64 (1) 105–111 © Museum für Tierkunde Dresden, ISSN 1863-7221, 30.10.2006

Notes on Neotropical Proconiini (Hemiptera: Cicadellidae: Cicadellinae), IV: lectotype designations of *Aulacizes* Amyot & Audinet-Serville species described by Germar and revalidation of *A. erythrocephala* (Germar, 1821)

Gabriel Mejdalani [1], Daniela M. Takiya [2] & Rachel A. Carvalho [1]

[1] Departamento de Entomologia, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, São Cristóvão, 20940-040 Rio de Janeiro, RJ, Brazil [mejdalan@acd.ufrj.br]

[2] Center for Biodiversity, Illinois Natural History Survey, 1816 S. Oak Street, Champaign, IL 61820, USA [takiya@acd.ufrj.br]

Received 17.iii.2005, accepted 22.viii.2006.
Available online at www.arthropod-systematics.de

> Abstract

Lectotypes are designated for the sharpshooter species *Aulacizes erythrocephala* (Germar, 1821) and *A. quadripunctata* (Germar, 1821) based on recently located specimens from the Germar collection. The former species is reinstated from synonymy of the latter one and is redescribed and illustrated based on specimens from Southeastern Brazil. The male and female genitalia are described for the first time. The two species are similar morphologically, but they can be easily distinguished from each other, as well as from the other species of the genus, by their color patterns.

> Key words

Membracoidea, *Aulacizes quadripunctata*, leafhopper, sharpshooter, taxonomy, morphology, Brazil.

1. Introduction

This is the fourth paper of a series on the taxonomy of the leafhopper tribe Proconiini in the Neotropical region. The first three papers included descriptions of two new species and notes on other species in the tribe (Mejdalani & Emmrich 1998; Ceotto, Mejdalani & Felix 2000; Mejdalani 2006).

Young (1968), in his treatment of the genus *Aulacizes* Amyot & Audinet-Serville, 1843 considered *Tettigonia erythrocephala* Germar, 1821 as a junior synonym of *T. quadripunctata* Germar, 1821. He did not examine the types of both species because efforts on the part of European taxonomists have failed to reveal the location of the Germar collection (Young 1968). One of us (DMT) has recently been able to locate the Germar collection in the Ivan Franko National University, Lviv, Ukraine. The study of the type specimens (designated below as lectotypes) of *T. erythrocephala* and *T. quadripunctata* revealed that they are distinct species. Thus, the former one is herein revalidated, redescribed and illustrated. One sharpshooter type located in the Germar collection (*Homalodisca vitripennis* (Germar, Year 1821)) was previously designated by Takiya et al. (2006), but the majority will be treated in a future paper (D.M. Takiya, in prep.).

The morphological terminology adopted herein follows mainly Young (1968, 1977), except for the facial areas of head (Hamilton 1981; Mejdalani 1998), fore wing cells (Mejdalani 1998) and female genitalia (Hill 1970; Davis 1975). Techniques for preparation of genital structures follow those of Oman (1949) for males and Mejdalani (1998) for females. In quoting label data of type material, a reverse virgule (\) separates lines on a label. The specimens studied are deposited in the Ivan Franko National University (IFNU; Lviv, Ukraine), Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ; Rio de Janeiro, Brazil), and North Carolina State University (NCSU; Raleigh, U.S.A.).

2. Taxonomy

Aulacizes Amyot & Audinet-Serville, 1843

Aulacizes Amyot & Audinet-Serville, 1843: 571; YOUNG 1968: 89, figs. 77–81. Type-species: *Tettigonia quadripunctata* Germar, 1821, by monotypy.

YOUNG (1968) reported eight valid species of *Aulacizes* and recorded this genus from Venezuela, Southeastern and Southern Brazil, and Argentina. He observed that the Venezuelan record (the type-locality of *A. basalis* Walker, 1851) is possibly an error. According to him, *Aulacizes* is closely related to *Paraulacizes* Young, 1968 and *Pseudometopia* Schmidt, 1928, from both of which it may be distinguished by the incomplete hind wing vein R_{2+3} and the non-inflated aedeagus with a ventral scoop-shaped apical process. Furthermore, YOUNG (1968) noted that the genitalia of the male and the sternite VII of the female in *Aulacizes* do not appear to offer conclusive specific characters, and that the external characters are, to some degree, also variable. For these reasons he did not attempt to devise a key to the species of *Aulacizes*.

Preliminary phylogenetic analyses of the tribe Proconiini based on morphological and molecular data yielded conflicting results on the position of *Aulacizes* (TAKIYA et al. 2004), although both kinds of data suggested relationships for the genus that are to some extent in agreement with the aforementioned views of YOUNG (1968). The morphological data suggested that *Aulacizes* is the sister group of *Paraulacizes*, whereas the molecular data indicated *Proconosama* Young, 1968 as the sister group of *Aulacizes*. In the morphological hypothesis, *Proconosama* is the sister group of *Aulacizes* + *Paraulacizes*, whereas in the molecular hypothesis *Pseudometopia* is the sister group of *Aulacizes* + *Proconosama*.

Aulacizes erythrocephala (Germar, 1821), sp.rev. (Figs. 1–3, 7–15)

Tettigonia erythrocephala Germar, 1821: 59. Reinstated from synonymy. Type-locality: Brazil.

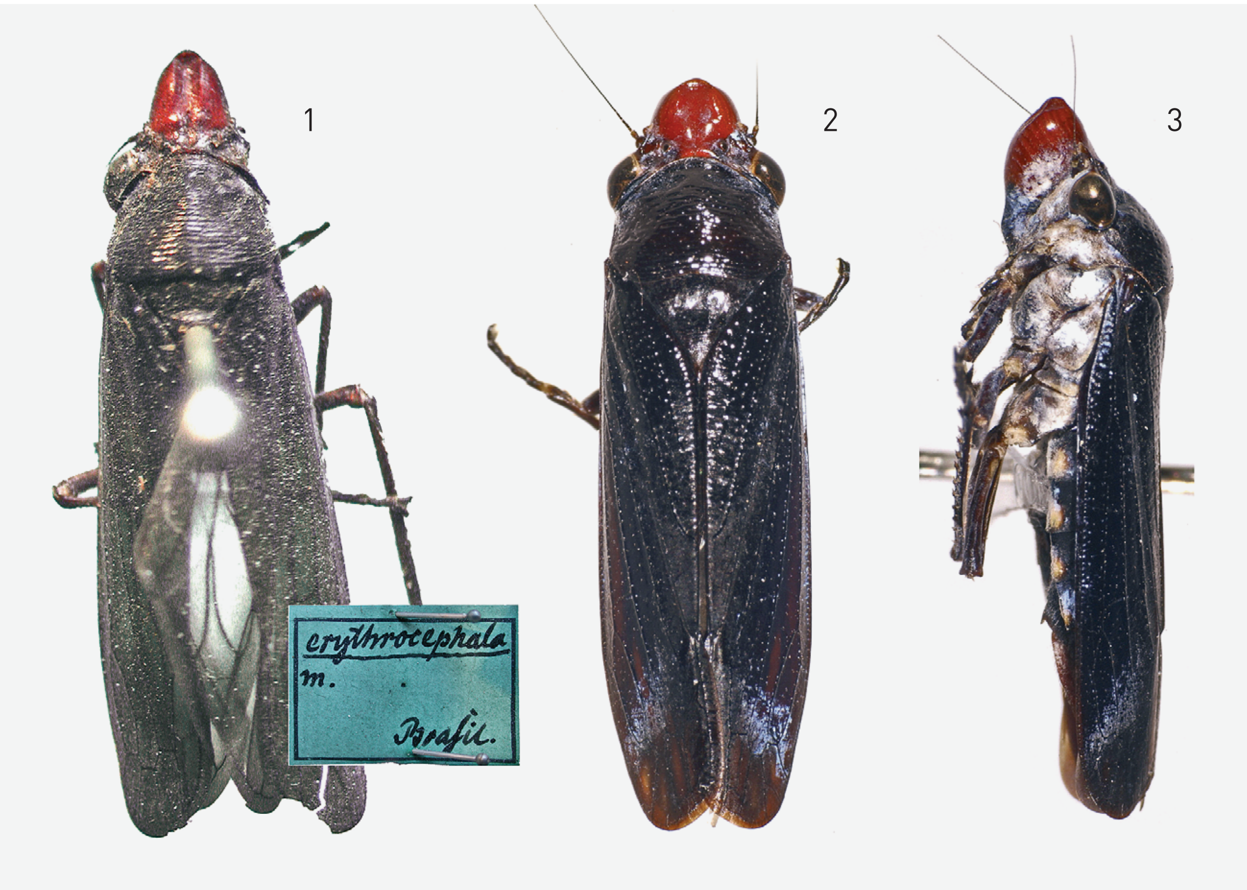
Description. Measurements. Length of male 13.6–14.7 mm (n = 4); length of female 14.3–15.3 mm (n = 5).

Head. Crown (Fig. 7) with median length 8/10 interocular width and 1/2 transocular width; anterior margin carinate medially; apical half with broad, deep median longitudinal fovea; short longitudinal carinae laterad of each ocellus; with slight M-shaped elevation bordering posterior margin. Ocelli (Fig. 7) located approximately on line between anterior angles of eyes, each slightly closer to median line than to adjacent eye angle. Antennal ledges (Fig. 7) with triangular anterior portion produced laterally in dorsal view. Face with long setae, especially on lower portion. Frons with superior portion depressed; muscle impressions distinct, demarcated by transverse rows of setae. Clypeus (Fig. 3) not produced, its contour continuing profile of frons, but with lower portion more horizontal.

Thorax. Pronotum with width slightly less than transocular width of head (Fig. 7); lateral margins slightly convergent anteriorly; posterior $^3/_4$ of pronotal disc with transverse rugae and sparse punctures; dorsopleural carinae complete, anteriorly declivous; posterior margin concave. Mesoscutellum finely transversely striate. Fore wings (Figs. 1, 2) not strongly coriaceous; without distinct membranous area; punctures concentrated mostly along costal margin and clavus; veins elevated and distinct; bases of inner and median anteapical cells approximately aligned, more basal than that of outer anteapical cell; five apical cells, base of second more proximal than base of third; without anteapical discal plexus of veins; without supernumerary anteapical crossveins to costal margin; female fore wings at rest concealing apex of ovipositor. Hind wings at rest extending almost as far posteriorly as fore wings; vein R_{2+3} interrupted. Hind legs with femoral setal formula 2:0:0, first tarsomere shorter than combined lengths of second and third.

Color. Head (Figs. 1, 2), in dorsal view, red; with pair of lateral brown to black maculae adjacent to eyes, extending from antennal ledges to posterior margin (absent in one female from Nova Friburgo, Rio de Janeiro State); ocelli located on inner margins of black maculae; posterior margin of crown with pair of small brown or yellow markings. Remainder of body (Figs. 1, 2), in dorsal view, black without maculae. Face (Fig. 3), in lateral view, with upper $^3/_4$ of frons red, lower fourth of frons and clypeus mostly black; genae with black and brown areas; lora and rostrum mostly dark brown. Thorax (Fig. 3), in lateral view, brownish-yellow with dark brown or black areas; legs mostly dark brown. Specimens may be covered laterally by thick white coat of brochosomes. Abdomen (Fig. 3), in ventral view, mostly black; laterotergites with yellow markings; male pygofer and subgenital plates, in ventral view, mostly red; female pygofer, in ventral view, mostly red; gonoplacs black. The black areas of dried, pinned specimens were mostly dark blue in live specimens collected in Santa Teresa (Espírito Santo State) by RAC.

Male genitalia. Pygofer (Fig. 8), in lateral view, not strongly produced posteriorly; posterior margin convex; dorsal margin with very long slender process



Figs. 1–3. *Aulacizes erythrocephala* (Germar, 1821), sp. reval. **1**: Dorsal view of lectotype and associated label (IFNU). **2–3**: Female specimen from Espírito Santo State, Brazil (MNRJ). **2**: Dorsal view. **3**: Lateral view.

arising near middle, extending ventrally then curved dorsally; disc with dispersed microsetae, concentrated mostly on posteroventral portion and extending anteriorly along ventral margin. Valve (Fig. 8) fused with pygofer laterally. Subgenital plates (Figs. 8, 9) separate throughout their length, extending posteriorly approximately as far as pygofer apex or slightly farther than pygofer apex; subtriangular in ventral view; with short dorsal dentiform projection on lateral margin at mid-length; with numerous scattered microsetae. Styles (Fig. 10) extending farther posteriorly than apex of connective; with distinct external preapical lobe; outer margin beyond lobe with few small setae; apex obtuse. Connective (Fig. 10), in dorsal view, narrowly Y-shaped; arms not widely divergent; stem weakly keeled, longer than arms. Aedeagus (Fig. 11) symmetrical, short; in lateral view with apical ventral scoop-shaped process, which exceeds apex of shaft, lateral portions of process curved dorsomesally and irregularly serrated; with pair of lateral longitudinal projections extending from inferior portion of aedeagal shaft to scoop-shaped process. Paraphyses absent.

Female genitalia. Abdominal sternite VII (Fig. 12) with lateral margins convergent posteriorly; posterior margin deeply emarginate with distinct median lobe; with numerous dispersed microsetae. Internal sternite VIII (Fig. 13) with pair of slightly striated lobed sclerotized areas, which may be connected anteriorly. Pygofer (Fig. 14) produced posteriorly; posterior margin rounded; with numerous dispersed microsetae. Second valvulae of ovipositor (Fig. 15) distinctly broadened beyond basal curvature and then narrowing gradually towards obtuse apex; preapical prominence small but distinct; dorsal margin of shaft with distinct triangular or subtriangular noncontiguous teeth, each bearing denticles; apical portion with dorsal and ventral margins with denticles.

Material. Lectotype (hereby designated): specimen without abdomen and damaged right eye, green label on drawer “erythrocephala \ m. [*mihi* = I, mine] \ Brazil.”, label on pin “EΓ p446” (IFNU). – Southeastern and Southern Brazil (Atlantic Forest): 5♂, 4♀ Espírito Santo State, Santa Teresa [19°56’S 40°36’W], (MNRJ); 2♀ Rio de Janeiro State, Nova Friburgo [22°16’S 42°31’W], (from São Pedro da Serra) (MNRJ).

Figs. 4–6. *Aulacizes quadripunctata* (Germar, 1821). **4**: Dorsal view of male lectotype and associated label (IFNU). 5–6: Female specimen from Santa Catarina State, Brazil (NCSU). **5**: Dorsal view. **6**: Lateral view.

Aulacizes quadripunctata (Germar, 1821) (Figs. 4–6)

Tettigonia quadripunctata Germar, 1821: 59. Young 1968: 90, Fig. 77 a–c, e, f, i–k. Type-locality: São Paulo, Brazil.

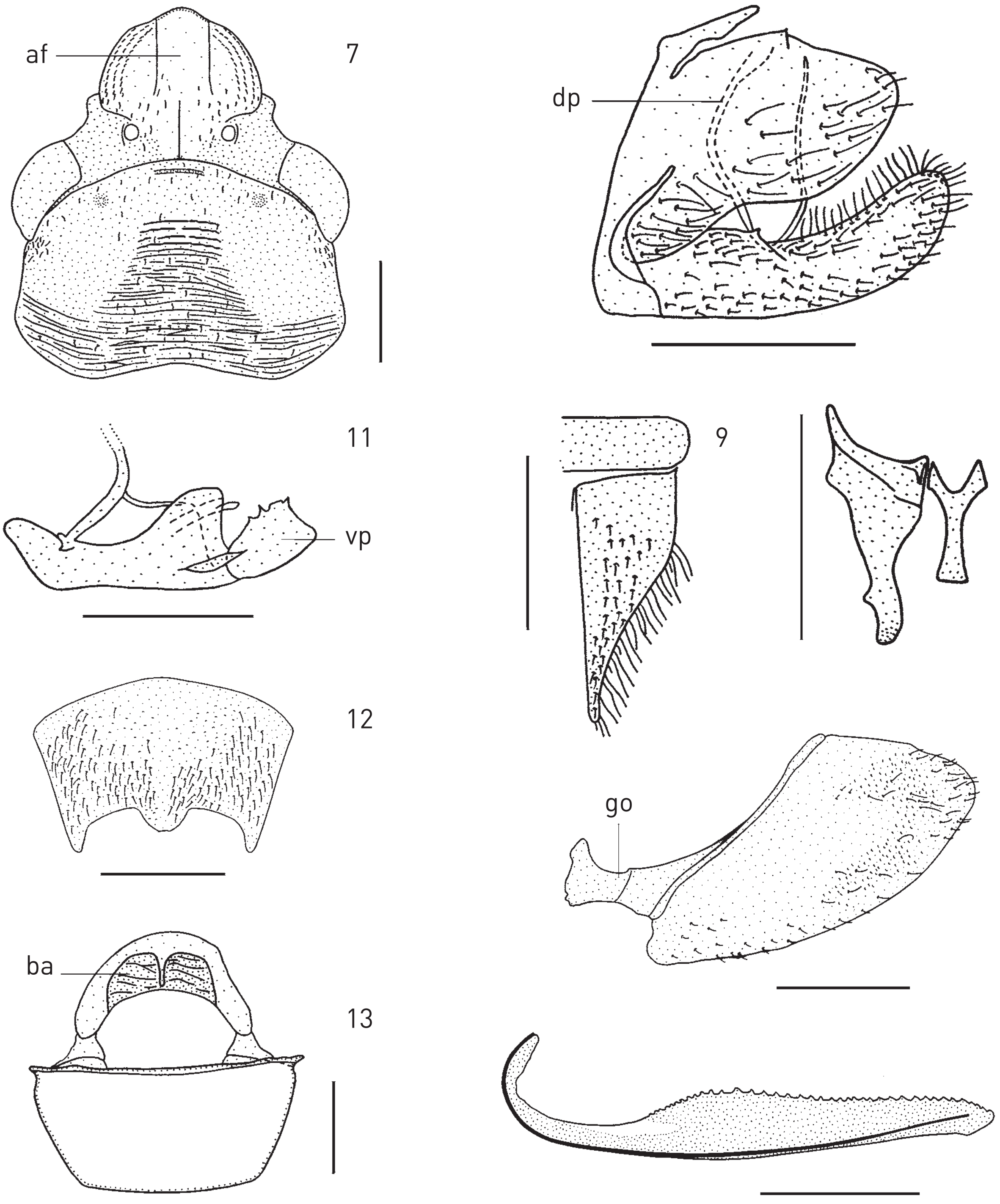
Measurements. Length of male 14.6–16.0 mm (n = 7); length of female 15.2–17.1 mm (n = 16).

Material. Lectotype (hereby designated): ♂, green label on drawer "quadripunctata \ m. [*mihi* = I, mine] \ St. Paul. Brazil.", label on pin "EΓ p448" (IFNU). Paralectotypes: 2♀, same data as lectotype, label on pin "EΓ p447" and "EΓ p449" (IFNU). – Southeastern and Southern Brazil (Atlantic Forest): 1♀ Minas Gerais State: Lambari [21°58'S 45°21'W], (MNRJ). 1♂, 1♀ Rio de Janeiro State: Teresópolis [22°29'S 42°57'W], (from MNRJ and from Vale da Revolta respectively); 2♀ Itatiaia [22°29'S 44°33'W], (MNRJ); 2♂(one from Corcovado), 2♀ (from Floresta da Tijuca) Rio de Janeiro [22°54'S 43°12'W], (MNRJ). 1♂, 2♀ São Paulo State: Bananal [22°41'S 44°19'W], (MNRJ); 1♀ São Paulo [23°32'S 46°38'W], (from Cantareira, Horto Florestal) (MNRJ). 1♂ Paraná State: Arapongas [23°25'S 51°25'W], (MNRJ). 1♀ Santa Catarina State: Corupá [26°25'S 49°14'W], (MNRJ); 1♀ Nova Teutônia [27°03'S 52°23'W], (NCSU); 1♀ Rancho Queimado [27°40'S 49°01'W], (MNRJ); 1♂ no specific locality (NCSU).

3. Discussion

Germar (1821) described the Brazilian sharpshooters *Aulacizes erythrocephala* and *A. quadripunctata* providing a good account of their distinct color patterns. Dorsally, both species are mostly dark (dark brown to bluish black), but *A. erythrocephala* (Figs. 1, 2) has only the apical portion of the crown red, while *A. quadripunctata* (Figs. 4, 5) has the whole crown and anterior portion of the pronotum red, with, as its name suggests, four large black maculae (one on the apex of the crown, a pair around the ocelli, and a median one on the anterior portion of the pronotum). After correctly identifying these species based on Germar´s (1821) descriptions, Blanchard (1840) and Signoret (1855: pl. 12 figs. 9, 10) redescribed and illustrated specimens of these two species, keeping their identities separate. Based on Signoret´s illustrations, Stål (1862) was even able to record *A. erythrocephala* from Rio de Janeiro State, previously described from an unknown locality in Brazil.

Previous attempts to locate the Hemiptera collection of Ernst F. Germar were unsuccessful (Schröder 1957: 257; Young 1968: 2). However, it has not been lost and as correctly indicated previously (Schröder 1957; Horn et al. 1990), the Hemiptera collection was



Figs. 7–15. *Aulacizes erythrocephala* (Germar, 1821), sp. reval. **7**: Crown and pronotum, dorsal view. 8–11: Male genitalia. **8**: Pygofer, valve and subgenital plate, lateral view. **9**: Valve and subgenital plate, ventral view. **10**: Connective and style, dorsal view. **11**: Aedeagus, lateral view. 12–15: Female genitalia. **12**: Sternite VII, ventral view. **13**: Internal sternite VIII and tergite VIII, dorsal view. **14**: Pygofer, lateral view. **15**: Second valvula of ovipositor, lateral view. All scale bars represent 1.0 mm, except 0.5 mm in Fig. 11. af: apical fovea, ba: bilobed sclerotized area of sternite VIII, dp: dorsal process, go: gonangulum, vp: ventral scoop-shaped process.

kept in Lemberg, which is currently the City of Lviv in Ukraine. In this collection, specimens of these two species determined by Germar´s handwriting (Figs. 1, 4; compare to Horn et al. 1990: pl. 37 fig. 36) were found and viewed as syntypes, because they agree perfectly with the description and their labels match the collecting localities given in the original paper (Germar 1821). Besides Germar´s main Hemiptera collection in Lviv, additional specimens may have been donated to other museums, such as the Zoologisches Institut und Museum Hamburg (vide Weidner & Wagner 1968). The single specimen of *A. erythrocephala* and the single male of *A. quadripunctata* from the syntype series found in Lviv are herein selected and designated as lectotypes (ICZN 1999, article 74.1).

Young (1968) based his concept of *A. erythrocephala* on a specimen from the Heyer collection in the Zoologisch Institut und Museum Hamburg, which he believed to be eligible as a lectotype, but never did designate it as such. Because of this wrongful concept, Young (1968) thought *A. erythrocephala* to be conspecific with *A. quadripunctata*, both described simultaneously by Germar (1821: 59). According to the International Code of Zoological Nomenclature (ICZN 1999, Article 24.2), Young acted as the first reviser, fixing the precedence of *Tettigonia quadripunctata* over *T. erythrocephala* and synonymizing these two species. Nevertheless, the study of the herein designated lectotypes shows that they are indeed separate species, consequently *A. erythrocephala* is herein revalidated.

Aulacizes erythrocephala and *A. quadripunctata* can be easily distinguished by their color patterns. Besides the distinct coloration of the crown and pronotum mentioned above, the clypeus is mostly black in *A. erythrocephala* (Fig. 3), whereas in *A. quadripunctata* (Fig. 6) it is distinctly red. The available data on body length suggest that males and females of *A. erythrocephala* tend to be smaller (13.6–14.7 mm and 14.3–15.3 mm, respectively) than those of *A. quadripunctata* (14.6–16.0 mm and 15.2–17.1 mm, respectively), but some size overlap occurs. The male genitalic structures of these two species differ slightly in quantitative traits, being remarkably similar, a fact noted previously by Young (1968) for this genus. The female genitalic structures known to vary interspecifically in other cicadellines (Nielson 1965; Young 1968; Takiya & Cavichioli 2004), such as the shape of sternites VII and VIII (Figs. 12, 13), bases of first valvulae of ovipositor, and shape of second valvulae (Fig. 15) are also indistinguishable. Finally, the presence of a sclerotized sternite VIII (Fig. 13) is herein for the first time reported for the genus *Aulacizes*.

4. Acknowledgements

The manuscript benefited from the useful comments of A. Carvalho (MNRJ), M. Felix (MNRJ), and M. Webb (The Natural History Museum, London). M. Hauser (California Department of Food and Agriculture, Sacramento) and F. Geller-Grimm (Museum Wiesbaden) were essential in obtaining literature. We thank R. Blinn and L. Deitz (NCSU) for the loan of specimens. Visit to the Germar collection in Lviv by DMT was supported by an Enhancement Fund from the School of Integrative Biology, University of Illinois at Urbana-Champaign to DMT, and a University of California Pierce's Disease Research Grant to S. McKamey (Systematic Entomology Laboratory, USDA-ARS, Washington, D.C.). Furthermore, this visit would not have been possible without the support of I. Shydlovsky and O. Holovachov (IFNU). Fellowships from Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, Brazil) for doctoral studies abroad to DMT (Proc. 200833/00-6) and Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES, Brazil) for M.Sc. studies to RAC are greatly acknowledged. This study was supported in part by Fundação Universitária José Bonifácio (FUJB).

5. References

Blanchard, E. 1840. Histoire Naturelle des Insectes Orthoptères, Néuroptères, Hémiptères, Hyménoptères, Lépidoptères, et Diptères. – P. Duménil, Paris, **3**: 672 pp.

Ceotto, P.C., G. Mejdalani & M. Felix 2000. Notes on Neotropical Proconiini (Hemiptera, Cicadellidae, Cicadellinae), II: description of the female of *Anacrocampsa wagneri* Young, 1968. – Boletim do Museu Nacional (Zoologia) **435**: 1–8.

Davis, R.B. 1975. Classification of selected higher categories of auchenorrhynchous Homoptera (Cicadellidae and Aetalionidae). – Technical Bulletin of the United States Department of Agriculture **1494**: 1–52.

Germar, E.F. 1821. Bemerkungen über einige Gattungen der Cicadarien. – Magazin der Entomologie **4**: 1–106.

Hamilton, K.G.A. 1981. Morphology and evolution of the rhynchotan head (Insecta: Hemiptera, Homoptera). – Canadian Entomologist **113**: 953–974.

Hill, B.G. 1970. Comparative morphological study of selected higher categories of leafhoppers (Homoptera: Cicadellidae). – University Microfilms, Ann Arbor, xi + 187 pp.

Horn, W., I. Kahle, G. Friese & R. Gaedike 1990. Collectiones entomologicae, ein Kompendium über den Verbleib entomologischer Sammlungen der Welt bis 1960, Teil I: A bis K. – Akademie der Landwirtschaftswissenschaften der Deutschen Demokratischen Republik, Berlin, 220 pp.

(ICZN) International Commission of Zoological Nomenclature 1999. International Code of Zoological Nomenclature, fourth edition. – International Trust for Zoological Nomenclature, London, 306 pp.

Mejdalani, G. 1998. Morfologia externa dos Cicadellinae (Homoptera, Cicadellidae): comparação entre *Versigonalia ruficauda* (Walker) (Cicadellini) e *Tretogonia cribrata* Melichar (Proconiini), com notas sobre outras espécies e análise da terminologia. – Revista Brasileira de Zoologia **15**: 451–544.

Mejdalani, G. 2006. Notes on Neotropical Proconiini (Hemiptera: Cicadellidae: Cicadellinae), III: redescription of the Amazonian sharpshooter *Ichthyobelus youngi* Kramer. – Deutsche Entomologische Zeitschrift 53: 108–113.

Mejdalani, G. & R. Emmrich 1998. Notes on Neotropical Proconiini: new species of *Acrobelus* Stål and *Dichrophleps* Stål and the male of *Proconosama haenschi* (Melichar) (Insecta: Auchenorrhyncha: Cicadellidae: Cicadellinae). – Entomologische Abhandlungen des Staatlichen Museums für Tierkunde Dresden **58**: 131–140.

Nielson, M.W. 1965. A revision of the genus *Cuerna* (Homoptera, Cicadellidae). – Technical Bulletin of the United States Department of Agriculture **1318**: 1–48.

Oman, P.W. 1949. The Nearctic leafhoppers (Homoptera: Cicadellidae). A generic classification and check list. – Memoirs of the Entomological Society of Washington **3**: 1–253.

Schröder, H. 1957. Neues zur Gattung *Homalodisca* (Ins. Hom. Cicad.). Senckenbergiana Biologica **38**: 251–258.

Signoret, V. 1855. Revue iconographique des Tettigonides. – Annales de la Société Entomologique de France **3**: 225–240.

Stål, C. 1862. Bidrag till Rio Janeiro – Traktens Hemipter – Fauna. – Kongliga Svenska Vetenskaps-Akademiens Handlingar **3**: 1–70.

Takiya, D.M. & R.R. Cavichioli 2004. A review of the Neotropical sharpshooter genus *Onega* Distant. – Zootaxa **718**: 1–19.

Takiya, D.M., S.H. McKamey & R.R. Cavichioli 2006. Validity of *Homalodisca* and of *H. vitripennis* as the name for glassy-winged sharpshooter (Hemiptera: Cicadellidae: Cicadellinae). – Annals of the Entomological Society of America: **99**: 648–655.

Takiya, D.M., R.A. Rakitov, C.H. Dietrich & G. Mejdalani 2004. Dados morfológicos e moleculares na filogenia da tribo Proconiini (Hemiptera: Cicadellidae). – In: Resumos, XXV Congresso Brasileiro de Zoologia. Sociedade Brasileira de Zoologia and Reginaldo Constantino, Brasília, p. 124.

Weidner, H. & W. Wagner 1968. Die entomologischen Sammlungen des Zoologischen Staatsinstituts und Zoologischen Museums Hamburg, VII. Teil, Insecta IV. – Mitteilungen aus dem Hamburgischen Zoologischen Museum und Institut **65**: 123–179.

Young, D.A. 1968. Taxonomic study of the Cicadellinae (Homoptera: Cicadellidae), Part 1, Proconiini. – Bulletin of the United States National Museum **261**: 1–287.

Young, D.A. 1977. Taxonomic study of the Cicadellinae (Homoptera: Cicadellidae), Part 2, New World Cicadellini and the genus *Cicadella*. – Technical Bulletin of the North Carolina Agricultural Experiment Station **239**: 1–1135.