ABSTRACT

BALME, GEOFFREY ROBERT. Phylogeny and Systematics of the Leafhopper Subfamily Typhlocybinae (Insecta: Hemiptera: Cicadellidae). (Under the direction of Lewis L. Deitz and Brian M. Wiegmann.)

This research examined the phylogeny of the tribes of the leafhopper subfamily Typhlocybinae using both morphological, 73 binary and multistate characters, and molecular, 16S rDNA and Histone (H3), evidence. Seventy-five taxa were included in the morphological study, and 48 were included in the molecular analysis. The combined, total evidence, analysis used 48 taxa common to both sets of data. Results of the total evidence analyses suggested four tribes with the following topology: Alebrini + (Empoascini + Typhlocybini) + (Dikraneurini including subtribe Erythroneurina). This topology does not completely resemble any of the last century's major typhlocybine works, but comes closest to Dr. Young's 1952 reclassification of the Western Hemisphere Typhlocybinae.

Based on the results of these analyses, a revised classification is proposed which synonymizes tribes Forcipatini Hamilton 1998 and Erythroneurini Young 1952 as Dikraneurini McAtee 1926, Jorumini McAtee 1926 and Helionini Haupt 1929 as Empoascini Distant 1908, and Zyginellini Dworakowska 1977 as Typhlocybini Distant 1908. A key is provided to distinguish the tribes, and each is described with notes on distribution and evolutionary relationships, a list of the included genera (current to February. 2007), and illustrations of key morphological characters.

DISCLAIMER

Nomenclatural acts included in this thesis are not considered published within the meaning of the 1999 International Code of Zoological Nomenclature (see Article 8.3). This work will be published in parts elsewhere, in accordance with Article 8 of the Code.

This dissertation is based upon work supported by the National Science Foundation under Grant number 9978026 and by the North Carolina Agricultural Research Service. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of the National Science Foundation or the North Carolina Agricultural Research Service.

PHYLOGENY AND SYSTEMATICS OF THE LEAFHOPPER SUBFAMILY TYPHLOCYBINAE (INSECTA: HEMIPTERA: CICADELLIDAE)

by
GEOFFREY R. BALME

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APPROVED BY:

P. Sterling Southern	Samuel C. Mozley
Lewis L. Deitz Co-Chair of Advisory Committee	Brian M. Wiegmann Co-Chair of Advisory Committee

BIOGRAPHY

Geoff Balme was born and grew up in rural Rhode Island, where he hunted, fished and developed a strong appreciation of nature. He graduated from Coventry High School in 1982 and went to work in various jobs through most of the 1980s. In 1997 Geoffrey obtained his B.A. in Biology from the University of Rhode Island, in Kingston, and went on to earn a Master's degree also from U.R.I. (2000) in Natural Resources under the direction of three charismatic entomology professors: Richard Casagrande, Roger Lebrun, and Patrick Logan. Geoff's Master's project focused on the natural herbivory of the wetland grass *Phragmites australis*. During this study, Geoff proved an herbivory link between *Poanes viator* (the Salt Marsh Skipper) and *Phragmites*, as well as attempting a growth regulation, on the same reed, through inundative release of *Rhizedra lutosa*, a recently discovered non-endemic noctuid species.

In August 2000, Geoff came to North Carolina State University to pursue his interest in systematics with Dr. Lewis Deitz. Supported by a National Science Foundation PEET project, Geoff focused on the tribal level relationships within the Typhlocybinae leafhoppers, a large, widespread, and diverse subfamily of minute leafhoppers. While studying these insects, he also committed himself to numerous outreach activities and served as a teaching assistant for several courses including the required graduate level entomology courses: Insect Systematics (ENT 502) and Insect Physiology and Morphology (ENT 503). Geoff also taught a new course in spring 2007, Introduction to Forensic Entomology (ENT 305) and was nominated for a Teaching Assistant of the year award for Introduction to Entomology (ENT 425). In 2001, Geoff visited major entomological collections in London (The Natural History

Museum and Linnean collections), Oxford, Paris, and Dresden. In 2004, he took part in a collecting and museum trip in Taiwan with Dr. Chris Dietrich.

Avid hiker, mushroom collector, insect identifier, musician, and martial artist, Geoff resides in Raleigh, N.C., with his dog and cockatoo.

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I am grateful to the following individuals for hospitality and lending specimens [the four letter coden following each individual's name refers to their institution as listed in Arnett et al. (1994)]: S.H. McKamey and T.J. Henry, National Museum of Natural History (USNM); R.L. Blinn, North Carolina State University (NCSU); M. Boulard, and T. Bourgoin, Muséum national d'Histoire naturelle (MNHN); M.D. Webb, The Natural History Museum (BMNH); G.C. McGavin, Oxford University Museum of Natural History (OXUM); R. Emmrich, Staatlisches Museum für Tierkunde (SMTD); N.D. Penny and K.J. Ribardo, California Academy of Sciences (CASC); M.M. Yang and J.F. "Afu" Tsai ,National Chung Hsing University (NCHU); and especially C.H. Dietrich, Illinois Natural History Survey (INHS).

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Music is a special source of satisfaction for me and I'm indebted to the works of Bob Dylan, Can, Stereolab, the late John Fahey, Ornette Coleman, and Captain Beefheart and His Magic Band for many hours of stress-relief and inspiration.

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INTRODUCTION

The leafhopper family Cicadellidae (ca. 22,000 described species) is among the 10 largest families of insects (Hamilton 1984). In North America, only about 70% of the species are thought to be described (Kosztarab *et al*. 1990), and recent collecting indicates that a much higher percentage of the fauna of other regions remains undescribed (C.H. Dietrich and S. H. McKamey, personal communication). Two of its subfamilies, Deltocephalinae and Typhlocybinae, together comprise roughly half of the world's species of the suborder Membracoidea, but neither has been revised in a comprehensive manner.

The focus of this research is on the higher-level relationships within the subfamily Typhlocybinae. Despite its tremendous taxonomic diversity, ubiquity in terrestrial ecosystems, and substantial economic importance, taxonomic expertise for this group is scarce, and daunting problems in the phylogeny and classification remain unaddressed. For example, species in enormous genera such as *Empoasca* and *Erythroneura* (both exceeding 800 described species) are essentially unidentifiable by non-experts because there are no comprehensive keys, and treatments of individual species are scattered throughout the literature. In fact, what few identification guides exist for these groups are incomplete or essentially nonexistent; species identification requires reference to scores of papers and hundreds of descriptions and illustrations. Difficulties also surround tribal diagnoses. Few workers agree on tribal descriptions, and, with few exceptions, tribes have been erected based on local faunal groupings from limited areas (Ruppel 1987).

With approximately 5000 described species, Typhlocybinae currently rank as the second largest membracoid subfamily (Table 1). Most species seem to be highly host specific, usually feeding on particular genera or species of woody plants, and this, coupled with their diminutive size (enabling species to section environs into microhabitats), may help to explain the group’s enormous diversity (Janzen 1976). Typhlocybinae comprise a dominant component of herbivore species richness in temperate and tropical forests, where individual forest trees may harbor 12-30 species (McClure & Price 1975, 1976; Novikov & Dietrich 2000). The subfamily includes major pests such as the potato leafhopper (*Empoasca fabae* Harris), white apple leafhopper (*Typhlocyba pomaria* McAtee), and grape leafhoppers (*Erythroneura comes* (Say) and related species).

Due to their small size (most 2-4 mm), worldwide distribution, and species richness, Typhlocybinae have long been the bane of leafhopper taxonomists. Ribaut (1936) and Young (1952) independently arranged European and Western hemisphere species into genus groups (tribes in Young's case), but used different criteria (male genitalia versus wing venation) to diagnose these groups, resulting in alternative classifications in which the status or placement of several tribes remained uncertain. Young’s 1965 inclusion of the Mileewini (as Mileewanini) in the Typhlocybinae has been rejected, especially by Mahmood (1967). Other workers tend to treat the Jorumini, Eupterygini and Helionini as synonyms of longer established tribes. Hamilton (1983), in an effort to simplify cicadellid classification, controversially reduced the most accepted tribes to subtribes and moved six additional cicadellid subfamilies into the Typhlocybinae as tribes. Forcipatini (Hamilton 1998) and Bakerini (Mahmood 1967) were erected primarily on the basis of genital characters and have either been ignored or synonomized (Dworakowska 1970). To date no tribal level phylogenetic analyses of typhlocybine taxa have been performed. Species identification are based solely on descriptions. Undescribed but distinct typhlocybine leafhoppers are continually being collected especially from tropical areas, and the numbers of described genera and species are likely to increase dramatically in the near future.

Table 1. Estimated diversity and distribution of the major leafhopper subfamilies Deltocephalinae and Typhlocybinae. Nearctic (Near.); Neotropical (Neot.); Palearctic (Pale.); Afrotropical (Afro.)[=Ethiopian], Indomalayan (Indo.) [=Oriental], Australian (Aust.) (C. H. Dietrich, and S.H. McKamey personal communication).

Subfamily	Number of currently accepted (sensu Oman *et al*. 1990):			Numbers of described species by region:					
	tribes	genera	species	Near.	Neot.	Pale.	Afro.	Indo.	Aust.
Deltocephalinae	23	985	8500	2000	1000	2500	1800	1000	200
Typhlocybinae	9	450	5000	1000	900	1100	400	500	100

Taxonomically, the subfamily Typhlocybinae is a notoriously challenging group for several reasons: (1) the subfamily is extremely diverse, with more than 450 genera and subgenera and approximately 5000 described species (S. H. McKamey's Biota database); (2) many additional taxa await discovery and description, especially in the Neotropical region (C.H. Dietrich, personal. communication); (3) its members are relatively small insects; (4) the male genitalia must be dissected to identify most genera and species, and the identification of females is impossible without associated males; (5) dissections are time-consuming, tedious, and require great skill; (6) tribes are currently recognized by hind wing venation, including anal veins which require full extension, and unfolding of the fragile anal fold (7) the taxonomic literature is vast and widely scattered among numerous journals and monographs; (8) few of the major workers on the group included taxonomic keys to aid in identification to the generic and specific levels; (9) morphological terminology can be quite variable amongst workers (for example, forewing apical cells are numbered 1-4 starting with innermost to outermost, which is reversed in membracid work); (10) although 19 tribes and 5 subtribes have been erected for dealing with the large number of genera, there is little agreement on the higher classification; (11) types and other authoritatively identified materials are widely dispersed among insect collections; (12) specimens are generally not well prepared (often the male genitalia are glued in a dry state to a card mount, rather than preserved in glycerine, and the hind wings, which hold key features for identification, are not readily visible).

Early nomenclature for the Typhlocybinae is confusing as *Eupteryx* (rather than *Typhlocyba*) was used, by both Baker (1915) and McAtee (1926), as the type genus for the subfamily, as well as being later placed as a junior synonym of *Cicadella* (Ruppel 1987). So much difficult work remains to be done, from the species level to the tribal level, that the task is overwhelming for any single taxonomist or project. A full revision of this subfamily is almost certainly beyond the lifetime goal that any one individual could hope to achieve. Therefore, the focus of the present work, and a major first step, is to provide a more stable higher-level classification, based on broad morphological and molecular evidence, on which to base an organizational context for the morphology, molecular systematics, biology, biogeography, behaviour, and ecology of the group and also, to impart predictive criteria for newly discovered taxa.

The objectives of the following research are to: (1) establish the phylogenetics limits of the leafhopper subfamily Typhlocybinae and its included tribes using morphological and molecular evidence, (2) determine evolutionary relationships among the tribes, (3) develop a revised phylogenetic classification with improved predictive value for interpreting biological and geographical patterns, and (4) facilitate tribal indentification through new taxonomic keys and morphological descriptions.

This research combines morphological data from the head, thorax, abdomen, and male genitalia, as well as molecular data from genes 16S rDNA and Histone H(3). Leg chaetotaxy terminology follows Rakitov (1998). Wing venation (Fig. 2A,B) follows Dietrich (2005: fig.3) except for apical cell designations: cell R_3 = apical cell 4 (also known as outer apical cell), cell R_5 = apical cell 3, cell M_2 = apical cell 2, cell M_4 = apical cell 1 (also known as the inner apical cell) which follow Deitz (1975).

The tribal key as well as all tribal descriptions are based on the analyses contained herein. The lists of genera included in each tribe are based in part on McKamey's database of Cicadellidae (S.H. McKamey personal communication).

LITERATURE REVIEW

Over the past 100 years the Typhlocybinae have undergone a great deal of addition and revision. Here I include a chronological list of major Typhlocybinae workers along with a summary of their contributions. It is not meant to be comprehensive.

W. L. Distant. The first major worker on the subfamily Typhlocybinae, Distant (1908), recognized two subfamilies based entirely on hind wing venation. Species with open cells in the hind wing he called Typhlocybaria, while those with closed apical cells in the hind wing he called Empoascaria. By 1918 Distant had described some 75 species in 16 genera. His was by far the most comprehensive work on the group for several decades (Metcalf 1968).

W. L. McAtee. Although *Typhlocyba* had been in use as the name bearer for the subfamily for 47 years (Kirschbaum 1868; (Metcalf 1968), McAtee incorrectly followed Baker (1915) in using *Eupteryx* as the type genus of Typhlocybinae, and emended the subfamily name to Eupteryginae. Baker (1915) first used *Eupteryx* to form the tribe Eupterygini.

McAtee (1926) defined the subfamily thus: "Sectors of hind wing usually evanescent basally, no forks or crossveins discernible in that part of tagmen; crossveins or anastomosing of sectors usually lacking also on disk of hind wing; anteapical cells rarely present; claval veins usually indistinguishable, the full complement never visible, ocelli usually lacking, when present, close to eyes (less than their own diameters from front margins of eyes)." He also described the tribe Dikraneurini as lacking an appendix in the forewing, and possessing a submarginal vein enclosing all the apical cells in the hind wing, and the tribe Jorumini as lacking an appendix in the forewing, and having one or two closed and one open cell in the hind wing and as possessing ocelli.

In 1934, McAtee stated that the usual subfamily definition -- small, fragile, often brightly colored leafhoppers with the venation of the forewings variously reduced and usually indistinct basally -- was not sufficient. While this is a common concept given for the group Eupteryginae (=Typhlocybinae), McAtee suggested it applies equally to the Jassidae (=Cicadellidae) in general. He then eliminated the ocelli placement as a key determinant and finished with the statement that the segregation of leafhoppers into well-marked families seemed a hopeless task. "If we constantly refer to specimens and heed intergradation we find that attempts to draw sharp lines of distinction fail in every direction." Nonetheless, McAtee provided a tribal key for Alebrini, Dikraneurini, Jorumini, and Eupterygini based on the number of closed cells in the hind wing, elaborating on the work of Distant. He then provided generic keys based almost entirely on forewing venation for each of these tribes. They included, the genera *Alebra* and *Protalebra*, as well as subgenera *Plagalebra*, *Paralebra, Aphanalebra*, *Kallebra* for the Alebrini; the genera *Parallaxis, Aneono, Kahaono, Dikraneura*, *Typhlocybella, Idona, Dikraneuroidea, Hybla, Eualebra, Empoanara, Heliona, Apheliona, Dialecticopteryx, Empoasca,* as well as subgenera *Hyloidea, Alconeura, Notus, Dikraneura, Koma, Kybos, Empasca, Acia, and Endeia* for the tribe Dikraneurini; genus *Joruma* and subgenera *Joruma* and *Jorumella* for the Jorumini; and finally, the genera *Eupteryx*, *Sirosoma, Molopoterus, Typhlocyba*, *Hymetta, Erythroneura*, *Aidola*, and *Zyginella* for the tribe Eupterygini.

McAtee was one of the few workers to deal with New World Typhlocybinae.

H. Haupt. Haupt (1929) considered the current major subfamilies of leafhoppers as families. He defined Typhlocybidae as a family based on the lack of transverse wing veins basally, and the presence of a wax gland on the costal margin of the wing. He also mentioned a detail about the hind femur, pointing out their lack of thickness and curvature. According to Haupt, subfamilies within this family were: Empoascinae (those typhlocybines with ocelli such as *Alebra*, *Chlorita*, and *Empoasca)*, Eupteryginae (those with scars rather than ocelli [vestigial ocelli], including *Erythria*), and Typhlocybinae (those completely lacking ocelli, including *Typhlocyba*, *Erythroneura*, *Eurhadina*, *Heliona*, and *Zyginella*). As a result, Eupterygini is considered a tribe separate from Typhlocybini erected by Haupt (1929).

H. Ribaut. Despite confining himself to the French fauna, Ribaut's (1936) description of the family Typhlocybidae is quite thorough. He also provided descriptions for genus groupings. Ribaut noted five characters important for distinguishing the typhlocybines from the jassids (=Cicadellidae): (1) wing veins simplified, veins not dividing on the forewing disk; (2) anepisternum and catepisternum without a suture or other clear separation (without anapleural suture); (3) males with stridulatory apparatus; (4) hind first tarsomere without apical crown macrosetae; (5) waxy area of tegmina well delimited.

Ribaut's family description noted that the crown lacks a sharp carina so that typhlocybines have a smooth transition from crown to frons (with a few exceptions in dikraneurine groups). Also, ocelli are usually not present except in alebrines, empoascines and some Typhlocybini; and their placement, when present, is on the margin, not the crown. Ribaut noted that females almost always have a more angular vertex than males, but the difference is very small. He described the posterior margin of the head as concave.

Ribaut also described the antennae, the shape of the scutellum (as triangular with a lateral scar), and again, the lack of an obvious suture separating the episternum from catepisternum. He further stated that in the males the abdominal appodemes are present, extend from sternite II to as far as sternite VI, and are probably used like drums. He also described a sclerotized anal collar at the base of the anal tube in the males of *Erythroneura* and *Empoasca*. On the legs he described two macrosetae on the first and second distal femur and provided the 2+1+1 macrosetal formula distally on the hind femur. Ribaut noted the two dorsal and two ventral rows of macrosetae on the hind tibia, and the acuminate tarsomere I of the hind leg.

Ribaut described the wing venation as diagnostic for genus groups. Also, he stated that the wings are always well developed, reaching at least the posterior extremity of abdomen (with the exception of *Erythridia*, which are brachypterous). The discal part of wing has four simple longitudinal veins, the subcosta being confluent with the outer margin of wing. He noted that the veins become indistinct basally and never branch, and that the waxy area on the forewing is almost always well delimited with fine striations on the underside of this area. In the hind wing he noted the submarginal vein's clear importance for dividing the groups based on how many longitudinal veins are enclosed, *i.e.*, just the vannal and Cu2 for certain *Typhlocyba*, to all of them for *Dikraneura* and *Alebra*.

He mentioned the coupling mechanism (hamulus) on the outer middle edge of the hind wing as present and clear. Lastly, he stated that the male genitalia are diagnostic, but female genitalia are not.

J. W. Evans. In 1947, Evans wrote that the Typhlocybinae have been considered both the most derived and most pleisiomorphic group of leafhoppers. He also reiterated McAtee's statement about the hopelessness of the task of classification of the group (see above). Nevertheless, Evans stated that "None will at the same time deny the existence of several distinct groups of leaf-hoppers, even though it is often difficult to differentiate between these by means of characters based on persistent structural features." He stated that typically the typhlocybines are poorly differentiated, and gave their size at 2-4mm. Evans refrained from using McAtee's tribes (Alebrini, Dikraneurini, Jorumini, and Cicadellini) due, he wrote, to his insufficient knowledge of the subfamily. Still, he described their lack of ocelli, flatness, wax oval on the forewing, and a ventral frons as distinctive for the subfamily.

D. M. DeLong . DeLong (1948) defined the Cicadellinae (=Typhlocybinae) as small and frail, noting that this characteristic alone is usually sufficient to separate them from the other groups. He further stated that the lack of crossveins on the disk of the tegmina and the usual lack of ocelli characterize the group. DeLong dealt only with the Nearctic genera and did not divide them into tribes. He provided a key based almost entirely on wing ventation (with one couplet mentioning the specialized male plates in *Forcipata*, and one couplet mentioning scutellar elevation) to distinguish the following genera: *Alebra*, *Protalebra*, *Empoasca*, *Alconeura*, *Dikraneura*, *Forcipata*, *Idona*, *Dikraneuroidea*, *Joruma*, *Cicadella*, *Typhlocyba*, *Hymetta*, and *Erythroneura*.

P.W. Oman. Small, usually fragile and often brightly colored leafhoppers is how Oman (1949) described the Cicadellinae (=Typholocybinae). He synonymized McAtee's

Eupterygini with Cicadellinae after realizing Cicadellini had priority. Oman added as diagnostic of the subfamily that the lora and genae are indistinctly separated, the clypellus extends past genae, and that the clypeal suture is often indistinct, but when visible is straight. Ocelli were present or absent, and if present, with lateral frontal sutures extending to them. He also described the wing venation as reduced.

Oman felt that the classification of the Cicadellinae (=Typhlocybinae) was the least satisfactory among all the cicadellid groups and listed four tribes Alebrini, Dikraneurini, Cicadellini, and Jorumini. He also noted that identifying characteristics were most inadequate when exotic specimens are studied.

Oman (1949) included keys to the families and subfamilies of Nearctic Hemiptera (excluding Heteroptera), as well as keys to tribes, genera and a few species. His tribal keys relied on number of closed apical cells in the hind wing. His generic keys were based mainly on forewing and genital characters, especially the aedeagus. Genera keyed included *Alebra* and *Protalebra* for the Alebrini, *Notus, Dikraneura, Forcipata*, *Kunzeana*, *Kidrella*, *Idona, Dikraneuroidea*, and *Empoasca* for the Dikraneurini, only *Joruma* for Jorumini, and *Cicadella, Typhlocybella*, *Typhlocyba*, *Erythroneura* and *Hymetta* for the Cicadellini.

D. A. Young. Young (1952) conceded that few constant typhlocybine characters have survived the study of the continually growing supply of new material. He mentioned the small size of typhlocybine but also noted size overlap with other groups. He further explained that reduced wing venation wasn't strictly limited to the typhlocibine leafhoppers and also varied significantly within the group. The appearance of adventitious crossveins made even the lack of discal crossveins, probably the best “typhlo” character, unreliable.

Although Young did not venture into phylogenetic relationships among subfamilies or tribes, he drew intuitive trees representing phenetic generic relations in Dikraneurini and Erythroneurini. Young provided tribal and generic keys for the Western Hemisphere, based on wing venation as well as internal and external genitalic characters. He recognized four tribes: Alebrini, Dikraneurini, Erythroneurini, and Typhlocybini. Despite this work being more than 50 years old, it is still the only work available for identifying Western Hemisphere Typhlocybinae of all tribes.

In 1957, Young revised the tribe Alebrini. In 1965, he placed the leafhopper tribe Mileewanini (Evans, 1947), later emended to Mileewini (Deitz in Young 1993), and included several genera (*Amahuaka*, and *Ujna* among them) - in the Typhlocybinae. The Mileewini are now universally placed outside the Typhlocybinae based on closed preapical cells in the forewings (Mahmood 1967).

S. H. Mahmood. In 1967, Mahmood erected the tribe Bakerini to deal with some specialized Indomalayan Typhlocybinae. He also included some intuitive trees at the tribal level based on phenetic studies of McAtee, Oman, Young, and himself. Mahmood and Ahmed (1968) summarized classification problems and removed Mileewini (as Mileewanini) to the Cicadellinae.

I. Dworakowska. Beginning in 1967, Dworakowska published a consistent stream of descriptions of Old World Typhlocybinae, 89 papers by 1984, and another 11 papers if one counts collaborators. More than half of the current genera are hers. Of the 700 new Typhlocybinae species described since 1980, 405 of them were described by Dworakowska.

Dworakowska used Oman's tribal groups, but revealed little of her methods, continually referring to her older papers for reference to wings and other illustrations, and providing no keys to genera or species. In 1970 she criticized Mahmood’s 1967 tribe Bakerini as being insufficiently defined and placed its members back in Erythroneurini.

In 1979, Dworakowska erected the tribe Zyginellini based largely on the hind wing submarginal venation and fusion of vannal veins. Ahmed (1983) criticized this concept, pointing out that the vannal veins are often fused in the *Alconeura* group of Dikraneurini and completely fused similarly in Erythroneurini. Ahmed further stated out that this grouping is too large to be based on a single character. In her 1979 paper, Dworakowska also published her only key to date, a tribal key flawed by its dependence on this vannal vein character.

P.S. Southern. Southern’s (1982) **“**A Taxonomoic Study of the Leafhopper Genus *Empoasca* (Homoptera: Cicadellidae) in Eastern Peru,” included detailed methods for specimen preparation focusing on genital dissection and study, as well as a useful key for the Empoascini of Peru. This was the first and only major work on Western Hemisphere typhlocybines since Young 1952. Southern’s interest in the Neotropical Empoascini fauna continues today (Southern 2006).

M. Ahmed. In 1983, M. Ahmed reviewed the literature with emphasis on Typhlocybinae of Pakistan. His (1983) description of typhlocybines was largely unchanged from McAtee’s informal traits of “small, fragile, and brightly colored” with reduced forewing venation. Ahmed, however, added a behavioral character of feeding consistently on the mesophyll layer of leaf tissue. This characteristic is distinctive as other cicadellids feed on sap from vascular bundles. However, field examination of hopper burn caused by typhlocybines suggests this hypothesis is incorrect (P.S. Southern personal communication).

Ahmed accepted five tribes; Alebrini, Dikraneurini, Typhlocybini, Empoascini, and Erythroneurini. In 1985, he published “Typhlocybinae of Pakistan” with keys to the four tribes of Pakistani genera.

K.G.A. Hamilton. In 1983, Hamilton published a revised classification of the family Cicadellidae based on morphological phylogenetic evidence (Hamilton 1983). In this paper, Hamilton reduced the number of leafhopper subfamilies to ten, created many tribes from subfamilies, and many subtribes from existing tribes. His 16-character matrix of “important character states in the Membracoidea” included shape, and chaatotaxy of the legs (10 characters), several suture characters, and placement of ocelli. His reclassification of the several subfamilies as tribes of Typhlocybinae is summarized in Table 2. More recent authors have not adopted Hamilton's classification because some of the characters upon which it was based are difficult to interpret and are not as conservative as Hamilton predicted (C.H. Dietrich personal communication), also, Hamilton was not explicit about his methods of analysis.

In 1998 Hamilton erected the tribe Forcipatini, including the genera *Forcipata* and *Notus* (formerly of Dikraneurini), based on elongated male plates of the pygofer.

R. F. Rupple. Rupple (1987) summarized 12 previously proposed tribal names for the Typhlocybinae (partly provided in Table 2) and presented their defining characters.

C. H. Dietrich. Dietrich's (2005) "Keys to the families of Cicadomorpha and subfamilies and tribes of Cicadellidae (Hemiptera: Auchenorrhyncha)" included keys to the tribes of Typhlocybinae sensu Oman *et al*. (1990) except that Helionini is considered a synonym of Empoascini. Dietrich's (1999) 28S rRNA study of auchenorrhynchous Hemiptera supported some of Hamilton's subfamily relationships with Typhlocybinae and provided some support for a relationship between Typhlocybinae (*sensu* Young 1952), Mileewini, and Tinterominae. Combining molecular and morphological data, Dietrich *et al*. (2005) also supported a sister-group relationship between Typhlocybinae + Mileewini and Evacanthinae (sensu Dietrich 2004). Contradicting Hamilton (1983), these analyses did not support a close relationship of Typhlocybinae with Paraboloponini, Macroceratogoniini, or Neocoelidiinae.

Dietrich's (2001, updated 2004) online resource "Leafhoppers (Hemiptera: Cicadomorpha: Cicadellidae)" provides much useful infomation, including keys, a bibliography, and a directory of specialists.

Other workers and recent progress. Generic revisions of significance include **William Robinson's** (1926) "*Erythroneura* North of Mexico", and **P. G. Christian's** (1953) A revision of the North American species of *Typhlocyba* and it's allies.

A search of the Zoological Record in February 2007 for new species of the Typhlocybinae since 1980 gave 84 titles. Of the 30 or so major workers only four have produced more than two papers: Dworakowska (20 publications), Ramakrishnan with Maicykutty (4 for India), Sohi with collaborators (13 for India), and Zhang with collaborators

(16 for China). Aside from Southern (1982, 2006), major workers of the past 25 years have not tackled the New World tropics, which promise a wealth of new typhlocybine genera and species.

Table 2. Subfamilies, tribes and subtribes of the Typhlocybinae as recognized by major workers (1908-present).

Distant 1908	McAtee 1926	Haupt 1929	Oman 1949	Young 1952
TYPHLOCYBINAE	EUPTERYGINAE	TYPHLOCYBIDAE	CICADELLINAE	TYPHLOCYBINAE
Typhlocybaria		TYPHLOCYBINAE		Typhlocybini
			Cicadellini	
	Eupterygini	EUPTERYGINAE		
	Dikraneurini		Dikraneurini	Dikraneurini
				Erythroneurini
	Jorumini		Jorumini	
Empoascaria		EMPOASCINAE		
		HELIONINAE		
	Alebrini		Alebrini	Alebrini

Table 2. Subfamilies, tribes and subtribes of the Typhlocybinae as recognized by major workers (1908-present). (Continued)

Metcalf 1968	Mahmood 1967	Oman et al. 1990	Hamilton 1983*/1998	Proposed: Balme 2007
CICADELLINAE	TYPHLOCYBINAE	TYPHLOCYBINAE	TYPHLOCYBINAE	TYPHLOCYBINAE
Typhlocybini	Typhlocybini	Typhlocybini	Typhlocybini	Typhlocybini
Cicadellini				
		Zyginellini	Zyginellina	
Dikraneurini	Dikraneurini	Dikraneurini	Dikraneurina	Dikraneurini
Erythroneurini	Erythroneurini	Erythroneurini	Erythroneurina	
	Bakerini			
Empoascini		Empoascini	Empoascina	Empoascini
Jorumini		Jorumini		
Helionini		Helionini		
ALEBRINAE	Alebrini	Alebrini	Alebrina	Alebrini
			Balbillini	
			Forcipatini	
			Macroceratogoniini	
			Neocoelidiini	
			Nirvanini	
			Paraboloponini	
			Pythamini	

*Although relatively recent this arrangement has not won general acceptance.

MATERIALS AND METHODS

Morphological study. To examine the phylogenetic relationships within the subfamily Typhlocybinae, a matrix of 73 morphological characters was compiled for 75 exemplar taxa representing 53 genera, exclusively males (Table 4). Of these taxa, three were outgroup species, *Amahuaka* sp., *Ujna* sp., and *Graphacephala coccinea*. Representatives from the nine tribes (sensu Oman 1990: Alebrini, Dikraneurini, Empoascini, Erythroneurini, Eupterygini, Helionini, Jorumini, Typhlocybini and Zyginellini) were included.

All of the specimens used for this study are recently collected and preserved in alcohol. The use of this fresh material allowed for thorough manipulation under the dissecting scope for morphological data collection and for extraction of genetic material. Many of the specimens were provided and tentatively identified to genus by Dr. Christopher H. Dietrich of the Illinois Natural History Survey. For some specimens, I have given tentative generic names placing them as closely as possible using Young's works for New World material, and Dworakowska's works for the few included Old World specimens. These tentatively identified specimens are marked with an asterisk (Table 4). Relatively few specimens are identified to species, but all represent distinct taxa. It is important to note that currently only males can be identified to species. Several female specimens were examined for genital characters that might be of taxonomic use. These females are marked with an "F" in Table 4. Valid genus lists were compiled from Dr. Stuart McKamey's database of the leafhoppers (McKamey personal communication), from the literature, and from recent

Zoological Record searches for recently used typhlocybine generic names. Unassigned genera (Dworakowska 1994), were placed to tribe based on illustrated features.

Vouchers for this study are deposited in the collection of the Illinois Natural History Survey (INHS).

Genitalic and abdominal characters were studied after abdomens and genitalia were removed from specimens as per Southern (1982) and cleared in 10% KOH solution at room temperature overnight. Cleared material was then rinsed in water and stored in glycerine. A variety of dissecting microscopes were used for viewing, especially a Leitz® stereoscopic microscope and an Olympus® SZX12 stereoscopic microscope equipped with a digital imaging system.

Morphological characters. A list of morphological characters used in this study is provided in Appendix 1. Terminology largely follows that of Young (1952) except in wing venation, which follows Dietrich (2005 fig. 3) for the discal veins, and Deitz (1975) for the apical veins and wing cell designations.

The head of the Typhlocybinae provides the following characters: ocelli presence, and placement when present; declination of the frons relative to body plane in profile; definition of coronal suture; the length of mouthparts relative to anteclypeus, as well as the length of the crown relative to width between the eyes.

Because wing venation, especially that of the hind wing, traditionally offers the most often used characters for defining the tribes, I scored an extensive set of wing vein characters. In the forewing the condition of the appendix, number of visible anal veins, the shape of the R_{2+3} vein, the existence of a petiole vein on the third apical cell, the relative size and shape of the apical cells, especially M_4 and M_2, and the overall shape of the forewing itself were all included. Hind wing features include: the existence of a fused R+M vein and a subcostal vein; the condition of the vannal veins if incompletely fused; where the Cu vein meets the wing margin; the condition of the apex of the anteapical cell M as well as its relative size compared to the anteapical cell R; the relative length of the visible stems of the major wing veins; the extension of the submarginal vein as it reaches or surpasses the apex of the wing; and presence of a distinct hamulus.

From the legs, I included: an acuminate hind tarsomere I, the number of hind tibia row AV macrosetae, basal, hair-like setae presence or absence on the profemur, and the condition of the intercalary row setae also on the profemur as well as, the number and condition of protibial AV row macrosetae.

Features examined on the abdomen were the development of the basal appodemes (whether or not they extend past the 3^{rd} sternite) and presence or absence of tergite X sclerotization. Male genital characters have long been in use for determination of species and many are included here, especially the shape and macrosetae, of the male plates, the presence, and moveability of dorsal appendages, the dorsal macrosetae, basolateral setal groups on the pygofer, and basolateral expansions of the male plate. Internally, the condition and shape of the connective were scored, and also whether or not the styles are serrated as in Empoascini or forked as in some Typhlocybini. Characters of the aedeagus, while important for species identification, were considered too variable for the present study. I dissected several female specimes from a variety of the tribes marked in Table 4, and compared their valvulae. However, no taxonomically informative characters were discovered relative to the female genitalia.

Morphological data analysis. Unweighted phylogenetic analysis of morphological data was conducted using the parsimony criterion in PAUP* Portable version 4.0b10 for Unix (Swofford 1998) with outgroup set to *Graphocephala* by heuristic search and 500 random taxon addition replicates.

Nucleic acid study. Forty-six alcohol preserved, exemplar species were studied by extracting, amplifying, and sequencing two genes: the ribosomal 16S rDNA, and the nuclear gene Histone (H3). Unsuccessful sequencing of these genes for another 15 species was attempted. I did not successfully obtain H3 sequences for four specimens used in the study (*Igutettix, Kidrella*, *Erythroneura tricincta*, and *Salka*) but these are included for their 16S sequences. All primers are listed in Table 2.

The Dneasy Tissue Kit from QiaQuick (QIAGEN Inc. 27220 Turnberry Lane Valencia, CA 91355) was used for extraction of nucleic acids. Protocol for nucleic acid extraction was modified from the Dneasy Tissue Kit Handbook (05/2002: pp. 17-19) in the following ways: alcohol preserved specimens had abdomens removed to exclude endosymbiont contamination and soaked for 24-36 hours in180 µl of buffer ATL and 20µl proteinase K on a heating block at 55°C. Elution volume was changed from 200µl to 50 µl of buffer AE. Nucleic acid extractions were then stored at –80° C.

Table 3. The primers used to amplify mitochondrial and nuclear genes.

Gene Region	Primer name and sequence		Reference
16SrDNA	LR-J-12887	CCG GTT TGA ACT CAG ATC ATG T	Simon et al. 1994
	SR-N-13398	CRC YTG TTT AWC AAA AAC AT	
HISTONE H(3)	HexAf	ATG GCT CGT ACC AAG CAG ACG GC	Svenson & Whiting 2004
	HexAr	ATA TCC TTG GGC ATG ATG GTG AC	

PCR amplification was performed using 1.0µl of the genomic nucleic acid solution plus: 5µl of buffer/ MgCl2, 4µl DNTPs, 37.8µl DH2O, 1µl each of forward and reverse primer, and 0.25µl of TaKaRa Ex-Taq™ (Mirus Corp., Madison, Wisconsin, U.S.A.) for the 16s rDNA; and 5µl Buffer/MgCl2, 4µl DNTPs, 36µl DH2O, 2µl each of up and down primer, 0.25µl and TaKaRa Ex-Taq for the H3. The thermocycler amplification protocol for PCR of 16S rDNA was as follows: 1 cycle of 92° C (3 min); 5 cycles of 92°C (15 s), 43°C (45 s), 62°C (2 min 30 s); 30 cycles of 92°C (15 s), 50°C (45 s), 62°C (2 min 30 s); 1 cycle 62°C (7 min); and held at 4°C. The thermocycler amplification protocol for H3 was as follows: 1 cycle 94°C (3 min); 46 cycles of 94°C (1 min), 54°C (1 min), 72°C (1 min); 1 cycle 72°C (7 min); and held at 4°C.

PCR products were purified using QIAquick Purification Kits (QIAGEN Inc.) sequencing products were purified using CENTRI-SEP Columns (Princeton Separations Inc. P.O. Box 300 Adelphia, NJ 07710) and analyzed by dye terminator cycle sequencing using the Applied Biosystems (ABI PRISM 377) automated DNA sequencer (PE Applied Biosystems, Foster City, CA).

Sequences were confirmed by comparing complementary DNA strands. Editing nucleotide sequences, contig assembly, and consensus sequence calculation were performed using the software program Sequencher 4.0 (Gene Codes Corp., Ann Arbor, MI U.S.A.).

Molecular data analysis. Sequences were aligned in ClustalX (Higgins, 1993) and analyzed together. The H3 gene is characters 1- 305; the 16S gene is characters 306-646 (Appendix III) under Parsimony criterion using PAUP*. Unweighted phylogenetic analysis of molecular data was conducted using parsimony criterion in PAUP* Portable version 4.0b10 for Unix (Swofford 1998) with outgroup set to *Amahuaka* and 500 random taxon addition replicates, set for heuristic search and random sequence addition. All molecular analyses herein are of these two genes combined.

Concatenated data analysis. Genetic and morphological data were concatenated in MacClade (Appendix IV) and a total information tree was generated using PAUP*. Decay indices (Bremer support, Bremer 1994) were calculated using Treerot (Sorensen 1999). Unweighted phylogenetic analysis of morphological data was conducted on an Apple Macbook using parsimony criterion in PAUP* Portable version 4.0b10 for Unix (Swofford 1998) with outgroup set to *Amahuaka* and 500, random taxon addition replicates, set for heuristic search and random sequence addition.

Table 4. Specimens examined for moloecular and morphological analyses.

TAXON	VIAL code	Identifier	Locality	Depository	16s + H3	Lot Code	Sex
outgroup							
Cicadellinae							
Graphocephala coccinea (Forster, 1771)	*Graphocephala*	Balme	North Carolina, USA	NCSU		NCSUbalmgrap01	M
Mileewaninae							
Amahuaka	*Amahuaka*	Dietrich	Mexico	USNM	Y	mx 01-31-01	M
Ujna	*Ujna*	Dietrich	Madagascar	CASC	Y	NCSUbalmujna01	M,F
Typhlocybinae							
Alebrini							
Alebra aurea (Walsh, 1862)	*Alebra*	Balme	Raleigh, NC USA	NCSU	Y	NCSUbalmaleb01	M
Barela	*Barela*	Dietrich	Mexico	USNM		mx01-10-07	M
Elabra	Alebrini 1	Dietrich	Peru	USNM	Y	NCSUbalmelab01	M
Habralebra	Alebrini 5	Dietrich	Peru	USNM	Y	NCSUbalmhabr01	M
Orientalebra	Alebrini (Taiwan)	Dietrich	Taiwan	INHS	Y	NCSUbalmaleb02	M
Paralebra	Alebrini 1543	Dietrich	Peru	USNM		NCSUbalmpara01	M,F
Protalebrella conica Ruppel & DeLong, 1953	*Protalebrella*	Dietrich	Mexico	USNM	Y	mx69-21-01	M
Trypanalebra	*Trypanalebra*	Dietrich	Mexico	USNM		mx01-07-02	M
Erythroneurini							
Accacidia	*Accacidia*	Dietrich	Madagascar	CASC		blf6067 CAS007671	M
Alnetoidia	*Alnetoidia*	Dietrich	Taiwan	NCSU	Y	NCSUbalmalne01	M
Anufrievia ciconia Dworakowska, 1973	*Anufrievia*	Dietrich	Taiwan	NCSU	Y	NCSUbalmanuf01	M
Arboridia	*Arboridia*	Dietrich	Taiwan	NCSU	Y	NCSUbalmarbo01	M
Coleana arcuata Dworakowska, 1981	*Coleana*	Dietrich	Taiwan	NCSU	Y	NCSUbalmcole01	M
Erythroneura Illinoiensis (Gillette, 1898)	*Erythroneura illinoiensis*	Balme	North Carolina, USA	NCSU	Y	NCSUbalmeryt01	M,F
Erythroneura lawsoni Robinson, 1924	*Erythroneura lawsoni*	Balme	Athens,Georgia, USA	NCSU	Y	NCSUbalmeryt02	M,F
Erythroneura tricincta Fitch, 1851	*Erythroneura tricincta*	Balme	Raleigh, NC USA	NCSU	Y	NCSUbalmerty03	M
Fruitoidia	*Fruitoidia*	Dietrich	Madagascar	CASC		blf6067 CAS007728	M
Ivorycoasta	*Ivorycoasta*	Dietrich	Madagascar	CASC	Y	blf6067 CAS007728	M
Lublinia	*Lublinia*	Dietrich	Madagascar	CASC		blf3011 CAS005098	M
Ntanga	Erythroneurini 6067	Balme	Madagascar	CASC	Y	blf6067 CAS007728	M
Salka	*Salka*	Balme	Taiwan	NCSU	Y	NCSUbalmsalk01	M
Seriana	*Seriana*	Dietrich	Taiwan	INHS	Y	NCSUbalmseri01	M
Singapora	*Singapora*	Dietrich	Taiwan	INHS	Y	NCSUbalmsing01	M

Table 4. Specimens examined for moloecular and morphological analyses. (Continued)

TAXON	VIAL code	Identifier	Locality	Depository	16s + H3	Lot Code	Sex
Zyginellini							
Limassola	*Limassola*	Dietrich	Madagascar	CASC	Y	ma01-06-07 CAS005093	M
Narta	*Narta*	Dietrich	Madagascar	CASC		ma01-08b-12 CAS007687	M
Dikraneurini							
Afrakra sp.	*Afrakra*	Dietrich	Madagascar	CASC		NCSUbalmafra01	M
Alconeura sp. 0	*Alconeura*	Dietrich	Mexico	USNM	Y	NCSUbalmalco01	M,F
*Alconeura sp. 1**	Dikraneura 3	Balme	Peru	USNM	Y	NCSUbalmAlco01	M
*Alconeura sp. 2**	Dikraneura 20	Balme	Peru	USNM	Y	NCSUbalmalco02	M
*Alconeura sp. 3**	Dikraneura 23	Balme	Peru	USNM	Y	NCSUbalmalco03	M
*Alconeura sp. 5**	Dikraneura 19	Balme	Peru	USNM		NCSUbalmalco05	M
*Dikraneura angustata*Ball & DeLong,1925	*Dikraneura*	Dietrich	Illinois, US	USNM		mx01-18-02	M
Dikrella sp. 0	*Dikrella*	Dietrich	Peru	USNM	Y	NCSUbalmDikr00	M
Dikrella sp. 2*	Dikraneura 2	Balme	Peru	USNM		NCSUbalmdikr02	M
Dikrella sp. 3*	Dikraneura 12	Balme	Peru	USNM	Y	NCSUbalmdikr03	M
Dikrella sp. 4*	Dikraneura 5	Balme	Peru	USNM	Y	NCSUbalmDikr04	M
Dikrella sp. 5*	Dikraneura 11	Balme	Peru	USNM	Y	NCSUbalmdikr05	M
Dikrella sp. 6*	Dikraneura 10	Balme	Peru	USNM	Y	NCSUbalmdikr06	M
Dikrella sp. 7*	Dikraneura 9	Balme	Peru	USNM	Y	NCSUbalmDikr07	M
Dikrella sp. 8*	Dikraneura 25	Balme	Peru	USNM	Y	NCSUbalmdikr08	M
Dikrella sp. 9*	Dikraneura 8	Balme	Peru	USNM	Y	NCSUbalmDikr09	M
Dikrella sp. 10*	Dikraneura 22	Balme	Peru	USNM		NCSUbalmdikr10	M
Dikrella sp. 11*	Dikraneura 21	Balme	Peru	USNM		NCSUbalmdikr11	M
Dikrella sp. 12*	Dikraneura 7	Balme	Peru	USNM		NCSUbalmDikr12	M
Dikrella sp. 13*	Dikraneura 15	Balme	Peru	USNM		NCSUbalmdikr13	M
Dikrellidia sp. 1*	*Dikrellidia*	Dietrich	Peru	USNM	Y	NCSUbalmDikr20	M,F
Dikrellidia sp. 2*	Dikraneura 4	Balme	Peru	USNM		NCSUbalmDikr02	M
Forcipata	*Forcipata*	Balme	Raleigh, NC USA	NCSU		NCSUbalmforc01	M
Idona	*Idona*	Balme	Smokies	NCSU	Y	NCSUbalmidon01	M
Igutettix	*Igutettix*	Dietrich	Taiwan	INHS	Y	NCSUbalmigut01	M
Kidrella	Dikraneura 1	Balme	Peru	USNM	Y	NCSUbalmkidr01	M,F
Kunzeana	*kunzeana*	Dietrich	Mexico	USNM	Y	mx01-03-01	M
Neodikrella	*Neodikrella*	Dietrich	Mexico	USNM		mx01-03-01	M
Parallaxis sp. 2	Dikraneura 16	Balme	Peru	USNM		NCSUbalmpara02	M
Parallaxis sp. 1	*Parallaxis*	Dietrich	Peru	USNM	Y	NCSUbalmpara00	M,F
NEW GENUS	RedDikraneurini ng		Peru	USNM		NCSUbalmredd01	M
Typhlocybella	*Typhlocybella*	Dietrich	Mexico	USNM		mx02-9-01	M

Table 4. Specimens examined for moloecular and morphological analyses. (Continued)

TAXON	VIAL code	Identifier	Locality	Depository	16s + H3	Lot Code	Sex
Typhlocybini							
Agnesiella sp.	*Agnesiella*	Balme	Taiwan	NCSU	Y	NCSUbalmAgne00	M
Hiratettix arisanellus Matsumura, 1931	*Hiratettix*	Dietrich	Taiwan	INHS	Y	NCSUbalmHira00	M
Typhlocyba quercus (Fabricius, 1794)	*Typhlocyba*	Balme	Illinois, US	NCSU		NCSUbalmTyph00	M
Eupterygini							
Euhardina sp.	*Euhardina*	Balme	Taiwan	NCSU	Y	NCSUbalmEuha00	M,
Empoascini							
*Acia*sp.	*Acia*	Dietrich	Madagascar	CASC		NCSUbalmAcia00	M
Apheliona ferrugiae Matsumura, 1931	*Apheliona*	Dietrich	Taiwan	INHS		NCSUbalmAphe00	M
NEW GENUS	black Empoascini	Balme	Taiwan	NCSU	Y	NCSUbalmbemp00	M
Empoasca fabae (Harris, 1841)	*Empoasca*	Balme	Raleigh, NC USA	NCSU	Y	NCSUbalmempo01	M,F
Empoasca sp. 1	*Empoasca*	Balme	Taiwan	NCSU	Y	NCSUbalmEmpo02	M
Empoasca sp. A	*Empoasca* A	Balme	Madagascar	CASC	Y	blf3011 CAS005098	M
*Unitra**	*Empoasca* B	Balme	Madagascar	CASC	Y	blf4507 CAS007651	M
Helionini							
Heliona constricta Melicar, 1903	*Heliona*	Dworakowska	Ceylon	BMNS		NCSUbalmheli00	M
Jorumini							
Eualebra sp.1	*Eualebra*	Dietrich	Taiwan	INHS		NCSUbalmEual00	M
Eualebra sp.10	*Eualebra* 10	Dietrich	Peru	USNM		NCSUbalmEual10	M
Joruma sp.15	*Joruma* 15	Dietrich	Peru	USNM		NCSUbalmJoru15	M
Joruma sp.17	*Joruma* 17	Dietrich	Peru	USNM		NCSUbalmJoru17	M
Joruma sp.19	*Joruma* 19	Dietrich	Peru	USNM	Y	NCSUbalmJoru19	M,F
*Paulomanus**	Empoascini 2045	Balme	Peru	USNM		NCSUbalmpaul00	M
Unplaced							
Columbonirvana	*Columbonirvana*	Dietrich	Peru	USNM	Y	NCSUbalmcolu00	M

DESCRIPTIONS

Subfamily TYPHLOCYBINAE Kirschbaum, 1868

Afrotropical, Australian, Indomalayan, Nearctic, Neotropical, and Palearctic

Type genus: *Typhlocyba* Germar,1833a

Figs. 1 A-L.

Cicadellae Latreille, 1802 (rank not specified)

Typhlocybidae Kirschbaum, 1868 (Subfamily)

Eupteryginae Kirkaldy, 1906 (rank not specified)

Empoascaria Distant, 1908 (Division)

Alebrini McAtee, 1926 (Tribe)

Dikraneurini McAtee, 1926 (Tribe)

Jorumini McAtee, 1926 (Tribe)

Helioninae Haupt, 1929 (Subfamily)

Zyginae Zachvatkin, 1946 (Subfamily)

Erythroneurini Young, 1952 (Tribe)

Bakerini Mahmood, 1967 (Tribe)

Zyginellini Dworakowska, 1977 (Tribe)

Foricipatini Hamilton 1998 (Tribe)

Diagnostic characters and description. Length generally less than 4mm; fragile; often green, yellow, or variously colored, some with iridescence. HEAD: ocelli not on crown, generally vestigial (many exceptions especially in, but not limited to, Alebrini, Empoascini, and Typhlocybini Fig. 4E). THORAX: mesothoracic anapleural suture (Matsuda 1970: fig. 108d) absent (some exceptions in Typhlocybini and perhaps other tribes). HIND LEGS: tibial row AV usually with 4 macrosetae apically, tibial apex with setal formula 2+1+1 in most species (this also occurs in Nirvaninae and Xestocephalinae and is inconsistent within the Typhlocybinae; these setae are easily broken); tarsomere I always acuminate. FOREWING: without closed anteapical cells (this commonly used character is simply a result of ill-defined forewing R and M veins; anteapical cells are often present in *Paralaxis*); all but Alebrini lacking appendix; often with single anal vein. HIND WING: with veins R+M often fused apically. ABDOMEN: tergite IX often absent or unsclerotized.

Distribution. Afrotropical, Australian, Indomalayan, Nearctic, Neotropical, and Palearctic regions.

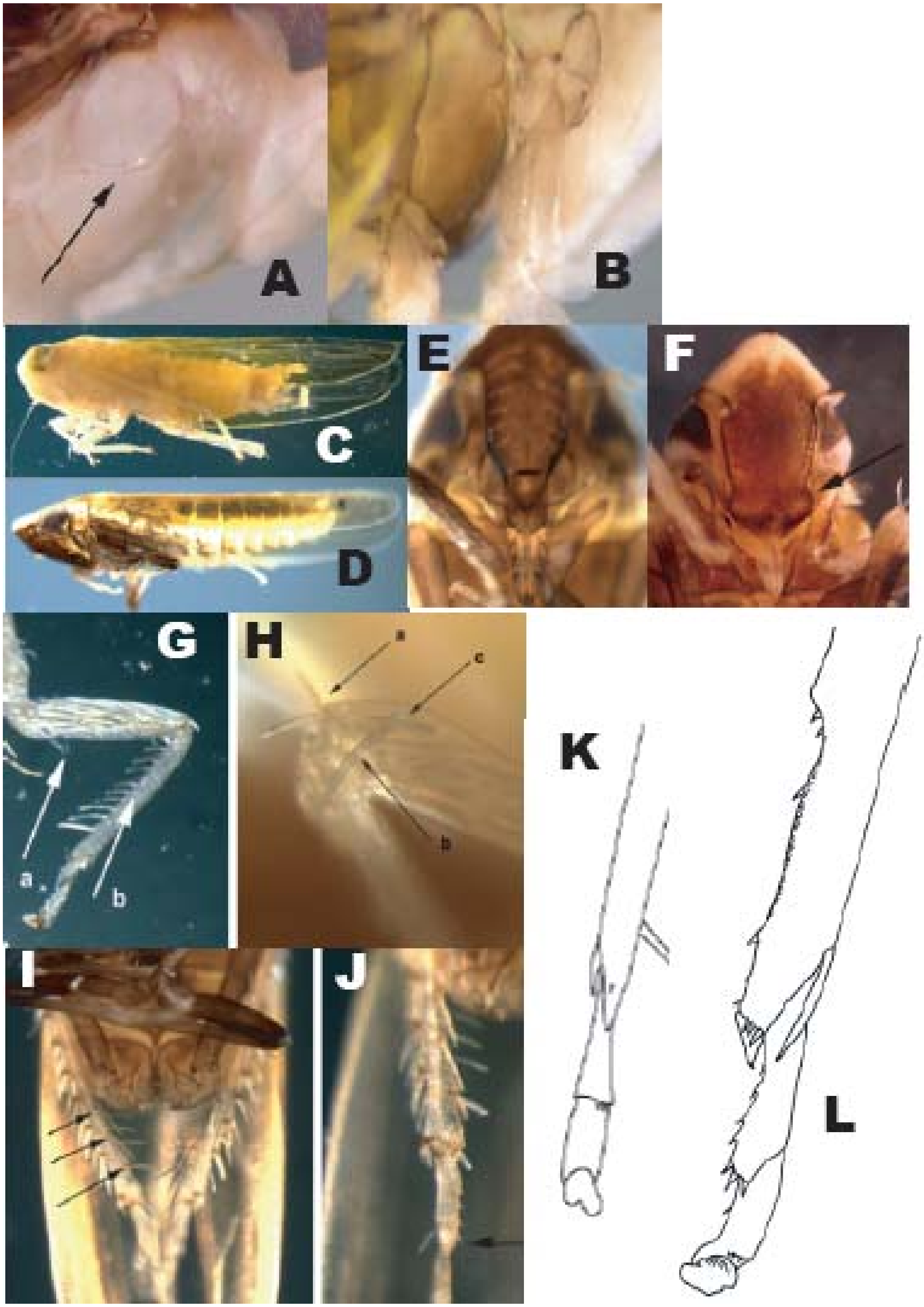
Ecology. Reportedly, some leaf parenchyma cell feeders.

Discussion. The subfamily Typhlocybinae is not an easily recognized group. Wing features and overall size overlap strongly with Mileewinae, which probably led Young (1965) to suggest the Mileewinae were a tribe of the Typhlocybinae. Only the placement of the ocelli on the crown in mileewines separates them from typhlocybines. Several other characters including the acuminate hind tarsomere I, the 2+1+1 hind femoral apical setal formula, and especially the lack of closed anteapical cells in the forewing, all appear to vary in the Typhlocybinae. The combined analysis -- a consensus of 8 trees using both genetic (16S rDNA and Histone H(3)) and morphological data (Fig 7) -- as well as the morphology and DNA, independently, all recovered the Typhlocybinae as a monophyletic group with respect to the Mileewinae. Nevertheless, this status could change significantly with the inclusion of further mileewine genera. At present 388 genera and 73 subgenera are recognized.

Unplaced valid genera within the typlocybinae:

Leuconeura Ishihara, 1978; *Triassojassus* Tillyard, 1919 (Fossil).

Figure 1. Subfamily Typhlocybinae characters. (A-B, showing pleuron of the mesothorax (anaplural suture enhanced); C-D, lateral habitus; E-F, face showing inflated clypellus of male; G, anterior proleg showing anteroventral intercalary setal row; H, apex of hind femur showing 2+1+1 macrosetal formula (enhanced); I, anterior proleg showing (a) basal macrosetae (b) anteroventral row of tibial macrosetae; J, anteroventral row of hind tibial macrosetae; K, hind tibial tarsomere I showing acuminate apex). A, H, I, L, *Amahuaka.* B,C, E, *Kunzeana*. F, J, *Eualebra* sp. 10. K *Alebra aurea.*


A
B
C
D
E
F
G
a
b
H
a
c
b
I
J
K
L

The following key to the tribes of the Typhlocybinae, as well as the tribal descriptions are based on the preceeding analyses.

KEY TO THE TRIBES OF THE TYPHLOCYBINAE.

1. Forewing with appendix (Fig. 2A).. Alebini

1'. Forewing without appendix (Figs. 3B,C,E)..2

2(1'). Hind wing with R+M fused (Figs. 3A,D)...3

2'. Hind wing with R+M not fused (Figs. 2B, 4D)...4

3(2). Hind wing with closed apical cells (Fig. 3A) 5

3'. Hind wing without closed apical cells (Fig. 3D) 6

4 (2'). Hind wing submariginal vein extending to apex of vein M, posterior edge of wing serrated (Fig. 4D)... Empoascini in part (*Joruma*)

4'. Hind wing submarginal vein extending to apex of vein R, posterior edge of wing not serrated (Fig. 4B) ....

Typhlocybini in part (*Euhardina* and *Eualebra*) and *Columbonirvana* unplaced

5(3). Hind wing with submarginal vein extending around apex of R+M (Fig. 3A).....

.... Dikraneurini (*sensu stricto*)

5. Hind wing with submarginal vein joining vein R+M (Fig. 4B). ....

.... Empoascini (except *Joruma*)

6(3'). Hind wing with anal vein not fused (Figs. 4B, 5B) ....Typhlocybini in part

6. Hind wing with anal vein fused (Figs. 3A, D)......Dikraneurini: Erythroneurina (=Erythroneurini)

Tribe ALEBRINI McAtee, 1926, sensu stricto

Afrotropical, Indomalayan, Nearctic, Neotropical, and Palearctic regions.

Figs. 2. A-I.

Type genus: *Alebra* Fieber,1872a

Alebrini McAtee, 1926

Diagnostic character. Forewing with appendix (Fig. 2A).

Description. HEAD: wider than pronotum; coronal suture distinct, as long as or longer than half crown length; crown without peak (median length little if any longer medially than next to eye), basal width between eyes distinctly wider than each eye width (dorsal aspect); sexual dimorphism not apparent; face in profile not depressed; ocelli present, round, on anterior margin of head; lorum extending to or nearly extending to genal margin; mouthparts longer than, but less than 2x, anteclypellus. THORAX: Mesothoracic anapleural suture absent, scutellar apex distinctly acuminate. FORELEGS: femur with AM1+AM seta absent, protibial AV row macrosetae all about uniform or appearing to grade larger distally AM1 seta distinctly longer than other AM setae, intercalary setae subequal in size or gradually reduced from base to apex, row PV usually with long, fine setae; number of protibial AV macrosetae >12. HIND LEGS: femoral macrosetal formula 2+1+1; tibial row AV with 5 or 6 macrosetae; tarsal length distinctly less than half tibial length; tarsomere I acuminate, less than length of II+III. FOREWING: apex rounded, without extension, opaque pigmentation sparse or absent, without closed pre-apical cells; appendix present, extending around wing apex; R_3 cell not attaining wing apex; vein R forked (2 branches), stem length complete to wing base shorter than distance to costal margin; vein R $_{3+4}$ gently curved to appendix; vein R+M not confluent before R_{2+3} fork; vein M stem complete to wing base, or longer than M_{1+2}; apical cell R_5 without petiole, M_{3+4} vein extending to or short of wing margin (or appendix); cell M up to 2x as wide as cell R; either 1 anal vein or none apparent; cell M_4 elongate and parallel-sided; apex of cell M transversely truncate, apex of vein Cu connecting to wing margin at or distad of apex of clavus; cell M_2 elongate with veins converging, at apex narrower than either adjoining apical cell. HIND WING: hamulus distinct or indistinct; vein Sc present or absent; vein R not fusing with vein M apically; submarginal vein present at wing apex; vein R_1 remnant absent; cell M up to 2x as wide as cell R; crossvein m-cu shorter than basal segment of vein M_{3+4}; distal segment of vein CuA present; veins CuA and M_{3+4} free, connected by a crossvein; vein 1A branching from 2A basally or at midlength; apex of cell M transversely or obliquely truncate: vein CuP confluent with submarginal vein at point opposite to or proximad of basal segment of M_{3+4}. ABDOMEN: overall shape narrow or tapered; second sternal apodemes poorly developed, not extending beyond posterior margin of sternite III; tergite X absent or unsclerotized; anal tube without basolateral hooks or processes. PYGOFER: dorsal and ventral appendages absent; dorsoapical macrosetae absent; ventrolateral setal group absent or indistinct. SUBGENITAL PLATE: in lateral view strongly curved, and length 2-5x width; basolateral setal group absent or present; long, fine setae absent or present; macrosetae present, numerous, in a row or band from base to near apex; angulate basolateral projection absent. STYLE: with or without preapical lobe; apex tapered, without serrations. CONNECTIVE: anterior margin truncate or shallowly emarginate.

Distribution. Afrotropical, Indomalayan, Nearctic, Neotropical, and Palearctic regions.

Discussion. The tribe Alebrini is based on a plesiomorphic trait—the presence of an appendix on the forewing. In the total evidence analysis (Fig.7) the Alebrini form a distinct group containing two monophyletic clades based on the extent to which the appendix wraps around the apex of the wing *Alebra* and *Orientalebra* have the appendix wrapping the apex of the wing whereas the alebrine group containing *Protalebrella*, *Elabra*, and *Habralebra* do not. Also, the genus *Columbonirvana* groups within the alebrines that do not have the more complete appendix. Based on the consensus of 4 trees using both genetic (16S rDNA and Histone H(3)) and morphological data, Alebrini form a monophyletic group, related to Empoascini, and former tribes Jorumini and Zyginellini. The morphological data alone break 8 alebrine genera into 4 groups nested under the outgroups *Ujna* + *Amuaka*. The molecular data alone show *Orientalebra* + *Alebra* as sister to *Elabra* + *Habralebra*, with this entire clade as sister to group including Typhlocybini, former tribe Zyginellini, and Empoascini. However, *Protalebrella* and *Columbonirvana* form a group with Jorumini basal to the former Erythroneurini (now Dikraneurini).

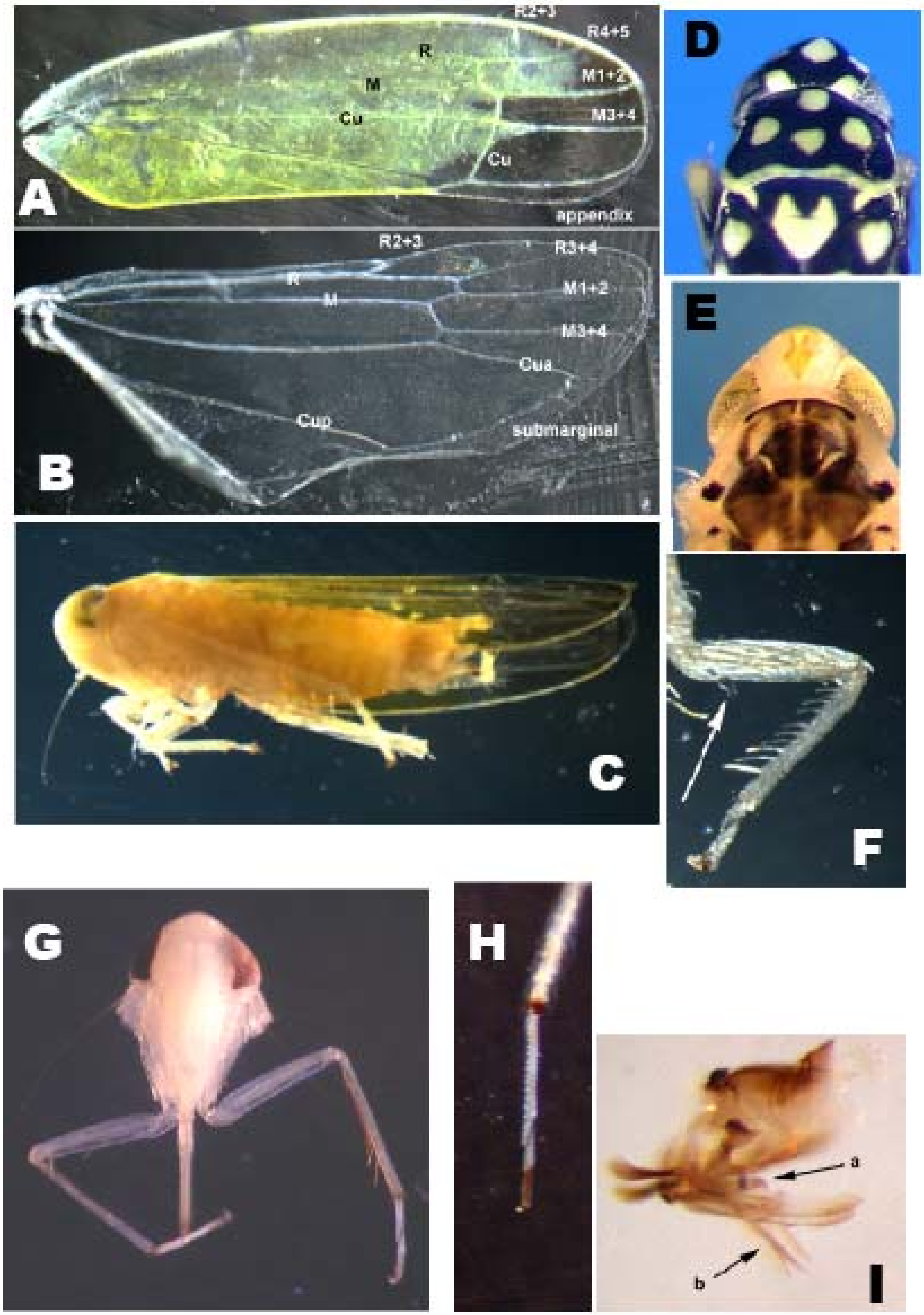
While none of the Typhlocybinae tribes are well represented in the Australian region, Alebrini is the only typhlocybine tribe not found there. This suggests the subfamily may have originated after the breakup of Gondwana.

Presently, 34 genera are recognized for the tribe Alebrini.

Valid genera of the Alebrini (*indicates genus examined)

**Alebra* Fieber, 1872; **Orientalebra* Young, 1952; *Abrabra* Dworakowska, 1976; *Abrela* Young, 1957; *Afralebra* Paoli, 1941; *Albera* Young, 1957; *Aphanalebra* McAtee, 1926; *Arbelana* Anufriev, 1978a; *Asialebra* Dworakowska, 1971; *Balera* Young, 1952; **Barela* Young, 1957; *Beamerulus* Young, 1957; *Blarea* Young, 1957; *Brunerella* Young, 1952; *Compsus* Fieber, 1866; *Diceratalebra* Young, 1952; **Elabra* Young, 1952; *Erabla* Young, 1957; **Habralebra* Young, 1952; *Hadralebra* Young, 1952; *Lareba* Young, 1957; *Lawsonellus* Young, 1957; *Omegalebra* Young, 1957; *Orsalebra* Dworakowska, 1971; *Osbornulus* Young, 1957; *Paralebra* McAtee, 1926; *Protalebra* Baker, 1899; **Protalebrella* Young, 1952; *Rabela* Young, 1952; *Relaba* Young, 1957; *Rhabdotalebra* Young, 1952; *Shaddai* Distant, 1918; *Sobrala* Dworakowska, 1977; **Trypanalebra* Young, 1952.

Figure 2. Tribe Alebrini (A-B, Wings showing vein designations; C, lateral aspect of Alebra aurea;; D, ventral aspect of abdomen showing apodemes; E-F, dorsal aspects of head and thorax; G, face; H, acuminate hind tarsomere I, genital capsule showing (a) style, and (b) basal macrosetea of male plate). A-B, *Alebra*. C-D, *Trypanalebra*. E, *Paralebra*. F, I, *Trypanalebra*. G-H, *Elabra*.


A
R2+3
R4+5
R
M
M1+2
Cu
M3+4
Cu
appendix
B
R2+3
R3+4
R
M
M1+2
M3+4
Cua
Cup
submarginal
C
D
E
F
G
H
I
a
b

Tribe DIKRANEURINI McAtee, 1926, *sensu lato*

(=Dikraneurini McAtee, 1926 + Erythroneurini Young, 1952)

Afrotropical, Australian, Indomalayan, Nearctic, Neotropical, and Palearctic regions.

Figs. 3. A-M.

Type genus: *Dikraneura* Hardy, 1850

Dikraneurini McAtee, 1926 (Tribe)

Erythroneurini Young, 1952 (NEW SYNONYMY)

Bakerini Mamood, 1967 (Tribe)

Forcipatini Hamilton 1998 (NEW SYNONYMY)

Diagnostic characters. Forewing without appendix. Hind wing with submarginal vein extending around apex beyond vein R+M (Fig. 3A) or with fused anal veins and submarginal vein not extending to apex of wing.

Description. HEAD: usually wider than pronotum; coronal suture distinct or indistinct; crown mostly without peak, median length variable, basal width between eyes usually distinctly wider than each eye width (dorsal aspect); sexual dimorphism rarely apparent; face in profile depressed or not; ocelli absent; lorum not separated or very narrowly separated from genal margin, or occasionally indistinct; labium variable in length. THORAX: Mesothoracic anapleural suture absent, scutellar apex acuminate. FORELEGS: femur with AM1+AM seta absent, AM1 seta either absent or present, protibial AV row macrosetae all about uniform or appearing to grade larger distally or with 1 or 2 setae distinctly larger, AM1 seta distinctly longer than other AM setae, intercalary setae subequal in size or gradually reduced from base to apex, row PV without long, fine setae; with 8-11 protibial AV macrosetae. HIND LEGS: femoral macrosetal formula 2+1+1, 2+0, or 2+1+0; tibial row AV with 3 usually 4 macrosetae; tarsal length usually distinctly less than half tibial length; tarsomere I acuminate, length usually less than length of II+III. FOREWING: apex rounded without extension, opaque pigmentation variable to absent, mostly without closed pre-apical cells; appendix absent; cell R_3 attaining wing apex or not; vein R forked (2 branches), stem length complete to wing base or not extending to wing base and longer than distance to costal margin; vein R_{4+5} mostly gently curved to appendix; vein R+M not confluent before R_{2+3} fork; vein M stem length mostly not extending to wing base and longer than M_{1+2}; apical cell R_5 with or without petiole, M_{3+4} vein extending to or short of wing margin; cell M up to 2x as wide as cell R; either 1 anal vein or none apparent; cell M_4 elongate and parallel-sided; apex of cell M transversely truncate, obliquely truncate, or acuminate; apex of vein Cu connecting to wing margin at or distad of apex of clavus; cell M_2 elongate, narrower than either adjoining apical cell. HIND WING: hamulus indistinct; vein Sc present or absent; vein R_{4+5} present; vein R fusing with vein M apically, mostly as long or longer than ¼ the total wing length; submarginal vein present or absent at wing apex; vein R_1 remnant present; cell M up to 2x as wide or wider than cell R; crossvein m-cu absent or present and shorter than basal segment of vein M_{3+4}; distal segment of vein CuA present; veins CuA and M_{3+4} free, connected by a crossvein, partially confluent or completely confluent; vein 1A branching from 2A basally or at midlength or completely fused; apex of cell M transversely or obliquely truncate; vein CuP confluent with submarginal vein at point opposite to or proximad of basal segment of M_{3+4}; anal margin not serrate or with sparse denticuli. ABDOMEN: overall shape mostly narrow and tapered or bulging midlength; second sternal apodemes variable; tergite X absent or unsclerotized, or present and sclerotized; anal tube with or without basolateral hooks or processes. PYGOFER: dorsal appendages absent or present, and some articulated; ventral appendages present or absent; dorsoapical macrosetae absent or present; ventrolateral setal group usually absent. SUBGENITAL PLATE: in lateral view variably curved dorsoapically, at least 2x to greater than 5x width; basolateral setal group absent or present; long, fine setae absent or present; macrosetae present, restricted to basal half or absent; angulate basolateral projection present or absent. STYLE: preapical lobe present or absent; apex tapered, bi- or trifurcate, without serrations. CONNECTIVE: variable.

Distribution. Afrotropical, Australian, Indomalayan, Nearctic, Neotropical, and Palearctic regions.

Discussion. The Dikraneurini and Erythroneurini are large, widely recognized tribes. Both the morphological and molecular evidence presented here, however, suggest that "Erythroneurini" may be better placed as a subtribe (Erythronerina) of Dikraneurini *sensu lato*, as discussed below.

The combined analysis -- a consensus of 4 trees using both genetic (16srDNA and Histone H(3)) and morphological data (Fig. 6) -- divided the tribe Dikraneurini into 6 groups. Group 1 included: *Alconeura* sp. 3, *Dikrella* sp. 8, *Dikrella* sp. 9, *Dikrellidia*, *Igutettix*, and *Kunzeana* and was morphologically defined by 4 characters: a single enlarged basal setae on the front femoral intercalary row, well developed second sternal apodemes, long fine setae present on the male plates, and male plates lacking the angulate basal projection. Group 2 included: *Alconeura* sp. 2, *Dikrella* sp. 1, *Dikrella* sp. 3, *Dikrella* sp. 4, *Dikrella* sp. 6, *Idona*, and *Kidrella*, and are morphologically defined by having sparse wing coloration and an obliquely angular cell M apex in the forewing. The widely recognized tribe Erythroneurini takes the position of group 3 and included: *Alnetoidia*, *Anufrieva*, *Arboridia*, *Coleana*, *Erythroneura lawsonii*, *E. illinoisensis*, *E. tricincta*, *Ivorycoasta*, *Ntanga*, *Salka*, *Seriana*, and *Singapora* and are morphologically defined by having distinct coronal sutures, short crown lengths, uniform front tibial AV setal row, submarginal vein absent at wing apex in hind wing, moveable dorsal pygofer appendages, and male plates from 2x to 5x longer than wide. Group 4 included: *Dikrella* sp. 5, and *Dikrella* sp. 6 these genera are defined by molecular characters only. Group 5 includes: *Alconeura* sp. 0, and *Parallaxis* and have head wider than pronotum, vein R abruptly curved to costal margin in the forewing, and well sclerotized abdominal segment IX. Group 6 (*Alconeura* sp. 1) has a petiolate cell R_3, and a single anal vein in the forewing, the hind wing posterior shows sparse denticuli, the abdomen bulges midlength, and the male plates are distinctly elbowed.

Morphological characters that support this broader definition of Dikraneurini (including Erythroneurina) are: ocelli vestigial or absent, vein Sc present in the hind wing (always in Dikraneurini *sensu stricto* and occasionally in Erythroneurina), with anal veins fused in the hind wing (all of Erythroneurina, many Dikraneurini *s. s.* (especially *Alconeura* group)), male plates with a basolateral projection, and preapical lobes present on the styles (most Erythroneurina and some Dikraneurini *s. s*.). A partitioned Bremer support shows –1.6 molecular and 4.6 morphological supports for this node.

The DNA consensus tree (9 trees) likewise supported Erythroneurina as a group nested within Dikraneurini *sensu lato*. The tribe Dikraneurini *sensu lato* is sister to the clade containing Alebrini, Empoascini, and Typhlocybini. The analyses (morphological, molecular, and total evidence) suggest that large genera, including *Dikrella*, *Alconeura*, and *Erythroneura*, may not be monophyletic, and should be reexamined in light of chracters used herein. Additionally, relationships at the level of subtribe remain largely uncertain. Because of these concerns and the limited number of taxa examined here, no formal nomenclatural changes are proposed at this time. On the other hand, *Erythroneura* and related genera appear to represent a monophyletic subtribe with a broader Dikraneurini based on both molecular and morphological evidence.

The Dikraneurini have a worldwide distribution, with five genera being found in the Australia . Presently, 201 genera and 31 subgenera are recognized in the Dikraneurini.

Valid genera of the Dikraneurini *sensu stricto* (* indicates genus examined)

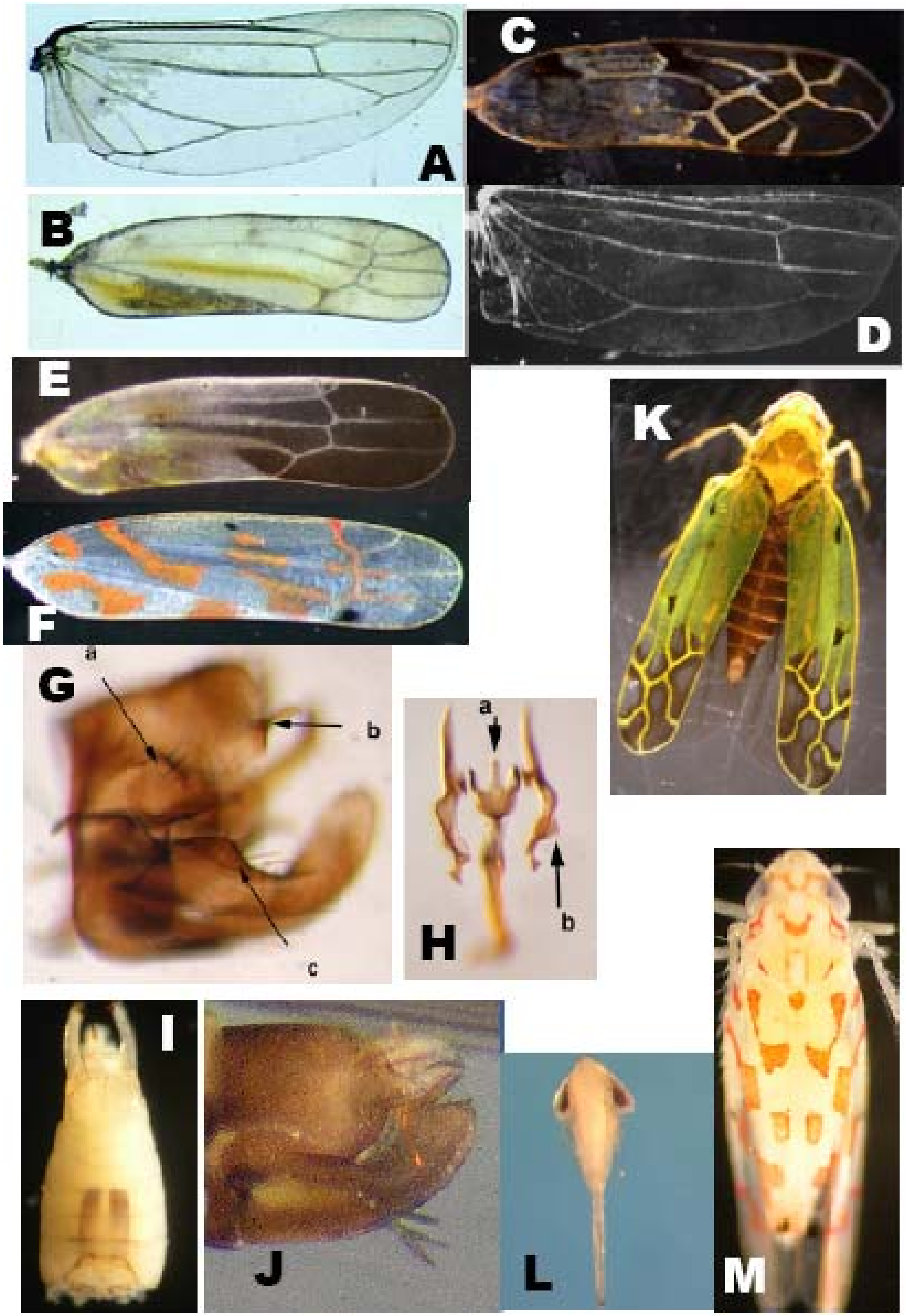
Afrakeura Einyu & Ahmed, 1979; **Afrakra* Dworakowska, 1979; **Alconeura* Ball & DeLong, 1925; *Anaka* Dworakowska & Viraktamath, 1975; *Aneono* Kirkaldy, 1906; *Aroonra* Dworakowska, 1993; *Aruena* Anufriev, 1972; *Ayubiana* Ahmed & Manzoor, 1969; *Britimnathista* Dworakowska, 1969; *Buritia* Young, 1952; *Cuanta* Dworakowska, 1993; *Delongia* Young, 1952; *Dicraneurula* Vilbaste, 1968; **Dikraneura* Hardy, 1850; **Dikrella* Oman, 1949; **Dikrellidia* Young, 1952; *Donidea* Young, 1952; *Dziwneono* Dworakowska, 1972; *Emelyanoviana* Anufriev, 1970; *Endoxoneura* Young, 1952; *Erythria* Fieber, 1866; **Forcipata* DeLong & Caldwell, 1942; *Fusiplata* Ahmed, 1969; *Golwala* Dworakowska, 1993; *Gullifera* Webb, 1980; *Hazaraneura* Samad & Ahmed, 1979; *Helionides* Matsumura, 1931; *Hybla* McAtee, 1932; **Idona* DeLong, 1931; **Igutettix* Matsumura, 1932; *Iniesta* Dworakowska, 1993; *Jimara* Dworakowska, 1971; *Kahaono* Kirkaldy, 1906; *Kalkiana* Sohi, Viraktamath & Dworakowska, 1980; *Kamaza* Dworakowska, 1977; *Karachiota* Ahmed, 1969; *Kerygma* Dworakowska, 1995; *Kidraneuroidea* Mahmood, 1967; **Kidrella* Young, 1952; *Kirkaldykra* Dworakowska, 1971; **Kunzeana* Oman, 1949; *Kunzella* Young, 1952; *Liguropia* Haupt, 1930; *Matatua* Knight, 1976; *Micantulina* Anufriev, 1970; *Micantulina* (*Anufrievola*) Kocak, 1981; *Michalowskiya* (*Burunra*) Dworakowska, 1993; *Motschulskyia* Kirkaldy, 1905; *Motschulskyia* (*Togaritettix*) Matsumura, 1931; *Naratettix* Matsumura, 1931; **Neodikrella* Young, 1952; *Notus* Fieber, 1866; **Parallaxis* McAtee, 1926; *Platfusa* Dworakowska, 1993; *Ramsisia* Einyu & Ahmed, 1979; *Readionia* Young, 1952; *Riyavaroa* Dworakowska, 1993; *Samruadkita* Dworakowska, 1993; *Saranella* Young, 1952; *Sarascarta* Young, 1952; *Smita* Dworakowska, 1993; *Togaricrania* Matsumura, 1931; *Typhlocybella* Baker, 1903; *Urvana* Dworakowska, 1993; *Uzeldikra* Dworakowska, 1971; *Vikabara* Dworakowska, 1993; *Wagneriala* Anufriev, 1970; *Zielona* Dworakowska, 1993.

<u>Valid genera of subgroup Erythroneurina</u> (* indicates genus examined, ** indicates personal favorite.) (SYNONYMY)

Aaka Dworakowska, 1972; **Accacidia* Dworakowska, 1971; *Ahmedra* Dworakowska & Viraktamath, 1979; *Aidola* Melichar, 1914; *Aisa* Dworakowska, 1979; *Ajika* Dworakowska, 1979; *_Alnetoidia_ Dlabola, 1958; _Alnetoidia_ (_Alnella_) Anufriev, 1971; _Ambara_ Dworakowska, 1981; _Andrabia_ Ahmed & Manzoor, 1970; *_Anufrievia_ Dworakowska, 1970; *_Arboridia_ Zachvatkin, 1946; _Arboridia_ (_Erythridula_) Young, 1952; _Arbosiria_ Dworakowska, 1994; _Asianidia_ Zachvatkin, 1946; _Assina_ Dworakowska, 1979; _Aylala_ Dworakowska, 1994; _Bakera_ Mahmood, 1967; _Bakshia_ Dworakowska, 1977; _Balanda_ Dworakowska, 1979; _Barinaga_ Dworakowska, 1995; _Baya_ Dworakowska, 1972; _Bengueta_ Mahmood, 1967; _Cassianeura_ Ramakrishnan & Menon, 1973; _Cemeura_ Ghauri, 1978; _Chagria_ Dworakowska, 1994; _Chikava_ Dworakowska, 1995; _Cerkira_ Dworakowska, 1994; _Ciudadrea_ Dworakowska, 1970; _Coganoa_ Dworakowska, 1976; *_Coleana_ Dworakowska, 1971; _Cubnara_ Dworakowska, 1979; _Davmata_ Dworakowska, 1979; _Diomma_ Motschulsky, 1863; _Diomma_ (_Bunyipia_) Dworakowska, 1972; _Diomma_ (_Dilobonota_) Dworakowska, 1972; _Dorycnia_ Dworakowska, 1972; _Duanjina_ Kuoh, 1981; _Elbelus_ Mahmood, 1967; _Eldama_ Dworakowska, 1972; _Empoascanara_ Distant, 1918; _Empoascanara_ (_Bza_) Dworakowska, 1979; _Empoascanara_ (_Kanguza_) Dworakowska, 1972; _Eryascara_ Dworakowska, 1995; *_Erythroneura_ Fitch, 1851; _Erythroneura_ (_Erasmoneura_) Young, 1952; _Erythroneura_ (_Eratoneura_) Young, 1952; _Erythroneura_ (_Punctigerella_) Young, 1952; *_Frutioidia_ Zachvatkin, 1946; _Frutioidia_ (_Dworakowskellina_) Kocak, 1981; _Gambialoa_ Dworakowska, 1972; _Gambialoa_ (_Nkasa_) Dworakowska, 1974; _Gindara_ Dworakowska, 1980; _Gladkara_ Dworakowska, 1995; _Goska_ Dworakowska, 1981; _Gredznskiya_ Dworakowska, 1972; _Hajra_ Dworakowska, 1981; _Harmata_ Dworakowska, 1976; _Hauptidia_ Dworakowska, 1970; _Hauptidia_ (_Melicharidia_) Dworakowska, 1970; _Helionidia_ Zachvatkin, 1946; _Ifeneura_ Ghauri, 1975; _Imbecilla_ Dworakowska, 1970; _Imugina_ Mahmood, 1967; _Iseza_

Dworakowska, 1981; *Iseza* (*Tamaga*) Dworakowska, 1981; *Ivorycoasta* Dworakowska, 1972; *Jalalia* Ahmed, 1970; *Jotwa* Dworakowska, 1995; *Kabakra* Dworakowska, 1979; *Kapsa* Dworakowska, 1972; *Kaukania* Dworakowska, 1972; *Koperta* Dworakowska, 1972; *Kropka* Dworakowska, 1970; *Kusala* Dworakowska, 1981; *Kwempia* Ahmed, 1979; *Lamtoana* Dworakowska, 1972; *Lankama* Dworakowska , 1994; *Lectotypella* Dworakowska, 1972; *Lichtrea* Dworakowska, 1976; *Lisciasta* Dworakowska, 1995; *Lokia* Thapa, 1984; **Lublinia* Dworakowska, 1970; *Luvanda* Dworakowska, 1995; *Makilingana* Mahmood, 1967; *Mandera* Ahmed, 1971; *Mandola* Ahmed, 1971; *Mangganeura* Ghauri, 1967; *Masumurina* Dworakowska, 1972; *Meremra* Dworakowska, 1979; *Michalowskiya* Dworakowska, 1972; *Mitjaevia* Dworakowska, 1970; ***Mizeria* Dworakowska, 1994; *Motaga* Dworakowska, 1979; *Musbrnola* Dworakowska, 1972; *Nababia* Dworakowska, 1994; *Nandara* Dworakowska, 1984; *Ngoma* Dworakowska, 1974; *Ngombela* Dworakowska, 1974; *Ngunga* Dworakowska, 1974; *Niedoida* Dworakowska, 1994; *Nitta* Dworakowska, 1995; *Nkonba* Dworakowska, 1974; *Nsanga* Dworakowska, 1974; *Nsesa* Dworakowska, 1974; *Nsimbala* Dworakowska, 1974; **Ntanga* Dworakowska, 1974; *Ntotila* Dworakowska, 1974; *Ntotila* (*Ngangula*) Dworakowska, 1974; *Nzinga* Dworakowska, 1974; *Ossuaria* Dworakowska ,1979; *Otbatara* Dworakowska, 1984; *Parathaia* Kuoh, 1982; *Pasara* Dworakowska, 1981; *Pettya* Kirkaldy, 1906; *Plumosa* Sohi, 1977; *Proskura* Dworakowska, 1981; *Pseudothaia* Kuoh, 1982; *Qadria* Mahmood, 1967; *Raabeina* Dworakowska, 1972; *Ramania* Dworakowska, 1972; *Ranbara* Dworakowska, 1983; *Ratburella* Ramakrishnan & Menon, 1973; *Ratjalia* Dworakowska, 1981; *Rhusia* Theron, 1977; *Rufitidia* Dworakowska, 1994; *Sajda* Dworakowska, 1981; **Salka* Dworakowska, 1972; *Sanatana* Dworakowska, 1984; *Sandalla* Mahmood, 1967; *Sandanella* Mahmood, 1967; *Sandia* Theron, 1982; *Sempia* Dworakowska, 1970; **Seriana* Dworakowska, 1971; **Singapora* Mahmood, 1967; *Sirosoma* McAtee, 1933; *Ska* Dworakwoska, 1976; *Stehliksia* Dworakowska, 1972; *Szymczakowskia* Dworakowska, 1974; *Takama* Dworakowska & Viraktamath, 1975; *Tamaricella* Zachvatkin, 1946; *Tautoneura* Anufriev, 1969; *Thaia* Ghauri, 1962; *Thaia* (*Niema*) Dworakowska, 1979; *Thaia* (*Nlunga*) Dworakowska, 1974; *Thailus* Mahmood, 1967; *Thaiora* Dworakowska, 1995; *Toroa* Ahmed, 1979; *Tuzinka* Dworakowska & Viraktamath, 1979; *Urmila* Dworakowska, 1981; *Vermara* Dworakowska, 1980; *Watara* Dworakowska, 1977; *Witera* Dworakowska, 1981; *Yeia* Dworakowska, 1995; *Zanjoneura* Ghauri, 1974; *Zicacella* Anufriev, 1970; *Zinga* Dworakowska, 1972; *Zygina* Fieber, 1866; *Zygina* (*Hypericella*) Dworakowska, 1970; *Zyginopsis* Ramakrishnan & Menon, 1973.

Figure 3. Tribe Dikraneurini (A-F, wings; G, lateral pygofer; H, dorsal connective and styles: I, ventral abdomen showing apodemes; J, Lateral pygofer; K, dorsal habitus showing unsclerotized abdominal tergite X; M dorsal habitus; L, face). A, *Dikrella* sp. 5. B, *Dikrella* sp. 13. C, *Parallaxis* sp. 2. D-F, *Erythroneura.* G-H, *Salka.* I, *Forcipata*. J,L *Dikrella* sp. 5. K, *Parallaxis*. M, *Erythroneura* .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Tribe EMPOASCINI Distant, 1908

Afrotropical, Australian, Indomalayan, Nearctic, Neotropical, and Palearctic regions.

Figs. 4. A-K.

Type genus: *Empoasca* Walsh,1862a

Empoascaria Distant, 1908 (Division)

Jorumini McAtee, 1926 (Tribe) NEW SYNONOMY

Helioninae Haupt, 1929 (Subfamily) NEW SYNONOMY

Empoascinae Distant, 1908: Haupt, 1929 (Subfamily)

Empoascini Distant, 1908: Haupt, 1935 (Tribe)

Helionini Haupt, 1929: Metcalf, 1968 (Tribe)

Diagnostic characters. Forewing without appendix. Hind wing with submarginal vein reaching vein R+M (4B, D). Genitalia with a simple tapered style, often with serrations at distal end (4J).

Description.. HEAD: wider or narrower than pronotum; coronal suture distinct or indistinct; crown without peak, median length little if any longer medially than next to either eye, basal width between eyes distinctly wider than each eye width (dorsal aspect); sexual dimorphism not apparent; face in profile not depressed; ocelli present, round, on anterior margin of head; lorum extending to or narrowly short of genal margin; mouthparts equal to or less than 2x length of clypellus. THORAX: Mesothoracic anapleural suture absent, scutellar apex distinctly acuminate. FORELEGS: femur with AM1+AM seta absent, AM1 seta distinctly longer than other AM setae, intercalary setae subequal in size or gradually reduced from base to apex, or with 1 or 2 basal setae distinctly enlarged; row PV without long, fine setae; number of protibial AV macrosetae >12, 1 or more protibial AV row macrosetae distinctly enlarged, or appearing to grade larger distally. HIND LEGS: femoral macrosetal formula 2+1+1; tibial row AV with 4, 5, 6 or more macrosetae; tarsomere I acuminate, tarsal length distinctly less than half tibial length and less than or nearly length of tarsomeres II+III. FOREWING: apex without or rarely with extension, opaque pigmentation present or sparse and transparent, without closed pre-apical cells; appendix absent; cell R_3 not attaining wing apex; vein R forked (2 branches), stem shorter than, equal to, or longer than vein R_{3+4} but not reaching wing base; vein R_{4+5} mostly straight to apical margin, rarely gently curved to coastal margin; vein M stem length complete to wing base or longer than M_{1+2}; apical cell R_5 with or without petiole; vein R+M not confluent before R_{2+3} fork; vein M_{3+4} extending to wing margin; cell M 1x to up to 2x as wide as cell R; either 1 anal vein or none apparent; cell M_4 mostly elongate but short of apex, tapered; apex of cell M transversely or obliquely truncate, apex of vein Cu connecting to wing margin at or distad of apex of clavus; cell M_2 variable length and width. HIND WING: hamulus distinct or indistinct; vein Sc absent; vein R+M as long or longer than ¼ total wing length, or no vein R+M (former Jorumini); submarginal vein present at wing apex; vein R_1 remnant present or absent; cell M variable; crossvein m-cu as long as or longer than length of basal segment of vein M_{3+4} or absent; distal segment of vein CuA present; veins CuA and M_{3+4} partially or completely confluent; vein 1A branching from 2A basally or at midlength; apex of cell M transversely or obliquely truncate: vein CuP confluent with submarginal vein at point opposite to or proximad of basal segment of M_{3+4}; anal margin with or without serrations (former Jorumini). ABDOMEN: overall shape narrow or tapered; second sternal apodemes poorly developed, not extending beyond posterior margin of sternite III or well developed and extending beyond sternite III; tergite IX present, well sclerotized; anal tube with basolateral hooks or processes. PYGOFER: dorsal appendages absent; ventral appendages present or absent; dorsoapical macrosetae absent or present; ventrolateral setal group absent or indistinct. SUBGENITAL PLATE: in lateral view strongly curved dorsally, elbowed or gently curved, and length 2x to greater than 5x width; basolateral setal group absent or present; long, fine setae absent or present; macrosetae present, numerous, in a row or band from base to near apex; angulate basolateral projection absent. STYLE: with or without preapical lobe; apex tapered, with serrations absent or present. CONNECTIVE: anterior margin truncate or shallowly emarginated, or with a distinct anterior, median lobe.

Distribution. Afrotropical, Australian, Indomalayan, Nearctic, Neotropical, and Palearctic regions.

Discussion. Based on the combined analysis (Fig. 7: a consensus of 4 trees based on genetic, 16S rDNA and Histone H(3), and morphological data, 73 binary and multistate characters) the Empoascini (including the former Jorumini) form a monophyletic group (excluding *Unitra*, which grouped with the Typhlocybini based on genetic data) that formed a sister clade with the Typhlocybini. The Typhlocybini along with the Empoascini form a sister clade to the Alebrini.

In the morphology tree (Fig. 10) the empoascine genera (including *Unitra*) combined with 3 taxa of the former Jorumini (*Joruma*) and one of the former Helionini (*Heliona*) form a monophyletic clade. This clade also includes part of the former Zyginellini (*Narta*), due largely to similar leg chaetotaxy, short crown, and length of major wing vein stems, as well as no anal veins visible (as in Empoascini). The DNA consensus tree (Fig.) supports the *Empoasca* genera (excluding the former Jorumini, which nested within a clade containing *Columbonirvana* and an Alebrini, (no DNA was collected for *Heliona*) within the Typhlocybini and that entire clade forming a sister group with most of the Alebrini (*Alebra, Elabra, Habralebra, Orientalebra*).

The Empoascini were erected by Distant (as Empoascaria) in 1908. Young considered the tribe Typhlocybini to encompass empoascine and jorumine complexes.

The Empoascini are worldwide in distribution with just 6 genera in Australia, and include some of the most speciose genera. Presently, 65 genera and 29 subgenera are recognized in the Empoascini.

<u>Valid genera of the Empoascini</u> (*indicates genus examined)

**Acia* McAtee, 1934; *Acia* (*Icaiana*) Dworakowska, 1981; *Acia* (*Africia*) Dworakowska, 1981; *Acia* (*Naracia*) Dworakowska, 1981; *Acia* (*Paolicia*) Dworakowska, 1981; *Afrasca* Dworakowska & Lauterer, 1975; *Afroccidens* Ghaui, 1967; *Alebroides* Matsumura, 1931; *Amrasca* Ghauri, 1967; *Amrasca* (*Quartasca*) Dworakowska, 1972; **Apheliona* Kirkaldy, 1907; *Asepodiva* Dworakowska, 1994; *Asymmetrasca* Dlabola, 1958; *Austroasca* Lower, 1952; *Badylessa* Dworakowska, 1981; *Bhatasca* Dworakowska, 1995; *Chlorita* Fieber, 1872;

Chlorita (*Artemisiella*) Zachvatkin, 1953; *Chlorita* (*Xerochlorita*) Zachvatkin, 1953; *Chloroasca* Anufriev, 1972; *Daluana* Ramakrishnan, 1982; *Dattasca* Dworakowska, 1979; *Dayus* Mahmood, 1967; *Dialecticopteryx* Kirkaldy, 1907; *Dialecticopteryx* (*Akotettix*) Matsumura, 1931; *Dunioa* Dworakowska, 1995; **Empoasca* Walsh, 1862; *Empoasca* (*Distantasca*) Dworakowska, 1972; *Empoasca* (*Endeia*) McAtee, 1934; *Empoasca* (*Greceasca*) Thapa, 1985; *Empoasca* (*Hebata*) DeLong, 1931; *Empoasca* (*Kybos*) Kieber, 1866; *Empoasca* (*Livasca*) Dworakowska & Viraktamath, 1978; *Empoasca* (*Marolda*) Dworakowska , 1977; *Empoasca* (*Matsumurasca*) Anufriev, 1973; *Empoasca* (*Ociepa*) Dworakowska, 1977; *Empoasca* (*Okubasca*) Dworakowska, 1982; *Epignoma* Dworakowska, 1972; *Faiga* Dworakowska, 1980; *Ficiana* Ghauri, 1963; *Ghauriana* Thapa, 1985; *Goifa* Dworakowska, 1977; *Habenia* Dworakowska, 1972; *Habenia* (*Atucla*) Dworakowska, 1972; *Ifuaria* Dworakowska, 1994; *Ifugoa* Dworakowska & Pawar, 1974; *Ishiharella* Dworakowska, 1970; *Jacobiella* Dworakowska, 1972; *Kaila* Dworakowska, 1974; *Krameriata* Dworakowska, 1977; *Kufajka* Dworakowska, 1995; *Kyboasca* Zachvatkin, 1953; *Lankasca* Ghauri, 1963; *Lipata* Dworakowska, 1974; *Luvila* Dworakowska, 1974; *Nikkotettix* Matsumura, 1931; *Nimabanana* Dworakowska, 1994; *Optya* Dworakowska, 1974; *Optya* (*Nkima*) Dworakowska, 1976; *Paolia* Lower, 1952; *Penangiana* Mahmood, 1967; *Pitadava* Dworakowska, 1995; *Pradama* Dworakowska, 1995; *Randhawa* Dworakowska, 1995; *Rawania* Ghauri, 1963; *Rhinocerotis* Theron, 1977; *Schizandrasca* Anufriev, 1972; *Sikkimasca* Dworakowska, 1994; *Smyga* Dworakowska, 1995; *Solanasca* Ghauri, 1974; *Szara* Dworakowska, 1995; *Szuletaia* Dworakwoska, 1995; *Theasca* Dworakowska, 1972; **Unitra* Dworakowska, 1974; *Usharia* Dworakowska, 1977; *Ussuriasca* Anufriev, 1972;

Varsha Dworakowska, 1995; *Velu* Ghauri, 1963; *Wemba* Dworakowska, 1974; *Wolvletta* Dworakowska, 1995; *Znana* Dworakowska, 1994.

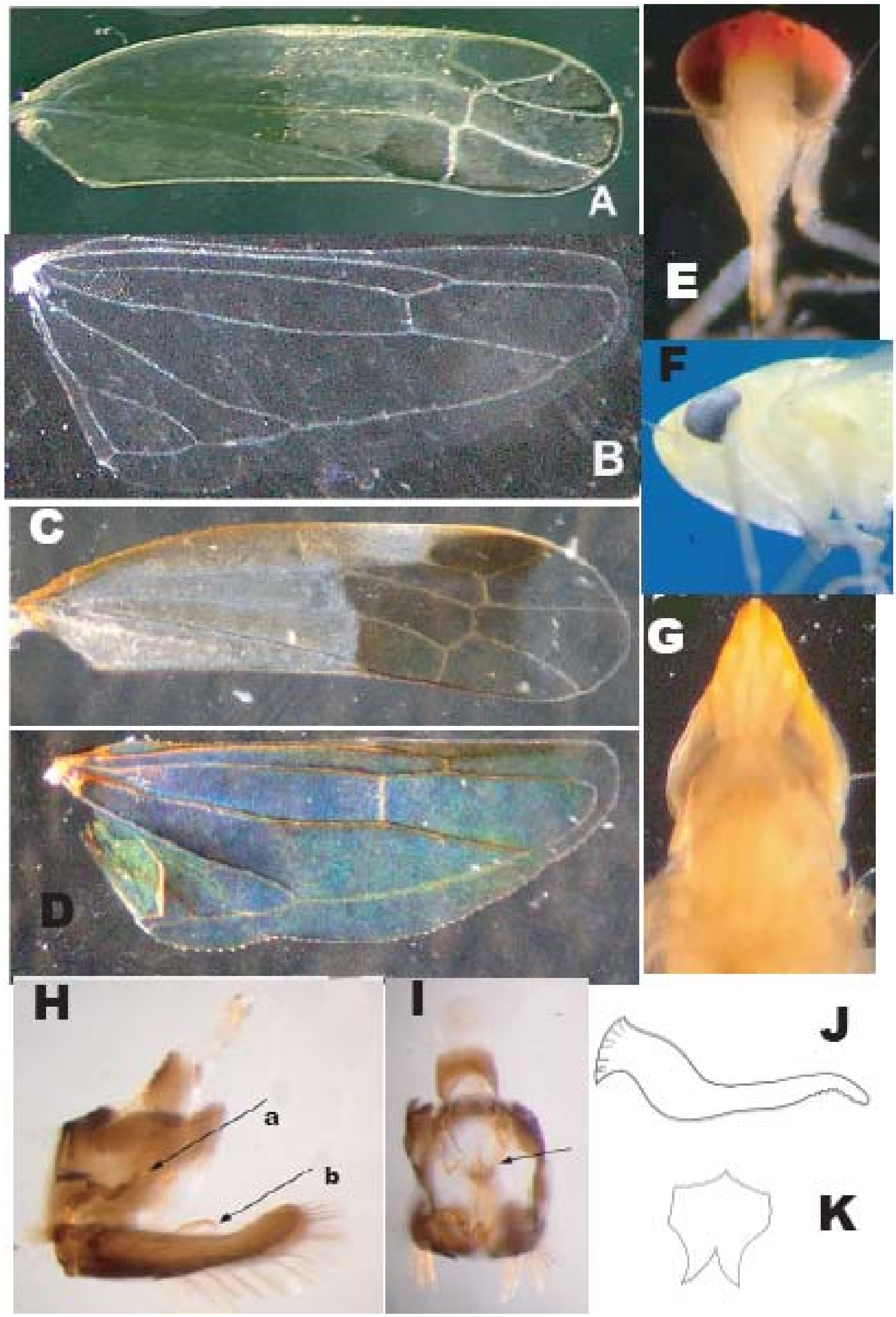
<u>Valid genera of the Helionini</u> (* indicates genus examined) (SYNONYMY)

**Heliona* Melicar, 1903.

<u>Valid genera of the Jorumini</u> (* indicates genus examined) (SYNONYMY)

Beamerana Young, 1952; **Eualebra* Baker, 1899; **Joruma* McAtee, 1924; *Joruma* (*Jorumidia*) Young, 1952; *Neojoruma* Young, 1952; *Paulomanus* Young, 1952.

Figure 4. Tribe Empoascini.(A-D, wings; E, face showing ocelli and narrow frons; F, lateral aspect of head; G, dorsal aspect of head; H, genital capsule showing: a, ventral process and b, tapered serrated style; I, Posterior aspect of genital capsule showing anal hooks; J, Lateral aspect of style; K, ventral aspect of connective). A-B, F, *Empoasca*. C-E, *Joruma*. G, *Acia*. H-K, *Empoasca*.


A
B
C
D
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b
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Tribe TYPHLOCYBINI Kirschbaum, 1868

Afrotropical, Australian, Indomalayan, Nearctic, Neotropical, and Palearctic regions.

Fig. 5. A-J

Type genus: *Typhlocyba* Germar,1833a

Typhlocybidae Kirschbaum, 1868 (Family)

Typhlocybini Kirschbaum, 1868: Oudemans, 1897 (rank not specified)

Eupteryginae Kirkaldy, 1906 (rank not specified)

Eupterygini Kirkaldy, 1906: Kirkaldy, 1907 (rank not specified)

Typhlocybaria Kirschbaum, 1868: Distant, 1908 (Division)

Eupterygini Kirkaldy, 1906: Baker, 1915 (=Typhlocybini)

Typhlocybinia Kirschbaum, 1868: Schumacher, 1915 (rank not specified)

Eupteryginae Kirkaldy, 1906: Ball, 1924 (=Typhlocybinae)

Typhlocybini Kirschbaum, 1868: McAtee, 1926 (Tribe)

Eupteryginae Kirkaldy, 1906: Haupt, 1929 (subfamily)

Eupterygidae Kirkaldy, 1906: Ossiannilsson, 1936 (Subfamily)

Zyginellini Dworakowska, 1977 (Tribe) NEW SYNONOMY

[Note: family group names based on the invalid genus *Cicadella* Duméril, 1806 (=Typhlocybinae), are suppressed under the plenary powers of the International Commission on Zoological Nomenclature (Opinion 647), Bulletin of Zoological Nomenclature 20(1): 35-38.]

Diagnostic characters. Forewing without appendix; often with exaggerated petiolate R5 cell (Figs. 5A,D). Hind wing with submarginal vein extending to apex of wing or not, if extending to apex of wing, then not extending to vein R+M (no closed apical cells form) and with anal veins branched, or with vein R+M not forming and no closed apical cells (Fig. 5B, C).

Description. HEAD: narrower than pronotum; coronal suture distinct or indistinct; crown without peak, median length little if any longer medially than next to eye, or distinctly longer than next to eye, basal width between eyes distinctly wider than each eye width (dorsal aspect); sexual dimorphism variable; face in profile may be depressed or not; ocelli present or absent, when present, on anterior margin of head; lorum obviously separated from genal margin or indistinct; mouthparts less than 2x length of clypellus. THORAX: Mesothoracic anapleural suture absent or present, scutellar apex distinctly acuminate. FORELEGS: femur with AM1+AM seta absent, AM1 seta distinctly longer than other AM setae, intercalary setae subequal in size or gradually reduced from base to apex, or 2 or more basal setae distinctly enlarged; row PV without long, fine setae; number of protibial AV macrosetae 8-11, protibial AV row macrosetae all about uniform or appearing to grade larger distally. HIND LEGS: femoral macrosetal formula 2+1+1; tibial row AV with 4 or 5 macrosetae; tarsomere I acuminate, tarsal length distinctly less than half tibial length and less than length of II+III. FOREWING: apex without or rarely with extension, opaque pigmentation present, without closed anteapical cells; appendix absent; R_3 cell not attaining wing apex; vein R forked (2 branches), vein R+M not confluent before R_{2+3} fork; vein R_{4+5} abruptly or gently curved to apical margin; vein m stem longer than vein M_{1+2} but not reaching wing base; apical cell R_5 with petiole; vein M_{3+4} extending to wing margin; cell M from less than width of cell R up to 2x as wide; either 1 anal vein or none apparent; cell M_4 short and oblique; apex of cell M transversely or obliquely truncate; apex of vein Cu connecting to wing margin at apex of clavus; cell M_2 wider than long or as wide as long, elongate and wide, larger than either adjoining apical cells. HIND WING: hamulus distinct or indistinct; vein Sc absent; vein R+M as long or longer than ¼ total wing length, or no vein R+M (Eupterygini); submarginal vein present at wing apex or absent (former Zyginellini); vein R_1 remnant present or absent; cell M width at least 1x to greater than 2x as wide or wider than cell R; crossvein m-cu as long as or longer than length of basal segment of vein M_{3+4}, less than length of basal segment of vein M_{3+4}, or absent; distal segment of vein CuA present or absent (former Zyginellini); veins CuA and M_{3+4} may be free, partially or completely confluent; vein 1A branching from 2A basally or at midlength; apex of cell M transversely or obliquely truncate; vein CuP confluent with submarginal vein at point opposite to or proximad of basal segment of M_{3+4}; anal margin without serrations. ABDOMEN: overall shape narrow or tapered; second sternal apodemes well developed and extending beyond sternite III; tergite IX present, well sclerotized; anal tube without basolateral hooks or processes. PYGOFER: dorsal appendages absent; ventral appendages absent or present (former Zyginellini); dorsoapical macrosetae absent; ventrolateral setal group absent or present. SUBGENITAL PLATE: in lateral view straight or only gently curved dorsoapically, or abruptly elbowed, and length from less than 2x to greater than 5x width; basolateral setal group absent or present; long, fine setae absent or present; macrosetae present, numerous, in a row or band from base to near apex, few restricted to basal half, or 1 basally; angulate basolateral projection absent. STYLE: without preapical lobe; apex tapered or bi-or trifurcate, with serrations absent. CONNECTIVE: Y or V-shaped or anterior margin truncate or shallowly emarginated.

Distribution. Afrotropical, Australian, Indomalayan, Nearctic, Neotropical, and Palearctic regions.

Discussion. The name Typhlocybinae for the subfamily and also Typhlocybini for the tribe result from a nomenclature ruling provided by the International Commission on Zoological Nomenclature (International Commission on Zoological Nomenclature 1963).

Based on the combined analysis resulting in a consensus of 8 trees using both genetic (16SrDNA and Histone H(3)) and morphological data (73 binary and multistate characters), (Fig.7), the Typhlocybini including *Euhardina*, and former Zyginellini (*Limassola*) form a monophyletic group (excluding *Unitra* which belongs with Empoascini morphologically) forms a sister clade to the Empoascini. The Typhlocybini along with the Empoascini form a sister clade with the Alebrini.

In the morphology tree (Fig. 10) the typhlocybine genera (including *Typhlocyba quercus*) nest with some Dikraneurini genera, *Columbonirvana*, and *Eualebra*. This group forms a sister clade with the former Erythroneurini. The DNA consensus tree (9 trees) supports the typhlocybine genera forming a clade but results in a polytomy with the Empoascini and the Alebrini.

Typhlocybinae occur in all major zoogeographic regions. Presently, 88 genera and 13 subgenera are recognized in the tribe Typhlocybini.

Valid genera of the Typhlocybini (* indicates genus examined).

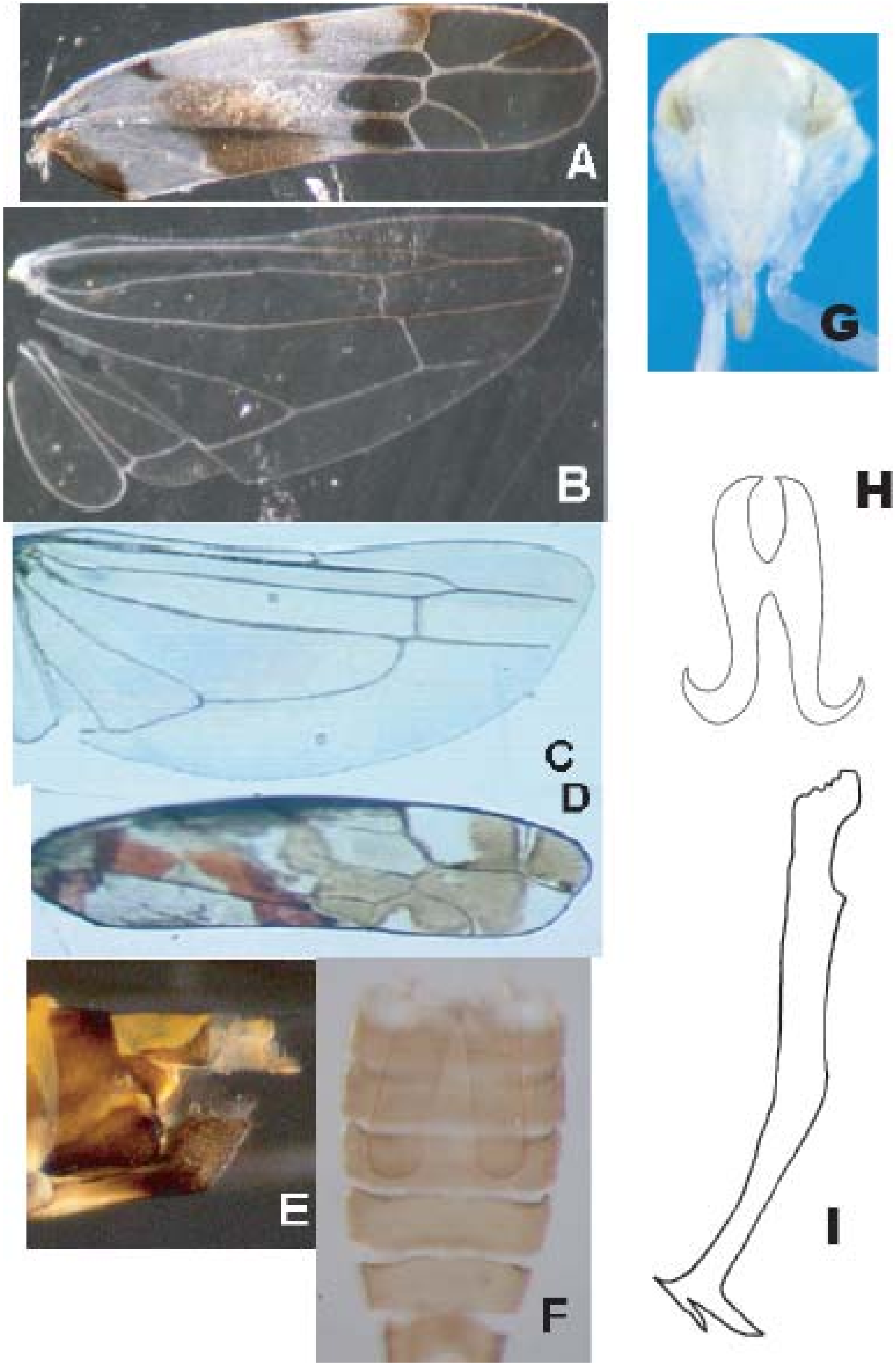
**Agnesiella* Dworakowska, 1979; *Agnesiella* (*Draberiella*) Dworakowska, 1971; *Almunisna* Dworakowska, 1969; *Amurta* Dworakowska, 1977; *Baaora* Dworakowska, 1981; *Baguoidea* Mahmood, 1967; *Bolanusoides* Distant, 1918; *Byphlocyta* Ahmed & Manzoor, 1971; *Caknesia* Dworakowska, 1994; *Dapitana* Mahmood, 1967; *Edwardsiana* Zachvatkin, 1929; *Eupterella* DeLong & Ruppel, 1950; *Fagocyba* Dlabola, 1958; *Farynala* Dworakowska, 1970; *Gratba* Dworakowska, 1982; *Guheswaria* Thapa, 1983; *Henribautia* Young & Christian, 1952; **Hiratettix* Matsumura, 1931; *Homa* Distant, 1908; *Kadrabia* Dworakowska & Sohi, 1978; *Knightipsis* Dworakowska, 1969; *Kotwaria* Dworakowska, 1984; *Labrangia* Dworakowska, 1994; *Lindbergina* Dlabola, 1958; *Lindbergina* (*Youngiada*) Dlabola, 1959; *Linnavuoriana* Dlabola, 1958; *Linnavuoriana* (*Sharmana*) Dworakowska, 1982; *Mahmoba* Dworakowska, 1982; *Mahmoodia* Dworakowska, 1970; *Mcateeana* Christian, 1952; *Meketia* Dworakowska, 1982; *Mfutila* Dworakowska, 1974; *Mindanaoa* Mahmood, 1967; *Ndokia* Dworakowska, 1994; *Nkaanga* Dworakowska, 1974; *Nkumba* Dworakowska, 1974; *Olszewskia* Dworakowska, 1974; *Opamata* Dworakowska, 1971; *Paracyba* Vilbaste, 1968; *Paratyphlocyba* Ahmed, 1985; *Pemoasca* Mahmood, 1967; *Rabiana* Mahmood, 1967; *Ribautiana* Zachvatkin, 1947; *Sacapome* Schumacher, 1915; *Sannella* Dworakowska, 1982; *Savitara* Dworakowska, 1984; *Serratulus* Mahmood, 1967; *Shamala* Dworakowska, 1980; *Thailocyba* Mahmood, 1967; *Thampoa* Mahmood, 1967; **Typhlocyba* Germar, 1833; *Typhlocyba* (*Anomia*) Fieber, 1866; *Typhlocyba* (*Empoa*) Fitch, 1851; *Typhlocyba*

(*Eupterycyba*) Dlabola, 1958; *Typhlocyba* (*Ficocyba*) Vidano, 1960; *Vatana* Dworakowska, 1995; *Wagneriunia* Dworakowska, 1969; *Warodia* Dworakowska, 1970; *Yisiona* Kuoh, 1981; *Zonocyba* Wilbaste, 1982; *Zorka* Dworakowska, 1970; *Zyginidia* Haupt, 1929.

<u>Valid genera of the former tribe Eupterygini</u> (* indicates genus examined) (SYNONYMY)
Aguriahana Distant, 1918; *Eupterix* Fieber, 1866; *Euperyx* Curtis, 1831; *Eupteryx* (*Stacia*) Dworakowska, 1969; **Eurhadina* Haupt, 1929; *Eurhadina* (*Singhardina*) Mahmood, 1967; *Molopopterus* Jacobi, 1910; *Omanesia* Thapa, 1983; *Scinda* DeLong & Ruppel, 1951.

<u>Valid genera of the former tribe Zyginellini</u> (* indicates genus examined) (SYNONYMY)
Ahimia Dworakowska, 1979; *Borulla* Dworakowska, Sohi & Viraktamath, 1980; *Castoriella* Dworakowska, 1974; *Dlabolaiana* Dworakowska, 1974; *Dworakowskaia* Chou & Zhang, 1985; *Hellerina* Dworakowska, 1972; *Lautereriana* Dworakowska, 1974; *Ledeira* Dworakowska, 1969; **Limassolla* Dlabola, 1965; *Lowata* Dworakowska, 1977; *Mordania* Dworakowska, 1979; *Muluana* Dworakowska, 1979; **Narta* Dworakowska, 1979; *Parazyginella* Chou & Zhang, 1985; *Platycyba* Matsumura, 1932; *Polluxia* Dworakowska, 1974; *Ramakrishnania* Dworakowska, 1974; *Sundara* Ramakrishnan & Menon, 1972; *Sylhetia* Ahmed, 1972; *Tafalka* Dworakowska, 1979; *Takagiana* Dworakowska, 1974; *Tataka* Dworakowska, 1974; *Wiata* Dworakowska, 1972; *Yangida* Dworakowska, 1994; *Zyginella* Loew, 1855.

Figure 5. Tribe Typhlocybini (A-D, wings; E, lateral aspect of pygofer; F, ventral aspect of abdomen showing appodemes; G, face; H, ventral aspect of connective; I, lateral aspect of style). A-B,E, H-I, *Agnesiella*. C-D, *Limassola*. F-G, *Typhlocyba*.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RESULTS

Phylogeny of the Typhlocybinae. The phylogenetic trees and tribal descriptions presented here are the first extensive morphological and genetic analyses of the evolutionary relationships within the subfamily Typhlocybinae, and the conclusions drawn herein are based on these findings. Findings based on combined total evidence are presented first and then compared to the morphological and molecular analyses.

Total evidence. Figure 6 shows the concatenated phylogenetic analysis comprising 719 characters (73 morphological and 646 from combined 16S rDNA and Histone H3), which resulted in 8 equally parsimonious trees of 2544 steps, with a consistency index (CI) of 0.25, and a retention index (RI) of 0.39. Fig. 7 shows one of the 8 equally parsimonious trees with the nodes numbered and partitioned Bremer supports (decay indices) for the subfamily and tribes.

As a result of these analyses, the tribes Alebrini, Dikraneurini (including the subgroup Erythroneurina), Empoascini, and Typhlocybini are recognized (Figs.6,7). Five tribes are placed in synonymy. The present classification most closely supports that of Young (1952), except that Young erected a separate tribe Erythroneurini (here synonymized with Dikraneurini) and did not recognize an Empoascini (Table 2). The tribal descriptions give details on the morphology and summaries of tribal synonyms.

The Typhlocybinae, as defined here are a monophyletic group based on the phylogenetic analysis (Figs.6,7). Of the 13 morphological characters that support the

Typhlocybinae node, only two characters, the lack of ocelli on the crown of the head (character 655), and the acuminate hind tarsomere I (character 668) are shared by all the typhlocybines examined. Moreover, the absence rather than presence, of structures defines the subfamily. Traditionally, the lack of any closed anteapical cells in the forewing (especially cell M) were regarded as diagnostic for the group. While in this analysis I considered the vagueness of veins R and M in the forewing as evidence of the absence of cell M, in many specimens, the veins can be observed to extend to the wing base, thereby comprising the anteapical M cell. The lack of the anteapical cell M in the forewing can not be accepted as diagnostic for Typhlocybinae. On the basis of their lacking the preapical cell alone Young's placement of Mileewini in the Typhlocybini (1965) was rejected by Mahmood (1967), but this argument is not convincing. Thus, in the future Mileewini may be combined with the Typhlocybinae as Young suggested. Fletcher and Stevens (1988) suggested that hind femoral apical setal formulas are consistent within the tribes present in Australia. Typhlocybinae are represented as having the formula 2+1+1. This setal character was not consistent within the taxa studied and, in any case, these setae are very fragile, easily broken, and probably misleading. The absence of the anapleural suture in most of the Typhlocybinae appears to be a useful character, but it reappears in the heavier bodied specimens (and darker and more sclerotized specimens), especially those of the tribe Typhlocybini.

The Typhlocybinae can be broken into two large groups: one consisting of Alebrini, Typhlocybini, and Empoascini, and the other consisting of the large group Dikraneurini. Partitioned Bremer support was low for nodes delimiting most tribes, but support for the subfamily Typhlocybinae (5.5 molecular, 6.5 morphological) was stronger. The remaining supports are provided in Table 5. In Fig. 7, node 53 representing the tribe Alebrini required one step to form with molecular data (-1), and only two steps to break morphologically (2), and node 57 including the Empoascini required 3.5 steps to form with molecular data (-3.5) and only 4.5 steps to break morphological (4.5). Several terminal taxa pairings faired slightly better, often having support from both molecular and morphological data, but these numbers remain well below any expected for strong support. A few unexpected pairings, *Unitra* (an Empoascini) and *Limassola* (formerly a Zyginellini, now represented as Typhlocybini) have larger molecular support (22) and very low morphological support (-16). Such low numbers, based on a 2544 step tree, reflect high homoplasy (CI=0.25) among the characters in the analysis.

The Alebrini resemble the Mileewini in having an appendix on the forewing. In some genera prominent macrosetae adorn the genitalia. This character seems to situate them closest to the tribe Empoascini, which often shares that characteristic. Typhlocybini tend to have complex styles (often bi- or trifurate), as in *Agnesiella*. Such complexity is not found in the empoascines, which always have a simple tapered style, sometimes with serrations at the apex. All three groups also frequently have prominent ocelli.

The Dikraneurini *sensu stricto* were the largest group of specimens examined (32 of 75 taxa for the morphology, and 18 of 48 taxa for the concatenated DNA + morphology); they vary broadly except in hind wing venation. Dikraneurini and subgroup Erythroneurina comprise 30 of the 48 taxa in the total evidence analysis. Six clades form in all 8 equally parsimonious trees. Bremer supports are provided in Table 6 except for the single taxon

Alconeura sp. 1 branch, which is sister to the remaining Dikraneurini. In general, the morphological supports are low with the exception of the Erythroneurina clade (6.95). Relationships within Dikraneurini are thus largely ambiguous but the latter monophyletic clade probably merits subtribal status. No other formal subtribes are recognized here and even the limits of the nominotypical subtribe Dikraneurina are unclear.

Molecular evidence Histone H3 and 16S rDNA. Six equally parsimonious trees of 1917 steps (CI= 0.27; RI= 0.39) were recovered for the genetic analysis. The strict consensus of all six trees (Fig. 9) gave a topology that presented tribe Dikraneurini closest to the outgroup with two large clades comprised of the same taxa that were in Dikraneurini clade 3 (node 68) and clade 5 (node 74) in the total evidence tree (Fig. 7). Nested within the Dikraneurini clades are a large pair of sister groups, the first is comprised mostly of erythroneurines with *Columbonirvana* (unplaced), *Protalebrella* (Alebrini), and *Joruma* sp. 19 (Empoascini) outermost. The second sister group, which begins with three Dikraneurini genera, is mostly comprised of empoascines (with an Erythroneurina) nested within Typhlocybini (*Agnesiella*, *Hiratettix*, *Limassola*, *Euhardina*) with an empoascine (*Unitra*), all nested within the alebrine genera *Orientalebra*, *Alebra aurea*, *Elabra*, and *Habralebra*.

The molecular data seem to have lent the most information toward developing the generic groupings, but morphology seems to have had the largest influence on tribal ancestry. The Typhlocybini clade nested within the Dikraneurini close to the Erythroneurina (fairly derived) in the morphological analysis, and while nested in the Dikraneurini, more closely related to the Empoascini and Alebrini in the molecular analysis (still derived). Only in the total information analysis did the tribal grouping of (Alebrini (Typhlocybini + Empoascini)) become the sister group of the Dikraneurini (with subgroup Erythroneurina). This total analysis conclusion is reasonable based on plesiomorphic characters: regularly possessing ocelli, forewing appendix (Alebrini), and clear anapleural suture (Typhlocybini). Both the molecular analysis and the morphological analysis alone suggest that the tribe Dikraneurini is the ancestral Typhlocybinae group giving rise to the other tribes.

Morphological evidence. Nine equally parsimonious trees of 815 steps (CI= 0.13; RI= 0.49), were recovered for 75 taxa using 73 binary and multistate morphological characters. While not as clear as the concatenated tree, a similar topology was recovered from morphology alone (Fig. 8), the main difference being that the tribe Typhlocybini is nested within the Dikraneurini, close to the former Erythroneurini. Alebrini are closest to the outgroup and broken into a series of paired nested groups, rather than a single clade, suggesting that the alebrine apomorphy of "forewing with appendix" is not a very strongly uniting character. This series is then followed by a clade containing the Empoascini and the former Jorumini, Helionini, and one of the former zyginellines (*Narta*). The other former zyginelline (*Limassola*) grouped with the Typhlocybini as expected. *Columbonirvana*, as yet unplaced, groups with the tribe Typhlocybini in the morphology trees as opposed to grouping with the tribe Alebrini in the total information tree. The morphological grouping makes better "sense" as the genus *Columbonirvana* lacks the defining appendix found in all Alebrini.

DISCUSSION

As a result of these analyses four typhlocybine tribes and one subtribe are recognized: Alebrini, Dikraneurini (Erythroneurina), Empoascini, and Typhlocybinae. Oman *et al*. (1990), formally recognize these same five groupings. Three others are here placed in synonymy: the Jorumini, and Helionini, are both placed in the Empoascini; and the Zyginellini are placed in the Typhlocybini. Eupterygini (Haupt 1929: described as a subfamily within family Typhlocybidae) is synonymized with Typhlocybini.

Alebrini. The tribe Alebrini is based on a plesiomorphic trait—the presence of an appendix on the forewing. In the total evidence analysis (Fig.7) the Alebrini form a distinct clade containing two monophyletic clades based on the extent to which the appendix wraps around the apex of the wing *Alebra* and *Orientalebra* have the appendix wrapping the apex of the wing whereas the alebrine group containing *Protalebrella*, *Elabra*, and *Habralebra* do not. Also, the genus *Columbonirvana* groups within the alebrines that do not have the more complete appendix. Based on the consensus of 4 trees using both genetic (16S rDNA and Histone H(3)) and morphological data, Alebrini form a monophyletic group, sister to Empoascini, plus the former tribes Jorumini and Zyginellini. The morphological data alone break 8 alebrine genera into 4 groups nested under the outgroups *Ujna* + *Amuaka*. The molecular data alone show *Orientalebra* + *Alebra* as sister to *Elabra* + *Habralebra*, with this entire clade as sister to a group including Typhlocybini, former tribe Zyginellini, and

Empoascini. However, *Protalebrella* and *Columbonirvana* form a group with Jorumini basal to the former Erythroneurini (now Dikraneurini).

Dikraneurini. The Dikraneurini and Erythroneurini are large, widely recognized tribes. Both the morphological and molecular evidence presented here, however, suggest that "Erythroneurini" may be better placed as a subtribe (Erythronerina) of Dikraneurini *sensu lato*, as discussed below.

The combined analysis -- a consensus of 4 trees using both genetic (16srDNA and Histone H(3)) and morphological data (Fig. 6) -- divided the tribe Dikraneurini into 6 groups. Group 1 includes: *Alconeura* sp. 3, *Dikrella* sp. 8, *Dikrella* sp. 9, *Dikrellidia*, *Igutettix*, and *Kunzeana* and was morphologically defined by 4 characters: a single enlarged basal setae on the front femoral intercalary row, well developed second sternal apodemes, long fine setae present on the male plates, and male plates lacking the angulate basal projection. Group 2 includes: *Alconeura* sp. 2, *Dikrella* sp. 1, *Dikrella* sp. 3, *Dikrella* sp. 4, *Dikrella* sp. 6, *Idona*, and *Kidrella*, and are morphologically defined by having sparse wing coloration and an obliquely angular cell M apex in the forewing. The widely recognized tribe Erythroneurini here appears derived from Dikraneurini, and takes the position of group 3 and includes: *Alnetoidia*, *Anufrieva*, *Arboridia*, *Coleana*, *Erythroneura lawsonii, E. illinoisensis, E. tricincta*, *Ivorycoasta*, *Ntanga*, *Salka*, *Seriana*, and *Singapora.* Erythroneurina are morphologically defined by having distinct coronal sutures, short crown lengths, uniform front tibial AV setal row, submarginal vein absent at wing apex in hind wing, moveable dorsal pygofer appendages, and male plates from 2x to 5x longer than wide. Group 4 includes: *Dikrella* sp. 5, and *Dikrella* sp. 6; these genera are only supported by the molecular evidence. Group 5 includes: *Alconeura* sp. 0, and *Parallaxis* and have the head wider than pronotum, vein R abruptly curved to costal margin in the forewing, and a well sclerotized abdominal segment IX. Group 6 (*Alconeura* sp. 1) has a petiolate cell R_3, and a single anal vein in the forewing, the hind wing posterior shows sparse denticuli, the abdomen bulges at midlength, and the male plates are distinctly elbowed.

Morphological characters that support this broader definition of Dikraneurini (including Erythroneurina) are: ocelli vestigial or absent, vein Sc present in the hind wing (always in Dikraneurini *sensu stricto* and occasionally in Erythroneurina), with anal veins fused in the hind wing (all of Erythroneurina, many Dikraneurini *s. s.* (especially *Alconeura* group)), male plates with a basolateral projection, and preapical lobes present on the styles (most Erythroneurina and some Dikraneurini *s. s*.). A partitioned Bremer support shows –1.6 molecular and 4.6 morphological support values for this node.

The DNA based consensus tree (9 trees) likewise supports Erythroneurina as a group nested within Dikraneurini *sensu lato*. The tribe Dikraneurini *sensu lato* is sister to the clade containing Alebrini, Empoascini, and Typhlocybini. The analyses (morphological, molecular, and total evidence) suggest that large genera, including *Dikrella*, *Alconeura*, and *Erythroneura*, may not be monophyletic, and should be reexamined in light of morphological characters used herein. Additionally, relationships at the level of subtribe remain uncertain. Because of these concerns and the limited number of taxa examined here, no formal nomenclatural changes are proposed at this time. On the other hand, *Erythroneura* and related genera appear to represent a monophyletic subtribe within a broadened concept of Dikraneurini based on both molecular and morphological evidence.

Empoascini. The combined data phylogenetic analysis (Fig. 7) supports the Empoascini (including the former Jorumini) as a monophyletic group (excluding *Unitra*, which groups with the Typhlocybini based on genetic data) placed as sister to the Typhlocybini. The Typhlocybini along with the Empoascini form a sister clade to the Alebrini.

In the morphology based tree (Fig. 8) the empoascine genera (including *Unitra*) combines with 3 taxa of the former Jorumini (*Joruma*) and one of the former Helionini (*Heliona*) form a monophyletic clade. This clade also includes part of the former Zyginellini (*Narta*), due largely to similar leg chaetotaxy, short crown, and length of major wing vein stems, as well as no anal veins visible (as in Empoascini). The DNA consensus tree (Fig. 9) supports the *Empoasca* genera (excluding the former Jorumini, which nested within a clade containing *Columbonirvana* and an Alebrini, (no DNA was collected for *Heliona*) within the Typhlocybini and that entire clade forming a sister group with most of the Alebrini (*Alebra, Elabra, Habralebra, Orientalebra*).

The Empoascini were erected by Distant (1908) as Empoascaria. Young considered the tribe Typhlocybini to encompass empoascine and jorumine complexes.

Typhlocybinae. Use of the names Typhlocybinae for the subfamily and also Typhlocybini for the tribe result from a nomenclature ruling provided by the International Commission on Zoological Nomenclature (International Commission on Zoological Nomenclature 1963).

The Typhlocybini including *Euhardina*, and former Zyginellini (*Limassola*) form a monophyletic group (excluding *Unitra*) that is a sister group to the Empoascini based on the combined analysis (Fig.6). The Typhlocybini along with the Empoascini are sister group to the Alebrini.

In the morphology based tree (Fig. 8) the typhlocybine genera (including *Typhlocyba quercus*) nest within some Dikraneurini genera, *Columbonirvana*, and *Eualebra*. This group forms a sister clade to the former Erythroneurini. The DNA based consensus tree (Fig. 9) supports the typhlocybine genera as a monophyletic clade but results in a polytomy for the Empoascini and the Alebrini.

Biogeography. Members of the tribe Alebrini do not occur in Australia or New Zealand (related outgroup Mileewini [Cicadellinae] are likewise unknown from Australia (Evans 1966). The other three typhlocybine tribes recognized here occur in all six major biogeographic regions: Afrotropical, Australian, Indomalaysian, Nearctic, Neotropical, and Palearctic. McKamey (2002), used a leafhopper database program to summarize leafhopper diversity by biogeographic regions and found that far fewer typhlocybine genera exist in the Australian (17 genera) and Oceanic regions (30 genera) than in the other realms (Indomalaysian 240 genera, Afrotropical 100 genera, Palearctic 116 genera, Nearctic 62 genera, and Neotropical 57 genera). A similar pattern occurs in the cicadellid tribe Deltocephalini (subfamily Cicadellinae) (McKamey 2002). The depauperate typhlocybine fauna of the Australian region (including a total absense of Alebrini) suggests that this group originated after the breakup of Gondawana, and the invasion of the Australian and Oceanic regions has been relatively slow. Regarding the large numbers of Old World genera, it is important to note that nearly half of the genera in the Typhlocybinae were erected by Dworakowska, and most of her work was restricted to Old World taxa. When similar attention is turned to the Neotropics, it is likely that the number of described genera will increase steeply.

Conclusions. My study of the history of typhlocybine tribal designations over the last century shows that no single worker's concepts fit the current analysis (Table 2). McAtee (1926) described four tribes (although with the incorrect subfamily type) and in name, at least, his results match the conclusions reached herein. However, McAtee worked with far fewer characters and genera than later workers. With minor modification to his extensive morphological examination of New World Typhlocbynae, Young's (1952) conclusions are quite close to the current findings. His empoascine leafhoppers were considered to be a complex within the Typhlocybini. My total evidence analysis confirms this belief with the two tribes in question forming a sister group with the Alebrini. Erythroneurine genera have nested within the Dikraneurini and form a monophyletic group (subtribe Erythroneurina) in the total evidence tree. Established by Young (1952), Erythroneurini were originally considered close to the Typhlocybini based on hind wing venation.

The molecular and morphological analysis resulted in different tree topologies. Because only two genes were sequenced, this variation is likely the result of limited sampling. For this reason concatenating all available information seems the best approach for advancing our knowledge of the highly diverse and morphologically complex leafhopper clade.

Table 5. Partitioned Bremer support values for the subfamily Typhlocybinae, its tribes, and selected subgroups in the total evidence analyses (Fig. 7).

Partition	Taxon					
Clade	Typhlocybinae	Alebrini	Empoascini	Dikraneurini	Dikraneurini: Erythroneurina	Typhlocybini
Node	93	53	57	92	85	61
Morphology	6.5	2	4.5	-2.5	6.95	-1.4
Molecular (H3 and 16s)	5.5	-1	-3.5	5.5	0.04	2.4

Table 6. Partitioned Bremer support values for the six subgroups within the tribe Dikraneurini in the total evidence analyses (Fig. 7).

Partition	Subgroup					
Clade	*Alconeura* sp1	*Alconeura* sp0-	*Kunzeana* – *Dikrellidia*	*Dikrella* sp5 +*Dikrella* sp7	*Kidrella* – *Idona*	Erythroneurina
Node		90	68	87	74	85
Morphology		-0.3	-0.38	-2.2	2.3	6.95
Molecular (H3 and 16s)		1.3	1.38	19.2	0.7	0.04

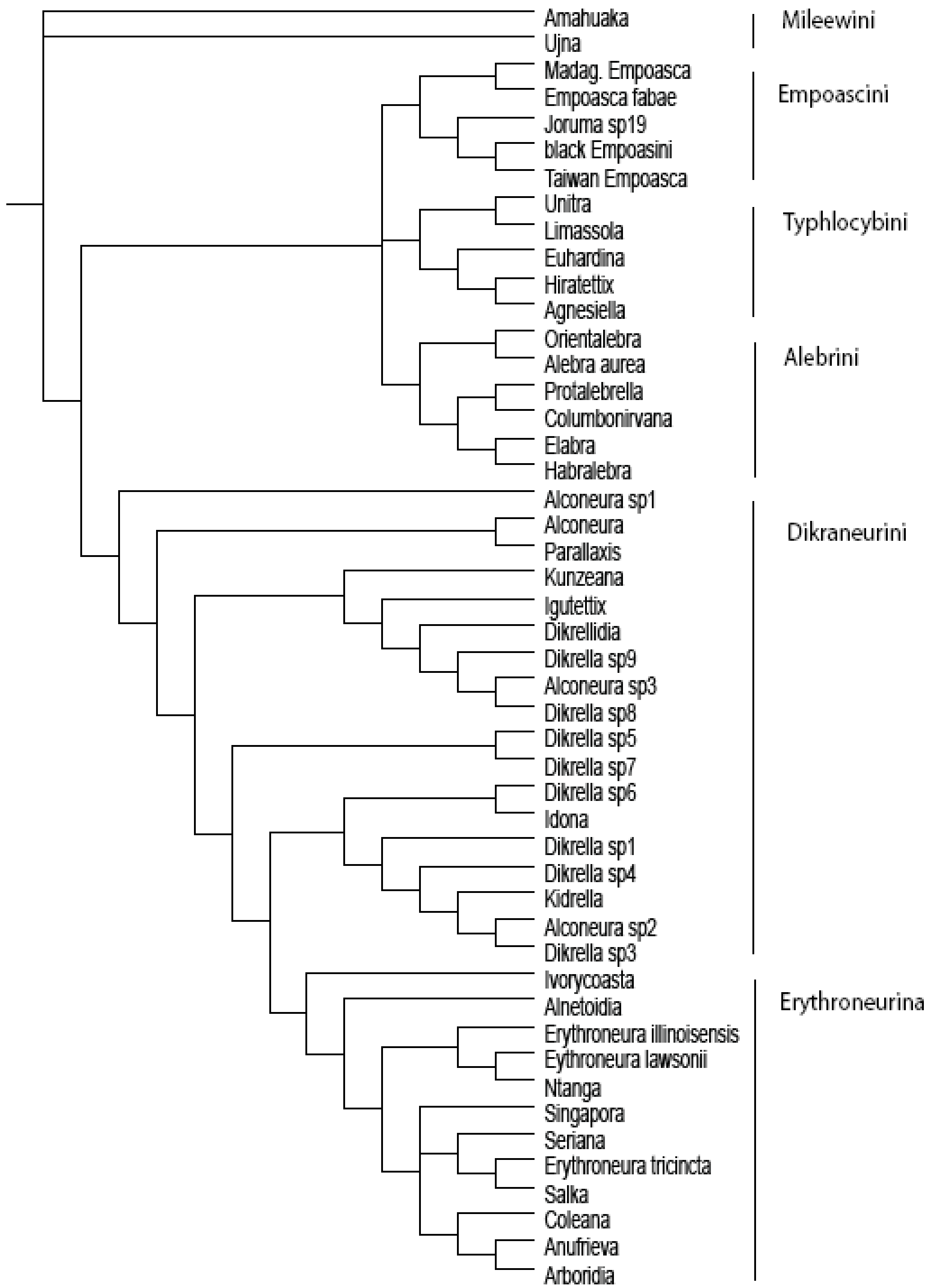

Figure 6. The strict consensus of eight equally parsimonious total evidence trees (Tribal names as defined herein).

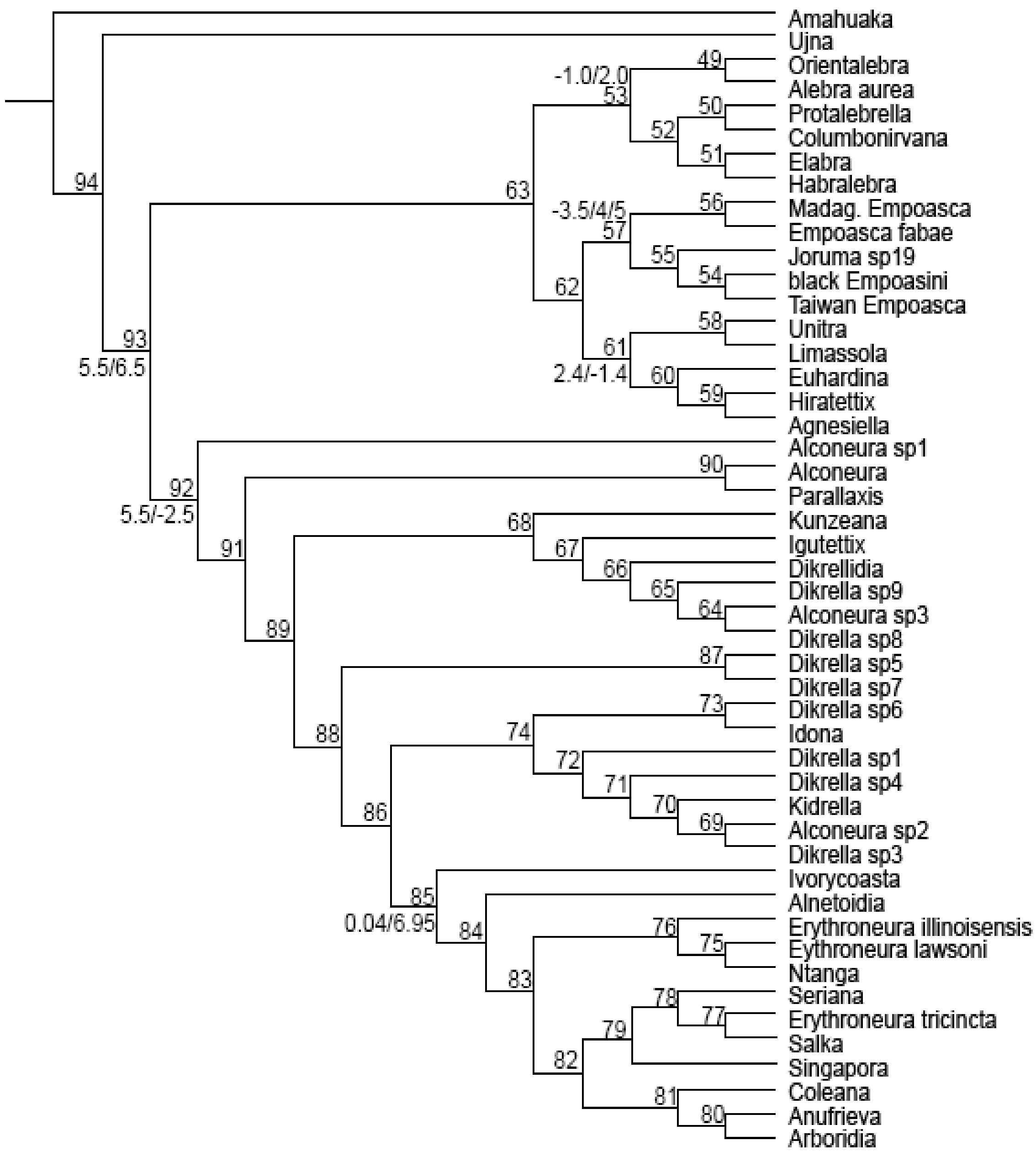

Figure 7. One of eight most parsimonious total evidence trees. Nodes numbered and partitioned Bremer supports added for subfamily and tribes (Molecular/ morphological). For apomorphy list see Appendix II.

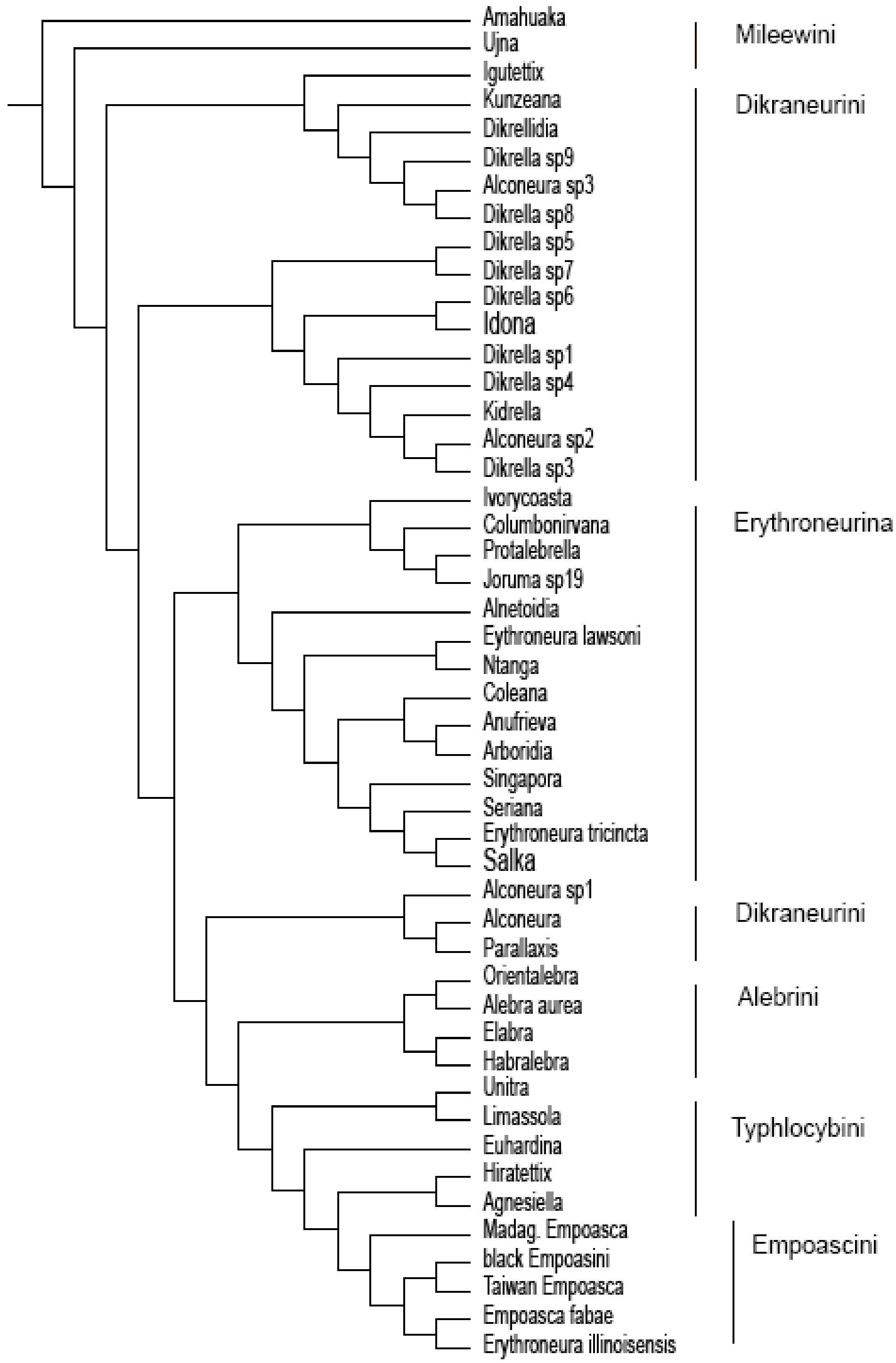

Figure 8. Strict consensus of eight equally parsimonious molecular trees (H3 and 16S rDNA).

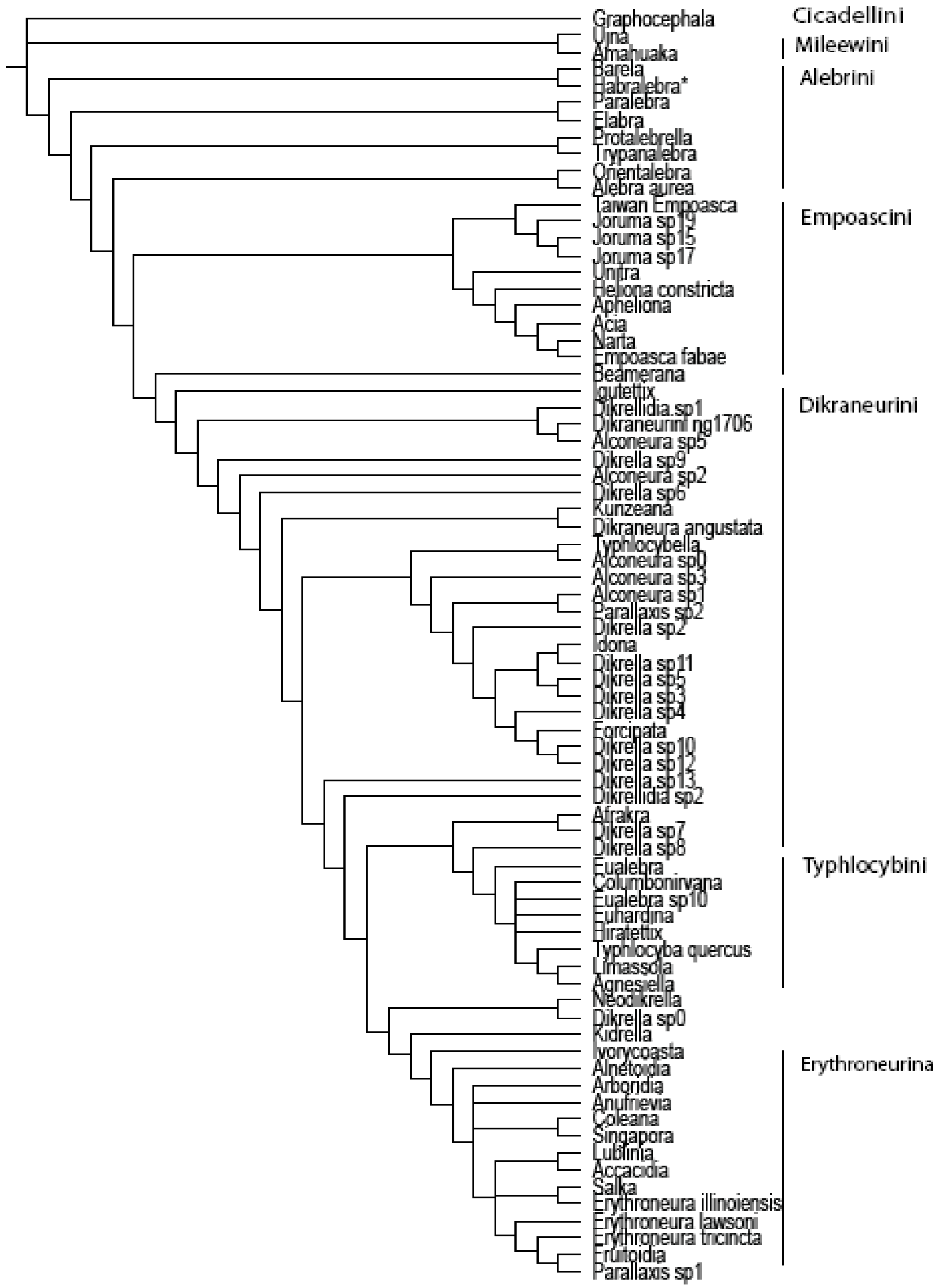

Figure 9. Strict consensus of nine equally parsimonious morphological trees (Tribal names as defined herein).

REFERENCES CITED

Ahmed, M. 1983. Biotaxonomy of typhlocybine leafhoppers of Pakistan. pp.179-183. *In* Knight, W. J., N. C. Paut, T. S. Robertson, and M. S. Wilson (eds.). Proceedings of the 1st International Workshop on Leafhoppers and Planthoppers (Auchenorrhyncha) of Economic Importance. London, 4-7 October 1982. Commonwealth Institute of Entomology, London. 500 pp.

Ahmed, M. 1985. Typhlocybinae of Pakistan. Fauna of the subfamily Typhlocybinae (Cicadellidae: Homoptera: Insecta). Pakistan Agricultural Research Council, Islamabad. 279 pp.

Bremer, K. 1994. Branch support and tree stability. Cladistics 10:295-304.

China, W. E. 1961. *Cicadella* Latreille, 1817: proposed validation under the plenary powers (Insecta, Hemiptera). Z.N.(S.) 457. Bulletin of Zooloical Nomenclature 18(3): 161-167.

Christian, P. C. 1953. A revision of North American species of *Typhlocyba* and its allies (Homoptera, Cicadellidae). University of Kansas Science Bulletin 35(9): 1103-1277.

Deitz, L. L. 1975. Classification of the higher categories of the New World treehoppers (Homoptera: Membracidae). North Carolina Agricultural Experiment Station Technical Bulletin 225: 1-177.

Deitz, L. L. 1993. Introduction. pp. 228-229. *In* Young, D. A. New genus and five new species of mileewine leafhoppers from New Guinea (Homoptera: Cicadellidae). Proceedings of the Entomological Society of Washington 95(2): 228-240.

DeLong, D. M. 1948. The leafhoppers, or Cicadellidae, of Illinois (Eurymelinae-Balcluthinae). Bulletin of the Illinois Natural History Survey 24(2): 92-376.

Dietrich, C. H. 1999. The role of grasslands in the diversification of leafhoppers (Homoptera: Cicadellidae). A phylogenetic perspective. pp. 44-48. *In* Warwick, C. (ed.). Proceedings Fifteenth North American Prairie Conference 1997. Natural Areas Association, Bend, Oregon. 255 pp.

Dietrich, C. H. 2001 (updated 2004). Leafhoppers (Hemiptera: Cicadomorpha: Cicadellidae)**.** Illinois Natural History Survey, Champaign, Illinois. Online publication: http://www.inhs.uiuc.edu/~dietrich/leafhome.html.

Dietrich, C. H. 2005. Keys to the families of Cicadomorpha and subfamilies and tribes of Cicadellidae (Hemiptera: Auchenorrhyncha). Florida Entomologist 88(4): 502-517.

Dietrich, C. H., R. A. Rakitov, J. L. Holmes, and W. C. Black. 2001. Phylogeny of the major lineages of Membracoidea (Insecta: Hemiptera: Cicadomorpha) based on 28S rDNA Sequences. Molecular Phylogenetics and Evolution 18(2): 293-305.

Distant, W. L. 1908. Rhynchota- Homoptera. The Fauna of British India including Ceylon and Burma. Secretary of State for India in Council, London: Vol. 4, 501 pp.

Dworakowska, I. 1967. A new species of the genus *Doratura* Shlb. (Homop., Cicadell.) from Mongolia. Bulletin de l'Academie Polonaise des Sciences, Serie des Sciences Biologiques, 15(3): 159-160.

Dworakowska, I. 1970. Remarks on the tribe Bakerini Mahmood. With description of one new genus of Typhlocybinae (Cicadellidae, Typhlocybinae). Bulletin de l'Academie Polonais des Sciences, Serie Sciences Biologiques, 17(11-12): 691-696.

Dworakowska, I. 1979. The leafhopper tribe Zyginellini (Homoptera: Auchenorrhyncha, Cicadellidae, Typhlocybinae). Revue Zoologie Africaine 93(2): 299-331.

Evans, J. W. 1947. A natural classification of leafhoppers. Transactions of the Royal Entomological Society, London 98(6): 105-271.

Evans, J. W. 1966. The Leafhoppers and Froghoppers of Australia and New Zealand. (Homoptera: Cicadelloidea and Cercopoidea). Australian Museum Memoir **12**: 1-347.

Hamilton, K. G. A. 1983.Classification, morphology and phylogeny of the family Cicadellidae (Rhynchota: Homoptera). pp.15-37. *In* Knight, W. J., N. C. Paut, T. S. Robertson, and M. S. Wilson (eds.). Proceedings of the 1st International Workshop on Leafhoppers and Planthoppers (Auchenorrhyncha) of Economic Importance, London, 4-7 October 1982. Commonwealth Institute of Entomology, London. 500 pp.

Hamilton, K. G. A. 1998. New World species of *Chlorita*, *Notus*, and *Forcipata* (Rhynchota: Homoptera: Cicadellidae: Typhlocybinae) with a new tribe Forcipatini. The Canadian Entomologist 130(4): 491-507.

Haupt, H. 1929. Neueinteilung der Homoptera-Cicadina nach phylogenetisch zu Wertenden. Merkmalen Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere 58: 173-286.

International Commission on Zoological Nomenclature. 1963. Opinion 647. Bulletin of Zoological Nomenclature 20(1): 35-38.

Janzen, D. H. 1977. Why are there so many species of insects? Proceedings of the XV International Congress of Entomology, Washington, D.C., 15: 84-94.

Kosztarab, M., L. B. O'Brien, M. B. Stoetzel, L. L. Deitz, and P. H. Freytag. 1990.

Problems and needs in the study of Homoptera in North America. pp. 119-145. *In* Kosztarab, M., and C. W. Schaefer (eds.). Systematics of the North American Insects and Arachnids: Status and Needs. Virginia Agricultural Experiment Station Information Series 90-1. Virginia Polytechnic Institute and State University, Blacksburg. xii + 247 pp.

Mahmood, S. H. 1967. A study of the typhlocybine genera of the Oriental region (Thailand, the Philippines and adjoining areas). Pacific Insects Monograph 12: 1-55.

Mahmood, S. H., and M. Ahmed. 1968. Problems of higher classification of Typhlocybinae (Cicadellidae: Homoptera). University Studies, University of Karachi 5(3): 72-79.

McAtee, W. L. 1926. Notes on the Neotropical Eupteryginae, with a key to the varieties of *Alebra albostiella*. (Homoptera: Jassidae). Journal of the New York Entomological Society 34: 141-174.

McAtee, W. L. 1934. Genera and subgenera of Eupteryginae (Homoptera: Jassidae). Proceedings of the Zoological Society of London 1934: 93-117.

McClure, M. S., and P. W. Price. 1975. Competition among sympatric *Erythroneura* leafhoppers (Homoptera: Cicadellidae) on America sycamore. *Ecology* 56(6): 1388-1397.

McKamey, S. H. 2002. The distribution of leafhopper pests in relation to other leafhoppers (Hemiptera: Cicadellidae). Denisia 4: 357-378.

Metcalf, Z. P. 1968. General Catalogue of the Homoptera. Fas. VI. Cicadelloidea. Part 17.

Cicadellidae. Agricultural Research Service. United States Department of Agriculture, Washington, D.C. vii +1513 pp.

Moulton, J. K. and B. M. Wiegmann. 2004. Evolution and phylogenetic utility of CAD (rudimentary) among Mesozoic-aged eremoneuran Diptera (Insecta). Molecular Phylogenetics and Evolution 31: 363-378.

Nault, L. R., and J. G. Rodriguez. 1985. The leafhoppers and planthoppers. Wiley, New York, 500 pp.

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.

Oman, P. W., W. J. Knight, and M. W. Nielson. 1990. Leafhoppers (Cicadellidae): a Bibliography, Generic Check-List and Index to the World Literature 1956-1985. C. A. B. International Institute of Entomology, Wallingford, Oxon, United Kingdom. Iii + 368 pp.

Ribaut, H. 1936. Homopteres Auchenorhynques (Typhlocybidae). Faune de France 31: 1-228.

Rakitov, R. A. 1999. On differentiation of cicadellid leg chaetotaxy (Homoptera: Auchenorrhyncha: Membracoidea). Russian Entomological Journal 6: 7-27.

Robinson, W. 1926. The genus *Erythroneura* north of Mexico. The University of Kansas Science Bulletin 16(3): 101-155.

Ruppel, R. F. 1987. A summary of the tribes proposed in Typhlocybinae (Hemiptera: Cicadellidae). Michigan Academician 19(1): 29-35.

Simon C., F. Frati, A. Beckenbach, B. Crespi, H. Liu, and P. Flook. 1994. Evolution, weighting, and phylogenetic utility of mitochondrial gene sequences and a compilation of conserved polymerase chain reaction primers. Annals of the Entomological Society of America 87: 651-701.

Sorensen, M.D. 1999. TreeRot, version 2. Boston University, Boston, MA.

Southern, P. S. 1982. A taxonomic study of the leafhopper genus *Empoasca* (Homoptera: Cicadellidae) in Eastern Peru. North Carolina Agricultural Experiment Station Technical Bulletin 272: 1-194.

Southern, P. S. 2006. Three new species of Empoasca (Hemiptera: Cicadellidae: Typhlocybinae) from northern South America. Zootaxa 1314: 41-51.

Svenson, G. J. and M. F. Whiting. 2004. Phylogeny of Mantodea based on molecular data: evolution of a charismatic predator. Systematic Entomology 29(3): 359-370.

Swofford, D. L. (1998). PAUP*: Phylogenetic Analysis Using Parsimony (*and other methods). Version 4. Sinauer. Sunderland. MA.

Young, D. A. 1952. A reclassification of Western Hemisphere Typhlocybinae (Homoptera: Cicadellidae). University of Kansas Science Bulletin 3(1): 3-217.

Young, D. A. 1957. The leafhopper tribe Alebrini (Homoptera: Cicadellidae). Proceedings of the United States National Museum 107:127-277.

Young, D. A. 1965. Western Hemisphere Mileewanini (Homoptera: Cicadellidae). Zoologische Beitrage 11(1-2): 369-380.

APPENDICES

APPENDIX I

MORPHOLOGICAL CHARACTERS AND THEIR STATES

[Characters in square brackets refer to the total evidence analysis]

HEAD

1. [647] *Head width to pronotal width*: (0) head narrower or about equal; (1) head wider.
2. [648] *Coronal suture vs. crown length*: (0) suture indistinct, less than half crown length; (1) suture distinct and as long as or longer than half crown length.
3. [649] *Crown median*: (0) with peak; (1) without peak.
4. [650] *Crown length*: (0) little if any longer medially than next to eye; (1) distinctly longer medially than next to eye.
5. [651] *Crown basal width between eyes in dorsal aspect*: (0) distinctly wider than each eye width; (1) little if any wider than each eye width (Jorumini).
6. [652] *Sexual dimorphism of face*: (0) male and female similar; (1) male with clypellus and lorum inflated.
7. [653] *Face in profile*: (0) not depressed (more vertical than horizontal) (Empoascini); (1) depressed, forming <45° angle with horizontal (Dikraneurini).
8. [654] *Ocelli*: (0) present, round; (1) vestigial, crescent-shaped, or absent.
9. [655] *Ocelli on crown*: (0) absent (Typhlocybinae); (1) present.
10. [656] *Lorum*: (0) not obviously separated from genal margin; (1) obviously separated from genal margin (2) indistinct.

11. [657] *Labium*: (0) longer than anteclypeus (clypellus); (1) about equal to or shorter than anteclypeus; (2) 2x or more longer than anteclypeus.

THORAX

12. [658] Anaplural suture (divides anepisternum from katepisternum): (0) absent (most Typhlocybinae); (1) present.
13. [659] *Scutellar apex*: (0) distinct acuminate point, 1/4 or more scutellar length; (1) indistinct, much shorter than 1/4 the scutellar length.

FORELEGS

14. [660] *Front femoral AV1+AM*: (0) absent; (1) present (Mileewini).
15. [661] *Front femoral AM1 seta*: (0) absent or inconspicuous (Erythroneurini); (1) distinctly enlarged.
16. [662] *Front femoral intercalary setal row*: (0) subequal in size or gradually reduced from base to apex; (1) with 2 or more basal setae distinctly enlarged; (2) with 1 basal seta distinctly enlarged (*Empoasca*).
17. [663] *Front femoral row PV*: (0) without long fine basal setae; (1) with long fine basal setae (Alebrini).
18. [664] *Front tibial AV row macrosetae number*: (0) 8 or less; (1) 9-11; (2) 12-15; (3) >15
19. [665] *Front tibial AV row macrosetae size*: (0) all similar; (1) more than 1 seta distinctly enlarged; (2) appearing to grade larger from base to apex.

HIND LEG

20. [666] *Hind femoral macrosetal formula*: (0) 2+1+1 (most Typhlocybinae); (1) 2+0, 2+1+0.

21. [667] *Hind tibial row AV*: (0) with 3 or 4 macrosetae (Typhlocybinae); (1) with 5 marcosetae; (2) with 6 macrosetae; (3) with more than 6 macrosetae.

22. [668] *Hind tarsomere I*: (0) truncate apically; (1) acuminate apically (Typhlocybinae).

23. [669] *Hind tarsomere I length*: (0) less than or equal to length of tarsomeres 2+3; (1) distinctly longer than tarsomeres 2+3.

24. [670] *Hind tarsus length*: (0) distinctly <half tibial length; (1) subequal to or longer than tibia (some Alebrini).

FOREWING

25. [671] *Wing apex shape*: (0) rounded without extension; (1) with extension (*Euhardina*) or truncate.

26. [672] *Wing with opaque pigmentation*: (0) strongly present; (1) sparse and transparent; (2) absent.

27. [673] *Closed anteapical cells*: (0) absent; (1) present (Young 1952: fig. 46f). (Young 1952: p. 51.Typhlocybinae definition, fig. 46f.)

28. [674] *Appendix*: (0) extending around wing apex; (1) not extending around wing apex; (2) entirely absent.

29. [675] *Apical cell R_3*: (0) not attaining wing apex or absent (no R_I apparent)(Young 1952: figs. 25b, 28b); (1) attaining wing apex. (Alebrini description)

30. [676] *Vein R branching*: (0) 3 or more branches; (1) 2 branches; (2) unbranched.

31. [677] *Vein R stem length*: (0) less than or equal to the length of R_{2+3} or shorter than distance to costal margin (Young 1952c: fig. 21b); (1) longer than R_{2+3} but not extending to wing base; (2) extending to wing base.

32. [678] *Vein R+M*: (0) confluent before R_{2+3} fork; (1) not confluent.

33. [679] *Shape of vein R_{4+5}*: (0) straight to apical margin; (1) gently curved to costal margin or appendix; (2) abruptly curved to costal margin.

34. [680] *Vein M stem length*: (0) less than or equal to length of M_{1+2}; (1) longer than length of M_{1+2}; (2) complete to wing base.

35. [681] *Apical cell R_3*: (0) not petiolate; (1) petiolate (Young 1952: fig. 39b).

36. [682] *Vein M_{3+4} at wing margin*: (0) not extending to margin, or extending to appendix); (1) extending to margin (Young 1952: figs. 68b, 42b, 56j, 46b).

37. [683] *Cell M width*: (0) less than or equal to width of cell R; (1) greater than 1x to 2x width of cell R; (2) much wider than 2x cell R.

38. [684] *Anal veins*: (0) 1; (1) none apparent (Young 1952: fig. 67b); (2) 2.

39. [685] *Apical cell M_4*: (0) short and oblique (Young 1952: fig. 82b) (Typhlocybini, Eupterygini); (1) elongate parallel-sided (Young 1952: fig. 75b) (Dikraneurini, Erythroneurini); (2) elongate with veins converging (Alebrini); (3) elongate but short of apex, tapered (Empoascini, Jorumini).

40. [686] *Apex of cell M*: (0) transversely truncate (Young 1952: fig. 19b); (1) obliquely truncate and angular; (2) nearly acute (Young 1952: fig. 54f).

41. [687] *Apex of Cu connects to margin*: (0) at apex of clavus; (1) distad of apex of clavus.

42. [688] *Apical cell M_2 width at apex*: (0) elongate, slender, narrower than either adjoining apical cell (Young 1952: fig. 49b); (1) wider than long or as wide as long; (2) elongate and wide, larger than either adjoining apical cells.

HIND WING

43. [689] *Basal coastal anterior extension (hamulus)*: (0) indistinct; (1) distinct (*Ujna*).

44. [690] V*ein R_{2+3}*: (0) absent; (1) present. (Dikraneurini, Alebrini, many Erythroneurini).

45. [691] *Vein R + M*: (0) much shorter than ¼ total wing length; (1) as long or longer than ¼ total wing length; (2) not fused (Alebrini).

46. [692] *Submarginal vein at wing apex* (0) absent; (1) present (Alebrini, Dikraneurini, Empoascini, Jorumini).

47. [693] *R_1 vein remnant on R*: (0) absent; (1) present.

48. [694] *Cell M*: (0) less than or equal to width of cell R; (1) up to 2x as wide as cell R; (2) wider than 2x cell R.

49. [695] *Crossvein m-cu*: (0) as long as or longer than length of basal segment of vein M_{3+4}; (1) less than length of basal segment of vein M_{3+4}; (2) absent.

50. [696] *Distal segment of vein CuA*: (0) absent (Zyginellini); (1) present.

51. [697] *CuA and M_{3+4}*: (0) free, connected by crossvein, or only at single point (Young 1952: figs. 65a, 74a); (1) partially confluent (separate distally)(Young 1952: figs. 55a, 57a); (2) completely confluent (Young 1952: figs. 91a, 97a).

52. [698] *Vein 1A branching from 2A*: (0) near its base; (1) near its midlength; (2) completely fused.

53. [699] *Apex of cell M (basal segment of M_{3+4})*: (0) transversely truncate; (1) obliquely truncate.

54. [700] *CuP*: (0) confluent with submarginal vein at point opposite or proximad of basal segment of M_{3+4} (some *Typhlocyba*); (1) confluent with submarginal vein at point distad of basal segment of M_{3+4}.

55. [701] *Anal margin*: (0) not serrate; (1) serrate (Jorumini); (2) with sparse denticuli.

MALE ABDOMEN

56. [702] *Overall abdominal shape*: (0) narrow, tapering; (1) oval, bulging at midlength (dorsoventrally compressed).

57. [703] *Second sternal apodemes*: (0) poorly developed, not extending beyond posterior margin of sternite III; (1) well developed, extending beyond posterior margin of sternite III.

58. [704] *Tergite IX*: (0) absent or unsclerotized; (1) present, well sclerotized.

59. [705] *Segment X (anal tube)* : (0) without basolateral hooks or processes; (1) with basolateral hooks or processes (*Empoasca*).

PYGOFER

60. [706] *Dorsal appendage*: (0) absent; (1) present, not moveably articulated; (2) present, moveably articulated (Erythroneurini).
61. [707] *Ventral appendage*: (0) absent; (1) present.
62. [708] *Dorsoapical macrosetae*: (0) absent; (1) present. (Empoascini).
63. [709] *Ventrolateral setal group*: (0) absent or indistinct; (1) present, distinct.

SUBGENITAL PLATE

64. [710] *Male plate in lateral view*: (0) straight or only gently curved; (1) strongly bent near middle (elbowed); (2) strongly bent dorsoapically.
65. [711] *Male plate length to width in lateral view:* (0) 2x to 5x width; (1) greater than 5x width; (2) less than 2x width.
66. [712] *Basolateral setal group*: (0) absent or poorly differentiated; (1) present, distinct.
67. [713] *Long fine setae*: (0) absent; (1) present.
68. [714] *Macrosetae*: (0) numerous, extending in row or band from base to near apex; (1) few, restricted to basal half; (2) one present basally; (3) absent.
69. [715] *Angulate basolateral projection*: (0) absent; (1) present (most Erythorneurini)

STYLE

70. [716] *Preapical lobe*: (0) absent or poorly differentiated; (1) well developed (Erythroneurini).
71. [717] *Apex*: (0) tapered; (1) bi- or trifurcate.

72. [718] *Apex with serrations*: (0) absent; (1) present (Empoascini).

CONNECTIVE

73. [719] *Shape*: (0) Y- or V-shaped, without median anterior lobe; (1) anterior margin truncate or shallowly emarginated; (2) with distinct median anterior lobe; (3) indistinct, unsclerotized.

APPENDIX II

APOMORPHY LIST FOR FIG. 7.

Branch	Character	Steps	CI	Change
node_94 --> Amahuaka	24	1	0.154	C ==> T
	42	1	0.500	G ==> A
	48	1	0.176	T ==> G
	51	1	0.273	A --> C
	60	1	0.133	A --> C
	75	1	0.250	T ==> C
	93	1	0.375	C ==> G
	96	1	0.200	A ==> G
	165	1	0.200	G ==> A
	177	1	0.143	T ==> C
	234	1	0.188	C ==> G
	243	1	0.143	A ==> G
	270	1	0.214	C ==> T
	318	1	0.182	A ==> C
	330	1	0.118	A --> C
	331	1	0.118	A --> C
	335	1	0.500	T ==> C
	382	1	0.214	C --> T
	418	1	0.250	A ==> G
	461	1	0.182	A --> T
	503	1	0.222	A ==> T
	504	1	0.214	A --> T
	505	1	0.250	A ==> G
	506	1	0.176	C --> G
	508	1	0.167	A ==> C
	512	1	0.400	A ==> G
	523	1	0.231	T ==> C
	531	1	0.167	A ==> T
	554	1	0.182	T ==> C
	557	1	0.333	A ==> G
	569	1	0.143	C ==> T
	570	1	0.250	C ==> T
	586	1	1.000	A ==> T
	646	1	0.250	T ==> A
	657	1	0.125	A --> C
	669	1	0.333	A ==> C
	676	1	1.000	C ==> A
	690	1	0.111	A --> C
	693	1	0.167	C ==> A
	699	1	0.077	A --> C
	700	1	1.000	A ==> C
	701	1	0.400	A ==> G
	708	1	0.143	A ==> C
	710	1	0.105	A ==> C
	717	1	0.143	A ==> C
node_94 --> Ujna	6	1	0.250	T ==> A
	9	1	0.300	C ==> G
	12	1	0.500	G ==> A
	19	1	0.100	C ==> T
	60	1	0.133	A --> T
	117	1	0.167	G ==> A
	132	1	0.167	C ==> T
	144	1	0.500	G ==> C
	195	1	0.250	C ==> T
	235	1	0.500	C ==> T
	249	1	0.333	C ==> T
	259	1	0.111	C ==> T
	264	1	0.667	C ==> T
	273	1	0.167	C ==> T
	297	1	0.250	C ==> T
	329	1	0.154	A ==> G
	330	1	0.118	A --> T
	417	1	0.500	T ==> A
	427	1	0.222	A ==> T
	428	1	0.214	A ==> T
	442	1	0.231	A ==> C
	443	1	0.143	A ==> T
	453	1	0.333	T ==> A
	460	1	0.143	A --> T
	462	1	0.143	T ==> C
	471	1	0.154	T ==> C
	491	1	0.200	T ==> A
	507	1	0.400	A ==> T
	511	1	0.176	A ==> G
	524	1	0.273	A ==> C
	528	1	1.000	A ==> G
	538	1	0.200	A ==> G
	540	1	0.222	A ==> T
	544	1	0.143	T ==> A
	546	1	0.111	C ==> T
	553	1	1.000	A ==> C
	563	1	0.100	A ==> T
	565	1	0.231	C ==> A
	576	1	0.667	T ==> A
	584	1	1.000	T ==> A
	645	1	0.273	T ==> A
	652	1	0.250	A ==> C
	668	1	1.000	C ==> A
	672	1	0.100	A ==> C
	685	1	0.429	A ==> G
	686	1	0.188	A --> C
	688	1	0.167	A ==> G
	694	1	0.143	A --> G
	705	1	0.111	A ==> C
	707	1	0.100	A ==> C
	711	1	0.154	A --> C
	716	1	0.083	A ==> C
node_94 --> node_93	18	1	0.250	A ==> G
	36	1	0.167	C --> G
	51	1	0.273	A --> G
	105	1	0.143	C ==> G
	141	1	0.200	T ==> G
	153	1	0.100	A ==> G
	171	1	0.273	C --> G
	246	1	0.500	G ==> C
	267	1	0.231	A --> T
	326	1	0.133	C ==> T
	331	1	0.118	A --> T
	333	1	0.100	A ==> T
	431	1	0.118	A --> T
	499	1	0.400	T ==> A
	506	1	0.176	C --> T
	552	1	0.200	C ==> T
	604	1	0.500	C ==> T
	612	1	0.333	G ==> A
	644	1	0.300	G ==> T
	655	1	1.000	C ==> A

Branch	Character	Steps	CI	Change
	658	1	0.333	C ==> A
	660	1	1.000	C ==> A
	667	1	0.300	G ==> A
	673	1	0.500	C ==> A
	674	1	0.500	A --> G
	682	1	0.500	A ==> C
	684	1	0.222	G --> C
	687	1	0.125	C ==> A
	691	1	0.286	G --> C
	694	1	0.143	A --> C
	695	1	0.182	C --> G
	704	1	0.154	C --> A
node_93 --> node_63	6	1	0.250	T ==> G
	252	1	0.143	G --> A
	382	1	0.214	C --> T
	393	1	0.125	A ==> T
	441	1	0.182	A ==> T
	456	1	0.333	A ==> T
	460	1	0.143	A --> T
	461	1	0.182	A --> T
	504	1	0.214	A --> T
	571	1	0.125	C ==> T
	581	1	0.143	A ==> G
	656	1	0.154	C ==> A
	677	1	0.143	G --> A
	706	1	0.154	C ==> A
	711	1	0.154	A --> C
	713	1	0.083	A --> C
	714	1	0.250	C ==> A
	719	1	0.176	A --> C
node_63 --> node_53	81	1	0.200	T --> C
	261	1	0.111	G --> C
	323	1	0.143	C --> T
	326	1	0.133	T ==> A
	439	1	0.133	A ==> T
	613	1	0.286	A ==> T
	663	1	1.000	A ==> C
	674	1	0.500	G --> A
	684	1	0.222	C --> G
	685	1	0.429	A ==> C
	691	1	0.286	C --> G
	695	1	0.182	G --> C
node_53 --> node_49	63	1	0.154	A --> C
	66	1	0.273	G --> C
	252	1	0.143	A --> G

Branch	Character	Steps	CI	Change
	316	1	0.333	T --> C
	317	1	0.286	T --> C
	316	1	0.333	T --> C
	317	1	0.286	T --> C
	331	1	0.118	T ==> C
	333	1	0.100	T ==> A
	383	1	1.000	C ==> T
	452	1	0.400	T ==> C
	453	1	0.333	T ==> A
	459	1	0.400	T ==> A
	460	1	0.143	T ==> C
	472	1	0.333	A ==> C
	552	1	0.200	T ==> A
	572	1	0.091	C ==> T
	644	1	0.300	T ==> A
	650	1	0.091	C ==> A
	664	1	0.167	C --> G
	667	1	0.300	A --> C
	672	1	0.100	A --> C
	682	1	0.500	C ==> A
	710	1	0.105	A ==> G
	711	1	0.154	C --> A
node_49 --> Orientalebra	3	1	0.250	G ==> A
	15	1	0.100	G ==> A
	21	1	0.400	G ==> T
	36	1	0.167	G ==> A
	45	1	0.167	C ==> T
	51	1	0.273	G ==> T
	57	1	0.400	C ==> A
	63	1	0.154	C --> T
	72	1	0.182	A ==> G
	81	1	0.200	C --> T
	84	1	1.000	C ==> T
	93	1	0.375	C ==> A
	96	1	0.200	A ==> C
	105	1	0.143	G ==> T
	141	1	0.200	G ==> C
	168	1	0.273	T ==> A
	171	1	0.273	G --> T
	180	1	0.500	G ==> A
	204	1	0.167	C ==> T
	207	1	1.000	G ==> C
	219	1	0.167	C ==> T
	234	1	0.188	C ==> T
	255	1	0.250	C ==> G

Branch	Character	Steps	CI	Change
	259	1	0.111	C ==> T
	261	1	0.111	C --> G
	267	1	0.231	T --> G
	291	1	1.000	C ==> T
	294	1	0.273	C ==> A
	300	1	1.000	C ==> A
	323	1	0.143	T --> C
	327	1	0.375	T ==> C
	357	1	1.000	C ==> T
	363	1	0.333	T ==> C
	384	1	0.500	C ==> A
	420	1	0.182	T ==> A
	426	1	0.167	T ==> C
	427	1	0.222A ==> C	
	428	1	0.214	A ==> T
	431	1	0.118	T --> A
	433	1	0.222	A ==> G
	440	1	0.143	A ==> T
	471	1	0.154	T ==> C
	481	1	0.333	A ==> C
	504	1	0.214	T --> G
	505	1	0.250	A ==> G
	509	1	0.273	T ==> A
	511	1	0.176	A ==> T
	526	1	0.250	A ==> T
	539	1	0.250	T ==> A
	544	1	0.143	T ==> C
	545	1	0.167	T ==> C
	565	1	0.231	C ==> A
	624	1	0.167	C ==> T
	627	1	1.000	T ==> A
	635	1	0.250	A ==> G
	637	1	0.091	G ==> A
	645	1	0.273	T ==> C
	664	1	0.167	G --> T
	667	1	0.300	C --> G
	680	1	0.111	G ==> C
	683	1	0.200	A ==> C
	690	1	0.111	A --> C
	713	1	0.083	C --> A
	716	1	0.083	A ==> C
node_49 --> Alebra aurea	6	1	0.250	G ==> T
	19	1	0.100	C ==> T
	24	1	0.154	C ==> T
	33	1	0.250	G ==> A

Branch	Character	Steps	CI	Change
	48	1	0.176	T ==> A
	54	1	0.125	C ==> T
	66	1	0.273	C --> T
	75	1	0.250	T ==> C
	78	1	0.333	C ==> T
	90	1	0.375	C ==> T
	132	1	0.167	C ==> T
	135	1	0.667	C ==> A
	156	1	0.667	G ==> T
	159	1	0.375	C ==> G
	222	1	0.222	C ==> T
	228	1	0.333	C ==> A
	270	1	0.214	C ==> A
	319	1	0.333	C ==> T
	320	1	1.000	T ==> G
	321	1	0.273	A ==> C
	328	1	0.273	A ==> T
	417	1	0.500	T ==> A
	436	1	0.182	A ==> T
	441	1	0.182	T ==> G
	442	1	0.231	A ==> T
	501	1	0.333	A ==> T
	506	1	0.176	T ==> A
	523	1	0.231	T ==> C
	524	1	0.273	A ==> T
	657	1	0.125	A ==> C
	665	1	0.143	G ==> C
	672	1	0.100	C --> G
	677	1	0.143	A --> G
	687	1	0.125	A ==> C
	689	1	0.091	C ==> A
	698	1	0.182	A ==> C
	699	1	0.077	A ==> C
	701	1	0.400	A ==> G
	712	1	0.143	A ==> C
node_53 --> node_52	51	1	0.273	G --> C
	60	1	0.133	A --> C
	171	1	0.273	G --> A
	321	1	0.273	A ==> T
	324	1	0.500	C --> A
	325	1	0.167	C --> T
	371	1	0.125	G ==> A
	381	1	0.500	C --> T
	455	1	0.250	A --> T
	503	1	0.222	A --> T
	508	1	0.167	A --> T
	635	1	0.250	A --> T
	674	1	0.500	A --> C
	677	1	0.143	A --> C
	679	1	0.118	C ==> G
	694	1	0.143	C --> G
	708	1	0.143	A --> C
node_52 --> node_50	24	1	0.154	C ==> T
	54	1	0.125	C ==> T
	57	1	0.400	C ==> T
	105	1	0.143	G ==> T
	138	1	0.167	G ==> A
	142	1	0.100	C ==> T
	154	1	0.200	C ==> T
	222	1	0.222	C ==> T
	237	1	0.167	G ==> C
	255	1	0.250	C ==> T
	267	1	0.231	T --> G
	270	1	0.214	C ==> G
	382	1	0.214	T ==> C
	460	1	0.143	T --> A
	546	1	0.111	C ==> T
	665	1	0.143	G ==> A
	681	1	0.125	A ==> C
	702	1	0.200	A ==> C
	703	1	0.083	A ==> C
node_50 --> Protalebrella	39	1	0.250	G ==> A
	90	1	0.375	C ==> T
	123	1	0.500	C ==> T
	273	1	0.167	C ==> T
	331	1	0.118	T ==> C
	375	1	0.200	T ==> A
	383	1	1.000	C ==> A
	384	1	0.500	C ==> A
	423	1	0.333	T ==> A
	431	1	0.118	T --> A
	441	1	0.182	T ==> A
	444	1	0.667	A ==> T
	445	1	0.667	A ==> T
	462	1	0.143	T ==> A
	504	1	0.214	T --> A
	507	1	0.400	A ==> T
	514	1	0.400	C ==> A
	524	1	0.273	A ==> C
	552	1	0.200	T ==> A
	563	1	0.100	A ==> T
	588	1	0.143	T ==> G
	625	1	0.667	A ==> T
	634	1	0.333	T ==> A
	645	1	0.273	T ==> A
	651	1	0.200	A ==> C
	656	1	0.154	A ==> C
	664	1	0.167	C ==> G
	667	1	0.300	A ==> T
	680	1	0.111	G ==> C
	683	1	0.200	A ==> C
	695	1	0.182	C ==> A
	698	1	0.182	A ==> C
	706	1	0.154	A ==> C
	709	1	0.222	A ==> C
	716	1	0.083	A ==> C
node_50 --> Columbonirvana	321	1	0.273	T ==> G
	323	1	0.143	T --> C
	324	1	0.500	A --> C
	325	1	0.167	T --> C
	326	1	0.133	A ==> T
	327	1	0.375	T ==> A
	364	1	0.500	T ==> G
	381	1	0.500	T --> C
	388	1	0.400	A ==> C
	393	1	0.125	T ==> A
	418	1	0.250	A ==> T
	420	1	0.182	T ==> A
	425	1	0.333	A ==> T
	428	1	0.214	A ==> C
	432	1	0.250	A ==> T
	434	1	0.182	T ==> A
	435	1	0.222	G ==> A
	436	1	0.182	A ==> G
	440	1	0.143	A ==> T
	442	1	0.231	A ==> T
	453	1	0.333	T ==> G
	454	1	0.143	A ==> T
	455	1	0.250	T --> A
	461	1	0.182	T ==> A
	481	1	0.333	A ==> T
	502	1	0.214	A ==> C
	505	1	0.250	A ==> C
	506	1	0.176	T ==> C
	508	1	0.167	T --> A

Branch	Character	Steps	CI	Change
	511	1	0.176	A ==> T
	523	1	0.231	T ==> C
	531	1	0.167	A ==> T
	539	1	0.250	T ==> C
	541	1	0.250	A ==> C
	550	1	1.000	T ==> C
	568	1	0.333	T ==> C
	572	1	0.091	C ==> T
	610	1	0.100	C ==> T
	613	1	0.286	T ==> A
	635	1	0.250	T --> A
	637	1	0.091	G ==> A
	652	1	0.250	A ==> C
	657	1	0.125	A ==> C
	658	1	0.333	A ==> C
	674	1	0.500	C --> G
	677	1	0.143	C --> G
	685	1	0.429	C ==> A
	686	1	0.188	A ==> C
	688	1	0.167	A ==> C
	704	1	0.154	A --> C
	705	1	0.111	A ==> C
	707	1	0.100	A ==> C
	708	1	0.143	C --> A
	710	1	0.105	A ==> G
	714	1	0.250	A ==> C
	719	1	0.176	C --> A
node_52 --> node_51	30	1	0.125	G ==> A
	36	1	0.167	G ==> C
	48	1	0.176	T ==> G
	171	1	0.273	A --> C
	177	1	0.143	T ==> C
	234	1	0.188	C --> A
	243	1	0.143	A ==> G
	328	1	0.273	A --> C
	330	1	0.118	A --> C
	334	1	0.167	A --> T
	438	1	0.200	A ==> T
	451	1	0.222	T ==> A
	506	1	0.176	T ==> A
	524	1	0.273	A ==> T
	581	1	0.143	G ==> A
	662	1	0.118	A ==> G
	688	1	0.167	A ==> G
	690	1	0.111	A --> C

Branch	Character	Steps	CI	Change
node_51 --> Elabra	15	1	0.100	G ==> A
	19	1	0.100	C ==> T
	27	1	0.333	C ==> G
	37	1	0.333	A ==> C
	51	1	0.273	C --> G
	96	1	0.200	A ==> G
	141	1	0.200	G ==> T
	192	1	0.125	C ==> T
	382	1	0.214	T ==> A
	425	1	0.333	A ==> T
	426	1	0.167	T ==> A
	427	1	0.222	A ==> T
	428	1	0.214	A ==> T
	429	1	0.500	A ==> T
	430	1	0.273	T ==> A
	431	1	0.118	T --> A
	435	1	0.222	G ==> A
	440	1	0.143	A ==> T
	452	1	0.400	T ==> A
	453	1	0.333	T ==> A
	459	1	0.400	T ==> A
	464	1	0.500	A ==> T
	471	1	0.154	T ==> C
	482	1	0.500	T ==> C
	504	1	0.214	T --> A
	507	1	0.400	A ==> G
	534	1	0.429	A ==> T
	557	1	0.333	A ==> C
	569	1	0.143	C ==> T
	570	1	0.250	C ==> T
	571	1	0.125	T ==> C
	579	1	0.143	A ==> G
	610	1	0.100	C ==> T
	644	1	0.300	T ==> C
	651	1	0.200	A ==> C
	657	1	0.125	A ==> G
	664	1	0.167	C ==> T
	667	1	0.300	A ==> T
	669	1	0.333	A ==> C
	670	1	0.500	A ==> C
	683	1	0.200	A ==> G
	686	1	0.188	A ==> C
	689	1	0.091	C ==> A
	704	1	0.154	A --> C
	705	1	0.111	A ==> C

Branch	Character	Steps	CI	Change
	709	1	0.222	A ==> C
node_51 --> Habralebra	33	1	0.250	G ==> C
	60	1	0.133	C --> A
	168	1	0.273	T ==> A
	234	1	0.188	A --> G
	441	1	0.182	T ==> A
	442	1	0.231	A ==> T
	461	1	0.182	T ==> A
	503	1	0.222	T --> A
	505	1	0.250	A ==> T
	508	1	0.167	T --> C
	544	1	0.143	T ==> A
	545	1	0.167	T ==> C
	548	1	0.333	C ==> T
	565	1	0.231	C ==> A
	588	1	0.143	T ==> G
	624	1	0.167	C ==> T
	637	1	0.091	G ==> A
	642	1	1.000	A ==> G
	654	1	0.167	A ==> C
	656	1	0.154	A ==> C
	665	1	0.143	G ==> C
	672	1	0.100	A ==> C
	685	1	0.429	C ==> G
	699	1	0.077	A ==> C
	707	1	0.100	A ==> C
	714	1	0.250	A ==> C
	719	1	0.176	C --> A
node_63 --> node_62	15	1	0.100	G --> A
	102	1	0.188	C --> A
	142	1	0.100	C ==> T
	177	1	0.143	T --> C
	267	1	0.231	T --> A
	329	1	0.154	A --> T
	365	1	0.400	A --> T
	387	1	0.286	T --> A
	436	1	0.182	A --> T
	454	1	0.143	A --> T
	505	1	0.250	A ==> T
	681	1	0.125	A --> C
	688	1	0.167	A --> G
	697	1	0.182	A --> C
	704	1	0.154	A --> C
node_62 --> node_57	294	1	0.273	C --> T
	318	1	0.182	A --> T

Branch	Character	Steps	CI	Change
	420	1	0.182	T --> A
	450	1	0.500	G ==> A
	462	1	0.143	T --> A
	463	1	0.500	C ==> T
	470	1	0.250	A ==> G
	491	1	0.200	T --> A
	501	1	0.333	A ==> T
	523	1	0.231	T ==> A
	540	1	0.222	A --> T
	545	1	0.167	T ==> C
	565	1	0.231	C ==> A
	604	1	0.500	T ==> C
	648	1	0.062	C ==> A
	650	1	0.091	C ==> A
	664	1	0.167	C ==> G
	685	1	0.429	A ==> T
	687	1	0.125	A ==> C
	697	1	0.182	C --> G
	698	1	0.182	A ==> C
	705	1	0.111	A ==> C
	712	1	0.143	A ==> C
	719	1	0.176	C --> G
node_57 --> node_55	15	1	0.100	A --> G
	105	1	0.143	G ==> T
	222	1	0.222	C --> G
	237	1	0.167	G --> C
	330	1	0.118	A ==> T
	363	1	0.333	T ==> A
	431	1	0.118	T --> A
	437	1	0.300	A --> C
	457	1	0.200	T ==> A
	461	1	0.182	T ==> A
	464	1	0.500	A --> G
	471	1	0.154	T ==> C
	544	1	0.143	T ==> C
	571	1	0.125	T --> C
	614	1	0.250	A --> T
	635	1	0.250	A ==> T
	679	1	0.118	C ==> G
	680	1	0.111	G ==> C
	681	1	0.125	C --> A
	686	1	0.188	A --> C
	693	1	0.167	C --> A
	694	1	0.143	C --> G
	699	1	0.077	A ==> C

Branch	Character	Steps	CI	Change
node_55 --> node_54	19	1	0.100	C ==> T
	30	1	0.125	G ==> A
	99	1	0.333	C ==> G
	168	1	0.273	T ==> G
	169	1	0.333	C ==> T
	174	1	0.500	C ==> G
	237	1	0.167	C --> T
	316	1	0.333	T --> A
	437	1	0.300	C --> G
	438	1	0.200	A --> G
	442	1	0.231	A ==> T
	456	1	0.333	T ==> A
	462	1	0.143	A --> C
	540	1	0.222	T --> A
	551	1	0.429	T --> A
	667	1	0.300	A --> C
node_54 --> black Empoasini	48	1	0.176	T ==> A
	102	1	0.188	A --> G
	117	1	0.167	G ==> A
	189	1	0.400	G ==> A
	204	1	0.167	C ==> T
	270	1	0.214	C ==> T
	279	1	0.500	C ==> T
	286	1	0.125	C ==> T
	306	1	0.400	T ==> A
	307	1	0.400	C ==> A
	308	1	0.333	G ==> A
	317	1	0.286	T ==> A
	319	1	0.333	C ==> T
	328	1	0.273	A ==> T
	333	1	0.100	T ==> A
	336	1	0.200	C ==> T
	360	1	0.667	A ==> T
	363	1	0.333	A ==> C
	393	1	0.125	T ==> A
	418	1	0.250	A ==> T
	424	1	0.333	C ==> A
	433	1	0.222	A ==> T
	434	1	0.182	T ==> G
	435	1	0.222	G ==> A
	437	1	0.300	G --> T
	438	1	0.200	G --> T
	454	1	0.143	T --> A
	464	1	0.500	G --> A
	476	1	0.300	G ==> A

Branch	Character	Steps	CI	Change
	491	1	0.200	A --> C
	497	1	0.500	C ==> T
	498	1	1.000	C ==> A
	501	1	0.333	T ==> A
	504	1	0.214	T --> A
	506	1	0.176	T ==> A
	509	1	0.273	T ==> A
	511	1	0.176	A ==> T
	523	1	0.231	A ==> T
	526	1	0.250	A ==> T
	546	1	0.111	C ==> T
	551	1	0.429	A --> G
	554	1	0.182	T ==> C
	570	1	0.250	C ==> T
	571	1	0.125	C --> T
	572	1	0.091	C ==> T
	578	1	1.000	A ==> G
	613	1	0.286	A ==> G
	648	1	0.062	A ==> C
	657	1	0.125	A ==> C
	662	1	0.118	A ==> C
	667	1	0.300	C --> T
	671	1	0.250	A ==> C
	677	1	0.143	A ==> C
	681	1	0.125	A --> C
	686	1	0.188	C --> A
	687	1	0.125	C ==> A
	688	1	0.167	G ==> C
	693	1	0.167	A --> C
	694	1	0.143	G --> C
	695	1	0.182	G ==> A
	697	1	0.182	G ==> C
	703	1	0.083	A ==> C
	712	1	0.143	C ==> A
node_54 --> Taiwan Empoasca	27	1	0.333	C ==> T
	39	1	0.250	G ==> A
	60	1	0.133	A --> T
	108	1	0.500	T ==> C
	150	1	0.500	C ==> A
	159	1	0.375	C ==> T
	267	1	0.231	A ==> C
	276	1	0.167	A ==> G
	316	1	0.333	A --> C
	326	1	0.133	T ==> C
	330	1	0.118	T ==> C

Branch	Character	Steps	CI	Change
	370	1	0.333	A ==> T
	390	1	1.000	A ==> C
	423	1	0.333	T ==> A
	436	1	0.182	T --> A
	439	1	0.133	A ==> T
	440	1	0.143	A ==> T
	462	1	0.143	C --> T
	471	1	0.154	C ==> A
	500	1	0.500	A ==> T
	528	1	1.000	A ==> T
	543	1	0.667	T ==> C
	550	1	1.000	T ==> A
	552	1	0.200	T ==> A
	568	1	0.333	T ==> C
	610	1	0.100	C ==> T
	614	1	0.250	T --> A
	621	1	0.333	A ==> G
	628	1	1.000	T ==> A
	665	1	0.143	G ==> C
	680	1	0.111	C ==> A
	689	1	0.091	C ==> A
	707	1	0.100	A ==> C
	710	1	0.105	A ==> G
	718	1	0.500	A ==> C
	719	1	0.176	G --> C
node_55 --> Joruma sp19	24	1	0.154	C ==> T
	51	1	0.273	G ==> C
	54	1	0.125	C ==> T
	57	1	0.400	C ==> T
	60	1	0.133	A --> C
	81	1	0.200	T ==> C
	90	1	0.375	C ==> T
	102	1	0.188	A --> C
	138	1	0.167	G ==> A
	154	1	0.200	C ==> T
	171	1	0.273	G ==> A
	177	1	0.143	C --> T
	222	1	0.222	G --> T
	255	1	0.250	C ==> T
	261	1	0.111	G ==> C
	267	1	0.231	A ==> G
	270	1	0.214	C ==> G
	294	1	0.273	T --> C
	318	1	0.182	T --> A
	329	1	0.154	T --> A

Branch	Character	Steps	CI	Change
	337	1	1.000	T ==> C
	361	1	0.333	C ==> A
	364	1	0.500	T ==> A
	370	1	0.333	A ==> C
	371	1	0.125	G ==> A
	375	1	0.200	T ==> A
	388	1	0.400	A ==> T
	408	1	0.667	A ==> T
	420	1	0.182	A --> T
	444	1	0.667	A ==> G
	472	1	0.333	A ==> T
	482	1	0.500	T ==> A
	491	1	0.200	A --> T
	499	1	0.400	A ==> C
	502	1	0.214	A ==> T
	504	1	0.214	T ==> G
	508	1	0.167	A ==> T
	512	1	0.400	A ==> T
	515	1	1.000	T ==> C
	524	1	0.273	A ==> T
	539	1	0.250	T ==> C
	541	1	0.250	A ==> T
	548	1	0.333	C ==> T
	588	1	0.143	T ==> G
	624	1	0.167	C ==> T
	637	1	0.091	G ==> A
	644	1	0.300	T ==> C
	645	1	0.273	T ==> C
	651	1	0.200	A ==> C
	654	1	0.167	A ==> C
	656	1	0.154	A ==> G
	666	1	0.250	A ==> C
	691	1	0.286	C --> G
	701	1	0.400	A ==> C
	713	1	0.083	C --> A
	719	1	0.176	G --> A
node_57 --> node_56	9	1	0.300	C --> A
	12	1	0.500	G ==> A
	36	1	0.167	G --> A
	72	1	0.182	A ==> G
	234	1	0.188	C ==> A
	276	1	0.167	A --> G
	442	1	0.231	A --> C
	520	1	0.667	T ==> A
	610	1	0.100	C ==> T

Branch	Character	Steps	CI	Change
	621	1	0.333	A ==> G
	662	1	0.118	A ==> C
	672	1	0.100	A ==> C
	683	1	0.200	A ==> C
	707	1	0.100	A ==> C
	710	1	0.105	A ==> C
	711	1	0.154	C --> A
node_56 --> Madag. Empoasca	24	1	0.154	C ==> T
	30	1	0.125	G ==> A
	45	1	0.167	C ==> T
	48	1	0.176	T ==> A
	51	1	0.273	G ==> C
	54	1	0.125	C ==> T
	60	1	0.133	A --> C
	66	1	0.273	G ==> C
	102	1	0.188	A --> T
	103	1	0.500	C ==> T
	108	1	0.500	T ==> A
	129	1	0.333	G ==> A
	147	1	0.500	C ==> A
	153	1	0.100	G ==> A
	154	1	0.200	C ==> T
	189	1	0.400	G ==> A
	228	1	0.333	C ==> G
	240	1	0.333	G ==> A
	249	1	0.333	C ==> T
	270	1	0.214	C ==> A
	326	1	0.133	T ==> C
	327	1	0.375	T ==> C
	328	1	0.273	A ==> T
	333	1	0.100	T ==> A
	334	1	0.167	A ==> T
	336	1	0.200	C ==> T
	363	1	0.333	T ==> C
	364	1	0.500	T ==> C
	389	1	1.000	A ==> G
	428	1	0.214	A ==> T
	436	1	0.182	T --> A
	439	1	0.133	A ==> T
	440	1	0.143	A ==> T
	442	1	0.231	C --> G
	443	1	0.143	A ==> T
	454	1	0.143	T --> A
	456	1	0.333	T ==> A
	460	1	0.143	T ==> A

Branch	Character	Steps	CI	Change
	472	1	0.333	A ==> T
	481	1	0.333	A ==> C
	491	1	0.200	A --> C
	504	1	0.214	T --> C
	508	1	0.167	A ==> C
	527	1	0.500	A ==> G
	541	1	0.250	A ==> T
	551	1	0.429	T ==> C
	570	1	0.250	C ==> T
	631	1	1.000	T ==> G
	647	1	0.333	A ==> C
	684	1	0.222	C ==> A
	686	1	0.188	A ==> T
	689	1	0.091	C ==> A
node_56 --> Empoasca fabae	6	1	0.250	G ==> C
	9	1	0.300	A --> G
	10	1	0.250	A ==> C
	19	1	0.100	C ==> T
	36	1	0.167	A --> C
	105	1	0.143	G ==> C
	138	1	0.167	G ==> A
	169	1	0.333	C ==> T
	177	1	0.143	C --> T
	243	1	0.143	A ==> G
	259	1	0.111	C ==> T
	329	1	0.154	T --> A
	331	1	0.118	T ==> A
	375	1	0.200	T ==> A
	382	1	0.214	T ==> C
	418	1	0.250	A ==> G
	424	1	0.333	C ==> G
	431	1	0.118	T --> G
	434	1	0.182	T ==> A
	435	1	0.222	G ==> T
	441	1	0.182	T ==> A
	446	1	1.000	T ==> A
	447	1	1.000	A ==> T
	448	1	1.000	A ==> T
	449	1	0.500	A ==> T
	452	1	0.400	T ==> A
	453	1	0.333	T ==> A
	455	1	0.250	A ==> T
	457	1	0.200	T ==> G
	458	1	0.333	T ==> C
	462	1	0.143	A --> C

Branch	Character	Steps	CI	Change
	471	1	0.154	T ==> A
	500	1	0.500	A ==> T
	554	1	0.182	T ==> A
	645	1	0.273	T ==> A
	718	1	0.500	A ==> C
node_62 --> node_61	10	1	0.250	A --> C
	12	1	0.500	G ==> C
	48	1	0.176	T ==> A
	63	1	0.154	A --> C
	96	1	0.200	A --> C
	102	1	0.188	A --> T
	153	1	0.100	G --> A
	306	1	0.400	T --> A
	307	1	0.400	C --> T
	321	1	0.273	A ==> T
	459	1	0.400	T --> A
	504	1	0.214	T --> A
	554	1	0.182	T ==> A
	563	1	0.100	A ==> T
	653	1	0.143	A --> C
	654	1	0.167	A --> C
	671	1	0.250	A --> C
	689	1	0.091	C ==> A
	691	1	0.286	C --> A
	703	1	0.083	A --> C
	713	1	0.083	C --> A
node_61 --> node_58	60	1	0.133	A --> C
	105	1	0.143	G --> C
	261	1	0.111	G ==> C
	327	1	0.375	T ==> C
	333	1	0.100	T ==> A
	336	1	0.200	C ==> T
	365	1	0.400	T --> A
	387	1	0.286	A --> T
	438	1	0.200	A ==> G
	439	1	0.133	A ==> T
	464	1	0.500	A ==> T
	471	1	0.154	T ==> C
	472	1	0.333	A ==> C
	499	1	0.400	A ==> T
	506	1	0.176	T ==> A
	511	1	0.176	A ==> C
	534	1	0.429	A ==> G
	538	1	0.200	A ==> G
	539	1	0.250	T ==> A

Branch	Character	Steps	CI	Change
	565	1	0.231	C ==> T
	612	1	0.333	A ==> G
	635	1	0.250	A --> T
	664	1	0.167	C --> A
	693	1	0.167	C ==> A
node_58 --> Unitra	6	1	0.250	G ==> C
	9	1	0.300	C ==> A
	10	1	0.250	C --> A
	12	1	0.500	C ==> A
	15	1	0.100	A --> G
	36	1	0.167	G ==> T
	48	1	0.176	A ==> G
	63	1	0.154	C --> A
	81	1	0.200	T ==> C
	102	1	0.188	T --> A
	159	1	0.375	C ==> G
	174	1	0.500	C ==> A
	177	1	0.143	C --> A
	180	1	0.500	G ==> A
	219	1	0.167	C ==> T
	228	1	0.333	C ==> T
	235	1	0.500	C ==> T
	243	1	0.143	A ==> G
	246	1	0.500	C ==> T
	255	1	0.250	C ==> G
	267	1	0.231	A ==> C
	270	1	0.214	C ==> T
	285	1	0.500	C ==> T
	294	1	0.273	C ==> T
	650	1	0.091	C ==> A
	653	1	0.143	C --> A
	654	1	0.167	C --> A
	662	1	0.118	A ==> G
	664	1	0.167	A --> T
	667	1	0.300	A ==> C
	671	1	0.250	C --> A
	680	1	0.111	G ==> A
	681	1	0.125	C --> A
	685	1	0.429	A ==> C
	687	1	0.125	A ==> C
	688	1	0.167	G --> A
	691	1	0.286	A --> C
	699	1	0.077	A ==> C
	703	1	0.083	C --> A
	705	1	0.111	A ==> C

Branch	Character	Steps	CI	Change
	708	1	0.143	A ==> C
node_58 --> Limassola	24	1	0.154	C ==> T
	72	1	0.182	A ==> G
	90	1	0.375	C ==> A
	99	1	0.333	C ==> T
	105	1	0.143	C --> T
	132	1	0.167	C ==> T
	138	1	0.167	G ==> A
	171	1	0.273	G ==> C
	186	1	0.300	C ==> T
	204	1	0.167	C ==> T
	249	1	0.333	C ==> T
	252	1	0.143	A --> G
	297	1	0.250	C ==> T
	648	1	0.062	C ==> A
	656	1	0.154	A ==> G
	665	1	0.143	G ==> A
	677	1	0.143	A --> G
	679	1	0.118	C ==> G
	684	1	0.222	C ==> A
	686	1	0.188	A ==> G
	692	1	0.333	C ==> A
	695	1	0.182	G ==> C
	696	1	1.000	C ==> A
	697	1	0.182	C --> A
	698	1	0.182	A ==> C
	707	1	0.100	A ==> C
	710	1	0.105	A ==> G
	714	1	0.250	A ==> G
	717	1	0.143	A ==> C
	719	1	0.176	C --> A
node_61 --> node_60	19	1	0.100	C ==> T
	66	1	0.273	G ==> C
	96	1	0.200	C --> G
	174	1	0.500	C ==> G
	192	1	0.125	C --> T
	259	1	0.111	C --> T
	323	1	0.143	C --> T
	328	1	0.273	A ==> T
	419	1	0.429	A ==> T
	436	1	0.182	T --> A
	441	1	0.182	T --> A
	454	1	0.143	T --> A
	523	1	0.231	T --> C
	524	1	0.273	A --> C
	557	1	0.333	A --> C
	610	1	0.100	C --> T
	645	1	0.273	T ==> A
	656	1	0.154	A ==> C
	657	1	0.125	A --> C
	658	1	0.333	A ==> C
	662	1	0.118	A --> C
	680	1	0.111	G --> C
	688	1	0.167	G ==> C
	709	1	0.222	A --> C
node_60 --> Euhardina	3	1	0.250	G ==> A
	6	1	0.250	G ==> T
	18	1	0.250	G ==> A
	30	1	0.125	G ==> A
	36	1	0.167	G ==> T
	39	1	0.250	G ==> T
	42	1	0.500	G ==> A
	45	1	0.167	C ==> T
	51	1	0.273	G ==> T
	54	1	0.125	C ==> T
	63	1	0.154	C --> T
	96	1	0.200	G --> T
	99	1	0.333	C ==> G
	111	1	0.500	G ==> A
	126	1	0.333	G ==> A
	154	1	0.200	C ==> T
	165	1	0.200	G ==> A
	177	1	0.143	C --> T
	186	1	0.300	C ==> T
	189	1	0.400	G ==> A
	198	1	1.000	G ==> A
	204	1	0.167	C ==> T
	237	1	0.167	G ==> T
	240	1	0.333	G ==> A
	270	1	0.214	C ==> G
	286	1	0.125	C ==> T
	297	1	0.250	C ==> T
	329	1	0.154	T --> A
	438	1	0.200	A ==> C
	440	1	0.143	A ==> C
	442	1	0.231	A ==> T
	443	1	0.143	A ==> T
	505	1	0.250	T ==> A
	511	1	0.176	A ==> G
	527	1	0.500	A ==> T
	552	1	0.200	T ==> A
	677	1	0.143	A ==> C
	679	1	0.118	C ==> G
	686	1	0.188	A ==> C
	691	1	0.286	A --> G
	695	1	0.182	G ==> A
	697	1	0.182	C --> G
	711	1	0.154	C --> A
node_60 --> node_59	24	1	0.154	C --> T
	72	1	0.182	A --> G
	153	1	0.100	A --> G
	252	1	0.143	A --> G
	294	1	0.273	C --> G
	308	1	0.333	G --> A
	309	1	0.667	A --> C
	311	1	0.286	C --> A
	313	1	0.500	G ==> A
	315	1	0.429	C ==> A
	317	1	0.286	T ==> A
	318	1	0.182	A --> C
	319	1	0.333	C --> A
	322	1	1.000	C ==> T
	324	1	0.500	C ==> T
	382	1	0.214	T --> C
	424	1	0.333	C ==> T
	431	1	0.118	T --> A
	433	1	0.222	A ==> T
	434	1	0.182	T ==> G
	435	1	0.222	G ==> A
	437	1	0.300	A ==> T
	457	1	0.200	T ==> A
	459	1	0.400	A --> T
	461	1	0.182	T --> A
	476	1	0.300	G ==> T
	524	1	0.273	C --> T
	540	1	0.222	A ==> T
	557	1	0.333	C --> T
	581	1	0.143	G ==> A
	665	1	0.143	G ==> A
	683	1	0.200	A ==> C
	692	1	0.333	C ==> A
	714	1	0.250	A ==> C
	719	1	0.176	C --> A
node_59 --> Hiratettix	9	1	0.300	C ==> A
	48	1	0.176	A ==> C

Branch	Character	Steps	CI	Change
	117	1	0.167	G ==> A
	138	1	0.167	G ==> A
	192	1	0.125	T --> C
	195	1	0.250	C ==> T
	213	1	1.000	C ==> T
	234	1	0.188	C ==> A
	259	1	0.111	T --> C
	261	1	0.111	G ==> C
	267	1	0.231	A ==> T
	308	1	0.333	A --> T
	309	1	0.667	C --> T
	311	1	0.286	A --> T
	316	1	0.333	T ==> A
	318	1	0.182	C --> T
	320	1	1.000	T ==> C
	323	1	0.143	T --> C
	325	1	0.167	C ==> T
	326	1	0.133	T ==> C
	331	1	0.118	T ==> A
	382	1	0.214	C --> G
	441	1	0.182	A --> T
	461	1	0.182	A --> G
	471	1	0.154	T ==> C
	502	1	0.214	A ==> G
	504	1	0.214	A ==> T
	523	1	0.231	C --> T
	551	1	0.429	T ==> A
	648	1	0.062	C ==> A
	652	1	0.250	A ==> C
	654	1	0.167	C --> A
	689	1	0.091	A ==> C
	693	1	0.167	C ==> A
	694	1	0.143	C ==> G
	698	1	0.182	A ==> C
	711	1	0.154	C --> G
node_59 --> Agnesiella	10	1	0.250	C --> A
	33	1	0.250	G ==> C
	36	1	0.167	G ==> C
	102	1	0.188	T ==> C
	222	1	0.222	C ==> G
	319	1	0.333	A --> T
	321	1	0.273	T ==> C
	328	1	0.273	T ==> G
	329	1	0.154	T --> G
	386	1	0.400	T ==> A

Branch	Character	Steps	CI	Change
	418	1	0.250	A ==> T
	436	1	0.182	A --> T
	438	1	0.200	A ==> T
	439	1	0.133	A ==> T
	440	1	0.143	A ==> T
	452	1	0.400	T ==> A
	454	1	0.143	A --> T
	505	1	0.250	T ==> G
	610	1	0.100	T --> C
	650	1	0.091	C ==> A
	653	1	0.143	C --> A
	657	1	0.125	C --> A
	662	1	0.118	C --> A
	667	1	0.300	A ==> C
	671	1	0.250	C --> A
	677	1	0.143	A --> G
	680	1	0.111	C --> G
	684	1	0.222	C ==> A
	709	1	0.222	C --> A
	710	1	0.105	A ==> G
	712	1	0.143	A ==> C
	713	1	0.083	A ==> C
	717	1	0.143	A ==> C
node_93 --> node_92	48	1	0.176	T ==> A
	168	1	0.273	T --> G
	364	1	0.500	T ==> A
	388	1	0.400	A ==> T
	420	1	0.182	T ==> A
	438	1	0.200	A --> T
	509	1	0.273	T ==> A
	511	1	0.176	A ==> T
	514	1	0.400	C ==> A
	565	1	0.231	C --> T
	654	1	0.167	A ==> C
	657	1	0.125	A --> C
	686	1	0.188	A --> C
	690	1	0.111	A --> C
	698	1	0.182	A ==> G
	699	1	0.077	A --> C
	715	1	0.143	A --> C
node_92 --> node_91	36	1	0.167	G --> C
	102	1	0.188	C --> G
	171	1	0.273	G --> C
	237	1	0.167	G --> C
	329	1	0.154	A ==> T

Branch	Character	Steps	CI	Change
	331	1	0.118	T --> A
	371	1	0.125	G ==> A
	418	1	0.250	A ==> T
	431	1	0.118	T --> A
	635	1	0.250	A --> T
	648	1	0.062	C --> A
	661	1	0.167	C --> A
	677	1	0.143	G ==> C
	716	1	0.083	A --> C
node_91 --> node_89	15	1	0.100	G ==> A
	102	1	0.188	G --> T
	141	1	0.200	G --> T
	177	1	0.143	T --> C
	393	1	0.125	A ==> T
	438	1	0.200	T --> A
	462	1	0.143	T ==> C
	471	1	0.154	T --> C
	565	1	0.231	T --> C
	685	1	0.429	A ==> C
	686	1	0.188	C --> A
	689	1	0.091	C ==> A
	697	1	0.182	A ==> C
node_89 --> node_68	105	1	0.143	G ==> C
	267	1	0.231	T --> A
	270	1	0.214	C ==> T
	286	1	0.125	C --> T
	326	1	0.133	T ==> C
	370	1	0.333	A --> T
	382	1	0.214	C --> T
	506	1	0.176	T ==> A
	544	1	0.143	T --> C
	545	1	0.167	T ==> C
	552	1	0.200	T --> A
	554	1	0.182	T ==> A
	563	1	0.100	A --> T
	588	1	0.143	T ==> G
	662	1	0.118	A ==> G
	703	1	0.083	A ==> C
	713	1	0.083	A --> C
	715	1	0.143	C --> A
node_68 --> Kunzeana	24	1	0.154	C ==> G
	36	1	0.167	C --> T
	54	1	0.125	C ==> T
	57	1	0.400	C ==> A
	63	1	0.154	A ==> C

Branch	Character	Steps	CI	Change
	81	1	0.200	T ==> C
	111	1	0.500	G ==> A
	169	1	0.333	C ==> T
	171	1	0.273	C --> G
	177	1	0.143	C --> T
	186	1	0.300	C ==> T
	192	1	0.125	C ==> T
	204	1	0.167	C ==> T
	228	1	0.333	C ==> G
	234	1	0.188	C ==> T
	240	1	0.333	G ==> A
	273	1	0.167	C ==> T
	294	1	0.273	C ==> T
	297	1	0.250	C ==> T
	328	1	0.273	A ==> C
	415	1	0.250	C ==> T
	437	1	0.300	A ==> T
	452	1	0.400	T ==> A
	472	1	0.333	A ==> T
	540	1	0.222	A ==> T
	571	1	0.125	C ==> T
	581	1	0.143	A ==> G
	602	1	0.667	T ==> A
	604	1	0.500	T ==> A
	613	1	0.286	A ==> T
	634	1	0.333	T ==> G
	664	1	0.167	C ==> A
	666	1	0.250	A ==> C
	669	1	0.333	A ==> C
	670	1	0.500	A ==> C
	672	1	0.100	A ==> C
	675	1	0.250	A ==> C
	684	1	0.222	C ==> A
	704	1	0.154	A ==> G
	706	1	0.154	C ==> G
	707	1	0.100	A ==> C
	708	1	0.143	A ==> C
	709	1	0.222	A ==> C
	712	1	0.143	A ==> C
	714	1	0.250	C ==> G
node_68 --> node_67	102	1	0.188	T --> C
	219	1	0.167	C --> T
	259	1	0.111	C --> T
	318	1	0.182	A ==> C
	329	1	0.154	T ==> A

Branch	Character	Steps	CI	Change
	433	1	0.222	A --> T
	451	1	0.222	T --> A
	509	1	0.273	A --> C
	541	1	0.250	A ==> T
	635	1	0.250	T --> A
	648	1	0.062	A --> C
	661	1	0.167	A --> C
	665	1	0.143	G ==> A
	680	1	0.111	G ==> C
	694	1	0.143	C ==> G
	716	1	0.083	C --> A
node_67 --> Igutettix	306	1	0.400	T ==> G
	307	1	0.400	C ==> A
	308	1	0.333	G ==> A
	311	1	0.286	C ==> A
	315	1	0.429	C ==> A
	316	1	0.333	T ==> C
	317	1	0.286	T ==> A
	330	1	0.118	A ==> T
	331	1	0.118	A ==> C
	370	1	0.333	T --> A
	371	1	0.125	A ==> G
	382	1	0.214	T --> C
	424	1	0.333	C ==> A
	434	1	0.182	T ==> G
	435	1	0.222	G ==> A
	445	1	0.667	A ==> G
	457	1	0.200	T ==> A
	458	1	0.333	T ==> A
	459	1	0.400	T ==> C
	460	1	0.143	A ==> T
	461	1	0.182	A ==> G
	462	1	0.143	C ==> T
	476	1	0.300	G ==> C
	499	1	0.400	A ==> C
	520	1	0.667	T ==> C
	552	1	0.200	A --> T
	563	1	0.100	T --> A
	565	1	0.231	C ==> T
	568	1	0.333	T ==> A
	644	1	0.300	T ==> C
	649	1	1.000	A ==> C
	662	1	0.118	G ==> C
	684	1	0.222	C ==> G
	698	1	0.182	G ==> C

Branch	Character	Steps	CI	Change
	719	1	0.176	A ==> C
node_67 --> node_66	319	1	0.333	C --> T
	386	1	0.400	T --> C
	426	1	0.167	T ==> A
	471	1	0.154	C --> T
	472	1	0.333	A --> G
	491	1	0.200	T ==> A
	502	1	0.214	A ==> T
	503	1	0.222	A ==> T
	509	1	0.273	C --> T
	544	1	0.143	C --> A
	554	1	0.182	A ==> C
	634	1	0.333	T --> A
	679	1	0.118	C --> A
	689	1	0.091	A ==> C
	713	1	0.083	C --> A
node_66 --> node_65	9	1	0.300	C ==> G
	60	1	0.133	A ==> C
	63	1	0.154	A ==> T
	66	1	0.273	G ==> T
	75	1	0.250	T --> C
	78	1	0.333	C ==> T
	96	1	0.200	A --> C
	141	1	0.200	T --> G
	142	1	0.100	C ==> T
	159	1	0.375	C ==> G
	165	1	0.200	G --> A
	270	1	0.214	T ==> G
	333	1	0.100	T ==> A
	387	1	0.286	T --> C
	430	1	0.273	T ==> A
	439	1	0.133	A ==> T
	511	1	0.176	T --> A
	539	1	0.250	T ==> C
	544	1	0.143	A --> T
	572	1	0.091	C --> T
	579	1	0.143	A --> G
	672	1	0.100	A --> C
	686	1	0.188	A --> C
	702	1	0.200	A --> C
node_65 --> node_64	3	1	0.250	G ==> A
	27	1	0.333	C --> A
	33	1	0.250	G --> C
	138	1	0.167	G ==> A
	177	1	0.143	C --> T

Branch	Character	Steps	CI	Change
	222	1	0.222	C ==> T
	234	1	0.188	C ==> T
	286	1	0.125	T --> C
	364	1	0.500	A --> T
	370	1	0.333	T --> A
	386	1	0.400	C --> T
	431	1	0.118	A --> G
	449	1	0.500	A ==> T
	453	1	0.333	T ==> A
	457	1	0.200	T ==> A
	472	1	0.333	G --> A
	563	1	0.100	T --> A
	568	1	0.333	T ==> C
	624	1	0.167	C ==> T
	641	1	1.000	G --> A
	648	1	0.062	C ==> A
	662	1	0.118	G ==> A
	666	1	0.250	A ==> C
	694	1	0.143	G ==> C
node_64 --> Alconeura sp3	27	1	0.333	A --> T
	33	1	0.250	C --> T
	36	1	0.167	C --> T
	37	1	0.333	A ==> C
	39	1	0.250	G ==> T
	48	1	0.176	A ==> C
	51	1	0.273	G ==> T
	66	1	0.273	T ==> C
	75	1	0.250	C --> T
	96	1	0.200	C --> A
	105	1	0.143	C ==> G
	115	1	1.000	A ==> C
	132	1	0.167	C ==> T
	165	1	0.200	A --> G
	168	1	0.273	G ==> C
	237	1	0.167	C ==> G
	270	1	0.214	G ==> C
	288	1	1.000	G ==> C
	303	1	1.000	C ==> G
	382	1	0.214	T ==> C
	388	1	0.400	T ==> A
	426	1	0.167	A ==> T
	428	1	0.214	A ==> C
	431	1	0.118	G --> T
	432	1	0.250	A ==> T
	433	1	0.222	T --> A

Branch	Character	Steps	CI	Change
	502	1	0.214	T ==> C
	506	1	0.176	A ==> T
	518	1	1.000	T ==> C
	534	1	0.429	A ==> C
	544	1	0.143	T --> A
	554	1	0.182	C ==> A
	565	1	0.231	C ==> A
	610	1	0.100	C ==> T
	634	1	0.333	A --> T
	635	1	0.250	A --> T
	637	1	0.091	G ==> A
	651	1	0.200	A ==> C
	679	1	0.118	A --> C
	681	1	0.125	A ==> C
	689	1	0.091	C ==> A
	702	1	0.200	C --> A
	710	1	0.105	A ==> C
	716	1	0.083	A --> C
node_64 --> Dikrella sp8	19	1	0.100	C ==> T
	60	1	0.133	C ==> T
	63	1	0.154	T ==> C
	90	1	0.375	C ==> G
	93	1	0.375	C ==> A
	102	1	0.188	C --> G
	150	1	0.500	C ==> T
	153	1	0.100	G ==> A
	156	1	0.667	G ==> A
	186	1	0.300	C ==> A
	246	1	0.500	C ==> G
	258	1	1.000	C ==> T
	259	1	0.111	T ==> C
	264	1	0.667	C ==> A
	387	1	0.286	C --> T
	430	1	0.273	A ==> G
	438	1	0.200	A ==> T
	451	1	0.222	A --> T
	462	1	0.143	C ==> T
	472	1	0.333	A --> C
	504	1	0.214	A ==> T
	508	1	0.167	A ==> T
	509	1	0.273	T ==> A
	519	1	1.000	T ==> G
	523	1	0.231	T ==> G
	524	1	0.273	A ==> T
	527	1	0.500	A ==> T

Branch	Character	Steps	CI	Change
	530	1	1.000	T ==> A
	531	1	0.167	A ==> T
	535	1	1.000	T ==> A
	540	1	0.222	A ==> C
	552	1	0.200	A ==> C
	572	1	0.091	T --> C
	574	1	1.000	A ==> T
	576	1	0.667	T ==> A
	579	1	0.143	G --> A
	580	1	1.000	A ==> G
	581	1	0.143	A ==> G
	613	1	0.286	A ==> T
	625	1	0.667	A ==> C
	626	1	1.000	T ==> A
	629	1	1.000	A ==> T
	636	1	1.000	G ==> T
	653	1	0.143	A ==> C
	664	1	0.167	C ==> A
	672	1	0.100	C --> A
	677	1	0.143	C ==> A
	680	1	0.111	C ==> A
	686	1	0.188	C --> A
	688	1	0.167	A ==> G
	695	1	0.182	G ==> C
	699	1	0.077	C ==> A
	704	1	0.154	A ==> C
node_65 --> Dikrella sp9	6	1	0.250	T ==> A
	15	1	0.100	A ==> G
	21	1	0.400	G ==> C
	24	1	0.154	C ==> T
	102	1	0.188	C --> T
	186	1	0.300	C ==> T
	294	1	0.273	C ==> A
	336	1	0.200	C ==> T
	415	1	0.250	C ==> T
	428	1	0.214	A ==> T
	442	1	0.231	A ==> T
	443	1	0.143	A ==> T
	471	1	0.154	T --> C
	476	1	0.300	G ==> A
	491	1	0.200	A ==> C
	511	1	0.176	A --> C
	540	1	0.222	A ==> T
	541	1	0.250	T ==> A
	557	1	0.333	A ==> C

Branch	Character	Steps	CI	Change
	570	1	0.250	C ==> T
	588	1	0.143	G ==> T
	625	1	0.667	A ==> T
	635	1	0.250	A ==> C
	656	1	0.154	C ==> A
	679	1	0.118	A ==> G
	703	1	0.083	C ==> A
	707	1	0.100	A ==> C
	713	1	0.083	A --> C
node_66 --> Dikrellidia	6	1	0.250	T ==> G
	36	1	0.167	C --> A
	45	1	0.167	C ==> T
	153	1	0.100	G ==> A
	168	1	0.273	G --> T
	205	1	0.250	C ==> T
	237	1	0.167	C ==> T
	243	1	0.143	A ==> G
	325	1	0.167	C ==> T
	326	1	0.133	C ==> T
	331	1	0.118	A ==> T
	335	1	0.500	T ==> C
	366	1	0.667	A ==> G
	433	1	0.222	T --> A
	451	1	0.222	A --> T
	506	1	0.176	A ==> T
	534	1	0.429	A ==> T
	569	1	0.143	C ==> T
	590	1	0.333	T ==> C
	602	1	0.667	T ==> G
	664	1	0.167	C ==> A
	675	1	0.250	A ==> C
	698	1	0.182	G ==> A
	705	1	0.111	A ==> C
	710	1	0.105	A ==> G
	716	1	0.083	A --> C
node_89 --> node_88	6	1	0.250	T ==> G
	36	1	0.167	C --> G
	39	1	0.250	G --> A
	48	1	0.176	A --> G
	60	1	0.133	A ==> C
	96	1	0.200	A --> G
	168	1	0.273	G --> A
	261	1	0.111	G ==> C
	328	1	0.273	A --> T
	330	1	0.118	A ==> T

Branch	Character	Steps	CI	Change
	569	1	0.143	C --> T
	637	1	0.091	G --> A
node_88 --> node_86	168	1	0.273	A --> T
	318	1	0.182	A --> T
	420	1	0.182	A ==> T
	427	1	0.222	A --> T
	430	1	0.273	T ==> A
	434	1	0.182	T --> A
	471	1	0.154	C --> T
	481	1	0.333	A ==> T
	502	1	0.214	A --> T
	572	1	0.091	C ==> T
	635	1	0.250	T --> A
	657	1	0.125	C ==> A
node_86 --> node_74	39	1	0.250	A --> G
	334	1	0.167	A ==> T
	371	1	0.125	A ==> G
	512	1	0.400	A --> G
	541	1	0.250	A ==> T
	554	1	0.182	T --> A
	614	1	0.250	A ==> T
	637	1	0.091	A --> G
	672	1	0.100	A ==> C
	686	1	0.188	A --> C
node_74 --> node_72	48	1	0.176	G --> A
	66	1	0.273	G --> A
	177	1	0.143	C ==> T
	234	1	0.188	C --> A
	306	1	0.400	T --> A
	331	1	0.118	A --> T
	433	1	0.222	A ==> T
	434	1	0.182	A --> G
	460	1	0.143	A --> T
	470	1	0.250	A ==> G
	477	1	1.000	T ==> C
	643	1	1.000	A ==> T
	683	1	0.200	A --> C
	703	1	0.083	A ==> C
node_72 --> node_71	15	1	0.100	A ==> G
	36	1	0.167	G ==> T
	141	1	0.200	T --> G
	234	1	0.188	A --> T
	330	1	0.118	T --> A
	414	1	0.500	A ==> G
	502	1	0.214	T --> A

Branch	Character	Steps	CI	Change
	512	1	0.400	G --> A
	526	1	0.250	A ==> T
	538	1	0.200	A ==> G
	539	1	0.250	T ==> A
	563	1	0.100	A --> T
	569	1	0.143	T --> C
	650	1	0.091	C --> A
	656	1	0.154	C ==> A
	689	1	0.091	A ==> C
node_71 --> node_70	21	1	0.400	G --> T
	66	1	0.273	A --> G
	222	1	0.222	C --> T
	267	1	0.231	T --> A
	331	1	0.118	T --> A
	557	1	0.333	A --> T
	579	1	0.143	A ==> G
	590	1	0.333	T ==> C
	643	1	1.000	T ==> C
	644	1	0.300	T ==> C
	683	1	0.200	C --> A
	711	1	0.154	A --> C
	715	1	0.143	C --> A
	716	1	0.083	C --> A
node_70 --> Kidrella	330	1	0.118	A --> T
	361	1	0.333	C ==> A
	363	1	0.333	T ==> C
	415	1	0.250	C ==> T
	419	1	0.429	A ==> T
	426	1	0.167	T ==> C
	428	1	0.214	A ==> T
	439	1	0.133	A ==> G
	462	1	0.143	C ==> A
	481	1	0.333	T ==> A
	505	1	0.250	A ==> G
	656	1	0.154	A ==> G
	665	1	0.143	G ==> C
	672	1	0.100	C ==> A
	679	1	0.118	C ==> G
	699	1	0.077	C ==> A
	706	1	0.154	C ==> G
	719	1	0.176	A ==> C
node_70 --> node_69	321	1	0.273	A --> C
	326	1	0.133	T ==> C
	460	1	0.143	T --> A
	461	1	0.182	A ==> T

Branch	Character	Steps	CI	Change
	504	1	0.214	A ==> T
	507	1	0.400	A ==> T
	563	1	0.100	T --> A
	569	1	0.143	C --> T
	648	1	0.062	A ==> C
	650	1	0.091	A --> C
	694	1	0.143	C ==> G
	703	1	0.083	C ==> A
	710	1	0.105	A --> C
node_69 --> Alconeura sp2	33	1	0.250	G ==> T
	51	1	0.273	G ==> C
	93	1	0.375	C ==> T
	129	1	0.333	G ==> A
	135	1	0.667	C ==> T
	142	1	0.100	C ==> T
	330	1	0.118	A --> C
	331	1	0.118	A --> T
	420	1	0.182	T ==> C
	426	1	0.167	T ==> A
	451	1	0.222	T ==> C
	456	1	0.333	A ==> G
	502	1	0.214	A ==> G
	511	1	0.176	T ==> C
	524	1	0.273	A ==> G
	534	1	0.429	A ==> G
	544	1	0.143	T ==> A
	557	1	0.333	T --> A
	572	1	0.091	T ==> C
	602	1	0.667	T ==> A
	661	1	0.167	A ==> C
	662	1	0.118	A ==> G
	664	1	0.167	C ==> A
	665	1	0.143	G ==> A
	701	1	0.400	A ==> C
	710	1	0.105	C --> G
	711	1	0.154	C --> A
	713	1	0.083	A ==> C
	716	1	0.083	A --> C
node_69 --> Dikrella sp3	99	1	0.333	C ==> G
	102	1	0.188	T ==> C
	105	1	0.143	G ==> C
	234	1	0.188	T --> A
	321	1	0.273	C --> T
	327	1	0.375	T ==> A
	414	1	0.500	G ==> A

Branch	Character	Steps	CI	Change
	439	1	0.133	A ==> T
	441	1	0.182	A ==> T
	477	1	1.000	C ==> A
	505	1	0.250	A ==> T
	542	1	0.667	A ==> G
	614	1	0.250	T ==> A
	647	1	0.333	A ==> C
	657	1	0.125	A ==> G
	675	1	0.250	A ==> C
	679	1	0.118	C ==> A
	684	1	0.222	C ==> A
	686	1	0.188	C ==> A
	698	1	0.182	G ==> A
	704	1	0.154	A ==> C
node_71 --> Dikrella sp4	33	1	0.250	G ==> A
	57	1	0.400	C ==> T
	117	1	0.167	G ==> A
	135	1	0.667	C ==> A
	186	1	0.300	C ==> T
	219	1	0.167	C ==> T
	307	1	0.400	C ==> A
	308	1	0.333	G ==> A
	311	1	0.286	C ==> A
	313	1	0.500	G ==> A
	315	1	0.429	C ==> A
	316	1	0.333	T ==> A
	317	1	0.286	T ==> A
	360	1	0.667	A ==> T
	424	1	0.333	C ==> T
	427	1	0.222	T ==> C
	430	1	0.273	A ==> T
	435	1	0.222	G ==> A
	438	1	0.200	A ==> T
	445	1	0.667	A ==> T
	457	1	0.200	T ==> A
	458	1	0.333	T ==> A
	460	1	0.143	T ==> C
	472	1	0.333	A ==> C
	476	1	0.300	G ==> A
	477	1	1.000	C ==> G
	478	1	1.000	T ==> C
	479	1	1.000	C ==> T
	480	1	1.000	T ==> C
	511	1	0.176	T ==> C
	524	1	0.273	A ==> G

Branch	Character	Steps	CI	Change
	550	1	1.000	T ==> G
	581	1	0.143	A ==> G
	657	1	0.125	A ==> G
	672	1	0.100	C ==> G
	680	1	0.111	G ==> C
	691	1	0.286	C ==> A
	698	1	0.182	G ==> C
	704	1	0.154	A ==> C
node_72 --> Dikrella sp1	18	1	0.250	G ==> A
	60	1	0.133	C ==> T
	63	1	0.154	A ==> C
	90	1	0.375	C ==> T
	96	1	0.200	G ==> A
	132	1	0.167	C ==> T
	142	1	0.100	C ==> T
	144	1	0.500	G ==> C
	171	1	0.273	C ==> G
	189	1	0.400	G ==> T
	192	1	0.125	C ==> T
	255	1	0.250	C ==> G
	294	1	0.273	C ==> T
	326	1	0.133	T ==> C
	328	1	0.273	T --> A
	329	1	0.154	T ==> A
	393	1	0.125	T ==> A
	428	1	0.214	A ==> T
	462	1	0.143	C ==> A
	506	1	0.176	T ==> A
	508	1	0.167	A ==> T
	518	1	1.000	T ==> A
	523	1	0.231	T ==> C
	540	1	0.222	A ==> T
	572	1	0.091	T ==> C
	637	1	0.091	G --> A
	653	1	0.143	A ==> C
	675	1	0.250	A ==> C
	678	1	1.000	C ==> A
	688	1	0.167	A ==> G
	706	1	0.154	C ==> A
node_74 --> node_73	19	1	0.100	C ==> T
	141	1	0.200	T --> C
	228	1	0.333	C --> A
	319	1	0.333	C --> A
	427	1	0.222	T --> A
	456	1	0.333	A ==> G

Branch	Character	Steps	CI	Change
	491	1	0.200	T ==> A
	498	1	1.000	C ==> T
	552	1	0.200	T ==> A
	565	1	0.231	C ==> T
	568	1	0.333	T ==> A
	579	1	0.143	A ==> G
	590	1	0.333	T ==> C
	645	1	0.273	T --> A
	646	1	0.250	T --> A
	662	1	0.118	A ==> G
	664	1	0.167	C ==> A
	704	1	0.154	A --> C
	719	1	0.176	A ==> C
node_73 --> Dikrella sp6	6	1	0.250	G ==> C
	24	1	0.154	C ==> G
	27	1	0.333	C ==> G
	33	1	0.250	G ==> C
	63	1	0.154	A ==> C
	72	1	0.182	A ==> G
	75	1	0.250	T ==> G
	78	1	0.333	C ==> T
	102	1	0.188	T ==> C
	105	1	0.143	G ==> C
	108	1	0.500	T ==> C
	129	1	0.333	G ==> A
	142	1	0.100	C ==> T
	186	1	0.300	C ==> G
	259	1	0.111	C ==> T
	261	1	0.111	C ==> G
	267	1	0.231	T ==> A
	282	1	1.000	C ==> G
	329	1	0.154	T ==> G
	393	1	0.125	T ==> A
	435	1	0.222	G ==> A
	436	1	0.182	A ==> T
	437	1	0.300	A ==> G
	440	1	0.143	A ==> T
	441	1	0.182	A ==> T
	497	1	0.500	C ==> T
	502	1	0.214	T --> C
	505	1	0.250	A ==> T
	523	1	0.231	T ==> C
	543	1	0.667	T ==> A
	551	1	0.429	T ==> A
	554	1	0.182	A --> T

Branch	Character	Steps	CI	Change
	570	1	0.250	C ==> T
	657	1	0.125	A ==> C
	661	1	0.167	A ==> C
	689	1	0.091	A ==> C
	695	1	0.182	G ==> C
	711	1	0.154	A ==> C
	713	1	0.083	A ==> C
	716	1	0.083	C ==> A
node_73 --> Idona	39	1	0.250	G --> A
	48	1	0.176	G --> T
	159	1	0.375	C ==> A
	192	1	0.125	C ==> T
	205	1	0.250	C ==> T
	228	1	0.333	A --> G
	273	1	0.167	C ==> T
	276	1	0.167	A ==> G
	326	1	0.133	T ==> C
	330	1	0.118	T ==> A
	363	1	0.333	T ==> C
	418	1	0.250	T ==> A
	421	1	1.000	C ==> A
	432	1	0.250	A ==> T
	434	1	0.182	A --> T
	438	1	0.200	A ==> T
	506	1	0.176	T ==> A
	509	1	0.273	A ==> T
	512	1	0.400	G --> T
	513	1	1.000	G ==> A
	514	1	0.400	A ==> G
	546	1	0.111	C ==> T
	563	1	0.100	A ==> T
	648	1	0.062	A --> C
	656	1	0.154	C ==> A
	672	1	0.100	C ==> G
	680	1	0.111	G ==> C
	688	1	0.167	A ==> G
	697	1	0.182	C ==> G
	705	1	0.111	A ==> C
	706	1	0.154	C ==> A
	710	1	0.105	A ==> C
	714	1	0.250	C ==> G
	715	1	0.143	C --> A
node_86 --> node_85	328	1	0.273	T --> A
	425	1	0.333	A ==> T
	509	1	0.273	A ==> T

Branch	Character	Steps	CI	Change
	511	1	0.176	T --> A
	514	1	0.400	A ==> C
	531	1	0.167	A ==> T
	568	1	0.333	T ==> C
	569	1	0.143	T --> C
	571	1	0.125	C ==> T
	581	1	0.143	A ==> G
	610	1	0.100	C ==> T
	648	1	0.062	A --> C
	650	1	0.091	C ==> A
	665	1	0.143	G ==> A
	692	1	0.333	C ==> A
	706	1	0.154	C ==> G
	711	1	0.154	A ==> C
node_85 --> node_84	18	1	0.250	G --> A
	30	1	0.125	G ==> A
	54	1	0.125	C ==> T
	60	1	0.133	C ==> A
	72	1	0.182	A ==> G
	96	1	0.200	G ==> C
	105	1	0.143	G --> C
	252	1	0.143	G ==> A
	259	1	0.111	C ==> T
	261	1	0.111	C ==> G
	267	1	0.231	T ==> A
	329	1	0.154	T ==> A
	426	1	0.167	T ==> C
	462	1	0.143	C ==> T
	523	1	0.231	T ==> C
	565	1	0.231	C ==> A
	699	1	0.077	C ==> A
	709	1	0.222	A ==> C
	717	1	0.143	A ==> C
node_84 --> node_83	33	1	0.250	G ==> C
	36	1	0.167	G ==> C
	39	1	0.250	A --> G
	48	1	0.176	G --> A
	75	1	0.250	T ==> C
	93	1	0.375	C --> A
	234	1	0.188	C ==> T
	294	1	0.273	C ==> T
	331	1	0.118	A --> T
	457	1	0.200	T --> A
	460	1	0.143	A --> T
	505	1	0.250	A ==> T

Branch	Character	Steps	CI	Change
	695	1	0.182	G --> C
	697	1	0.182	C --> A
	712	1	0.143	A ==> C
node_83 --> node_76	9	1	0.300	C ==> G
	18	1	0.250	A --> G
	21	1	0.400	G ==> C
	45	1	0.167	C ==> T
	96	1	0.200	C ==> A
	126	1	0.333	G --> A
	205	1	0.250	C ==> T
	243	1	0.143	A ==> G
	439	1	0.133	A --> T
	442	1	0.231	A --> T
	650	1	0.091	A --> C
	664	1	0.167	C --> A
	687	1	0.125	A --> C
	711	1	0.154	C ==> A
node_76 --> node_75	237	1	0.167	C ==> T
	270	1	0.214	C ==> T
	318	1	0.182	T --> A
	321	1	0.273	A ==> G
	323	1	0.143	C ==> T
	330	1	0.118	T ==> A
	331	1	0.118	T --> A
	333	1	0.100	T ==> A
	457	1	0.200	A --> T
	460	1	0.143	T --> A
	503	1	0.222	A ==> T
	541	1	0.250	A ==> T
	645	1	0.273	T --> A
	665	1	0.143	A --> C
	679	1	0.118	C ==> G
	694	1	0.143	C ==> G
	699	1	0.077	A ==> C
node_75 --> Eythroneura laws	3	1	0.250	G ==> A
	7	1	1.000	C ==> G
	27	1	0.333	C ==> G
	72	1	0.182	G ==> A
	75	1	0.250	C ==> T
	90	1	0.375	C ==> T
	286	1	0.125	C ==> T
	328	1	0.273	A ==> T
	427	1	0.222	T ==> C
	428	1	0.214	A ==> C
	430	1	0.273	A ==> C

Branch	Character	Steps	CI	Change
	439	1	0.133	T --> A
	440	1	0.143	A ==> T
	441	1	0.182	A ==> T
	444	1	0.667	A ==> T
	451	1	0.222	T ==> C
	542	1	0.667	A ==> T
	645	1	0.273	A --> G
	650	1	0.091	C --> A
	662	1	0.118	A ==> G
	665	1	0.143	C --> G
	672	1	0.100	A ==> C
	683	1	0.200	A ==> C
	687	1	0.125	C --> A
	690	1	0.111	C ==> A
	704	1	0.154	A ==> C
node_75 --> Ntanga	36	1	0.167	C ==> A
	126	1	0.333	A --> G
	153	1	0.100	G ==> A
	195	1	0.250	C ==> T
	222	1	0.222	C ==> T
	326	1	0.133	T ==> A
	382	1	0.214	C ==> G
	419	1	0.429	A ==> C
	431	1	0.118	A ==> T
	442	1	0.231	T --> A
	443	1	0.143	A ==> T
	508	1	0.167	A ==> T
	511	1	0.176	A --> T
	546	1	0.111	C ==> T
	644	1	0.300	T ==> C
	648	1	0.062	C --> A
	656	1	0.154	C ==> A
	664	1	0.167	A --> C
	680	1	0.111	G ==> C
	697	1	0.182	A --> C
	703	1	0.083	A ==> C
	709	1	0.222	C ==> G
	710	1	0.105	A ==> G
	714	1	0.250	C ==> A
	716	1	0.083	C ==> A
	717	1	0.143	C ==> A
node_76 --> Erythroneura ill	48	1	0.176	A --> G
	117	1	0.167	G ==> A
	255	1	0.250	C ==> T
	329	1	0.154	A ==> T

Branch	Character	Steps	CI	Change
	703	1	0.083	A ==> C
	709	1	0.222	C ==> G
	710	1	0.105	A ==> G
	714	1	0.250	C ==> A
	716	1	0.083	C ==> A
	717	1	0.143	C ==> A
node_76 --> Erythroneura ill	48	1	0.176	A --> G
	117	1	0.167	G ==> A
	255	1	0.250	C ==> T
	329	1	0.154	A ==> T
	364	1	0.500	A ==> T
	365	1	0.400	A ==> T
	371	1	0.125	A ==> G
	375	1	0.200	T ==> A
	387	1	0.286	T ==> A
	388	1	0.400	T ==> A
	415	1	0.250	C ==> T
	418	1	0.250	T ==> A
	420	1	0.182	T ==> A
	425	1	0.333	T ==> A
	426	1	0.167	C ==> T
	428	1	0.214	A ==> G
	430	1	0.273	A ==> T
	434	1	0.182	A ==> T
	446	1	1.000	T ==> C
	450	1	0.500	G ==> A
	461	1	0.182	A ==> G
	463	1	0.500	C ==> T
	470	1	0.250	A ==> G
	471	1	0.154	T ==> A
	476	1	0.300	G ==> A
	481	1	0.333	T ==> A
	491	1	0.200	T ==> A
	501	1	0.333	A ==> T
	506	1	0.176	T ==> A
	523	1	0.231	C ==> A
	531	1	0.167	T ==> A
	554	1	0.182	T ==> A
	570	1	0.250	C ==> T
	571	1	0.125	T ==> C
	572	1	0.091	T ==> C
	588	1	0.143	T ==> G
	604	1	0.500	T ==> C
	621	1	0.333	A ==> G
	635	1	0.250	A ==> T

Branch	Character	Steps	CI	Change
	637	1	0.091	A ==> G
	646	1	0.250	T ==> A
	702	1	0.200	A ==> C
	710	1	0.105	A ==> C
node_83 --> node_82	93	1	0.375	A --> G
	306	1	0.400	T --> A
	307	1	0.400	C --> A
	308	1	0.333	G --> A
	309	1	0.667	A --> T
	311	1	0.286	C --> A
	312	1	1.000	A --> T
	313	1	0.500	G --> A
	315	1	0.429	C --> A
	316	1	0.333	T --> A
	327	1	0.375	T ==> A
	334	1	0.167	A --> T
	424	1	0.333	C ==> A
	428	1	0.214	A ==> T
	434	1	0.182	A ==> G
	435	1	0.222	G ==> A
	451	1	0.222	T --> A
	458	1	0.333	T --> A
	476	1	0.300	G ==> T
	511	1	0.176	A --> T
	657	1	0.125	A --> C
	672	1	0.100	A --> G
	690	1	0.111	C --> A
	706	1	0.154	G --> A
node_82 --> node_79	6	1	0.250	G --> T
	33	1	0.250	C --> A
	36	1	0.167	C ==> T
	102	1	0.188	T ==> C
	108	1	0.500	T ==> A
	177	1	0.143	C --> A
	270	1	0.214	C --> G
	326	1	0.133	T --> A
	333	1	0.100	T ==> A
	437	1	0.300	A ==> T
	481	1	0.333	T --> A
	544	1	0.143	T ==> C
	545	1	0.167	T --> C
	648	1	0.062	C --> A
	662	1	0.118	A --> C
	694	1	0.143	C ==> G
node_79 --> node_78	19	1	0.100	C --> T

Branch	Character	Steps	CI	Change
	33	1	0.250	A --> T
	48	1	0.176	A --> G
	99	1	0.333	C --> G
	141	1	0.200	T --> G
	142	1	0.100	C --> T
	210	1	0.500	T --> A
	234	1	0.188	T --> C
	315	1	0.429	A --> G
	318	1	0.182	T --> A
	334	1	0.167	T --> A
	375	1	0.200	T ==> A
	382	1	0.214	C ==> T
	431	1	0.118	A --> T
	451	1	0.222	A --> T
	458	1	0.333	A --> T
	503	1	0.222	A ==> T
	505	1	0.250	T ==> A
	657	1	0.125	C --> A
	664	1	0.167	C ==> A
	672	1	0.100	G --> A
	679	1	0.118	C --> G
	699	1	0.077	A ==> C
	706	1	0.154	A --> G
node_78 --> node_77	326	1	0.133	A --> T
	331	1	0.118	T --> A
	360	1	0.667	A ==> C
	374	1	1.000	A ==> T
	419	1	0.429	A ==> T
	424	1	0.333	A --> C
	426	1	0.167	C --> A
	427	1	0.222	T ==> A
	502	1	0.214	T ==> C
	613	1	0.286	A ==> T
	646	1	0.250	T ==> A
	680	1	0.111	G --> A
	687	1	0.125	A ==> C
	711	1	0.154	C ==> A
node_77 --> Erythroneura tri	317	1	0.286	T ==> A
	330	1	0.118	T ==> A
	424	1	0.333	C --> G
	425	1	0.333	T ==> C
	426	1	0.167	A --> T
	428	1	0.214	T ==> A
	432	1	0.250	A ==> T
	458	1	0.333	T --> A

Branch	Character	Steps	CI	Change
	504	1	0.214	A ==> T
	508	1	0.167	A ==> T
	511	1	0.176	T ==> C
	523	1	0.231	C ==> T
	544	1	0.143	C ==> T
	650	1	0.091	A ==> C
	656	1	0.154	C ==> A
	662	1	0.118	C --> A
	665	1	0.143	A ==> C
	680	1	0.111	A --> C
	690	1	0.111	A ==> C
	697	1	0.182	A ==> C
	704	1	0.154	A ==> C
node_77 --> Salka	312	1	1.000	T ==> G
	314	1	1.000	A ==> C
	315	1	0.429	G ==> T
	316	1	0.333	A --> T
	430	1	0.273	A ==> T
	431	1	0.118	T --> A
	433	1	0.222	A ==> T
	434	1	0.182	G ==> T
	436	1	0.182	A ==> G
	437	1	0.300	T ==> A
	439	1	0.133	A ==> T
	440	1	0.143	A ==> T
	442	1	0.231	A ==> T
	454	1	0.143	A ==> T
	457	1	0.200	A ==> T
	460	1	0.143	T ==> A
	476	1	0.300	T ==> G
	506	1	0.176	T ==> A
	551	1	0.429	T ==> G
	610	1	0.100	T ==> C
	612	1	0.333	A ==> G
	664	1	0.167	A ==> T
	677	1	0.143	C ==> A
	679	1	0.118	G --> C
	683	1	0.200	A ==> C
	694	1	0.143	G ==> C
	706	1	0.154	G ==> C
	710	1	0.105	A ==> C
	719	1	0.176	A ==> G
node_78 --> Seriana	311	1	0.286	A ==> T
	313	1	0.500	A --> T
	316	1	0.333	A ==> G

Branch	Character	Steps	CI	Change
	321	1	0.273	A ==> G
	330	1	0.118	T ==> C
	393	1	0.125	T ==> A
	476	1	0.300	T ==> A
	520	1	0.667	T ==> A
	527	1	0.500	A ==> T
	542	1	0.667	A ==> T
	545	1	0.167	C --> T
	546	1	0.111	C ==> T
	572	1	0.091	T ==> C
	637	1	0.091	A ==> G
	648	1	0.062	A --> C
	662	1	0.118	C ==> G
	672	1	0.100	A --> C
	676	1	1.000	C ==> G
node_79 --> Singapora	18	1	0.250	A --> G
	24	1	0.154	C ==> G
	30	1	0.125	A ==> G
	54	1	0.125	T ==> C
	75	1	0.250	C ==> T
	153	1	0.100	G ==> A
	177	1	0.143	A --> T
	186	1	0.300	C ==> G
	252	1	0.143	A ==> G
	264	1	0.667	C ==> A
	273	1	0.167	C ==> T
	276	1	0.167	A ==> G
	313	1	0.500	A --> C
	317	1	0.286	T ==> A
	371	1	0.125	A ==> G
	420	1	0.182	T ==> A
	436	1	0.182	A ==> T
	438	1	0.200	A ==> T
	440	1	0.143	A ==> C
	481	1	0.333	A --> G
	501	1	0.333	A ==> T
	514	1	0.400	C ==> A
	531	1	0.167	T ==> A
	548	1	0.333	C ==> T
	552	1	0.200	T ==> C
	565	1	0.231	A ==> C
	644	1	0.300	T ==> C
	645	1	0.273	T ==> A
	677	1	0.143	C ==> G
	705	1	0.111	A ==> C
	709	1	0.222	C ==> A
	717	1	0.143	C ==> A
	719	1	0.176	A ==> C
node_82 --> node_81	27	1	0.333	C --> G
	168	1	0.273	T ==> A
	330	1	0.118	T --> C
	331	1	0.118	T --> C
	366	1	0.667	A --> G
	370	1	0.333	A --> T
	382	1	0.214	C --> G
	386	1	0.400	T --> C
	393	1	0.125	T --> A
	504	1	0.214	A ==> T
	695	1	0.182	C --> G
	697	1	0.182	A --> C
	704	1	0.154	A ==> C
node_81 --> node_80	21	1	0.400	G ==> C
	27	1	0.333	G --> T
	153	1	0.100	G ==> A
	174	1	0.500	C --> G
	243	1	0.143	A ==> G
	429	1	0.500	A ==> T
	430	1	0.273	A --> T
	438	1	0.200	A --> C
	443	1	0.143	A ==> T
	546	1	0.111	C ==> T
	572	1	0.091	T ==> C
	679	1	0.118	C --> A
	711	1	0.154	C ==> A
node_80 --> Anufrieva	9	1	0.300	C ==> G
	15	1	0.100	A ==> G
	18	1	0.250	A --> G
	45	1	0.167	C ==> T
	66	1	0.273	G ==> C
	171	1	0.273	C ==> T
	210	1	0.500	T ==> A
	225	1	1.000	C ==> A
	286	1	0.125	C ==> T
	423	1	0.333	T ==> A
	437	1	0.300	A ==> T
	438	1	0.200	C --> T
	439	1	0.133	A ==> T
	455	1	0.250	A ==> T
	456	1	0.333	A ==> G
	476	1	0.300	T ==> C
	511	1	0.176	T ==> C
	534	1	0.429	A ==> G
	657	1	0.125	C --> A
	677	1	0.143	C ==> G
	679	1	0.118	A --> G
	703	1	0.083	A ==> C
	706	1	0.154	A --> G
	710	1	0.105	A ==> G
node_80 --> Arboridia	96	1	0.200	C ==> A
	142	1	0.100	C ==> T
	174	1	0.500	G --> T
	177	1	0.143	C ==> T
	189	1	0.400	G ==> A
	204	1	0.167	C ==> T
	216	1	1.000	G ==> A
	237	1	0.167	C ==> G
	279	1	0.500	C ==> T
	408	1	0.667	A ==> G
	419	1	0.429	A ==> T
	425	1	0.333	T ==> C
	426	1	0.167	C ==> T
	431	1	0.118	A ==> T
	451	1	0.222	A ==> C
	482	1	0.500	T ==> C
	509	1	0.273	T ==> A
	526	1	0.250	A ==> T
	648	1	0.062	C --> A
	652	1	0.250	A ==> C
	672	1	0.100	G ==> C
	686	1	0.188	A ==> C
	699	1	0.077	A ==> C
node_81 --> Coleana	9	1	0.300	C ==> T
	72	1	0.182	G ==> A
	99	1	0.333	C ==> G
	159	1	0.375	C ==> T
	192	1	0.125	C ==> T
	234	1	0.188	T ==> A
	294	1	0.273	T ==> C
	419	1	0.429	A ==> G
	420	1	0.182	T ==> A
	424	1	0.333	A ==> T
	440	1	0.143	A ==> T
	502	1	0.214	T ==> A
	506	1	0.176	T ==> A
	509	1	0.273	T ==> G

Branch	Character	Steps	CI	Change
	526	1	0.250	A ==> C
	551	1	0.429	T ==> G
	610	1	0.100	T ==> C
	677	1	0.143	C ==> A
	680	1	0.111	G ==> A
	690	1	0.111	A --> C
	713	1	0.083	A ==> C
	719	1	0.176	A ==> C
node_84 --> Alnetoidia	63	1	0.154	A ==> C
	102	1	0.188	T ==> C
	105	1	0.143	C --> T
	150	1	0.500	C ==> A
	168	1	0.273	T ==> A
	195	1	0.250	C ==> T
	219	1	0.167	C ==> T
	237	1	0.167	C ==> T
	246	1	0.500	C ==> G
	255	1	0.250	C ==> T
	270	1	0.214	C ==> T
	286	1	0.125	C ==> T
	330	1	0.118	T ==> A
	427	1	0.222	T --> A
	430	1	0.273	A ==> T
	431	1	0.118	A ==> T
	443	1	0.143	A ==> T
	461	1	0.182	A ==> T
	502	1	0.214	T --> G
	524	1	0.273	A ==> T
	648	1	0.062	C --> A
	662	1	0.118	A ==> G
	667	1	0.300	A ==> C
	703	1	0.083	A ==> C
	707	1	0.100	A ==> C
	719	1	0.176	A ==> G
node_85 --> Ivorycoasta	19	1	0.100	C ==> T
	48	1	0.176	G ==> T
	141	1	0.200	T --> C
	159	1	0.375	C ==> A
	192	1	0.125	C ==> T
	205	1	0.250	C ==> T
	228	1	0.333	C ==> G
	273	1	0.167	C ==> T
	276	1	0.167	A ==> G
	318	1	0.182	T --> A

Branch	Character	Steps	CI	Change
	408	1	0.667	A ==> T
	428	1	0.214	A ==> T
	439	1	0.133	A ==> T
	441	1	0.182	A ==> G
	482	1	0.500	T ==> A
	502	1	0.214	T --> A
	503	1	0.222	A ==> T
	506	1	0.176	T ==> A
	511	1	0.176	A --> C
	544	1	0.143	T ==> C
	546	1	0.111	C ==> T
	644	1	0.300	T ==> A
	653	1	0.143	A ==> C
	679	1	0.118	C ==> A
	680	1	0.111	G ==> C
	688	1	0.167	A ==> G
	690	1	0.111	C ==> A
	693	1	0.167	C ==> A
	708	1	0.143	A ==> C
	715	1	0.143	C --> A
	644	1	0.300	T ==> A
	653	1	0.143	A ==> C
	679	1	0.118	C ==> A
	680	1	0.111	G ==> C
	688	1	0.167	A ==> G
	690	1	0.111	C ==> A
	693	1	0.167	C ==> A
	708	1	0.143	A ==> C
	715	1	0.143	C --> A
node_88 --> node_87	27	1	0.333	C ==> G
	51	1	0.273	G ==> C
	66	1	0.273	G ==> C
	72	1	0.182	A ==> G
	141	1	0.200	T --> G
	142	1	0.100	C ==> T
	186	1	0.300	C ==> T
	333	1	0.100	T ==> A
	366	1	0.667	A ==> T
	386	1	0.400	T ==> A
	387	1	0.286	T ==> C
	426	1	0.167	T ==> A
	440	1	0.143	A --> C
	460	1	0.143	A ==> T
	462	1	0.143	C ==> A

Branch	Character	Steps	CI	Change
	508	1	0.167	A --> C
	526	1	0.250	A --> C
	538	1	0.200	A ==> G
	539	1	0.250	T ==> A
	570	1	0.250	C ==> A
	579	1	0.143	A ==> G
	624	1	0.167	C ==> T
	644	1	0.300	T ==> C
	647	1	0.333	A ==> C
	679	1	0.118	C ==> G
	704	1	0.154	A ==> C
node_87 --> Dikrella sp5	18	1	0.250	G ==> C
	28	1	1.000	A ==> C
	37	1	0.333	A ==> C
	60	1	0.133	C ==> T
	147	1	0.500	C ==> A
	153	1	0.100	G ==> A
	228	1	0.333	C ==> G
	365	1	0.400	A ==> G
	430	1	0.273	T ==> C
	481	1	0.333	A ==> G
	526	1	0.250	C --> T
	544	1	0.143	T ==> C
	645	1	0.273	T ==> A
	648	1	0.062	A --> C
	656	1	0.154	C ==> A
	672	1	0.100	A ==> G
	708	1	0.143	A ==> C
	710	1	0.105	A ==> G
node_87 --> Dikrella sp7	15	1	0.100	A ==> G
	36	1	0.167	G ==> T
	63	1	0.154	A ==> T
	96	1	0.200	G --> A
	132	1	0.167	C ==> T
	150	1	0.500	C ==> T
	156	1	0.667	G ==> T
	237	1	0.167	C ==> G
	285	1	0.500	C ==> T
	321	1	0.273	A ==> G
	325	1	0.167	C ==> T
	371	1	0.125	A ==> G
	431	1	0.118	A ==> T
	433	1	0.222	A ==> T
	440	1	0.143	C --> T

Branch	Character	Steps	CI	Change
	508	1	0.167	C --> T
	651	1	0.200	A ==> C
	653	1	0.143	A ==> C
	661	1	0.167	A --> C
	664	1	0.167	C ==> A
	680	1	0.111	G ==> C
	686	1	0.188	A --> C
	694	1	0.143	C ==> G
	699	1	0.077	C ==> A
	703	1	0.083	A ==> C
	715	1	0.143	C --> A
node_91 --> node_90	6	1	0.250	T --> C
	9	1	0.300	C ==> G
	24	1	0.154	C --> G
	33	1	0.250	G ==> C
	63	1	0.154	A ==> C
	72	1	0.182	A --> C
	93	1	0.375	C --> A
	96	1	0.200	A ==> C
	142	1	0.100	C ==> T
	234	1	0.188	C --> A
	252	1	0.143	G ==> A
	442	1	0.231	A ==> T
	502	1	0.214	A ==> T
	503	1	0.222	A --> G
	541	1	0.250	A ==> T
	544	1	0.143	T ==> A
	679	1	0.118	C ==> G
	695	1	0.182	G --> C
	706	1	0.154	C --> A
	709	1	0.222	A ==> C
	719	1	0.176	A --> G
node_90 --> Alconeura	30	1	0.125	G ==> A
	72	1	0.182	C --> G
	90	1	0.375	C ==> G
	93	1	0.375	A --> T
	103	1	0.500	C ==> T
	117	1	0.167	G ==> A
	123	1	0.500	C ==> T
	219	1	0.167	C ==> T
	267	1	0.231	T --> A
	318	1	0.182	A ==> T
	324	1	0.500	C ==> T
	325	1	0.167	C ==> T
	326	1	0.133	T ==> A

Branch	Character	Steps	CI	Change
	327	1	0.375	T ==> A
	331	1	0.118	A --> T
	365	1	0.400	A ==> G
	387	1	0.286	T ==> C
	431	1	0.118	A --> T
	438	1	0.200	T --> G
	470	1	0.250	A ==> G
	491	1	0.200	T ==> C
	506	1	0.176	T ==> A
	509	1	0.273	A ==> T
	534	1	0.429	A ==> G
	538	1	0.200	A ==> G
	539	1	0.250	T ==> A
	543	1	0.667	T ==> A
	546	1	0.111	C ==> T
	554	1	0.182	T ==> A
	557	1	0.333	A ==> G
	565	1	0.231	T --> G
	579	1	0.143	A ==> G
	588	1	0.143	T ==> G
	613	1	0.286	A ==> T
	634	1	0.333	T ==> A
	635	1	0.250	T --> C
	657	1	0.125	C ==> A
	661	1	0.167	A --> C
	664	1	0.167	C ==> A
	665	1	0.143	G ==> A
	666	1	0.250	A ==> C
	672	1	0.100	A ==> C
	680	1	0.111	G ==> C
	681	1	0.125	A ==> C
	713	1	0.083	A ==> C
	715	1	0.143	C --> A
	716	1	0.083	C --> A
	719	1	0.176	G --> T
node_90 --> Parallaxis	24	1	0.154	G --> T
	60	1	0.133	A ==> T
	105	1	0.143	G ==> C
	159	1	0.375	C ==> G
	168	1	0.273	G --> T
	171	1	0.273	C --> G
	174	1	0.500	C ==> A
	186	1	0.300	C ==> G
	228	1	0.333	C ==> G
	234	1	0.188	A --> T

Branch	Character	Steps	CI	Change
	237	1	0.167	C --> G
	286	1	0.125	C ==> T
	294	1	0.273	C ==> T
	321	1	0.273	A ==> G
	323	1	0.143	C ==> T
	329	1	0.154	T ==> G
	330	1	0.118	A ==> T
	333	1	0.100	T ==> A
	336	1	0.200	C ==> T
	361	1	0.333	C ==> A
	362	1	1.000	T ==> C
	382	1	0.214	C ==> G
	390	1	1.000	A ==> G
	420	1	0.182	A ==> C
	421	1	1.000	C ==> T
	436	1	0.182	A ==> T
	437	1	0.300	A ==> T
	439	1	0.133	A ==> T
	457	1	0.200	T ==> A
	460	1	0.143	A ==> T
	462	1	0.143	T ==> A
	499	1	0.400	A ==> T
	503	1	0.222	G --> T
	563	1	0.100	A ==> T
	571	1	0.125	C ==> T
	624	1	0.167	C ==> T
	628	1	1.000	T ==> G
	637	1	0.091	G ==> A
	673	1	0.500	A ==> C
	688	1	0.167	A ==> C
	698	1	0.182	G ==> C
	705	1	0.111	A ==> C
	706	1	0.154	A --> G
	707	1	0.100	A ==> C
	710	1	0.105	A ==> C
	712	1	0.143	A ==> C
	717	1	0.143	A ==> C
node_92 --> Alconeura sp1	30	1	0.125	G ==> A
	66	1	0.273	G ==> C
	154	1	0.200	C ==> T
	165	1	0.200	G ==> A
	222	1	0.222	C ==> T
	255	1	0.250	C ==> T
	261	1	0.111	G ==> C
	276	1	0.167	A ==> G

Branch	Character	Steps	CI	Change	Branch	Character	Steps	CI	Change	Branch	Character	Steps	CI	Change
	327	1	0.375	T ==> G										
	334	1	0.167	A ==> T										
	419	1	0.429	A ==> T										
	439	1	0.133	A ==> T										
	501	1	0.333	A ==> G										
	507	1	0.400	A ==> G										
	526	1	0.250	A ==> T										
	540	1	0.222	A ==> T										
	557	1	0.333	A ==> T										
	576	1	0.667	T ==> C										
	634	1	0.333	T ==> G										
	650	1	0.091	C ==> A										
	662	1	0.118	A ==> G										
	672	1	0.100	A ==> C										
	681	1	0.125	A ==> C										
	683	1	0.200	A ==> C										
	684	1	0.222	C --> A										
	694	1	0.143	C --> G										
	701	1	0.400	A ==> G										
	702	1	0.200	A ==> C										
	710	1	0.105	A ==> C										

APPENDIX III

DATA MATRIX FOR CONCATENATED DATASET (H3 (1-305)+16S (306-646)+MORPHOLOGY)

	1 10 20 30 40 50 60
Amahuaka	AAGGCTCCCAGGAAGCAACTGGCTACCAAGGCGGCCAGGAAAAGCGCGCCCGCCACCGGC
Ujna	AAGGCACCGAGAAAGCAATTGGCCACCAAGGCGGCCAGGAAGAGCGCTCCAGCCACCGGT
Orientalebra	AAAGCGCCCAGGAAACAGCTTGCCACCAAGGCGGCAAGGAAGAGTGCTCCTGCCACAGGA
Alebra aurea	AAGGCTCCCAGGAAGCAGTTGGCTACCAAGGCAGCGAGGAAGAGCGCACCGGCTACCGGA
Protalebrella	AAGGCGCCCAGGAAGCAGCTGGCTACCAAGGCGGCGAGAAAGAGCGCTCCCGCTACTGGC
Elabra	AAGGCGCCCAGGAAACAGTTGGCCACGAAAGCGGCCCGGAAGAGCGCGCCGGCCACCGGC
Habralebra	AAGGCGCCCAGGAAGCAGCTGGCCACCAAAGCCGCCAGGAAGAGCGCGCCCGCCACCGGA
black Empoasini	AAGGCGCCCAGGAAGCAGTTGGCCACCAAAGCGGCGAGGAAGAGCGCACCGGCCACCGGA
Taiwan Empoasca	AAGGCGCCCAGGAAGCAGTTGGCCACTAAAGCGGCGAGAAAGAGCGCTCCGGCCACCGGT
Unitra	AAGGCCCCAAGAAAGCAGCTGGCCACCAAGGCGGCTAGGAAGAGCGCGCCGGCCACCGGC
Madag. Empoasca	AAGGCGCCAAGAAAACAGCTGGCTACCAAAGCGGCAAGGAAGAGTGCACCCGCTACCGGC
Empoasca fabae	AAGGCCCCGCGAAAACAGTTGGCCACCAAGGCGGCCAGGAAGAGCGCTCCGGCCACCGGA
Joruma sp19	AAGGCGCCCAGGAAGCAGCTGGCTACCAAGGCGGCGAGGAAGAGCGCTCCCGCTACTGGC
Columbonirvana	AAGGCGCCCAGGAAGCAGCTGGCTACCAAGGCGGCGAGGAAGAGCGCTCCCGCTACTGGC
Euhardina	AAAGCTCCCCGCAAACAATTGGCCACCAAAGCGGCTAGTAAAAGTGCACCTGCTACCGGA
Hiratettix	AAGGCGCCACGCAAACAGTTGGCTACCAAGGCGGCGAGGAAGAGCGCCCCGGCCACCGGA
Agnesiella	AAGGCGCCCAGCAAACAGTTGGC?ACCAAGGCCGCCAGGAAGAGCGCACCGGCCACCGG?
Limassola	AAGGCGCCCCGCAAACAGCTGGCTACCAAGGCGGCGAGGAAGAGCGCACCGGCCACCGGC
Kunzeana	AAGGCTCCCAGGAAACAGCTGGCGACCAAGGCGGCTAGGAAGAGCGCACCGGCTACAGGA
Kidrella	??
Igutettix	??
Dikrella sp1	AAGGCGCCCAGGAAACAACTGGCCACCAAGGCGGCGAGGAAGAGCGCACCGGCCACCGGT
Alconeura sp1	AAGGCTCCCAGGAAGCAGCTGGCCACCAAAGCGGCGAGGAAGAGCGCACCGGCCACCGGA
Alconeura	AAGGCCCCGAGGAAGCAGCTGGCGACCAAAGCCGCCAGGAAGAGCGCACCGGCCACCGGA
Alconeura sp2	AAGGCGCCCAGGAAGCAGCTTGCCACCAAGGCTGCTAGGAAGAGCGCACCCGCCACCGGC
Alconeura sp3	AAAGCTCCGAGGAAACAGCTGGCCACTAAGGCTGCTCGTAAGAGCGCCCCTGCCACCGGC
Dikrella sp3	???????????????????????????AAGGCGGCTAGGAAGAGCGCACCGGCCACCGGC
Dikrella sp4	AAGGCGCCCAGGAAGCAGCTGGCCACCAAGGCAGCTAGGAAGAGCGCACCGGCCACTGGC
Dikrella sp5	AAGGCGCCCAGGAAACACCTGGCCACGCAGGCGGCGCGAAAGAGCGCGCCCGCCACCGGT
Dikrella sp6	AAGGCCCCCAGGAAACAGTTGGCGACGAAGGCCGCGAGGAAGAGCGCGCCGGCCACCGGC
Dikrella sp7	AAGGCGCCCAGGAAGCAGCTGGCCACGAAGGCGGCTAGAAAGAGCGCGCCCGCCACCGGC
Dikrella sp8	AAAGCTCCGAGGAAACAGTTGGCCACAAAGGCCGCCAGGAAGAGCGCACCGGCCACCGGT
Dikrella sp9	AAGGCACCGAGGAAGCAGCTCGCTACCAAGGCGGCCAGGAAGAGCGCACCGGCCACCGGC
Idona	AAGGCGCCCAGGAAACAGTTGGCCACCAAGGCGGCGAGAAAGAGCGCTCCGGCCACCGGC
Dikrellidia	AAGGCGCCCAGGAAACAGCTGGCCACCAAGGCGGCAAGGAAGAGTGCACCGGCCACCGGA
Parallaxis	AAGGC-CCGAGGAAGCAGCTGGCTACCAAGGCCGCCAGGAAGAGCGCACCGGCCACCGGT
Eythroneura lawsoni	AAAGCGG--AGGAAA-AGCTCGCCACGAAAGCCGCCAGGAAGAGTGCACCGGCTACCGGA
Erythroneura illinoisensis	AAGGCGCCGAGGAAACAGCTCGCCACCAAAGCCGCCAGGAAGAGTGCGCCGGCTACCGGA
Erythroneura tricincta	??
Alnetoidia	AAGGCGCCCAGGAAACAACTGGCCACCAAAGCGGCGAGAAAGAGCGCGCCGGCTACCGGA
Salka	???????????????CAATTGGCCACCAAAGCTGCTAGGAAGAGCGCGCCGGCTACCGGA
Anufrieva	AAGGCGCCGAGGAAGCAGCTCGCCACTAAAGCCGCCAGGAAGAGTGCACCGGCTACCGGA
Arboridia	AAGGCGCCCAGGAAACAACTCGCCACTAAAGCCGCCAGGAAGAGCGCACCGGCTACCGGA
Coleana	AAGGCGCCTAGGAAACAACTGGCCACGAAAGCCGCCAGGAAGAGCGCACCGGCTACCGGA
Singapora	AAGGCTCCCAGGAAACAGCTGGCGACCAAGGCAGCTAGGAAGAGCGCACCGGCCACCGGA
Ivorycoasta	AAGGCGCCCAGGAAACAGTTGGCCACCAAGGCGGCGAGAAAGAGCGCTCCGGCCACCGGC
Seriana	??
Ntanga	AAGGCGCCGAGGAAACAGCTCGCCACCAAAGCCGCAAGGAAGAGTGCACCGGCTACCGGA

	61 70 80 90 100 110 120
Amahuaka	GGAGTGAAGAAACCCCACCGTTACAGGCCCGGGACGGTCGCCCTCCGTGAGATCAGGCGT
Ujna	GGAGTGAAGAAACCTCACCGTTACAGGCCCGGCACAGTCGCCCTCCGTGAGATCAGACGT
Orientalebra	GGTGTCAAGAAGCCTCACCGTTATAGGCCCGGAACCGT?GCCCTTCGTGAGATCAGGCGT
Alebra aurea	GGCGTTAAGAAACCCCATCGCTACAGGCCTGGCACAGTCGCCCTGCGTGAGATCAGGCGT
Protalebrella	GGAGTGAAGAAACCTCACCGCTACAGGCCTGGCACAGTCGCCCTTCGTGAGATCAGGCGT
Elabra	GGAGTGAAGAAACCTCACCGCTACAGGCCCGGCACGGTCGCCCTGCGTGAGATCAGGCGT
Habralebra	GGAGTGAAGAAACCTCACCGCTACAGGCCCGGCACAGTCGCCCTGCGTGAGATCAGGCGT
black Empoasini	GGAGTGAAGAAACCTCACCGTTACAGGCCCGGCACAGTGGCGCTTCGTGAGATCAGACGT
Taiwan Empoasca	GGAGTGAAGAAACCTCACCGTTACAGGCCCGGCACAGTGGCACTTCGCGAGATCAGGCGT
Unitra	GGAGTGAAGAAACCTCACCGCTACAGGCCCGGCACCGTCGCACTCCGTGAGATCAGGCGT
Madag. Empoasca	GGAGTCAAGAAGCCTCACCGTTACAGGCCCGGCAC?GTCGCTTTGCGAGAGATCAGGCGT
Empoasca fabae	GGAGTGAAGAAGCCTCACCGTTACAGGCCCGGCACAGTCGCACTCCGTGAGATCAGGCGT
Joruma sp19	GGAGTGAAGAAACCTCACCGCTACAGGCCTGGCACAGTCGCCCTTCGTGAGATCAGGCGT
Columbonirvana	GGAGTGAAGAAACCTCACCGCTACAGGCCCGGCACAGTCGCCCTTCGTGAGATCAGGCGT
Euhardina	GGTGTCAAGAAACCTCA?CGTTACAGGCCCGGCACTGTGGCTCTGCGTGAAATC?GKCGT
Hiratettix	GGCGTCAAGAAGCCTCACCGTTACAGGCCCGGCACGGTCGCTCTGCGTGAGATCAGACGT
Agnesiella	GG?GTCAAGAA?CCTCACCGTTACAGGCCCGGCACGGTCGCCCTGCGTGAGATCAGGCGT
Limassola	GGCGTGAAGAAGCCTCACCGTTACAGGCCAGGCACCGTTGCTCTTCGTGAGATCAGGCGT
Kunzeana	GGCGTGAAGAAACCTCACCGCTACAGGCCCGGCACAGTCGCTCTCCGTGAAATCAGGCGT
Kidrella	??
Igutettix	??
Dikrella sp1	GGCGTAAAGAAACCTCACCGTTACAGGCCTGGCACAGTCGCTCTGCGTGAGATCAGGCGT
Alconeura sp1	GGAGTCAAGAAACCTCACCGTTACAGGCCCGGCACAGTCGCCCTGCGTGAGATCAGGCGT
Alconeura	GGCGTGAAGAAGCCTCACCGTTACAGGCCGGGTACCGTCGCGTTGCGTGAGATCAGACGT
Alconeura sp2	GGAGTGAAGAAACCTCACCGTTACAGGCCCGGTACGGTCGCTCTGCGTGAGATCAGGCGT
Alconeura sp3	GGTGTCAAGAAACCTCATCGTTACAGGCCCGGCACAGTCGCCCTGCGTGAGATCCGGCGT
Dikrella sp3	GGAGTGAAGAAACCTCACCGTTACAGGCCCGGCACGGTGGCCCTCCGTGAGATCAGGCGT
Dikrella sp4	GGAGTAAAGAAACCTCACCGTTACAGGCCCGGCACGGTCGCTCTGCGTGAGATCAGACGT
Dikrella sp5	GGAGTCAAGAAGCCTCACCGTTACAGGCCCGGCACGGTCGCTCTGCGTGAGATCAGGCGT
Dikrella sp6	GGCGTGAAGAAGCCGCATCGTTACAGGCCCGGCACGGTCGCCCTCCGCGAGATCAGGCGT
Dikrella sp7	GGTGTCAAGAAGCCTCACCGTTACAGGCCCGGCACAGTCGCTCTGCGTGAGATCAGGCGT
Dikrella sp8	GGCGTTAAGAAACCCCATCGTTACAGGCCGGGAACCGTCGCGCTCCGTGAGATCAGGCGT
Dikrella sp9	GGTGTTAAGAAACCCCATCGTTACAGGCCCGGCACCGTCGCTCTCCGTGAGATCAGGCGT
Idona	GGAGTGAAGAAACCTCACCGTTACAGGCCCGGCACGGTCGCTCTGCGTGAGATCAGGCGT
Dikrellidia	GGAGTGAAGAAACCTCACCGTTACAGGCCCGGCACAGTCGCCCTCCGTGAGATCAGGCGT
Parallaxis	GGCGTGAAGAACCCTCACCGTTACAGGCCCGGAACCGTCGCGCTCCGTGAGATCAGGCGT
Eythroneura lawsoni	GGAGTGAAGAAACCTCACCGTTACAGGCCTGGAACAGTCGCTCTCCGTGAGATCAGGCGT
Erythroneura illinoisensis	GGAGTGAAGAAGCCCCACCGTTACAGGCCCGGAACAGTCGCTCTCCGTGAGATCAGACGT
Erythroneura tricincta	??
Alnetoidia	GGCGTGAAGAAGCCTCACCGTTACAGGCCCGGCACCGTCGCCCTTCGTGAGATCAGGCGT
Salka	GGAGTGAAGAAGCCCCACCGTTACAGGCCCGGGACCGTGGCCCTCCGAGAGATCAGGCGT
Anufrieva	GGAGTCAAGAAGCCCCACCGTTACAGGCCCGGGACCGTCGCTCTCCGTGAGATCAGGCGT
Arboridia	GGAGTGAAGAAGCCCCACCGTTACAGGCCCGGGACAGTCGCTCTCCGTGAGATCAGGCGT
Coleana	GGAGTGAAGAAACCCCACCGTTACAGGCCCGGGACCGTGGCTCTCCGTGAGATCAGGCGT
Singapora	GGAGTGAAGAAGCCTCACCGTTACAGGCCCGGGACCGTCGCCCTCCGAGAGATCAGGCGT
Ivorycoasta	GGAGTGAAGAAACCTCACCGTTACAGGCCCGGCACGGTCGCTCTGCGTGAGATCAGGCGT
Seriana	??
Ntanga	GGAGTGAAGAAGCCCCACCGTTACAGGCCCGGAACAGTCGCTCTCCGTGAGATCAGGCGT

	121 130 140 150 160 170 180
Amahuaka	TACCAGAAGAGCACCGAGCTTCTGATCCGCAAACTGCCCTTCCAACGTCTCGTCCGCGAG
Ujna	TACCAGAAGAGTACCGAGCTTCTCATCCGCAAACTGCCCTTCCAGCGTCTCGTCCGTGAG
Orientalebra	TACCAGAAGAGCACCGAGCTCCTGATCCGCAAGCTGCCCTTCCAGCGACTTGTCCGTGAA
Alebra aurea	TACCAGAAGAGTACAGAGCTGCTGATCCGCAAGCTTCCGTTCCAGCGTCTGGTCCGTGAG
Protalebrella	TATCAGAAGAGCACCGAACTGTTGATCCGCAAGTTGCCCTTCCAGCGTCTAGTCCGTGAG
Elabra	TACCAGAAGAGCACCGAGCTTCTGATCCGCAAGCTGCCCTTCCAGCGTCTCGTCCGCGAG
Habralebra	TACCAGAAGAGCACCGAGCTGCTGATCCGCAAGCTGCCCTTCCAGCGACTCGTCCGCGAG
black Empoasini	TACCAGAAGAGCACCGAGCTGTTGATCCGCAAGCTGCCCTTCCAGCGGTTGGTGCGCGAG
Taiwan Empoasca	TACCAGAAGAGCACCGAGCTGTTGATCCGAAAGCTGCCTTTCCAGCGGTTGGTGCGCGAG
Unitra	TACCAGAAGAGCACCGAGCTGTTGATCCGCAAACTGCCGTTCCAGCGTCTGGTACGAGAA
Madag. Empoasca	TACCAGAAAAGCACCGAGCTGTTGATACGCAAATTGCCCTTCCAGCGTCTGGTCCGCGAG
Empoasca fabae	TACCAGAAGAGCACCGAACTGTTGATCCGCAAGCTGCCCTTCCAGCGTTTGGTCCGTGAG
Joruma sp19	TA?CAGAAGAGCACCGAACTGTTGATCCGCAAGTTGCCCTTCCAGCGTCTAGTCCGTGAG
Columbonirvana	TACCAGAAGAGCACCGAACTGTTGATCCGCAAGTTGCCCTTCCAGCGTCTAGTCCGTGAG
Euhardina	TACCAAAAGAGCACCGAGCTGTTGATCCGCAAATTGCCCTTCCAACGTCTGGTGCGTGAG
Hiratettix	TACCAGAAGAGCACCGAACTGTTGATCCGCAAGCTGCCCTTCCAGCGTCTGGTGCGCGAG
Agnesiella	TACCAGAAGAGCACCGAGCTGTTGATCCGCAAGCTGCCCTTCCAGCGTCTGGTGCGCGAG
Limassola	TACCAGAAGAGTACCGAACTGTTGATCCGCAAACTGCCCTTCCAGCGTCTCGTCCGCGAG
Kunzeana	TACCAGAAGAGCACCGAGCTTCTGATCCGCAAGCTGCCCTTCCAGCGGTTGGTCCGTGAG
Kidrella	??
Igutettix	??
Dikrella sp1	TACCAGAAGAGTACCGAGCTTTTCATCCGCAAGCTGCCCTTCCAGCGTCTGGTCCGTGAG
Alconeura sp1	TACCAGAAGAGCACCGAGCTGCTGATCCGCAAGTTGCCCTTCCAACGGCTGGTCCGTGAG
Alconeura	TATCAGAAGAGCACCGAGCTGTTGATCCGCAAGCTGCCCTTCCAGCGGCTCGTCCGTGAG
Alconeura sp2	TACCAGAAAAGCACTGAGCTGTTGATCCGCAAGCTGCCCTTCCAGCGTCTCGTCCGTGAG
Alconeura sp3	TACCAGAAGAGTACCGAACTGTTGATCCGCAAGCTGCCGTTCCAGCGCCTCGTCCGTGAG
Dikrella sp3	TACCAGAAGAGCACCGAGCTGCTGATCCGCAAGCTGCCCTTCCAGCGTCTCGTCCGTGAG
Dikrella sp4	TACCAGAAGAGCACAGAGCTGCTGATCCGCAAGCTGCCCTTCCAGCGTCTCGTCCGTGAG
Dikrella sp5	TACCAGAAGAGCACCGAGCTGTTGATACGCAAACTGCCCTTCCAGCGACTCGTCCGCGAG
Dikrella sp6	TACCAGAAAAGCACCGAGCTCTTGATCCGCAAGCTGCCCTTCCAGCGTCTCGTCCGCGAG
Dikrella sp7	TACCAGAAGAGTACCGAGCTGTTGATCCGTAAGCTTCCCTTCCAGCGACTCGTCCGCGAG
Dikrella sp8	TACCAGAAGAGCACCGAACTGTTGATCCGTAAA?TACCGTTCCAACGGCTCGTCCGTGAG
Dikrella sp9	TACCAGAAGAGCACCGAGCTGTTGATCCGCAAGCTGCCGTTCCAACGGCTCGTCCGCGAG
Idona	TACCAGAAGAGCACCGAGCTCCTGATCCGCAAGCTGCCATTCCAGCGTCTCGTCCGCGAG
Dikrellidia	TACCAGAAGAGCACCGAGCTTCTGATCCGCAAACTGCCCTTCCAGCGTCTCGTCCGCGAG
Parallaxis	TACCAGAAGAGCACCGAGCTGTTGATCCGCAAGCTGCCGTTCCAGCGTCTGGTACGTGAG
Eythroneura lawsoni	TACCAAAAGAGCACCGAGCTTCTGATCCGCAAGCTGCCCTTCCAGCGTCTCGTCCGCGAG
Erythroneura illinoisensis	TACCAAAAGAGCACCGAGCTTCTGATCCGCAAGCTGCCCTTCCAGCGTCTCGTCCGCGAG
Erythroneura tricincta	??
Alnetoidia	TACCAGAAGAGCACCGAGCTTCTGATCCGAAAGCTGCCCTTCCAGCGACTCGTCCGCGAG
Salka	TACCAGAAGAGCACCGAGCTGTTGATCCGCAAGCTGCCCTTCCAGCG?CTYGTCCGAGAG
Anufrieva	TACCAGAAGAGCACCGAGCTTCTGATCCGCAAACTGCCCTTCCAGCGACTTGTGCGCGAG
Arboridia	TACCAGAAGAGCACCGAGCTTTTGATCCGCAAACTGCCCTTCCAGCGACTCGTTCGTGAG
Coleana	TACCAGAAGAGCACCGAGCTTCTGATCCGCAAGCTGCCTTTCCAGCGACTCGTCCGCGAG
Singapora	TACCAGAAGAGCACCGAGCTTCTGATCCGCAAACTGCCCTTCCAGCGTCTCGTCCGTGAG
Ivorycoasta	TACCAGAAGAGCACCGAGCTCCTGATCCGCAAGCTGCCATTCCAGCGTCTCGTCCGCGAG
Seriana	??
Ntanga	TACCAGAAGAGCACCGAGCTTCTGATCCGCAAACTGCCCTTCCAGCGTCTCGTCCGCGAG

	181 190 200 210 220 230 240
Amahuaka	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTCATGGCGCTGCAG
Ujna	ATCGCCCAGGACTTTAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTCATGGCCTTGCAG
Orientalebra	ATCGCCCAGGACTTCAAGACCGATCTCCGTTTCCAGAGTTCCGCCGTCATGGCTCTGCAG
Alebra aurea	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCTGCCGTAATGGCCCTGCAG
Protalebrella	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCTGCCGTCATGGCCCTCCAG
Elabra	ATCGCCCAGGATTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTCATGGCACTGCAG
Habralebra	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTCATGGCGCTGCAG
black Empoasini	ATCGCCCAAGACTTCAAGACCGATCTGCGTTTCCAGAGCTCGGCCGTCATGGCCCTTCAG
Taiwan Empoasca	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCGGCCGTCATGGCCCTTCAG
Unitra	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGTTCCGCCGTTATGGCCTTGCAG
Madag. Empoasca	ATCGCCCAAGACTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTGATGGCACTGCAA
Empoasca fabae	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTCATGGCACTGCAG
Joruma sp19	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCTGCCGTCATGGCCCTCCAG
Columbonirvana	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCTGCCGTCATGGCCCTCCAG
Euhardina	ATCGCTCAAGATTTCAAAACCGATCTGCGTTTCCAGAGCTCCGCCGTCATGGC?CTTCAA
Hiratettix	ATCGCCCAGGACTTTAAGACCGACCTGCGTTTTCAGAGCTCCGCCGTCATGGCACTGCAG
Agnesiella	ATCGCCCAGGATTTCAAGACCGACCTGCGTTTCCAGAGCTCGGCCGTCATGGCCCTGCAG
Limassola	ATCGCTCAGGACTTCAAGACCGATCTGCGTTTCCAGAGCTCCGCCGTCATGGCCCTGCAG
Kunzeana	ATCGCTCAGGATTTCAAGACCGATCTGCGTTTCCAGAGCTCCGCCGTGATGGCTCTCCAA
Kidrella	??
Igutettix	??
Dikrella sp1	ATCGCCCATGATTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTCATGGCACTCCAG
Alconeura sp1	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCTGCCGTCATGGCCCTGCAG
Alconeura	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGTTCCGCCGTCATGGCACTCCAG
Alconeura sp2	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCTGCCGTCATGGCTCTCCAG
Alconeura sp3	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGTTCTGCCGTCATGGCTCTGCAG
Dikrella sp3	ATCGCCCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCTGCCGTCATGGCACTCCAG
Dikrella sp4	ATCGCTCAGGACTTCAAGACCGACCTGCGTTTCCAGAGTTCCGCCGTCATGGCTCTCCAG
Dikrella sp5	ATCGCTCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTGATGGCCCTCCAG
Dikrella sp6	ATCGCGCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTAATGGCCCTCCAG
Dikrella sp7	ATCGCTCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTCATGGCCCTGCAG
Dikrella sp8	ATCGCACAGGACTTCAAGACCGACCTGCGTTTCCAGAGTTCTGCCGTCATGGCTCTCCAG
Dikrella sp9	ATCGCTCAGGACTTCAAGACCGACCTGCGTTTCCAGAGTTCCGCCGTCATGGCCCTCCAG
Idona	ATCGCCCAGGATTTCAAGACCGACTTGCGTTTCCAGAGCTCCGCCGTGATGGCCCTCCAG
Dikrellidia	ATCGCCCAGGACTTCAAGACCGACTTGCGTTTCCAGAGTTCCGCCGTCATGGCCCTTCAG
Parallaxis	ATCGCGCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTGATGGCTCTGCAG
Eythroneura lawsoni	ATCGCCCAGGACTTCAAGACCGACTTGCGTTTCCAGAGCTCCGCCGTCATGGCTCTTCAG
Erythroneura illinoisensis	ATCGCCCAGGACTTCAAGACCGACTTGCGTTTCCAGAGCTCCGCCGTCATGGCTCTCCAG
Erythroneura tricincta	??
Alnetoidia	ATCGCCCAGGACTTTAAGACCGACCTGCGTTTCCAGAGTTCCGCCGTCATGGCCCTTCAG
Salka	ATCGCCCAGGACTTCAAGACCGACCTGCGATTCCAGAGCTCCGCCGTCATGGCCCTCCAG
Anufrieva	ATCGCCCAGGACTTCAAGACCGACCTGCGATTCCAGAGCTCCGCAGTCATGGCTCTCCAG
Arboridia	ATCGCCCAAGACTTCAAGACCGATCTGCGTTTCCAAAGCTCCGCCGTCATGGCTCTGCAG
Coleana	ATCGCCCAGGATTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTCATGGCACTCCAG
Singapora	ATCGCGCAGGACTTCAAGACCGACCTGCGTTTCCAGAGCTCCGCCGTCATGGCTCTCCAG
Ivorycoasta	ATCGCCCAGGATTTCAAGACCGACTTGCGTTTCCAGAGCTCCGCCGTGATGGCCCTCCAG
Seriana	??
Ntanga	ATCGCCCAGGACTTTAAGACCGACTTGCGTTTCCAGAGCTCTGCCGTCATGGCTCTTCAG

	241 250 260 270 280 290 300
Amahuaka	GAGGCGAGCGAGGCCTACCTGGTCGGACTTTTCGAAGACACCAACCTGTGCGCCATCCAC
Ujna	GAAGCGAGTGAGGCCTACTTGGTTGGACTCTTTGAAGACACCAACCTGTGCGCCATTCAC
Orientalebra	GAAGCCAGCGAGGCGTACTTGGTCGGGCTCTTCGAAGACACCAACCTGTGTGCAATCCAA
Alebra aurea	GAAGCCAGCGAGGCCTACCTCGTCGGTCTATTCGAAGACACCAACCTGTGCGCCATCCAC
Protalebrella	GAAGCCAGCGAAGCTTACCTCGTCGGGCTGTTTGAAGACACCAACCTGTGCGCCATCCAC
Elabra	GAGGCCAGCGAAGCCTACCTCGTCGGTCTCTTCGAAGACACCAACCTGTGCGCCATCCAC
Habralebra	GAGGCCAGCGAAGCCTACCTCGTCGGTCTCTTCGAAGACACCAACCTGTGCGCCATCCAC
black Empoasini	GAAGCCAGCGAAGCCTACCTGGTCGGACTTTTCGAAGATACCAACTTGTGCGCTATCCA?
Taiwan Empoasca	GAAGCCAGCGAAGCCTACCTGGTCGGCCTCTTCGAGGACACCAACCTGTGCGCTATCCAC
Unitra	GAGGCTAGCGAAGCGTACCTCGTCGGCCTTTTCGAAGACACCAATCTGTGCGCTATCCAC
Madag. Empoasca	GAAGCCAGTGAAGCCTACCTGGTCGGACTATTC???????????????????????????
Empoasca fabae	GAGGCCAGCGAAGCCTACTTGGTCGGACTCTTCGAGGACACCAACCTGTGCGCTATCCAC
Joruma sp19	GAAGCCAGCGAAGCTTACCTCGTCGGGCTGTTCGAAGACACCAACCTGTGCGCCATCCAC
Columbonirvana	GAAGCCAGCGAAGCTTACCTCGTCGGGCTGTTCGAAGACACCAACCTGTGCGCCATCCAC
Euhardina	GAAGCCAGCGAAGCCTACTTGGTCGGACTGTTCGAAGACACCAACTTGTGCGCCATTCAC
Hiratettix	GAAGCCAGCGAGGCCTACCTCGTCGGTCTCTTCGAAGACACCAACCTGTGCGCGATCCAC
Agnesiella	GAAGCCAGCGARGCCTACTTGGTCGGACTCTTCGAAGACACCAAC???????????????
Limassola	GAAGCCAGTGAGGCCTACCTCGTCGGACTCTTCGAAGACACCAACCTGTGCGCCATTCAC
Kunzeana	GAAGCCAGCGAGGCCTACCTGGTCGGACTTTTTGAAGACACCAACTTGTGCGCTATTCAC
Kidrella	??
Igutettix	??
Dikrella sp1	GAAGCCAGCGAGGCGTACCTCGTCGGTCTCTTCGAAGACACCAACCTGTGCGCTATCCAC
Alconeura sp1	GAAGCCAGCGAGGCTTACCTCGTCGGTCTCTTCGAGGACACCAACCTGTGCGCCATCCAC
Alconeura	GAAGCCAGCGAAGCCTACCTGGTCGGACTCTTCGAAGACACCAACCTGTGCGCCATCCAC
Alconeura sp2	GAAGCCAGCGAGGCCTACCTCGTCGGACTCTTCGAAGACACCAACCTGTGCGCCATCCAC
Alconeura sp3	GAAGCCAGCGAGGCCTACTTGGTCGGACTCTTCGAAGACACCAACCTCTGCGCCATCCAC
Dikrella sp3	GAAGCCAGCGAGGCCTACCTCGTCGGACTCTTCGAAGACACCAACCTGTGCGCCATCCAC
Dikrella sp4	GAAGCCAGCGAGGCCTACCTCGTCGGTCTCTTCGAAGACACCAACCTGTGCGCCATCCAC
Dikrella sp5	GAAGCCAGCGAGGCCTACCTCGTCGGTCTCTTCGAAGACACCAACCTGTGCGCCATCCAC
Dikrella sp6	GAAGCCAGCGAGGCCTACTTGGTCGGACTCTTCGAAGACACGAACCTGTGCGCCATCCAC
Dikrella sp7	GAAGCCAGCGAGGCCTACCTCGTCGGTCTCTTCGAAGACACCAATCTGTGCGCCATCCAC
Dikrella sp8	GAAGCGAGCGAGGCCTATCTGGTAGGACTGTTCGAAGACACCAACCTGTGCGCCATCCAC
Dikrella sp9	GAAGCCAGCGAGGCCTACTTGGTCGGACTGTTCGAAGACACCAACTTGTGCGCAATCCAC
Idona	GAAGCCAGCGAGGCCTACCTCGTCGGTCTCTTTGAGGACACCAACCTGTGCGCCATCCAC
Dikrellidia	GAGGCCAGCGAGGCCTACTTGGTCGGACTTTTCGAAGACACCAAC???????????????
Parallaxis	GAAGCCAGCGAAGCCTACCTGGTCGGTCTCTTCGAAGACACCAACTTGTGCGCTATCCAC
Eythroneura lawsoni	GAGGCCAGCGAAGCCTACTTGGTCGGACTTTTCGAAGACACCAACTTGTGCGCTATCCAC
Erythroneura illinoisensis	GAGGCCAGCGAAGCTTACTTGGTCGGACTCTTCGAAGACACCAACCTGTGCGCTATCCAC
Erythroneura tricincta	??
Alnetoidia	GAAGCGAGCGAAGCTTACTTGGTCGGACTTTTCGAAGACACCAACTTGTGCGCCATCCA?
Salka	GAAGCCAGCGAAGCCTACTTGGTCGGACT?TTCGAAGA??????????????????????
Anufrieva	GAGGCCAGCGAAGCCTACTTGGTCGGACTCTTCGAAGACACCAACTTGTGCGCTATCCAC
Arboridia	GAGGCCAGCGAAGCCTACTTGGTCGGACTCTTCGAAGATACCAACCTGTGCGCTATCCAC
Coleana	GAAGCCAGCGAAGCCTACTTGGTCGGACTCTTCGAAGACACCAACCTGTGCGCCATCCAC
Singapora	GAAGCCAGCGAGGCCTACTTGGTAGGACTGTTTGAGGACACCAACCTGTGCGCTATCCAC
Ivorycoasta	GAAGCCAGCGAGGCCTACCTCGTCGGTCTCTTTGAGGACACCAACCTGTGCGCCATCCAC
Seriana	??
Ntanga	GAGGCCAGCGAAGCCTACTTGGTCGGACTTTTCGAAGACACCAACCTGTGCGCTATCCAC

	301 310 320 330 340 350 360
Amahuaka	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? ? C C T A C C C C T A A C C T A A C C T T A A T T C A A C A T C G A G G T C G C A A A
Ujna	G C C A A T C G A A C A G A C T T A C T A C C C C C T A G T A T A A T C T T A A T T C A A C A T C G A G G T C G C A A A
Orientalebra	G C C A A T C G A A C A G A C C C A C T A C C C C A C A A A C T A A T C T T A A T T C A A C A T C G A G G T C G T A A A
Alebra aurea	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? A T G C C T C C A T T A A C T A A T C T T A A T T C A A C A T C G A G G T C G C A A A
Protalebrella	G C C A A T C G A A C A G A C T T A C T T C T A T A T A A A C T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Elabra	G C C A A ? C G A A C A G A C T T A C T T C T A T A T C A C T T T T T C T T A A T T C A A C A T C G A G G T C G C A A A
Habralebra	G C C A A ? A A C A T C G A G G T C G C A A A
black Empoasini	? ? ? ? ? A A A A A T A A A A A A T T Y A C C C C T T T T T T T A A T T T T A A T T C A A C A T C G A G G T C G C A A T
Taiwan Empoasca	G C C A A T C G A A C A G A C C T T C T A C C C C C T A T C T T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Unitra	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? A C T T C C C C T C A T A T T A A T T T T A A T T C A A C A T C G A G G T C G C A A A
Madag. Empoasca	? ? ? ? ? T C G A A C A G A C T T T C T A C C C C C C T T A T T A T T T T T A A T T C A A C A T C G A G G T C G C A A A
Empoasca fabae	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? ? C T A C C C C T T A A A A T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Joruma sp19	G C C A A T C G A A C A G A C T T A C T A C C C C T T A A T T T T A T C C T A A T T C A A C A T C G A G G T C G C A A A
Columbonirvana	G C C A A T C G A A C A G A C T T A S T G C C C C T A A A A T T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Euhardina	G C C A A ? ? G A A C A G A C T T A C T T C T C C T T T A A T T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Hiratettix	G C C A A A T T T A T A A A A A A T A C T T C T T C T T T A A T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Agnesiella	? ? ? ? ? A T A C A A A A A A T A C T T C T T T C T T G G A T T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Limassola	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? A C T T C C C C T C A T A T T A A T T T T A A T T C A A C A T C G A G G T C G C A A A
Kunzeana	G C C A A T C G A A C A G A C T T A C T A C C C C C T C T A A T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Kidrella	? ? ? ? ? ? C G A A C A G A C T T T C T A C C C C T T T T T A T T T T C T T A A T T C A A C A T C G A G G T C G C A A A
Igutettix	? ? ? ? ? G A A - A A A G A A C A C C T A C C C C C T A A T C T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Dikrella sp1	G C C A A ? ? ? ? ? ? ? ? ? ? T T T C T A C C C C C T A A T T T T T T C T T A A T T C A A C A T C G A G G T C G C A A A
Alconeura sp1	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? A C T A C C C C T G A A A T T T T T C T T A A T T C A A C A T C G A G G T C G C A A A
Alconeura	G C C A A T C G A A C A G A C T T T C T A C C T T A A A T A T T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Alconeura sp2	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? T C T C C C C C C T T T C T T T T T C T T A A T T C A A C A T C G A G G T C G C A A A
Alconeura sp3	G C G A A ? A T A A T C T T A A T T C A A C A T C G A G G T C G C A A A
Dikrella sp3	G C C A A ? ? G A A C A G A C T T T C T T C C C C A T T A A T T T T T C T T A A T T C A A C A T C G A G G T C G C A A A
Dikrella sp4	G C C A A A A A A A A A A A A A A T C T A C C C C T T T T A T T T T T C T T A A T T C A A C A T C G A G G T C G C A A T
Dikrella sp5	G C - A A T C G A A C A G A C T T A C T A C C C C T T T T T A T A A T C T T A A T T C A A C A T C G A G G T C G C A A A
Dikrella sp6	G C C A A T C G A A C A G A C T T T A T A C C C C T T T G T A T T T T C T T A A T T C A A C A T C G A G G T C G C A A A
Dikrella sp7	G C C A A T C G A A C A G A C T T A C T G C C C T T T T T T T A T A A T C T T A A T T C A A C A T C G A G G T C G C A A A
Dikrella sp8	G C C A A ?
Dikrella sp9	G C C A A T C G A A C A G A C T T C T T A C C C C C T A A A A T A A T T T T A A T T C A A C A T C G A G G T C G C A A A
Idona	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? ? ? T A C C C C C T T T A A T T T T C T T A A T T C A A C A T C G A G G T C G C A A A
Dikrellidia	? C C C T T T A A A T T T A C C T T A A T T C A A C A T C G A G G T C G C A A A
Parallaxis	G C C A A T C G A A C A G A C T T A C T G C T C C T T A G T A T A A T T T T A A T T C A A C A T C G A G G T C G C A A A
Eythroneura lawsoni	G C C A A T C G A A C A G A C T T A C T G C T C C T T T A A A T A A T C T T A A T T C A A C A T C G A G G T C G C A A A
Erythroneura illinoisensis	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? T C T A C C C C T T A T T T T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Erythroneura tricincta	? ? ? ? ? A A A T A A T A A G A A A C T A C C C C T A A A A A T A A T C T T A A T T C A A C A T C G A G G T C G C A A C
Alnetoidia	? ? ? ? ? ? C G A A C A G A C T T T C T A C C C C T T A A A A T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Salka	? ? ? ? ? ? ? ? ? ? ? G A C T T T A C T A C C C C T A A A T A T A A T C T T A A T T C A A C A T C G A G G T C G C A A C
Anufrieva	G C C A A ?
Arboridia	G C C A A ?
Coleana	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? ? C C C C T A A A C C T T T T C T T A A T T C A A C A T C G A G G T C G C A A A
Singapora	G C C A A A A A T A A T C A A A A T C T A C C C C A A A A T T T A T T C T T A A T T C A A C A T C G A G G T C G C A A A
Ivorycoasta	G C C A A ? ? ? ? ? ? ? ? ? ? ? ? A C T A C C C C T T A T T A T T A T C T T A A T T C A A C A T C G A G G T C G C A A A
Seriana	? ? ? ? ? A A A T A T T T A G G T A C T G C C C C A A A A C T T A A T C T T A A T T C A A C A T C G A G G T C G C A A A
Ntanga	G C C A A T C G A A C A G A C T T A C T G C T C C A T A A A A T A A T C T T A A T T C A A C A T C G A G G T C G C A A A

	361 · 370 · 380 · 390 · 400 · 410 · 420
Amahuaka	CTTTAATATAGATATGAACTCTCCATTAAAATAACGCTGTTATCCCTAAGGTAACTTGAT
Ujna	CTTTAATATAGATATGAACTCCCCATTAAAATAACGCTGTTATCCCTAAGGTAACTAAAT
Orientalebra	CTCTAATATAGATATGAACTCTTAATTAAAATTACGCTGTTATCCCTAAGGTAACTTAAA
Alebra aurea	CTTTAATATAGATATGAACTCTTCATTAAAATTACGCTGTTATCCCTAAGGTAACTAAAT
Protalebrella	CTTTAATATAAATAAGAACTTCAAATTAAAATTACGCTGTTATCCCTAAGGTAACTTAAT
Elabra	CTTTAATATAAATATGAACTTACCATTAAAATTACGCTGTTATCCCTAAGGTAACTTAAT
Habralebra	CTTTAATATAAATATGAACTTTCCATTAAAATTACGCTGTTATCCCTAAGGTAACTTAAT
black Empoasini	CTCTTATATAGATATGAACTCTCCATAAAAATAACGCTGTTATCCCTAAGGTAACTTTAA
Taiwan Empoasca	CTATTATATTGATATGAACTCTCCATAAACATTACGCTGTTATCCCTAAGGTAACTTAAA
Unitra	CTTTAATATAGATATGAACTCTCCATTAAAATTACGCTGTTATCCCTAAGGTAACTTAAT
Madag. Empoasca	CTCCTATATAGATATGAACTCTCCATAAGAATTACGCTGTTATCCCTAAGGTAACTTAAA
Empoasca fabae	CTTTTATATAGATAAGAACTCCCCATAAAAATTACGCTGTTATCCCTAAGGTAACTTGAA
Joruma sp19	ATAATATATCAATAAGAACTCTCCATATAAATTACGCTGTTATCCCTTAGGTAACTTAAT
Columbonirvana	CTTGAATATAAATATGAACTCCCCATTCAAATAACGCTGTTATCCCTAAGGTAACTTTAA
Euhardina	CTTTTATATAGATATGAACTCTCCATAAAAATTACGCTGTTATCCCTAAGGTAACTTATT
Hiratettix	CTTTTATATAGATATGAACTCGCCATAAAAATTACGCTGTTATCCCTAAGGTAACTTATT
Agnesiella	CTTTTATATAGATATGAACTCCCCAAAAAAATTACGCTGTTATCCCTAAGGTAACTTTTT
Limassola	CTTTAATATAGATATGAACTCTCCATTAAAATTACGCTGTTATCCCTAAGGTAACTTAAT
Kunzeana	CTTAAATATTAATATGAACTCTCCATTTAAATTACGCTGTTATCCCTAAGGTAATTTTAA
Kidrella	ATCAAATATAGATATGAACTCCCCATTTAAATTACGCTGTTATCCCTAAGGTAGTTTTTT
Igutettix	CTTAAATATAGATATGAACTCCCCATTTAAATTACGCTGTTATCCCTAAGGTAACTTTAA
Dikrella sp1	CTTAAATATAGATATGAACTCCCCATTTAAATAACGCTGTTATCCCTAAGGTAACTTTAT
Alconeura sp1	CTTAAATATAGATATGAACTCCCCATTTAAATAACGCTGTTATCCCTAAGGTAACTTATA
Alconeura	CTTAGATATAAATATGAACTCCCCATCTAAATAACGCTGTTATCCCTAAGGTAACTTTAA
Alconeura sp2	CTTAAATATAGATATGAACTCCCCATTTAAATTACGCTGTTATCCCTAAGGTAGCTTTAC
Alconeura sp3	CTTTAATATAAATATGAACTCCCCATCAAAATTACGCTGTTATCCCTAAGGTAACTTTAA
Dikrella sp3	CTTAAATATAGATATGAACTCCCCATTTAAATTACGCTGTTATCCCTAAGGTAACTTTAT
Dikrella sp4	CTTAAATATAGATATGAACTCCCCATTTAAATTACGCTGTTATCCCTAAGGTAGCTTTAT
Dikrella sp5	CTTAGTTATAAATATGAACTCCCCAACTAAATTACGCTGTTATCCCTAAGGTAACTTTAA
Dikrella sp6	CTTAAATATAGATATGAACTCCCCATTTAAATAACGCTGTTATCCCTAAGGTAACTTTAT
Dikrella sp7	CTTAATTATAGATATGAACTCCCCAACTAAATTACGCTGTTATCCCTAAGGTAACTTTAA
Dikrella sp8	?????????????????????TCCATTTAAATTACGCTGTTATCCCTAAGGTAACTTTAA
Dikrella sp9	CTTAAATATTAATATGAACTCTCCACCTAAATTACGCTGTTATCCCTAAGGTAATTTTAA
Idona	CTCAAATATAGATATGAACTCCCCATTTAAATTACGCTGTTATCCCTAAGGTAACTTAAT
Dikrellidia	CTTAAGTATTAATATGAACTCTCCACTTAAATTACGCTGTTATCCCTAAGGTAACTTTAA
Parallaxis	ACTAAATATAAATATGAACTCGCCATTTAGATAACGCTGTTATCCCTAAGGTAACTTTAC
Eythroneura lawsoni	CTTAAATATAAATATGAACTCCCCATTTAAATTACGCTGTTATCCCTAAGGTAACTTTAT
Erythroneura illinoisensis	CTTTTATATAGATAAGAACTCCCCATAAAAATTACGCTGTTATCCCTAAGGTAATTTAAA
Erythroneura tricincta	CTTAAATATAAATTAGAACTCTCCATTTAAATTACGCTGTTATCCCTAAGGTAACTTTTT
Alnetoidia	CTTAAATATAAATATGAACTCCCCATTTAAATTACGCTGTTATCCCTAAGGTAACTTTAT
Salka	CTTAAATATAAATTAGAACTCTCCATTTAAATTACGCTGTTATCCCTAAGGTAACTTTTT
Anufrieva	??????????????????????????????????????GTTATCCCTAAGGTAACTTTAT
Arboridia	???????????????????????????????????????TTATCCCTGAGGTAACTTTTT
Coleana	CTTAAGTATTAATATGAACTCGCCACTTAAATAACGCTGTTATCCCTAAGGTAACTTTGA
Singapora	CTTAAATATAGATATGAACTCCCCATTTAAATTACGCTGTTATCCCTAAGGTAACTTTAA
Ivorycoasta	CTTAAATATAAATATGAACTCCCCATTTAAATTACGCTGTTATCCCTTAGGTAACTTTAT
Seriana	CTTAAATATAAATAAGAACTCTCCATTTAAATAACGCTGTTATCCCTAAGGTAACTTTAT
Ntanga	CTTAAATATAAATATGAACTCGCCATTTAAATTACGCTGTTATCCCTAAGGTAACTTTCT

	421 430 440 450 460 470 480
Amahuaka	C T T C A T A A A T A A A T G A A A A A A A A A A T A A A G T T T A A A T T T A T T C A C C C C A A T A A A A G T T C T
Ujna	C T T C A T T T A - A A A T G A A A A A A C T A A T A A A G T T A A A A T T T T A C C A C C C C A A C A A A A G T T C T
Orientalebra	C T - C A C C T A T A A G T G A A A T T T A A A A T A A A G T C A A A T T T A C T T C A C C C C A A C C A A A G T T C T
Alebra aurea	C T T C A T A A A T T A A T G T A A T A G T A A A T A A A G T C A A A T T T A C T T C A C C C C A A T C A A A G T T C T
Protalebrella	C T A C A T A A A T A A A T G A A A T A A A A T T T A A A G T T T A T T T T T A T A C A C C C C A A T A A A A G T T C T
Elabra	C T T - T A T T T A A A A T A A A T T T T A A A A T A A A G A A A A T T T T A T T T C T C C C C A A C A A A A G T T C T
Habralebra	C T T C A T A A A T T A A T G A A T T A A T A A A T A A A G A T T A T T - T T T A T C A C C C C A A T A A A A G T T C T
black Empoasini	C T T A A T A A A T A A T G A T T T A A T T A A A T A A A A T T T A A A A T T T A C T A C C C C A G C A A A A A T T C T
Taiwan Empoasca	C T A C A T A A A T A A A T G A G G T T T T A A A T A A A A T T T T A A A T T T A T T G C C C C A G A A A A A G T T C T
Unitra	C T T C A T A A A T T A A T G T A G T A T A A A A T A A A G T T T T A T T T A T T T C T C C C C A A C C A A A G T T C T
Madag. Empoasca	C T T C A T A T A T T A A T G A A A T T T G T A A T A A A A T T T A A A T T T A T A T A C C C C A G T T A A A G T T C T
Empoasca fabae	C T T G A T A A A T G A A A T T A A A A A C A A A A T T T A T A A T T T G C T T T C T A C C C C A G A A A A A G T T C T
Joruma sp19	C T T C A T A A A T A A A T G T C A A A T A A G A T A A A A T T T T A T A T T T A A T G C C C C A G C T A A A G T T C T
Columbonirvana	C T T C T T A C A T T T A A A G A A T T T T A A A T A A A G T T G T A - T T T A A T C A C C C C A A T A A A A G T T C T
Euhardina	C T T C A T A A A T T A A T G A A C A C A T T A A T A A A G T T T A A T T T A T T T C A C C C C A A T A A A A G T T C T
Hiratettix	C T T T A T A A A T A A T G A A T A A A T A A A A T A A A G T T T A A - A T T T G T C A C C C C A A C A A A A T T T C T
Agnesiella	C T T T A T A A A T A A T G A T T T T T A A A A A T A A A G T A T T A - A T T T A T C A C C C C A A T A A A A T T T C T
Limassola	C T T C A T A A A T T A A T G T A G T A T A A A A T A A A G T T T T A T T T A T T T C T C C C C A A C C A A A G T T C T
Kunzeana	C T T C A T A A A T A A A T G A T A A A A A A A A T A A A G T A T A A A T T T A A C C A C C C C A A C T A A A - T T C T
Kidrella	C T T C A C T T A A A A T - G A A A G A A A A A A T A A A G T T T A A A T T T T A A C A C C C C A G T A A A A - C T C T
Igutettix	C T T A A T A A A T A A T G A A A A A A A A A A G T A A A G A T T A A - A A C T G T C A C C C C A A C A A A A C T T C T
Dikrella sp1	C T T C A T T T A A A A T - G A A A A A A A A A A T A A A G T T T A A A T T T T A A C A C C C C A G T A A A A G C T C T
Alconeura sp1	C T T C A T A A A T T A A T G A A T T A A A A A A T A A A G T T T A A A T T T A A T C A C C C C A A T A A A A G T T C T
Alconeura	C T T C A T A A A T T A A T G A A G A A A T A A A T A A A G T T T A A A T T T A A T C A C C C C A G T A A A A G T T C T
Alconeura sp2	C T T C A A T A A A A A T - G A A A A A A A A A A T A A A G C T T A A G T T T A T C C A C C C C A G T A A A A G C T C T
Alconeura sp3	C T T C A T A C A A T T A T G A A A T A A A A A A T A A T G A T A A A A A T T A A C C A C C C C A A T A A A A G T T C T
Dikrella sp3	C T T C A T T A A A A A T - G A A A T A T A A A A T A A A G T T T A A A T T T A T C C A C C C C A G T A A A A G A T C T
Dikrella sp4	C T T T A T C A A T A A T G A A A T A A A A A A T T A A A G T T T A A A A A T C A C C A C C C C A G T C A A A A G C T C
Dikrella sp5	C T T C A A A A A C A A A T G - A A A C A A A A A T A A A G T T T A A A T T T T A A C A C C C C A A C A A A A G T T C T
Dikrella sp6	C T T C A T A A A A A A A A T G A A T T A A A A T A A A G T T T A A G T T T A A C C A C C C C A A T A A A A G T T C -
Dikrella sp7	C T T C A A A A A T T A T T G - A A A T A A A A A T A A A G T T T A A A T T T T A A C A C C C C A A C A A A A G T T C T
Dikrella sp8	C T T C A A A A A G G A T T G A A T T A A A A A A T A A T G T T A A A A A T T A A T C A C C C C A A T C A A A G T T C T
Dikrella sp9	C T T C A A A T A A A A T - G A A A T A A T T A A T A A A G A T T A A A T T T A A C C A C C C C A A C G A A A A T T C T
Idona	A T T C A T A A A A A T A T G A A T A A A A A A A T A A A G T T T A A G T T T A A C C A C C C C A A T A A A A G T T C T
Dikrellidia	C T T C A A A A A T A A A T G A A A A A A A A A A T A A A G T T T A A A T T T A A C C A C C C C A A T G A A A G T T C T
Parallaxis	T T T C A T A A A T A A A T G T T T T A A T A A A T A A A G T T T A A A A T T T A A C A C C C C A A T A A A A G T T C T
Eythroneura lawsoni	C T T C T C C C A C A A A A G A A A A T T T A T A T A A A G C T T A A A T T T A A T C A C C C C A A T A A A A G T T C T
Erythroneura illinoisensis	C T T C A T T G A T A A A T G A A A T A A T A A A C A A A A T T T A A A A T T T G T T A C C C C A G A A A A A A T T C T
Erythroneura tricincta	C T T G C T A A A A T T A G A A T A A A A A A A A T A A A G T T T A - A A A T T A T C A C C C C A A T A A A A T T T C T
Alnetoidia	C T T C T C A A A T T A A A G A A A A A A A T A A T A A A G T T T A A A T T T A T T C A C C C C A A T A A A A G T T C T
Salka	C T T C T A A T A T A A T T A G A A T T A T A A A T A A A G T T T T A A T T T A A T C A C C C C A A T A A A A G T T C T
Anufrieva	C T A A T C T T T T A A A G A A T T T A A A T A A T A A A G A T T A T G A A T T A T C A C C C C A A T A A A A C T T C T
Arboridia	C T T A C T T T T - T A A G A A A C A A A A T A A T A A A G C T T A A A A A T T A T C A C C C C A A T A A A A T T T C T
Coleana	C T T T T C T T A A A A A G A A A A A T A A A A A T A A A G A T T A A A A A T T A T C A C C C C A A T A A A A T T T C T
Singapora	C T T A T C T T A A A A A G A T T T A C A A A A A T A A A G A T T A A A A A T T A T C A C C C C A A T A A A A T T T C T
Ivorycoasta	C T T C T T T T A A A A A A G A A A T A G A A A A T A A A G T T T A A A T T T A A C C A C C C C A A T A A A A G T T C T
Seriana	C T T A T C T T A A T A A G A A T A A A A A A A A T A A A G T T T A A A A T T T A T C A C C C C A A T A A A A A T T C T
Ntanga	C T T C T - T A A A T A A A G A A A T A A A T A A T A A A G T T T A A A T T T A A T C A C C C C A A T A A A A G T T C T

	481 490 500 510 520 530 540
Amahuaka	ATAGGGTCTTTTCGTCCCTAAATTGGACTTAGGCTTTTTTACCAAAAAATTAAATTAATA
Ujna	ATAGGGTCTTATCGTCCCTAAAAAACTATTGAGCTTTTTTACTCAAAGATAAAATTAGTT
Orientalebra	CTAGGGTCTTTTCGTCCCAAAAAGGTAAATTAGCTTTTTTACTAATAAATAAAATTAAAA
Alebra aurea	ATAGGGTCTTTTCGTCCCAATAATAAAATTAAGCTTTTTTACCTAAAAATAAAATTAATA
Protalebrella	ATAGGGTCTTTTCGTCCCAAAATAATTTTTAAGATTTTTTACTCAAAAATAAAATTAATA
Elabra	ACAGGGTCTTTTCGTCCCAAAATAAAGTTTAAGCTTTTTTACTTAAAAATAAATTTAATA
Habralebra	ATAGGGTCTTTTYGTCCCAAAAATTAACTTAAGCTTTTTTACTTAAAAATAAAATTAATA
black Empoasini	ATAGGGTCTTCTCGTCTAAAAAAATAAAATTAGCTTTTTTACTAATAAATAAAATTAATA
Taiwan Empoasca	ATAGGGTCTTATCGTCCCATTAATTTAATTAAGCTTTTTTACAAAAATATAAAATTAATA
Unitra	ATAGGGTCTTTTCGTCCCTAAAAATAAATTCAGCTTTTTTACTAAAAAATAAAGTTAGAA
Madag. Empoasca	CTAGGGTCTTCTCGTCCCAATAACTTACTTAAGCTTTTTAACAAAAGAATAAAATTAATT
Empoasca fabae	ATAGGGTCTTATCGTCCCATTAATTTAATTAAGCTTTTTAACAAAAAAATAAAATTAATT
Joruma sp19	AAAGGGTCTTTTCGTCCCCATTAGTTATTTATGCCTTTTTACATAAAAATAAAATTAACT
Columbonirvana	TTAGGGTCTTTTCGTCCCAAACTTCCAATTTAGCTTTTTTACCAAAAAATTAAATTAACA
Euhardina	ATAGGGTCTTTTCGTCCCAAAAAAATAATTGAGCTTTTTTACCCAATAATAAAATTAATA
Hiratettix	ATAGGGTCTTTTCGTCCCAAAGATTTAATTAAGCTTTTTTACTTAAAAATAAAATTAATT
Agnesiella	ATAGGGTCTTTTCGTCCCAAAAAAGTAATTAAGCTTTTTTACCTAAAAATAAAATTAATT
Limassola	ATAGGGTCTTTTCGTCCCTAAAAATAAATTCAGCTTTTTTACTAAAAAATAAAGTTAGAA
Kunzeana	-TAGGGTCTTTTCGTCCCAAAAAAAAAAATTAGATTTTTTACTAAAAAATAAAATTAATT
Kidrella	ATAGGGTCTTTTCGTCCCAAAAAAGTAAATTAGATTTTTTACTAATAAATAAAATTAGAA
Igutettix	ATAGGGTCTTTTCGTCCCCAAAAAAAAACTTAGATTTTTCACTAAAAAATAAAATTAATA
Dikrella sp1	TTAGGGTCTTTTCGTCCCAAATAAAAATATTGGATTTATTACCAAAAAATAAAATTAATT
Alconeura sp1	ATAGGGTCTTTTCGTCCCAAGAAAATGAATTAGATTTTTTACTAATAAATAAAATTAATT
Alconeura	ATAGGGTCTTCTCGTCCCAAATGAAAAATTTAGATTTTTTACTAAAAAATAAAGTTAGAA
Alconeura sp2	TTAGGGTCTTTTCGTCCCAAAGATATTAATCAGATTTTTTACTGATAAATAAAGTTAGAA
Alconeura sp3	ATAGGGTCTTATCGTCCCAAACTAATAATTAAGATTTCTTACTAAAA-ATAAACTTAACA
Dikrella sp3	TTAGGGTCTTTTCGTCCCAAAAATTTTAATTAGATTTTTTACTAATAAATAAAATTAGAA
Dikrella sp4	TTAGGGTCTTTTCGTCCCAAAAAAATAAATCAGATTTTTTACTGATAAATAAAATTAGAA
Dikrella sp5	GTAGGGTCTTTTCGTCCCAAAAAAATACATTAGATTTTTTACTAATAAATAAAATTAGAA
Dikrella sp6	TTAGGGTCTTATCGTCTTAAACAATTAAATTGGATTTTTTACCAAAAAATAAAATTAATA
Dikrella sp7	ATAGGGTCTTTTCGTCCCAAAAAAATATATTAGATTTTTTACTAACAAATAAAATTAGAA
Dikrella sp8	ATAGGGTCTTATCGTCCCAAATTTAAATATAAGATTTTGTACGTAATAAATAAAATAACC
Dikrella sp9	ATAGGGTCTTCTCGTCCCAAATTAAAAATTCAGATTTTTTACTAAAAAATAAAATTAACT
Idona	-TAGGGTCTTATCGTCCTAAATAAAA-ATTTTAGTTTTTTACTAAAAAATAAAATTAATA
Dikrellidia	ATAGGGTCTTATCGTCCCAAATTAATAATTTAGATTTTTTACTAAAAAATAAATTTAATA
Parallaxis	ATAGGGTCTTTTCGTCCCTAATTAATAAATTAGATTTTTTACTAAAAAATAAAATTAATA
Eythroneura lawsoni	TTAGGGTCTTTTCGTCCCAAATTATTAATTAAGCTTTTTTACCAAAAAATTAAATTAATA
Erythroneura illinoisensis	ATAGGGTCTTATCGTCCCAATTAATAAATTAAGCTTTTTTACAAAAAAATAAAATTAATA
Erythroneura tricincta	ATAGGGTCTTTTCGTCCCAAACTTATATTTCAGCTTTTTTACTAAAAAATTAAATTAATA
Alnetoidia	TTAGGGTCTTTTCGTCCCAAAGAAATAATTAAGCTTTTTTACCTAAAAATTAAATTAATA
Salka	ATAGGGTCTTTTCGTCCCAAACTAAAAATTTAGCTTTTTTACCAAAAAATTAAATTAATA
Anufrieva	TTAGGGTCTTTTCGTCCCAAATATTTAATTCAGCTTTTTTACCAAAAAATTAAGTTAATA
Arboridia	TCAGGGTCTTTTCGTCCCAAATATTTAAATTAGCTTTTTTACCAATAAATTAAATTAATA
Coleana	-TAGGGTCTTTTCGTCCCAAAAATTAAAGTTAGCTTTTTTACCAACAAATTAAATTAATA
Singapora	GTAGGGTCTTTTCGTCCCAATTAATTAATTTAGATTTTTTACCAAAAAATAAAATTAATA
Ivorycoasta	TAAGGGTCTTTTCGTCCCAAAATAAAAATTCAGCTTTTTTACTAAAAAATTAAATTAATA
Seriana	ATAGGGTCTTTTCGTCCCAAATTAATAATTTAGCTTTTTAACCAAATAATTAAATTAATA
Ntanga	TTAGGGTCTTTTCGTCCCAAATTATTATTTTAGCTTTTTTACCAAAAAATTAAATTAATA

	541 550 560 570 580 590 600
Amahuaka	AATTTCTCATTCACTCGTTCATACCAGTTTCCAATTAAAAAACTATTTATTATGCTACCT
Ujna	AATATTTCATTCCTTCATTCATTCAAGTCCCCAATAAAAAAACAAATTATTATGCTACCT
Orientalebra	AATCCCTCATTAATTCATTCATACAAGTCCTTAATTAAAAGACTAATTATTATGCTACCT
Alebra aurea	AATTTCTCATTAATTCATTCATACCAGTCCTTAATTAAAAGACTAATTATTATGCTACCT
Protalebrella	AATTTTTCATTAATTCATTCATTCCAGTCCTCAATTAAAAGACTAATGATTATGCTACCT
Elabra	AATTTCTCATTTATTCCTTCATACCAGTTTCCAATTAAGAAACTAATTATTATGCTACCT
Habralebra	AATACCTTATTTATTCATTCATACAAGTCCTCAATTAAAAAACTAATGATTATGCTACCT
black Empoasini	AATCCTTCATGTACTCATTCATACAAGTCTTTAATTAGAAGACTAATTATTATGCTACCT
Taiwan Empoasca	AACCCCTCAAAAATTCATTCATACAAGCCCCCAATTAAAAGACTAATTATTATGCTACCT
Unitra	AATTTCTCATTTAATCATTCATTCTAGTCCTCAATTAAAAGACTAATTATTATGCTACCT
Madag. Empoasca	TATTCCTCATCTATTCATTCATACAAGTCTTCAATTAAAAGACTAATTATTATGCTACCT
Empoasca fabae	AATTCCTCATTTAATCATTCATACAAGTCCTCAATTAAAAGACTAATTATTATGCTACCT
Joruma sp19	TATCCCTTATTTATTCATTCATACAAGTCCCCAATTAAAAGACTAATGATTATGCTACCT
Columbonirvana	CATTTTTCACTTATTCATTCATACCAGCCCTTAATTAAAAGASTAATTATTATGCTACCT
Euhardina	AATTTCTCATTAAATCCTTCATTCCAGTCCTCAATTAAAAGACTAATTATTATGCTACCT
Hiratettix	AATTTCTCATATAATCTTTCATTCCAGTCCTCAATTAAAAAACTAATTATTATGCTACCT
Agnesiella	AATTTCTCATTTAATCTTTCATTCCAGTCCTCAATTAAAAAACTAATTATTATGCTACCT
Limassola	AATTTCTCATTTAATCATTCATTCTAGTCCTCAATTAAAAGACTAATTATTATGCTACCT
Kunzeana	AATCCCTCATTAAATCATTCATTCCAGTCCTCAATTAAAAGACTAATGATTATGCTACCT
Kidrella	TATTTCTCATTTAATCTTTCATTCCAGTCCCTAATTAAGAAACTAATTACTATGCTACCT
Igutettix	TATCCCTCATTTAATCATTCATACTAGACCCCAATTAAAAAACTAATGATTATGCTACCT
Dikrella sp1	TATTTCTCATTTAATCATTCATACCAGTTCCCAATTAAAAAACTAATTATTATGCTACCT
Alconeura sp1	AATTTCTCATTTATTCTTTCATACTAGTCCCCAATCAAAAAACTAATTATTATGCTACCT
Alconeura	TAAATTTCATTTAATCGTTCATACGAGTCCCCAATTAAGAAACTAATGATTATGCTACCT
Alconeura sp2	TATATCTCATTTAATCATTCATACCAGTTCCCAATTAAGAAACTAATTACTATGCTACCT
Alconeura sp3	TATACCTCATTAAATCATTCATACAAGCCCCTAATTAAGAAACTAATGATTATGCTACCT
Dikrella sp3	TGTTTCTCATTTAATCTTTCATACCAGTTCCTAATTAAGAAACTAATTACTATGCTACCT
Dikrella sp4	TATTTCTCAGTTAATCATTCATTCCAGTCCCTAATTAAAAGACTAATTATTATGCTACCT
Dikrella sp5	AATCTCTCATTTATTCATTCATACCAGTTACCAATTAAGAAACTAATTATTATGCTACCT
Dikrella sp6	TAATTCTCATAAATTCATTCATACTAGATTCTAATTAAGAAACTAATTACTATGCTACCT
Dikrella sp7	AATTTCTCATTTATTCATTCATACCAGTTACCAATTAAGAAACTAATTATTATGCTACCT
Dikrella sp8	TATTCCTCATTCACTCATTCATACCAGCCCCCATTAAAAGGACTAATGATTATGCTACCT
Dikrella sp9	AATTCCTCATTAACTCCTTCATTCCAGTCTCTAATTAAGAAACTAATTATTATGCTACCT
Idona	TATTTTTCATTAAATCATTCATTCTAGATCCTAATTAAGAAACTAATTACTATGCTA???
Dikrellidia	TATACCTCATTAACTCATTCATTCCAGTTCCCAATTAAAAAACTAATGACTATGCTACCT
Parallaxis	TATATCTCATTTATTCATTCATTCTAGTCCTCAATTAAAAAACTAATTATTATGCTACCT
Eythroneura lawsoni	TTTTTCTCATTTATTCATTCATACAAGCCCTTAATTAAAAGACTAATTATTATGCTACCT
Erythroneura illinoisensis	AATTTCTCATTTAATCATTCATACAAGCCTCCAATTAAAAGACTAATGATTATGCTACCT
Erythroneura tricincta	AATTCCTCATTTATTCATTCATACAAGCCCTTAATTAAAAGACTAATTATTATGCTACCT
Alnetoidia	AATTTCTCATTTATTCATTCATACAAGCCCTTAATTAAAAGACTAATTATTATGCTACCT
Salka	AATCCCTCATGTATTCATTCATACAAGCCCTTAATTAAAAGACTAATTATTATGCTACCT
Anufrieva	AATTTTTCATTTATTCATTCATACAAGCCCTCAATTAAAAGACTAATTATTATGCTACCT
Arboridia	AATTTTTCATTTATTCATTCATACAAGCCCTCAATTAAAAGACTAATTATTATGCTACCT
Coleana	AATTTCTCATGTATTCATTCATACAAGCCCTTAATTAAAAGACTAATTATTATGCTACCT
Singapora	AATCCCTTATTCATTCATTCATACCAGCCCTTAATTAAAAGACTAATTATTATGCTACCT
Ivorycoasta	AATCTTTCATTTATTCATTCATACCAGCCCTTAATTAAAAGACTAATTATTATGCTACCT
Seriana	ATTCTTTCATTTATTCATTCATACAAGCCCTCAATTAAAAGACTAATTATTATGCTACCT
Ntanga	TATTTTTCATTTATTCATTCATACAAGCCCTTAATTAAAAGACTAATTATTATGCTACCT

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                            601      610       620       630       640       650       660
Amahuaka                    TTGCACAGTCAGAATACTGCAGCCATTTAATCATAGGGCAGAAGTAACACAAAACCCCAC
Ujna                        TTGCACAGTCAGAATACTGCAGCCATTTAATCATAGGGCAGAAGATACACACAACCACAC
Orientalebra                TTGTACAGTCAATATACTGCAGCTATATAATCATGGAGCAGAAACTACAAAAAAAAAAAA
Alebra aurea                TTGTACAGTCAATATACTGCAGCCATTTAATCATAGGGCAGAAATTACAAAAAAAACAAA
Protalebrella               TTGTACAGTCAATATACTGCAGCCTTTTAATCAATGGGCAGAATATACACCAAAACAA?A
Elabra                      TTGTACAGTTAATATACTGCAGCCATTTAA-CATTGGGCAGAACTTACACCAAAAAGAAA
Habralebra                  TTGTACAGTCAATATACTGCAGCTATTTAATCATTGAGCAGGAT??ACACAAACACAAAA
black Empoasini             TTGCACAGTCAAGTTACTGCAGCCATTTAA????????????????ACAAAAAAACAAA
Taiwan Empoasca             TTGCACAGTTAAAATACTGCGGCCATTAAATCATTGGGCAGAATTTAAAAAAAAAAAAAA
Unitra                      TTGTACAGTCAGAATACTGCAGCCATTTAATCATTGGGCAGAATTTACAAAAAAAAAAAA
Madag. Empoasca             TTGCACASTTAAAATACTGCGGCCATTTAAGCATAGGGCAGAATTTCAAAAAAAAAAAAA
Empoasca fabae              TTGCACAGTTAAAATACTGCGGCCATTTAATCATAGGGCAGAATATAAAAAAAAAAAAAA
Joruma sp19                 TTGCACAGTCAAATTACTGCAGCTATTTAATCATTGAGCAGAACCTAAAACAACAGAAAA
Columbonirvana              TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGAGCAGAATTTACACACAAAACCAA
Euhardina                   TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGGGCAGAATATACACAACCACCCAA
Hiratettix                  TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGGGCAGAATATAAACACCAACCCAA
Agnesiella                  TTGTACAGTCAAAATACTGCAGCCATTTAATCATAGGGCAGAATATACAAAAACACACAA
Limassola                   TTGTACAGTCAGAATACTGCAGCCATTTAA????????????????AAACAACCAGAA?A
Kunzeana                    TAGAACAGTCAATATACTGCAGCCATTTAATCAGTGGGCAGAATTTAAACAAACACCA?A
Kidrella                    TTGTACAGTCAAATTACTGCAGCCATTTAATCATAGGGCAGACCTTAAAAAAACAGAAAA
Igutettix                   TTGTACAGTCAAAATACTGCAGCCATTTAATCATAGGGCAGAAC??ACCCAAACACCAAA
Dikrella sp1                TTGTACAGTCAAATTACTGCAGCCATTTAATCATAGAGCAGATTTTAAACAACCACAA?A
Alconeura sp1               TTGTACAGTCAAAATACTGCAGCCATTTAATCAGAGGGCA??????ACAAAAACACCAAA
Alconeura                   TTGTACAGTCAATATACTGCAGCCATTTAATCAACGGGCAGAATTTAAACAAACACAAAA
Alconeura sp2               TAGTACAGTCAAATTACTGCAGCCATTTAATCATAGGGCAGACCTTACACAAACAAAAAA
Alconeura sp3               TTGTACAGTTAAAATACTGCAGCTATTTAATCATTGAGCAA??TTTAAACCAACACCAAA
Dikrella sp3                TTGTACAGTCAAAATACTGCAGCCATTTAATCATAGGGCA??????CCACAAACAAGAAA
Dikrella sp4                TTGTACAGTCAAATTACTGCAGCCATTTAATCATAGGGCAGATTTTAAAAAAACAAGAAA
Dikrella sp5                TTGTACAGTCAAAATACTGCAGCTATTTAATCATTGAGCAGAACATCCACAAACAACAAA
Dikrella sp6                TTGTACAGTCAAATTACTGCAGCCATTTAATCATAGGGCAGAATAAAAACAAACACCAAA
Dikrella sp7                TTGTACAGTCAAAATACTGCAGCTATTTAATCATTGAGCAGAACTTCAACCACCACCAAA
Dikrella sp8                TTGTACAGTCAATATACTGCAGCTCATTTATCAAATG?????????AAACAACCACCAAA
Dikrella sp9                TTGTACAGTCAAAATACTGCAGCCTTTTAATCAACGGGCAGAATTTACACAAACAACAAA
Idona                       ??????????????????????????????????????????????ACACAAACAAAAA?
Dikrellidia                 TGG???????????????????????????????????????????ACACAAACACCAAA
Parallaxis                  TTGTACAGTCAAAATACTGCAGCTATTGAATCATTGAGCAGAATTTAAACAAACACCAAA
Eythroneura lawsoni         TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGAGCAGAATGWACAAAAACACAAAA
Erythroneura illinoisensis  TTGCACAGTTAAAATACTGCGGCCATTTAATCATTGGGCAGAATTAACACAAACACAA?A
Erythroneura tricincta      TTGTACAGTTAATATACTGCAGCCATTTAATCATAGAGCAGAATTAAAACAAACAAAAAA
Alnetoidia                  TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGAGCAGAATTTAAAAAAACACAAAA
Salka                       TTGTACAGTCAGTATACTGCAGCCATTTAATCATAGAGCAGAATTAAAAAAAACACAAAA
Anufrieva                   TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGAGCAGAATTTACAAAAACACAAAA
Arboridia                   TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGAGCAGAATT?AAAAACACACCAAA
Coleana                     TTGTACAGTCAAAATACTGCAGCCATTTAA????????????????ACAAAAACACCAAA
Singapora                   TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGAGCAGAACATAAAAAAACACCAAA
Ivorycoasta                 TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGAGCAGAAATTACAAAACCACAAAA
Seriana                     TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGGGCAGAATTTACAAAAACACAAAA
Ntanga                      TTGTACAGTTAAAATACTGCAGCCATTTAATCATAGAGCAGAACATAAACAAACAAAAAA
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	661 · 670 · 680 · 690 · 700 · 710 · 719
Amahuaka	CAACGAGACAAACAAAGCCGAAACAACACCGCAACCAACCGAACACACACAAACAACAA
Ujna	CAACGAGAAAACCAACGCCGAAACGCCGCAGCCGCCAAAAAAAACCCCAAACAACACAAA
Orientalebra	CACTGAGCAAACAAACACCCAACCGAAACCGCCCCCAAAAAAAAAAAAAAGAAAAACAAC
Alebra aurea	CACGCACCAAAGAAACGCCGAAACGACAAAGCCCCCACCAG??AAAAAAGACCAAAAAC
Protalebrella	CACGAATCAAAAACACCCGCCCCCGAAACAGCCGACACAAACCAACACCACACAACAAC
Elabra	CGCTGATCCCAAACACCCGGACGCGCAGACGCCGCCAAAAAAACCAACCACACAAAAAC
Habralebra	CGCCCAACAAACACACCCGGACACGAAGCCGCCGCCAACAAAAAAACCAACACCAAAAA
black Empoasini	CCAGGATCAACAAGACCCGCCCACTAACCACCCCACCCCAAACCCAAAAACACAAAAAG
Taiwan Empoasca	CAAGCACCAAAAAGACACGAAC?CTCCGAACCAGGCGCCAAAACCACAAGCCCAAAACC
Unitra	CGATGACCAAAAAGACACCAACACCACAAACCACGCCACAAAACCAACAACAAAAAAAC
Madag. Empoasca	CCAGGAACAAACAGACACCGCCCATACGAACCCCGCGCAAAAACCACAACACCAAAAAG
Empoasca fabae	CCAGGAACAAACAGACACCGCCCCTACGCACCCCGCGCAAAAACCACAACACCAAAACG
Joruma sp19	CAAGGCACAAAAAGACACGCACACTCCGCAGCAGGCGCCACAACCAAAAACCAAAAAAA
Columbonirvana	CACCAAACAAAAAGACGCGGCCAGACACCAGCCGCCAAAAACCCCACAAGCACCAAAAA
Euhardina	CCACGAACAACAAGACCCGCCCACACACAAGCCCACGAAAAACCAAAACAAAAAAAAAC
Hiratettix	CCACAAACAACAAGACACCCCCCCAAACCAAAAGGCCCAAAACCAAAACAGAACAAAAA
Agnesiella	CAACAACCAAAAAGACGCCGCCCAAAACAAAACCGCCAAAAACCAAAAGCCCCAACAA
Limassola	CAAAAAACAACAAGACGCGGCCAAACAGAAAAACCAACAAAACCAACAAGCAAGAACAA
Kunzeana	AGAAGCACCCACAGCCCCCGACAACAAAACCCCCGCCGCAAACCAGCCCAACCGACAAA
Kidrella	AAACCAACAAAAAGACCCGGACACCCAACCCCCCGCCGAAAACAAGAAAACAACAAAAC
Igutettix	CCACAAACAAAAAGACCCCCACAGCAAAACCCCGGCCCCAAACAACAAAAAAACCAAAAC
Dikrella sp1	AAACGAACAAACAGCCCACGACCCCCAGACCC?C?C???AAACAAAAAAAAAACCCAAA
Alconeura sp1	CGACGAACAAACAGACGCCGCCCAACAACCCCCGGCAGCAGCAAACAAACAAACCAAAA
Alconeura	CAAAACACAAACAGACCCGCCCACACAACCCCCCCCCAGCAAAAAAAAAACAAACCAAAAT
Alconeura sp2	CGAAAAACAAACAGACCCCGACACCCAACCCCCGGCCGCAGAAAACAAAGAACCACAAA
Alconeura sp3	CAACACACAAACAGACCCCCCCACCCAAACCCCCGCCGCAAACAACAAACAAACACAAA
Dikrella sp3	AAACGAACAAACAGCCCAGACAACAAACCCCCGGCCACAAAACACAAACCAACAAAAA
Dikrella sp4	AAACGAACAAAGAGACCCCCACCCCCAACCACCCGCCCCAAACCACAAAAAAAACCCAAA
Dikrella sp5	AAACGAACAAAGAGACCCGGACACCAAAACCCCCGCCGCAAAACACACAGAAACCCAAA
Dikrella sp6	CGAAGAACAAACAGACCCCGACACCCAACCCCCCCCCGCAAAACACAAAACACCCAAAC
Dikrella sp7	CAAAG?????AAAGACCCGCACACCCAAACCCCGGCCGAAAACC?CAAAAAAACACAAA
Dikrella sp8	CAAAACACAAAAAGACACAAACACCAAGCCCCCCCCCGAAACCCACAAAAAAAACAAAAA
Dikrella sp9	CGACAAACAAACAGACCCGCACACCCAACCCCCGGCCGCAACAAACCAAAAACCAAAAA
Idona	AGAAG?AC??AGAGACCCCCACACCCAGACCCCCGCGGCAA???CAAAACAAAGACAAC
Dikrellidia	CGAAAAACAAAAAGCCCCACACACCAAACCCCCGGCCACAAA?ACCAAAGAAACACAAA
Parallaxis	AAACGAACAAAACGACCCGGACACACACCCCCCCCCACCAAAAACGCACCACACCCCAG
Eythroneura lawsoni	AGAAGAACAAACAGACCCGGACCCCAAAAACACGCCAGCAAAACAGAACAACACCCCAA
Erythroneura illinoisensis	AAAAAAACAAAAAGACCCCGACACCACAACCACCCCAGAAACAAAGAACCACACCCCAA
Erythroneura tricincta	AAAACAACAAAAAGACCCGCACACCACAACCACGCCCGCAAAACAGAACAACACCCCAA
Alnetoidia	AGACAACCAAAAAGACCCCGACACCAAAACCACCGCCGAAAACAAGCACACAACCCCAG
Salka	ACATAAACAAAAAGACACCAACCCCACAAACACCCCAGCAAAAAAACAACCACACCCCAG
Anufrieva	AAACAAACAAAGAGACGCGGACACCAAAAACACCGCCGAAAACCAGAACGACACCCCAA
Arboridia	AAACAAACAAACAGACCCAGACACCCAAAACACCGCCGCAAAACAAAACAACACCCCAA
Coleana	AAACAAACAAAGAGACACCAACACCAAAACCACCGCCGAAAAACAAAACACCCCCCCAC
Singapora	ACACAAACAAAGAGACGCCGACACCAAAAACACGCCAGAAAAAACAAAAACCACCCAAC
Ivorycoasta	AAACAAACAAAAAGACCCACACACCAAGAACAACGCCGCAAAAAAGACAACAACACAAA
Seriana	AGAAAAACAAACAGAGCCGGACACCAAAAACACGCCAGCAAAAAAGAACACCACCCCAA
Ntanga	AAACCAACAAAAAGACCCGCACACCACAACCACGCCCGCAAACAAGAAGGACAACAAAA

APPENDIX IV

DATA MATRIX FOR MORPHOLOGY DATASET

Taxon	1 . . . 10 . . . 20 . . . 30 . . . 35
Graphocephala	0 1 0 1 0 0 0 0 1 1 0 1 0 0 0 0 0 3 0 0 3 0 0 0 0 0 1 1 0 0 1 1 1 1 0
Ujna	0 1 0 1 0 1 0 0 1 1 0 1 0 1 1 0 0 1 2 0 2 0 0 0 0 1 1 0 0 1 2 1 1 2 0
Amahuaka	0 1 0 1 0 0 0 0 1 1 1 1 0 1 1 0 0 1 2 0 2 1 1 0 0 0 1 0 0 0 2 1 1 2 0
Columbonirvana	0 1 0 1 0 1 0 0 0 0 1 1 0 0 1 0 1 1 0 0 0 1 0 0 0 0 0 2 0 1 2 1 2 2 1
Orientalebra	0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 1 3 2 0 2 1 0 0 0 1 0 0 0 1 0 1 1 1 0
Alebra aurea	0 1 0 0 0 0 0 0 0 0 1 0 0 0 1 0 1 2 1 0 1 1 0 0 0 2 0 0 0 1 2 1 1 2 0
Protalebrella	0 1 0 1 1 0 0 0 0 1 0 0 ? 0 1 0 1 2 0 0 3 1 0 0 0 0 0 1 0 1 1 1 2 1 1
Trypanalebra	0 0 0 1 0 0 0 0 0 0 2 0 ? 0 1 0 1 2 2 1 0 1 0 0 0 0 0 1 0 1 1 1 2 1 1
Paralebra	0 1 0 1 1 0 0 0 0 0 0 0 ? 0 1 2 1 2 1 0 0 1 0 0 0 0 0 1 0 1 2 1 2 2 1
Elabra	0 1 0 1 1 0 0 0 0 0 2 0 0 0 1 2 1 3 2 0 3 1 1 1 0 0 0 1 0 1 1 1 2 2 0
Barela	0 1 0 1 1 0 0 0 0 1 0 0 ? 0 1 0 1 1 1 0 3 1 0 0 0 1 0 1 1 1 1 1 0 2 0
Habralebra	0 1 0 1 0 0 0 1 0 1 0 0 0 0 1 2 1 1 1 0 0 1 0 0 0 1 0 1 0 1 1 1 2 2 0
Narta	0 0 0 0 0 0 0 1 0 1 0 0 ? 0 1 2 0 2 0 1 1 1 0 0 0 1 0 2 0 1 1 1 1 1 1
Limassola	0 0 0 1 0 0 1 1 0 2 0 0 ? 0 1 0 0 0 0 0 0 1 0 0 1 0 0 2 0 1 2 1 2 2 1
Agnesiella	0 1 0 0 0 0 0 1 0 1 0 1 0 0 1 0 0 1 0 0 1 1 0 0 0 0 0 2 0 1 2 1 1 2 1
Typhlocyba quercus	0 1 0 1 1 0 0 1 0 1 0 1 0 0 0 1 0 1 1 0 0 1 0 0 0 2 0 2 0 1 1 1 2 1 1
Hiratettix	0 0 0 1 0 1 1 0 0 1 1 1 0 0 1 1 0 1 0 0 0 1 0 0 1 0 0 2 0 1 0 1 1 1 1
Euhardina	0 1 0 1 0 0 1 1 0 1 1 1 0 0 1 1 0 1 2 0 0 1 0 0 1 0 0 2 0 1 1 1 2 1 1
Eualebra	1 0 0 1 0 0 1 1 0 1 1 1 0 0 1 0 0 0 0 0 0 1 0 0 0 0 0 2 0 1 1 1 2 2 1
Eualebra sp10	0 0 0 1 0 1 1 0 0 2 0 0 0 0 0 0 0 1 2 0 0 0 1 0 0 1 0 0 2 0 1 2 1 1 2 0
Erythroneura tricincta	0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 0 0 1 0 0 0 0 0 2 0 1 1 1 2 1 0
Ivorycoasta	0 1 0 0 0 0 1 1 0 1 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 2 0 1 1 1 0 1 0
Lublinia	0 0 0 1 0 0 1 1 0 0 2 0 ? 0 0 2 0 0 0 0 0 1 0 0 0 1 0 2 0 1 1 1 2 1 0
Accacidia	0 0 0 0 0 0 0 1 0 1 0 0 ? 0 0 0 0 0 0 0 0 1 0 0 0 0 0 2 0 1 1 1 2 1 1
Salka	0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 1 0 3 0 0 0 1 0 0 0 0 0 2 0 1 0 1 1 0 0
Erythroneura illinoiensis	0 1 0 1 0 0 0 1 0 1 0 0 ? 0 0 0 0 0 0 0 0 1 0 0 0 0 0 2 0 1 1 1 1 2 0
Coleana	0 1 0 0 0 0 0 1 0 1 1 0 0 0 0 0 0 1 0 0 0 1 0 0 0 2 0 2 0 1 0 1 1 0 0
Singapora	0 0 0 0 0 0 0 1 0 1 1 0 0 0 0 1 0 1 0 0 0 1 0 0 0 2 0 2 0 1 2 1 1 2 0
Arboridia	0 0 0 0 0 1 0 1 0 1 1 0 0 0 0 0 0 1 0 0 0 1 0 0 0 1 0 2 0 1 1 1 0 2 0
Anufrievia	0 1 0 0 0 0 0 1 0 1 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 2 0 2 0 1 2 1 2 2 0
Alnetoidia	0 0 0 0 0 0 0 1 0 1 0 0 0 0 0 2 0 1 0 0 1 1 0 0 0 0 0 2 0 1 1 1 1 2 0
Erythroneura lawsonii	0 1 0 0 0 0 0 1 0 1 0 0 0 0 0 2 0 0 2 0 0 1 0 0 0 1 0 2 0 1 1 1 2 2 0
Fruitoidia	0 0 0 1 0 0 1 1 0 1 1 0 0 0 0 2 0 0 2 0 0 1 0 0 0 0 0 2 0 1 1 1 2 2 0
Parallaxis sp1	0 0 0 1 0 0 0 1 0 1 1 0 0 0 0 0 0 1 2 0 0 1 0 0 0 0 1 2 0 1 1 1 2 2 0
Typhlocybella	0 0 0 1 0 0 0 1 0 1 1 0 0 0 0 0 0 0 2 0 0 1 0 0 0 1 0 2 0 1 1 1 2 1 1
Kunzeana	0 0 0 1 0 0 0 1 0 1 1 0 ? 0 0 2 0 0 2 1 0 1 1 1 0 1 0 2 1 1 1 1 1 2 0
Neodikrella	0 0 0 1 0 0 1 1 0 1 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 1 0 2 0 1 1 1 2 1 0
Dikrellidia sp2	0 1 0 1 0 0 1 1 0 1 1 0 0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 2 0 1 1 1 1 0 0
Idona	0 1 0 1 0 0 0 1 0 0 0 0 0 ? 0 2 0 0 2 ? ? 1 ? ? 0 2 0 2 0 1 1 1 1 1 0
Dikrella sp0	0 0 0 1 0 0 1 1 0 1 0 0 ? 0 0 0 0 1 2 0 0 1 0 0 0 1 0 2 1 1 1 0 1 2 0
Kidrella	0 0 0 0 0 0 0 1 0 2 0 0 0 0 0 0 0 1 1 0 0 1 0 0 0 0 0 2 0 1 1 1 2 2 0
Dikrella sp13	0 0 0 1 0 0 1 1 0 1 0 0 0 0 0 0 0 0 2 0 0 1 0 0 0 1 0 2 0 1 1 1 1 2 0
Dikrella sp2	0 1 0 0 0 0 0 1 0 1 0 0 1 0 0 0 0 2 2 0 0 1 0 0 0 1 0 2 0 1 1 1 1 1 0
Dikrella sp11	0 1 0 1 0 0 0 1 0 2 1 0 0 0 0 2 0 1 0 0 0 1 0 0 0 2 0 2 0 2 1 1 1 2 0
Dikrella sp4	0 0 0 0 0 0 0 1 0 0 2 0 0 0 0 0 0 1 2 0 0 1 0 0 0 2 0 2 0 1 1 1 1 1 0
Dikrella sp5	1 1 0 1 0 0 0 1 0 0 1 0 0 0 0 0 0 1 2 0 0 1 0 0 0 2 0 2 0 1 1 1 2 2 0
Dikrella sp3	1 1 0 1 0 0 0 1 0 0 2 0 0 0 0 0 0 1 2 0 0 1 0 0 0 1 0 2 1 1 1 1 0 2 0
Dikrella sp10	0 1 0 0 0 0 1 1 0 0 1 0 0 0 1 2 0 1 0 0 0 1 0 0 0 1 0 2 0 1 0 1 1 1 0
Dikrella sp12	0 1 0 1 0 0 0 1 0 0 0 0 ? 0 1 2 0 1 2 0 0 1 0 0 0 2 0 2 0 1 1 1 2 1 0
Afrakra	1 0 0 1 1 0 1 1 0 0 1 0 ? 0 1 0 0 1 0 0 0 1 0 0 0 0 0 2 0 1 2 1 2 2 1
Dikrella sp7	1 0 0 1 1 0 1 1 0 1 1 0 0 0 1 0 0 0 2 ? ? ? ? ? 0 0 0 2 0 1 1 1 2 1 0
Alconeura sp3	0 0 0 1 1 0 0 1 0 1 1 0 0 0 1 0 0 1 0 1 0 1 0 0 0 1 0 2 0 1 1 1 1 1 1
Alconeura sp1	0 1 0 0 0 0 0 1 0 1 1 0 0 0 1 2 0 1 2 0 0 1 0 0 0 1 0 2 0 1 2 1 1 2 1
Parallaxis sp2	0 1 0 0 0 1 0 1 0 1 1 0 0 0 1 0 0 1 2 0 0 1 0 0 1 0 0 2 0 1 1 1 1 1 1
Alconeura sp0	0 0 0 1 0 0 0 1 0 1 0 0 0 0 1 0 0 0 0 1 0 1 0 0 0 1 0 2 0 1 1 1 2 1 1
Dikraneurini ng1706	0 1 0 1 0 0 1 1 0 1 0 0 0 0 1 2 0 1 2 0 0 1 0 0 0 0 0 2 0 1 1 1 1 1 0
Alconeura sp5	1 1 0 0 0 0 1 1 0 1 1 0 ? 0 1 2 0 1 0 0 0 1 0 0 0 0 0 2 0 1 1 1 1 1 1
Dikrellidia sp1	0 1 0 1 0 0 0 1 0 1 1 0 0 0 1 2 0 0 0 0 0 1 0 0 0 0 0 2 1 1 1 1 0 1 0
Igutettix	0 1 1 1 0 0 0 1 0 1 1 0 0 0 1 1 0 1 0 0 0 1 0 0 0 0 0 2 0 1 1 1 1 1 0
Dikrella sp9	0 1 0 1 0 0 0 1 0 0 1 0 0 0 1 2 0 1 0 0 0 1 0 0 0 1 0 2 0 1 1 1 2 1 0
Alconeura sp2	0 1 0 1 0 0 0 1 0 0 0 0 0 0 1 2 0 0 0 0 0 1 0 0 0 1 0 2 0 1 1 1 1 2 0
Dikrella sp8	0 0 0 1 0 0 1 1 0 1 1 0 0 0 1 0 0 0 0 1 0 1 0 0 0 0 0 2 0 1 0 1 0 0 0
Dikraneura angustata	0 0 0 1 0 0 0 1 0 1 1 0 1 0 1 2 0 1 2 0 0 1 0 0 0 1 0 2 1 1 2 1 0 2 0
Dikrella sp6	0 0 0 1 0 0 0 1 0 1 1 0 0 0 1 2 0 0 2 0 0 1 0 0 0 1 0 2 0 1 1 1 1 2 0
Forcipata	0 1 0 0 0 0 0 1 0 1 1 0 0 0 1 2 0 1 1 0 0 1 0 0 0 2 0 2 0 1 1 1 1 2 0
Acia	1 1 0 1 1 0 0 0 0 1 2 0 0 0 1 2 0 3 2 0 1 1 0 0 0 2 0 2 0 1 1 1 2 1 1
Empoasca fabae	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 2 2 0 0 1 0 0 0 1 0 2 0 1 0 1 1 2 1
Taiwan Empoasca	0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 0 0 2 1 0 1 1 0 0 0 0 0 2 0 1 0 1 2 0 0
Apheliona	0 1 0 0 0 0 0 0 0 1 0 0 0 0 1 1 0 3 2 0 1 1 0 0 0 2 0 2 0 1 2 1 1 2 0
Unitra	0 1 0 0 0 0 0 0 0 0 0 0 0 0 1 2 0 3 2 0 1 1 0 0 0 0 0 2 0 1 0 1 1 0 0
Beamerana	0 1 0 0 0 0 0 1 0 2 2 0 ? 0 1 1 0 2 0 0 1 1 1 1 0 0 0 2 1 1 1 1 0 1 0
Heliona constricta	0 1 0 0 1 0 0 0 0 0 ? 0 0 0 ? ? ? ? ? ? ? ? ? ? 0 2 0 2 0 1 1 1 1 0 0
Joruma sp19	0 0 0 0 1 0 0 1 0 2 0 0 0 0 1 0 0 2 2 1 0 1 0 0 0 0 0 2 0 1 0 1 2 1 0
Joruma sp15	1 1 0 1 1 0 0 0 0 0 0 0 ? 0 1 2 0 1 1 0 0 1 0 0 0 1 0 2 0 1 0 1 2 1 0
Joruma sp17	1 1 0 0 1 0 0 0 0 1 0 0 0 0 1 0 0 1 2 0 0 1 0 0 0 0 0 2 0 1 2 1 2 2 0

	36 40 50 60 70
Graphocephala	1 0 2 1 0 0 2 1 0 2 1 1 1 2 1 2 2 0 0 0 0 0 1 0 0 0 1 0 0 1 1 1 0 0 1
Ujna	0 0 2 2 1 1 2 1 0 2 1 1 2 1 1 0 0 0 0 0 0 0 1 1 1 1 0 0 0 1 0 0 1 0 1
Amahuaka	0 0 2 1 0 1 0 1 1 2 1 0 0 1 1 0 0 1 1 2 0 0 1 0 1 0 1 0 1 0 0 0 1 0 0
Columbonirvana	1 0 2 0 1 0 1 1 0 2 1 1 2 1 1 0 0 0 0 0 1 1 1 1 0 1 0 0 2 1 0 1 1 0 0
Orientalebra	0 1 2 1 0 0 0 1 1 2 1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 2 0 0 0 0 0 1
Alebra aurea	0 0 2 1 0 1 0 0 0 2 1 1 1 1 1 0 1 1 0 2 ? ? 0 0 0 0 0 0 2 0 1 1 0 0 0
Protalebrella	1 1 2 1 0 0 0 1 0 2 1 1 2 0 1 0 1 0 0 0 1 1 0 0 1 0 1 1 0 1 0 1 0 0 1
Trypanalebra	1 1 2 1 1 0 0 0 1 2 1 1 1 1 1 0 1 0 0 0 1 1 0 0 1 1 1 0 0 1 0 1 0 1 0
Paralebra	1 0 2 1 1 0 2 0 1 2 1 0 1 1 1 0 0 0 0 0 1 0 1 0 0 0 1 0 1 1 0 1 1 0 0
Elabra	1 2 2 1 1 0 2 0 1 2 1 1 2 1 1 0 0 0 0 0 0 0 1 1 0 0 1 1 0 1 0 1 0 0 0
Barela	1 1 2 1 0 0 2 0 0 2 1 0 2 2 1 1 0 0 0 0 ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
Habralebra	1 0 2 2 0 0 2 1 1 2 1 1 2 1 1 0 0 1 0 0 0 0 0 0 0 1 1 0 0 1 0 1 1 0 0
Narta	1 0 1 0 0 1 2 0 0 0 0 0 1 2 0 2 1 0 0 0 ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
Limassola	1 0 0 0 2 0 2 0 0 0 0 0 1 1 0 0 1 0 0 0 0 1 1 0 0 1 0 0 2 1 0 0 2 0 0
Agnesiella	1 1 0 0 0 0 1 0 0 0 0 1 1 2 1 1 0 0 0 0 0 1 1 0 0 0 0 0 2 1 1 1 1 0 0
Typhlocyba quercus	1 0 0 0 0 1 1 0 0 0 0 1 1 1 1 0 0 0 0 0 0 1 1 0 0 0 0 1 0 0 0 0 1 0 0
Hiratettix	1 1 1 0 0 0 1 1 0 0 0 0 2 2 1 1 1 0 0 0 0 1 1 0 0 0 0 1 0 2 0 0 1 0 0
Euhardina	1 0 1 0 1 0 1 0 0 2 1 1 1 0 1 2 0 0 0 0 0 1 1 0 0 0 0 1 0 0 0 0 0 0 0
Eualebra	1 0 1 0 1 0 1 1 0 2 1 1 0 1 1 0 2 0 0 0 1 1 1 0 1 0 0 0 0 1 0 0 1 0 0
Eualebra sp10	1 1 1 0 1 0 1 1 0 2 1 1 0 1 1 0 1 0 0 2 0 1 1 0 2 1 0 0 0 0 0 1 0 1 0
Erythroneura tricincta	1 0 1 1 0 1 0 0 1 1 0 1 2 1 1 1 2 1 0 0 0 0 1 0 2 0 0 1 0 0 1 0 1 1 1
Ivorycoasta	1 1 1 1 0 0 2 0 0 1 0 0 1 2 1 1 2 1 0 0 0 0 0 0 2 0 1 0 0 1 0 0 1 0 1
Lublinia	1 1 1 1 1 0 0 0 0 1 0 0 2 2 1 1 2 1 0 0 0 0 0 0 2 1 0 1 1 0 1 0 1 1 1
Accacidia	1 1 1 1 0 0 0 0 0 1 0 0 1 2 1 1 2 1 0 0 0 0 0 0 2 1 0 1 1 0 1 0 1 1 1
Salka	1 1 1 1 0 1 0 0 0 1 0 1 1 1 1 0 2 1 0 0 0 0 0 0 1 0 0 1 1 0 1 0 1 1 1
Erythroneura illinoiensis	1 0 1 1 0 1 0 0 1 1 0 1 1 1 1 0 2 0 0 0 1 0 0 0 2 0 0 1 1 0 1 0 1 1 1
Coleana	1 0 1 1 0 0 0 0 1 1 0 1 1 2 1 1 2 0 0 0 0 0 1 0 0 0 0 1 0 1 1 1 1 1 1
Singapora	1 0 1 1 0 0 0 0 0 1 0 1 2 1 1 0 2 0 0 0 0 0 0 1 0 0 0 0 0 1 1 0 1 1 1
Arboridia	1 0 1 1 1 0 0 0 0 1 0 1 1 2 1 1 2 1 0 0 0 0 1 0 0 0 0 1 0 0 1 0 1 1 1
Anufrievia	1 0 1 1 0 0 0 0 0 1 0 1 1 2 1 1 2 0 0 0 0 1 1 0 2 0 0 1 2 0 1 0 1 1 1
Alnetoidia	1 0 1 1 0 0 0 0 0 1 0 1 1 2 1 1 2 0 0 0 0 1 0 0 2 1 0 1 0 1 0 0 1 1 1
Erythroneura lawsonii	1 1 1 1 0 0 0 0 0 1 0 1 2 1 1 0 2 1 0 0 0 0 1 0 2 0 0 1 0 0 1 0 1 1 1
Fruitoidia	1 0 1 1 0 0 0 0 1 1 0 1 2 2 1 1 2 1 0 0 0 0 0 1 2 1 0 1 0 0 1 0 1 1 1
Parallaxis sp1	1 0 1 0 1 0 1 1 1 1 1 1 1 1 1 0 1 1 0 0 0 0 0 1 2 1 0 1 1 0 1 0 1 1 1
Typhlocybella	1 0 1 1 1 0 0 1 1 1 1 0 1 2 1 2 0 1 0 2 0 0 1 0 0 0 1 1 0 0 1 1 1 1 1
Kunzeana	1 0 0 1 0 0 0 0 1 1 1 1 1 2 1 1 2 1 0 0 0 1 2 0 2 1 1 1 0 0 1 1 2 0 1
Neodikrella	1 0 1 0 1 0 2 0 1 1 1 0 2 2 1 1 2 0 0 0 1 0 0 1 0 0 0 0 1 0 0 0 0 1 0
Dikrellidia sp2	1 0 1 0 1 1 2 0 1 1 1 1 1 2 1 1 2 1 0 0 0 1 1 0 1 0 0 0 0 0 0 0 0 0 0
Idona	1 0 1 1 1 0 2 0 1 1 1 1 1 2 1 2 2 1 0 0 ? ? ? 1 0 0 0 0 1 0 0 0 2 0 1
Dikrella sp0	1 1 1 1 1 0 2 0 1 1 1 ? 1 ? 1 ? ? ? 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 1 1
Kidrella	1 0 1 1 1 0 0 1 1 1 1 1 1 2 1 1 2 0 0 0 0 1 0 0 2 0 0 0 0 1 0 0 1 0 0
Dikrella sp13	1 1 1 1 1 1 0 1 1 1 1 1 1 2 1 1 2 1 0 0 0 1 1 0 1 0 0 0 1 2 0 1 1 0 1
Dikrella sp2	1 0 0 1 1 0 0 1 1 1 1 1 1 2 1 1 2 1 0 0 1 1 1 0 1 0 0 0 1 0 0 0 0 0 1
Dikrella sp11	1 0 1 1 1 1 0 0 0 0 1 0 1 2 1 1 2 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 1 0 1
Dikrella sp4	1 1 1 1 1 0 0 1 1 0 1 1 1 2 1 1 1 1 0 0 0 1 1 0 1 0 0 0 0 0 0 0 1 1 1
Dikrella sp5	1 0 1 1 0 0 0 0 1 1 1 1 1 2 1 1 2 1 0 0 0 0 1 0 1 0 1 0 2 0 0 0 1 1 1
Dikrella sp3	1 0 0 1 0 0 0 1 1 1 1 1 2 2 1 1 0 1 0 0 0 0 1 0 1 0 0 0 1 1 0 0 1 0 0
Dikrella sp10	1 1 1 1 0 1 0 0 1 1 1 1 2 2 1 1 2 1 0 0 1 1 1 0 1 0 0 0 1 0 0 0 1 0 0
Dikrella sp12	1 1 1 1 0 1 0 1 1 1 1 1 2 2 1 1 2 1 0 2 ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
Afrakra	1 0 0 1 1 0 0 0 1 1 1 1 2 2 1 1 1 1 0 0 0 1 0 0 1 0 0 0 0 1 0 0 1 1 1
Dikrella sp7	1 0 1 1 1 0 0 0 1 1 1 1 2 2 1 1 2 0 0 0 0 1 1 ? 1 0 0 0 0 0 0 0 1 0 1
Alconeura sp3	1 0 1 1 1 0 0 0 1 1 1 1 1 2 1 1 2 1 0 0 0 1 0 0 1 0 0 0 1 0 0 0 1 0 1
Alconeura sp1	1 1 0 0 1 0 0 1 1 1 1 1 2 2 1 0 2 1 0 2 1 0 0 0 1 0 0 0 1 0 0 0 1 1 0
Parallaxis sp2	1 0 1 3 1 0 2 1 1 1 1 1 2 2 1 0 2 1 0 2 0 1 1 0 1 0 1 0 1 0 0 0 1 1 1
Alconeura sp0	1 0 1 0 1 0 0 1 1 1 1 1 1 1 1 0 2 1 0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 0 0
Dikraneurini ng1706	1 0 0 0 2 1 0 1 1 0 1 1 2 0 1 0 2 1 0 0 1 0 0 0 1 0 0 0 0 0 0 0 1 0 1
Alconeura sp5	1 0 1 1 0 0 2 1 1 1 1 1 1 2 1 1 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 1 0 1
Dikrellidia sp1	1 0 1 1 0 0 0 1 1 1 1 1 2 2 1 1 0 1 0 0 0 ? 0 1 1 0 0 0 2 0 0 0 1 0 1
Igutettix	1 0 2 1 0 0 0 0 1 1 1 1 2 2 1 1 1 1 0 0 0 1 0 0 1 0 0 0 0 0 0 1 1 0 0
Dikrella sp9	1 0 1 1 1 0 0 1 1 1 1 1 2 2 1 1 2 1 0 0 1 0 0 0 1 1 0 0 0 0 0 1 1 0 0
Alconeura sp2	1 0 1 1 1 0 0 1 1 1 1 1 2 2 1 1 2 1 0 1 0 0 0 0 1 0 0 0 2 0 0 1 1 0 1
Dikrella sp8	1 0 1 1 0 0 2 1 1 1 1 1 1 1 1 1 2 0 0 0 1 1 1 0 1 0 0 0 0 0 0 0 1 0 0
Dikraneura angustata	1 1 1 1 0 0 0 1 1 1 1 1 2 1 1 0 1 0 0 0 0 1 1 0 1 0 1 0 0 0 0 1 1 0 1
Dikrella sp6	1 0 1 1 1 0 0 1 1 1 1 1 1 1 1 1 2 1 0 0 0 0 1 0 1 0 0 0 0 1 0 1 1 1 0
Forcipata	1 1 1 1 0 1 0 1 1 1 1 1 1 0 1 0 2 1 0 0 0 1 1 0 0 0 0 1 2 1 0 0 0 0 0
Acia	1 2 1 3 1 1 2 1 0 1 1 1 2 2 1 2 1 0 0 0 0 1 1 0 0 1 1 0 0 0 1 1 0 1 0
Empoasca fabae	1 1 1 3 0 1 2 1 0 1 1 1 1 2 1 2 1 0 0 0 0 0 1 1 0 1 0 0 1 0 1 1 0 0 0
Taiwan Empoasca	1 ? 1 3 1 1 2 0 0 1 1 0 2 2 1 2 1 1 0 0 0 0 1 1 0 1 0 0 2 1 1 1 0 0 0
Apheliona	1 2 1 1 0 1 0 1 0 1 1 1 2 1 1 0 1 1 0 0 0 1 1 1 0 1 0 0 2 1 1 1 0 0 0
Unitra	1 0 1 1 0 1 0 0 0 1 1 0 1 2 1 1 0 1 0 0 0 0 1 1 0 0 1 0 0 1 0 0 0 0 0
Beamerana	1 2 1 1 1 0 0 0 0 1 1 2 2 2 1 2 0 1 0 0 ? ? ? 0 0 0 0 0 0 1 0 0 1 0 0
Heliona constricta	1 0 1 1 0 1 0 0 0 1 1 0 2 2 1 2 1 0 0 0 ? 1 ? 1 0 1 0 0 0 0 0 1 0 0 0
Joruma sp19	1 0 1 3 1 1 2 1 0 2 1 0 2 2 1 2 1 1 0 1 0 0 1 1 0 0 0 0 0 1 1 0 0 0 0
Joruma sp15	1 1 1 3 0 1 2 1 0 2 1 0 2 2 1 1 1 0 0 1 ? ? ? ? ? ? ? ? ? ? ? ? ? ? ?
Joruma sp17	1 1 1 3 0 1 2 1 0 2 1 0 2 2 1 2 1 1 0 1 0 0 1 1 0 0 0 0 1 1 0 0 0 0 0

	71		73
Graphocephala	0	0	0
Ujna	0	0	0
Amahuaka	1	0	0
Columbonirvana	0	0	0
Orientalebra	0	0	1
Alebra aurea	0	0	1
Protalebrella	0	0	1
Trypanalebra	0	0	3
Paralebra	0	0	3
Elabra	0	0	1
Barela	?	?	?
Habralebra	0	0	0
Narta	?	?	?
Limassola	1	0	0
Agnesiella	1	0	0
Typhlocyba quercus	0	0	2
Hiratettix	0	0	0
Euhardina	0	0	1
Eualebra	0	0	0
Eualebra sp10	0	0	0
Erythroneura tricincta	1	0	0
Ivorycoasta	0	0	0
Lublinia	0	0	0
Accacidia	1	0	2
Salka	1	0	2
Erythroneura illinoiensis	1	0	0
Coleana	1	0	1
Singapora	0	0	1
Arboridia	1	0	0
Anufrievia	1	0	0
Alnetoidia	1	0	2
Erythroneura lawsonii	1	0	0
Fruitoidia	1	0	0
Parallaxis sp1	1	0	2
Typhlocybella	0	0	0
Kunzeana	0	0	0
Neodikrella	0	0	0
Dikrellidia sp2	1	0	0
Idona	0	0	1
Dikrella sp0	0	0	0
Kidrella	0	0	1
Dikrella sp13	0	0	0
Dikrella sp2	0	0	0
Dikrella sp11	1	0	0
Dikrella sp4	0	0	0
Dikrella sp5	0	0	0
Dikrella sp3	0	0	0
Dikrella sp10	0	0	0
Dikrella sp12	?	?	?
Afrakra	0	0	0
Dikrella sp7	0	0	0
Alconeura sp3	0	0	0
Alconeura sp1	0	0	0
Parallaxis sp2	0	0	2
Alconeura sp0	0	0	3
Dikraneurini ng1706	0	0	0
Alconeura sp5	0	0	0
Dikrellidia sp1	0	0	0
Igutettix	0	0	1
Dikrella sp9	0	0	0
Alconeura sp2	0	0	0
Dikrella sp8	0	0	0
Dikraneura angustata	0	0	3
Dikrella sp6	0	0	1
Forcipata	0	0	3
Acia	0	1	1
Empoasca fabae	0	1	2
Taiwan Empoasca	0	1	1
Apheliona	0	1	1
Unitra	0	0	1
Beamerana	0	0	?
Heliona constricta	0	0	1
Joruma sp19	0	0	0
Joruma sp15	?	?	?
Joruma sp17	0	0	0