Host Plant and Descriptions of Nymphs of the Planthopper *Rhabdocephala brunnea* (Homoptera: Fulgoridae)

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ABSTRACT Second through fifth instars and adult male and female genitalia of *Rhabdocephala brunnea* Van Duzee are described and illustrated. In Arizona, nymphs and adults were collected from a perennial bunchgrass, bush muhly, *Muhlenbergia porteri* Scribn. ex Beal, which is the first documented host for this fulgorid. Grass-feeding habits have not been reported previously in the Fulgoridae, host plant records of whose members are reviewed.

KEY WORDS Insecta, *Rhabdocephala brunnea*, immature stages, host plants

ALTHOUGH PLANTHOPPERS in the family Fulgoridae are among the largest and most conspicuous of all insects, little is known about the biology of any of the ≈550 species. From the limited information available, it has been assumed that most feed on dicotyledonous trees in tropical forests. *Phrictus diadema* (L.) has been recorded from cacao, *Theobroma cacao* L., in Brazil, and *Pyrops candelaria* (L.) was observed developing on longan, *Nephelium longana* Camb. (Sapindaceae), and mango, *Mangifera indica* L. (Anacardiaceae), in China (Kershaw & Kirkaldy 1910). Eggs, nymphs, and adults of *Lycorma delicatula* (White) were found on *Ailanthus altissima* Swingle (Simaroubaceae) and *Melia azederach* L. (Meliaceae) in China (Chu 1931). Several species have been found associated with, and perhaps feeding on, trees in Central and South America. In Costa Rica, >100 *Fulgora laternaria* (L.) were observed on trunks of *Hymenaea coubaril* L. (Fabaceae) (Janzen & Hogue 1983). Peruvian records include *Lystra lanata* L. and *F. laternaria* on *Simarouba amara* Aublet (Simaroubaceae); *F. laternaria* on *Hymenaea oblongifolia* var. *palustris* (Ducke) Lee & Langenheim (Fabaceae) and *Zanthoxylum* sp. (Rutaceae); *Fulgora* sp. on *Hymenaea coubaril* L., *Vochysia tucanorum* Martius (Vochysiaceae), *Lecythis* sp. (Lecythidaceae), *Myroxylon balsamum* (L.) Harms (Fabaceae), and *Simaba versicolor* St. Hilaire (Simaroubaceae) (Hogue 1984); and *Aspidosperma tambopatense* Gentry (Apocynaceae) and *Hura crepitans* L. (Euphorbiaceae) (Hogue et al. 1989). Those from Panama are *Enchophora longirostris* Distant on *S. amara*, *Quararibea asterolepis* Pittier (Bombaceae), and four other unspecified trees; *Phrictus quinquepartitus* on *Terminalia oblonga* Stevd. (Combretaceae); *Fulgora* sp. on *Eugenia oerstediana* Berg (Myrtaceae); and *Diareusa conspersa* Schmidt on *Poulsenia armata* (Miq.) Standl. and *Ficus tonduzii* Standley (Moraceae) (Johnson & Foster 1986). Records from Mexico include *Fulgora castresii* Guérin Méneville on *Jacaranda acutifolia* Humboldt & Bonpland (Bignoniaceae) and *Cerogenes auricoma* (Burmeister) on *Quercus reticulata* Humboldt & Bonpland (Fagaceae) (Hogue et al. 1989). *Hypaepa illuminata* Distant was found on *Trichilia arborea* DeCandolle (Meliaceae) in Honduras and *Acmonia dichroa* Germar on *Capparis* sp. (Capparidaceae) in Argentina (L. B. O'Brien, personal communication).

Several host records were published for five species of *Cyrpoptus* reviewed by Kramer (1978); however, these involved only one or two specimens collected from each host, and the hosts included common crops such as lima beans and cotton. These are probably merely sitting records.

Except for the studies of *L. delicatula* and *P. candelaria* nymphs, all records are those of adults. Nymphs of *P. candelaria* also fed on *Xanthium strumarium* L. (Asteraceae), *Urena lobata* L. (Malvaceae), and *Citrus decumana* (Kershaw & Kirkaldy 1910). Nymphs of *Itzalana submaculata* Schmidt were collected on *Baccharis* sp. (Asteraceae) in the southern United States (Wilson & O'Brien 1986). Egg masses and first instars of *Cerogenes auricoma* and "*Diareusa imitatrix* Ossiannilsson (?)" were found on *Quercus reticulata* and *Cocos nucifera* L. (Arecaceae), respectively (Hogue et al. 1989).

The only descriptions or illustrations of fulgorid nymphs are those of *Pyrops*? sp. (Burmeister 1845 *in* Kershaw & Kirkaldy 1910), *Pyrops candelaria* (Kershaw & Kirkaldy 1910), *Fulgora laternaria* (Hagmann 1928), *Cathedra serrata* (F.) (Fonseca 1931), *Cyrpoptus nubeculosus* Stål

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(Kramer 1978), *Itzalana submaculata* (Wilson & O'Brien 1986), *Cerogenes auricoma* and "*Diareusa imitatrix*" (Hogue et al. 1989), and unidentified species of Kirkaldy (1906, 1907).

Rhabdocephala brunnea Van Duzee, a member of a monotypic genus, is a poorly known but distinctive species belonging to a group of New World Fulgoridae having an elongate head process (O'Brien 1988). Adults and nymphs were found (by A.G.W.) in the thatch and at the base of their host plant, the grass bush muhly, *Muhlenbergia porteri* Scribn. ex Beal, in Arizona. The present paper includes descriptions (by S.W.W.) of the male and female genitalia and the second through fifth instars of this fulgorid planthopper.

Materials and Methods

Descriptions of adult genitalia are based on specimens of *R. brunnea* as follows. MEXICO: Sonora: 1♂, 15 mi N Hermosillo, 1-X-1979, M. W. Nielson. UNITED STATES: Arizona: Cochise Co., 1♀, 3 mi N Portal, San Simone Road, 4,550′, 31° 57′N, 109° 8–9′W, 1-VI-1981, K. Nagamura, on *Baccharis sarothroides;* 1♀, 2 mi N Portal, San Simone Road, 4,550′, 31° 56–57′N, 109° 8′W, 24-V-1981; Pima Co., 2♂♂, 1♀, Baboquivara Mt., 19-VII-1932, R. H. Beamer; 1♀, Tucson, 24-VIII-1967, W. & C. Manos; 1♀, 6 April 1970, C. Gay; 1♀, T135, R11E, S12, 28-IX-1971, E. Yensen; 1♀, Florida Canyon, Santa Rita Mountains, 15-VIII-1971, T. Halstead; 1♂, Sabino Canyon, 31-VII-1941, R. H. Beamer; 1♂, Santa Rita Mountains, 17-IV-1925, C. T. Vorhies, 1♂, 2♀♀, 7-V-1944, M. H. Frost, Jr.; 1♂, Santa Rita Exp. Range, S of Sahuarita, 11-IV-1989, A. G. Wheeler, Jr.; 1♀, Gates Pass Rd. at Camino de Oeste, west edge of Tucson, 13-IV-1989, A. G. Wheeler, Jr., beaten from crowns of *Muhlenbergia porteri.*

Descriptions of nymphs are based on the following specimens collected by A. G. Wheeler, Jr., by beating clumps of *Muhlenbergia porteri* into a net unless otherwise indicated (II–V are nymphal instars): Arizona: Pima Co.: 1-IV, 3-V, Baboquivara Mt., 19-VII-1932, R. H. Beamer; 1-IV, 3-V, Catalina Hwy. at Mt. Lemmon Short Rd., NE of Tucson, 8-III-1990; 1-III, 5-IV, 6-V, 10-III-1990; 3-III, 3-IV, 2-V, Tucson Mt. Park, W of Tucson, 15-IV-1989, 5-II, 2-III, 8-IV, 4-V, 10-III-1990; 5-III, 2-IV, 2-V, Gates Pass Rd. at Camino de Oeste, W of Tucson, 13-IV-1989; 3-IV, 3-V, Rt. 86, 4.3 mi. W Quijotoa, 7-III-1990; 2-IV, 1-V, Sabino Canyon, 12-VII-1932, R. H. Beamer; 6-III, 7-IV, 13-V, Santa Rita Exp. Range, S of Sahuarita, 11-IV-1989; 3-II, 2-III, 3-V, 17-II-1991, W. A. Jones.

Adults were pinned and nymphs were preserved in 70% ethyl alcohol. Measurements are given in millimeters as $\bar{x} \pm$ SD. Length was measured from the apex of the vertex to the apex of the abdomen, thoracic length along the midline from the anterior margin of the pronotum to the posterior margin of the metanotum, and width across the widest part of the body. Specimens are in the following collections: Snow Museum, University of Kansas, Lawrence; L. B. O'Brien collection; and S. W. Wilson collection.

Fig. 1. *Rhabdocephala brunnea.* Adult female.

Descriptions

Adult (Fig. 1 and 2). Length, male 6.2 ± 0.22; female 7.2 ± 0.15; n = 10 for each. Adult *R. brunnea* were described by Van Duzee (1929); a brief description and illustration of the head and thorax was provided by O'Brien (1988).

Male Genitalia (Fig. 2A and B). Pygofer in lateral view subquadrate. Anal flap in lateral view elongate, subcylindrical. Styles in lateral view elongate, subtriangular, with anteroventrally directed hook on ventrolateral aspect. Aedeagus with a broad, triangular, posteriorly directed lobe and 3 pairs of inflated sacs; dorsal pair of sacs, each elongate, narrow basally, expanding apically, almost as large as anal flap; lateral pair each subacute, bent in middle and folded back upon itself; median pair each subcylindrical, curved posterodorsally, with broad bifurcate apex (Fig. 2B) and anteroventrally directed spine on dorsolateral aspect (Fig. 2A).

Female Genitalia (Fig. 2C). Anal flap flat, circular. Lateral gonapophyses of segment 9 in ven-

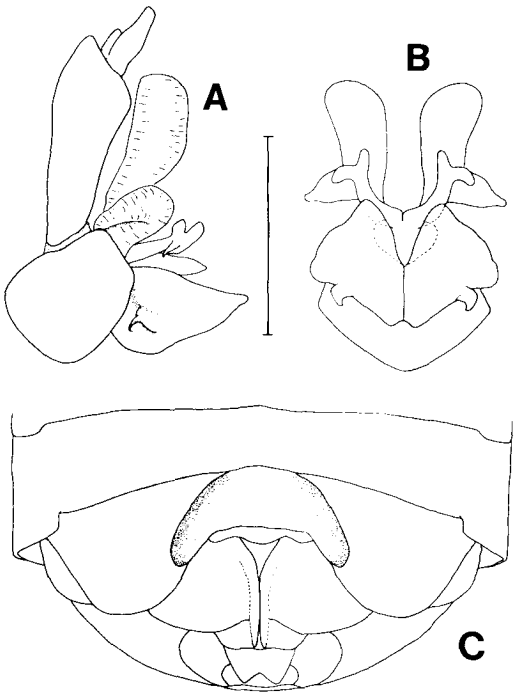

Fig. 2. *Rhabdocephala brunnea,* adult genitalia. (A) Male, lateral view of complete genitalia. (B) Male, caudo-ventral view of aedeagal inflated processes and foreshortened styles. (C) Female, ventral view of complete genitalia. Bar = 1 mm.

tral view broad, median margin of each thickened and pointed apically.

Fifth Instar (Fig. 3, 4, 6D). Length 9.9 ± 0.54; thoracic length 2.4 ± 0.14; width 2.4 ± 0.16. n = 10.

Form subcylindrical, slightly flattened dorsoventrally; length of head prolongation ≈0.5 times total length of nymph; body widest across mesothoracic wing pads; reddish tan to medium brown, heavily marked with dark brown to black, with an overall mottled appearance.

Head in dorsal view with length on midline ≈5 times width at widest point. Vertex with lateral margin on each side above eye forming carinate shelf, carina extending anteromedially almost to apex of head. Frons with length on midline ≈5 times width at widest point; lateral margins carinate (outer carinae), each roughly paralleled by an inner carina extending from near clypeus anterolaterally to apex, with weak median longitudinal carina; ≈37–40 pits on each side of head, most between each inner and outer carina. Clypeus consisting of a subconical basal anteclypeus and a subconical distal postclypeus; anteclypeus with longitudinal lateral carina on each side. Beak 3-segmented, extending to metacoxae; segment 1 obscured by postclypeus, segment 2 ≈1.5 times length of 3. Eyes red. Antennae 3-segmented; scape ringlike, cylindrical;

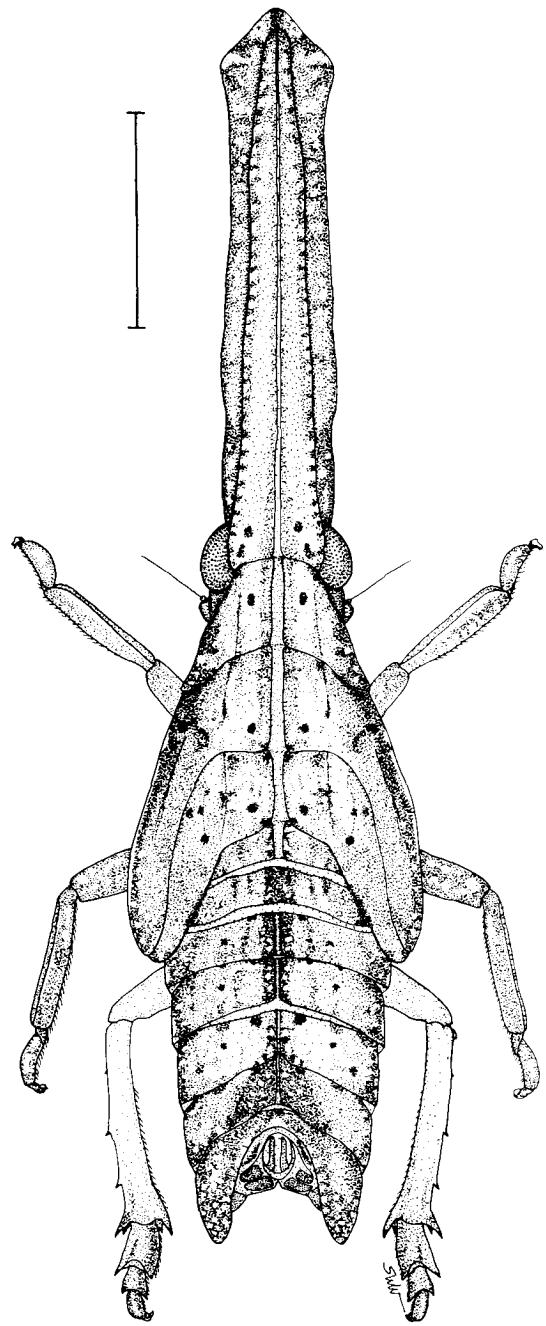

Fig. 3. *Rhabdocephala brunnea,* fifth-instar habitus, dorsal view. Bar = 1 mm.

pedicel spherical; pedicel with 32 pits; flagellum whiplike distally, bulbous base ≈0.3 times that of pedicel.

Thoracic nota divided by longitudinal middorsal line into 3 pairs of plates. Pronotal plates each subtriangular in dorsal view, subquadrate in lateral view; anterior margin carinate, carina (outer

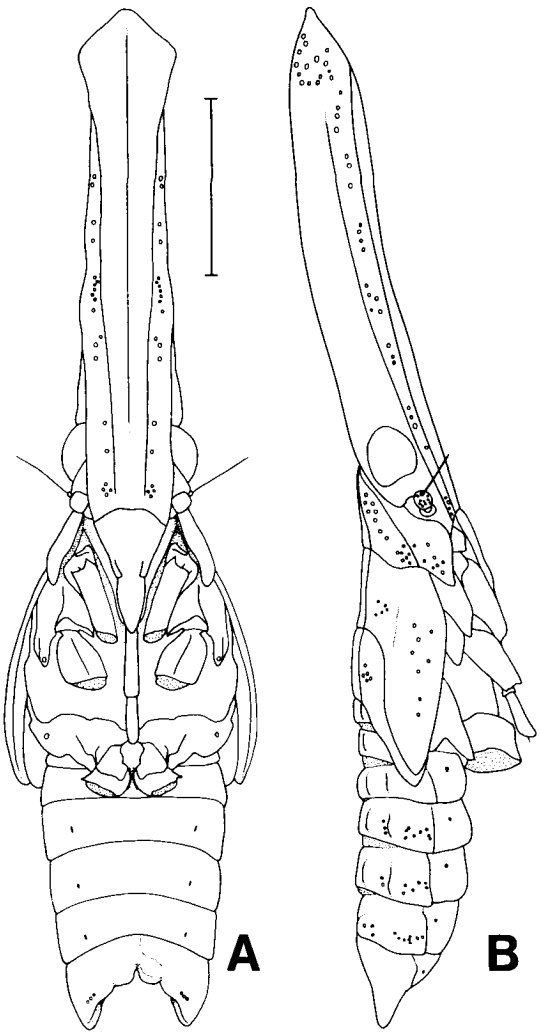

Fig. 4. *Rhabdocephala brunnea,* fifth instar. (A) Ventral view. (B) Lateral view. Bar = 1 mm.

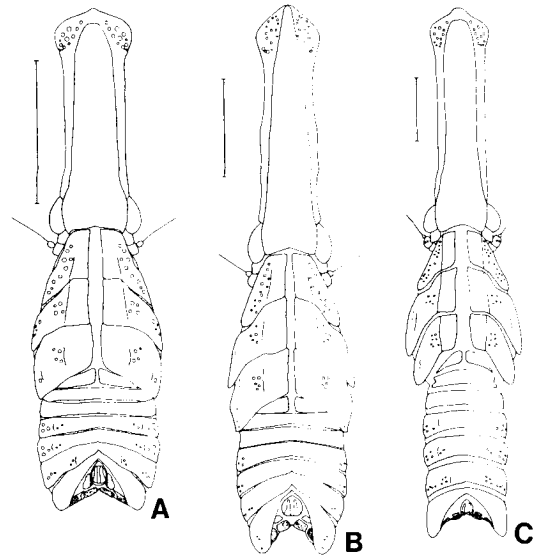

Fig. 5. *Rhabdocephala brunnea,* second through fourth instars. (A) Second instar. (B) Third instar. (C) Fourth instar. Bars = 1 mm.

carina) forming lateral border of plate by extending from anterior margin posterolaterally to sinuate posterior margin; weak longitudinal carina (inner carina) near middle of each plate; 15–19 pits between inner and outer carinae and 7–8 between outer carina and lateral border of plate. Mesonotal median length slightly longer than that of pronotum; each plate with weak longitudinal carina in median 1/3; cluster of 5 pits just lateral to carina and 8 pits on lateral aspect of wingpad; wingpad lobate, extending nearly to apex of metanotal wingpad. Metanotal median length ≈0.7 times that of mesonotum; each plate with weak longitudinal carina in median 1/3; cluster of 5 pits just lateral to carina; wingpad broadly lobate, extending laterally to tergite 3. Procoxae elongate, cylindrical, posteromedially directed; mesocoxae subcylindrical, broader than procoxae, with longitudinal carina on ventral aspect; metacoxae broad, flat, fused to sternum. Metatrochanters each with a row of 9 interlocking, flattened teeth on median aspect. Femora slightly flattened; pro- and mesofemora shorter than metafemora. Pro- and mesotibiae slightly flattened, outer aspect strongly concave; metatibiae laterally flattened, with longitudinal row of 3 black-tipped lateral spines on shaft and transverse apical row of 7 black-tipped spines on plantar surface. Pro- and mesotarsi each with 2 tarsomeres; tarsomere 1 wedge-shaped, tarsomere 2 subcylindrical and curved. Metatarsi each with 3 tarsomeres; tarsomeres 1–3 subcylindrical; tarsomere 1 with transverse apical row of 8 black-tipped spines on plantar surface; tarsomere 2 with 6 very weak black-tipped spines; tarsomere 3 similar to terminal tarsomere of other legs. All legs with terminal pair of black curved claws and a clear, membranous, lobate, median pulvillus.

Abdomen 9 segmented, widest across segment 3; segment 7 tubelike with 1 dark brown oval waxpad and 1 dark brown sclerite dorsal to it on caudal aspect on each side; segment 8 compressed, surrounded by segment 7, with 1 dark brown oval waxpad and 1 dark brown sclerite dorsal to it on caudal aspect on each side; waxpads with minute pores. Segment 9 surrounded by segment 8, ringlike, encompassing anus, with one small fingerlike process on each side; tergites 1–6 each with a partial longitudinal carina on each side near median line; tergites 3–5 with an additional partial longitudinal carina on each side near lateral margin. Each tergite with the following number of pits on either side of mid-

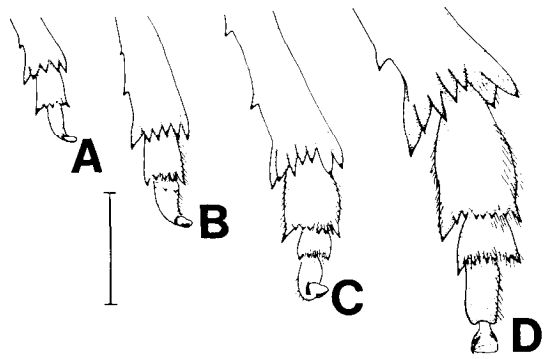

Fig. 6. *Rhabdocephala brunnea*, apices of metathoracic legs, plantar surface. (A) Second instar. (B) Third instar. (C) Fourth instar. (D) Fifth instar. Bar = 0.5 mm.

line (lateralmost pits not visible in dorsal view because of curving of tergites onto ventral aspect): tergite 4 with 8–11, 5 with 8–9, 6 with 10–11. Sternite 2 divided by coxae; sternite 7 with 3 pits on each side, 8 with 1 pit on each side.

Fourth Instar (Fig. 5C and 6C). Length 7.5 ± 0.65; thoracic length 1.8 ± 0.08; width 1.7 ± 0.16. $n = 10$.

Head in dorsal view with length on midline ≈4 times width at widest point. Frons with length on midline ≈5 times width at widest point; ≈32–36 pits on each side of head, most between each inner and outer carina. Antennal pedicel with 12 pits.

Mesonotal wing pad extending ≈2/3 of distance to apex of metanotal wing pad. Metatarsomere 1 with transverse apical row of 7 black-tipped spines on plantar surface; tarsomere 2 with 4 very weak, black-tipped spines.

Abdominal tergites with the following number of pits on either side of midline (lateralmost pits not visible in dorsal view because of curving of tergites onto ventral aspect): tergite 4 with 8, 5 with 9, 6 with 10.

Third Instar (Fig. 5B and 6B). Length 5.4 ± 0.35; thoracic length 1.4 ± 0.05; width 1.3 ± 0.06. $n = 10$.

Head with 23–25 pits on each side. Antennal pedicel with 7 pits; flagellum with bulbous base ≈0.7 times that of pedicel.

Pronotal plates each with 14–15 pits between inner and outer carinae and 7 between outer carina and lateral border of plate. Mesonotal wing pad extending <1/3 distance to apex of metanotal wing pad. Metatibiae with transverse apical row of 6 black-tipped spines on plantar surface. Metatarsi with 2 tarsomeres; tarsomere 1 with transverse apical row of 6 black-tipped spines on plantar surface; tarsomere 2 partially subdivided, with 2–3 small, black-tipped spines near middle on plantar surface; tarsomere 2 similar to that of other legs.

Abdominal tergites 4–6 each with 7 pits on either side of midline (lateralmost pits not visible in dorsal view because of curving of tergites onto ventral aspect).

Second Instar (Fig. 5A and 6A). Length 3.6 ± 0.19; thoracic length 1.0 ± 0.03; width 0.9 ± 0.06. $n = 5$.

Head in dorsal view with length on midline ≈3 times width at widest point. Frons with length on midline ≈3.5 times width at widest point; ≈22–23 pits on each side of head. Antennal pedicel with 4 pits.

Pronotal plates each with 11 pits between inner and outer carinae and 5 between outer carina and lateral border of plate (some pits not visible in dorsal view because of curvature of plate). Mesonotal plates each with cluster of 4 pits just lateral of carina and 5 pits on lateral aspect of wing pad. Metatibiae with transverse apical row of 5 black-tipped spines on plantar surface. Metatarsomere 1 with transverse apical row of 5 black-tipped spines on plantar surface; tarsomere 2 not partially subdivided, without spines on plantar surface.

Abdominal tergites 4–6 each with 6 pits on either side of midline (lateralmost pits not visible in dorsal view because of curving of tergites onto ventral aspect).

Discussion

In Arizona, nymphs of *Rhabdocephala brunnea* were associated consistently with *Muhlenbergia porteri* in April 1989, March 1990, and February 1991. This is the first report of a grass serving as a fulgorid host, although grass-inhabiting planthoppers are known in other fulgoroid families, especially the Delphacidae (O'Brien & Wilson 1985).

The host, bush muhly, is a fine, wiry perennial bunchgrass that is a highly palatable forage. It once was one of the most abundant and important grasses in southern Arizona. Because of overgrazing, bush muhly has become almost restricted to individual plants growing under the protection of shrubs and trees (Hitchcock 1935, U.S. For. Serv. 1937, Humphrey 1970). At the collection sites, it often occurred near or under creosotebush, *Larrea tridentata* (DC.) Cav. (or *L. divaricata* Cav.); saguaro, *Cereus giganteus* Engelm.; mesquite, *Prosopis* spp.; and cholla and pricklypears, *Opuntia* spp. Bush muhly is found mainly on dry mesas and rocky slopes, usually below 1,524 m (5,000 ft) in Arizona and New Mexico (U.S. For. Serv. 1937).

Individuals of *R. brunnea* were difficult to dislodge from crowns of bush muhly; they were easiest to collect from plants overhanging small washes in the Santa Rita Experimental Range. In several areas near Tucson, nymphs were parasitized by a dryinid wasp (Hymenoptera: Dryinidae). Similar collecting (shaking or beating

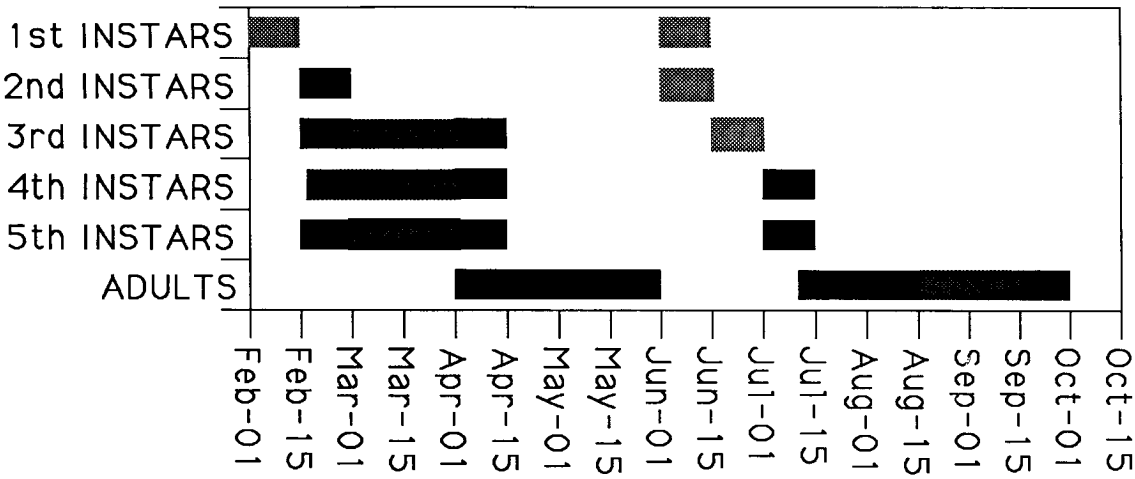

Fig. 7. *Rhabdocephala brunnea* seasonal life history. Black bars, seasonal distribution of specimens examined; dark stippling, predicted distribution based on seasonal distribution of same instar; light stippling, predicted distribution of instars based on seasonal distribution of other instars.

plants over a shallow net) from a few other grass species did not produce any fulgorids.

On clumps of bush muhly that yielded *R. brunnea*, no individuals were observed by examining plants before they were shaken or beaten over a net. Even large numbers of this fulgorid were undetected. In the laboratory, nymphs usually sat motionless on host stems where their mottled tannish to brown coloration blended well with the color of previous season's stems. In spring, new growth of this grass begins near the base of last year's stems (U.S. For. Serv. 1937).

The few newly molted (teneral) nymphs observed in mid-February and early March indicates that nymphal development was proceeding. The presence of second instars and absence of adults in early spring suggests that these planthoppers overwinter as eggs. In both years, development of populations at Tucson Mountain Park lagged slightly behind those in Tucson at lower elevations. Comments on the phenology of *R. brunnea* are, of course, speculative, and season-long sampling is needed to determine whether this species is bivoltine as suggested by Fig. 7 or whether it is univoltine as might be predicted from the limited life history information available on fulgorids and certain other Fulgoroidea (O'Brien & Wilson 1985). The apparent bivoltine seasonal distribution may be an artifact resulting from combining data from individuals collected at different elevations or years or both with differences in precipitation. Further work also is necessary to determine whether (1) nymphs and adults may emerge at night from host crowns or thatch at the base of their hosts, thus making them easier to collect by sweeping, and (2) if adults disperse to various nongramineous plants during summer; such dispersal could account for apparently accidental occurrences on *Baccharis sarothroides* (O'Brien 1988) and on certain other composites (i.e., species of *Gutierrezia* and *Haplopappus* (University of Arizona collections)).

Known collections of *R. brunnea* are limited to southern Arizona (Cochise, Pima, and Santa Cruz counties) and the adjacent Mexican state of Sonora (O'Brien 1988, present paper). This distribution may somewhat reflect the activity of collectors, who have tended to emphasize Tucson and Pima County. Attempts to collect this planthopper need to be made in other portions of the host's range, which also includes western Texas, New Mexico, Utah, Nevada, and Colorado (Hitchcock 1935, U.S. For. Serv. 1937). This cryptic, seldom-collected fulgorid, however, seems particularly common in the Arizona upland Sonoran Desert. If not actually restricted to the Sonoran Desert (the Cochise County record lies in a Chihuahuan–Sonoran transition zone), *R. brunnea* at least may be considered among the numerous insect species characteristic of this biologically diverse region of the desert Southwest.

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