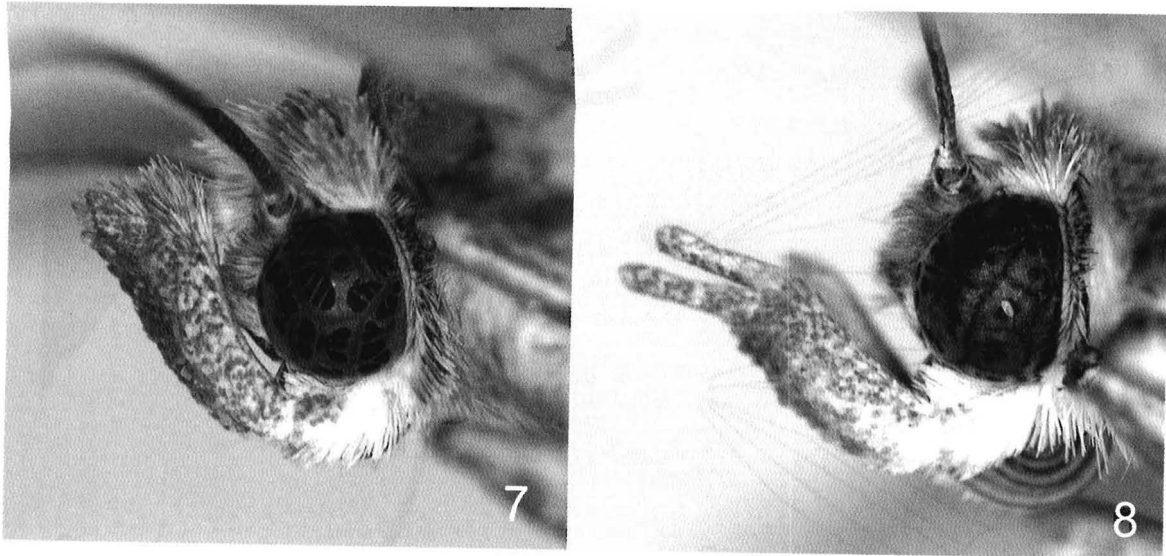
FIGS. 2-6. 2, Wing venation of *B. confirmans*. 3, Descaled head of male *B. confirmans*, arrow indicates elongate median projection. 4, Broad scales enclosed in median projection. 5, Narrow scales enclosed in median projection. 6, Mesothoracic leg with hair pencil from apex of mesothoracic tibia.

Utah, south through Texas, throughout northern Mexico, including Baja California, and down the east coast of Mexico through Veracruz and Yucatan. The range of *Prosopis pubescens* is from southwest Texas west to southern California and southwest Utah, south to northern Mexico including Baja California, Sonora, Chihuahua, and Coahuila. Based on the distributions of these species and that of *B. deducta* it is likely that *P. glandulosa* is the plant host of *B. deducta*. The other species of *Bulia* may also feed on *Prosopis*. The distri-

bution of *Bulia similaris* Richards overlaps that of *P. glandulosa* and is sympatric with *B. deducta* in southern California and southern Texas. More rearing needs to be done in the southwestern United States to see if *Bulia* species are restricted to *Prosopis* or if they are on any related plant species.

Bulia Walker

Biula Walker [1858] 1857:1169 [type species: *Biula propira* Walker by monotypy.] Preoccupied by *Biula*



FIGS. 7-8. 7, Scaled head of male *B. deducta*. 8, Scaled head of female *B. deducta* showing differences in labial palps.

Walker [1858] 1857, Notodontidae. Nye, 1975:91; Poole 1989:163.

Bulia Walker 1858:1815 Proposed as an objective replacement name for *Biula* Walker [1858] 1857. Richards 1936a:431; Richards 1936b:365; McDunnough 1938:132; Richards 1941:255; Nye, 1975:91; Franclemont and Todd 1983:125; Poole 1989:180; Poole and Gentili 1996:729.

Arsisaca Walker [1866] 1865:1261 [type species: *Arsisaca bolinalis* Walker by monotypy.] Nye, 1975:62 [junior synonym of *Bulia*]. Poole 1989:126.

Cirrhobolina Grote 1875:117 [type species: *Syneda deducta* Morrison by subsequent designation by Kirby 1875:442.] Druce 1889:358; Smith 1891:58; Smith 1893:325; Dyar 1902 [1903]:222; Holland 1903:259; Barnes and McDunnough 1917:85; Richards 1936a:431 [junior synonym of *Bulia*]; Richards 1941:255; Nye 1975:123; Poole 1989:253.

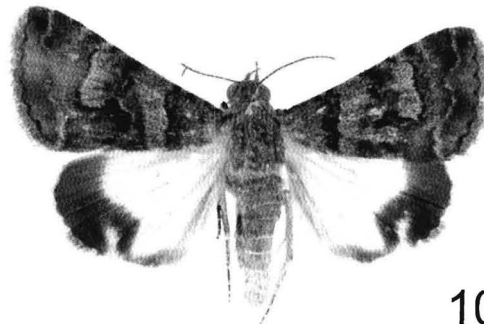
Cirrhobolina; Dyar 1902 [1903]:222. An incorrect subsequent spelling.

Diagnosis. *Bulia* species can be confused with some species of *Drasteria*, *Melipotis*, and *Forsebia*. The best character to separate *Bulia* from these genera is the presence of an elongate median projection of the vertex (Fig. 3). The hindwing anal lunule is yellow in all North American species of *Bulia* and the anal lunule in the other genera, if present, is white. *Bulia confirmans* has a white anal lunule, but the brown border is narrower than in the other genera (Figs. 9-10). *Bulia confirmans* is also much smaller in forewing length (less than 15 mm) than the most similar species in the other genera (greater than 15 mm). *Bulia* is distinct from the other genera in the male genitalia. The valva lacks internal armature, such as the clasper, clavus, and ampulla, while these are all present in the outgroup genera and the coremata arises from the base of the eighth abdominal segment in *Bulia* (Fig. 33), but in the other genera the coremata (when present) arises from the base of the valva.

Description. Head: Vestiture rough, scales narrow, hairlike. Frons base bare, forming a triangle shaped area; frontal prominence

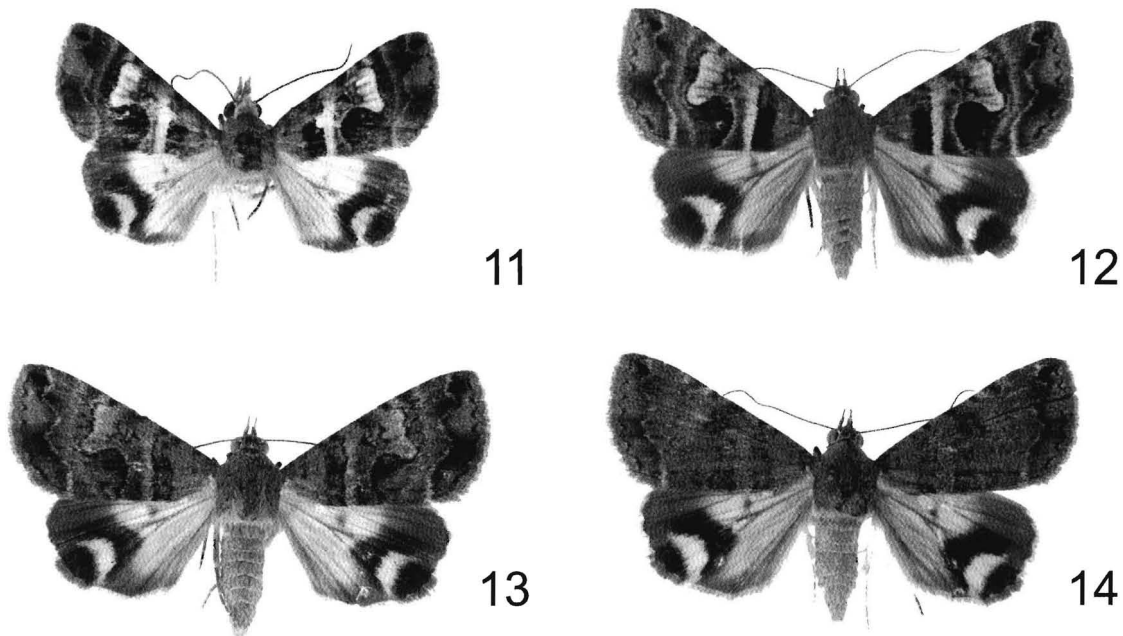


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FIGS. 9-10. Adults of *B. confirmans*. 9, ♂, Venezuela, Trujillo, Valera (USNM). 10, ♀, Dominican Republic, Los Hidalgos (USNM).



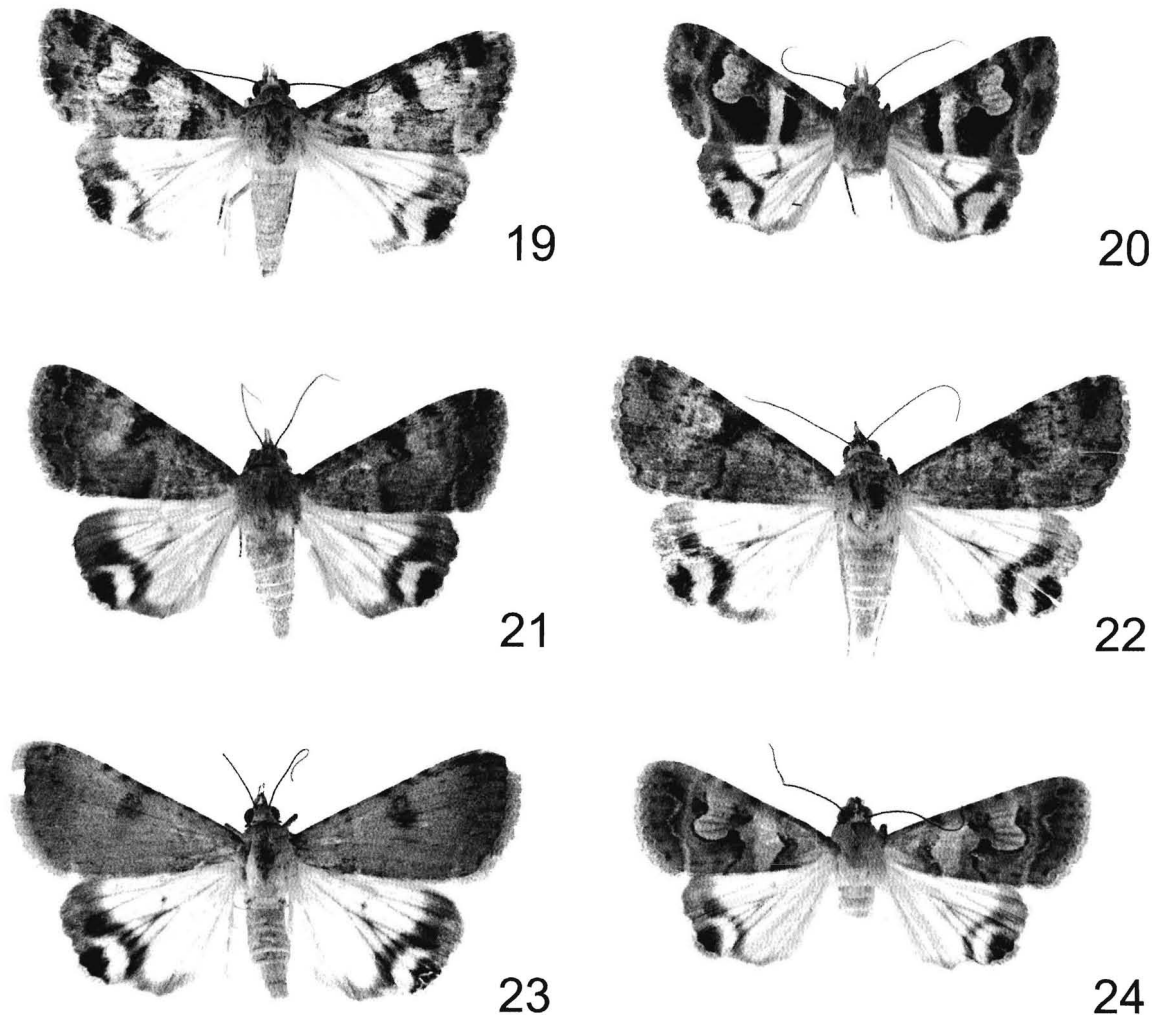
FIGS. 11–14. Adults of *B. mexicana*. 11, ♂, Mexico, Jalisco, Estación de Biología, Chamela (UNAM). 12, ♀, Costa Rica, Guanacaste, Area de Conservación Guanacaste, Sector Santa Rosa, Estero Naranjo (D. H. Janzen & W. Hallwachs rearing voucher no. 97-SRNP-219). 13, ♀, Costa Rica, Guanacaste, Area de Conservación Guanacaste, Sector Santa Rosa, Estero Naranjo (D. H. Janzen & W. Hallwachs rearing voucher no. 97-SRNP-85). 14, ♀, Costa Rica, Guanacaste, Area de Conservación Guanacaste, Sector Santa Rosa, Estero Naranjo (D. H. Janzen & W. Hallwachs rearing voucher no. 97-SRNP-91).

present; scale tuft of frontal prominence directed dorsad; scales lateral to frontal prominence tuft directed dorsad and curved medially. Labial palpus appressed to front; middle segment elongate, more than 3 times length of basal segment; apical segment longer than basal segment, less than a third length of middle segment; apical segment wider in male than female and more concealed by scales of

both the median and apical segments, female apical segment narrow and prominent. Eye well developed. Ocelli present. Vertex with a pair of elongate (longer than head) triangular shaped projections (Fig. 3) that enclose 2 types of scales (Figs. 4–5) and a median elongate spine with a slightly decurved apex; projections invaginated into vertex. Vertex with lateral hairlike scale tufts from near antennal



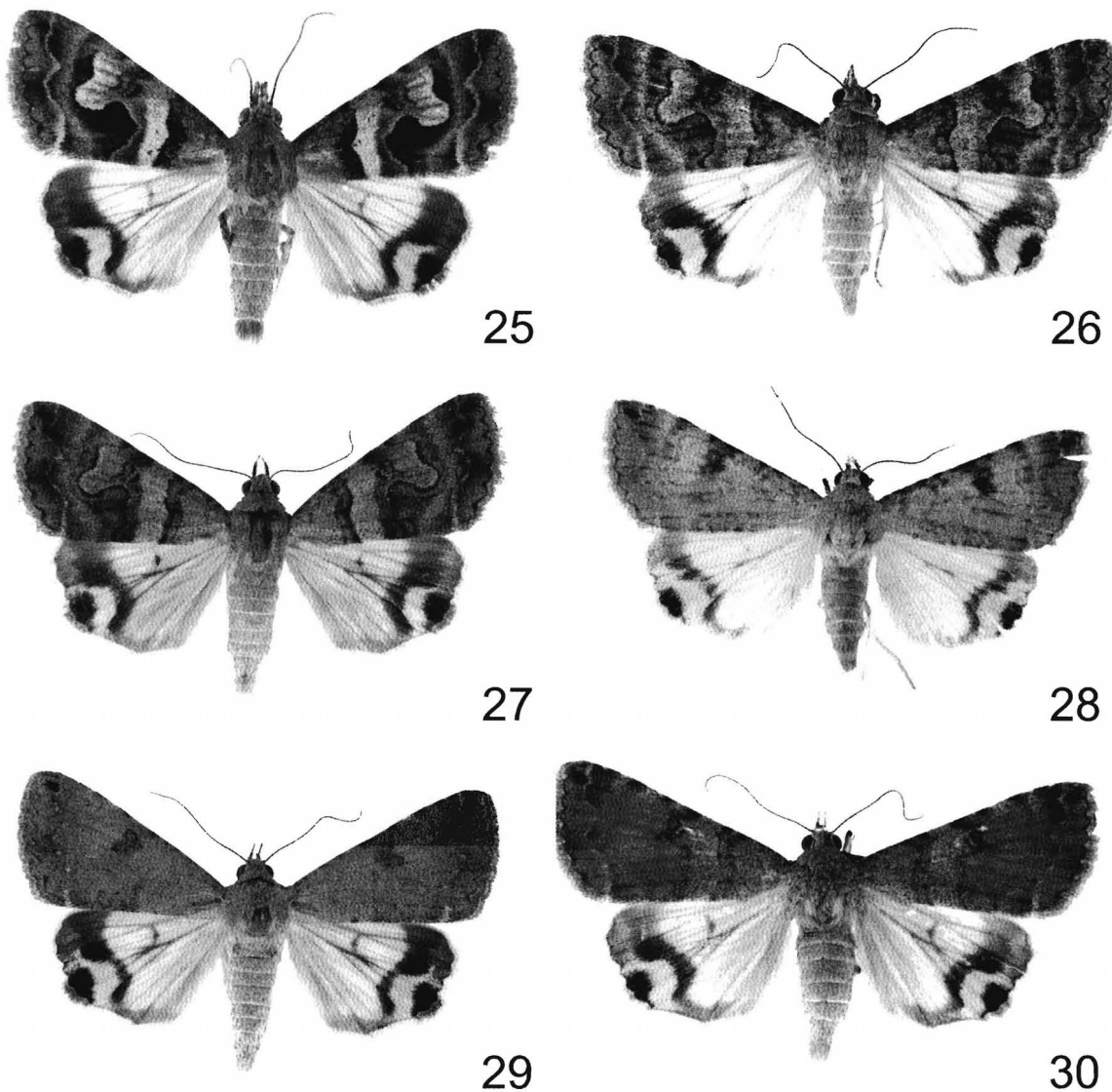
FIGS. 15–18. Adults of *B. schausi*. 15, ♂, Mexico, Distrito Federal (UNAM). 16, ♂, Mexico, Veracruz, Orizaba (USNM). 17, ♀, Mexico, Distrito Federal (UNAM). 18, ♀, Mexico, Distrito Federal, Ajuco (UNAM).



FIGS. 19–24. Adults of *B. similaris*. 19, ♂, California, San Diego Co., Oriflamme Canyon, Anza Borego State Park (USNM). 20, ♂, Texas, Nueces Co., N. Padre Island (USNM). 21, ♀, Mexico, Baja California Norte, 14.4 mi S Campo Alfonsina (SDNH). 22, ♀, Mexico, Baja California Norte, 2.8 mi S of Catanina (SDNH). 23, ♀, Mexico, Baja California Norte, 1.2–5.4 mi S Santa Ines (SDNH). 24, ♀, Mexico, Baja California Norte, 11.5 mi SW San Miguel de Comondu (SDNH).

scape, curved medially to partially conceal triangular shaped projection; a median scale tuft from base of triangular shaped projection, extending over projection. Female vertex with flat scales arranged in a triangular pattern. Antenna filiform; setose ventrally. Proboscis well developed. **Thorax:** Smoothly scaled. Proleg with epiphysis present on tibia, less than half length of tibia. Mesotibia with elongate (more than 3/4 length of tibia) hair pencil arising from a specialized scale patch laterad at proximal apex, hair pencil enclosed in a laterad elongate groove (Fig. 6); spines absent; spurs with shortest less than half length of longest. Mesotibia with 2 pairs of tibial spurs; proximal pair with shortest more than half length of longest; distal pair with shortest less than half length of longest; spines absent. **Forewing:** Length 12–19 mm. Vein R1 from discal cell, ending on costal margin; R2 and R3 + 4 from areole; R2 ending on costal margin; R3 and R4 long stalked, ending on costal margin; R5 from areole, connate with R3 + 4, ending on outer margin; M1 from upper angle of discal cell; M2 and M3 from anal angle of discal cell; M3 nearer M2 than CuA1. **Hindwing:** Length 10–13 mm. Vein Sc + R1 to apex; Rs and M1 connate; M2 present well developed from anal angle of discal cell; M3 and CuA1 connate; 2A and 3A present. **Ab-**

domen: Smooth scaled. Male with seventh tergite with a small, median, pointed projection on proximal margin. Eighth tergite with a narrow X-shaped tergite, remainder membranous (Fig. 31). Eighth sternum with a wine glass shaped sternite that forms a small triangle at proximal end bearing a pair of tennis lateral arms and a median elongate arm extending dorsad into wide intersegmental membrane, remainder membranous (Fig. 32); a pair of elongate coremata from lateral arms, bifurcate and covered with fine hairs (Fig. 33). Female abdomen without modifications. **Male Genitalia:** Uncus well developed, base broader than apex, lateral setae at middle. Scaphium as long as uncus well sclerotized. Subscaphium well developed, narrower than scaphium, striate. Valva elongate, narrow, length greater than 6 times width. Cucullus truncate and not as sclerotized as valva. Sacculus well developed, extends beyond apex of valva; costal lobe prominent; apex produced into a dorsally curved spine. Juxta well developed, excavated dorsad. Clasper, ampulla, and valvula absent. Aedoeagus slender, well sclerotized. Vesica well developed with multiple diverticula, spines, and cornuti of two types, (1) variously sized, spinelike and (2) elongate, hairlike. **Female Genitalia:** Seventh sternite indented medially at apex, with or without a median



FIGS. 25–30. Adults of *B. deducta*. **25**, ♂, Arizona, Cochise Co., Peloncillo Mts., Guadalupe Canyon (USNM). **26**, ♀, Arizona, Cochise Co., Cherry Canyon, near Cherry (USNM). **27**, ♀, Texas, Cameron Co., San Benito (USNM). **28**, ♀, Texas, Brewster Co., Alpine (USNM). **29**, ♀, Arizona, Cochise Co., Huachuca Mts., Ash Canyon Road (USNM). **30**, ♀, Texas (USNM).

prong. Ostium at apex of seventh sternite. Eighth segment telescopes inside seventh. Eighth sternite not joined medially. Segment 9 and 10 membranous and longer than segment 8. Apophyses posteriores elongate, extending beyond proximal margin of segment 8. Apophyses anteriores elongate, extending to or beyond middle of segment 7. Papillae analis sparsely setose, apex produced.

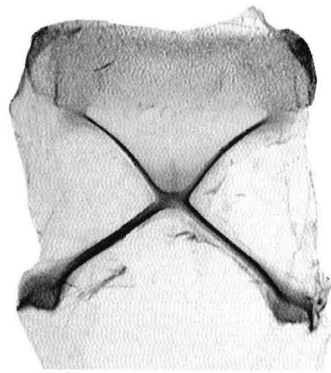
Discussion. The only species in *Bulia* that can be readily separated from the others is *B. confirmans*, with its small size and white anal lunule in the hindwing. All other species of *Bulia*, with the yellow anal lunule in the hindwing, can only be identified by genitalic characters.

Other species with which *Bulia* species potentially can be confused are *Drasteria eubapta* Hampson, *D.*

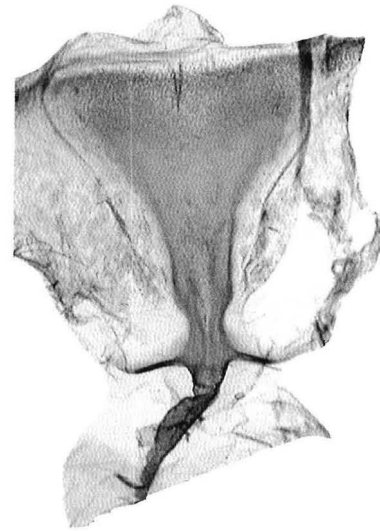
fumosa (Strecker), *D. pallescens* (Grote & Robinson), *Forsebia perlaeta* (H. Edwards), *Melipotis novanda* (Guenée), and *M. indomita* (Walker).

KEY TO SPECIES

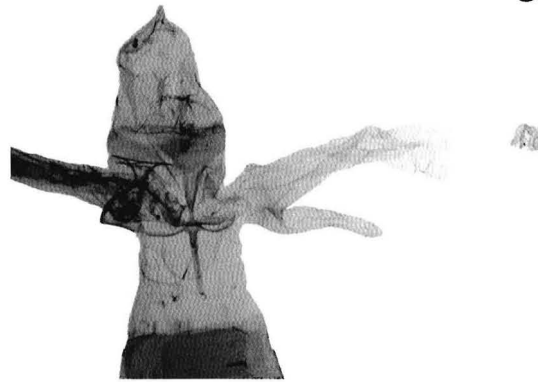
1. Hindwing with anal lunule white (Figs. 9–10) *confirmans*
- 1'. Hindwing with anal lunule yellow (Figs. 11–30) 2
2. Head with large median projection of vertex, can be concealed by hairlike scale tufts; (Fig. 3); apical segment of labial palpus short and partially concealed by scales of middle segment (Fig. 7); male 3
- 2'. Head without large median projection of vertex, scales flat not tufted; apical segment of labial palpus long and not concealed by scales of middle segment (Fig. 8); female 6
3. Juxta with dorsal margin V-shaped; lateral projections scobinate, pointed and heavily sclerotized (Figs. 38 and 43) *deducta*



31



32



33

FIGS. 31-33. Structures associated with the abdomen. 31, ♂, Eighth abdominal sternite of *B. confirmans* (genitalia slide USNM 46368). 32, ♂, Eighth abdominal tergite of *B. confirmans* (genitalia slide USNM 46368). 33, ♂, Coremata of *B. similaris* (genitalia slide USNM 46332).

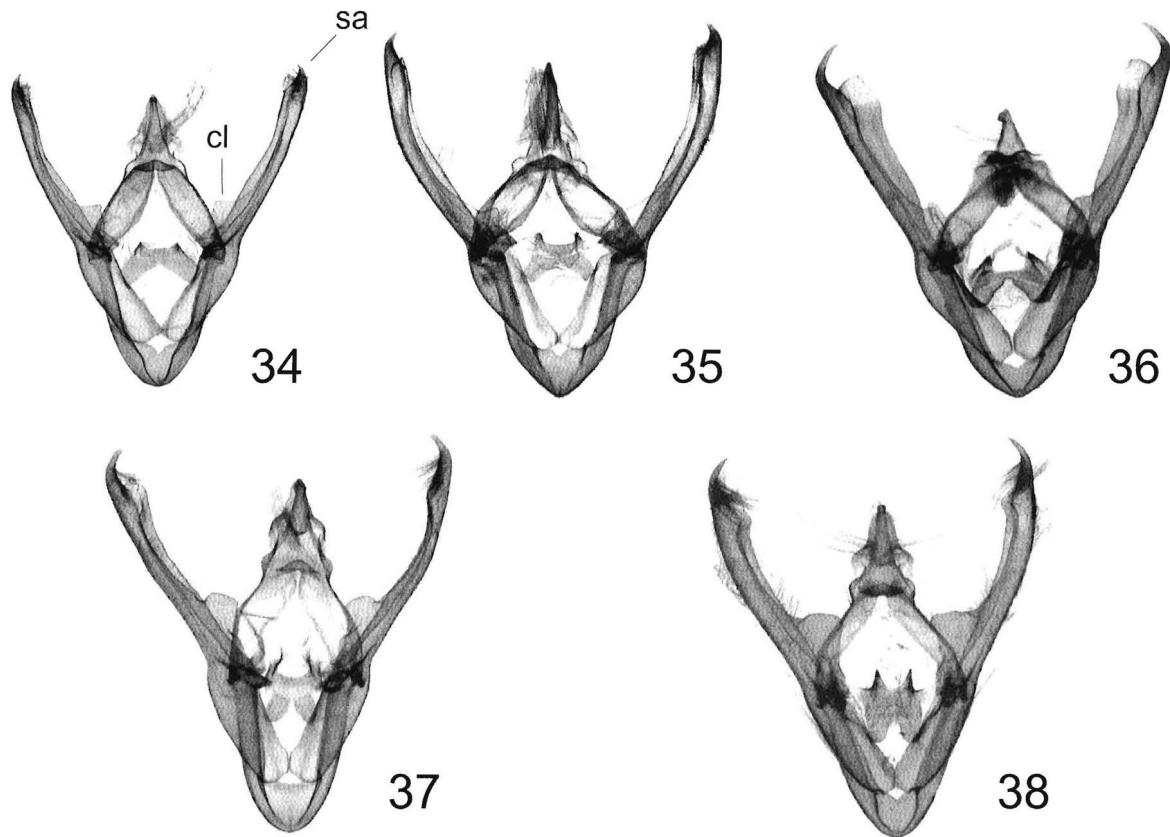
- 3' Juxta with dorsal margin U-shaped, lateral projections absent (Figs. 35-37 and 40-42) 4
- 4. Vesica with a single large spine (Fig. 46) *schausi*
- 4'. Vesica with two large spines (Figs. 45 and 47) 5
- 5. Costal lobe of sacculus small, triangulate (Fig. 35); disto-lateral diverticulum elongate, more than twice length of apical spine (Fig. 45); base of vesica lacking small pair of ventral diverticula (Fig. 45) *mexicana*
- 5'. Costal lobe of sacculus large, truncate to triangulate (Fig. 37); disto-lateral diverticulum short, less than twice length of apical spine (Fig. 47); base of vesica with a pair of small ventral diverticula (Fig. 47) *similaris*
- 6. Seventh sternite with median prong elongate, extending above apex of lateral prolongation (Figs. 53 and 58) *deducta*
- 6'. Seventh sternite with median prong short, extending to or below apex of lateral prolongation (Figs. 50-52 and 55-57) 7
- 7. Corpus bursae with two sclerotized structures, (1) an elongate curved process with pointed apex at base of ductus seminalis, (2) ventral to 1 a sclerotized area with a curved apex pointed in the opposite direction of 1 (Fig. 51) *schausi*
- 7'. Corpus bursae lacking large sclerotized structures (Figs. 50 and 52) 8

- 8. Seventh sternite with median prong short, height less than width (Fig. 55) *mexicana*
- 8'. Seventh sternite with median prong elongate, height greater than width (Fig. 57) *similaris*

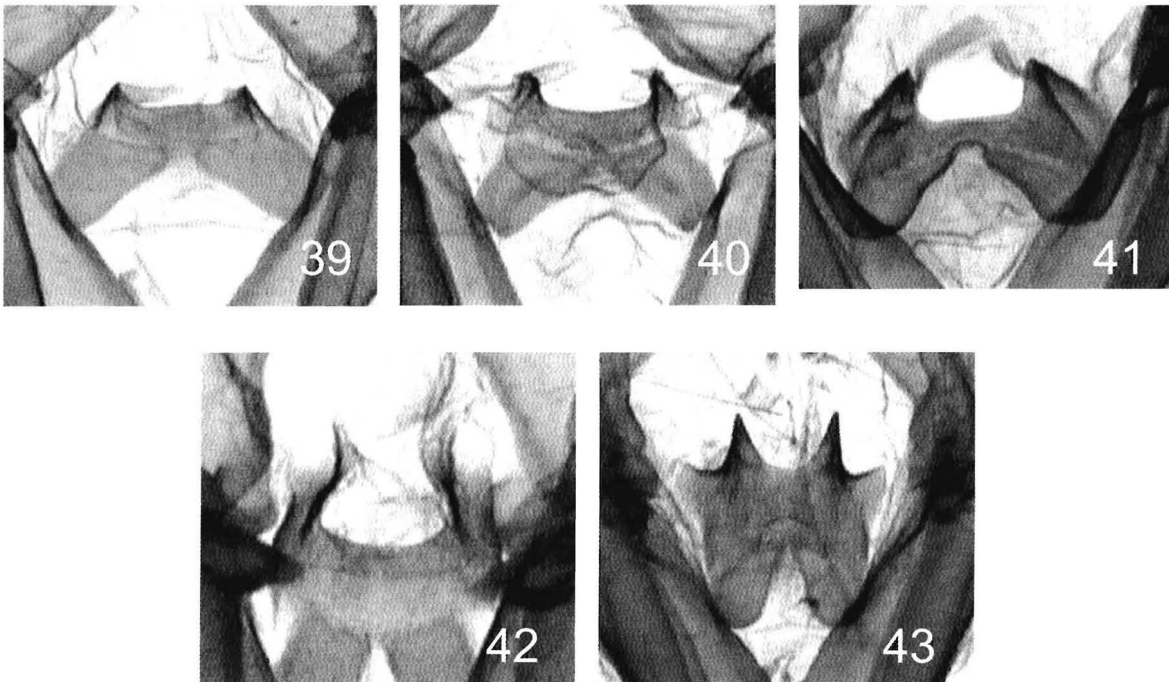
Bulia confirmans (Walker)

(Figs. 2-6, 9-10, 31-32, 34, 39, 44, 49, 54, 59)

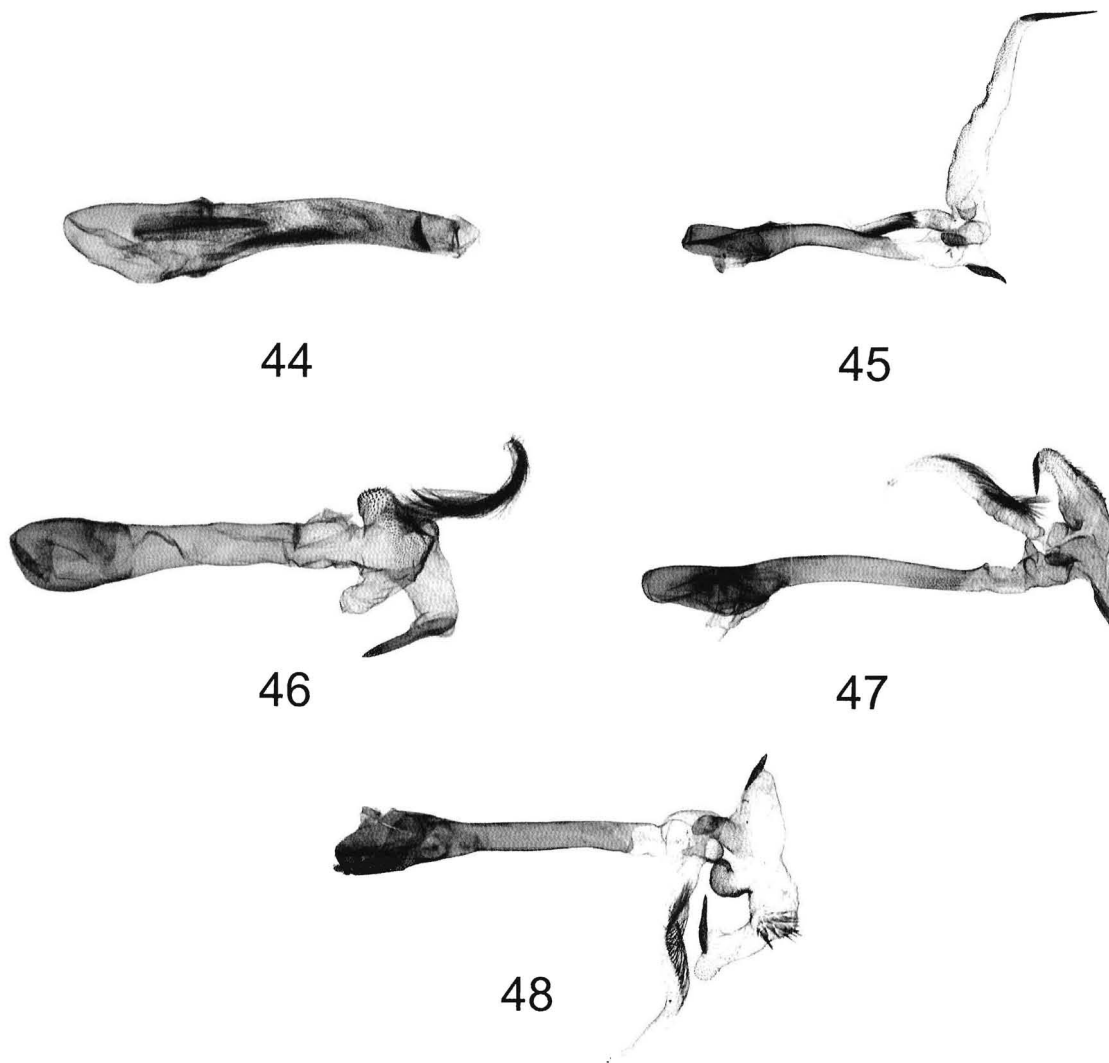
- Bolina confirmans* Walker [1858] 1857:1157.
- Bolina umbrosa* Walker [1858] 1857:1158. [Synonymized by Richards 1936a:433.]
- Biula propira* Walker [1858] 1857:1170. [Synonymized by Richards 1936a:433.]
- Arsisaca bolinalis* Walker [1866] 1865:262, **new synonym.**
- Bulia bolinalis*, Poole 1989:180.
- Bulia confirmans*, Richards 1936a:433; Richards 1939:pl. V, Figs. 7-9; Richards 1941:258; Poole 1989:180.



FIGS. 34–38. Male genitalia. **34**, *B. confirmans* (genitalia slide USNM 46366). **35**, *B. mexicana* (genitalia slide USNM 46333). **36**, *B. schausi* (genitalia slide USNM 46362). **37**, *B. similaris* (genitalia slide USNM 46323). **38**, *B. deducta* (genitalia slide USNM 46322), cl = costal lobe of sacculus, sa = sacculus apex.



FIGS. 39–43. Male juxta. **39**, *B. confirmans* (genitalia slide USNM 46366). **40**, *B. mexicana* (genitalia slide USNM 46333). **41**, *B. schausi* (genitalia slide USNM 46362). **42**, *B. similaris* (genitalia slide USNM 46323). **43**, *B. deducta* (genitalia slide USNM 46322).



FIGS. 44–48. Male aedoeagus. **44**, *B. confirmans* (genitalia slide USNM 46366). **45**, *B. mexicana* (genitalia slide USNM 46333). **46**, *B. schausi* (genitalia slide USNM 46362). **47**, *B. similis* (genitalia slide USNM 46323). **48**, *B. deducta* (genitalia slide USNM 46322).

Diagnosis. This is the most easily recognized species of *Bulia*. It is the only one with a white lunule on the hindwing, all other *Bulia* have a yellow lunule.

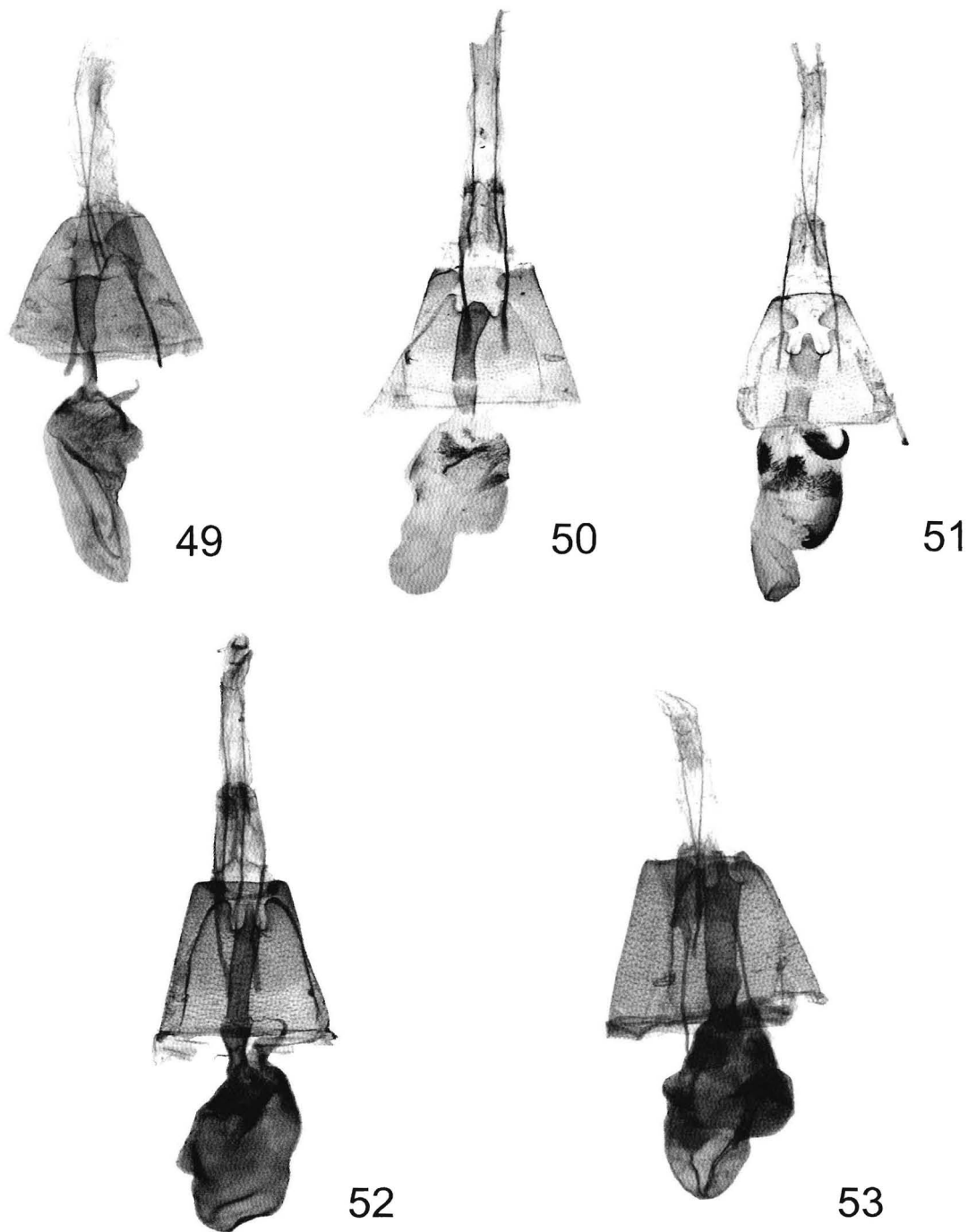
Description. Adult male. Head: Frons white with light brown scales. Vertex light brown. Labial palpus with basal segment mostly white with some brown scales laterally; middle and apical segments brown with some white. Antennal scape brown, light brown laterally; scaled dorsally, setose ventrally, setae approximately width of antennal segments. **Thorax:** Patagium, mesothorax, and metathorax light brown. Prothoracic femur brown with some white scales; tibia brown with an indistinct median white band, apical band white; tarsi brown with white apical rings. Mesothoracic femur white speckled with brown; tibia brown speckled with white; tarsi brown with white apical rings. Metathoracic femur white speckled with brown; tibia brown speckled with white dorsally, white ventrally, a tuft of scales below proximal apex buff; tarsal segment I brown and white, with white apical ring, rest brown speckled with white, white apical rings. Underside white. **Forewing:** Length 11.5–13.5 mm. Basal patch light brown; costal margin brown; basal band brown to M vein; me-

dian line black to R vein; median band cream to middle of discal cell, speckled with brown to costal margin; orbicular spot a small black patch; two indistinct whitish scale patches beyond orbicular spot; reniform spot cream; postmedial line black from posterior margin, angled back toward outside of median band and bordering outside of reniform spot to its apex; postmedial band brown; subterminal line buff from termen to M1 cell; terminal line black, scalloped, from termen to M1 vein. Underside ground color white; brown patch at end of discal cell; brown band on terminal third.

Hindwing: Ground color white; band on terminal fourth brown; white spot at apex of CuA1 cell. Underside as in upperside; white apical spot larger. **Abdomen:** Light brown dorsally; white ventrally.

Genitalia (Figs. 34, 39, 44): Sacculus with costal lobe triangular; apex a short projection. Juxta with U-shaped dorsal margin. Aedoeagus without dorsal spiculations near apex. Vesica with a large and a small spine; numerous minute cornuti. (All attempts at inflating vesica failed.)

Adult female. Essentially as described for male except: **Forewing:** Length 13.0–14.5 mm. Basal patch brown speckled with white and light brown; median band indistinct, speckled with light



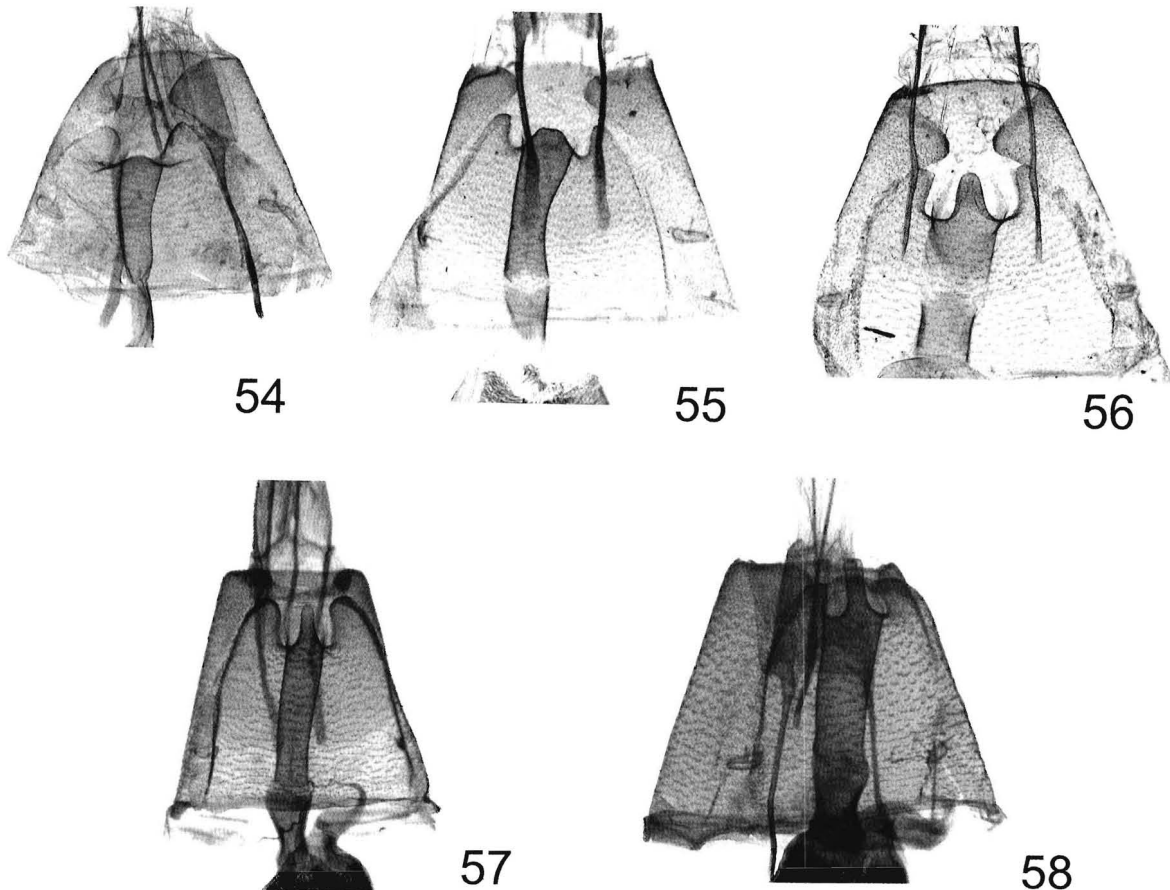
FIGS. 49–53. Female genitalia. **49**, *B. confirmans* (genitalia slide USNM 46367). **50**, *B. mexicana* (genitalia slide USNM 46378). **51**, *B. schausi* (genitalia slide USNM 46379). **52**, *B. similaris* (genitalia slide USNM 46325). **53**, *B. deducta* (genitalia slide USNM 46327).

brown, white, and brown; reniform spot speckled with light brown, white, and brown; subterminal line from termen to costa; terminal line from termen to costa. **Abdomen:** Underside white, pale brown to buff at apex. **Genitalia** (Figs. 49, 54): Seventh segment deeply invaginated; median prong absent.

Type material. *Bolina confirmans* Walker; holotype ♀, St. Domingo [Dominican Republic], in BMNH. *Bolina umbrosa* Walker; holotype ♀, St. Domingo [Dominican Republic], in BMNH.

Biula propira Walker; holotype ♂, St. Domingo [Dominican Republic], in BMNH. *Arsisaca bolinalis* Walker; holotype ♂, Jamaica, in BMNH.

Material examined. 47 ♂ and 102 ♀. All material is from the USNM unless otherwise noted. **COLOMBIA:** ATLANTICO: Cuatro Bocas, 22 Jan. 1959, J.F.G. Clarke, 1 ♂. **CUBA:** No specific locality, 2 ♀; Santiago, 1 ♂, 1 ♀. **CURAÇAO:** 3 km NE Willemstad, 8–15 Feb. 1987, 1 ♀, 13 Feb. 1987, 2 ♀, W.E. Steiner & J.M.



FIGS. 54–58. Female ventral plate of ostium bursa. **54**, *B. confirmans* (genitalia slide USNM 46367). **55**, *B. mexicana* (genitalia slide USNM 46378). **56**, *B. schausi* (genitalia slide USNM 46379). **57**, *B. similaris* (genitalia slide USNM 46325). **58**, *B. deducta* (genitalia slide USNM 46327).

Swearingen; 3 km NW Fuik, 11 Feb. 1987, W.E. Steiner & J.M. Swearingen, 1 ♂. **DOMINICAN REPUBLIC:** LA VEGA PROVINCE: Constanza, Hotel Nueva Suiza, 1164m, 29 May 1973, D. & M. Davis, 1 ♂, 1 ♀. MONTE CRISTI PROVINCE: 10 km S Monte Cristi, 5 m, 23 May 1973, D. & M. Davis, 10 ♂, 36 ♀; Los Hidalgos, 4–5 June 1969, Flint & Gomez, 6 ♀; Mt. Cristy, Santo Domingo, Atwater, 1 ♀; Santo Domingo, Atwater, 1 ♂. **GRENADA:** Hardy Bay, 26 Oct.–4 Nov. 1975, E.L. Todd, 2 ♂, 3 ♀; Lance aux Epines, 30 Oct. 1975, E.L. Todd, 1 ♀. **HAITI:** No specific locality, 1 ♂. **JAMAICA:** No specific locality, Col. B. Neumogen, 2 ♂, 1 ♀, Collection J.B. Smith, 1 ♂, 1 ♀, Collection Wm Schaus, 3 ♀, Collection Brklyn Mus, 1 ♀, Col. E.L. Graef, 1 ♂, 1 ♀. **CLARENDON PARISH:** 2 km S Rocky Pt., nr. Jackson Bay Cave, 5 m, 10 Dec. 1975, D. & M. Davis, 1 ♂, 1 ♀; Portland Ridge, nr. Jackson Bay Cave, 40 ft., 4 May 1973, D. & M. Davis, 6 ♂, 7 ♀, ♀ genitalia slide USNM 46367; **ST. ANDREW PARISH:** Upper Mt. View, July 1942, 2 ♀, July 1948, 1 ♀, Aug. 1942, 1 ♂, ♂ genitalia slide USNM 46366, C.B. Lewis. **ST. ANN PARISH:** nr. Runaway Bay Cave, 50 ft., 1–2 May 1973, D. & M. Davis, 1 ♀; Hill Gardens, 14 June 1923, C.O. Gowdy, 1 ♂; Kingston, about 70 ft., 4–10 Dec. 1910, 1 ♂ (AMNH); Mandeville, Manchester, about 2250 ft., 18–20 Jan. 1920, 1 ♂ (AMNH); Port Royal, 27 Feb. 1911, 1 ♀ (AMNH). **PUERTO RICO:** Isla Maguay, Parguera, 20 Dec. 1962, P. & P. Spangler, 2 ♀. **VENEZUELA:** ARAGUA: Rancho Grande, 1100 m, cloud forest, 30–31 Mar. 1978, J.B. Heppner, 1 ♀. LARA: El Cuji, 7 mi N Barquisimeto, 29 June–1 July 1967, R.W. Poole, 1 ♀; Puente Torres, 24 km E Carora, 10 Mar. 1978, thorn forest, J.B. Heppner, 9 ♂, 16 ♀, ♂ genitalia slide USNM 46368. **MERIDA:** Río

Chama Valley, 12 km SW Ejido, 4000 ft., dry forest, 17 Feb. 1978, J.B. Heppner, 1 ♂, 7 ♀. **ZULIA:** El Tucuco, Sierra de Perijá, montane forest, 28–29 Jan. 1978, J.B. Heppner, 2 ♀. **Isla de Margarita, Nueva Esparta,** 23 June 1997, R. Segura, stem borer *Jatropha gossypifolia*, 1 ♂; Valera, E.P. de Ballard, 1 ♂; Valera, Trujillo, Nov. 1922, H. Pittier, 1 ♂.

Larval host. *Jatropha gossypifolia* (L.) (Euphorbiaceae). This species is considered a noxious weed in Puerto Rico (GRIN Database 2000). The distribution of *J. gossypifolia* is from Mexico south to Honduras and Nicaragua, throughout the Caribbean to Venezuela and Colombia south to Ecuador and Brazil. *Bulia confirmans* completely overlays this distribution. The single specimen reared was from Isla de Margarita, Nueva Esparta, Venezuela.

Distribution (Fig. 59). Collections from the Caribbean include localities in Cuba, Jamaica, Haiti, Dominican Republic, Puerto Rico, Grenada, and Curaçao and in South America from northern Venezuela and Colombia.

Discussion. The female of *B. confirmans* is more variable in maculation than the male. Specimens from the Dominican Republic and Jamaica show a pattern (Fig. 10), which is less distinct, but has all of the pattern elements that are present in the male. In Venezuela the patterned female is present, but uncommon. The most common female there is completely without pattern, except for a black orbicular spot and terminal line. The ground color is brown.

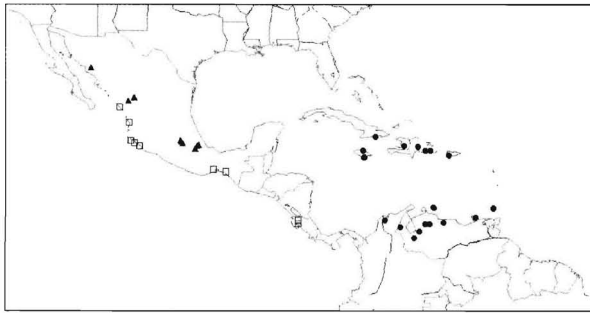


FIG. 59. Known localities from collections of *B. confirmans* (solid circles), *B. mexicana* (open squares), *B. schausi* (solid triangles).

An adult specimen of *B. confirmans* was sent to the senior author for identification as a possible biological control agent for *J. gossypifolia*.

Bulia mexicana (Behr)

(Figs. 11–14, 35, 40, 45, 50, 55, 59)

Syneda mexicana Behr 1870:26.

Bulia mexicana, Richards 1936a:433; Richards 1941:258; Poole 1989:180.

Diagnosis. The remaining species of *Bulia* are almost indistinguishable from each other except for characters in the male and female genitalia. *Bulia mexicana* is separated from the other species by the following combination of characters in the male genitalia (Fig. 35): (1) juxta U-shaped; (2) sacculus lobe small, triangular; (3) aedeagus with external spiculations absent; and (4) disto-lateral diverticulum longer than aedeagus. The most closely related species to *B. mexicana* is *B. schausi*, but the females of *B. mexicana* can be differentiated from the females of *B. schausi* by the absence of any heavily sclerotized areas in the corpus bursae (compare Figs. 50 and 51); and females of *B. mexicana* can be separated from females of *B. similis* and *B. deducta* by the median prong of the seventh segment being wider than high in *B. mexicana* (compare Figs. 50 and 57–58).

Description. Adult male. Head: Frons white with light brown scales. Vertex light brown. Labial palpus with basal segment mostly white with some light brown scales laterally; middle and apical segments light brown with some white. Antennal scape brown, white laterally; scaled dorsally, setose ventrally, setae approximately width of antennal segments. **Thorax:** Patagium, mesothorax, and metathorax brown. Prothoracic femur brown with some white scales; tibia brown with some white scales, apical band white; tarsi brown with white apical rings. Mesothoracic femur white speckled with brown; tibia with equal amounts of brown and white; tarsi brown with white apical rings. Metathoracic femur white speckled with brown; tibia with equal amounts of brown and white, white ventrally, a tuft of scales below proximal apex buff; tarsal segment 1 brown and white, with white apical ring, rest brown speckled with white, white apical rings. Underside white. **Forewing:** Length 14.0–16.0 mm. Basal patch brown; costal margin brown; basal band black to M vein; median line black to R vein; median band cream to middle R vein, light

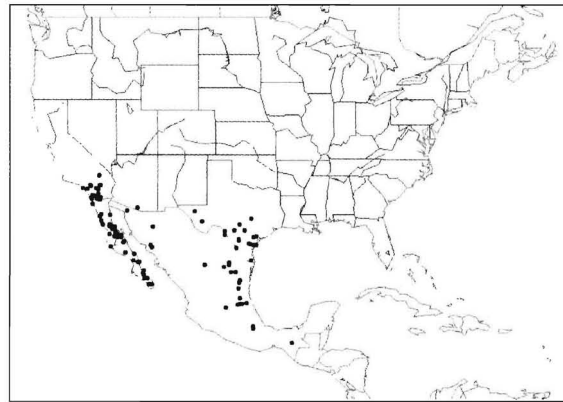


FIG. 60. Known localities from collections of *B. similis*.

brown to costal margin; orbicular spot a small black patch; two indistinct whitish to pale gray scale patches beyond orbicular spot; reniform spot cream; postmedial line black from posterior margin, angled back toward outside of median band and bordering outside of reniform spot to its apex; postmedial band brown with pale gray median stripe; subterminal line cinnamon from termen to M1 cell; terminal line black, scalloped, from termen to apex. Underside ground color cream; wide brown patch at end of discal cell from R to 1A + 2A vein; brown band on terminal third. **Hindwing:** Ground color light brown; band on terminal two-fifths brown; lunule yellow. Underside ground color cream; small brown spot in middle of discal cell; brown terminal band; lunule cream. **Abdomen:** Light brown dorsally; white ventrally. **Genitalia** (Figs. 35, 40, 45): Sacculus with costal lobe triangular; apex a short projection. Juxta with U-shaped dorsal margin. Aedeagus without dorsal spiculations near apex. Vesica with a small spine at apex of lateral diverticulum, disto-lateral diverticulum longer than aedeagus with large apical spine; numerous minute cornuti on all diverticula except lateral.

Adult female. Essentially as described for male except: **Forewing:** Length 15.0–17.0 mm. Basal patch light brown speckled with brown; basal band black, thin, same width as postmedial line; median band light brown, speckled with brown; reniform spot light brown speckled with brown; subterminal line faint, from termen to costa. **Abdomen:** Light brown speckled with brown. Underside white speckled with brown, buff at apex. **Genitalia** (Figs. 50, 55): Seventh segment deeply invaginated; median prong short, width greater than height, does not extend above lateral projections. Corpus bursa with basal spicules larger than rest.

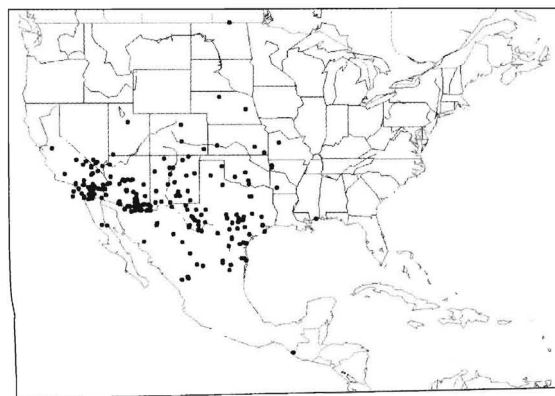


FIG. 61. Known localities from collections of *B. deducta*.

Type material. *Bolina mexicana* Behr; neotype ♂, Mexico, Sinaloa, Mazatlan, in USNM [designated by Richards 1936a].

Material examined. 20 ♂ and 26 ♀. All material is from the USNM unless otherwise noted. **COSTA RICA:** GUANACASTE: Area de Conservación Guanacaste, Sector Santa Rosa, Estero Naranjo, 2 ♂, 13 Jan. 1997, 97-SRNP-87, 97-SRNP-92, 2 ♂, 97-SRNP-85, 97-SRNP-88, 97-SRNP-91, 97-SRNP-97.1, 4 ♀, 23 Jan. 1997, 97-SRNP-219, 1 ♀; Playa Naranjo, Santa Rosa P.N., Mar. 1991, INBIOCR1000674402, INBIOCR1000674399, 2 ♀, May 1991, 1 ♀, INBIOCR1000386796, Dec. 1990, INBIOCR1000514740, 1 ♀, E. Alcazar; R. San Lorenzo, R.F. Cord., (Tenorio), 1050m, June 1991, INBIOCR1000610645, C. Alvarado, 1 ♀; Santa Rosa National Park, 1–3 June 1979, INBIOCR1002581940, D.H. Janzen, 1 ♀ PUNTARENAS: Est. San Miguel, Punta San Miguel, 1 ♂, 2 Oct 1997, INBIOCR1002561384, F. Alvarado, 1 ♀ (INBIO). Avangarez, July, 1 ♂, ♂ genitalia slide USNM 46377, Schaus and Barnes Coll., June, 1 ♀, ♀ genitalia slide USNM 46378, Wm. Schaus Coll. **MEXICO:** CHIAPAS: SE Tonalá, 5 June 1969, 2 ♂, 5 ♀, ♀ genitalia slide MGP # 1128, A. Mutuura (CNC). COLIMA: Cuyutlan, Jan., C.C. Hoffmann, 1 ♂, 1 ♀ (AMNH). JALISCO: Estación de Biología, Chamela, 23–24 Feb. 1981, 1 ♂, 24–27 May 1982, 1 ♂, 5/12/1980, 1 ♂, 1–3 Dec. 1981, 1 ♂, A. Pescador, 1–2 May 1976, 1 ♂, C. Beutelspacher (UNAM); Navidad, 1 Apr. 1939, A.H. & S.H. Rinde, ♀ on genitalia slide 3622, 1 ♀ (AMNH). NAYARIT: 5 mi E San Blas, 24–26 Apr. 1961, Howden & Martin, 4 ♀; Nuevo Vallarta, 27 Dec. 1988, A.D. Warren, 1 ♀ (CSU). OAXACA: Tehuantepec, 15–16 July 1964, 2 ♂, P.J. Spangler, 11 July 1955, Vaurie, 1 ♀, ♀ on genitalia slide 8760 (AMNH). SINALOA: Mazatlan, 17–23 July 1963, P.J. Spangler, 1 ♂, 2 ♀, ♂ genitalia slide USNM 46333, 9 May 1961, 2 ♂, 10 May 1961, 1 ♂, 7 ♀, ♀ genitalia slide MGP # 1127, Howden & Martin (CNC), 22 July 1954, 1 ♂, M. Casier, W. Gertsch, Bradts (AMNH).

Larval host. Specimens were reared on *Prosopis juliflora* (Sw.) DC. (Fabaceae) from Area de Conservación Guanacaste, Sector Santa Rosa, Estero Naranjo, Guanacaste Province, Costa Rica. It is considered a noxious weed species in Puerto Rico and Hawaii (GRIN Database 2000). Data for these rearings can be found on the Caterpillar Rearing Voucher Databases for the Area de Conservación (ACC) in northwestern Costa Rica (Janzen 2000).

Distribution (Fig. 59). Collections of *B. mexicana* are from west central Mexico along the Pacific coast to Chiapas and northwestern Costa Rica.

Discussion. The overall shade of the color pattern can vary between light and dark. This also occurs in specimens of *B. similis* from Mexico. There are two forms in the female forewing color pattern. The maculate form shows all of the color pattern elements that are present in the male, but not as distinct, giving these specimens a washed out appearance. The immaculate form is almost completely lacking a pattern, except for the faint subterminal and terminal lines, the small black subapical spot and the large dark reniform spot.

Bolina schausi Richards

(Figs. 15–18, 36, 41, 46, 51, 56, 59)

Bolina schausi Richards 1941:259; Poole 1989:180.

Diagnosis. *Bolina schausi* tends to be grayer in ground color than *B. mexicana*, but dissection is nec-

essary for accurate identification. The differences in the male genitalia of *B. schausi* from other species of *Bolia* are the costal lobe of the sacculus is slightly bifurcate (Fig. 36) and the vesica bears a single spine (Fig. 46). In the female genitalia, these differences are the corpus bursa has a heavily sclerotized cone within the ductus seminalis and ventral to this is a heavily sclerotized area that ends in a blunt apex (Fig. 51).

Description. Adult male. Forewing: Length 15.0–16.5 mm. **Genitalia** (Figs. 36, 41, 46): Sacculus with costal lobe slightly bifurcate; apex an elongate projection. Juxta with U-shaped dorsal margin. Aedoeagus without dorsal spiculations near apex. Vesica with lateral diverticulum absent, disto-lateral diverticulum with large apical spine and minute cornuti at base of disto-lateral diverticulum, cornuti larger on ventro-proximo lateral diverticula.

Adult female. Forewing: Length 15.5–16.0 mm. **Genitalia** (Figs. 51, 56): Seventh segment deeply invaginated; median prong short, width greater than height, extends to lateral projections. Corpus bursa with heavily sclerotized cone within the ductus seminalis; ventral to this is a heavily sclerotized area ending in a blunt apex; a band of elongate spicules between these two areas.

Type material. *Bolina schausi* Richards; holotype ♂, Mexico, Tehuacan, in USNM.

Material examined. 12 ♂ and 10 ♀. All material is from the USNM unless otherwise noted. **MEXICO:** DISTRICTO FEDERAL: Ajusco, 3000m, 1 June 1981, 1 ♀, C. Beutelspacher (UNAM); Chapultepec, 20 June 1939, 1 ♀, C. Beutelspacher (UNAM); Jardín Botánico, C.U., 5 Nov. 1969, C. Beutelspacher (UNAM); Xochimilco, 3 July 1983, 1 ♂, C. Beutelspacher (UNAM); 18 June 1963, 1 ♂, 21 June 1963, 1 ♀, 12 July 1960, 1 ♂, R. Johnson (UNAM). DURANGO: 10 mi W Durango, 15 June 1964, W.C. McGuffin, (1 ♀) (CNC); 7 mi W Durango, 26 July 1964, 1 ♂, ♂ genitalia slide MGP # 1132, W.C. McGuffin (CNC); El Salto, Reho. Nuevo, 10–13 June 1989, Broomfield, 1 ♂ (SDNH); Vte. Gro., 3 June 1984, 1 ♂, 1 ♀ (UNAM). MEXICO: 7 air mi WSW Juchitepec, 275m, 24 Aug. 1987, J. Brown & J. Powell, 1 ♀ (UCB). PUEBLA: Tehuacán, Sep. 1908, Muller, 1 ♀, paratype, ♀ genitalia slide USNM 46379; Sep. 1937, ♀ on genitalia slide 3612, 20 May 1941, ♂ on genitalia slide 3501, 1 ♂, 1 ♀ (AMNH). SONORA: 16 mi NE Cd. Obregon, 13–17 May 1961, Howden & Martin, 1 ♂, ♂ genitalia slide MGP# 1131 (CNC). VERACRUZ: Fortin, 7 June 1988, T. Taylor, 1 ♂ (CSU); Orizaba, 2 ♂, ♂ genitalia slide USNM 46380, 2 ♀, ♀ genitalia slides USNM 46381, 46382.

Larval host. Unknown.

Distribution (Fig. 59). Collections from northwest to east central Mexico. Localities are near or in the Sierra Madre Occidental.

Discussion. This is the rarest species of *Bolia*. The sexual dimorphism in the female is the immaculate form in which there is virtually no pattern and the reniform spot is large and dark.

Bolina schausi is associated with the mountainous central region of Mexico. It is sympatric with *B. similis* in the vicinity of Tehuacan, Puebla, Mexico.

Bolina similis Richards

(Figs. 19–24, 33, 37, 42, 47, 52, 57, 60)

Bolina similis Richards 1936a:433; Richards 1941:262; Poole 1989:180; Poole and Gentili 1996:729.

Bulia similaris race *californica* Richards 1939:70; 1941:262. [Synonymized by Poole 1989:80.]
Bulia morelosa Richards 1941:261; Poole 1989:180, new synonym.

Diagnosis. *Bulia similaris* is most closely related to *B. deducta*, but can be separated by the shape in the juxta in the male genitalia. The juxta in *B. similaris* has a U-shaped dorsal margin (Fig. 42), whereas the juxta in *B. deducta* has a V-shaped dorsal margin (Fig. 43). The elongate apex of the sacculus is round in *B. similaris* (Fig. 37), but pointed in *B. deducta* (Fig. 38). The spiculations near the apex of the aedoeagus are larger and cover a smaller area in *B. similaris* (Fig. 47), in *B. deducta* the spiculations are smaller and cover a larger area (Fig. 48). The cornuti on the disto-lateral diverticulum are smaller and greater in number in *B. similaris* (Fig. 47) than in *B. deducta* (Fig. 48). The females can be separated by the shape of the median prong of the seventh abdominal segment. The prong width is greater than its height in *B. mexicana* and *B. schausi* (Figs. 55–56), but in *B. similaris* and *B. deducta* the height is greater than the width (Figs. 57–58). In *B. similaris* the length of the median prong is less than or equal to the height of the lateral projections (Fig. 57); in *B. deducta* the median prong is greater than the height of the lateral projections (Fig. 58).

Description. Adult male. Forewing: Length 13.0–16.5 mm. **Genitalia** (Figs. 37, 42, 47): Sacculus with costal lobe triangular with a rounded apex; apex an elongate projection. Juxta with U-shaped dorsal margin. Aedoeagus with dorsal spiculations near apex. Vesica with largest spine on lateral diverticulum, smallest spine on disto-lateral diverticulum; minute cornuti ventral and lateral on disto-lateral diverticulum and ventro-lateral diverticula; ventro-proximal diverticula absent; largest cornuti dorsally on disto-lateral diverticulum; an extra pair of small ventral diverticula at base of vesica.

Adult female. Forewing: Length 12.5–18.0 mm. **Genitalia** (Figs. 52, 57): Seventh segment deeply invaginated; median prong width less than or equal to height, extending to or below lateral projections, apex truncate or with slight V-shaped notch. Corpus bursa with dorso-medial invagination lightly sclerotized and containing fine spicules; a band of elongate spicules below junction with ductus bursae.

Type material. *Bolina similaris* Richards; holotype ♂, U.S.A., Texas, San Benito, in USNM

Material examined. 203 ♂ and 244 ♀. All material is from USNM unless otherwise noted. **MEXICO:** BAJA CALIFORNIA [label data]: Las Parras, W.M. Mann, 1 ♂; Punta Prieta, 27 Mar. 1935, V.H. dos Passos, 1 ♀; 23 mi S San Ignacio, 10 Oct. 1967, G.A. Marsh, 1 ♀ (UCB); Desengano, 9 Oct. 1962, F.T. Thorue, 1 ♀ (UCB); L. Cantilla Cyn., Sierra Juarez, 20 Mar. 1967, P.A. Opler & J. Powell, 2 ♀ (UCB); San Felipe, 26 Mar. 1963, G.J. Stage, 2 ♂ (UCB); Canyon del Tajo, 1 Apr. 1953, J. Powell, 3 ♂, 6 ♀ (UCB); 17 mi N Punta Prieta, 3 Oct. 1961, C.F. Harbison, 1 ♂ (SDNH); 20 mi N Punta Prieta, 27 Apr. 1962, C.F. Harbison, 1 ♂ (SDNH); 8 mi N El Refugio Magdalena, 19 Oct. 1961, F.F. Gander, 1 ♂, 2 ♀ (SDNH); Agua Refugio, 1 Apr. 1935, C.F. Harbison, 1 ♀ (SDNH); Cautiles (Tajo Canyon), 20 Apr. 1955, C.F. Harbison, 1 ♀ (SDNH); Mesquital, Apr. 1928, 1 ♂ (SDNH); Santiago,

1952, C.F. Harbison, 1 ♂ (SDNH); 15 Nov. 1936, F. Gander, 1 ♂ (SDNH). BAJA CALIFORNIA NORTE: 14.4 mi S Campo Alfonsina, 20–26 Oct. 1987, N. Bloomfield, 1 ♂, ♂ genitalia slide USNM 46364; 14.4 mi S Campo Alfonsina, 20–26 Oct. 1987, N. Bloomfield, 1 ♂, ♂ genitalia slide USNM 46364; 59 mi S Puertecitos, 14–15 Mar. 1988, N. Bloomfield, 1 ♂, ♂ genitalia slide USNM 46363; Rancho Santa Ines, 540 m, 30 June 1979, W.H. Clark, 2 ♂, 3 ♀; 10 mi SE El Rosario, 31 Mar. 1976, J. Doyen, P. Rude, R. Morrison, 1 ♂, 2 ♀ (UCB); 24 mi N Punta Prieta, 1–2 Apr. 1973, S.L. Szerlip, J. Doyen, J.A. Powell, 1 ♀, 1 Apr. 1973, 1 ♀, S.L. Szerlip, 2 Apr. 1973, 1 ♀, J.A. Powell (UCB); 7 mi SW Mission San Borja, 30 Mar. 1973, J.A. Powell, 1 ♀ (UCB); 9 km NW Rancho Santa Ines, 550m, 1 July 1979, W.H. Clark, 1 ♂, 1 ♀ (CNC); Arroyo Catavina, 35 mi S El Progreso, 2 Apr. 1976, Doyen & Rude, 2 ♀ (UCB); Bahia los Angeles, 26 Dec. 1978, R.E. Dietz, 1 ♂ (UCB); Diablito Cyn., E face Sierra San Pedro Martir, 5–6 Apr 1973, J.A. Powell, 1 ♂ (UCB); 1.2 mi E Santa Ines (arroyo), 23 Mar. 1986, Faulkner & Broomfield, 2 ♀ (SDNH); 1.2–5.4 mi S Santa Ines, 5–9 Dec. 1987, N. Broomfield, 3 ♂, 5 ♀ (SDNH); 1.5 mi SW San Miguel, 16–20 Dec. 1987, N. Broomfield, 4 ♂, 6 ♀ (SDNH); 10.2 mi W Ranch Progreso (S. Francisquito), 6–7 Nov. 1987, N. Broomfield, 2 ♂ (SDNH); 11.5 mi SW San Miguel de Comondu, 15 Dec. 1987, N. Broomfield, 3 ♂ (SDNH); 12 mi N Catavina, 30 Apr. 1962, C.F. Harbison, 1 ♀ (SDNH); 13.3 mi S B. de los Angeles, 1–13 Mar. 1988, N. Broomfield, 4 ♀ (SDNH); 14.4 mi S Campo Alfonsina, 20–26 Oct. 1987, N. Broomfield, 20 ♂, 31 ♀ (SDNH); 19 mi SW Campo Alfonsina (Canyon), 27–28 Oct. 1987, N. Broomfield, 1 ♂, 1 ♀ (SDNH); 2.8 mi S Catavina, 23 Mar. 1981, Faulkner & Brown, 2 ♂, 4 ♀ (SDNH); 25.5 mi NE El Arco, 11–15 Dec. 1987, N. Broomfield, 1 ♂, 1 ♀ (SDNH); 3 mi S B. de los Angeles, 2 Nov. 1987, N. Broomfield, 1 ♀ (SDNH); 51 mi S Catavina, 7 Apr. 1982, Faulkner & Brown, 1 ♀ (SDNH); 7 mi S Chapala, 29 Oct.–1 Nov. 1987, N. Broomfield, 2 ♂, 7 ♀ (SDNH); 9 mi E EJ Bonfil, 11 June 1986, Broomfield, 1 ♂ (SDNH); 9 mi S Rosarito, 5 Oct. 1983, Faulkner & Andrews, 1 ♀ (SDNH); Bahia de Los Angeles, 30 Mar. 1983, C. Brey, 1 ♂ (SDNH); El Marmol, 15 Mar. 1947, 1 ♀, Harbison, 12 Apr. 1940, 2 ♂ (SDNH); Sierra San Pedro Martir, Las Encinas, 15 June 1980, Brown & Faulkner, 1 ♀ (SDNH); Wash, 2 mi N Catavina just east of Hwy 1, 3 Apr. 1992, J. Brown, 1 ♂, 1 ♀ (SDNH). BAJA CALIFORNIA SUR: 16.3 mi NE Arco, 8–10 Mar. 1988, N. Bloomfield, 1 ♂, ♂ genitalia slide USNM 46365; 2 mi NW El Triunfo, 12 Aug. 1966, J.A. Chemsak (UCB); 2 mi SE San Bartolo, 900, 9 Nov. 1993, Y.F. Hsu (UCB); 26 mi W. La Paz, 11 Aug. 1966, J. A. Chemsak, 1 ♀ (UCB); 7 mi S San Pedro, 10 Aug. 1966, J. Powell (UCB); 7 mi SE Guerrero Negro, 8 Apr. 1976, J. Doyen & P. Rude, 2 ♂, 10 ♀ (UCB); 90 km NW La Paz, 8 Nov. 1993, Y.F. Hsu, 1 ♂, 2 ♀ (UCB); El Coyote, 12 Apr. 1972, R.W. Holland, 1 ♂ (AMNH); Sierra Laguna, 17 air mi ENE Todos Santos, 6000', 12–18 Dec. 1979, 3 ♂, J. Doyen & W. Tschinkel, 6 ♂, 1 ♀, P. Rude (UCB); 16.3 mi NE El Arco, 8–10 Mar. 1988, N. Broomfield, 2 ♂, 3 ♀ (SDNH); 2 mi W Catavina, 4 Apr. 1935, C.F. Harbison, 3 ♂, 4 ♀ (SDNH); 3 mi NE San Isidro (La Purisima), 14 Apr. 1985, Broomfield & Faulkner, 2 ♀ (SDNH); 3.3 mi S El Cien, 26 Sep. 1981, D. Faulkner & F. Andrews, 1 ♂, 2 ♀ (SDNH); 5 mi N San Isidro, 18 July 1986, Broomfield, 1 ♀ (SDNH); 7 mi SW Loreto, 12 Oct. 1981, D. Faulkner & F. Andrews, 1 ♀ (SDNH); 9.2 mi SSE Mulege, 23 Sep. 1981, F. Andrews & D. Faulkner, 1 ♀ (SDNH); I. San Jose, NW end, 11 July 1985, D.K. Faulkner, 1 ♂ (SDNH); La Paz, Econohotel Palmira, 29 Nov. 1980, Brown & Brown, 1 ♂ (SDNH); San Isidro, 29 May 1984, Broomfield & Faulkner, 8 ♂, 3 ♀ (SDNH). CHIAPAS: 8 mi NW San Cristobal, 28 May 1969, A. Mutuura, 1 ♂ (CNC). COAHUILA: 10 mi N Monclova, 1500, 7 July 1963, Duckworth & Davis, 5 ♂, 1 ♀, ♂ genitalia slide USNM 46330; Saltillo, 7 Aug. 1963, P.J. Spangler, 1 ♀; Saltillo, 23 May 1952, ♂ genitalia slide on 8699, ♀ genitalia slide on 8756, M. Casier, W. Gertsch, R. Schrammei, 1 ♂, 1 ♀ (AMNH); 25 mi S Cd. Acuna, 30 June 1983, Wolfe & Valverde, 1 ♂, 3

♀ (SDNH). GUANAJUATO: San Miguel de Allende, 14 May 1979, J.R. Powers, 2 ♀ (UCB). MORELOS: Jalastoc, 4 Feb. 1949, J.J. McKeelvey, 1 ♀. NUEVA LEON: 2 mi S Monterrey, Chipinque Mesa, 4200, 10 Aug. 1963, Duckworth & Davis, 1 ♀; 3 mi E Galeana, 5000, 7–9 Aug. 1963, Duckworth & Davis, 3 ♂, 2 ♀; Laredo, Km 1086, 375m, 29 Nov. 1950, C. Dowling, 1 ♂; Monterrey, 8 Aug. 1963, P.J. Spangler, 4 ♂, 9 ♀, ♂ genitalia slide USNM 46331, 46332; Monterrey, 21 Mar. 1999, B. Mather, 1 ♀ (BM); 2 mi S. Monterrey, Chipinque Mesa, 4200, 10 Aug. 1963, Duckworth & Davis, 1 ♀ (CNC); 5 mi S. Monterrey, 10 July 1963, 1 ♂, 11 July 1963, 1 ♂, 7 July 1963, 1 ♀, 13 July 1963, 1 ♀, 27 July 1963, 3 ♀, ♀ genitalia slides MGP # 1124, 1125, H. & A. Howden (CNC); Chipinque Mesa, nr. Monterrey, 5400, 22 July 1963, 1 ♀, ♀ genitalia slide MGP # 1126, H. & A. Howden (CNC); Linares, 13 Apr. 1954, D.H. Janzen, 1 ♂ (UCB); Monterrey, 9 May 1976, J.R. Powers, 5 ♂, 2 ♀ (UCB). PUEBLA: 2 mi SW Tehuacán, 5300, 4 Oct. 1975, 3 ♂, 1 ♀, 5 Oct. 1975, 1 ♂, 2 ♀, J.A. Powell (UCB); 7.5 km NE Azumbilla, 2200m, 21 Aug. 1987, Brown & Powell, 1 ♀ (UCB). QUERETARO: Km 4 Carretera La Lagunita-Tilaco, 1160 m, 11 Jan. 1998, Vences & Ibarra, 1 ♀ (UNAM). SAN LUIS POTOSI: 15 mi N Valles, 18 May 1952, ♀ genitalia slide on 8758 M. Casier, W. Gertsch, R. Schrammei, 1 ♀ (AMNH); Tamazunchale, 20 May 1952, ♂ genitalia slide on 8713 M. Casier, W. Gertsch, R. Schrammei, 1 ♂ (AMNH); Xilitla, Vencidor Station, 22 Apr. 1977, W.H. Howe, 2 ♂ (AMNH). SONORA: 22 mi N Cd. Obregon, 11 June 1962, D.H. Janzen, 1 ♀ (UCB); 5 mi S Presa Obregon, 23 Mar. 1980, J.T. Doyen, 1 ♀ (UCB); Rio Yaqui, 12 mi E Esperanza, 300, 25 Mar. 1980, J. Doyen (UCB); 20 mi S Sonoyta, 22 Sep. 1967, C.F. Harbison, 1 ♀ (SDNH); 4.3 mi E Moctezuma, 2–4 Sep. 1987, N. Broomfield, 2 ♀ (SDNH). TAMAULIPAS: Guemez, 28 June 1965, P.J. Spangler, 1 ♀; 4 mi SW C. Victoria, 10 July 1963, Duckworth & Davis, 1 ♀ (CNC); Gomes Farias, 3 Oct. 1986, L. Cervantes, 1 ♀ (UNAM); Victoria, 12 Mar. 1953, 1 ♀, 14 Mar. 1953, 14 Mar. 1953, 1 ♂, 1 ♀, D.H. Janzen (UCB). VERACRUZ: 36 mi S Tantoyuca, 120m, 3 July 1983, K. Wolfe & N. Valverde, 3 ♀ (SDNH). U.S.A.: ARIZONA: Pima Co.. Baboquivera Mts., 5000 ft., 15–30 June 1923, 1 ♂, 1 ♀, ♂ genitalia slide made VI-3-35 A.G. Richards, 1–7 July 1923, 1 ♀, O.C. Poling. CALIFORNIA: Imperial Co.. Carrizo, 10 Mar. 1928, C.C. Searl, 1 ♂ (SDNH). Orange Co.: Silverado Canyon, Santa Ana Mts., 1650, 25 Apr. 1979, G.A. Marsh, 1 ♂ (UCB). Riverside Co.: Palm Springs, 16–23 Apr., 1 ♂, 3 ♀, ♀ genitalia slide USNM 40520, 29 Mar. 1952, 1 ♀, 19 May 1950, 1 ♀, A.H. Rindge (AMNH); Boyd Desert Research Center, 4 mi S Palm Desert, 6 Apr. 1963, J. Powell, 1 ♂ (UCB); Chino Canyon, Palm Springs, 19 Apr. 1950, E.C. Johnston, 1 ♂ (CNC); Chino Cyn, nr. Palm Springs, 20 Apr. 1960, J. Powell, 5 ♂, 3 ♀ (UCB). San Bernardino Co.: Joshua Tree Nat. Mon., Indian Cove, 25–26 Mar. 1981, S.E. Miller & P.M. Mercer, 3 ♂; Loma Linda, 8–15 Apr., 2 ♂, 4 ♀, ♂ genitalia slide USNM 446384, ♀ genitalia made VI-11-35 A.G. Richards, 16–23 Apr., 3 ♂, 2 ♀, ♀ genitalia slide USNM 46783, 16–23 May, 2 ♂, 1–7 July, 1 ♀; San Bernardino, 27 May 1920, E. Piazza, 1 ♂; 29 Palms, 20 Apr. 1950, E.C. Johnston 1 ♂ (CNC); Afton Rd., 23 mi SW Baker, 23 Apr. 1977, Cave & Chemsak, 1 ♀ (UCB). San Diego Co.: Jacumba, 1, 28 May 1924, 2 ♂, 20, 24 June 1924, 3 ♂, 3 ♀, ♀ genitalia slide USNM 46325, H.G. Dyar, 9 May 1924, 1 ♂ (CNC); Oriflamme Cyn., Anza Borego State Park, 18 Apr. 1998, N. Broomfield, 9 ♂, 4 ♀, ♂ genitalia slide USNM 46323; San Diego, 24 May 1924, 1 ♂, 23 July 1924, 1 ♀, H.G. Dyar, 29 May 1920, 1 ♀, 30 June 1920, 1 ♂, 17 June 1920, 1 ♂, E. Piazza, Apr. 1 ♀, ♀ genitalia slide made VI-12-35 A.G. Richards, Apr., 1 ♂, ♂ genitalia made VI-2-35, Coquillet; Borego, 1 May 1941, 1 ♂, G.H. & J.L. Sperry, Apr. 1941, 1 ♀, June 1946 1 ♀, N. Cricaker (AMNH); La Jolla, 25 June 1963, J. Powell, 1 ♀ (UCB); 1 mi W Jacumba, 25 May 1981, C. Bruyera, 1 ♀ (SDNH); 2 mi E Jacumba, 17 Aug. 1979, Brown & Faulkner, 1 ♂ (SDNH); 5 mi N Escondito, 250 m, 24 Apr. 1983, 1 ♀, 16 June 1983, 1 ♀, K. Wolfe & M. Valverde (SDNH); Boulevard-Manzanita, 3 June 1980, R. Messner, 1 ♂

(SDNH); Crouch Meadow Spr., 22 May 1979, D.K. Faulkner, 1 ♀ (SDNH); Green Vly. TT Poway, 5 Apr. 1981, C. Bruyera, 1 ♂ (SDNH); Jacumba, 20 June 1978, Faulkner & Brown, 1 ♂ (SDNH); Kitchen Creek Cyn., 25 May 1981, C. Bruyera, 1 ♂ (SDNH); NAS Miramar, Lep. Sur. Site 7, 3.5 mi E I-15, 0.25 mi S Green Farms Road, 22 Apr. 1996, N. Broomfield, 1 ♀ (SDNH); Rancho Bernardo Industrial Park, 30 Apr. 1981, C. Bruyera, 1 ♀ (SDNH); San Diego Wild Animal Park, San Pasqual, 19 June 1982, G.P. Bruyera, 1 ♂ (SDNH). Stanislaus Co.: Del Rio, 26 Apr. 1959, M.R. MacKay, 2 ♂ (CNC). La Puerta Valley, July 1911, G.H. Field, 2 ♂, 1 ♀ (SDNH); Vallecito Vy., 4–29, C.F. Harbison, 1 ♀ (SDNH). TEXAS: Bexar Co.: San Antonio, 24–30 Mar., 2 ♂, 2 ♀, ♂ genitalia slide USNM 46324, 1–7 Apr., 1 ♂, 1 ♀, H. Schwarz. Brewster Co.: K-Bar Ranch, Chisos Mountains, 3400, 5 June 1973, D.C. Ferguson, 1 ♂; Alpine, 22 May 1950, E.C. Johnston 1 ♀ (CNC). Cameron Co.: San Benito, 24–30 Apr., 1 ♂, 8–15 May, 1 ♂, 1 ♀, ♀ genitalia slide USNM 46393, 16–23 May, 4 ♀. Culberson Co.: Sierra Diablo, 20 mi NNW Van Horn, 29 May 1973, D.C. Ferguson, 1 ♂. Goliad Co.: Goliad, Nov. 1895, 1 ♀, ♀ genitalia slide USNM 46392. Kerr Co.: Kerrville, 31 May 1906, 2 ♂, ♂ genitalia slide USNM 46394, F.C. Pratt. La Salle Co.: Artesia Wells, 11 July 1972, A. & M.E. Blanchard, 1 ♀; Cotulla, 12 May 1907, Crawford & Pratt, 2 ♂. Nueces Co.: Corpus Christi, 1 ♀; N. Padre Island, 9 Sep. 1974, A. & M.E. Blanchard, 2 ♂. San Patricio Co.: Sinton Welder Wildlife Foundation (San Patricio), 22, 24–26 May 1962, 9 ♂, 8 ♀, 5 ♂ and 2 ♀ genitalia slides USNM 46385–46390, 46395, A. & M.E. Blanchard. Uvalde Co.: Garner State Park, 21 Sep. 1965, 1 ♀, ♀ genitalia slide USNM 46391, A. & M.E. Blanchard. Victoria Co.: Victoria, 30 Mar., 1 ♀, 4 Apr. 1 ♀, E.A. Schwarz. Williamson Co.: Georgetown, 21 Apr. 1937, L.J. Milne, 1 ♂ (CNC). No specific locality, 1 ♂, 2 ♀.

Larval host. Unknown.

Distribution (Fig. 60). Collections indicate a disjunct distribution for *B. similaris*. The western distribution is from southern California throughout Baja California, Mexico, with an isolated record from the Baboquivari Mountains in south central Arizona and a few scattered localities in northwestern Sonora, Mexico. The eastern distribution extends from central Texas along eastern Mexico to central Chiapas.

Discussion. The females of *B. similaris* show four distinct phenotypes. There are two maculate forms, a light one (Fig. 21), and a dark one (Fig. 22) that are very similar to the males (Figs. 19–20). There is an immaculate form that lacks most of the pattern and has a large dark reniform spot (Fig. 23). A fourth form is intermediate in maculation with a distinct median band and median line with the terminal half of the forewing a cinnamon ground color (Fig. 24). Richards (1939) described the race *californica* for a pale form of *B. similaris* from southern California and northern Baja California. In this form the overall coloration is lighter and the median band and reniform spot are pure white. The hindwing is pure white in the *californica* race, but is generally darker in the Texas and Mexican specimens.

Bulia deducta (Morrison)

(Figs. 7–8, 25–30, 38, 43, 48, 53, 58, 61)

Syneda deducta Morrison 1875:220.

Syneda pavitensis Morrison 1875:221. [Synonymized by Richards 1936:434.]

Cirrhobolina incandescens Grote 1875:117. [Synonymized by Richards 1936:434.]

Cirrhobolina mexicana var. *vulpina* H. Edwards 1882:14. [Synonymized by Richards 1936a:435.]

Syneda mexicana var. *albina* Strecker 1900:35. [Synonymized by Richards 1936a:435.]

Bulia deducta, Richards 1936a:434; Richards 1941:263; Poole 1989:180; Poole and Gentili 1996:729.

Diagnosis. *Bulia deducta* is most likely to be confused with *B. similis*. The only way to accurately identify these species is by examining the characters of the male and female genitalia. In the male, *B. deducta* can be separated from *B. similis* by the shape of the juxta. The dorsal margin of the juxta is V-shaped in *B. deducta* (Fig. 43) and U-shaped in *B. similis* (Fig. 42). At the apex of the aedoeagus the patch of spiculations near the apex are smaller and cover a larger area in *B. deducta* (Fig. 48), and these spiculations are larger and cover a smaller area in *B. similis* (Fig. 47). The cornuti on the disto-lateral diverticulum in *B. deducta* are larger and fewer in number (Fig. 53), and in *B. similis* they are smaller and greater in number (Fig. 52). The females can be separated by the shape of the median prong of the seventh abdominal segment. In *B. deducta* the median prong is greater than the height of the lateral projections (Fig. 58), and in *B. similis* the length of the median prong is less than or equal to the height of the lateral projections (Fig. 57).

Description. Adult male. Forewing: Length 13.0–17.0 mm. **Genitalia** (Figs. 38, 43, 48): Sacculus with costal lobe large, apex truncate; apex an elongate projection. Juxta with V-shaped dorsal margin. Aedoeagus without dorsal spiculations near apex. Vesica with largest spine on disto-lateral diverticulum, smaller spine on lateral diverticulum; minute cornuti on apex of disto-lateral diverticulum and on ventral diverticula; patch of large cornuti medially on disto-lateral diverticulum.

Adult female. Forewing: Length 12.5–18.5 mm. **Genitalia** (Figs. 53, 58): Seventh segment deeply invaginated; median prong width less than or equal to height, extending above lateral projections, apex truncate. Corpus bursa with a band of elongate spicules below junction with ductus bursae.

Type material. *Syneda deducta* Morrison; holotype ♂, U.S.A., Texas, Waco, in the Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts. *Syneda pavitensis* Morrison; holotype ♀, U.S.A., Texas; Peab. Acad.; *Syneda pavitensis* Type Morr. [Hand written in black ink], in USNM. *Cirrhobolina incandescens* Grote; holotype ♀, U.S.A., Texas, in BMNH. *Cirrhobolina mexicana* var. *vulpina* H. Edwards; holotype ♀, U.S.A., [no locality label]; *Cirrhobolina mexicana* Behr var. *vulpina* Hy. Ed.; Col. B. Neumogen; Collection Brklyn Mus; Type No. 34118 U.S.N.M. [Red label black type]; Genitalia Slide USNM 40256 [green label], ♀ gen. 978, 24 May 34 FHB [hand written black ink]; in USNM. *Syneda mexicana* var. *albina* Strecker; 2 syntypes ♀, Mexico, Chihuahua, in Field Museum of Natural History, Chicago, Illinois.

Material examined. 839 ♂ and 863 ♀. All material is from the USNM unless otherwise noted. **CANADA:** MANITOBA:

Cartwright, 1 ♂. **MEXICO:** BAJA CALIFORNIA [label data]: 9 mi SE Catavina, 16 Oct. 1967, G.A. Marsh, 1 ♂ (UCB); Gaskill's, 14 Nov. 1936, C.F. Harbison, 1 ♂ (SDNH). BAJA CALIFORNIA NORTE: Laguna Salada, 21 Sep. 1967, G.A. Marsh, 1 ♂ (UCB); 14.4 mi S Campo Alfonsina, 20–26 Oct. 1987, N Broomfield, 1 ♀ (SDNH); 8 mi E Tecate, 6 July 1984, Brown and Tocco, 1 ♀ (SDNH); Cantil, Tajo Canyon, 25 Oct. 1955, Harbison, 3 ♂, 5 ♀ (SDNH); Tajo Canyon, 25 Oct. 1955, Harbison, 3 ♂, 4 ♀ (SDNH). CHIAPAS: 20 mi NE Huixtla, 900 m, 9 July 1983, Wolfe & Valverde, 1 ♀ (SDNH). CHIHUAHUA: 12 mi N Escalon, 18 Apr. 1961, Howden & Martin, 1 ♂, 3 ♀ (CNC); 25 mi W Del Perral, 6800, 14 July 1964, J.A. Chemsak, 1 ♂ (UCB); 42 mi N Chihuahua in cyn. 3 mi W Parrita, 2 June 1981, J. Doyen, 1 ♂, 2 ♀ (UCB); Majalca Rd., 25 mi NW Chihuahua, 14–17 Apr. 1961, Howden & Martin, 2 ♂ (CNC); Mesa del Huracán, 7400, 21–25 July 1964, J.E.H. Martin, 2 ♀ (CNC). COAHUILA: sand dunes at Bilbao, 8 mi N Viesca, 30–31 May 1981, J. Doyen, J. Liebherr, 1 ♀ (UCB); 25 mi S Cd. Acuna, 300 m, 30 June 1983, Wolfe & Valverde, 1 ♂, 3 ♀ (SDNH). DURANGO: Lerdo, 1 ♀; 10 mi W El Salto, 26 June 1964, 1 ♂, 12 July 1964, 1 ♀, W.C. McGuffin, 26 June 1964, 1 ♂, 5 July 1964, 1 ♂, 8 July 1964, 1 ♀, J.E.H. Martin (CNC); 16 mi SE Durango, 14 July 1964, W.C. McGuffin, 2 ♀ (CNC); 5 mi W Durango, 11 June 1964, J.E.H. Martin, 1 ♂ (CNC); Durango, 3 May 1961, Howden & Martin, 1 ♀ (CNC); Vte. Gro., 3 June 1984, 1 ♀ (UNAM). NUEVA LEON: Monterrey, 25 Nov. 1909, F.C. Bishopp, 1 ♂, ♂ genitalia made V-12-40 A.G. Richards; Gomez Palacio, 11 May 1918, U.C. Loftin, 1 ♂; Chipinque Mesa, nr. Monterrey, 5400', 22 July 1963, 1 ♀, H. & A. Howden, 1760', 27–28 Apr. 1969, J.E.H. Martin, 2 ♀ (CNC); Linares, 9 May 1969, 7 ♂, ♂ genitalia slides MGP # 1129, 1130, 2 ♀ (CNC). SONORA: Nogales, 2 Aug. 1919, F.J. Dyar, 1 ♂; 95 mi E San Luis R.C., Hwy. 2, 4 Apr. 1966, M. Lundgren, 1 ♂ (UCB); Alamos, 1 July 1971, G. Kageyama, 1 ♂ (UCB); 4.3 mi E Moctezuma, 18–21 July 1987, 1 ♀, 2–4 Sep. 1987, 3 ♂, 3 ♀, N. Broomfield (SDNH). CUYAMACA, 20 June 1940, 1 ♀ (SDNH). **U.S.A.:** ARIZONA: Apache Co.: White Mts., near McNarry P.O., 1–5 Aug. 1925, 1 ♂, 1 ♀, O.C. Poling, ♂ genitalia made VI-8-35, A.G. Richards. Cochise Co.: Ash Canyon Rd., (1/2 mi W Hwy 92, Lot 4, 5100 ft. el.), 19 May 1981, 1 ♀, June 1982, 2 ♀, 18 June 1980, 1 ♀, 13, 25 July 1980, 1 ♂, 1 ♀, N. McFarland; Cherry Canyon, near Cherry, 9 May 1959, R.F. Sternitzky, 1 ♀; Chiricahua Mts., 3 ♂, 1 ♀, 26 June, H.G. Hubbard, 1 ♂, 2 ♀; Guadalupe Canyon, Peloncillo Mts., 4250, 19 June 1976, 5 ♂, 2 ♀, C.J. & S. Werner; Hereford, 2 ♂, 1 ♀, C.R. Biederman; Huachuca Mts., 9 ♂, 11 ♀, ♂ genitalia made VI-5-35 A.G. Richards; Palmerlee, 17 ♂, 24 ♀, 2 ♂ genitalia made VI-1-35, VI-5-35, A.G. Richards, 1–7 July, 1 ♀, 8–14 July, 1 ♂, Aug. 1 ♂, 1 ♀; Paradise, 15 ♂, 19 ♀, June 43 ♂, 19 ♀, 3 ♂ genitalia made VI-5-35, 8-VI-1935 + H58 A.G. Richards, July 5 ♂, 5 ♀, Aug. 7 ♂, 9 ♀, Sep. 1 ♀; Southwest Research Station, Chiricahua Mts., 16 June 1963, 4 ♂, 1 ♀; SW Res. Sta., Chiricahua Mts., 5400', 5–8 July 1964, D.R. Davis, 1 ♂, 1 ♀; SW Research Sta., Chiricahua Mts., 5 mi W Portal, 22 June 1956, O.L. Cartwright, 1 ♂, 2 ♀; Wilgus, 3 ♂, 1 ♀; Ash Canyon, Huachuca Mts., 19 Oct. 1966, 1 ♂, 22 Oct. 1966, 2 ♂, R.F. Sternitzky (CNC); Barfoot Park, Chiricahua Mts., 3 May 1934, G.H. & J.L. Sperry, 1 ♀ (AMNH); Carr Canyon, Huachuca Mts., 28 Sep. 1967, R.F. Sternitzky, 1 ♀ (CNC); Chiricahua Mts., Onion Saddle, 29 July 1996, Opler & Buckner, 1 ♀ (CSU); Cochise Stronghold, 3–5 Sep. 1965, J.T. Doyen, 1 ♂, 1 ♀ (UCB); Coronado Nat. For., Harshaw Cr., 7 mi SE Patagonia, 5 Aug. 1996, P. Opler, 1 ♂ (CSU); Coronado Nat. For., Upper Pinery Cyn., campground, Chiricahua Mts., 30–31 July 1996, P. Opler & E. Buckner, 1 ♂ (CSU); Garden Canyon, Huachuca Mts., 26 July 1966, R.F. Sternitzky, 1 ♂ (CNC); Guadalupe Cyn., 29 mi E Douglas, 15–16 Aug. 1972, J.T. Doyen, 1 ♂ (UCB); Huachuca Mts., 30 May 1910, 1 ♂, 1 June 1910, 2 ♀, 5 June 1910, 1 ♂, L.R. Clemence (CNC); Huachuca

- Mts., Ash Canyon Rd., 6 Aug. 1996, P.A. Opler, 1 ♀ (CSU); Miller Canyon, Huachuca Mts., 23 Aug 1966, R.F. Sternitzky, 1 ♂ (CNC); Parker Canyon, Huachuca Mts, 6 Sep. 1966, 1 ♂, 1 ♀, 16 Sep. 1966, 1 ♂, R.F. Sternitzky (CNC); Perilla Mts., 8 mi E Douglas, 29 Apr. 1989, 1 ♂ (UCB); Pinery Cyn., Chiricahua Mts., 6500', 6-7 Aug. 1991, D. Rubinoff, Y.R. Hsu, J.A. Powell, 1 ♀ (UCB); Ramsey Canyon, 15 mi S Sierra Vista, Huachuca Mts., 6000', 5 Aug. 1967, 1 ♂, 9 Aug. 1967, 1 ♀, 15 Aug. 1967, 1 ♂, 1 ♀, Sternitzky (CNC); Ramsey Canyon, Huachuca Mts., 11 May 1966 1 ♀, 7 June 1965, 1 ♀, 8 Sep. 1967, 1 ♂, 1 ♀, R.F. Sternitzky (CNC); Rustler Park, Chiricahua Mts., 8500', 3 July 1972, 1 ♀, 14 July 1972, 1 ♂, J. Powell, 2 Aug. 1973, 1 ♀, J. Powell & S. Szerlip (UCB); Sierra Vista, 2 May 1966, 2 ♀, 8 July 1967, 1 ♀, 23 July 1967, 1 ♀, 17 Aug. 1967 1 ♀, 5 Sep. 1966, 1 ♀, R.F. Sternitzky (CNC); Southwestern Research Station, Chiricahua Mts., 10 July 1962, C.W. Kirkwood, 1 ♂, 1 ♀ (CNC); Sunnyside, 7 Sep. 1966, R.F. Sternitzky, 2 ♀ (CNC); SW Research Sta. of AMNH, Cave Creek Canyon, Chiricahua Mts., 5400 ft., 16 June 1958, 1 ♀, J.M. & S.N. Burns, 28 June 1960, 2 ♂, 1 ♀, J.M. Linsley (UCB); SW Research Sta., 5 mi W Portal, 22 July 1959, 1 ♂, 4 Aug. 1959, 1 ♂, E.G. Linsley, 24 July 1961, 1 ♀, J.M. Linsley (UCB); SW Research Sta., Chiricahua Mts., 9 Sep. 1958, E.G. Linsley, 2 ♂ (UCB); Turkey Creek, Chiricahua Mts., 5600', 1-2 Aug. 1986, J. Brown, 3 ♂, 1 ♀ (UCB); 4.5 mi SW Portal, 16-26 June 1981, 1 ♂, 1 ♀, 25-31 July, 1981, 1 ♀, 1-3 Sep. 1981, 1 ♂, 1 ♀, K. & M. Cazier (SDNH); Chiricahua Mts., 3 July 1908, V.L. Clemence, 1 ♂ (SDNH); Chiricahua Mts., Portal, 17-19 Aug. 1979, D.K. Faulkner, 5 ♂, 8 ♀ (SDNH); Douglas, Oct. 1961, 1 ♀ (SDNH); Dragoon Mts., Cochise Stronghold, 8 Aug. 1980, 1 ♀ (SDNH); Huachuca Mts., Ash Canyon Rd. (1/2 mi W Hwy 92, Lot 4, 1100 ft), 5 Apr. 1979, 1 ♀, 23, 27, 28 May 1981, 2 ♂, 4 ♀, 13 June 1979, 1 ♀, 25, June 1979, 1 ♂, 30 June 1979, 1 ♀, 4, 8, 11, 14 July 1979, 4 ♀, 13 July 1980, 1 ♀, 16 July 1981, 1 ♂, 14, 16, Aug. 1979, 3 ♂, 25, 27, Aug. 1979, 2 ♂, 26 Aug. 1979, 1 ♀, 27 Aug. 1981, 1 ♀, 1 Sep. 1981, 1 ♀, 10 Sep. 1980, 1 ♂, 6 Oct. 1980, 1 ♂, 13 Oct. 1979, 1 ♂, 24 Oct. 1979 1 ♂, N. McFarland (SDNH); Rusler Park, Chiricahua Mts., 27, 29 June 1931, 2 ♀ (SDNH). Gila Co.: Christmas, 1 ♂, 1 ♀; 1902, O.C. Poling, 1 ♀; 15-30 June, O.C. Poling, 1 ♀. Graham Co.: Safford, 8 Aug. 1964, J. Powell, 4 ♀ (UCB). Hempstead Co.: Hope, 22 July 1931. L. Knobel, 1 ♂, ♂ genitalia slide I-5-32 A.G. Richards. La Paz Co.: Ehrenberg, 10 Aug. 1938, F.H. Parker, 1 ♀. Maricopa Co.: Phoenix, 2 ♀, Apr. 24-30, 1 ♀, 14 June, 1 ♀, J. Doll, 22 June, 1 ♀, Collection Brklyn. Mus., 6, 12 Apr. 1978, 2 ♀, 21, 23, 28, May 1978, 4 ♀, 10 Aug. 1974, 1 ♂, R. Wielgus; Rio Verde Mts., Phoenix, 9 1983, W. Barnes, 1 ♂, 2 ♀; Tempe, 5 Apr. 1920, E.V. Walter & H.L. Arnold, 1 ♀; 24-30 July, 1 ♂; Scottsdale, Mt. Shadows, 20-22 June 1978, M. Buegler, 1 ♂ (UCB). Mohave Co.: Hualapai Mts., 24-31 May, 1 ♀; Pierce Ferry, 5-7 May 1967, D. Davis, 1 ♂. Pima Co.: Baboquivera Mts., Aug. 3 ♂, 1 ♀; Baboquivera Mts., 5000 ft., 1-15 June 1923, 9 ♂, 8 ♀, 1-15 June 1924, 21 ♂, 17 ♀, 15-30 June 1923, 110 ♂, 58 ♀, 8 ♂ genitalia slide made VI-3-35 A.G. Richards, 1-7 July 1923, 20 ♂, 16 ♀, 1-15 July 1923, 2 ♂, 3 ♀, 1-15 July 1924, 15 ♂, 5 ♀, 15-20 July 1923, 1 ♀, 15-30 July 1923, 1 ♂, 15-30 July 1924, 1 ♂, 1-15 Aug. 1924, 2 ♂, 1 ♀, 15-30 Aug. 1923, 1 ♂, 2 ♀, 15-30 Aug. 1924, 1 ♀, 1-15 Sept. 1923, 3 ♀, 1-15 Sept. 1924, 1 ♂, 4 ♀, 15-30 Oct. 1923, 1 ♂, 1 ♀, O.C. Poling; Redington, 16 ♂, 18 ♀, 2 ♂ genitalia slides made VI-1-35 and VI-8-35 A.G. Richards; Santa Catalina Mts., 1 ♀, 1-7 Aug., 3 ♀; Santa Rita Mts., 1 Apr. 1940, 1 ♀, Aug. 1960, 1 ♂, 1 Sep. 1960, 1 ♂, 2 ♀, K. Brown, 14, 15 June 1898, 1 ♂, 2 ♀, E.A. Schwarz, July 1 ♀, Coll. Brklyn. Mus., 26 July 1925, 1 ♂; Selis P.O., Indian Oasis, 1-10 May 1923, O.C. Poling, 1 ♂, ♂ genitalia slide made VI-5-35 A.G. Richards; Tucson, May 22, 1 ♂, June 14, 1 ♂, 1 ♀, J. Doll, 1 ♀, B. Neumoen; 3 mi N Ajo, 19 Feb. 1963, W.C. Cook, 1 ♂ (CNC); Alamo Canyon, Ajo Mts., 22 Apr. 1947, G.H. & J.L. Sperry, 1 ♂ (AMNH); Baboquivari Mts., 26 Apr. 1938, 28 Apr. 1938, 2 ♀, G.H. & J.L. Sperry (AMNH); Baboquivari Mts., 5000 ft., 15-30 June 1923, O.C. Poling, 1 ♂, 25 Apr. 1947, G.H. & J.L. Sperry, 1 ♀ (CNC); Blacksprings Campground, Madera Canyon, 10 July 1976, D. Whitman, 1 ♂ (UCB); Madera Canyon, 5-12 Sep. 1951, W. Hammer, 1 ♂ (CNC); Madera Canyon, Santa Rita Mts., 27 Aug. 1962, 1 ♀, H.E. Milliron, 18 Sep. 1966, 1 ♀, 22 Sep. 1966, 1 ♂, C.W. Kirkwood (CNC); Madera Canyon, Santa Rita Mts., 6 June 1968, 2 ♂, 1 ♀, P. Opler & J. Powell, 2 ♀, P. Opler, 3-5 Sep. 1969, 1 ♂, J. Powell (UCB); Molino Basin, Santa Catalina Mts., 4500 ft., 12 June 1968, J.M. & S.N. Burns, 1 ♂ (UCB); Organ Pipe Nat. Mon., 24 Mar. 1964, 1 ♂, C.W. O'Brien, 1 ♂, C.N. Slobodchikoff (UCB); Tucson, 5 June 1935, 1 ♀, 10 June 1935 1 ♀, Bryant, 30 June 1935, O. Watts, 1 ♂ (CNC), 5 Mar. 1987, J. Reichel, 1 ♂ (AMNH); Bates Well, 18 Nov. 1939, 1 ♀ (SDNH); Madera Canyon, Santa Rita Mts., 4 Aug. 1980, 1 ♀, 5 Aug. 1980, 1 ♀, C. Bruyca (SDNH); Santa Rita Mts., 14 Sep. 1977, M. Plagens, 1 ♀ (SDNH). Pinal Co.: Superior, 5 June 1938, 1 ♂, ♂ genitalia USNM 46370, 15 June 1938, 1 ♀, S.E. Crumb; Oracle Junction, 3300, 9 May 1964, 1 ♀, 12 May 1964, 1 ♀, W.C. Cook (CNC); Rancho Linda Vista, nr. Oracle, 4 May 1967, R.F. Sternitzky, 1 ♂, 1 ♀ (CNC). Santa Cruz Co.: Madera Canyon, Santa Rita Mts., 5100', 10-26 July 1964, 2 ♀, D.R. Davis, 5 Sep. 1956, 6 ♂, 3 ♀; 12 mi S Sonoita, Hidden Springs Canyon, 29 July 1966, R.F. Sternitzky, 1 ♂, 1 ♀ (CNC); 5 mi SE Sonoita, 30 July 1966, R.F. Sternitzky, 1 ♂ (CNC); Canelo, 22 Apr. 1966 1 ♀, 5 Sep. 1966, 1 ♂, 1 ♀, 12 Sep. 1966, 2 ♂, R.F. Sternitzky (CNC); Elgin, 14 Aug. 1966, 1 ♀, 4 Sep. 1966, 1 ♀, R.F. Sternitzky (CNC); Madera Canyon, Rec. Area, Santa Rita, 30 July 1991, P.A. Opler, 1 ♂ (CSU); Nogales, 12 July 1906, 1 ♂, 12 Aug. 1906, 1 ♀, 14 Aug. 1906, 1 ♀, 24 Aug. 1906, 1 ♂, 21 Sep. 1906, 1 ♂, 1 ♀, A. Koebele (CNC); Patagonia, 30 Apr. 1910, 1 ♀, L.R. Clemence (CNC); Patagonia Mts., 7 mi SE Nogales, 1 Aug. 1991, P. Opler, Y.F. Hsu, D. Rubinoff, 1 ♀ (UCB); Sycamore Cyn., Hank Yank Springs, 9 mi W Pena Blanca, 31 July 1991, P.A. Opler, 1 ♀ (CSU); Madera Canyon, 25 Aug. 1980, 1 ♂, 15 Aug. 1980, 1 ♀, 22 Aug. 1978, 3 ♀, D.K. Faulkner (SDNH); Nogales, 9 Aug. 1977, D.K. Faulkner, 1 ♂, 1 ♀ (SDNH). Washington Co.: 20 July 1966, R.L. Brown, 1 ♀ (CNC); Yavapai Co.: Congress Junction, 23 June 1938, 1 ♂, ♂ genitalia USNM 46371, S.E. Crumb; Dewey, 16-23 June, 1 ♀; Douglas, 16-23 May, 4 ♀, 8-15 June 3 ♀, 16-23 June 1 ♂, 1 ♀, 8-15 Aug., 1 ♀; Prescott, 16-23 June, 1 ♂, Barnes Collection, July 14, 1 ♀, J. Doll; 4 mi N Prescott, 22 May 1973, 1 ♂, 27 June 1973, 1 ♀, L.M. Martin (CNC); 5 mi N Prescott, 7 July 1973, L.M. Martin, 1 ♂ (CNC); Granite Dells, 4 mi N Prescott, 8 Sep. 1971, L.M. Martin, 1 ♀ (CNC); Mayer, 4800 ft., 26 Apr. 1961, R.F. Sternitzky, 1 ♂ (AMNH); Prescott, 29 May 1907, R.E. Kunze, 1 ♂ (UCB), 2 Sep. 1907, 1 ♀, 8 Sep. 1907, 1 ♀, 1909, 1 ♀, R.E. Kunze (CNC), 30 May 1907, R.E. Kunze, 1 ♂ (SDNH); July 1910, O. Bucholz, 1 ♀ (CNC); Camp Verde, 11 June 1941, 1 ♀ (SDNH). Yuma Co.: Planet Mine, Bill Williams R., 24-31 May, 1 ♂; Welton, 1-6 Mar. 1925, 1 ♂, 3 ♀, O.C. Poling, 13 June 1939, 1 ♀, L.L. Stitt; Yuma, 22 July 1925, 3 ♂, 6 ♀; Martinez Lake, 10 June 1961, C.A. Toschi, 1 ♂ (UCB), 1 Apr. 1910, 1 ♀, 4 Apr. 1910, 1 ♂, L.R. Clemence (CNC), 9 Aug. 1941, W.P. Medlar, 1 ♂ (SDNH); Wellton, 14 Apr. 1938, F.H. Parker, 1 ♂ (CNC). Bill Wms. Fork, July, F.H. Snow, 3 ♀ No specific locality, 1-7 May 7 ♂, 4 ♀. Southern, 5 ♂, 6 ♀. Poling, 1 ♂, 1 ♀, Oslar. Washington Mts., B.P. Clark, 2 ♂, 3 ♀. CALIFORNIA: Imperial Co.: Dixieland, 1-15 Mar. 1922, 1 ♀, 15-30 Mar. 1922, 2 ♂, 5 ♀, 15-30 Apr. 1922, 1 ♂, 1-15 May 1922, 2 ♂, O.C. Poling; 16 mi NW Westmoreland, 2 Nov. 1974, J. Powell, 1 ♂ (UCB); Fish Creek Mts., 1 Apr. 1955, D.F. Hardwick 1 ♂ (CNC); Harpers Well, Mar. 1981, J. Smiley, 1 ♀ (UCB); Carrizo, 10 Mar. 1928, 1 ♀, 10 June 1928, 1 ♀, C.C. Searl (SDNH); 5 Apr. 1941, W.P. Medlar, 1 ♀ (SDNH). Inyo Co.: 1-15 Apr. 2 ♂, 1 ♀; 9 mi W Lone Pine, 19 July 1961, P.D. Hurd, J. Powell, 1 ♂ (UCB); Furnace Creek, Death Valley, 12 Apr. 1957, R.L.

- Langston, 1 ♂ (UCB); Shoshone, 9 Apr. 1962, R.W. Thorp, 1 ♀ (UCB); Surprise Canyon, Panamint Mts., 24 Apr. 1957, J. Powell, 1 ♀ (UCB); Tecopa, 7 June 1961, R.P. Allen, 1 ♂, 1 ♀ (UCB). Kern Co.: Taft, 28 Nov. 1942, 1 ♀ (CNC). Los Angeles Co.: Mt. Lowe, 8 July 1924, H.G. Dyar, 1 ♀; Santa Catalina Island, 20 Oct. 1932, D. Meadows, 1 ♂; 1 ♂, ♂ genitalia made VI-2-35 A.G. Richards, May 1 ♀, Coquillet; Pasadena, 16 June 1910, L.R. Clemence 1 ♂ (CNC); San Clemente Isl., Stone Biol. Sta., 4-6 Dec. 1981, J. Powell, 1 ♀ (UCB). Orange Co.: Warehouse, U.C. Irvine, 6 July 1969, 1 ♂ (UCB). Riverside Co.: Indio, 25 Feb. 1940, 3 ♂, 1 ♀, D. Meadows, 11, ♂ genitalia slide made VI-2-35 A.G. Richards, ♂ genitalia slide USNM 40524, 12, 13, 14, May 1921, 8 ♂, 3 ♀, E. Piazza; 2 mi N. of Desert Center, 31 Aug. 1946, C.I. Smith, 2 ♀ (UCB); 4 mi S Palm Desert, 2 July 1963, R.L. Langston, 2 ♂, 2 ♀ (UCB); 5 mi NW Palm Springs, 20 Sep. 1961, J.A. Chemsak, 1 ♀ (UCB); 6 mi N Desert Center, 31 Aug. 1946, C.I. Smith, 2 ♂ (UCB); Chino Canyon, Palm Springs, 10 June 1930, 1 ♀, 10 Apr. 1950, E.C. Johnston, 2 ♀ (CNC); Hopkins Well, 16 Apr. 1958, J. Powell, 2 ♂, 3 ♀ (UCB); Indio, 24 Feb. 1955, 1 ♂, 20 Apr. 1955, D.F. Harwick 1 ♂, 1 ♀ (CNC), 20 Apr. 1942, 1 ♀, 17, 20 May 1942, 2 ♀, 2 June 1942, 3 ♂, 1 ♀, 5 June 1942, 1 ♀, 30 June 1942, 1 ♀, W.P. Medlar (SDNH); Painted Canyon, near Mecca, 27 Mar 1971, L. Orsak, 1 ♂ (UCB); Palm Springs, 3 Apr. 1932, 1 ♂, 10 Apr. 1934, 1 ♀ (CNC), 24 Jan. 1947, 1 ♀, 13 Oct. 1945, 1 ♀, C. Smith (UCB), 22 Mar. 1916, 1 ♀, 28 Mar. 1916, 1 ♂ C.L. Fox (SDNH); San Jacinto Mts., Pinyon Flat, 10 July 1967, J.W. Johnson, 2 ♂ (UCB); Thermal, 10 July 1956, M. Wassbauer, 1 ♀ (UCB); Thousand Palms, 14 Feb. 1955, 1 ♀, 29 Apr. 1955 1 ♂, 1 ♀, J.E.H. Martin (CNC); San Bernardino Co.: Loma Linda, 12 May 1912, 1 ♂, ♂ genitalia slide USNM 40523, G.R. Pilate, 8-15 Apr., 1 ♂, 1 ♀, ♂ genitalia slide USNM 46322, 8-15 May, 1 ♂, 16-23 May, 2 ♀, ♀ genitalia made VI-11-35 A.G. Richards, 8-15 June, 1 ♀; Coquillet; 10 mi NE Earp, 22 Apr. 1960, J.R. Powers, 2 ♂, 1 ♀ (UCB); 29 Palms, 21 Apr. 1950, E.C. Johnston 1 ♀ (CNC); 6 air mi W Rice, dunes, 1 Apr. 1978, J. Powell, R. Dietz, 1 ♀ (UCB); 9 air mi S Baker, Zzyzx Springs, 20 Apr. 1977, 2 ♂ 4 ♀, Chemsak & Powell, 21 Apr. 1977, 3 ♂, 2 ♀, Powell, 30 June 1978, 1 ♀, Powell (UCB); Apple Valley, 19 May 1955, J.E.H. Martin 1 ♀ (CNC); Cronise Lake, 26 Apr. 1937, H.B. Leech 1 ♀ (CNC); Cronise Vy., 29 Apr. 1956, J. Powell, 1 ♂ (UCB); Joshua Tree Nat. Mon., 15 mi S 29 Palms, 3600 ft., 19 Oct. 1966, D.F. Hardwick 4 ♂, 3 ♀ (CNC); Wheaton Springs, Ivanpah Mts., 18 July 1947, C. Smith, 1 ♀ (UCB). San Diego Co.: Jacumba, 22 June 1924, H.G. Dyar, 1 ♂ (USNM), 13 May 1978, 2 ♂, 26 Aug. 1979, 1 ♂, J.W. Brown, 20 July 1984, 3 ♀, 26 July 1980, 3 ♂, 9 Aug. 1980, 3 ♀, Faulkner & Brown, 4 Aug. 1980, 1 ♂, 1 ♀ (SDNH); Mason Valley, 22 Sep. 1935, D. Meadows, 1 ♀; S. Felipe Val., 5 Sep. 1937, D. Meadows, 1 ♀; San Diego, 30 Apr. 1924, H.G. Dyar, 1 ♂; 6 mi E Banner, 13 July 1963, J. Powell, 3 ♂ (UCB); Borego, 24 Feb. 1940, 1 ♀ Woodcock, Mar. 1947, N. Crickmer 1 ♀ (CNC); Borego, 21 Apr. 1960, 1 ♀, J.F. Lawrence, 3 May 1956, 1 ♂, J. Powell (UCB); Mt. Laguna, 4 mi NW, 5600', 3 Nov. 1966, D.F. Hardwick 1 ♂, 2 ♀ (CNC); Anza-Borrego Des. St. Pk., Grapevine Canyon, 25 Aug. 1986, Faulkner & Brown, 1 ♀ (SDN11); Boulevard-Manzanita, 10 June 1979, 1 ♂, 3 June 1980, 1 ♀, R. Messner (SDNH); NAS Miramar, Lep. Sur. Site 9, 11 July 1996, N. Broomfield, 1 ♂ (SDNH); Ocnasaside, 5 Aug. 1957, A.A. Lee, 1 ♂ (SDNH); San Diego, 12 Oct. 1921, 1 ♀, June, 1 ♀, E. Piazza (SDNH); So. San Diego, 9 June 1978, 1 ♀ (SDNH). Stanislaus Co.: Del Rio, 26 Apr. 1922 1 ♀ (CNC). Werner Mts., 22 July 1922, 1 ♀, ex collection J.A. Comstock. La Puerta Valley, July 1911, G.H. Field, 1 ♂ (UCB), July 1911, G.H. Field, 2 ♂, 8 ♀ (SDNH). Warner's, Sep. 1919, G.H. Field, 1 ♀ (SDNH). No specific locality, 1 ♀. COLORADO: Boulder Co.: Boulder, Silver Saddle Motel, 5500', 8 June 1961, M.R. McKay, 1 ♂ (CNC). Fremont Co.: Canon City, 7 Aug. 1973, G.F. Hevel, 1 ♂. Prowers Co.: Two Buttes Dam, 21 July 1990, P.A. Opler, 1 ♂ (CSU). KANSAS: Finney Co.: Garden City, F.B. Miliken, 1 ♀. Greenwood Co.: Eureka, 13 July 1954, E.L. Todd, 3 ♀. Labette Co.: Oswego, 23 May 1964, 1 ♂, 4 June 1965, 1 ♀, G.F. Hevel. MISSISSIPPI: Hinds Co.: Jackson, 19 June 1960, B. Mather, 1 ♂ (BM); Clinton, 23 Mar. 1975, B. Mather, 1 ♂ (BM). Jackson Co.: Ocean Springs, 4 Aug. 1921, R.P. Barnhart, 1 ♂. Rankin Co.: Pearl, 14 July 1970, B. Mather, 1 ♀ (BM). MISSOURI: Benton Co.: Warsaw, 11 May 1962, J.R. Heitzman, 1 ♀. NEBRASKA: Cherry Co.: Hackberry Lake, Valentine N.W.R., 28 June 1983, D.C. Ferguson, 1 ♀. Platte Co.: Columbus, 24 June 1937, E.A. Froemel, 1 ♂. NEVADA: Clark Co.: Charlestown Mts., 1-15 July 1921, O.C. Poling, 1 ♂; Las Vegas, 15 June 1905, 1 ♂, 2, 14, 20 June 1905, 3 ♀, T. Spalding; 16-23 Mar., 1 ♀, 16-23 May, 1 ♀, 8-15 June, 3 ♂, 24-30 June, 1 ♂, 24-30 July, 1 ♀. Nye Co.: Mercury, 4 Aug. 1965, 1 ♂. NEW MEXICO: Bernalillo Co.: 15 mi E Albuquerque, 3 Sep. 1975, Lafontaine & Bowen 1 ♀ (CNC). Catron Co.: Gila Nat'l. Mon., 6000', 4 July 1964, D.R. Davis, 1 ♀. Chaves Co.: Roswell, Aug., Cockerell, 1 ♀, 12 June, on grape, 1 ♀, A.G. Hammar. Colfax Co.: 2 mi E Ute Park, 15-18 July 1974, E.L. Todd, 1 ♀; Cimarron Canyon, Sangre de Cristo Mts., 7900 ft., 11 July 1962, 1 ♂, E. & I. Munroe (CNC); Raton, 6600 ft., 5 July 1962, 1 ♂, 2 ♀, E.G. Munroe (CNC). Dona Ana Co.: Organ Mts., Finley Canyon, 5200 ft., 4 May 1979, R. Holland, 1 ♂, 1 ♀ (AMNH). Eddy Co.: Carlsbad, 17 May 1950, E.C. Johnston 1 ♀ (CNC); White City, 14 May 1950, 1 ♂, 15 May 1950, 1 ♀, H86 E.C. Johnston (CNC). Gaudalupe Co.: Santa Rosa, 12 July 1951, A.K. Wyatt, 1 ♀. Grant Co.: 2 mi SW Separ, 9 July 1964, J. Powell, 1 ♀ (UCB). Hidalgo Co.: Rodeo, 4 Sep. 1959, 1 ♂, D.D. Linsdale, 7 Sep. 1959, 1 ♂, J.R. Powers (UCB). Lincoln Co.: Cedar Creek Campground, Ruidoso, 7000', 28 July 1962, 1 ♂, 29 July 1962, 1 ♀, E. & I. Munroe (CNC). Luma Co.: Deming, 8-15 July, 3 ♂, 16-23 July, 7 ♂, 1 ♀, 1 ♀. McKinley Co.: McGaffey, 23 July 1962, 1 ♂, E. & I. Munroe (CNC); McGaffey, Zuni Mts., 7500 ft., 22 July 1962, 1 ♀, E. & I. Munroe (CNC). Otero Co.: High Rolls, Sep. 1 ♂, 2 ♀, ♂ genitalia made VI-3-35 A.G. Richards, 3 ♀; James Can., Sacramento Mts., 1 July 1940, D.G. Hall, 10 ♂, 9 ♀; Alamogordo, 10 May 1950, E.C. Johnston 1 ♀ (CNC). Quay Co.: Tucumcari, 25 June 1924, J.R. Horton, 1 ♂. Rio Arriba Co.: 2 mi E Gobernador, 6700', 20 Aug. 1971, D.F. Hardwick 1 ♀ (CNC). Sandoval Co.: Jemez Springs, 1 ♂; Frijoles Canyon, Bandelier Nat. Mon., 6050 ft, 18 July 1962, 1 ♂, 1 ♀, E. & I. Munroe (CNC). Socorro Co.: Socorro, 27 July 1962, 1 ♀, E. Munroe (CNC); Gran Quivira Nat'l Mon., 6600', 1-3 July 1964, 3 ♂, 5 ♀, D.R. Davis. Wemple, 8 July 1939, 1 ♂, 11 July 1939, 3 ♀, D. Meadows (USNM), 9 Sep. 1939, 1 ♂ (CNC). OKLAHOMA: Cleveland Co.: Norman, 18 May 1950, W.J. Reinthal 1 ♂ (CNC). Comanche Co.: Witchata Nat. Forest, 11 June 1926, T.H. Hubbell, 1 ♂, 2 ♀; Witchata Falls Nat. W. Ref., The Narrows, 10-18 July 1984, D. & M. Davis, 3 ♀. Love & Carter Cos.: Lake Murray, 20 May 1950, W.J. Reinthal 1 ♂, 2 ♀ (CNC). Murray Co.: Arbuckle Mts., 1 km W Turner Falls, 28 June-2 July 1984, D. & M. Davis, 2 ♀. Paine Co.: 1962, J.F. Reinert, 1 ♂. TEXAS: Bexar Co.: San Antonio, 5 ♂, 3 ♀, 2 ♂ genitalia slides USNM 40525, 46326, ♂ genitalia slide made XII-24-32 A.G. Richards, ♂ genitalia slide made VI-8-35 A.G. Richards, H. Schwarz, 1 ♀, 1-7 Apr., 1 ♀, June 1899, 1 ♀, July 1899, 3 ♀, O.C. Poling (USNM), 19 May 1939, Newman, 1 ♂, 1 ♀ (CNC). Blanco Co.: Blanco, 23 May 1963, A. & M.E. Blanchard, 1 ♀ Brazoria Co.: Churchill Bridge, 24 June 1962, A. & M.E. Blanchard, 1 ♂. Brewster Co.: Alpine, 2 ♂, 1928, 15-31 July 1926, 2 ♂, 2 ♂ genitalia made VI-5-35 A.G. Richards, 8-14 Aug. 1926, 1 ♀, ♀ genitalia made VI-12-35 A.G. Richards, 1926, 2 ♂, 1 ♀, 8-14 Mar. 1926, 1 ♀, 22-31 Mar. 1926, 1 ♀, 1-7 Apr. 1926, 3 ♀, 8-14 Apr. 1926, 3 ♀, 15-21 Apr. 1926, 4 ♂, 4 ♀, 22-30 Apr. 1926, 1 ♂, 1-7 May 1926, 2 ♂, 1 ♀, ♀ genitalia made VI-12-35 A.G. Richards, 8-14 May 1926, 5 ♀, 15-21 May 1926, 1 ♀, 1-7 June 1926, 1 ♀, 6-14 July 1926, 1 ♂, 15-21 July 1926, 2 ♂, 2 ♀, 22-31

July 1926, 2 ♂, O.C. Poling; Marathon, 7 June 1908, Mitchell & Cushman, 1 ♀ (USNM), 23 May 1950, E.C. Johnston, 1 ♀ (CNC); 1–7 Aug., 2 ♂, 15–30 Aug., 5 ♂, 3 ♀, 15–30 Aug. 1926, 1 ♀, O.C. Poling; Big Bend Nat. Park, 24 May 1950, E.C. Johnston 1 ♂, 1 ♀ (CNC); Hot Springs, Big Bend Nat. Park, 29 Apr. 1959, 1 ♂, M.R. MacKay, 6 May 1959, 1 ♀, L. Bottimer (CNC); Panther Jct., Big Bend Nat. Park, 19 May 1959, M.R. MacKay, 1 ♀ (CNC); The Basin, Big Bend Nat. Park, 4 May 1959, 1 ♂, 3 ♀, 8 May 1959, 1 ♂, 2 ♀, 10 May 1959, 2 ♀, 11 May 1959, 1 ♀, 16 May 1959, 1 ♀, M.R. MacKay (CNC). Burnet Co.: San Antonio, Shovel Mt., June 1899, O.C. Poling, 1 ♀, ♀ genitalia slide USNM 46327; Shovel Mt., 2 ♂, 2 ♀, 8–15 Apr., 1 ♂, 8–15 May, 1 ♀, 24–30 May, 1 ♀, 16–23 June 1 ♀. Cameron Co.: Brownsville, 2 ♂, Mar. 1911, 1 ♂, May 1911, 2 ♀, June 1911, 3 ♀, G. Dorner, 1 Apr. 1929, 1 ♀, 25 Apr. 1928, 1 ♀, 31 May 1915, 2 ♀, M.M. High, 1 Apr. 1929, 1 ♀, 25 Apr. 1928, 2 ♀, 7, 13, 22, 23, 24, 25, 26, 27, 29 May 1928, 4 ♂, 19 ♀, 25 Sep. 1928, 1 ♀, F.H. Benjamin, June 1911, 1 ♂, ♂ genitalia slide USNM 40521, G. Dorner, 12 Nov. 1968, 1 ♂, A. & M.E. Blanchard, 1 July 1895, 1 ♀, Townsend, 1–7 Aug. 1926, 1 ♀, O.C. Poling, 7 June 1904, 1 ♀, H.S. Barber; Brownsville, Esper Ranch, 1 ♀; San Benito, 7 ♀, 1–7 Apr., 1 ♂, 8–15 May, 3 ♂, 1 ♀, 16–23 May, 58 ♂, 30 ♀, 2 ♂ genitalia made VI-7-35 A.G. Richards, ♂ genitalia made VI-9-35 A.G. Richards, 2 ♀ genitalia made VI-11-35 A.G. Richards, 16–23 July 1 ♀, 8–15 Sept., 1 ♂, 1 ♀; Harlingen, 13 May 1958, J. Hunt, 2 ♂ (UCB). Chambers Co.: Black Jack Sprgs., 1 ♀. Cottle Co.: 8 mi NW Paducah, 1800, 23 Sep. 1968, 2 ♂, 24 Sep. 1968, 1 ♂, 1 ♀, D.F. Hardwick (CNC). Crane Co.: Crane, 28 May 1950, E.C. Johnston 2 ♂, 3 ♀ (CNC). Culberson Co.: Sierra Diablo, 20 mi NNW Van Horn, 27, 29 May 1973, D.C. Ferguson, 5 ♂, 4 ♀; Smith Cany., Guadalupe Mts., 5750', 22 May 1973, D.C. Ferguson, 1 ♀. Dallas Co.: Dallas, 22 May 1906, F.C. Pratt, 1 ♂ (USNM), 12 June 1942, C.I. Smith, 1 ♀ (UCB); vic. Irving, 29 Apr. 1984, 1 ♀, 6, 27 May 1984, 1 ♂, 2 ♀, 28 May 1983, 1 ♂, 1 ♀, 3, 23, 31 May 1981, 3 ♂, 3 ♀, 1 June 1980, 12 ♂, 3 June 1981, 2 ♂, 10 June 1983, 1 ♂, 10 June 1984, 1 ♂, 1 ♀, 22 June 1980, 1 ♀, R.A. Rahn; Irving, 15 Mar. 1953, Woodcock, 1 ♂ (CNC). Duval Co.: San Diego, 20 May 1895, bred from larva on Mesquite, E.A. Schwarz, 1 ♀. El Paso Co.: El Paso, 4000', 19, 24 June, 2 ♂, 6 Aug., 1 ♀, J. Woodgate (USNM), 26 May 1964, J.E.H. Martin, 1 ♀ (CNC). Gonzales Co.: Ottine, Palmetto St. Pk., 12–13 Aug. 1963, P.J. Spangler, 1 ♀. Harris Co.: July, 1 ♀; Houston, Aug. 1916, 1 ♂. Hemphill Co.: Canadien, Wildl. Mgt. Area Canadien, 11–12 July 1974, E.L. Todd, 1 ♂, 2 ♀. Hidalgo Co.: Donna, A.W. Nations, 1 ♀. Jeff Davis Co.: Davis Mtns., Mount Locke, 6700', 30 Aug. 1969, A. & M.E. Blanchard, 1 ♀; Davis Mtns. Resort, 5800', 27 Apr. 1992, D.G. Marqua, 1 ♂ (UCB); Ft. Davis, 29 May 1959, 2 ♂, 30 May 1959, 3 ♀, 31 May 1959, 1 ♂, 5 ♀, M.R. MacKay (CNC). Kerr Co.: Kerrville, 3 ♀, 11, 12 Apr. 1907, 1 ♂, 1 ♀, 30, 31 May 1906, 3 ♂, 6 ♀, ♂ genitalia made VI-2-35 A.G. Richards, 1 June 1906, 1 ♂, 2 ♀, F.C. Pratt, May 1912, 1 ♂, 1 ♀, H. Lacey, 16–23 Apr., 1 ♀, May 1903, 1 ♀, 17 May 1902, 1 ♀ (USNM), 5 Apr. 1959, 1 ♀, 15 Apr. 1959, 1 ♂, R.H. Wigmore (CNC). Kimble Co.: Junction, 3 Apr. 1968, A. & M.E. Blanchard, 1 ♂, 14–17, June 1972, 10 ♂, 9 ♀, D.C. Ferguson. La Salle Co.: Artesia Wells, 12, 13 June 1972, D.C. Ferguson, 3 ♂; Cotulla, Crawford & Pratt, 2 ♂, 2 ♂ genitalia made VI-8-35 A.G. Richards. Menard Co.: Menard, 25 July 1940, Hall, 2 ♂, 1 ♀. Nueces Co.: Corpus Christi, May, 1 ♂; Nueces River, 1 ♂, 26, 28, Apr. 1910, 2 ♂, F.C. Pratt, 22 June, 1 ♂, J. Doll. Pecos Co.: Ft. Stockton, 14 Aug. 1938, D. Meadows, 1 ♀. Presidio Co.: Presidio, 20 July 1944, ex. Prosopis, 1 ♂, 3 ♀; Shafter, 4000', 31 May 1973, D.C. Ferguson, 1 ♂, 1 ♀, 16 Oct. 1973, 1 ♀, A. & M.E. Blanchard. Randall Co.: Palo Duro Canyon State Pk., 15 Apr. 1969, A. & M.E. Blanchard, 1 ♂. Reeves Co.: Pecos, 6 Sep. 1952, 2 ♀, 8, 9 Sep. 1952, 2 ♂, R. Leuschner (USNM), 18 May 1950, E.C. Johnston 1 ♂, 1 ♀ (CNC). Robertson Co.: Calvert, G.H. Harris, 1 ♀. San Patri-

cio Co.: Sinton Welder Wildlife Foundation (San Patricio), 24, 25 May 1962, 1 ♂, 1 ♀, 22 June 1962, 3 ♀, ♀ genitalia slide USNM 46376, 22 Aug. 1962, 1 ♂, 1 ♀, 13 Sep. 1963, 1 ♂, 7 Oct. 1964, 2 ♀, ♀ genitalia slide USNM 46373, 13 Nov. 1963, 1 ♀, ♀ genitalia slide USNM 46374, A. & M.E. Blanchard. Terrell Co.: Sanderson, 27 Apr. 1959, 5 ♂, 2 ♀, M.R. MacKay, 28–29 Apr. 1959, 1 ♀, W.R.W. Mason (CNC). Travis Co.: Austin, 3 May 1897, H. Schwarz, 2 ♂, ♂ genitalia made VI-4-35 A.G. Richards; Bee Cave, 4 Sep. 1962, 1 ♂, 1 ♀, A. & M.E. Blanchard, ♂ genitalia slide USNM 46372. Uvalde Co.: Sabinal, 1 Apr. 1910, 1 ♂, 1 ♀, 26 May 1910, 1 ♀, F.C. Pratt. Victoria Co.: Victoria, 22 May 1915, 1 ♂, 18 June 1911, 1 ♀, J.D. Mitchell. Walker Co.: Huntsville S'te. Park, 19 May 1963, 1 ♀, A. & M.E. Blanchard, ♀ genitalia slide USNM 46375. Webb Co.: Laredo, 1 Aug. 1938, D. Meadows, 1 ♂, 1 ♀. Williamson Co.: Georgetown, 13 Apr. 1937, L.J. Milne, 1 ♂ (CNC). Belfrage, C.V. Riley, 1 ♀. 16 mi ESE Canyon, 3000', 26 Sep. 1968, D.F. Hardwick, 3 ♂, 1 ♀ (CNC). UTAH: Utah Co.: Vineland, 7 Aug. 1912, T. Spalding, 1 ♂. Washington Co.: St. George, 24–31 May, 1 ♀, 1–7 June, 1 ♂, 3 ♀, 8–15 June, 1 ♂.

Larval host. *Prosopis* sp. (Fabaceae). A female from the vicinity of Presidio, Texas in the USNM was reared.

Distribution (Fig. 61). Southern Manitoba, south to Nebraska and east to Mississippi, west to California and south to central Mexico.

Discussion. The type of *B. deducta* is the usual form of the male (Richards 1936a) (Fig. 25). The females have three distinct phenotypes. One is the maculate female that has all of the forewing pattern of the male, but is less distinct, and the median band and reniform spot are not as bright, but more infuscated with light brown (Figs. 26–27). The second is the immaculate female that was described as *B. pavitensis* (Figs. 28–29). The third form, *culpina*, is a female with the terminal half of the forewing with cinnamon ground color (referred to as “dull foxy red” by Edwards (1882)) (Fig. 30). *Cirrhobolina incandescens* Grote is a large female and the form *albina* is a light female (Richards 1936a).

Collections indicate that *B. deducta* has a more migratory pattern than other species of *Bulia* based on the specimen record from southern Manitoba, Canada. There is a definite southern limit to the distribution in Mexico, from a line extending from the vicinity of Monterrey and Linares west to El Salto and Durango. A single stray specimen from southeastern Chiapas, Mexico, is probably a migrant.

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APPENDIX 1. Characters and character states used for phylogenetic analysis of *Bulia*; 0 = plesiomorphic state, 1–3 = apomorphic states. All characters were treated as ordered, with Figure numbers illustrating those character states.

1. Head	0—vertex of male without an elongate median projection 1—vertex of male with an elongate median projection (Fig. 3)
2. Head	0—labial palpus third segment not extending above vertex 1—labial palpus third segment extending above vertex
3. Hindwing	0—anal lunule white 1—anal lunule yellow
4. Eighth segment	0—tergum not reduced, mostly sclerotized 1—tergum reduced to a narrow X-shaped tergite, mostly membranous (Fig. 31)
5. Eighth segment	0—sternum not reduced, mostly sclerotized 1—sternum reduced to a wine glass shaped sternite, remainder membranous (Fig. 32)
6. Uncus	0—bearing long bifurcate setae 1—long bifurcate setae absent
7. Valva	0—clasper present 1—clasper absent
8. Valva	0—clavus present 1—clavus absent
9. Sacculus	0—lacking an expanded costal lobe 1—costal lobe small, triangular (Figs. 34–35) 2—costal lobe large, apex slightly bifurcate (Fig. 36) 3—costal lobe large, apex truncate to produced (Figs. 37–38)
10. Sacculus	0—apex not differentiated 1—apex not extending beyond cucullus 2—apex extending beyond cucullus, short (Figs. 34–35) 3—apex extending beyond cucullus, elongate (Figs. 36–38)
11. Juxta	0—dorsal margin slightly concave 1—dorsal margin U-shaped (Figs. 34–37 and 39–42) 2—dorsal margin V-shaped (Fig. 38 and 43)
12. Aedoeagus	0—external spiculations absent 1—external spiculations present (Figs. 47–48)
13. Vesica	0—lacking large spines 1—with 2 large spines (Figs. 44–45, 47–48) 2—with 1 large spine (Fig. 46)
14. Coremata	0—if present, arising from base of valva 1—arising from base of 8th tergum (Fig. 33)
15. Genital plate	0—not fused to the 7th sternum 1—fused to the 7th sternum
16. Median prong	0—absent 1—short, width greater than height (Figs. 49–51, 54–56) 2—long, width less than height (Figs. 52–53, 57–58)

APPENDIX 2. Data matrix for 2 outgroups, *Melipotis* (designated outgroup) and *Drasteria*, and species of *Bulia*. Character numbers refer to those in Appendix 1.

	1	11111	1
	12345	67890	12345
<i>Melipotis</i>	00000	00000	00000
<i>Drasteria</i>	01000	10001	00000
<i>confirmans</i>	11011	11112	10111
<i>mexicana</i>	11111	11112	10111
<i>schausi</i>	11111	11123	10211
<i>similaris</i>	11111	11133	11111
<i>deducta</i>	11111	11133	21111