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Phylogeny and systematics of the leafhopper subfamily Ledrinae (Hemiptera: Cicadellidae)

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Abstract

Ledorinae represent a relatively small subfamily within the very large and diverse leafhopper family Cicadellidae. Prior to this study, the subfamily contained approximately 450 species in 5 tribes and 73 genera distributed worldwide, but primarily in Australia, Africa, and the Indomalayan region. Several authors have suggested Ledorinae are not monophyletic, and recent studies based on molecular and morphological data have called the existing classification into question. The goals of this study were to collect and analyze morphological data under rigorous phylogenetic criteria in order to test the monophyly of Ledorinae, provide robust definitions for the subfamily and its tribes, and provide a phylogenetic framework for understanding relationships among these leafhoppers. New phylogenetic hypotheses are presented here regarding the monophyly of Ledorinae and its included tribes. A total of 235 morphological characters were coded for 60 species from 31 genera in the tribes Ledorini and Petaloccephalini, 5 species from the tribes Stenocotini, Thymbrini, and Xerophloeini, and 10 species selected as outgroups from various other cicadellid subfamilies. Data were analyzed in PAUP*, resulting in a single completely resolved topology with many well-supported nodes. Ledorinae, as previously defined, were found to be polyphyletic with respect to Stenocotini, Thymbrini, and various ledorine genera, which were placed with the outgroup taxa. Stenocotini and Thymbrini were placed with Tartessinae, agreeing with results of other recent studies. *Rubria*, *Hespenedra*, and the *Afrorubria* genus group formed independent lineages within Ledorinae. The tribe Xerophloeini was placed as a basal lineage within Ledorinae closely associated with the *Afrorubria* group. Ledorini and Petaloccephalini, as previously defined, did not form monophyletic lineages, but were randomly interspersed (paraphyletic) with respect to one another. Stenocotini and Thymbrini are here removed to the subfamily Tartessinae, and Petaloccephalini is made a synonym of Ledorini. The new tribes Afrorubrini, Hespenedrini, and Rubrini are described within Ledorinae by the first author, and several new informal genus groups are named. Within Ledorini, *Epiclinata* Metcalf is made a synonym of *Tituria* Stål, *Epiclinata planata* (Fabricius) and *Epiclinata flavomarginata* Kuoh & Cai are moved to *Tituria*, *Tituria obtusa* Walker is moved to *Thlasia* Germar, and two additional species are included in *Latycephala* McKamey as new combinations. Taxa placed outside of Ledorinae in this analysis are removed to other subfamilies or considered unplaced within Cicadellidae. This newly revised classification strengthens hypotheses that the Ledorinae are a very old group within Cicadellidae. As here defined, the subfamily includes five tribes with a total of 38 genera and approximately 300 species.

Key words: Afrorubrini, Auchenorrhyncha, distribution, Hespenedrini, Homoptera, identification, key, Ledorini, morphology, new tribe, phylogeny, Rubrini, Stenocotini, Thymbrini, Xerophloeini, revision