PHYLOGENETIC ANALYSIS OF TRIBE HABROLEPIDINI AND REVISION OF *Homalopoda* AND *Ceraptroceroideus* (HYMENOPTERA: ENCYRTIDAE)

A Dissertation

by

BEATRIZ RODRIGUEZ VELEZ

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

December 2005

Major Subject: Entomology

PHYLOGENETIC ANALYSIS OF TRIBE HABROLEPIDINI AND REVISION OF *Homalopoda* AND *Ceraptroceroideus* (HYMENOPTERA: ENCYRTIDAE)

A Dissertation

by

BEATRIZ RODRIGUEZ VELEZ

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

Approved by:

Chair of Committee,	James B. Woolley
Committee Members,	Robert A. Wharton
	Julio S. Bernal
	Merrill H. Sweet
Head of Department,	Kevin M. Heinz

December 2005

Major Subject: Entomology

ABSTRACT

Phylogenetic Analysis of Tribe Habrolepidini and Revision of *Homalopoda* and *Ceraptroceroideus* (Hymenoptera: Encyrtidae). (December 2005)

Beatriz Rodríguez Velez, B.S., Universidad de Guadalajara

Chair of Advisor Committee: Dr. James Woolley

A taxonomic and phylogenetic study of the tribe Habrolepidini is described. A cladistic analysis was carried out in order to establish the phylogenetic relationships of the supraspecific taxa of the tribe. An illustrated key for the identification at the level of genera is included. Based on the results of the phylogenetic analysis, the diagnosis and taxonomic descriptions of the recognized taxa are presented.

A single most parsimonius parsimony tree was obtained from the cladistic analysis based on 67 morphological characters, generated by a two-step procedure using PAUP. Initially, heuristic searches considering all characters with equal weights resulted in three equally parsimonious trees. Then the method of successive approximation weighting was applied to the three trees. The values of statistic parameters of the most parsimonious tree are: length = 582 steps; consistency index = 0.4966, retention index = 0.5850.

The results support the hypothesis that the tribe Habrolepidini is monophyletic. It is defined by the presence of a specialized ventral mandibular tooth that is formed through modification of a seta into a stout socketed spine and three more unambiguous

characters, clava length from 2.57 to 3.28, small hexagonal sculpture of scutellum and sensilla in three circles in a straight line. The inclusion of the genera *Anthemus, Arrenophagoidea*, *Arrenophagus*, *Thomsonisca* and *Zaomma* into Habrolepidini is supported by the presence of the mandibular tooth or by sister group relationships to other taxa with the mandibular tooth.

The revision of the genera *Ceraptroceroideus* and *Homalopoda* is included; the taxonomic revision of each genus includes a key, diagnosis, descriptions and illustrations for all the species.

DEDICATION

To my parents for their encouragement and love, Miguel Rodríguez and María Vélez

To my siblings Miguel, Alberto, Rosi, Luis and Manuel.

To Angel

ACKNOWLEDGMENTS

I would like to thank my committee chair, Dr. Woolley, and my committee members, Dr. Wharton, Dr. Bernal, and Dr. Sweet, for their guidance and support throughout the course of this research. I also want to extend my gratitude to the Partnerships for Enhancing Expertise in Taxonomy (PEET), and the project Encyrtid parasitoids of mealybugs in Mexico (TAMU-CONACYT "FY2003"), which provided the economic resources for this research.

Thanks also to my friends for their encouragement and love, Carla, Sonia, Dina, Yanil, Chela, Isca, Mayra, Ixel, Togui, Carlos, Gildardo, and Freder.

TABLE OF CONTENTS

CHAPTER Page

CHAPTER I

INTRODUCTION

Encyrtidae is a large family of parasitoid wasps (Hymenoptera) belonging to the superfamily Chalcidoidea. The family has a worldwide distribution, and includes approximately 3,500 described species belonging to about 450 described genera (Noyes 1990). The actual number of encyrtid species, however, is significantly higher and many of them are yet to be discovered, named and described.

Most encyrtids have sexual reproduction but thelytokous parthenogenesis is also common (De Santis 1963). The eggs are oviposited in the host by introducing the ovipositor in the host body in different ways (De Santis 1963). Most encyrtids during the larval stage are internal parasitoids of insects and arachnids. The host insects can be attacked during each developing state but it is most common to be attacked during the larval, nymphal, or pupal stages (Noyes and Hayat 1984). About two-thirds of the species for which biology is known parasitize Homoptera, and the remaining one-third are parasitoids in eggs, larvae and pupae of other insects (Lepidoptera, Diptera, Coleoptera, Hemiptera, Blattaria, Orthoptera, Neuroptera, Hymenoptera), eggs of spiders, and nymphs of ticks (De Santis 1963; Noyes and Hayat 1984; Noyes 1990). Some species are hyperparasitoids parasitoids that parasitize other parasitoids (including Lepidoptera and Hymenoptera) are polyembryonic: the female lays a single egg, which

---

This dissertation follows the style of *Journal of Hymenoptera Research.*

by way of multiple divisions produces hundreds (or even thousands) of larvae (De Santis 1963). Species of the genus *Pseudorhopus* are the only known polyembryonic parasitoids of soft scales (Coccidae) (Noyes 1990), and species of *Epiencyrtus* are polyembryonic hyperparasitoids (Noyes 1990). Larvae of some species of Microterys feed as predators on eggs of Coccidae. After completing development, encyrtid larvae pupate inside the host. When adult encyrtids emerge, they chew a round hole in the host integument and exit. Adult encyrtids usually feed on honeydew (sweet excretions) produced by their homopteran host, or do not feed at all (De Santis 1963; Noyes 1990).

Many species of encyrtids are economically important as natural enemies of agricultural and forest pests, with several species successfully used in biological control programs against both indigenous and imported pests (Noyes and Hayat 1984). Some research has been done on the use of encyrtids in the genus *Ixodiphagus* to control ixodid ticks transmitting Lime disease and encephalitis (Mwangi et al. 1991). *Habrolepis dalmanni* has provided substantial or useful levels of control of golden oak scale, *Asterolecanium variolosum*, a pest of *Quercus* species in New Zealand, Australia and Chile (Clausen 1978). *Anagyrus lopezi* was responsible for complete biological control of cassava mealybug, *Phenacoccus manihot,* in tropical Africa. By 1990 this pest threatened one of the most important food crops of 200 million people. Importation of *A. lopezi* resulted in good biological control of this pest throughout most of its range, with enormous economic and human benefits (Neuenschwander et al. 1990).

The family Encyrtidae was founded by the English entomologist F. Walker in 1837 but it was more clearly defined by A. Foerster in 1856 in Hymenopterologische

Studien (De Santis 1963). Encyrtidae can be recognized by six major characteristics: 1) head with dorsal tentorial arms reaching frontovertex between inner eye margin and torulus (autapomorphy for Encyrtidae); 2) forewing with a well-defined linea calva; 3) mesopleuron convex and not divided obliquely into separate parts; 4) mid coxae inserted level with mid line of mesopleura (autapomorphy for Encyrtidae); 5) cerci advanced towards anterior of gaster, sometimes even into anterior half. The latter character is shown in all Encyrtidae except two genera of the Encyrtinae, *Oriencyrtus* and *Oesol*; 6) outer plates of ovipositor completely separate from ninth tergite of abdomen or connected by an elongate sclerotized strip (paratergite) (Noyes 2000).

Although several classifications of Encyrtidae have been proposed, workers now follow the classification of Trjapitzin (1973a, b) in which the family is divided into two subfamilies: Encyrtinae and Tetracneminae (Noyes and Hayat 1994).

Monophyly of the Tetracneminae is indicated by presence of a paratergite which more or less retains the connection of outer plates of the ovipositor with the ninth abdominal tergite, the shape of the outer plates, and the immovable fusion of the third valvulae to the second valvifers (Noyes 2000).

The subfamily Encyrtinae has the linea calva generally with setae on proximal side longer and stronger than those on distal side, filum spinosum almost always present, hypopygium often short and subrectangular (not reaching more than half way along gaster) but often triangular and reaching apex of gaster, mandibles sometimes with a broadly truncate edge or tooth (Noyes and Hayat 1984).

Trjapitzin (1973b) divided Encyrtinae into 36 tribes, which he later reduced to 25 tribes (Trjapitzin 1989). Although some of these tribes may represent natural groups, others appear to be defined by arbitrary combinations of characters of unknown polarity. One tribe for which there is some evidence for monophyly is Habrolepidini, which was described by Hoffer in 1955 in his work "The phylogeny and taxonomy of the family Encyrtidae (Hymenoptera: Chalcidoidea)". Hoffer (1955) described Habrolepidini as a group with head transversally subquadratic, a configuration of the wing veins with the postmarginal vein distinctly longer than wide, postmarginal vein suppressed, and stigmal vein very short; wings in the female with smoky coloration either compact or broken up into radial bands; male wings hyaline. The antennae of the female are normally built, but the flagellum of the male is composed only of two anelli and a huge clava distinctly longer than the remaining part of the antenna. Sculpture varies from shagreened forms to punctate forms in which the punctae touch each other. Coloration is intensively metallic green to blue. Sexual dimorphism is highly developed and species are parasites of Homoptera: Coccoidea. Two genera were placed in this tribe by Hoffer (1955), *Habrolepis* (Förster 1856) and *Anabrolepis* (Timberlake 1920). Trjapitzin (1973b) described Habrolepidini as body slight flattened; head exhibiting a tendency to become opisthognathous (with the mouth aperture facing downward and backward); occipital margin and apex of scutellum frequently bearing strongly enlarged setae or large squamiform hairs, and commonly with dark markings on fore wings. Finally Noyes (1990) says that Habrolepidini can be defined on a number of morphological characters, the most important being the following female characters: body slightly flattened;

mandibles relatively broad apically with one or two teeth and a broad truncation or with four teeth, never bi-or tridentate; head in side view distinctly triangular with planes of face and vertex forming a strongly acute angle; notaular lines absent; metasoma moderately long and apically acute with hypopygium not reaching more than two-thirds along metasoma. All species included in the tribe also have a mandible which possesses a socketed, peg-like structure on its inner surface near the ventral margin (Noyes 1990) (see Figs. 2.4.2.33; 2.4.2.43, 2.4.2.48 in Noyes 1990). This structure is very difficult to see unless the mandible is removed and examined at high magnification. This peg-like structure has been found in *Anthemus* (see Fig. 2.4.2.2 in Noyes 1990) and a similar bristle-like structure is present in *Thomsonisca* and *Zaomma*, however, a similar structure is found in several genera of Aphelinidae (Heraty and Schauff 1998), (see Fig. 2.4.2.45 in Noyes 1990). It has not been found in other genera of Encyrtidae. Thus, the peg-like or bristle-like structure may represent an autapomorphy for Habrolepidini in Encyrtidae, which in turn suggests that *Anthemus*, *Thomsonisca* and *Zaomma* are members of this tribe.

Two subtribes have been described for Habrolepidini: Habrolepidina and Comperiellina (Trjapitzin 1973b). Habrolepidina was characterized by antennae of females not broadened. Club of antennae in males usually very strongly enlarged; male funicle with clearly expressed tendency toward reduction of the segments: most often only 2 are retained (Trjapitzin 1973b). Noyes (1990) described this subtribe as males with a two-segmented funicle and long unsegmented clava. Comperiellina is characterized by antennae of female (and sometimes also of male) strongly broadened

(Trjapitzin 1973b). Noyes (1990) described males in this subtribe as prossessing a six-segmented funicle and a relatively short clava.

The concept of Habrolepidini by Trjapitzin and Noyes is broader than that of Hoffer, primarily by the inclusion of Comperiellina and the inclusion of species with more normal male flagellum.

Generic classification

The following genera belong to the tribe Habrolepidini (in alphabetic order). The genera with their respective species are placed in Appendix 1.

The genus *Adelencyrtus* was described by Ashmead (1900) for the single species, *Encyrtus chionaspidis* (Howard, 1896) (type-species by monotypy). The genus belongs to the subtribe Habrolepidina (Encyrtinae) (Trjapitzin 1989) and is very closely related to *Epitetracnemus* (Girault, 1915b). *Epiencyrtoides* (Girault, 1915a) (type-species *E. quadridentatus*, by original designation) was treated as a synonym by Mercet (1921) and *Rotrencyrtus* (Risbec, 1959) (type-species *R. depressus*, by monotypy) was treated as a synonym by Annecke and Insley (1971).

The genus *Caenohomalopoda* was founded by Tachikawa (1979) and the type-species by original designation was *Pseudhomalopoda shikokuensis* Tachikawa. To separate this genus from *Pseudhomalopoda* Girault, Noyes and Hayat (1984) found that the shape of the pronotum is important: in *Caenohomalopoda* the posterior margin of the pronotum is almost straight, whereas in *Pseudhomalopoda* it is strongly concave and medially incised (Noyes and Hayat 1984).

In 1916 the genus *Ceraptroceroideus* was founded for the species *C. cinctipes* (Girault, 1916) (type-species by monotypy).

The genus *Coccidencyrtus* was founded in 1900 by Ashmead (1900) who designated *Encyrtus ensifer* Howard, as type-species. *Encyrtomyia* Girault (1915a) (type-species *E. albiflagellum*;) was treated as a synonym of *Coccidencyrtus* by Noyes and Hayat (1984). *Omphalencyrtus* Girault (1915a) (type-species *O. wallacei*)) was treated as a synonym by Noyes and Hayat 1984. *Coccidencyrtoides* Blanchard (1940) (type-species *C. annulipes*) also was treated as synonym of *Coccidencyrtus* by Compere and Annecke (1961) and *Neoadelencyrtus* Hayat, Alam and Agarwal (1975) (type-species *N. mandibularis*) was treated as a synonym of *Coccidencyrtus* by Noyes and Hayat (1984).

In 1906 Howard described Comperiella and included the species *C. bifasciata* (Howard 1906) (type-species by monotypy). *Pseudanusia* Girault (1915a) (type-species *P. pia*) was treated as a synonym of *Comperiella* by Girault (1917); *Habrolepistia* Mercet (1921) (type-species *H. cerapterocera*) was treated as a synonym of *Comperiella* by Mercet (1926) and *Gentakola* by Noyes and Hayat (1984). This genus is placed in the subtribe Comperiellina by Trjapitzin 1973a, 1989).

The genus *Epitetracnemus* was founded by Girault (1915a) who designated *E. sexguttatipennis* as a type-species. *Anabrolepis,* Timberlake (1920) (type-species is *A. extranea*) was treated as a synonym of *Epitetracnemus* by Noyes and Hayat (1994). The following species were also transferred from *Anabrolepis* to *Epitetracnemus: japonicus* Ishii and *lindingaspidis* Tachikawa. This genus was placed in the subtribe Habrolepidina

(Trjapitzin 1973a, 1989) and appears to be related to *Adelencyrtus.* The two genera have been separated on the basis of the presence or absence of a line of silvery setae across the face and the pattern and strength of infuscation of the forewings (Noyes and Hayat 1984). These genera are not easy to distinguish and Noyes and Hayat (1984) suggested that in the future they should be considered synonymous.

The genus *Epitetralophidea* was described by Girault (1915a), who designed *E. bicinctipes* as type-species. *Ectromomyiella* Girault (1915a) (type-species *E. articulus*) was treated as a synonym of *Epitetralophidea* by Noyes and Hayat (1984). *Epitetralophidea* appears to be very close to *Coccidencyrtus* from which it can be separated by an uninterrupted linea calva and a two-segmented funicle in the male (Noyes and Hayat 1984). The latter suggests that it may also be closely related to *Adelencyrtus* from which it differs in having the mandible with a single tooth and a broad truncation, that of *Adelencyrtus* having four teeth or occasionally two teeth and a truncation (Noyes and Hayat 1984).

The genus *Habrolepis* was founded in 1856 by Förster who designed *Encyrtus nubilipennis* Walker, as type-species. *Gymnoneura* Risbec (1951), (type-species is *G. bambeyi* by monotypy) was treated as a synonym by Annecke and Insley (1971).

Howard also described the genus *Homalopoda* for the species *H. cristata* (Howard, 1894 in Riley et al. 1894) (type-species by monotypy). This genus belongs to the subtribe Habrolepidina (Noyes and Hayat 1984).

Girault (1915) described *Neocladella* and designated *N. compressipes* as the type-species and in same paper *Pteromalencyrtus* with *P. quadridentatus*, by original

designation. The genera were synonymized by Noyes and Hayat (1984) who described *Neocladella* as the valid generic name since the holotype of *N. copressipes* is in much better condition than that of *P. quadridentatus*. Placement of this genus is difficult, but the wing venation suggests that it very probably belongs to the subtribe Comperiellina (Noyes and Hayat 1984). It is easily separated from genera included in this subtribe by the quadridentate mandible, relatively high placement of the antennal toruli on the head, relatively small scape and hyaline wings (Noyes and Hayat 1984).

Compere in 1928 described the genus *Neococcidencyrtus* which included *N. alula* (Compere, 1928).

Crawford (1910) founded the genus *Plagiomerus* and designated *P. diaspidis* as type-species. *Parahomalopoda* Girault (1915b), (type-species *P. peruvien*sis) was treated as a synonym of *Plagiomerus* by Noyes (1980). This genus is placed in the subtribe Habrolepidina (Encyrtidae) (Noyes and Hayat 1984). It can be separated from related genera by having hyaline wings and a four-segmented funicle with the first joint being shorter than the fourth (Noyes and Hayat 1984).

Girault (1915b) described *Pseudhomalopoda* and designated *P. prima* as type species.

Girault (1923a) founded the genus *Ruskiniana* and designated *R. sexguttatipennis* as type-species. Girault (1923a) described this genus and species from at least two specimens, both of which appear to have been lost (Noyes and Hayat 1984). However, three specimens (BMNH) agree totally with Girault's brief description and the interpretation of Noyes and Hayat (1984) of the genus is based on these. *Ruskiniana*

belongs to the subtribe Habrolepidina. It is extremely close to *Habrolepis* and presently can only be separated by the number of scale-like setae at the apex of the scutellum. Very probably they should be synonymized (Noyes and Hayat 1984).

Gahan (1927) founded the genus *Spaniopterus* and designated *S. crucifer* as type-species. This genus was placed in the subtribe Comperiellina. It can be distinguished from *Comperiella* by having a four-segmented funicle; *Comperiella* has a six-segmented funicle (Noyes and Hayat 1984).

Girault (1920) described *Xenostryxis* and Myartseva & Trjapitzin designated *X. margiscutellum* as type-species.

CHAPTER II

OBJECTIVES

Many species of encyrtids are economically important as natural enemies of agricultural and forest pests. However, few rigorous hypotheses of phylogenetic structure of this group exist. For this reason I consider my dissertation project an important contribution to the knowledge of this family.

1. Analyze the phylogenetic relationships among the genera of wasps of the tribe Habrolepidini (Hymenoptera: Encyrtidae), and test the monophyly of the tribe.

2. Review generic level taxa in Habrolepidini. Diagnose, describe, and illustrate existing valid taxa and new taxa as appropriate.

3. Construct a dichotomous and multiple entry key for taxonomic determination of valid genera.

4. Analyze the evolution of morphological characters based on the phylogenetic hypothesis proposed.

5. Make a check list of the known species of Habrolepidini of the world.

6. Revise the species of *Ceraptroceroideus* and *Homalopoda*.

CHAPTER III

METHODOLOGY

Only females were used in this reseach, since males were difficult to find.

Taxon selection

The selection of taxa and specimens was based on the exemplar method (Yeates 1995; Schuh 2000). In using an exemplar method actual taxa serve as the terminals in the analysis and the data are coded directly from them. The terminals were species, coding should be straightforward, but if the terminal exemplar represent higher taxa, it is important that they possess only a single state for all characters being coded. If two or more states were present in a terminal, then two or more exemplars were necessary or the terminal was coded as polymorphic. The greater the variation in a terminal taxon, the greater the number of exemplars necessary to allow for correct optimization of the characters for the hypothetical common ancestor of the group (Schuh 2000). For nomenclatural reasons I included type-species of genus group taxa as exemplars wherever possible. Other exemplar species were chosen to encompass the observed variation in taxa..

Morphological terminology

The taxonomic review and the phylogenetic analysis was based on the external morphology and the genitalia of adults of females and males. Morphological terminology followed Noyes (1990), unless otherwise noted. To facilitate the recognition of structures, I include illustrations labeled with the morphological terms.

Specimen preparation

Detailed morphological study of encyrtids requires study of slide-mounted specimens using compound microscopy. For this work I made slides using a modification of Noyes method (Noyes 1990).

Method:

(1). Ensure that specimens are thoroughly dry. If material to be mounted is in alcohol then dry them in critical-point drying chamber.

(2). Mount the specimen on a card so that the antennae, head and wings are completely free of adhesive.

(3). When the specimen is completely dry remove wings with a fine pin and place in 100% alcohol first, then clove oil to get out the air from the venation.

(4). Place the rest of the specimen in 10% NaOH for 24 hrs.

(5). Glacial acetic acid for 10 min.

(6). Distilled water for 10 min.

(7). 35% alcohol for 10 min.

(8). 50% alcohol for 10 min.

(9). 70% alcohol for 10 min.

(10). 95% alcohol for 10 min.

(11). Clearing solution (1 pt. Terpineol, 2pt. 87.5% ETOH) at least 1 hr, depending on how clear the insect is.

(12). Male: Dissect out genitalia with two micro-pins and transfer to a drop of balsam in the center of the slide and position genitalia ventral surface uppermost.

(13). Remove gaster and transfer to a drop of balsam in the center of the slide. Place gaster ventral surface uppermost. Place two micro-pins as far as possible inside the gaster via the petiole (second abdominal segment); gently pull the tergites away from the sternites leaving the ovipositor attached to the epipygium (9^{th} + 10^{th} abdominal tergites); if it is necessary separate the hypopygium (7^{th} abdominal sternite) from other sternites, gently pull ovipositor away from abdominal tergites 8-10. Position tergites ventral surface uppermost. Position ovipositor ventral surface uppermost and gently flatten out valves with the bent end of a pin and add a drop of xylene to thin and spread out balsam so that when it dries it pulls the component parts of the gaster flat against the surface of the slide.

Key, diagnosis and descriptions

An illustrated dichotomous key for identification of genera of Habrolepidini was produced including both characters used in the phylogenetic analysis, and characters that are useful only for identification with emphasis on structures that are easy to observe.

Genera are described using the states of characters of each taxon in the character matrix, and any additional characters useful in recognizing the genus. The characters on the descriptions are numbered according to the list used for the phylogenetic analysis to permit an easy comparison of the state of characters among the taxa. The characters on the general list and the descriptions were ordered from the anterior part of the insect to the genitalia. At the beginning of each description, I include a diagnosis based on characters that distinguish the taxon from others. Descriptions include comments about taxonomic aspects, biogeographic distribution and relevant biological characteristics.

Phylogenetic analysis

Character matrix

The taxa by character matrix were compiled in NEXUS format using MacClade 4.0 program (Maddison and Maddison 1992). The NEXUS format is also used in PAUP version 4.0 (Swofford et al. 1993). In this way the NEXUS matrix can be used for the cladistics analysis, the character analysis and the descriptions. MacClade was also used to visualize phylogenetic results and examine models of characters state change.

Selection and coding of the characters

Characters used for this study will include characters used in previous publications, and characters not considered previous to this work. Characters which appear as autapomorphies for terminal taxa do not provide any information for the phylogenetic analysis but will not be removed from the matrix. These characters do not affect the analysis and they will be used in the descriptions in which they may be diagnostic. In addition, they may become synapomorphies if new taxa are discovered.

Ordering and polarization of characters

All multistate characters for this analysis were considered as unordered. This permits multistate characters to be included in the analysis, even though they are difficult to order. These characters can have important information on common ancestry. In this way all multistate characters can be incorporated in the analysis using Fitch parsimony, where any state of a character can be transformed in to other state with the same increase in tree length (Fitch 1971: Wiley et al. 1991; Swofford and Begle 1993).

Characters were polarized using the out-group method in which the state present in both out-group and in-group is presumed to be plesiomorphic. In some cases outgroups may not be adequate to completely polarize all states of multi-state transformation series, however, such characters may still provide valuable information for the analysis and can often by polarized by the internal structure of the ingroup (Watrous and Wheeler 1981). Characters were not weighted by any *priori* criteria.

Choice of outgroup can be a difficult problem in groups such as Encyrtidae in which few rigorous hypothesis of phylogenetic structure are available. As noted above, some evidence supports a relationship between Habrolepidini, *Zaomma* (currently placed in Cheiloneurini) and *Anthemus* (currently placed in Anthemini). These genera were included as out-groups as well as *Arrenophagoidea*, *Arrenophagus* and *Thomsonisca*. Three genera were included to allow tests of the monophyly of Habrolepidini and sister group relationships of *Zaoma* and *Anthemus*: *Microterys* (Microterini), *Cheiloneurus* (Cheiloneurini), and *Anicetus* (Cerapterocerini).

Analysis method

The method for inferring the phylogeny of Habrolepidini will follow the theories proposed by Hennig (1956, 1966), as reviewed by Wiley (1981). The cladistics analysis will be done with PAUP (Phylogenetic Analysis Using Parsimony) and NONA programs. Because the analysis we expect to have at least 40 to 50 OTU's, searches for the shortest trees will be done using the Heuristics method with 1000-10,000 random addition sequences followed by TBR branch-swapping and the parsimony ratchet (Nixon 1999) as implemented in WinClada.

For multiple equally parsimony solutions result, I used successive approximation character weighting (Carpenter 1988) and strict consensus trees. I did not use any specific methods of optimization to examine models of characters state change; instead I examed each possible optimization to look for potential synapomorphies (Swofford and Maddison 1987; Maddison and Maddison 1992). The amount of support for individual clades was assessed by calculating Bremer support (Bremer 1994).

Characters for the phylogenetic analysis

Character matrix is placed in appendix 2.

Head

1. Head color: (0) Metallic green. (1) Brown with green-violet reflections (It is easier to see the violet reflections in the frontovertex). (2) Brown with two horizontal white bands crossing the face. The first band crosses the face below the ventral margin of the eye. The second band crosses the area between the toruli (Fig. 1). (3) Frontovertex with two white longitudinal bands, each one is next to the inner margin of the eyes. The space between the bands is brown with green-violet reflections (Fig. 2). Face brown with strong green reflections. (4) Frontovertex with a white spot around the ocelli (Fig. 3). Rest of frontovertex and face brown with green reflections. (5) Frontovertex green-blue metallic. Face brown with green reflections. (6) Face yellow with brown ventral margin (Figs. 4, 5). (7) Frontovertex yellow. Face yellow with the area between the ventral eye margin and the toruli light yellow with a soft green shine spot around the toruli. Brown area below the toruli. Small and thin brown band over the lighter yellow spot (Fig. 6). (8) Frontovertex and face entirely yellow. (9) Frontovertex and face dark brown with

violet and green reflections. (A) Frontovertex green-blue metallic with a darker horizontal band. (B) Brown with soft green reflections. (C) Frontovertex varies from orange to yellow, face is light brown. (D) Frontovertex yellow, face with the area between ventral eye margin and the toruli whitish, brown band over the whitish area and a second band between the brown with green-blue sheen, with a vertical darker band. Face dark brown with green-blue sheen.

2. Head width vs. mouth cavity width (Fig. 8 b, d): (0) Head is from 2.37 to 3.26 times wider toruli. The area below the toruli is light yellow (Fig. 7). (E) Frontovertex, dark than mouth cavity. (1) Head is 3.36 times wider than mouth cavity. (2) Head is from 3.46 to 3.57 times wider than mouth cavity. (3) Head is 3.77 times wider than mouth cavity.

3. Head width vs. frontovertex width (Fig. 8 a, b): (0) Head is from 1.50 to 1.68 times wider than frontovertex. (1) Head is 1.91 times wider than frontovertex. (2) Head is from 2.16 to 2.20 times wider than frontovertex. (3) Head is from 2.36 to 2.76 times wider than frontovertex. (4) Head is from 3.06 to 3.83 times wider than frontovertex. (5) Head is 4.25 times wider than frontovertex. (6) Head is from 4.56 to 5.25 times wider than frontovertex.

4. Head height vs. malar space height (Fig. 8 e, l): (0) Head is from 1.73 to 2.35 times higher than malar space. (1) Head is from 2.45 to 2.70 times higher than malar space. (2) Head is from 3.00 to 3.10 times higher than malar space. (3) Head is 3.26 times higher than malar space. (4) Head is 3.74 times higher than malar space. (5) Head is 4.23 times higher than malar space. (6) Head is 4.81 times higher than malar space.

5. Head width vs. head height (figure 8 b, e): (0) Head is about 22% higher than wide. (1) Head is about 8% higher than wide. (2) Head is from 1.00 to 1.48 times wider than high.

6. Space between toruli vs. width of torulus (Fig. 8 c, g): (0) Space between toruli is 1.38 times wider than the greatest width of torulus. (1) Space between toruli is 1.60 times wider than torulus. (2) Space between toruli is from 1.75 to 2.25 times wider than torulus. (3) Space between toruli is from 2.50 to 3.33 times wider than torulus. (4) Space between toruli is 3.5 times wider than torulus. (5) Space between toruli is from 3.66 to 3.68 times wider than torulus. (6) Space between toruli is 3.85 times wider than torulus. (7) Space between toruli is 4.16 times wider than torulus.

7. Space between toruli and mouth margin vs. height of torulus (Fig. 8 j, k): (0) Space between toruli and mouth margin is 15% of the torulus height. (1) Space between toruli and mouth margin is from 31% to 96% of the torulus height. (2) Space between toruli and mouth margin is from 1.11 to 1.16 times higher than torulus. (3) Space between toruli and mouth margin is from 1.28 to 1.32 times higher than torulus. (4) Space between toruli and mouth margin is from 1.44 to 1.66 times higher than torulus. (5) Space between toruli and mouth margin is from 1.76 to 1.8 times higher than torulus.

8. Space between toruli and ventral eye margin vs. torulus height (Fig. 8 f, k): (0) Torulus dorsal margin is over the ventral margin of eyes from 62% to 74% of the torulus height. (1) Torulus dorsal margin is over the ventral margin of eyes from 18% to 46% of the torulus height. (2) Torulus dorsal margin is at the same level of the eye ventral margin; or the torulus dorsal margin is up to 0.20 times of the torulus height below the

eye ventral margin. (3) Torulus dorsal margin is below the ventral margin of eyes from 0.31 to 0.81 times of the torulus height. (4) Torulus dorsal margin is below the ventral eye margin from 0.97 to 1.13 times of the torulus height. (5) Torulus dorsal margin is below the eye ventral margin 1.31 times of the torulus height.

9. Space between toruli and mid ocelli vs. head height (Fig. 8 h, e): (0) Head is from 1.41 to 1.87 times higher than space between toruli and mid ocelli. (1) Head is from 2.01 to 2.22 times higher than space between toruli and mid ocelli. (2) Head is 2.69 times higher than space between toruli and mid ocelli

10. Head height vs. eye height (Fig. 8 i, e): (0) Head is from 1.27 to 1.38 times higher than eye. (1) Head is from 1.52 to 2.43 times higher than eye.

11. Eye height vs. malar space height (Fig. 8 i, l): (0) Eye height is smaller than malar space or from 1.00 to 1.62 times higher than malar space. (1) Eye is from 2.03 to 2.07 times higher than malar space. (2) Eye is 2.37 times higher than malar space. (3) Eye is 3.15 times higher than malar space. (4) Eye is 3.5 times higher than malar space.

12. Head scales: (0) Head without scales. (1) Head with two scales (Fig. 9).

13. Orbital setae on inner margin of eye: (0) Without distinct pattern. (1) Not scale-like, forming a single continuous line. (2) Scale-like, forming single continuous line (Fig. 10).

14. Head scrobes: (0) Head without scrobes. (1) Scrobes present, shape similar to that of scape.

15. Sculpture of the frontovertex: (0) Reticulations smaller or about the same size as ommatidia. (1) Bigger than omatidia. (2) Frontovertex between anterior ocellus and antennal toruli with T-shaped membranous area.

16. Mandible shape: (0) Mandible relatively broad apically with one tooth with a flat broad truncation (Fig. 11). (1) Mandible relatively broad apically with two teeth with a bidentate broad truncation (Fig. 12). (2) Mandible relatively broad apically with two teeth with a serrate broad truncation and a small lobe (Fig. 13). (3) Mandible enlarged with a leaf-shaped prominence (Fig. 14). (4) Mandible enlarged with a small tooth (Fig. 15). (5) Mandible relatively broad apically with two teeth of different size, with a flat broad truncation (Fig. 16). (6) Mandible with apex broadly truncated (Figure 17). (7) Mandible enlarged without any tooth (Fig. 18). (8) Mandible relatively broad apically with two teeth about the same size, with a flat broad truncation (Fig. 19). (9) Mandible with three teeth (Fig. 20). (10) Mandible relatively broad apically with one tooth with a bidentate truncation (Fig. 21).

17. Peg – like tooth on the medio-ventral margin of the mandible: (0) Absent (Figs. 14, 15, 18-21). (1) Present (11-13, 16, 17).

Antennae

18. Antenna color: (0) Entirely yellow or yellowish. (1) Brown, except for the last funicular segment, which is yellow. (2) Entirely dark brown. (3) Brown except for the last two funicular segments, which are yellow. (4) Brown except for the last funicular segments and the scape, which are yellow. (5) Brown except for the last three segments, which are yellowish. (6) Light brown. (7) Scape yellow, pedicel, funicle and clava brown.

19. Antennal funicular segment number: (0) Three funicular segments. (1) Four funicular segments. (2) Five funicular segments. (3) Six funicular segments.

20. Scape length vs. scape width: (0) Scape length is shorter than wide, about 20% or less (Fig. 22). (1) Scape is from 1.47 to 1.68 times longer than wide (Figs. 23- 28). (2) Scape is from 2.40 to 2.44 times longer than wide (Figs. 29, 30). (3) Scape is from 2.79 to 3.00 times longer than wide (Figs. 31-36). (4) Scape is from 3.25 to 5.00 times longer than wide (Figs. 37-56). (5) Scape is from 5.28 to 5.55 times longer than wide (Figs. 57-59) (6) Scape length is 5.83 times bigger than scape width (Fig. 60). (7) Scape length is more than 6.00 times bigger than scape width (Fig. 61).

21. Pedicel length vs. width: (0) Pedicel shorter than wide, subquadrate, or up to 1.10 times longer than wide (Figs. 22-29, 30, 36). (1) Pedicel is from 1.27 to 2.14 times longer than wide (Figs. 31-33, 35, 37-61). (2) Pedicel is at least 2.50 times longer than wide (Fig. 34).

22. Clava length vs. clava width: (0) Clava is from 1.22 to 1.57 times longer than wide (Figs. 28, 56). (1) Clava is from 1.84 to 2.40 times longer than wide (Figs. 22, 24-27, 30, 32, 45, 51-53, 57, 61). (2) Clava is from 2.57 to 3.28 times longer than wide (Figs. 23, 29, 31, 33, 34, 37, 38, 41-44, 47, 49, 50, 55, 58-60). (3) Clava is from 3.52 to 4.22 times longer than wide (Fig. 35, 39, 40, 48, 59). (4) Clava is from 4.54 to 5.5 times longer than wide (Figs. 36, 46, 54).

23. First funicular segment width vs. length: (0) First funicular segment longer than wide, subquadrate, or up to 1.71 times wider than long. (1) From 2.00 to 2.80 times wider than long. (2) From 3.12 to 4.00 times wider than long. (3) At least 4.25 times wider than long.

24. Second funicular segment width vs. length: (0) Second funicular segment longer than width. (1) From 1.00 to 1.5 times wider than long. (2) It is 1.85 times wider than long. (3) From 2.00 to 2.80 times wider than long. (4) From 3.33 to 4.00 times wider than long. (5) From 4.33 to 5.00 times wider than long.

25. Third funicular segment width vs. length: (0) Third funicular segment longer than wide, subquadrate, or up to 1.85 times wider than long. (1) From 2.07 to 2.66 times wider than long. (2) From 3.00 to 3.37 times wider than long. (3) It is 3.75 times wider than long. (4) From 4.37 to 4.80 times wider than long. (5) It is 5.33 times wider than long.

26. Fourth funicular segment width vs. length: (0) Absent. (1) Fourth funicular segment is longer than wide or up to 1.30 times wider than long. (2) From 1.60 to 1.75 times wider than long. (4) From 2.00 to 2.33 times wider than long. (5) 3.43 times wider than long. (6) 5.00 times wider than long.

27. Fifth funicular segment width vs. length: (0) Absent. (1) Fifth funicular segment is longer than wide, subquadrate, or up to 1.40 times wider than long. (2) From 1.70 to 1.80 times wider than long. (3) From 2.10 to 2.87 times wider than long. (4) 4.44 times wider than long.

28. Sixth funicular segment width vs. length: (0) Absent. (1) Longer than wide, subquadrate, or up to 1.28 times wider than long. (2) From 1.60 to 1.66 times wider than long. (3) From 2.18 to 2.62 times wider than long. (4) 4.25 times wider than long.

29. Scape length vs. pedicel length: (0) Scape is 1.65 times longer than pedicel (Fig. 22). (1) From 1.90 to 2.12 times longer than pedicel (Figs. 24-27, 35, 38, 49). (2) From 2.40

to 3.00 times longer than pedicel (Figs. 28-31,33, 34, 36, 37, 39-42, 44, 45, 47, 48, 51-55, 57, 60, 61). (3) Fom 3.20 to 3.50 times longer than pedicel (Figs. 23, 32, 43, 46, 50, 56, 59). (4) 3.85 times longer than pedicel (Fig. 58).

30. Scape length vs. funicle length: (0) Scape is shorter than funicle, subquadrate or up to 1.66 times longer than funicle (Figs. 1-35, 37-50, 52, 55-61). (1) Scape is 3.33 times longer than funicle (Figs. 36, 54). (2) Scape is from 3.69 to 4.06 times longer than funicle (Figs. 51-53).

31. Scape length vs. clava length: (0) Scape is shorter than clava, subquadrate or up to 1.83 times longer than scape (Figs. 1-21, 23-61). (1) Clava is 2.27 longer than scape (Fig. 22).

32. Funicle length vs. pedicel length: (0) Funicle is smaller than pedicel (Figs. 51-53). (1) Funicle is from 1.66 to 2.50 times longer than pedicel (Figs. 24-29, 32, 37, 38, 42, 44, 45, 49, 55, 60). (2) Funicle is from 2.71 to 3.25 times longer than pedicel (Figs. 22, 30, 31, 33-35, 39, 41, 47, 50, 57). (3) Funicle is 3.47 times longer than pedicel (Fig. 46). (4) Funicle is from 3.66 to 3.75 times longer than pedicel (Figs. 23, 40, 56, 58). (5) Funicle is from 4.21 to 4.36 times longer than pedicel (Figs. 43, 48, 59). (6) Funicle is 7.75 times longer than pedicel (Fig. 61). (7) Funicle is 8.33 times longer than pedicel (Fig. 54). (8) Funicle is 10 times longer than pedicel (Fig. 36).

33. Clava length vs. pedicel length: (0) Clava is 1.29 times longer than pedicel (Fig. 51). (1) Clava is from 1.75 to 2.92 times longer than pedicel (Figs. 1-21, 23-30, 32-35, 37-39, 40-45, 47-49, 51, 53, 59-61). (2) Clava is from 3.125 to 3.76 times longer than pedicel

(Figs. 22, 31, 39, 46, 50, 52, 55, 58). (3) Clava is from 4.58 to 5.00 times longer than pedicel (Figs, 36, 54).

34. Funicle length vs. clava length: (0) Funicle is from 18% to 28% of the clava length (Figs. 51-53). (1) Funicle is from 56% of the clava length, subquadrate or up to 1.36 times longer than clava (Figs. 1-35, 37-47, 49, 50, 55, 57, 58, 60). (2) Funicle is from 1.66 to 2.00 longer than clava (Figs. 36, 48, 54, 56, 59). (3) Funicle is 2.83 longer than clava (Fig. 61).

Thorax

35. Mesoscutum color: (0) Green metallic in all aspects. (1) Brown with green shine. (2) Dark brown with green reflections, with a green-blue metallic band crossing the mesoscutum longitudinally. (3) Brown with strong green shine (lateral view brown; dorsal view green metallic). (4) Brown with strong green-violet shine. (5) Yellow. (6) Yellow with soft green shine. (7) Dark brown. (8) Light yellowish brown.

36. Scutellum color: (0) Green metallic. (1) Light brown with soft green shine. (2) Dark brown with violet-green shine. (3) Yellow. (4) Light brown with strong green shine. (5) Dark brown shine.

37. Mesoscutum setae: (0) Setae about the same length as the distance between them; low central area bare. (1) Setae about the same length as the distance between them; regular distribution without bare areas. (2) Setae longer than the distance between them. (3) Hair length longer than the distance between them, the low half of scutellum shows a denser distribution than the rest of scutellum.

38. Mesoscutum sculpture: (0) Regular hexagonal sculpture about the same size as sculpture on scutellum. (1) Regular hexagonal sculpture, bigger than the sculpture on scutellum. (2) Enlarged transversally hexagonal sculpture, bigger than sculpture on scutellum.

39. Scutellum sculpture: (0) Longitudinal enlarged hexagonal sculpture with reticulate edges (1) Reticulate sculpture with big hexagonal edges (2) Small hexagonal sculpture (3) Semi-circular reticulate sculpture (4) horizontal enlarged hexagonal sculpture. (5) Enlarged reticulate sculpture, as horizontal lines (Fig. 63). (6) The upper half has hexagonal sculpture; the lower area has semi-reticulate sculpture. (7) Entirely small hexagonal sculpture (Fig. 62). (8) Semi-reticulate. (9) Entirely large hexagonal sculpture (Figs. 64, 65).

40. Tuft of scales on scutellum: (0) Absent. (1) Two broad scales as long or longer than scutellum. (2) Two thin scales. (3) Four scales, all of them thin, the two upper scales are thinner than the other two. (4) Four scales, all of them broad and longer than scutellum. (5) About 20 scales, all of them forming a line on the inferior margin of scutellum. (6) Tuft of setae.

41. Tegula color: (0) Brown with green reflections. (1) White base, the rest is brown. (2) Entirely yellow (3) Light brown. (4) Yellow base, the rest is brown.

42. Mesopleuron color: (0) Brown with green reflections. (1) Shining light brown. (2) Yellow. (3) Dark brown.

43. Axilla color: (0) Green metallic. (1) Brown with green reflections. (2) Yellow. (3) Dark brown.

44. Pronotum shape: (0) Narrow with a small central incision (Fig. 66). (1) Wide with truncated anterior margin and almost straight posterior margin (Fig. 67). (2) Thick with a curved posterior margin (Fig. 68). (3) Thick with a small central incision in the posterior margin (Fig. 69). (4) Narrow curved pronotum with rounded ends (Fig. 70).

45. Pronotum color: (0) Light brown with soft green reflections. (1) Entirely green metallic. (2) Dark brown with green metallic reflections; with a white central band. (3) Brown with strong green reflections (lateral view brown; dorsal view green). (4) Brown with strong green-violet reflections.

46. Metapleuron color: (0) Brown with green reflections. (1) Shiny light brown. (2) Brown with strong green-violet reflections. (3) Yellow. (4) Shiny dark brown.

Legs

47. Tarsal segments: (0) 4. (1) 5.

48. Procoxa color: (0) Entirely yellow. (1) Dark (In some specimens it looks brownish)

49. Profemur color: (0) Entirely yellow. (1) Entirely dark or dark except the ends. (2) Yellow with a brown band close to the distal end.

50. Protibia color: (0) Entirely yellow. (1) Dark except for the ends. (2) Yellow with a brown band close to the basal end.

51. Mesocoxa color: (0) Entirely yellow. (1) Dark (In some specimens it looks light brown).

52. Mesofemur color: (0) Entirely yellow. (1) Entirely dark or dark except for the ends (Fig. 72, a). (2) Yellow with a wide brown band close to the distal end (Fig. 73, a). (3) Dark with a yellow band close to the basal end (Fig. 74,a). (4) Brown, except for the

basal end (Fig. 75, a). (5) Brown-yellowish (some specimens it looks only yellowish) with a thin brown band close to the distal end (Fig. 76, a).

53. Mesotibia color: (0) Entirely yellow. (1) Yellow with two brown bands, one is in the distal end, the second one is close to the basal end (figure 72, b). (2) Yellow with a brown band in the basal end (Fig. 77). (3) Yellow with a brown band or spot close to the basal end (Fig. 78). (4) Brown with the distal end yellow (Fig. 74, b). (5) Entirely dark. (6) Yellow with two brown bands, one is close to the basal end, the second one is close to the distal end (Figs. 75, b, 73, b).

54. Metacoxa color: (0) Entirely yellow. (1) Entirely dark (in some specimens it looks light brown).

55. Metafemur color: (0) Entirely yellow. (1) Entirely dark or dark except for the ends (Figs. 79, a, 83, a). (2) Yellow with a brown spot close to the distal end (Fig. 80, 71, a). (3) Yellow with brown shadows (in some specimens it looks almost completely yellow).

56. Metatibia color: (0) Entirely yellow. (1) Approximately half brown and half yellow (figure 79, b). (2) Brown with a yellow band in the center (Fig. 72, c). (3) Entirely brown. (4) Brown with the two ends yellow (Fig. 82). (5) Brown with the distal end yellow (Fig. 83, b). (6) Yellow with two brown bands, one is in the basal end, and the second one is close to the distal end (Fig. 81, b). (7) Yellow with two brown bands, one is close to the basal end, and the second one is thinner than the first one, it is close to the distal end (Fig. 71, b).

Wings

57. Hairs bordering hindwing: (0) Shorter than the width of the hindwing. (1) Large, about the width of the hindwing or wider.

58. Hairs bordering forewing: (0) Very short. (1) Shorter than the width of the forewing, well-defined bordering line. (2) Large, about the width or forewing or wider.

59. Forewing hair: (0) Thin hair-like (Fig. 107). (1) Infuscate areas with thicker scales (Figs. 108, a, b, 109, a, b); hair on veins and under them is thicker and longer that the one on the infuscate areas (Fig. 109). (2) Infuscate areas with well defined scales; scales on veins and under them are bigger than the ones on the infuscate areas.

60. Forewing venation: (0) Obsolete, represented by an infuscate patch only. (1) Marginal vein at least two times stigmal vein length, postmarginal vein shorter than stigmal vein. (2) Marginal and stigmal vein about the same size, postmarginal vein minute. (3) Marginal vein slightly shorter than stigmal vein, without postmarginal vein. (4) Marginal vein at least two times stigmal vein length, postmarginal minute. (5) Marginal vein about 2 times longer than stigmal vein, postmarginal vein absent. (6) Stigmal vein slightly longer than marginal vein, postmarginal absent. (7) Stigmal vein slightly longer than marginal vein, postmarginal and stigmal vein about the same length. (8) Marginal and stigmal vein about the same, postmarginal vein absent. (9) Stigmal vein broad and square, about the same length as marginal vein and longer than postmarginal vein. (10) Marginal vein about three times longer than stigmal vein, which is longer than postmarginal vein. (11) Stigmal vein slightly longer than marginal vein, postmarginal vein shorter than stigmal vein. (12) Broad veins with few hairs, marginal and stigmal

vein about the same length, postmarginal vein shorter than stigmal vein. (13) Marginal vein about 1.5 times longer than stigmal vein, postmarginal vein absent.

61. Forewing size: (0) Forewing is from 2.04 to 2.85 longer than width. (1) Forewing is from 3.12 to 3.16 longer than width. (2) Forewing is 5.00 longer than width.

62. Wing reduced or normal: (0) Reduced. (1) Normal.

63. Forewing color pattern: (0) Hyaline. (1) Forewing with two hyaline spots, one just distal of margin of stigmal vein, the other at the widest point of wing on posterior margin; there is a small infuscation under the postmarginal vein (Fig. 84). (2) Forewing with infuscation in apical one-third of the wing, with a short extension to the center of the wing (Fig. 85). (3) Forewing with circular infuscation in the center of the wing (Fig. 86). (4) Forewing with central infuscation which reaches the apex of the wing; showing three hyaline areas on the anterior margin of the forewing, one sub-hyaline area in the apex and two hyaline areas on the posterior margin of the wing; a seventh hyaline area is present in the central infuscation close to the base of the wing. The base of the forewing is hyaline (Fig. 87). (5) Forewing with two transverse infuscate bands extending from central longitudinal infuscate ray (Fig. 88). (6) Forewing with two longitudinal infuscate rays (Fig. 89). (7) Forewing with one longitudinal infuscate ray (Fig. 90). (8) Forewing with infuscation reaching the apex of the wing; with three hyaline areas on the anterior margin of the forewing and two hyaline areas on the posterior margin of the wing; a sixth hyaline area is present in the central infuscation close to the base of the wing. The base of the forewing is hyaline (Fig. 91). (9) As 8 except the area behind the post marginal vein has thick setae, which appears to be an infuscation. (Fig. 92). (10)

Forewing with apex infuscate; and a subapical transverse hyaline band. The rest of the wing is infuscate except for the base and two hyaline areas on the anterior margin and one hyaline area on the posterior margin (Fig. 93). (11) Forewing infuscation with two hyaline areas on the anterior margin of the wing, one hyaline area on the posterior margin of the wing, and a hyaline area in the infuscation close to the base of the wing, which is also hyaline. The apex of the wing is hyaline but has thick setae contrasting with the proximal hyaline area (Fig. 94). (12) Forewing infuscate in apical two thirds with hyaline areas at anterior and posterior margins in apical fourth fifths of wing (Fig. 95). (13) Forewing infuscate in apical three fourths, except for a hyaline spot distal to the margin of stigmal vein, which is narrowly connected to a second posterior hyaline spot, at widest point of wing (Fig. 96). (14) Forewing infuscation with two hyaline areas close to the apex of the wing, two hyaline areas on the anterior margin and one hyaline area on the posterior margin of the wing. A sixth hyaline area in posterior third under the marginal vein, and a seventh long hyaline area in on the posterior margin under the infuscate area under the postmarginal vein (Fig. 97). (15) Forewing with infuscation taking form of an oblique, irregular cross in center of wing composed of flattened darker setae (Fig. 98). (16) Forewing except at base infuscate to apex with two transverse hyaline bands, the most basal with basal margin at stigmal vein (Fig. 99). (17) Forewing infuscate except for the basal area (Fig. 100). (18) Forewing infuscation enclosed subapically by darker band (Fig. 101).

64. Linea calva: (0) Open, interrupted, group of setae present under stigmal vein. (1) Open, not interrupted, group of setae present under stigmal vein. (2) Closed, interrupted,

group of setae present under stigmal vein (3) Barely closed, interrupted, no group of setae present under stigmal vein (4) Closed, not interrupted, group of setae present under stigmal vein.

65. Sensilla in the apex of stigmal vein: (0) Three circles in straight line (Fig. 102). (1) Two first circles, one below the other, followed for three circles in line (Fig. 103). (2) Four circles in line (Fig. 104). (3) Three circles which are distributed as a triangle (Fig. 105). (4) Two circles, one below the other, followed for two circles in line (Fig. 106). (5) Two circles in a horizontal line, under them two circles in vertical straight line.

Abdomen

66. Abdomen color: (0) Brown with green shine. (1) Yellow with brown edges. (2) Brown with green-violet shine. (3) Yellow with one brown spot in each side. (4) Color varies from yellow to brown.

67. Ovipositor; length was measured from base of 1st and 2nd valvulae (= gonapophyses) to the base of the 3rd valvula (= gonostyli) (figure 112, a) compared to length of the 3rd valvulae (= gonostyli) (Fig. 112, b): (0) Ovipositor is about 1.60 times longer than gonostyli (Fig. 110). (1) Ovipositor is from 2 to 2.25 times longer than the gonostyli (Fig. 111). (2) Ovipositor is from 2.60 to 3.94 times longer than gonostyli (Figs. 112, 113). (3) Ovipositor is from 4.15 to 4.714 times longer than gonostyli (Figs. 114, 115). (4) Ovipositor is 5.611 times longer than gonostyli (Fig. 116). (5) Ovipositor is 8.00 times longer than gonostyli (Fig. 117).

CHAPTER IV

RESULTS

Parsimony analysis of unweighted characters

Parsimony analysis of the full dataset of 40 taxa and 67 unordered characters resulted in three equally parsimonious trees of 576 steps, with consistency index (CI) of 0.5017 and retention index (RI) of 0.5935.

The strict consensus tree resulting from the three trees is shown on Fig. 115. The tree suggests the monophyly of Habrolepidini by the presence of four unambiguous character changes (17 (0-1), 22 (0-2), 39 (0-7), 65 (2-0)). One character that has been suggested as indicating monophyly of Habrolepidini is the presence of a small tooth on the middle length of the ventral margin of the mandible (character 17 (1)), which is present. Into Habrolepidini is one of the out-group genera, *Cheiloneurus*. Of the four unambiguous characters that suggest the monophyly of Habrolepidini, three of them are reversed in *Cheiloneurus* (characters 17, 22, 65).

The monophyly of *Comperiella* is supported by four unambiguous character changes. The monophyly of *Plagiomerus* is supported eleven unambiguous character changes.

Caenohomalopoda and *Homalopoda* appear as sister groups, eight unambiguous character changes support the relationship. *Ceraptroceroideus* and *Spaniopterus* appear as sister groups, six unambiguous characters changes support the relationship.

Ruskiniana is characterized by eleven unambiguous autapomorphies. *Pseudhomalopoda* is supported by nine unambiguous autapomorphies, *Epitetralophidea* is supported by fifteen unambiguous autapomorphies. *Coccidencyrtus* is supported by ten unambiguous autapomorphies.

Xenostryxis (supported by seventeen unambiguous autapomorphies) appears as a sister group of *Neococcidencyrtus pudaspidis*. This relationship is supported by two unambiguous character changes. At the same time, *Xenostryxis* and *Neococcidencyrtus pudaspidis* appear very close of *N. alula*. All of them are consistently at on the base of the tree, suggesting they are the most plesiomorphic Habrolepidini.

The following genera formerly belonging to other tribes are now included in Habrolepidini: *Anthemus* (supported by 18 unambiguous character changes), *Arrenophagoidea* (supported by three unambiguous characters changes) *Arrenophagus*, *Thompsonisca* and *Zaomma*. The monophyly of *Arrenophagus* is supported by five unambiguous character changes. The monophyly of *Arrenophagus* as sister group of *Arrenophagoidea* by 10 unambiguous character changes. The monophyly of *Thompsonisca* is supported by eight unambiguous characters. *Zaomma* (supported by eleven unambiguous character changes) is as sister group of *Adelencyrtus moderatus*.

The genera, *Adelencyrtus*, *Epitetracnemus* and *Neococcidencyrtus* are distributed in the tree as polyphyletic groups; and *Habrolepis* as a paraphyletic group.

Bootstrap analysys

Bootstrap analysis of the data (Fig. 116), supports the monophyly of Habrolepidini by 63%, *Comperiella* (94%), *Plagiomerus* (80%), *Arrenophagoidea* as sister group of *Arrenophagus* (95%) and *Thomsonisca* (99%).

Successive approximation character weighting

Successive approximation method was executed using the rescaled consistency index. Since more than one tree was used, the maximum value (best fit) option was used for initial weights for each character, followed for the heuristic search using closest addition sequences and TBR branch-swapping. The weights stabilized after three iterations, producing a single tree, 582 steps, CI of 0.4966, RI of 0.5850 (Fig. 117). This cladogram shows better resolution than the strict consensus tree.

The results are very similar to consensus tree, both trees show *Adelencyrtus* and *Neococcidencyrtus* as polyphyletic groups, the mayor differences are: *Habrolepis* and *Epitetracnemus* appear as monophylectic groups in the successive approximation tree, each supported by three unambiguous character changes; however in strict consensus tree they are paraphyletic and polyphyletic respectively.

Habrolepis appears as sister group of *Caenohomalopoda*, this relationship is supported by two unambiguous character changes.

Evolution of characters

The evolution of the characters was performed on the successive approximations tree. The synapomorphies that support each of the clades are presented here. Synapomorphies will be distinwished as two: hard synapomorphies (a character

transformation state that occurs only one time in the tree) and soft synapomorphies (character transformations occur as parallelisms or reversals in other parts of the tree).

Caenohomalopoda as sister group of *Habrolepis* is supported by one hard synapophorphy (40-1) and one soft synapomorphy (9-1). *Caenomalopoda* by itself is characterized by two hard autapomorphies (6-2, 45-0) and four soft autapomorphies (33-2, 35-0, 44-1, 64-3). The monophyly of *Habrolepis* is supported by three hard synapomorphies (1-5, 27-1, 28-1).

Ceraptroceroideus and Spaniopterus occur in the tree as sister groups, this relationship is supported by five hard synapomorphies (4-3, 35-1, 36-1, 45-0, 59-2) and one soft synapomorphy (42-1). *Ceraptroceroideus* is supported by three hard autapomorphhies (22-2, 24-3, 39-3) and one soft autapomorphies (32-4). *Spaniopterus* is supported by four hard autapomorphies (6-6, 25-3, 31-1, 65-4) and five soft autapomorphies (4-1, 19-1, 20-0, 33-2, 67-1).

The monophyly of *Comperiella* is supported by three hard synapomorphies (25-2, 28-3, 39-5) and two soft synapomorphies (32-1, 64-2). The relationship of *Comperiella* as sister group of *Spaniopterus* and *Ceraptroceroideus* is supported by two hard synapomorphies (14-1, 20-1).

Ruskiniana is supported by seven hard autapomorphies (7-5, 13-2, 18-7, 24-5, 40-5, 41-1, 53-5) and four soft autapomorphies (2-2, 6-5, 9-1, 25-4). *Pseudhomalopoda* is supported by two hard autapomorphhies (40-4, 41-2) and three soft autapomorphies (7-3, 32-1, 64-4).

The genus *Epitetracnemus* is supported by one hard synapomorphy (13-1) and two soft synapomorphies (39-0, 43-0). *Epitetralophidea* is supported by seven hard autapomorphies (18-7, 32-5, 36-5, 42-3, 43-3, 55-2, 56-8) and four soft autapomorphies (4-1, 39-0, 45-4, 67-1).

The monophyly of *Plagiomerus* is supported by two hard synapomorphies (40-3, 52-2) and four soft synapomorphies (19-1, 27-0, 28-0, 38-1). The relationship of *Plagiomerus* as sister group of *Epitetralophidea* is supported by one hard synapomorphy (1-9) and one soft synapomorphy (29-3).

Zaomma is supported by seven hard autapomorphies (1-9, 18-1, 27-2, 49-2, 50-2, 52-2, 60-9) and three soft synapomorphies (6-5, 33-2, 53-3). *Coccidencyrtus* is supported by five hard autapomorphies (4-5, 11-3, 38-0, 55-0, 66-1) and five soft synapomorphies (10-0, 32-4, 44-2, 51-0, 54-0).

The monophyly of *Arrenophagus* is supported by two hard synapomorphies (44-4, 55-0) and three soft synapomorphies (48-0, 49-0, 51-0). *Arrenophagus* as sister group of *Arrenophagoidea* is supported by seven hard synapomorphies (22-1, 23-2, 26-0, 30-2, 32-0, 34-0, 39-9) and three soft synapomorphies (17-0, 25-4, 27-0). *Arrenophagoidea* by itself is supported by two hard autapomorphies (2-1, 33-0) and one soft autapomorphies (50-1). The relationship of *Arrenophagus* and *Arrenophagoidea* as sister group of *Anthemus* is supported by two hard synapomorphies (57-0, 64-0) and one soft synapomorphy (28-0). *Anthemus* is supported by 12 hard autapomorphies (1-C, 35-8, 36-3, 42-1, 43-2, 44-3, 46-1, 55-3, 58-2, 61-2, 63-J, 67-2) and six soft autapomorphhies (4-2, 20-3, 29-1, 41-2, 45-7, 65-2).

The monophyly of *Thomsonisca* is supported by four hard synapomorphies (22-4, 30-1, 33-3, 39-0) and four soft synapomorphies (9-1, 34-2, 50-1, 53-3). The relationship of *Thomsonisca* as sister group of *Anthemus*, *Arrenophagoidea* and *Arrenophagus* is supported by two hard synapomorphies (48-1, 49-1) and one soft synapomorphy (24-0).

Xenostryxis is supported by 13 hard autapomorphies (3-3, 6-1, 18-7, 22-3, 35-7, 36-5, 41-4, 42-3, 43-3, 45-6, 46-4, 56-7, 60-7) and four soft autapomorphies (2-2, 7-2, 39-1, 44-3).

Proposed key to genera of Habrolepidini (females)

1 Tarsi 4-segmented……..…….2

- Tarsi 5-segmented……..…..……3

2(1) Forewing narrow, not less than three times as long as wide, with marginal fringe at least as long as wing width; mandible with apex broadly truncate (Fig. 17)……..…….*Anthemus* Howard

- Forewing broad, at most two and one-half times as long as broad, with marginal fringe much shorter than maximum wing width; mandible with a single tooth (Fig. 14, 15)……....…….*Arrhenophagus* Aurivillius

3(1) Forewing always fully developed and submarginal vein with not more than 5 setae dorsally; marginal, postmarginal and stigmal veins obsolete, represented by

an infuscate patch only; frontovertex between anterior ocellus and antennal toruli with T-shaped membranous area ……..*Arrhenophagoidea* Girault

- If forewing fully developed then submarginal vein with more than 5 setae dorsally; marginal, postmarginal and stigmal veins well defined; frontovertex without any membranous areas; brachypterous species known……..…...4

4(3) Funicle 4- segmented…….….5

- Funicle 6- segmented ……...…..9

5(4) Forewing with a distinct infuscate pattern……..6

- Forewing hyaline……..23

6(5) Forewing with infuscation taking form of an oblique, irregular cross composed of flattened darker setae (Fig. 98); antenna clearly flattened (Fig. 22). Apex of scutellum with setae normal and not lamelliform……..…….*Spaniopterus* Gahan

- Forewing with infuscation more extensive than above and not in form of cross; antenna not clearly flattened, clava 3-segmented and pedicel less than half as broad as length of scape (Figs. 29, 31, 46) ; apex of scutellum usually with at least two lamelliform setae……..……..…….…...…7

7(6) Posterior margin of pronotum broadly and evenly concave and not emarginated medially, pronotum measured along midline nearly half as long as mesoscutum (Fig. 67)……...*Caenohomalopoda* Tachikawa

- Posterior margin of pronotum strongly emarginated medially and not evenly concave, pronotum measured along midline not more than about one-eighth as long as mesoscutum (Fig. 66)…… ……..…….8

8(7) Antenna with all funicle segments transverse or at most with 3rd and 4th segments quadrate; clava much longer than funicle (Fig. 29)…....*Pseudhomalopoda* Girault

- Antenna with all funicle segments as long as broad or longer; clava not longer than funicle (Fig. 46)……...……..*Homalopoda* Howard

9(4) Either forewing with a distinct pattern of darker and paler areas or pedicel and flagellum clearly broadened and flattened……..……..…10

- Forewing hyaline or only very weakly infuscate (including species that have a weak infuscation below marginal and stigmal veins); pedicel and flagellum more or less cylindrical, not broadened and flattened……...17

10(9) Pedicel and flagellum broadened and flattened, scape extending slightly past level of pedicel (Figs. 23, 24)…….……..…11

- Either pedicel and flagellum more or less cylindrical and not flattened or clava at least about twice as wide as 1st funicle segment; lamina of scape never extending past level of pedicel……..…12

11(10) Forewing either shortened and not reaching apex of gaster or fully developed, if fully developed then disc distad of apex of venation with hyaline areas surrounded by fuscous streaks (Fig. 88); apex of scutellum never with scale-like setae; head hypognathous……..…….*Ceraptroceroideus* Girault

- Foreweing always fully developed and with one or two longitudinal fuscous streaks in disc distad of apex of venation (Figs. 89, 90) or if as above (southern African species) then apex of scutellum has a pair of flattened scale-like setae; head opisthognathous……. *Comperiella* Howard

12(10) Head and thorax (excluding axillae) at least partly yellow or orange……..13

- Head and thorax (excluding axillae) completely dark brown or black and usually with at least a slight metallic green, blue or purple sheen, without any areas of yellow or orange……...……14

13(12) Head viewed dorsally with frontovertex relatively narrow, much narrower than width of an eye…….…….…….*Neococcidencyrtus* Compere

- Head viewed dorsally with frontovertex broader than, at least as wide as an eye.....…… *Xenostryxis* Girault

14(12) Apex of scutellum with a row of about 15 elongate scale-like setae …….. *Ruskiniana* Girault

- Apex of scutellum either with normal, unmodified setae or with not more than 4 scale-like setae……..….15

15(14) Apex of scutellum with at least one pair of flattened scale-like setae, or, if setae normal then forewing either with an uninterrupted subapical hyaline fascia (Fig. 93) or apex more or less abruptly hyaline and conspicuously paler than infuscate areas of disc (Fig. 94)……..….*Habrolepis* Förster

- Apex of scutellum with normal setae; forewing without a complete subapical hyaline fascia and apex not conspicuously paler than infuscate areas of disc……16

16(15) Forewing distal of apex of venation with 4 hyaline areas (Fig. 91); head with fairly to very conspicuous lines of silvery setae below eye, which usually extend across frons and meet above antennal scrobes ……...….*Epitetracnemus* Girault

- Forewing distad of apex of venation with only 2 hyaline areas, apex of wing occasionally slightly paler than disc; head without conspicuous lines of silvery setae below eyes and across frons……...*Adelencyrtus* Ashmead

17(9) Forewing with linea calva interrupted in posterior half by several setae or ovipositor exserted with exserted part at least about one-third as long as gaster; not brachypterous species known …….……...18

- Either forewing fully developed and with linea calva not interrupted, except perhaps by a single seta, or forewing shortened and not reaching apex of gaster; ovipositor not or hardly exserted…….…….20

18(17) Clava not more than two-thirds as long as funicle, all funicles segments longer than broad…….*Thomsonisca* Ghesquière

- Clava at least more than two-thirds as long as funicle and usually longer, only rarely all funicle segments longer than broad and usually at least one segment transverse……..……19

19 (18) Width of frontovertex more than one-third head width...*Coccidencyrtus* Ashmead

- Width of frontovertex less than one-third head width…...*Epitetralophidea* Girault

20(17) Head matt yellow to orange-brown, not metallic……..…...*Xenostryxis* Girault

- Head at least slightly metallic green, blue or purple……....21

21(20) Either mid or hind tibia with two conspicuous dark bands……...*Neococcidencyrtus* Compere

- Mid and hind tibia each with at most one dark band……22

22(21) Gland-like structures on metasomal tergites II and VII not present; head in facial view with antennal toruli situated slightly nearer to imaginary line drawn between lower eye margins than to mouth margin; mesoscutum without conspicuous silvery setae in posterior half; scutellum with a pair of long subapical setae only, never with a tuft of setae ……..……. *Adelencyrtus* Ashmead

- Metasoma with gland-like structures on tergites II and VI; head in facial view with antennal toruli situated slightly nearer to mouth margin than to imaginary line drawn between lower eye margins; mesoscutum often with conspicuous silvery setae in posterior half; scutellum often with a subapical tuft of setae…….. *Zaomma* Ashmead

23(6) All or some funicle segments not longer than wide…….*Plagiomerus* Crawford

- All segments longer than long……..*Homlopoda* Howad

Review of generic level taxa of Habrolepidini

The review was made only for females.

Adelencyrtus Ashmead, 1900

(Figs. 8, 37, 38, 39, 57, 62, 66, 79, 82, 84, 85, 86, 102, 103, 112, 116)

Type species. *Encyrtus chionaspidis* Howard, 1896; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of funicle 6-segmented (Figs. 37, 38, 39, 57). Mandible with 2 teeth and a bidentate truncation (Fig. 12), or, mandible with one tooth and a flat broad truncation (Fig. 11); gland-like structures on abdominal tergites III and VII not present; head in facial view

with antennal toruli situated slightly nearer to imaginary line drawn between lower eye margins than to mouth margin (Fig. 8); mesoscutum without conspicuous silvery setae in posterior half; scutellum with a pair of long subapical setae only, never with a tuft of setae.

Description. Head in female viewed from in front wider than long. Head in facial view with antennal toruli situated slightly nearer to imaginary line drawn between lower eye margins than to mouth margin (Fig. 8). Mouth cavity and frontovertex both less than one-half width of head. Malar space at least one-third length of eye. Occipital margin rounded.

Antennae with funicle 6-segmented (Figs. 37, 38, 39, 57), the flagellum clavate, the club enlarged, about twice as broad as the funicle, but as long or nearly, funicle joints transverse, the first two or three smaller than the others, submoniliform; pedicel rather large; scape short, subclavate or slightly thickened toward apex, clava 3-segmented.

Mandible with 2 teeth and a bidentate truncation (Fig. 12), or, with one tooth and a flat broad truncation (Fig. 11).

Mesoscutum without conspicuous silvery setae in posterior half; scutellum flat, with deep reticulate sculpture (Fig. 62) much deeper than sculpture of mesoscutum, scutellum with a pair of long subapical setae only, never with a tuft of setae. Mesopleuron not enlarged posteriorly, separated from metasoma by metapleuron and propodeum.

Wings hyaline, but with the venation quite different from that of *Zaomma*, the postmarginal and stigmal veins being much shorter than in that genus. Linea calva open,

interrupted, or, open not interrupted, or closed, interrupted. Postmarginal vein not longer than stigmal vein or hardly so. Marginal vein longer than broad, venation Y-shaped beyond hyaline break.

Tarsi 5-segmented (Fig. 82). Gland-like structures on abdominal tergites III and VII not present.

Ovipositor from 2.6 to 3.9 times longer than gonostyli (Fig. 112), or, about 5.6 times longer than gonostyli (Fig. 116).

Host. *Aonidiella aurantii, Aspidiella hartii, Aspidiotus, Aspidiotus nerii, Aulacaspis madiunensis, Brevennia rehi*(?), *Chionaspis margaritae, Chrysomphalus ficus, Clavaspis pectinata, Ledaspis distincta, Odonaspis, Rolaspis, Rolaspis whitehilli, Scleromytilus litothrix, Separaspis capensis* (Noyes 1998).

Country. Barbados, China, India, U.S.A., U.S.A.-Florida (Noyes 1998).

Region. Afrotropical, Nearctic, Neotropical, Oriental, Palearctic (Noyes 1998).

Anthemus Howard, 1896

(Figs. 17, 35, 110)

Type species. *Anthemus chionaspidis* Howard, 1896; designation by monotypy.

Diagnosis.- Distinguished from other genera of Habrolepidini by the combination of tarsi 4-segmented, forewing narrow, not less than three times as long as wide, with marginal fringe at least as long as wing width, mandible with apex broadly truncate (Fig. 17).

Description. Antenna cylindrical with 5-funicular segments (Fig. 35), clava 3-segmented. Mandible with apex broadly truncate (Fig. 17). Forewing narrow, not less than three times as long as wide, length of the hairs bordering fore and hind wings, at least the width of the wing. Linea calva open interrupted. Tarsi 4-segmented

Ovipositor about 1.6 times longer than gonostyli (Fig. 110).

Host. *Chionaspis minor, Duplachionaspis eritreana, Duplachionaspis exalbida, Evallaspis ampelodesmae, Evallaspis ampelodesmae*(?)*, Ledaspis distincta* (Noyes 1998).

Associate (plant). *Agave sisalana* (Noyes 1998).

Country. Australia, Australia-Victoria, North Africa, Tunisia (Noyes 1998).

Region. Afrotropical, Australian/Pacific, Palearctic (Noyes 1998).

Arrhenophagoidea Girault 1915

(Figs. 18, 51, 65, 107)

Type species. *Arrhenophagoidea coloripes*, Girault, 1915; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of tarsi 5-segmented. Postmarginal and stigmal veins obsolete, presented by an infuscate patch only; frontovertex between anterior ocellus and antennal toruli with T-shaped membranous area.

Description. Frontovertex with transverse membranous line intersected by vertical membranous lines from toruli. Funicle 3-segmented, adpressed to clava and difficult to distinguish (Fig. 51), funicle much shorter than clava, clava 1-segmented.

Forewing always fully developed and submarginal vein with not more than 5 setae dorsally; submarginal vein the only distinct vein present, marginal, stigmal, and postmarginal veins indistinct, represented by an infuscate patch only. Body shorter than 0.75mm. Tarsi 5-segmented.

Host. *Asymmetraspis* MacGillivray, *Aulacaspis* Cockerell, *Chionaspidis* Signoret, *Rolaspis* Hall, *Versiculaspis* MacGillivray (Noyes 1990).

Arrhenophagus Aurivillius 1888

(Figs. 14, 15, 52, 53, 64, 70)

Type species. *Arrhenophagus chionaspidis* Aurivillius, 1888; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of tarsi 4-segmented, forewing broad, at most two and one-half times as long as broad, with marginal fringe much shorter than maximum wing width, mandible with a single tooth.

Description. Funicle 3-segmented, with segments adpressed to clava and difficult to distinguish (Figs. 52, 53), funicle much shorter than clava. Mandible with a single tooth (Fig. 15), or mandible with a leaf-shape structure on the middle ventral margin of mandible (Fig. 14).

Forewing broad, at most two and one-half times as long as broad, with marginal fringe much shorter than maximum wing width. Tarsi 4- segmented. Ovipositor from 2.0 to 3.9 times longer than gonostyli (Figs. 111, 112).

Host. *Pinnaspis temporaria, Pseudaulacaspis pentágona* (Noyes 1998).

Associate (plant): *Passiflora edulis* (Noyes 1998).

Country. Peru, South Africa (Noyes 1998).

Region. Afrotropical, Neotropical (Noyes 1998).

Caenohomalopoda Tachikawa, 1979

(Figs. 9, 31, 67, 87, 113)

Type species. *Pseudhomalopoda shikokuensis*, Tachikawa, 1956; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of posterior margin of pronotum broaddly and evenly concave and not emarginate medially, pronotum measured along midline nearly half as long as mesoscutum (Fig. 67).

Description. Head in lateral view wedge-shaped, acutely angled between antennal scrobes and frontovertex. Occipital margin with 2 enlarged setae (Fig. 9).

Antenna not clearly flattened, funicle 4-segmented (Fig. 31) with all segments quadrate, pedicel less than half as broad as length of scape, clava 3-segmented, with apex rounded.

Pronotum with posterior margin nearly straight or slightly recurved, at midline one-half length of mesoscutum (Fig 67). Scutellum with some sculpture, and apically usually with slightly to strongly broadened and flattened lamelliform setae.

Forewing with infuscate pattern (Fig. 87). Body dorsoventrally flattened. Hypopygium extending at most one-half length of metasoma. Tarsi 5-segmented.

Ovipositor about from 2.6 to 3.9 times longer than gonostyli (Fig. 113).

Country. India (Noyes 1998).

Region. Oriental (Noyes 1998).

Ceraptroceroideus Girault, 1916

(Figures 1, 11, 23, 72, 88, 108, 118 – 133)

Type species.- *Ceraptroceroideus cinctipes* Girault, 1916; designation by monotypy.

Diagnosis.- Distinguished from other genera of Habrolepidini by the combination of antennae brown with purple and green reflections; funicle narrowing apically, with sixth segment not wider than first segment; club narrower than funicle, and narrowing apically, with apex rounded (Fig. 119); wings often reduced, reaching scutellum caudal margin, with a broad costal cell and distinct submarginal and marginal veins (Fig. 119, 132), or normal, extending past apex of metasoma, with transverse infuscate bands extending from central longitudinal infuscate ray (Fig. 120), hyaline areas with small, pale hairs and infuscate areas with thick dark scales, the largest on the veins and under the submarginal vein.

Description.- Length (14 specimens) 0.85mm – 1.7mm. Body dark brown with purple and green reflections.

Head brown with purple and green reflections, lighter on face than frontovertex; face with whitish bands or entirely brown. Sculpture of frontovertex hexagonal, smaller than omatidia. Sculpture of malar space reticulate, cells higher than wide. Head subquadrate (frontal aspect) with some scattered silver setae, 2.7 times wider than mouth cavity, 3.4 times wider than frontovertex, 1.7 times higher than malar space, 1.2 times wider than high. Space between toruli 2.7 times wider than torulus width. Space between toruli and mouth margin 85% of the torulus height. Dorsal margin of torulus same distance below eye ventral margin, as torulus height. Head 1.7 times higher than space between toruli and mid ocelli, 1.4 times higher than eye. Malar space 1.3 times higher than eye.

Mandible with one tooth, and a flat broad truncation (Fig. 133), with the presence of a small thick tooth in the middle of the ventral margin (Fig. 133).

Antennae entirely flat, brown with purple and green reflections, setose; setae dark brown, their length about half of the length of one funicle segment. Funicle narrowing apically, with sixth segment narrower than first segment; club narrower than funicle, and narrowing apically, with apex rounded (Fig. 118), all segments wider than long; funicle segments decreasing in width, increasing in length, sixth segment the narrowest and longest, all funicle segments with their distal margin concave. Scape greatly dilated, about 1.7 times longer than wide. Pedicel triangular, shorter than wide. Club conico-cylindrical, first segment subquadrate and largest of the three segments..

Pronotum about 20 % of mesoscutum length, broadly concave medially (Fig. 119). Mesoscutum wider than long, as long or nearly as long as the scutellum; scutellum with rounded apex reaching to the base of the metasoma (Fig. 119). Mesoscutum and tegulae brown with purple and green reflections, and weak hexagonal, reticulate sculpturing. Scutellum brown with purple and green reflections; sculpture reticulate, cells deep and smaller than those on mesoscutum, arranged in a whorl around a point in the center with rows of small hexagons apparently coming down from a middle line. The lateral and caudal margins of scutellum lustrous, mirror-like and without sculpture. Axillae meeting medially (easier to see in slide-mounted specimen).

Middle tibial spur long and stout, the caudal spur single and slender.

Wings often reduced, reaching caudal margin of scutellum, with a broad costal cell, and distinct submarginal and marginal veins (Fig. 119, 132), or normal, extending past apex of metasoma, with transverse infuscate bands extending from central longitudinal infuscate ray (Fig. 120); hyaline areas with small, pale hairs, and infuscate areas with thick dark scales, the largest on the veins and under the submarginal vein, stigmal vein; with three sencillae in straight line.

Abdomen lustrous brown with purple and green reflections, subglabrous.

Length of ovipositor from the base of 1st and 2nd valvulae (=gonapophyses) to the base of the 3rd valvula (gonostyli) is 3.8 times longer than gonostyli (Fig. 121).

Distribution.- MEXICO: Zacatecas. U. S. A.: Florida, Idaho, Kansas, Texas

Region.- Neartic.

Coccidencyrtus Ashmead, 1900

(Figs. 40, 104)

Type species. *Encyrtus ensifer* Howard, 1885; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of head at least slightly metallic green or purple. Funicle 6-segmented, not all funicular segments longer than broad (Fig. 40), clava at least more than two-thirds as long as funicle and usually longer. Mandible with a small tooth and a flat truncation (Fig. 11) or with two teeth and a truncation (Fig. 16), never with three acute teeth. Forewing hyaline, with linea calva interrupted.

Description. Head as wide as the thorax, with a vertex of moderate width, not narrow, the ocelli triangularly arranged, the lateral ocelli not lying close to the eye margin, at least their width, or a little more, from it. Head in frontal view with frontovertex wider than eye. Mouth cavity and frontovertex both less than one-half width of head. Malar space at least one-third length of eye.

Scape more than three times as long as broad. Funicle 6-segmented (Fig. 40), not with all segments longer than broad. Clava not longer than apical 5 funicular segments together, with sutures parallel or nearly so.

Mandible with 1 tooth or 2 teeth and a truncation (Figs. 11, 16).

Body robust, pronotum undivided. Mesosoma completely dark. Mesopleuron not enlarged posteriorly, separated from metasoma by metapleuron and propodeum. Scutellum without distinct tuft or bundle of setae or scale-like setae. Scutellum clearly sculptured, hardly shiny.

Forewing hyaline, fully developed. Linea calva interrupted by setae on dorsal surface. Postmarginal vein not longer than stigmal vein or hardly so. Marginal vein longer than broad , venation Y-shaped beyond hyaline break. Stigmal vein subsessile, not longer than marginal vein. Sensilla on stigma vein arrange as four circles on a strait line (Fig. 104). Costal cell with dorsal sur face having only 1 line of setae in apical half. Abdomen short, triangular, as viewed from above. Tarsi 5-segmented. Ovipositor about from 2.6 to 3.9 times longer than gonostyli (Fig. 112, 113).

Host. *Agrilus anxius*(?!), *Aleurothrixus, Aspidiotus destructor, Aspidiotus juglansregiae, Cerococcus, Cerococcus baccharidis, Diaspis bromeliae, Dynaspidiotus britannicus, Epilachna similis*(?!), *Hemiberlesia rapax, Lepidosaphes ulmi, Nipaecoccus viridis*(?!), *Quadraspidiotus gigas, Selenaspidus spinosus* (Noyes 1998).

Host interaction. egg parasitoid(?!), endoparasitoid, parasitism (Noyes 1998).

Associate (plant) : *Baccharis spicata, Zea mays Linnaeus* (Noyes 1998).

Country. Argentina, Canada, China, Ghana, Italy, Pakistan, U.S.S.R., Uruguay (Noyes 1998).

Region. Afrotropical, Nearctic, Neotropical, Oriental, Palearctic (Noyes 1998).

Comperiella Howard, 1906

(Figs. 2, 3, 24, 25, 26, 27, 63, 68, 77, 89, 90, 117)

Type species. *Comperiella bifasciata* Howard, 1906; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of having horizontal vertex with dark, metallic median area bordered by light-colored

areas (Fig. 2, 3). and one or two longitudinal infuscated bands on the fore wings (Figs. 89, 90), or infuscation with 5 hyaline areas, one on the base, two on the external margin, two on the internal margin and one on the apex.

Description. Scape not more than 3 times as long as broad, flagellum broad and flat, funicle 6-segmented, with all funicular segments transverse (Figs. 24, 25, 26, 27), clava 3-segmented with apex transversely truncate; the antenna of C. apoda is different, pedicel and flagellum are slender and not dilated and flattened (Prinsloo 1996).

Pronotum narrow in the middle with posterior margin slightly convex (Fig. 68). Scutellum with or without two large lamelliform setae.

Foreweing always fully developed at most 3 times as long as broad, and with marginal vein at most 5 times as long as broad and with one or two longitudinal infuscated bands (Figs. 89, 90), or or infuscation with 5 hyaline areas, one on the base, two on the external margin, two on the internal margin and one on the apex. Linea calva closed, interrupted.

Subgenital plate with anterior margin straight, posterior margin convex, divided into two lobes by a flask shaped notched in the middle, semicircular ridges on either sides of the notch not followed by knobs. Outer plates of ovipositor narrow at base, broad and obliquely truncated at apex with an oblique ridge along dorsal margin extending beyond three-fourths length of the plate. Third valvulac oblong, movably articulated with second valvifers. Tarsi 5-segmented.

Ovipositor about from 2.60 to 3.9 times longer than gonostyli (Fig. 112), or 8 times longer than gonostyli (Fig. 117).

Host. *Aonidiella aurantii, Chrysomphalus dictyospermi* (Noyes 1998).

Country. China, Italy, U.S.A., U.S.A.-California (Noyes 1998).

Region. Nearctic, Palearctic (Noyes 1998).

Epitetracnemus Girault, 1915

(Figs. 13, 41, 42, 78, 83, 91, 92)

Type species. *Epitetracnemus sexguttatipennis* Girault, 1915; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of head and thorax dark; head with fairly to very conspicuous lines of silvery setae below eye, which usually extend across frons and meet above antennal scrobes; forewing distad of apex of venation with 5 hyaline areas (Figs. 91, 92)

funicle 6-segmented, pedicel and flagellum more or less cylindrical, apex of scutellum with normal setae; forewing with strong infuscation (Figs.)

Description. Head with line of silvery setae across face above scrobes and below eyes. Mouth cavity and frontovertex both less than one-half width of head. Malar space at least one-third length eye. Occipital margin rounded.

Scape more than three times as long as broad, funicle 6-segmented, with not all segments longer than broad, usually first 4 segments broader than long, last 2 segments subquadrates (Figs. 41, 42), clava 3-segmented, rounded, as long as funicle or nearly so.

Mesosoma with dorsum completely dark. Mesopleuron not enlarged posteriorly, separated from metasoma by metapleuron and propodeum. Scutellum without distinct tuft or bundle of setae or scale-like setae.

Forewing fully developed, strongly infuscate, infuscation reaching the apex of the wing; with three hyaline areas on the anterior margin of the forewing and two hyaline areas on the posterior margin of the wing (Figs. 91, 92); the base of the forewing is hyaline; or, as it except by the area behind the post marginal vein has thick setae, which appears to be an infuscation. Linea calva entire or open, interrupted. Postmarginal vein not longer than stigmal vein or hardly so, marginal vein longer than broad, venation Y-shaped beyond hyaline break. Tarsi 5-segmented.

Ovipositor about from 2.0 to 3.9 times longer than gonostyli (Fig. 111, 112)

Country. India (Noyes 1998).

Region. Oriental (Noyes 1998).

Epitetralophidea Girault, 1915

(Figs. 43)

Type species. *Epitetralophidea bicinctipes* Girault, 1915.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of funicle 6-segmented, clava at least more than two-thirds as long as funicle and usually longer, only rarely all funicle segments longer than broad and usually at least one segment transverse.

Description. Head is three or more times wider than frontovertex. Mandible teeth acute equally.

Ovipositor about from 2.0 to 2.25 times longer than gonostyli (Fig. 111)

Habrolepis Förster, 1856

(Figs. 32, 33, 44, 45, 60, 74, 93, 94)

Type species. *Encyrtus nubilipennis* Walker, 1838.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of apex of scutellum with at least one pair of flattened scale-like setae, or, if setae normal then forewing either with an uninterrupted subapical hyaline fascia (Fig. 93) or apex more or less abruptly hyaline and conspicuously paler than infuscate areas of disc (Fig. 94).

Description. Frontovertex wider, one-third width of head. Antenna 6-segmented, more or less cylindrical (Figs. 32, 33), clava 3-segmented.

Body dark and metallic; apex of scutellum with at least one pair of flattened scale-like setae, or, if setae normal then forewing with apex infuscate, and a subapical transverse hyaline band, the rest of the wing is infuscate except for the base and two hyaline areas on the anterior margin and one hyaline area on the posterior margin (Fig. 93) or forewing infuscation with two hyaline areas on the anterior margin of the wing, one hyaline area on the posterior margin of the wing, and a hyaline area in the infuscation close to the base of the wing, which is also hyaline, the apex of the wing is

hyaline but has thick setae contrasting with the proximal hyaline area (Fig. 94). Tarsi 5-segmented.

Ovipositor about from 2.6 to 3.9 times longer than gonostyli (Fig. 112)

Host. *Aonidiella aurantii, Aspidiotus, Aspidiotus atomarius, Chionaspis margaritae, Coccus ehretiae, Froggattiella penicillata, Fulaspis monoloba, Lepidosaphes beckii, Lindingaspis rossi, Melanaspis pedina, Neoselenaspidus silvaticus, Odonaspis ruthae, Planococcus citri*(?), *Quadraspidiotus ostreaeformis, Quadraspidiotus perniciosus, Separaspis proteae, Spinaspidiotus fissidens* (Noyes 1998).

Host interaction. parasitism, parasitism rate (Noyes 1998).

Associate (plant). *Aleurites, Citrus, Ficus nitida Blume, Jasminum azoricum*

Country. Bermuda Is., Egypt, Malawi, Mozambique, Russia, U.S.A., U.S.A.-California, U.S.S.R (Noyes 1998).

Region. Afrotropical, Nearctic, Neotropical, Palearctic (Noyes 1998).

Habitat. Rhynch.: Asterodiaspis quercicola Bouché (Noyes 1998).

Homalopoda Howard, 1894

(Figs. 12, 46, 134-66)

Type species. Designation by monotypy, *Homalopoda cristata.* " Described from four female specimens, two labeled " Leeward side" (Riley et al. 1984).

Diagnosis. Distinguised from other genera of Habrolepidini by the combination of five-segmented tarsi, four-segmented funicle, all segments longer than width, and three-segmented club with apex rounded (Figs. 134-143).

Description. Length (32 specimens) 1.3 mm – 2.85 mm.

Head appears triangular from the side and quadrate from the front, ocelli forming an acute-angled triangle; occipital ridge rounded. Face metallic green with golden and blue reflections; with scattered silver hear, which shorter than the hair on the mandibles. Sculpture of malar space forming long hexagons as striated area. Frontovertex metallic green with golden and blue reflections, with deep hexagonal sculpture, which smaller than omatidia. From the occipital ridge near the eyes, arise two dark setae or scales.

Antenna cylindrical slender, dark brown with green and blue reflections or color varies from brown to yellow without metallic reflections. Funicle four-segmented, all segments longer than width. Club brown, three-segmented, decreasing in length, the first segment length about half of the club length, apex rounded (Figs. 134-143).

Mandibles with the presence of a small thick tooth near to the middle of the ventral margin of the mandible (Figs. 164-166), shape of it can vary from, mandibles with one tooth and a tri-dented truncation (Fig. 164) or with two teeth and a truncation (Fig. 165) or with one tooth and a broad truncation (Fig. 166).

Pronotum, mesoscutum, tegulae, axillae and scutellum metallic green brownish with golden and blue reflections. Pronotum with soft hexagonal sculpture and sharply incised in middle. Mesoscutum about 5 times longer than pronotum and 1.5 times longer than scutellum; it is about 1.5 times wider than long. Mesoscutum sculpture is soft,

regular hexagonal, bigger than sculpture of scutellum. Scutellum presents deeper and smaller sculpture than mesoscutum, its lateral and caudal margins without sculpture, shining as a mirror. From the caudal ridge of the scutellum arise several long setae or scales, which can be arranged by two dark, thin scales or four dark broad scales arrange in line, where the scales located in the ends are smaller than the ones in the middle.

Fore and middle legs normal, rather short; hind femora somewhat enlarged, convex on the outer surface, plane on the inner; hind tibiae flattened laterally.

Wings well developed, reaching the apex of metasoma. Forewings hyaline (Figs. 144-146) or with a infuscate pattern (Figs. 147-153). Submarginal vein reaching margin before one half the wing-length; marginal obscured by brown bristles, longer than the short, stigmal, which obliques into the wing-surface at an acute angle, stigmal vein with three sencillas arranged in strait line.

Abdomen shining brown with green, purple and golden reflections; as long as thorax, concave above, subtriangular, although somewhat rounded towards apex, terebra exserted to about one sixth the length of the abdomen.

Ovipositor: Length from the base of 1st and 2nd valvulae (=gonapophyses) to the base of the 3rd valvula (gonostyli) varies from 2.0 to 5.10 times longer than gonostyli (Figs. 154-163).

Host. *Aspidiotus secretus*, *Ceroplastes giganteus* (Noyes 1998).

Associate plant. *Ficus rubricosa* (Noyes 1998).

Distribution. Costa Rica, Cuba, Ecuador, Haiti, Panama, Puerto Rico, Sri Lanka, St. Vicent, Trinidad (Noyes 1998).

Region. Neotropical, Oriental (Noyes 1998).

Neococcidencyrtus Compere, 1928

(Figs. 4, 6, 16, 34, 47, 58, 59, 69, 75, 76, 80, 81, 95, 96, 114)

Type species. *Neococcidencyrtus alula* Compere, 1928; designation by monotypy.

Diagnosis.- Distinguished from other genera of Habrolepidini by the combination of funicle 6-segmented. Head viewed dorsally with frontovertex relatively narrow, much narrower than width of an eye. Either mid or hind tibia with two conspicuous dark bands.

Description. Head completely orange or at most with mouth margin very narrowly and inconspicuously darkened (Figs. 4, 6) or, head completely dark and metallic or with conspicuous dark markings on frontovertex.

Antenna with 6 funicular segments (Figs. 34, 47, 58, 59) apical funicular segments frequently yellow or white. Clava brown or tan, 3-segmented, as long as, or a little longer than funicle, or shorter than funicle.

Mesoscutum orange with a weak metallic green or purple luster, or, mesoscutum dark metallic or dark brown with a strong metallic green, blue or purple lustre. Scutellum with reticulate sculpture clearly deeper than sculpture of mesoscutum

Wings hyaline or with contrasting hyaline and infuscate areas (Figs. 95, 96) fully developed or conspicuously reduced in size (Fig. 95), venation reaching at least two-

thirds along wing, stigmal vein short and strait, not more than about twice as long as broad.

Hypopygium not extending more than two-thirds length of metasoma.

Legs completely orange, or, with dark brown markings (75, 76, 80, 81). Mesotibial spur cylindrical and pointed at apex.

Ovipositor about from 2.60 to 3.9 times longer than gonostyli (Fig. 112).

Xenostryxis Girault, 1920

(Figs. 48, 71)

Type species. *Xenostryxis margiscutellum*, Girault, 1920; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of head matt yellow to orange-brown, not metallic, dorsally view with frontovertex broader, at least as wide as an eye, head and thorax (excluding axillae) completely dark brown or black ; antennae cylindrical, funicle, for 6-segmented; forewing infuscate.

Description. Head and thorax (excluding axillae) at least partly yellow or orange; head viewed dorsally with frontovertex broader, at least as wide as an eye. Malar space as long as the eye high. Pedicel and flagellum more or less cylindrical; distance between torulus is the same that the mouth long; antennae inserted just under the ventral margin of eyes; funicle 6-segmented. Mandibles with one tooth and a broad truncation.

Thorax flat, shiny without hair. Wings fully developed with spots or bands infuscate, linea calva open. Ovipositor about from 2.60 to 3.9 times longer than gonostyli (Fig. 112).

Country. India

Region. Oriental

Plagiomerus Crawford, 1910

(Figs. 49, 50, 73, 105)

Type species. *Plagiomerus diaspidis* Crawford, 1910; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of Tarsi 5-segmented. Funicle 4-segmented, the first two funicular segments transverse (Figs. 49, 50) forewing hyaline.

Description. Head in lateral view wedge-shaped, acutely angled between antennal scrobes and frontovertex; labrum not prominent; eyes strongly convergent above. Occipital margin often with 2 enlarged setae.

Antennae inserted below the level of the eyes; funicle 4-segmented (Figs. 49, 50), the first two segments transverse, pedicel elongate, much longer than segments one and two of funicle together, no ring joint apparent, clava 3-segmented, with apex rounded. Body metallic, dorsoventrally flattened; scutellum with some sculpture, apically usually with slightly to strongly broadened and flattened lamelliform scales; axillae meeting along the median line. Tarsi 5-segmented.

Forewing hyaline, fully developed; marginal vein not punctiform, as long as the stigmal, postmarginal distinct. Hypopygium extending at most one-half length of metasoma.

Ovipositor about from 2.60 to 4.7 times longer than gonostyli (Fig. 112, 113, 114, 115).

Host. *Howardia biclavis* (Noyes 1998).

Country. Bermuda Is. (Noyes 1998).

Region. Neotropical (Noyes 1998).

Pseudhomalopoda Girault, 1915

(Fig. 29)

Type species. *Pseudhomalopoda prima* Girault, 1915; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of funicle 4-segmented. Antenna with all funicle segments transverse or at most with 3rd and 4th segments quadrate; clava longer than funicle (Fig. 30).

Female.- Differs from Homalopoda in having the antennae short and thick, the scape with a small convex dilation ventrad at apex, the funicle joints all much wider than long, the pedicel and funicle sub-compressed.

Description. Length, 1.00 mm. Differs from the genotype of Homalopoda in having the middle tibia except at base golden yellow, the ovipositor is not shortly extruded as in that species and the wings bear the following different pattern: The large naked hyaline area just cephalad of the venation is larger, larger than the one farther

distad of it (along cephalic margin), the latter cone-shaped (not crescentic as in the genotype) with the smallest end at the cephalic margin, this end narrow; on the caudal half of the wing there are not three spots as in the genotype but only two (the proximal one largest, both paired with the two cephalic spots) and these are larger than the corresponding two in the other species (which bears an additional spot farther proximad near the hairless line). Marginal vein black, the stigmal pale, the former over thrice longer than wide, about twice the length of the stigmal. Funicle joints much wider than long, one and two subannular. Pedicel subcompressed, short. Fronts moderate, narrower than in the other species, prominent, the head rounded, the face much inflexed. Mandibles tridentate but the third tooth is but shallowly separated from the second and is truncate. In the fore wing there is also a small round dot just at apex (but not at the margin).

Ovipositor about from 2.6 to 3.9 times longer than gonostyli (Fig. 112, 113)

Ruskiniana Girault, 1923

(Figs. 10, 30, 97)

Type species. *Ruskiniana sexguttattipenis* Girault, 1923; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of apex of scutellum with a row of about 15 elongate scale-like setae. Forewing with a well-defined color pattern (Fig.97). Head and thorax completely dark with green-violet metallic shine.

Description. Head and body dark with green-violet shine. Head is about 3.5 times wider than mouth cavity; and about 2.6 times wider than frontovertex (Fig. 10). Orbital scale-like, forming single conyinuous line on inner margin of eye (Fig. 10). Frontovertex dark brown with green-blue sheen, with a vertical darker band. Face dark brown with green-blue sheen.

Funicle 6-segmented, funicular segments transverse, 4-6 twice wider than long (Fig. 30), pedicel not flat, clava 3-segmented.

Mandible relatively broad apically with one tooth with a flat broad truncation (Fig. 11).

Apex of scutellum with a row of about 15 elongate scale-like setae. Wide median line of copper on thorax.

Forewing infuscate (Fig. 97) with two hyaline areas close to the apex of the wing, two hyaline areas on the anterior margin and one hyaline area on the posterior margin of the wing. A sixth hyaline area in posterior third under the marginal vein, and a seventh long hyaline area in on the posterior margin under the infuscate area under the postmarginal vein. Femur 3 dilated, tibia 1 beneath pale, tarsi-5segmented.

Ovipositor about from 2.6 to 3.9 times longer than gonostyli (Fig. 112, 113).

Spaniopterus Gahan, 1927

(Figs. 22, 98, 106, 109)

Type species. *Spaniopterus crucifer* Gahan, 1927; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of funicle 4-segmented; forewing with infuscation taking form of an oblique, irregular

cross composed of flattened darker setae (Fig. 98); antenna clearly flattened (Fig. 22). Apex of scutellum with setae normal and not lamelliform.

Description.Female.- Head about as wide as thorax, fronto-vertex flattened, ocelli in a nearly equilateral triangle; viewed from the side the frons prominent; viewed from in front the head broader than high, the scrobes deep and semicircular; antennae compressed; scape subtriangular, a little longer than broad; pedicel subtriangular; funicle joints all much broader than long; club solid and about as long as funicle; prothorax short, rounded in front; mesoscutum a little broader than long, finely shagreened and without grooves; axillae apparently very nearly meeting; scutellum as long as mesoscutum, rather narrow, finely shagreened medially, smooth laterally and at apex; propedeum short; legs normal; forewings developed, the venation extending to middle of anterior margin, the marginal and stigmal veins hidden by a tuft flattened bristles and behind the submarginal vein a little beyond its middle is a similar compact tuft of slightly longer bristles; wing marked by two narrow dark cross-bands which are united near the middle forming an irregular X-shaped figure, the dark areas caused by flattened scale-like black hairs; discal cilia except in the crossbands normal; hindwings hyaline, whitout scale-like hairs, the venation extending two-thirds the length of wing; abdomen as broad at base and about as long as thorax, the ovipositor not exserted; vibrissae as long as hind tibiae.

Ovipositor about from 2.0 to 2.25 times longer than gonostyli (Fig. 111)

Thomsonisca Ghesquière, 1946

(Figs. 36, 54)

Type species. *Thomsonisca tipica*, Mercet, 1921.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of antenna filiform, funicle 6-segmented, all funicle segments longer than broad, first segment of clava more or less separate giving the funicle a 7-segmented appearance (Figs. 36, 54). Head in facial view with antennal toruli situated relatively high on head with dorsal margins well above level of lowest eye margins. Forewing with linea calva interrupted in posterior half by several setae.

Description. Head in facial view with antennal toruli situated relatively high on head with dorsal margins well above level of lowest eye margins.

Antenna filiform, funicle 6-segmented with all segments, except perhaps first and last, subequal in size and shape hardly becoming broader distad; first segment of clava more or less separate; clava not more than two-thirds as long as funicle.

Mandible relatively broad apically with one tooth with a flat broad truncation (Fig. 11).

Forewing hyaline fully developed, linea calva interrupted in posterior half by several setae. Sensilla in the apex of stigmal vein arrange in four circles in line (Fig. 104). Tarsi 5-segmented.

Ovipositor about from 2.6 to 3.9 times longer than gonostyli (Fig. 112, 113)

Host. *Pseudaonidia duplex*

Associate (plant). *Camellia*

Country. China-Taiwan

Region. Oriental

Zaomma Ashmead 1898

(Figs. 55, 115)

Type species. *Encyrtus argentipes* Howard, 1894; designation by monotypy.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of Funicle 6-segmented. Mandible with 2 teeth and a truncation, or truncation bidentate (Fig. 13); gaster with gland-like structures on abdominal tergites III and VII; head in facial view with antennal toruli situated slightly nearer to mouth margin than to imaginary line drawn between lower eye margins; mesoscutum often with conspicuous silvery setae in posterior half; scutellum often with a subapical tuft of setae.

Description. Mouth cavity and frontovertex both less than one-half width of head. Malar space at least one-third length of eye.

Very large rounded eyes, which converge above and leave a very narrow linear vertex. Occipital margin rounded.

Short antennae which have the club enlarged, longer and thicker than the funicle. Funicle 6-segmented, with at least some apical segments yellow or white and contrasting with dark brown clava; funicular segments transverse. Clava 3-segmented

Mandible with 3 or 2 teeth and a truncation.

Wings hyaline. Marginal vein longer than broad, venation Y-shaped beyond hyaline break. Postmarginal vein not longer than stigmal vein or hardly so. Postmarginal and stigmal veins each shorter than marginal vein. Linea calva open, not interrupted.

Metasoma with gland-like openings on Mt2 and Mt6 (best seen in slide-mounted material). Hypopygium extending at most one-half length of metasoma, and with posterior margin of last tergum tapered. Mesoscutum almost always with a few conspicuous silvery setae. Scutellum flat, with deep reticulate sculpture much deeper than sculpture of mesoscutum. Mesopleuron not enlarged posteriorly, separated from metasoma by metapleuron and propodeum. Tarsi 5-segmented.

Ovipositor about from 4.15 to 4.7 times longer than gonostyli (Fig. 114, 115)

Revision of *Ceraptroceroideus* Girault, 1916 (Hymenoptera: Encyrtidae)

The genus *Ceraptroceroideus* was described for the species *C. cinctipes* Girault, 1916 (type-species by monotypy) (Girault, 1916). Trjapitzin and Gordh (1979) described another species for this genus, *C. idahoensis* Trjapitzin and Gordh, 1979.

***Key to species of* Ceraptroceroideus**

1 Wings reduced, extending only to the caudal margin of the scutellum (Figs. 119, 132)..…….…….. ……..…….2

- Wings extending past apex of metasoma……...……..……..…….3

2(1) Frontovertex with a whitish stripe (Fig. 119). Face with a broadly curved, narrow, transverse stripe terminating laterally under the compound eyes and a second curved, whitish stripe between toruli (Fig. 122)……....*cinctipes* Girault

- No secondary white strip between toruli (Fig. 123)……..……..……sp. C, n. sp.

3(1) Frontovertex with a whitish spot (FIG. 119)...…….……..…*cinctipes* Girault

- Frontovertex without whitish spot…..……4

4(3) Face uniformly brown with green and purple reflection..……..…...sp. B, n. sp.

- Face with one or two whitish transverse bands (Figs. 122, 124)……..……..5

5(4) Face with a broadly curved, narrow, transverse, whitish stripe terminating laterally under the compound eyes and a second curved, whitish stripe between the toruli (Fig. 122)…...…….…….. *idahoensis* Trjapitzin and Gordh

- Face with a single, broadly curved, narrow, transverse whitish stripe terminating between the eyes (Fig. 124)…...……...….……..……..sp. A, n. sp.

***Review of species level taxa of* Ceraptroceroideus**

Ceraptroceroideus Girault, 1916

Figures 118 – 133

Type species. *C. cinctipes* Girault, 1916 original designation.

Diagnosis. Distinguished from other genera of Habrolepidini by the combination of antennae brown with purple and green reflections; funicle narrowing apically, with

sixth segment not wider than first segment; club narrower than funicle, and narrowing apically, with apex rounded (Fig. 119); wings often reduced, reaching scutellum caudal margin, with a broad costal cell and distinct submarginal and marginal veins (Figs. 119, 132), or normal, extending past apex of metasoma, with transverse infuscate bands extending from central longitudinal infuscate ray (Fig. 120), hyaline areas with small, pale hairs and infuscate areas with thick dark scales, the largest on the veins and under the submarginal vein.

Description. Length (14 specimens) 0.85mm – 1.7mm. Body dark brown with purple and green reflections.

Head brown with purple and green reflections, lighter on face than frontovertex; face with whitish bands or entirely brown. Sculpture of frontovertex hexagonal, smaller than omatidia. Sculpture of malar space reticulate, cells higher than wide. Head subquadrate (frontal aspect) with some scattered silver setae, 2.7 times wider than mouth cavity, 3.4 times wider than frontovertex, 1.7 times higher than malar space, 1.2 times wider than high. Space between toruli 2.7 times wider than torulus width. Space between toruli and mouth margin 85% of the torulus height. Dorsal margin of torulus same distance below eye ventral margin, as torulus height. Head 1.7 times higher than space between toruli and mid ocelli, 1.4 times higher than eye. Malar space 1.3 times higher than eye.

Mandible with one tooth, and a flat broad truncation (Fig. 133), with the presence of a small thick tooth in the middle of the ventral margin (Fig. 133).

Antennae: Antennae entirely flat, brown with purple and green reflections, setose; setae dark brown, their length about half of the length of one funicle segment. Funicle narrowing apically, with sixth segment narrower than first segment; club narrower than funicle, and narrowing apically, with apex rounded (Fig. 118), all segments wider than long; funicle segments decreasing in width, increasing in length, sixth segment the narrowest and longest, all funicle segments with their distal margin concave. Scape greatly dilated, about 1.7 times longer than wide. Pedicel triangular, shorter than wide. Club conico-cylindrical, first segment subquadrate and largest of the three segments.

Pronotum about 20 % of mesoscutum length, posterior margin broadly concave medially (Fig. 119). Mesoscutum wider than long, as long or nearly as long as the scutellum; scutellum with rounded apex reaching to the base of the metasoma (Fig. 119). Mesoscutum and tegulae brown with purple and green reflections, and weak hexagonal, reticulate sculpturing. Scutellum brown with purple and green reflections; sculpture reticulate, cells deep and smaller than those on mesoscutum, arranged in a whorl around a point in the center with rows of small hexagons apparently coming down from a middle line. The lateral and caudal margins of scutellum lustrous, mirror-like and without sculpture. Axillae meeting medially (easier to see in slide-mounted specimen).

Middle tibial spur long and stout, the caudal spur single and slender.

Wings often reduced, reaching caudal margin of scutellum, with a broad costal cell, and distinct submarginal and marginal veins (Figs. 119, 132), or normal, extending past apex of metasoma, with transverse infuscate bands extending from central

longitudinal infuscate ray (Fig. 120); hyaline areas with small, pale hairs, and infuscate areas with thick dark scales, the largest on the veins and under the submarginal vein, stigmal vein; with three sensilla in straight line.

Abdomen lustrous brown with purple and green reflections, subglabrous.

Length of ovipositor from the base of 1st and 2nd valvulae (=gonapophyses) to the base of the 3rd valvula (gonostyli) is 3.8 times longer than gonostyli (Fig. 121).

Distribution. MEXICO: Zacatecas. U. S. A.: Florida, Idaho, Kansas, Texas

Region. Nearctic.

Ceraptroceroideus cinctipes Girault, 1916

Figures 122, 132

Type species. Syntypes 1 ♀, 1 ♂, Wellington, Kans., October 8, 1908. E. G. Kelly. From *Aspidiotus helianthi* Parr on *Erigeron canadense*. Catalogue No. 19317, U. S. N. M. "The above specimens on tags with a slide bearing a male head and fore wing and female head, legs, antenna and fore wings" (Girault, 1916). Paratype, 1 ♂, same data as syntypes.

Diagnosis. Distinguished from other species of *Ceraptroceroideus* by the combination of frontovertex with a whitish stripe along the ocelli (Fig. 119), face with a broadly curved, narrow whitish transverse strip, just under the vertex and ventral margin of the eyes, and a second curved, whitish stripe between the toruli (Fig. 122); wings reduced (Figs. 119, 132), extending only to the caudal margin of the scutellum, or extended past apex of metasoma (Fig. 120).

Description. Length (two specimens) 1.00 – 1.10 mm.

Frontovertex with a whitish spot between the ocelli (Fig. 119), rest of frontovertex brown with green and purple reflections. Lateral ocelli in the margin of the lateral black border of the vertex. Face with a broadly curved, narrow whitish stripe across, just under the vertex and ventral margin of the eyes, terminating under the external eye margin. A second curved, whitish stripe located between the toruli (Fig. 122).

Mesoscutum setae about the same as the distance among them; low central area without hair.

Wings reduced (Figs. 119, 132), as long as the scutellum, with black, scattered stiff bristles, fuscous dash across at the thickening of the submarginal vein, dusky spot at apex of the venation, and an irregular dusky blotch across the apex, or forewings extended (Fig. 120) past apex of metasoma, with transverse infuscate bands extending from central longitudinal infuscate ray, hyaline areas occupied by small light hairs and infuscate areas by thick dark scales, larger in the veins and under the submarginal vein.

Forelegs brown with purple and green reflections, except distal tip of the trochanter and tibia, and four proximal tarsal segments, which are yellow (Fig. 125). Middle legs with coxa and femur brown with purple and green reflections, except distal end of the femur, which is yellowish; tibia yellow with two brown bands, one at the basal end, the second close to the distal end (Fig. 129). First four tarsal segments yellow, the fifth segment brown. Hindlegs brown with purple and green reflections, except the three proximal tarsal segments and a broad white cinctus slightly proximal of the middle length of the tibia (Fig. 131).

Biology. Host: *Rhizaspidiotus dearnessi* (Thompson, 1954).

Material. 1 ♀, U.S.A. Texas, Pedernales Falls. St. Pk. 22. vii. 1986 (J. Heraty); 1 ♀, U.S.A. Florida, Alachua Co. Gainesville airport (N). 7. v. 1987 (J. Noyes); 3 ♀ U.S.A. Texas U.S.A. Texas, Brazos Co. Lick Creek Park. 4. viii. 1987. 87/059 (J.B. Woolley and Zolnerowich).

Distribution. U.S.A.: Florida, Kansas, Texas.

Region. Nearctic.

Discussion. *C. cinctipes* was diagnosed was diagnosed by Girault as a brachypterous species with wings extending only to the caudal margin of the scutellum (Fig. 119, 132), in this research was found than *C. cinctipes* also present individuals with wings well-developed, exceeding the apex of metasoma (Fig. 120).

Ceraptroceroideus idahoensis Trjapitzin and Gordh, 1979

Figures 118, 120, 121, 126, 133

Holotype ♀, U.S.A. Idaho, Bonneville, Idaho Falls 23m W, on *Chrysothamnus*, 6.vii.1975, G. E. Bohart; pin mounted, microscopic preparation no. 2410. Paratype ♂, same data as holotype.

Diagnosis. Distinguished from other species of *Ceraptroceroideus* by the combination of frontovertex brown with green and purple reflections, face with a broadly curved, narrow whitish strip across, just under the vertex and ventral margin of eyes, and a second curved, whitish stripe located between the toruli (Fig. 122), and wings extended past apex of metasoma.

Description. Length (four specimens) 1.30 – 1.40 mm.

Frontovertex and face brown, with green and purple reflections. Face with a broadly curved, narrow whitish stripe across, just under the vertex and ventral margin of the eyes, terminating under the eye ends. A second curved, whitish stripe between the toruli (Fig. 122).

Wings extended beyond tip of abdomen (Fig. 120). Forelegs brown with purple and green reflections, except distal tip of trochanter and femur and basal and distal tips of tibiae which are yellow (Fig. 126); first and fifth tarsal segments dark brown, second, third and fourth tarsal segments light brown (in some yellowish). Middle legs with coxa and femur brown, with purple and green reflections, except distal end of femur, which yellowish; tibia yellow with two brown bands, one at the basal end, the other close to distal end; first four tarsal segments yellow, fifth segment brown (Fig. 129). Hindlegs brown with purple and green reflections, except three proximal tarsal segments and a broad white cinctus sligtly proximal of the middle of the tibia (Fig. 131).

Material. U.S.A. Texas, Brewster Co. Big Bend National Park. No. Rosillos Mtns. Buttrill Spring. 10 – 19. vii. 1991. (R. Vogtsberger). U.S.A. Texas, Presidio Co. Big Bend Ranch SNA. Lat. 29° 28’ 34”. Long. 103° 49’ 12”. McGuirks Tanks. Elevation, 4100’ Z90-017. 12. v. 1990. (G. Zolnerowich).

Distribution. U.S.A., Idaho, Texas.

Region. Nearctic.

Ceraptroceroideus sp. A**,** new species

Figures 124, 127, 130, 131

Holotype ♀, U.S.A. Texas, Brewster Co. Big Bend National Park. Buttrill Spring. 10-19. vii. 1991. Yellow pan traps (R. Vogtsberger). Paratype 1♂, same locality, 15. vi. 1991. 91/022 (J. B. Woolley).

Diagnosis. Distinguished from other species of *Ceraptroceroideus* by the combination of frontovertex brown, with green and purple reflections, face with a broadly curved narrow whitish stripe across, just under the vertex, between the eyes (Fig. 124), wings extended past apex of metasoma (Fig. 120).

Description. Length (two specimens) 0.85 mm – 1.7 mm.

Frontovertex and face brown, with green and purple reflections. Reflections on face lighter than frontovertex. Face with a broadly curved, narrow, whitish stripe just under the vertex, between the eyes (Fig. 124).

Wings extended beyond the abdomen (Fig. 120). Forelegs brown, with purple and green reflections, except distal tip of trochanter and three first tarsal segments, which are yellow (in some specimens yellowish) (Fig. 127). Middle legs with coxa and femur brown, with purple and green reflections, except the distal end of the femur, which yellowish; tibia with a yellow band in the center; first four tarsal segments yellow, the fifth segment brown (Fig. 130). Hind legs brown, with purple and green reflections, except the three proximal tarsal segments (in some specimens the brown color of the fourth tarsal segment is vanished, and appears yellowish), and a broad white cinctus slightly proximal of the middle of the tibia (Fig. 131).

Distributio. U.S.A.: Texas.

Region. Nearctic.

Ceraptroceroideus sp. B**,** new species

Figures 128, 129

Holotype ♀, MEXICO. Zacatecas. 4 mi NE Concepción del Oro. 4. vii. 1984. 84/014 (J. B. Woolley). Paratype 1 ♀, U. S. A. Texas, Brewster Co. Big Bend National Park. Buttrill Spring. 15-18. vi. 1991. Malaise Z91/042 (G. Zolnerowich and J. B. Woolley).

Diagnosis. Distinguished from other species of *Ceraptroceroideus* by the combination of frontovertex and face brown, with green and purple reflections, and wings extended past apex of metasoma (Fig. 120).

Description. Length (two specimens) 1.15 - 1.6 mm.

Frontovertex and face brown, with green and purple reflections.

Fore legs brown, with purple and green reflections, except distal tip of the trochanter and femur, and basal and distal tips of the tibia, which are yellow; first and fifth tarsal segments dark brown, second, third and fourth segments light brown (in some specimens yellowish) (Fig. 126). Middle legs with coxa and femur brown, with purple and green reflections, except the distal end of the femur, which yellowish, tibia yellow, with two brown bands, one in the basal end, the second one close to the distal end; first four tarsal segments yellow, the fifth segment brown (Fig. 129). Hind legs with coxa and femur brown, with purple and green reflections; a broad, white cinctus slightly proximal of the middle of the tibia, tarsi yellow except for the fifth tarsal segment, which is brown (Fig. 131).

Distribution. MEXICO: Zacatecas. U.S.A.: Texas.

Region. Nearctic.

Ceraptroceroideus sp. **C,** new species

Figures 119, 123, 125

Holotype ♀, U.S.A. Texas, Brazos Co., Lick Creek Park. 4. viii. 1987. 87/059 (J. B. Woolley and Zolnerowich).

Diagnosis. Distinguished from other species of *Ceraptroceroideus* by the combination of frontovertex with a whitish spot along the ocelli, face with a broadly curved, narrow, whitish strip across, just under the vertex and ventral margin of the eyes, wings reduced, and extending only to the caudal margin of the scutellum.

Description. Length (one specimen) 1.15 mm.

Frontovertex with a whitish stripe along the ocelli (Fig. 119). Rest of frontovertex brown, with green and purple reflections. Lateral ocellus in the mesal margin of the lateral black border of the vertex. Face with a broadly curved, narrow, whitish stripe across, just under the vertex and ventral margin of the eyes, its (lateral) ends terminating under the eye ends (Fig. 123).

Forelegs brown, with purple and green reflections, except distal tips of the trochanter and tibia broadly and the four proximal tarsal segments (Fig. 125). Middle legs with coxa and femur brown, with purple and green reflections, except the distal end of the femur, which is yellowish; tibia yellow, with two brown bands, one in the basal end, the other close to the distal end; first four tarsal segments yellow, the fifth segment brown (Fig. 129). Hind legs with coxa and femur brown, with purple and green

reflections; tibia with a broad white cinctus sligtly proximal of its middle; tarsi yellow, except the fifth segment (Fig. 131).

Wings reduced, approximately the length of the scutellum (Figs. 119 and 132). Fore wings with black, scattered stiff bristles, with a fuscous dash across at the thickening of the submarginal vein, a dusky spot against the apex of the venation, and an irregular dusky blotch across the apex.

Distribution. U.S.A.: Texas.

Region. Nearctic.

Revision of the genus *Homalopoda* Girault, 1916 (Hymenoptera: Encyrtidae)

Howard described the genus *Homalopoda* for the species *H. cristata* Howard, 1894. No additional species have been described. The revision of this genus was made only for females, since was difficult to find a trusting relationship between females and males of the same species.

Key to species of* Homalopoda *(females)

1 Forewings hyaline (Figs. 144, 145, 146)……..……...……...……2

- Forewings with a well-defined infuscate pattern (Figs. 147-153).....……....4

2(1) Clava less than five times longer than width (Fig. 136).…..…..…...…sp. C, n. sp.

- Clava more than six times longer than width (Figs. 134, 135)……..……...…....3

3(2) Mandible with one tooth and a tri-dentate truncation (Fig. 164)…...…sp. A, n. sp.

- Mandible with two teeth and a truncation (Fig. 165)……..……...sp. B, n. sp.

4(1) Forewings with an infuscate pattern with three hyaline areas similar in size, and a smaller hyaline area under the submarginal vein, base of the forewing almost hyaline (Figs. 147, 148)……..…..……..…...…….....…sp. D, n. sp

- Forewing with infuscate pattern different (Figs. 149-153)…….…...….5

5(4) Apex of forewing hyaline, hyaline area on the external margin with an internal protuberance, almost reaching the next hyaline area, which is on the internal margin of the wing (Fig. 149)……. …….....sp. D, n. sp.

- Apex of forewing infuscate with two hyaline areas similar in shape and size (Figs. 150-153)…….……..……..……...6

6(5) Forewings with infuscate pattern, with four hyaline areas and fifth small hyaline areas under submarginal vein (Figs. 150, 153) ……...…. 7

- Forewings with infuscate pattern with five clear hyaline areas and a sixth small hyaline area under the submarginal vein (Figs. 151, 153)…….…….8

7(6) Funicle less than 1.5 times longer than scape and club; club four times longer than wide (Fig. 140) ……...……sp. F, n. sp.

- Funicle 1.5 times longer than scape and club; club six times longer than wide (Fig. 142) two dark scales present on occipital ridge near the eyes…….……..…….....sp. H, n. sp.

8(6) Four dark, broad scales present on caudal margin of the scutellum….sp. G, n. sp.

- Two dark bristles present on caudal margin of the scutellum.....cristata Howard

***Review of species level taxa of* Homalopoda**

The review is only for females

Homalopoda Howard, 1894

Figures 134-166

Type species. Designation by monotypy, *Homalopoda cristata.*

Diagnosis. Distinguised from other genera of Habrolepidini by the combination of five-segmented tarsi, four-segmented funicle, all segments longer than width, and three-segmented club with apex rounded (Figs. 134-143).

Description. Female: Length (32 specimens) 1.3 mm – 2.85 mm.

Head appears triangular from the side and quadrate from the front, ocelli forming an acute-angled triangle; occipital ridge rounded. Face metallic green with golden and blue reflections; with scattered silver setae that are shorter than the setae on the mandibles. Malar space with elongate reticulate sculpture. Frontovertex metallic green with golden and blue reflections, with deep hexagonal sculpture, cells smaller than ommatidia. Two dark setae or scales present on occipital ridge near the eyes.

Antenna cylindrical slender, dark brown with green and blue reflections or varying from brown to yellow without metallic reflections. Funicle four-segmented, all

segments longer than wide. Club brown, three-segmented, decreasing in length, the first segment length about half of the club length, apex rounded (Figs. 134-143).

Mandibles with a small thick tooth near to the middle of the ventral margin of the mandible (Figs. 164-166), and varying from one tooth and a tridentate truncation (Fig. 164) or with two teeth and a truncation (Fig. 165) or with one tooth and a broad truncation (Fig. 166).

Pronotum, mesoscutum, tegulae, axillae and scutellum metallic green brownish with golden and blue reflections. Pronotum with weak hexagonal sculpture and sharply incised in middle. Mesoscutum about 5 times longer than pronotum and 1.5 times longer than scutellum; it is about 1.5 times wider than long. Mesoscutum with weak regular hexagonal sculpture, cells bigger than sculpture of scutellum. Scutellum with deeper and smaller hexagonal sculpture than mesoscutum, its lateral and caudal margins without sculpture, shining and mirror-like. Long bristles or scales present on caudal ridge of the scutellum as two dark, thin bristles or four dark broad scales in a line, the scales located at the ends are smaller than the medial ones.

Fore and middle legs normal; hind femora enlarged, convex on the outer surface, flat on the inner; hind tibiae flattened laterally.

Forewings well developed, extending past apex of metasoma, hyaline (Figs. 144-146) or with an infuscate pattern (Figs. 147-153). Submarginal vein reaching margin in basal half marginal vein obscured by brown bristles, longer than the short, stigmal vein that projects into the wing-surface at an acute angle, stigmal vein with three sensilla arranged in strait line.

Metasoma shining brown with green, purple and golden reflections; as long as mesosoma, concave above, subtriangular, although somewhat rounded towards apex, terebra exserted to about one sixth the length of the abdomen.

Length of ovipositor from base of 1st and 2nd valvulae (=gonapophyses) to base of 3rd valvula (gonostyli) varies from 2.0 to 5.10 times longer than gonostyli (Figs. 154-163).

Biology. Known only for *H. cristata*, host: *Aspidiotus secretus*, *Ceroplastes giganteus*. Associate plant: *Ficus rubricosa* (Noyes 1998).

Distribution. Costa Rica, Cuba, Ecuador, Haiti, Panama, Puerto Rico, Sri Lanka, St. Vicent, Trinidad.

Region. Neotropical, Oriental.

Homalopoda cristata Howard, 1894

Figuras 143, 153, 163, 164

Syntypes. *Homalopoda cristata*, Howard, 1894, designation by monotype.

Diagnosis. Distinguished from other species of Homalopoda by the combination of two dark scales present on the occi´pital ridge near eyes, funicle very slightly longer than club and scape (Fig. 143); first two funicular sefments equal in size, which are slightly shorter than the third and fourth, which are equal in size; club about 4.7 times longer than wide (Fig. 143). Mandible with one tooth and a tridentate truncation (Fig. 164). Forewing fuscous hyaline at base and with six hyaline spots (Fig. 153). Two dark, long bristles on the tip of the caudal margin of scutellum. Length of ovipositor from the

base of gonapophyses to the base of the gonostyli about 2.9 times longer than gonostyli (Fig. 154).

Description. Length (five specimens) varying from 1.11 mm to 1.86 mm.

Two dark scales on occipital ridge near the eyes. Antenna, shining brown. Funicle slightly longer than club and scape. The first two segments equal in size, which are subtly shorter than the third and fourth, which are also equal in size. Club 4.7 times longer than width (Fig. 143).

Mandible with one tooth and a tridentate truncation (Fig. 164). Two dark, thick bristles present on the caudal margin of the scutellum.

Forewings fuscous (Fig. 153), hyaline at base and with six hyaline spots, three on either border of the wing, and all touching wing-border except the proximal caudal one, which is separated from border by a continuation of the fuscous; the two distal ones crescent-shaped and the others roundish, the proximal one on the costal margin considerably smaller than the others and situated halfway between beginning of fuscous shading and stigmal vein; middle costal hyaline spot beginning just at stigmal vein, the middle caudal spot being just opposite on caudal wing-border; marginal vein with many dark bristles, making a distinct brown patch.

Length of ovipositor from base of 1st and 2nd valvula to base of 3rd valvula is 2. 9 times longer than gonostyli (Fig. 154).

Host: *Aspidiotus secretus*, *Ceroplastes giganteus*. Associate plant: *Ficus rubricosa* (Noyes 1998).

Distribution. Cuba, Haiti, Panama, Puerto Rico, Sri Lanka, St. Vicent, Trinidad.

Region. Neotropical, Oriental.

Homalopoda sp. A new species

Figures 134, 144, 154

Type. Holotype ♀, ECUADOR, Napo.Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 4-8.x.1995. 220 m canopy fog. Lot # 1222 (T.L.W. Erwin et al.) BM 2000-22. Paratypes. 5 ♀, 1 ♀ same data as holotype; 1 ♀, ECUADOR, Napo. Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 9.ii.1995. 220 m canopy fog. Lot # 975 (T.L.W. Erwin et al.) BMNII 2000-22; 1 ♀, ECUADOR, Napo.Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 4-10.x.1994. 220 m. canopy fog. Lot # 877 (T.L.W. Erwin et al.); 1♀, ECUADOR, Napo.Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 3.x.1996. 220 m canopy fog. Lot # 1727 (T.L.W. Erwin et al.) BM (Ent) 2000-22; 1 ♀, ECUADOR, Napo.Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 20-25.vi.1994. 220 m canopy fog. Lot # 702 (T.L.W. Erwin et al.).

Diagnosis. Distinguished from other species of *Homalopoda,* by the combination of scape yellowish with soft brown shadows, subtly shorter than funicle and club. Pedicel color varies from brown to yellow. Funicle brown, as long as club or slightly longer than it, first two segments equal in size, both occupy among 38% to 40% of the funicle length; club 6.25 times longer than wide (Fig. 134). Forewing hyaline (Fig. 144). Foretibia brown with basal and distal tip yellowish. Mandible with one tooth and a tri-dented truncation (Fig. 164).

Description. Length (five specimens) 1.5 mm to 1.9 mm.

Two dark, long and thick setae on occipital ridge near the eyes.

Scape yellowish with soft brown shadows, slightly shorter than funicle and club. Pedicel color varies from brown to yellow. Funicle brown, as long as club or slightly longer (five specimens). The first two segments equal in size, together 38% to 40% (five specimens) of the funicle length. Club 6.25 times longer than wide (Fig. 134).

Mandible with one tooth and a tridentate truncation (Figure 164).

Two dark thick bristles present on caudal margin of the scutellum. Fore legs brown except for distal tip of femur, basal and distal tips of tibia and tarsi light brown. Middle legs brown, except for basal and distal tips of femur, tibia, tarsi yellow, except last segment, which is light brown. Hind legs brown except for the distal tip of the tibia and the first four tarsal segments yellow.

Forewings hyaline (Fig. 144). Length of ovipositor from base of 1st and 2nd valvulae to the base of 3rd valvula is 2. 4 times longer than gonostyli (Fig. 154).

Distribution. Ecuador.

Region. Neotropical.

Homalopoda sp, B new species

Figures 135, 145, 155

Type. Holotype ♀, ECUADOR, Napo.Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 10.ii.1996. 220 m canopy fog. Lot # 1493 (T.L.W. Erwin et al.) BMNII 2000-22. Paratype ♀, Holotype ♀, ECUADOR, Napo.Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 20-25.vi.1994. 220 m canopy fog. Lot # 707 (T.L.W. Erwin et al.).

Diagnosis. Most similar to sp. A based on the hyaline wing, color of the antenna, and subequal first two funicle segments. Differs from sp. A primarily in the shape of the mandible (Fig. 165 vs. 164).

Description.- Length (one specimen) 1.15 mm.

Two dark, long and thick setae onoccipital ridge near the eyes.

Scape yellowish with soft brown shadows. Pedicel color varies from brown to yellow. Funicle brown, 1.2 times longer than scape, 1.3 times longer than club (two specimens), the two first segments slightly shorter than the rest. Club 7.8 times longer than wide.

Mandible with two teeth and a truncation (Fig. 165).

Two dark, thick bristles on caudal margin of the scutellum. Fore legs brown, except for distal tip of femur and tibia yellow, tarsi light brown. Middle legs brown, except for basal and distal tips of femur and tibia yellow, tarsi yellow, except last segment brown. Hind legs brown except for distal tip of the tibia and first four tarsal segments yellow. Forewings hyaline (Fig. 145).

Length of ovipositor from base of 1st and 2nd valvulae to base of the 3rd valvula is 2.0 times longer than gonostyli (Fig. 155).

Distribution. Ecuador.

Region. Neotropical.

Homalopoda sp. C new species

Figures 136, 146, 156, 165

Type. Holotype ♀, ECUADOR, Napo.Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 4.x.1996. 220 m canopy fog. Lot # 1752 (T.L.W. Erwin et al.) BM (Ent) 2000-22. Paratypes. 4 ♀, 1 ♀, ECUADOR, Napo. Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 2.x.1996. 220 m canopy fog. Lot # 1709 (T.L.W. Erwin et al.) BM (Ent) 2000-22; 1 ♀, ECUADOR, Napo.Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 4.x.1996. 220 m canopy fog. Lot # 1755 (T.L.W. Erwin et al.) BM (Ent) 2000-22. 2 ♀, ECUADOR, Napo. Reserva Ethnica Waorani. 00° 39’ S 76° 26’ W. 3.vii.1995. 220 m canopy fog. Lot # 1109 (T.L.W. Erwin et al.) BMNH 2000-22.

Diagnosis. Distinguished from other species of *Homalopoda,* by the combination of. scape yellowish with soft brown shadows. Pedicel color varies from brown to yellow. Funicle brown, 1.18 times longer than club, 1.25 times longer than scape, four-segmented, all segments longer than width, the first segment is the longest, 1.6 times longer than the second segment, 1.15 times longer than the third and fourth segments, the second funicle segment is the shortest. Club 3.5 times longer than width (Fig. 136). Forewing hyaline (Fig. 146). Foretibia mostly yellow with brown shadow.

Description. Length (four specimens) 1.85 mm to 2.85 mm.

Two long, dark, setae on occipital ridge near the eyes. Scape yellowish with soft brown shadows. Pedicel color varies from brown to yellow. Funicle brown, 1.18 times longer than club, 1.25 times longer than scape, the first segment longest, 1.6 times longer than second segment, 1.15 times longer than the third and fourth segments, the second funicle segment is the shortest. Club 3.5 times longer than width (Fig. 136).

Mandible with two teeth and a truncation (Fig. 165).

Fore legs brown except for the distal tip of the femur, basal and distal tip of the tibia which yellow, tarsi light brown. Middle legs brown, except for the distal tip of the tibia which yellow, tarsi yellow, except the last segment, which is brown. Hind legs are brown except for the distal tip of the tibia and the next four tarsal segments which yellow. Two dark, thick bristles on caudal margin of the scutellum. Wings hyaline, (Fig. 146).

Length from base of 1st and 2nd valvulae to the base of 3rd valvula is 2.8 times longer than gonostyli (Fig. 156).

Distribution. Ecuador.

Region. Neotropical.

Homalopoda sp. D new species

Figures 137, 147, 157, 166

Type. Holotype ♀, COSTA RICA, Heredia OTS La selva. 10° 26' N 86° 05' W. 100 m, 4.iv.1993. Canopy fog FPM/08 Pentaciethra. Paratypes. 2 ♀, 1 ♀, COSTA RICA, Heredia OTS La selva. 100 m, 5.vii.1993. Canopy fog: Virola, FVK/09, INBio/OET; 1♀, ECUADOR, Napo. Reserva Ethnica Waorani. 00° 39' S 76° 26' W. 4.x.1996. 220 m canopy fog. Lot # 1755 (T.L.W. Erwin et al.) BM (Ent) 2000-22.

Diagnosis. Distinguished from other species of *Homalopoda,* by the combination of antennae dark brown with green and blue reflections, funicle from 1.25 to 1.30 times longer than scape, from 1,2 to 1.45 times longer than club, first segment from 1.3 to 1.5 times longer than each funicle segment; club slightly more than 3 times to 4.5 times longer than width (Fig. 137, 138); well defined line of silver setae bordering

the ventral margin of eyes; forewing with well-defined infuscate pattern, which base hyaline, three clearly hyaline areas and small hyaline area under the submarginal vein (Fig. 147).

Description. Length (five specimens) 2.00 mm. to 2.7 mm.

Two dark, long and thick setae on occipital ridge near the eyes.

Antenna dark brown with green and blue reflections, funicle from 1.25 to 1.30 times longer than scape, from 1.2 to 1.45 times longer than club, first segment from 1.3 to 1.5 times longer than each of the other funicle segments. Club from 3 to 4.5 times longer than wide (Figs. 137, 138).

Mandible with one tooth and a truncation (Fig. 166).

Several dark, thick bristles present on caudal margin of the scutellum.

Fore legs brown except for the distal tip of the femur, basal and distal tip of the tibia which yellow, tarsi light brown. Middle legs brown, except for the basal and distal tips of the femur and distal tip of the tibia which yellow, tarsi yellow, except the last segment, which brown. Hind legs brown except for the distal tip of the tibia and first four tarsal segments yellow.

Forewing with a well defined infuscate pattern, forewing base hyaline, plus three clearly hyaline areas and small hyaline area under the submarginal vein (Fig.147).

Length of ovipositor from base of 1st and 2nd valvulae to the base of 3rd valvula is from 4.6 to 5.10 times longer than gonostyli (Figs. 157, 158).

Distribution. Costa Rica, Ecuador.

Region. Neotropical.

Discussion. This species shows two groups of specimens based on the proportion of the antenna, (Figs. 137, 138) but it does not represent enough difference to place them as different species.

Homalopoda sp. E new species

Figures 139, 149

Type. Holotype ♀, COSTA RICA, Guanacaste, ZP Nosara, Fila Maravilla 24.xi-21.xii.2001 (L. Jiménez) # 66663 800 m LN 221350 381700. Paratypes. 2 ♀; 1♀, COSTA RICA, Guanacaste, RF Monte alto, Sedero La Ceiba, 600 m 22.x-26.xi.2001 (L. Jiménez) # 65435, LN 221100 392950; 1 ♀, COSTA RICA, Guanacaste, Est. Cacao (ACG) 2 km SW Cerro Cacao (R. Moraga) 1000 – 1400 m. iv.1996, LN 323100 375800.

Diagnosis. Distinguished from other species of *Homalopoda* by the combination of antennae dark brown with green and blue reflections. Funicle subtly longer than scape and club, first segment 1.40 times longer than each funicle segment, club 3.7 times longer than wide (Fig. 139). Ventral margin of eyes bordered by a well-defined line of continues silver setae. Two dark scales on occipital ridge. Mandible with one tooth and a tridentate truncation. Forewing with well defined infuscate pattern, base an apex of forewing hyaline plus two hyaline areas about the same size almost connected by a hyaline canal, an extra small hyaline area under the submarginal vein (Fig. 149). Four dark, broad scales on the caudal margin of scutellum.

Description. Length (two measured specimens) 1.7 mm. to 2.14 mm.

Two small, dark, scales on occipital ridge near the eyes. Antenna dark brown with green and blue reflections. Funicle slightly longer than scape and club, first

segment 1.40 times longer than each of the remaining funicle segments. Club 3.7 times longer than width (Fig. 139).

Mandible with one tooth and a tridentate truncation (Fig. 164).

Four dark, broad scales present on caudal margin of scutellum, which arranged in line, where the scales located in the ends are smaller than the ones in the middle.

Fore legs brown except for the distal tip of the femur, basal and distal tip of the tibia which yellow, tarsi light brown. Middle legs brown, except for the distal tip of the tibia which yellow, tarsi yellow, except the last segment, which brown. Hind legs brown except for the distal tip of the tibia and the next four tarsal segments which yellow. Forewing extending past apex of metasoma with a well defined infuscate patter (Fig. 149).

Length of ovipositor from base of 1st and 2nd valvulae to the base of 3rd valvula is 2.2 times longer than gonostyli (Fig. 159).

Distribution. Costa Rica.

Region. Neotropical.

Homalopoda sp. F new species

Figures 140, 150, 160

Type.- Holotype ♀, ECUADOR, Napo, Reserva Ethnica Waorani, 00° 39’ S 76° 26’ W, 8-23.ii.1995, 220 m canopy fog. Lot. # 953 (T.L.W. Erwin et al.) BMNH 2000-22. Paratypes. 2 ♀, 1 ♀, ECUADOR, Napo, Reserva Ethnica Waorani, 00° 39’ S 76° 26’ W, 22.vi.1996, 220 m canopy fog. Lot. # 1536 (T.L.W. Erwin et al.) BM (Ent) 2000-

22; 1 ♀, COSTA RICA, Puntarenas. Est. Altamira, Send. A Casa Coca 12.v-12.vi.2001, 1900 m (D. Rubi) # 62124, LS 332800 574250.

Diagnosis. Distinguished from other species of *Homalopoda* by the combination of antennae dark brown with green and blue reflections. Funicle 1.2 times longer than scape and club, first segment 1.4 times longer than the rest three segments, which increase slightly in length, club 4 times longer than wide (Fig. 140). Well-defined silver setae bordering ventral margin of eyes. Two long, dark setae on occipital ridge. Mandible with one tooth and a tridentate truncation. Forewing with well defined infuscate pattern, with five hyaline areas (Fig. 150). Four dark, broad scales on the caudal margin of scutellum.

Description. Length (two specimens) 2.00 mm.

Two long, dark, setae present on occipital ridge near the eyes. Well-defined line of silver setae bordering ventral margin of eyes.

Antenna dark brown with green and blue reflections. Funicle 1.2 times longer than scape and club, four-segmented, all segments longer than wide, first segment 1.4 times longer than the remaining three segments, which increase subtly in length. Club 4 times longer than wide (Fig. 140).

Mandible with one tooth and a tridentate truncation (Fig.164).

Four dark, broad scales present on caudal margin of scutellum, which arranged in line, where the scales located in the ends are smaller than the ones in the middle.

Fore legs brown except for the distal tip of the femur, basal and distal tip of the tibia which yellow, tarsi light brown. Middle legs brown, except for the distal tip of the

tibia which yellow, tarsi yellow, except the last segment, which is brown. Hind legs brown except for the distal tip of the tibia and the next four tarsal segments which yellow. Forewing with well-defined infuscate pattern, with five hyaline areas (Fig. 150).

Length of ovipositor from base of 1st and 2nd valvulae to the base of 3rd valvula is 2.85 times longer than gonostyli (Fig. 160).

Distribution. Costa Rica, Ecuador.

Region. Neotropical.

Homalopoda sp. G new species

Figures 141, 151

Type. Holotype ♀, ECUADOR, Napo, Reserva Ethnica Waorani, 00° 39' S 76° 26' W, 6.x.1995, 220 m canopy fog. Lot. # 1213 (T.L.W. Erwin et al.) BMNH 2000-22. Paratypes. 5 ♀; 1 ♀, ECUADOR, Napo, Reserva Ethnica Waorani, 00° 39' S 76° 26' W, 4-10.x.1994, 220 m. canopy fog. Lot. # 871 (T.L.W. Erwin et al.); 1 ♀, ECUADOR, Napo, Reserva Ethnica Waorani, 00° 39' S 76° 26' W, 2.vii.1995, 220 m. canopy fog. Lot. # 1083 (T.L.W. Erwin et al.) BMNH 2000-22; 1 ♀, ECUADOR, Napo, Reserva Ethnica Waorani, 00° 39' S 76° 26' W, 3.x.1996. 220 m canopy fog. Lot. # 1727 (T.L.W. Erwin et al.) BM (Ent) 2000-22, 1 ♀, ECUADOR, Napo, Reserva Ethnica Waorani, 00° 39' S 76° 26' W, 20-25.vi.1994, 220 m canopy fog. Lot. # 695 (T.L.W. Erwin et al.); 1 ♀, ECUADOR, Napo, Reserva Ethnica Waorani, 00° 39' S 76° 26' W, 4-10.x.1994, 220 m canopy fog. Lot. # 911 (T.L.W. Erwin et al.).

Diagnosis. Distinguished from other species of *Homalopoda* by the combination of dark brown with green and blue reflections. Funicle slightly shorter than club and

scape, first segment 1.3 times longer than the second segment, third and fourth segments sligtly longer than the second, club 3.2 times longer than width. Ventral margin of eyes bordered by a well defined line of continues silver hairs. Mandible with one tooth and a tridentate truncation. Two dark scales on occipital ridge. Forewing fuscous, hyaline at base and with six hyaline spots (Fig. 151). Four dark, broad scales present on the caudal margin of scutellum.

Description. Length (five specimens) 2.00 mm. to 2.15 mm.

Two dark scales on occipital ridge near eyes. The ventral margin of eyes bordered by a well defined line of silver hairs.

Antenna dark brown with green and blue reflections. Funicle slightly shorter than club and scape, first segment 1.3 times longer than the second segment, third and fourth segments slightly longer than the second. Club 3.2 times longer than wide.

Mandible with one tooth and a tridentate truncation (Fig. 164).

Four dark, broad scales present on caudal margin of scutellum, which arranged in line, where the scales located in the ends are smaller than the ones in the middle.

Fore legs are brown except for the distal tip of the femur, basal and distal tip of the tibia, tarsi are light brown. Middle legs are brown, except for the distal tip of the tibia, tarsi yellow, except the last segment, which is brown. Hind legs are brown except for the distal tip of the tibia and the next four tarsal segments.

Forewing fuscous, hyaline at base and with six hyaline spots, three on either border of the wing, and all touching wing-border except the proximal caudal one, which is separated from border by a continuation of the fuscous patch; the two distal ones

crescent-shaped and the others roundish, the proximal one on the costal margin considerably smaller than the others and situated halfway between beginning of fuscous shading and stigmal vein; middle costal hyaline spot beginning just at stigmal vein, the middle caudal spot being just opposite on caudal wing-border; marginal vein with many dark bristles, making a distinct brown patch at that point.

Length of ovipositor from base of 1st and 2nd valvulae to base of the 3rd valvula is 2.7 times longer than gonostyli (Fig. 161).

Distribution. Costa Rica, Ecuador.

Region. Neotropical.

Homalopoda sp. H new species

Figures 142, 152

Type. Holotype ♀, COSTA RICA, 800 m San Jose, Ciudad Colon, ii. 1990 (L. Fournier). Paratypes 3 ♀; 2 ♀, COSTA RICA, Puntarenas. Buenos Aires. Est. Altamira. Cerro Biolley, 1766 m, i. 2000, (D. Rubi) # 55199, LS 332400 572200; 1 ♀, ECUADOR, Napo, Reserva Ethnica Waorani, 00° 39' S 76° 26' W, 7.ii.1996, 220 m canopy fog. Lot. # 1450 (T.L.W. Erwin et al.) BMNH 2000-22.

Diagnosis. Distinguished from other species of *Homalopoda* by the combination of antennae dark brown with green and blue reflections. Funicle 1.5 times longer than scape and club, four-segmented, all segments longer than wide, first segment 1.4 times longer than the others, club 6 times longer than width (Fig. 9). Ventral margin of eyes bordered by a well defined line of continues silver hairs. Mandible with one tooth and a tridentate truncation. Two dark scales on the occipital ridge. Forewing with well-defined

infuscate pattern with five hyaline areas (Fig. 152). Four dark, broad scales on the caudal margin of scutellum.

Description. Length (three specimens) 2.15 mm. to 2.28 mm.

Two dark scales on occipital ridge near the eyes.

Antenna dark brown with green and blue reflections. Funicle 1.5 times longer than scape and club, first segment 1.4 times longer than the others. Club 6 times longer than wide (Fig. 142).

Mandible with one tooth and a tridentate truncation (Fig. 164).

Four dark, broad scales present on caudal margin of scutellum; the scales located on each side are smaller than the ones in the middle.

Fore legs brown except for the distal tip of the femur, basal and distal tip of the tibia which yellow, tarsi light brown. Middle legs brown, except for the distal tip of the tibia, tarsi yellow, except the last segment, which brown. Hind legs brown except for the distal tip of the tibia and the next four tarsal segments.

Forewing fuscous, hyaline at base and with six hyaline spots, three on either border of the wing, and all touching wing-border except the proximal caudal one, which is separated from border by a continuation of the fuscous patch; the two distal ones crescent-shaped and the others roundish, the proximal one on the costal margin considerably smaller than the others and situated halfway between beginning of fuscous shading and stigmal vein; middle costal hyaline spot beginning just at stigmal vein, the middle caudal spot being just opposite on caudal wing-border; marginal vein with many dark bristles, making a distinct brown patch at that point.

Length of ovipositor from base of 1st and 2nd valvulae to the base of 3rd valvula is 2.7 times longer than gonostyli (Fig. 162).

Distribution. Costa Rica, Ecuador.

Region. Neotropical.

CHAPTER V

DISCUSSION

That the most parsimonious tree better explains phylogenetic data has been stressed several times in the literature for more than 20 years (i.e., Farris 1982, 1983). Although initially most authors recommended analysis of unweighted characters, many authors have recognized the value of placing more weight on less homoplastic characters, using means such as successive approximations (Farris 1969, Carpenter 1988). Such character weighting is now well accepted (Kitching et al. 1998). However it is preferable to make the character weights *a posteriori*, as done in this research. Sharkey (1989) evokes the character weights only as a way to select among equally parsimonious trees. I agree with authors who consider that parsimony does not exclude character weighting and some times it is required (Goloboff 1993, Kluge and Farris 1969, Farris 1969, Platnick et al. 1991). Following this logic, successive approximations is the most robust phylogenetic hypothesis (Fig. 169) even though it is six steps longer than the simple parsimony trees.

The monophyly of Habrolepidini was supported by bootstrap of 63% and only for unambiguous character changes (mandible tooth, clava length from 2.57 to 3.28, small hexagonal sculpture of scutellum and sensilla in three circles in straight line). The presence of a small tooth on the middle of the ventral margin of the mandible is one of the most important characters that support Habrolepidini. This tooth has not been found in other genera of Encyrtidae, however some genera of Aphelinidae present a specialized ventroapical mandibular tooth that is formed through modification of a seta into a stout

socketed spine (Heraty and Shauff 1998). This tooth is present in both sexes and it is used for shearing off pieces of the mummified host remains and the scale cover during formation of the exit hole (Heraty and Shauff 1998). This tooth appears to be in a homologous position in some genera of Aphelinidae and Habrolepidini but nowhere else within Chalcidoidea (Heraty and Shauff 1998). Although *Cheiloneurus* is an outgroup and does not have comparable structure on the mandible, both the simple parsimony and successive approximations analyses place it within Habrolepidini, due to four unambiguous and ambiguous character state changes.

Noyes (1990) suggested that *Adelencyrtus, Epitetracnemus*, *Habrolepis* and *Ruskiniana* could be treated as synonymous, since they are separated only by unreliable characters. The successive approximations tree (Fig. 169) show all these groups to be far from each other, and no characters are share among them. In the strict consensus tree (Fig. 167) five species of *Habrolepis*, *Epitetracnemus zetterstedtii* and *Ruskiniana* are close. The only character that *Ruskiniana* and *H. aspidioti* share is the head width from 3.46 to 3.57 times wider than mouth cavity. *H. rouxi* and *E. zetterstedtii* have the space between toruli and mouth margin from 1.28 to 1.32 times higher than torulus, however these characters do not provide evidence to relate these groups. Near the base of the tree *Epitetracnemus comis* and two species of *Adelencyrtus* are close, but they do not share any character.

Noyes (1987) mentioned the close relationship between *Neococcidencyrtus* and *Paraschedius*, however for the lack of diverse material of *Paraschedius,* he treated them as distinct. Both the strict consensus and successive approximations trees show *P.*

caudatus and *N. pudaspidis* as sister groups, this relationship is supported by eight ambiguous characters and two unambiguous character changes. *N. alula* appears close to the group of *P. caudatus* and *N. pudaspidis*, possibly supporting the hypothesis of Noyes that *Neococcidencyrtus* and *Paraschedius* are the same genus. However, other species of *Neococcidencyrtus* appear not to be related. A further study that includes more species of both genera may help to find out the relationship between these two genera.

By the presence of the mandibular tooth *Zaomma*, *Anthemus* and *Thomsonisca* are included in Habrolepidini. *Arrenophagoidea* and *Arrenophagus* do not have the tooth, however, they appear in the tree as sister group of *Anthemus* (in which a tooth is present), and three unambiguous characters and four ambiguous character changes support this relationship. All of them are sister group of *Thompsonisca* (presence of tooth), this relationship is supported by three unambiguous and three ambiguous character changes. *Anthemus*, *Arrenophagoidea*, *Arrenophagus* and *Thompsonisca* appear as sister group of *Zaomma* and *Adelencyrtus moderatus*, in which is present the tooth; three unambiguous and two ambiguous characters, support this relationship.

Arrenophagus albitibiae presents a leaf-like structure on the mandible (Fig. 14) at the same position of the tooth. This structure was not coded as a tooth, but it could be a modification of the same structure. *Arrenophagus chionaspidis* does not show any structure similar to a tooth, but bootstrap of 86% and four unambiguous and three ambiguous character changes support its relationship with *A. albitibiae*. Character 17 (tooth) could have suffered a reversion in *A. chionaspidis* and *Arrenophagoidea,* which is the sister group of *Arrenophagus*, bootstrap of 95% and 10 unambiguous and four

ambiguous character changes support the relationship of these genera. So, even though *Arrenophagoidea* and *Arrenophagous* do not have a tooth, the presence of the leaf-like structure on *A. albitibiae* and the relationship of sister groups between them may support the inclusion of these genera in Habrolepidini.

Adelencyrtus and *Neococcidencyrtus* are distributed along the tree forming polyphyletic groups; they should be the object for future research.

CHAPTER VI

CONCLUSIONS

Cladistic analysis based on maximum parsimony was performed using heuristic searches (10,000) randomized addition sequences followed by TBR branch swapping). The characters were weighted equally, and all were unordered, implying that change is equall between any states. Three equally parsimonious trees were found under this method, all of them of 576 steps, with CI of 0.5017 and RI of 0.5935. The successive approximation character weighting method was applied *a posteriori*, the tree obtained was of 582 steps, CI of 0.4966, RI of 0.5850 and RC of 0.2905.

The results support the hypothesis that the tribe Habrolepidini is defined by the presence of a specialized ventral mandibular tooth that is formed through modification of a seta into a stout socketed spine and three more unambiguous characters, clava length from 2.57 to 3.28, small hexagonal sculpture of scutellum and sensilla on stigmal vein in three circles in straight line.

The monophyly of *Habrolepis*, *Comperiella*, *Epitetracnemus* and *Plagiomerus* was supported by hard and soft synapomorphies. However, *Adelencyrtus* and *Neococcidencyrtus* appear as polyphyletic groups.

The genera *Anthemus*, *Arrenophagoidea*, *Arrenophagus*, *Thompsonisca* and *Zaomma* are included in the tribe Habrolepidini by the presence of the mandibular tooth, or by sister group relationships to other taxa with the mandibular tooth.

LITERATURE CITED

Agarwal, M.M. 1965. Taxonomy of encyrtid parasites (Hymenoptera: Chalcidoidea) of Indian Coccoidea. *Acta Hymenopterologica Tokyo* 2(2): 37-97.

Alam, S.M. 1972. New species of Encyrtidae (Hymenoptera: Chalcidoidea) recorded from India. *Bulletin of Entomology. Entomological Society of India* 11(2): 131-137.

Annecke, D.P. 1963. Records and descriptions of African Encyrtidae 1 (Hymenoptera: Chalcidoidea). *Journal of the Entomological Society of Southern Africa* 25: 170-191.

Annecke, D.P. and H.P. Insley. 1971. Catalogue of Ethiopian Encyrtidae and Aphelinidae. *Entomology Memoir of the Department of Agricultural Technical Services of the Republic of South Africa* 23: 1-53.

Annecke, D.P. and M. J. Mynhardt. 1970. On some species of *Habrolepis* Foerster and *Adelencyrtus* Ashmead (Hym; Encyrtidae) in southern Africa and Mauritius. *Entomophaga* 15(2): 127-148.

Ashmead, W. H. 1888. Descriptions of new Florida Chalcids belonging to the subfamily Encyrtinae. *Entomologica Americana* 4: 15-17.

Ashmead, W.H. 1900. On the genera of chalcids files belonging to the subfamily Encyrtinae. *Proceedings of the United States National Museum* 22:323-412.

Ashmead, W.H. 1901a. Hymenoptera parasitica. *Fauna Hawaiiensis* 1(3): 277-364.

Ashmead, W. H. 1901b. Three new parasitic Hymenoptera from South Africa. *Canadian Entomologist* 33(5): 138-140.

Ashmead, W. H. 1904. A list of Hymenoptera of the Philippine Islands with descriptions of new species. *Journal of the New York Entomological Society* 12 (1): 1-22.

Ayyar, T.V.R. 1934. First record of the chalcid genus *Comperiella* Howard from India with a descriptions of a new species. *Records of the Indian Museum* 36: 219-221.

Battaglia, D. 1988. Notizie biologiche sul *Coccidencyrtus dynaspidioti sp.n.* (Hymenoptera: Encyrtidae), parassitoide di *Dynaspidiotus brittannicus* (Newstead) (Homoptera: Diaspididae). *Bolletino del Laboratorio di Entomologia Agraria 'Filippo Silvestri' Portizi* 45: 149-165.

Bhatnagar, S.P. 1952. Descriptions of a new and records of known Chalcidoidea (Parasitic, Hymenoptera) from India. *Indian Journal of Agricultural Science* 21(2): 155-178.

Blanchard, E.E. 1940. Apuntes sobre Encirtidos argentinos. *Anales de la Sociedad Cientifica Argentina* 130: 106-128.

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

Brèthes, J. 1914. Description d'un nouveau *Prionomitus* de Chile. *Anales de Zoología Aplicada* 1(1):29-30.

Botoc, M. 1962. Nouvelle contributions a letude des chalcidoides de la Republique Roumaine. VI. Quelques chalcidoides (Aphelinidae et Encyrtidae) parasites ou hyperparasites sue les coccides (Coccoidea). *Studi si Certari de Biologie. Filiala Cluj Academia RPR, Bucurest* 13: 103-112. (in Rumanian).

Carpenter, J.M. 1988. Choosing among multiple equally parsimonious cladograms, Cladistics 4: 291-296.

Chumakova, B.M. 1961. Parasites of injurious scale insects from Kabardino-Balkaria (Hymenoptera, Chalcidoidea). *Entomologicheskoe Obozrenie* 40 (2): 315-338.

Chumakova, B.M. 1964. The San José scale, *Diaspidiotus perniciosus* Comst. (Coccidae, Diaspididae), and its parasites in the Soviet Far East. *Entomologicheskoe Obozrenie* 43(3): 535-552.

Clausen, C.P. 1978. Introduced Parasites and Predators of Arthropod Pests and Weeds: A World Review. *Agricultural Handbook No. 480*, Agricultural Research Service, United States, United States Department of Agriculture, Waschington, D.C.

Compere, H. 1928. New coccid inhabiting chalcidoid parasites from Africa and California. *University of California Publications in Entomology* 4(8): 209-230.

Compere, H. 1936. A new species of *Habrolepis* parasitic in *Chrysomphalus-aurantii,* Mask. *Bulletin of Entomological Research* 27 (3): 493-496.

Compere, H. 1947. A new species of Encyrtidae parasitic in *Coccus hesperidum* . *Bulletin of Entomological Research* 38 (2): 281-283, PI. II.

Compere, H. and D. P. Annecke. 1961. Descriptions of parasitic Hymenoptera and comments (Hymenopt: Aphelinidae, Encyrtidae, Eulophidae). *Journal of the Entomological Society of Southern Africa*. 24:17-71.

Crawford, J.C. 1910. Three new genera and species of parasitic Hymenoptera. *Proceedings of the United States National Museum* 38: 87-90.

Curtis, J. 1832. Plates. *British Entomology*. 9: 386-433.

De Santis, L. 1954. Nota sobre himénopteros parásitos de dos cochinillas patagónicas. *Bollettino del Laboratorio di Zoologia Generale e Agraria della Facolta Agraria in Portici* 33:187-197.

De Santis, L. 1963. Encyrtidos de la Republica Argentina (Hymenoptera: Chalcidoidea). *Anales de la Comisión de Investigación Cientifica. Provincia de Buenos Aires Gobernación* 4:9-422.

De Santis, L. 1972. Adiciones a la fauna argentina de encírtidos. III. (Hymenoptera: Chalcidoidea). *Revista Peruana de entomología* 15(1): 44-60.

Delucchi, V. 1965. Les *Habrolepis* Foerster, 1856 (Hym. Chalcidoidea Encyrtidae). *Entomophaga* 10(3): 295-304.

Delucchi, V. and R. Traboulsi. 1965. *Habrolepis fanari* sp. n. (Chalc. Encyrtidae), a parasite of *Chrysomphalus ficus* Ashmead in North Africa and the middle East (Algeria, Egypt and the Lebanoon) and previosly confused with *H. pascuorum* Merc. And *H. dalmanni* (Westw.). *Annales de la Societe Entomologique de France* 1(2): 495-500

Dodd, A.P. 1917. Records, etc; of Australian Chalcidoidea. *Transactions of the Royal Society of South Australia* 41:344-368.

Doutt, R.L. 1951. The parasite complex of *Furcaspis oceanica*, Lindinger. *Annals of the Entomological Society of America* 43(4): 501-507.

Erdös, J. 1957. Series Encyrtidarum novarum hungaricarum. *Acta Zoologica Academiae Scientiarum Hungaricae*. 3(1/2): 5-87. (in Hungarian).

Fabres, G. 1974. Une nouvelle espece du genre *Habrolepis* (Hymenoptera: Chalcidoidea: Encyrtidae) parasite du *Pseudaonidia trilobitiformis* (Homoptera Diaspididae) en Nouvelle Calédonie. *Entomophaga* 19(1): 55-60. (in French).

Fatima, A. and S.A. Shafee. 1993. Studies on the taxonomy of India encyrtds (Hymenoptera: Encyrtidae). *Aligarh Muslim University Publication, Zoological Series on Indian Insect Types* 15: 141 pp.

Ferrière, C. 1953. Un nouvel encyrtidae (Hym. Chalcidoidea) de la Guinée Francaise. *Revue de Pathologie Végétale et d'Entomologie Agricole de France* 32(2): 115-119. (in French).

Ferrière, C. 1955. Encyrtides parasites de cochenilles sur graminées. *Bollettino del Laboratorio di Zoologia Generale e Agraria della Facoltà Agraria in Portici* 33: 350-364.

Fitch, W.M. 1971. Toward defining the course of evolution: minimum change for a specific tree topology. *Systematics Zoological* 20: 406-416.

Förster, A. 1856. Hymenopterologische Studien. 2. Chalcidiae und Proctotrupii. *Aachen* 152 pp. (in Italian).

Fonscolombe, E.L. and J.H. Boyer. 1832. Monographia chalciditum galloprovinciae circa aquas de gentum. *Anales des Sciences Naturelles (1) (Zoologie*) 26:273-307. (in French).

Fullaway, D.T. 1913. Report of the entomologist scale insect parasites. *Report of the Hawaii Agricultural Experiment Station* 1912: 26-31.

Fullaway, D.T. 1946. Insects of Guam II. Hymenoptera, new species of Guam Chalcidoidea. *Bulletin of the Bernice Pauahi Bishop Museum* 189: 201-210.

Gahan, A.B. 1927a. Miscellaneous descriptions of new parasitic Hymenoptera with some synonymical notes. *Proceedings of the United States National Museum* 71: 1-39, 1pl.

Gahan, A.B. 1927b. On some chalcidoid scale parasites from Java. *Bulletin of Entomological Research* 18(2): 149-153.

Ghesquière, J. 1960. Description de deux Aphelinidae recoltes au Maroc (Hymenoptera: Chalcidoidea). *Bulletin de I'Institut Royal des Sciences Naturelles de Belgique* 36: 1-10.

Girault, A.A. 1915a. Australian Hymenoptera Chalcidoidea VII. The family Encyrtidae with descriptions of new genera and species. *Memoirs of the Queensland Museum* 4:1-184.

Girault, A.A. 1915b. New genera of chalcid Hymenoptera. *Journal of the New York Entomological Society* 23(3): 165-173.

Giraul, A.A. 1915c. Some chalcidoid Hymenoptera from north Queensland. *Canadian Entomologist* 47: 17-20.

Girault, A.A. 1916. New Encyrtidae from North America. *Psyche, Cambridge* 23: 41-50.

Girault, A.A. 1917. Some new Australian Chalcid-flies, mostly of the family Encyrtidae. *Insecutor Inscitiae Menstruus* 5:29-37.

Girault, A.A. 1923a. Microscopitis, womanitis and new hexapods. 7 pp. Private publication, Sydney. (This paper is available on this web page: www.nhm.ac.uk/entomology/chalcidoids/browseRefs.dsml).

Girault, A.A. 1923b. New Encyrtidae From Australia II. *Insecutor Inscitiae Menstruus* 11 (7-9): 141-148.

Girault, A.A. 1923c. Loves wooed and won in Australia. 3pp. Private publication, Brisbane. (This paper is available on this web page: www.nhm.ac.uk/entomology/chalcidoids/browseRefs.dsml).

Girault, A.A. 1924. Notes and description of Australian chalcid flies. I. *Insecutor Inscitiae Menstruus* 12: 1-9.

Girault, A.A. 1929. Description of a case of lunacy in Homo and of new six-legged articulates. 3pp. Private publication, Brisbane. (This paper is available on this web page: www.nhm.ac.uk/entomology/chalcidoids/browseRefs.dsml).

Girault, A.A. 1932. New lower Hymenoptera from Australia and India. 6pp. Private publication, Brisbane. (This paper is available on this web page: www.nhm.ac.uk/entomology/chalcidoids/browseRefs.dsml).

Hayat, M. Alam, M. and M.M. Agarwal. 1975. Taxonomic survey of encyrtid parasites (Hymenoptera: Encyrtidae) in India. *Aligarh Muslim University Publication, Zoological Series on Indian Insect Types* 9: 83.

Hennig, W. 1956. Phylogenetic systematics. *Annual Review Entomology* 10: 97-116.

Hennig, W. 1966. *Phylogenetic systematics*. University of Illinois Press, Urbana.

Heraty, J.M. and M.E. Shauff. 1998. Mandibular teeth in Chalcidoidea: function and phylogeny. *Journal of Natural History* 32: 1227-1244.

Hoffer, A. 1955. Fylogenese a Taxonomie Celedi Encyrtidae (Hym., Chalcidoidea). The Phylogeny and Taxonomy of the family Encyrtidae (Hym., Chalcidoidea). *Acta Musei Nationalis Pragae*. 1: 3-22.

Hoffer, A. 1976. Zweiter Beitrag zur Kenntnis der Arten der famile Encyrtidae (Hym. Chalcidoidea) jugoslawiens. *Studia Entomologica Forestalia* 2(2): 19-39. (in German).

Howard, L.O. 1885. Descriptions of North American Chalcididae from the collections of the U.S. Department of Agriculture and of Dr. C.V. Riley, with biological notes. (First paper). Together with a list of the described North American species of the family. *Bulletin of the United States Department of Agriculture, Bureau of Entomology* 5: 1-47.

Howard, L.O. 1897. On the Chalcididae of the Island of Grenada. *Journal of the Linnean Society (Zoology)* 26-129-178.

Howard, L.O. 1906. An interesting new genus and species of Encyrtidae. *Entomological News* 17(4): 121-122.

Howard, L.O. and W.H. Ashmead. 1896. On some reared parasitic hymenopterous insects from Ceylon. *Proceedings of the United States National Museum* 18: 633-648.

Ishii, T. 1923. Observations on the hymenopterous parasites of *Ceroplastes rubens* Mask; with descriptions of new genera and species of the subfamily Encyrtidae. *Bulletin of Imperial Plant Quarantine Station Yokohama* 3:69-114.

Ishii, T. 1925. New Encyrtidae from Japan. *Technical Bulletin, Imperial Plant Quarantine Service, Yokohama* 3:21-30.

Kurdjumov, N.V. 1912. Six new species of chalcid flies parasitic upon *Ericoccus greeni* Newstead. *Russkoe Entomologicheskoe Obozrenie*. 12(2): 329-335.

Maddison, W.P. and D.R. Maddison. 1992. *MacClade Version 3. Analysis of Phylogeny and Character Evolution.* Sinauer Associates, Inc. Publishers. Sunderland, Massachusetts. 398 pp.

Masi, L. 1917. Chalcididae of Seychelles Island. (With an appendix by J.J. Kieffer). *Novitates Zoologicae* 24: 121-330.

Mercet, R.G. 1921. *Fauna Iberica. Himenopteros Fam. Encírtidos.* Museo Nacional de Ciencias Naturales, Madrid. 727 pp. (in Spanish).

Mercet, R.G. 1922. Calcidoideos nuevas de Francia. *Boletin de la Real Sociedad Española de Historia Natural* 22: 396-402. (in Spanish).

Mercet, R.G. 1925. Adiciones a la fauna española de Encírtidos (Hym. Chalc.). *Eos. Revista Española de Entomología. Madrid* 1:321-337. (in Spanish).

Mercet, R,G. 1926. Adiciones a la fauna española de Encirtidos. 6a nota. *Eos*. *Revista Española de Entomología. Madrid.* 2(4): 309-320. (in Spanish).

Mwangi, E.N; Dipeolo, O.O; Newson, R.M, Kaaya, G.P; and S.M. Hassan 1991. Predators, parasitoids and pathogens of ticks: a review. *Biocontrol Science and Technology* 1(3): 147-156.

Myartseva, S.N. 1977. The genus *Neococcidencyrtus* (Hymenoptera, Encyrtidae) new to the USSR, and a description of a new species, *N steinbergi* sp. n. from southeastern Turkmenian. *Entomologicheskoe Obozrenie* 56(1): 171-176.

Myartseva, S.N. 1978. Two new species of the genus *Coccidencyrtus* (Hymenoptera, Encyrtidae) from Turkmenia. *Zoologicheskiy Zhurnal* 57(11): 1735-1740.

Myartseva, S.N. 1981. New species of encyrtid (Hymenoptera: Chalcidoidea) from Turkmenistan, parasites of coccids (Homoptera, Coccoidea). *Izvestiya Akademii Nauk Turkmenskoy SSR (Seriya Biologicheskikh Nauk)* 1981 (5): 70-77.

Myartseva, S.N. 1982. New species of parasitic Hymenoptera (Chalcidoidea, Encyrtidae) from Central Asia and Afghanistan. *Izvestiya Akademii Nauk Turkmenskoy SSR (Seriya Biologicheskikn Nauk)* 1982 (6): 39-46.

Myartseva, S.N. and V.A.Trjapitzin. 1974. A new species of parasitic Hymenoptera *Parashedus jasnoshae sp. n*. (Hymenoptera, Encyrtidae) from central Asia. *Izvestiya Akademii Nauk Turkmenskoy SSR (Seriya Biologicheskikh Nauk)* 1974 (1): 88-91.

Nees, A.B. and C.G. Esenbeck, 1834. Hymenopterarum Ichneumonibus affinium Monographiae, genera. Europaea et species illustrantes. *Stuttgart und Tubingen.* 2: 1-448 pp. (in French).

Neuenschwander, P Hammond, W.N.O. Ajuonu, O. Gado, A. Echendu, N. Bokonon, G.A.H. Allomasso, R. and I. Okon. 1990. Biological control of the cassava mealybug, *Phenacoccus manihoti* (Homoptera: Pseudococcidae), by *Epidinocarsis*

lopezi (Hymenoptera: Encyrtidae), in west Africa as influenced by climate and soil. *Agricultural Ecosystems and Enviroment* 32 (1-2): 39-56.

Nixon, K.C. 1999. The parsimony ratchet, a new method for rapid parsimony analysis. *Cladistics* 15: 407-414.

Noyes, J.S. 1980. A review of the genera of Neotropical Encyrtidae (Hymenoptera: Chalcidoidea). *Bulletin of the British Museum Natural History. Entomology.* 41: 107-253.

Noyes, J.S. 1987. A review of the species of *Neococcidencyrtus* (Hymenoptera: Encyrtidae), parasites of diaspid scale insects. *Journal of Natural History* 21: 995-1019.

Noyes, J.S. 1990. Encyrtidae. Pp.133-166. In: D. Rosen (Ed.) *Armored Scale Insects their Biology, Natural Enemies and Control. Volume 4B.* The Hebrew University of Jerusalem, Faculty of Agriculture, Rehovot, Israel. 688p.

Noyes, J.S. 1998. Catalogue of the Chalcidoidea of the World. *Biodiversity Catalogue Database and Image Library CD-ROM. M series.* British National Museum, London.

Noyes, J.S. 2000. Encyrtidae of Costa Rica (Hymenoptera: Chalcidoidea).1. *Memoirs of the American Entomological Institute* 62: 1-355.

Noyes, J.S. and M. Hayat. 1984. A review of the genera of Indo-Pacific Encyrtidae (Hymenoptera: Chalcidoidea). *Bulletin of the British Museum (Natural History)* 48 (3): 131-395.

Noyes, J.S. and M. Hayat. 1994. *Oriental Mealybug Parasitoids of the Anagyrini (Hymenoptera: Encyrtidae).* The Natural History Museum, London.

Noyes, J.S. and H. Ren. 1987. Two new species of Encyrtidae (Hymenoptera) reared from diaspidid scale insects (Homoptera: Diaspididae) in China. *Entomotaxonomia* 9 (3): 167-174.

Prinsloo, G.L. 1996. The genus *Comperiella* Howard (Hymenoptera: Encyrtidae) in southern Africa: parasitoids of armoured scale insects (Homoptera: Diaspididae). *African Entomology* 4(2): 153-160.

Prinsloo, G.L. and D.P. Annecke. 1976. New Encyrtidae (Hymenoptera) from South West Africa. *Journal of the Entomological Society of Southern Africa* 39 (2): 185-199.

Ratzeburg, J. T. C. 1852. *Die Ichneumonen der Forstinsekten in Entomologischer and forstlicher Bezeihung*. 272pp. Berlin. (in German).

Riley, C.V. Ashmead, W.H. and L.O. Howard. 1894. Report upon the parasitic Hymenopteras of the island of St. Vincent. *Journal of the Linnean Society (Zoology)* 25: 56-254.

Risbec, J. 1951. 1. Les Chalcidoides del Afrique occidentale francaise. *Mémoires de I'Institute Francais d'Afrique Noire, Ifan-Dakar* 13: 7-409.

Risbec, J. 1952. Contribution á létude des chalcidoides de Madagascar. *Mémoires de I'Institut Screntifique de Madagascar* (E) 2:1-449.

Risbec, J. 1959. Encyrtidae de Madagascar (Hymen. Chalcid). *Bulletin del'Académie Malgache* 35:17-44.

Ruschka, F. and L. Fulmek. 1915. Verzeichnis der an der K.K. Pflanzenchutz-Station in wien erzogen parasitischen Hymenopteren. *Zeitschrift för Angewandte Entomologie* 2: 390-412.

Saraswat, G.G. and M.K. Mukerjee. 1975. Records of some known and descriptions of new species of chalcids (Hymenoptera) from India. *Memoirs of the School of Entomology, St. John's College, Agia* 4: 35-62.

Schuh, R.T. 2000. *Biological Systematics.* Cornell University Press, Itleaca, N.Y.

Shafee, S.A. Alam, M. and M.M. Agarwal, 1975. Taxonomic survey of encyrtid parasites (Hymenoptera: Encyrtidae) in India. *Aligarh Muslim University Publication, Zoological Series on Indian Insect Types* 10: 125pp.

Sharkov, A.V. and V.A. Trjapitzin. 1995. 41. Family Encyrtidae. Key to the insects of *Russian for east in six volumes*. Lera, P.A. Dal'nauka, Vladivostok 4(2): 178-256.

Silvestri, F. 1915. Contributo all concoscenza degli insetti dell'olivo dell Eritrea e dell'Africa meridionalei. *Bolletino del Laboratorio di Zoologia Generale e Agraria della R. Scuola Superiore di Agricoltura, Portici* 9: 240-334.

Six, G.A. 1867. Beschriving van eene nieuwe soort van Eupelmoide, benevens cenige aanteekenigen. *Tijdschrift voor Entomologie* 10: 218-221. (in Russian).

Subba Rao, 1957. Some new species of Indian Hymenoptera. *Proceedings of the Indian Academy of Sciences* 46:376:390.

Subba Rao, B.R. 1966. *Comperiella aspidiotiphaga* new species from India (Encyrtidae: Hymenoptera). *Mushi* 39: 135-138.

Swofford, D.L. and D.P. Begle.1993. *PAUP User's Manual.* Champaign, Illinois; Center for Biodiversity. Illinois Natural History Survey. 265pp.

Swofford, D.L. and W.P. Maddison. 1987. Reconstructing ancestral character states under Wagner parsimony. *Math. Biosci.* 87: 199-229.

Tachikawa, T. 1956. Description of a new species of the genus *Pseudhomalopoda* Girault from Japan, with a list of the known species and their hosts of *Habrolepis*-like genera. *Insecta Matsumurana* 20: 90-96.

Tachikawa, T. 1963a. A new and economically important species of sugarcane scale from the Ryukys (Hymen. Chalc. Encyrtidae). *Mushi* 37:131-131.

Tachikawa, T. 1963b. Revisional studies of the Encyrtidae of Japan (Hymenoptera: Chalcidoidea). *Memoirs of Ehime University* 9: 1-264.

Tachikawa,T. 1978. A new species of *Pseudohomalopoda* from Indonesia (Hymenoptera: Chalcidoidea Encyrtidae). *Transactions of the Shikoku Entomological Society* 14 (1/2): 65-67.

Tachikawa, T. 1979. A revision of the genus *Pseudohomalopoda* Girault with the description of a new genus (Hymenoptera: Chalcidoidea Encyrtidae). *Transactions of the Skikoku Entomological Society* 14(3/4): 163-170.

Tachikawa, T. Paik, W.H. and J.C. Paik. 1981. A new species of the genus *Caenohomalooda* Tachikawa (Hymenoptera: Encyrtidae) parasitic on *Odonaspis secreta* (Homoptera: Diaspididae) from Korea. *Transactions of the Shikoku Entomological Society* 15 (3-4): 183-186.

Timberlake, P.H. 1920. Descriptions of new genera and species of Hawaiian Encyrtidae (Hymenoptera). II. *Proceedings of the Hawaiian Entomological Society* 4: 409-437.

Trjapitzin, V.A. 1962. Novyy parazit Turanskoy shchitouki *Diaspidiotus pronorum* (Laing) v faune Armenii i Uzbekistan. *Doklady Akademii Nauk Armyanskoy SSR* 34(2): 93-96. (in Russian).

Trjapitzin, V.A. 1969. A Paleartic representative of the genus *Parahomalopoda* (Hymen. Encyrtidae). *Zoologicheskiy Zhurnal* 48(8): 1252-1254.

Trjapitzin, V.A. 1972. A new species of the genus *Paraschedius* Mercet (Hymenoptera, Chalcidoidea). *Vestnik Zoologii, Kiev* 1972 (1): 79-81.

Trjapitzin, V.A. 1973a. The classification of the family Encyrtidae (Hymenoptera, Chalcidoidea). Part 1. Survey of the systems of classification. The subfamily Tetracneminae Howard, 1982. *Entomologicheskoe Obozrenie* 52: 163-175.

Trjapitzin, V.A. 1973b. Classification of the Parasitic Hymenoptera of the Family Encyrtidae (Chalcidoidea) Part II. Subfamily Encyrtinae Walker, 1837. *Entomological Review* 2: 416-430.

Trjapitzin, V.A. 1989. *Parasitic Hymenoptera of the Fam. Encyrtidae of Palaearctics.* Academy of Sciences of the USSR. Zoological Institute, Leningrad.

Trjapitzin, V.A. and G. Gordh. 1979. Revision of the genus *Ceraptroceroideus* (Hymenoptera, Encyrtidae). *Zoologieheskiy Zhurnal* 58(5):668-673.

Trjapitzin, V.A. and A.V. Sharkov. 1992. A new species of the genus *Caenohomalopoda* Tachikawa (Hymenoptera, Encyrtidae) from Vietnam. *Trudy Zoologicheskogo Instituta Rossiskaya Akademiya Nauk. St. Petersburg* 245: 174-178. (in Russian).

Walker, F. 1837. Monographia Chalciditum. *Entomological Magazine* 5:102-118.

Watrous, L.E. and Q.D. Wheeler. 1981. The out-group comparison method of character analysis. *Systematics Zoological* 30: 1-11.

Waterson, J. 1917. Notes on coccid-infesting Chalcidoidea iii. *Bulletin of Entomological Research* 7(4): 311-326.

Westwood, J.O. 1837. Descriptions of some new British hymenopterous insects. *Philosophical Magazine* (3) 10: 440-442.

Wiley, E. O. 1981. *Phylogenetics. The Theory and Practice of Phylogenetic Systematics.* John Wiley and Sons, Inc. New York 439 pp.

Wiley, E. O., D.R. Brooks, and V.A. Funk. 1991. *The Compleat Cladist, A Primer of Phylogenetic Procedures*. Special Publication No. 19. The University of Kansas Museum of Natural History, Kansas 158pp.

Yeates, D. K. 1995. Groundplans and exemplars: paths to the tree of life. *Cladistics* 11: 343-357.

APPENDIX 1

List of species of the tribe Habrolepidini before this research

Adelencyrtus Ashmead, 1900

A. antennatus Compere & Annecke, 1961

A. aulacaspidis (Brèthes, 1914)

A. axillaris (Girault, 1915)

A. bifasciatus (Ishii, 1923)

A. bimaculatus Alam, 1972

A. brachycaudae Xu & Shi, 1999

A. chinensis Xu & Shi, 1999

A. chionaspidis (Howard, 1896)

A. coxalis Hayat, Alam & Agarwal, 1975

A. depressus (Risbec, 1959)

A. flagellatus Compere & Annecke, 1961

A. funicularis Hayat, Alam & Agarwal, 1975

A. inglisiae Compere & Annecke, 1961

A. longiclavatus Hayat, Alam & Agarwal, 1975

A. mangiphila (Risbec, 1952)

A. mayurai (Subba Rao, 1957)

A. minutus (Girault, 1915)

A. moderatus (Howard, 1897)

A. oceanicus (Doutt, 1951)

A. odonaspidis Fullaway, 1913

A. orissanus Hayat, 2003

A. quadridentatus (Girault, 1915)

A. quadriguttus (Girault, 1932)

A. quinquedentatus (Girault, 1929)

A. sarawaki Trjapitzin & Myartseva, 2001

A. simmondsi Compere, 1947

A. subapterus (Kurdjumov, 1912)

A. tibialis Compere & Annecke, 1961

Caenohomalopoda Tachikawa, 1971

C. darevskyi Trjapitzin & Sharkov, 1992

C. guamensis (Fullaway, 1946)

C. koreana Tachikawa, Paik & Paik, 1981

C. longiclava Basha & Hayat (unavailable name in Chalcicoidea)

C. nagaii (Tachikawa, 1978)

C. shikokuensis (Tachikawa, 1956)

Ceraptroceroideus Girault, 1916

C. cinctipes Girault, 1916

C. idahoensis Trjapitzin & Gordh, 1979

Coccidencyrtus Ashmead, 1900

C. albiflagellum (Girault, 1915)

C. albitarsus (Girault, 1915)

C. annulipes (Blanchard, 1940)

C. artemisiae Myartseva, 1981

C. auricornis (Girault, 1924)

C. australis (Girault, 1915)

C. bicolor (Girault, 1915)

C. blanchardi (De Santis, 1954)

C. clavatus (Hayat, Alam & Agarwal, 1975)

C. denieri Blanchard, 1940

C. duplachionaspidis Myartseva, 1978

C. dynaspidioti Battaglia, 1988

C. ensifer (Howard, 1885)

C. grioti Blanchard, 1940

C. infuscatus Compere & Annecke, 1961

C. lepidosaphidis Sharkov, 1995

C. longicaudatus Tan & Zhao, 1998

C. maculicornis (Blanchard, 1940)

C. malloi Blanchard, 1964

C. mandibularis (Hayat, Alam & Agarwal, 1975)

C. maritimus Sharkov, 1995

C. obesus De Santis, 1964

C. ochraceipes Gahan, 1927

C. phenacocci Ferrière, 1955

C. pinicola Mercet, 1921

C. plectroniae Risbec, 1959

C. punctatus Compere & Annecke, 1961

C. schizotargioniae Myartseva, 1978

C. secundus (Girault, 1915)

C. shafeei (Hayat, Alam & Agarwal, 1975)

C. steinbergi Chumakova & Trjapitzin, 1964

C. wallacei (Girault, 1915)

Comperiella Howard, 1906

C. apoda Prinsloo, 1996

C. aspidiotiphaga Subba Rao, 1966

C. bifasciata Howard, 1906

C. indica Ayyar, 1934

C. karoo Prinsloo, 1996

C. lemniscata Compere & Annecke, 1961

C. pia (Girault, 1915)

C. ponticula Prinsloo & Annecke, 1976

C. unifasciata Ishii, 1925

Epitetracnemus Girault, 1915

E. comis Noyes & Ren, 1987

E. intersectus (Fonscolombe, 1832)

E. japonicus (Ishii, 1923)

E. kosef Li & Byun, 2002

E. lindingaspidis (Tachikawa, 1963)

E. sexguttatipennis Girault, 1915

Epitetralophidea Girault, 1915a

E. articulus (Girault, 1915)

E. bicinctipes Girault, 1915

E. magnithorax (Girault, 1923)

Habrolepis Förster, 1856

H. aeruginosa Masi, 1917

H. algoensis Annecke & Mynhardt, 1970

H. apicalis Waterston, 1917

H. dalmanni (Westwood, 1837)

H. diaspidi (Risbec, 1951)

H. guineensis Ferrière, 1953

H. italicus Delucchi, 1965

H. montenegrina Hoffer, 1976

H. namibensis Prinsloo & Annecke, 1976

H. neocaledonensis Fabres, 1974

H. obscura Compere & Annecke, 1961

H. occidua Annecke & Mynhardt, 1970

H. oppugnati Silvestri, 1915

H. pascuorum Mercet, 1921

H. rouxi Compere, 1936

H. setigera Annecke & Mynhardt, 1970

H. tergrigorianae Trjapitzin, 1962

Homalopoda Howard, 1894

H. cristata Howard, 1894

Neocladella Girault. 1915a

N. compressipes Girault, 1915

Neococcidencyrtus Compere, 1928

N. brenhindis Noyes, 1987

N. chrysomphali (Blanchard, 1940)

N. cleddis Noyes, 1987

N. cliradainis Noyes, 1987

N. colynis Noyes, 1987

N. crouzelae De Santis, 1964

N. cullainis Noyes, 1987

N. delis Noyes, 1987

N. dryslydis Noyes, 1987

N. drysus Noyes, 1987

N. hynodis Noyes, 1987

N. melynis Noyes, 1987

N. poutiersi (Mercet, 1922)

N. pudaspidis (Annecke, 1963)

N. quadriceps (De Santis, 1972)

N. selogis Noyes, 1987

N. steinbergi Myartseva, 1977

N. syndodis Noyes, 1987

Plagiomerus Crawford, 1910

P. aulacaspis Tan & Zhao, 1998

P. bangaloriensis Shafee, Alam & Agarwal, 1975

P. cyaneus (Ashmead, 1888)

P. derceto (Trjapitzin, 1969)

P. diaspidis Crawford, 1910

P. hospes Timberlake, 1920

P. magniclavus Tan & Zhao, 1998

P. monticolus Hayat, 2003

P. peruviensis (Girault, 1915)

Pseudhomalopoda Girault. 1915b

P. prima Girault, 1915

Ruskiniana Girault, 1923a

R. sexguttatipennis Girault, 1923

Spaniopterus Gahan, 1972

S. crucifer Gahan, 1927

Xenostryxis Girault, 1920

X. bicolor (Myarstseva, 1982)

X. brevicauda Hayat, 2003

X. caudatus (Trjapitzin, 1972)

X. ductor (Mercet, 1925)

X. jasnoshae (Myartseva & Trjapitzin, 1974)

X. margiscutellum Girault, 1920

X. tenuicauda Hayat, 2003

X. thymicola (Mercet, 1925)

APPENDIX 2

		1	2	3	4	5	6	7	8	9	10	11	12
		Head	Head	Head	Head	Head	Spac	Spac	Spac	Spac	Eye	Eye	Head
1	Adelencyrtus mayurai	0	0	6	0	2	3	1	3	0	1	0	0
2	Adelencyrtus moderatus	1	0	4	1	2	3	1	2	0	1	0	0
3	Adelencyrtus odonaspidis	1	0	4	1	2	3	1	3	0	1	0	0
4	Adelencyrtus simmondsi	0	0	4	2	2	3	1	3	0	1	1	0
5	Caenohomalopoda guamensis	0	0	3	0	2	2	4	1	1	1	0	1
6	Ceraptroceroideus idahoensis	2	0	4	0	2	3	1	4	0	1	0	0
7	Coccidencyrtus ochraceipes	B	0	2	5	2	3	1	1	0	0	3	0
8	Comperiella bifasciata	3	0	3	0	2	3	4	1	1	1	0	0
9	Comperiella indica	4	2	3	0	2	3	4	2	1	1	0	0
10	Comperiella lemniscata	3	0	3	0	2	3	4	1	2	1	0	0
11	Comperiella unifasciata	3	0	3	0	2	3	1	3	0	1	0	0
12	Epitetracnemus comis	0	0	6	0	2	3	1	3	0	1	0	0
13	Epitetracnemus zetterstedtii	0	0	4	0	2	3	3	5	0	1	0	0
14	Epitetralophidea bicinctipes	9	0	4	1	2	3	1	3	0	1	0	0
15	Habrolepis aspidioti	5	2	3	0	2	3	2	1	1	1	0	1
16	Habrolepis dalmani	5	0	3	0	2	3	5	2	1	1	0	1
17	Habrolepis occidua	5	0	4	0	2	7	1	3	0	1	0	0
18	Habrolepis pascuarum	5	0	3	0	2	3	4	2	0	1	0	1
19	Habrolepis rouxi	5	0	4	0	2	3	3	1	1	1	0	1
20	Homalopoda cristata	0	0	4	0	2	2	1	3	0	1	0	1
21	Neococcidencyrtus alula	6	0	6	1	2	3	1	3	0	1	0	0
22	Neococcidencyrtus crouzelae	0	0	6	0	2	3	1	4	0	1	0	0
23	Neococcidencyrtus dryslydis	7	0	4	0	2	3	1	3	0	1	0	0
24	Neococcidencyrtus pudaspidis	8	0	6	1	2	3	1	4	0	1	0	0
25	Paraschedius caudatus	8	2	3	0	2	1	2	4	0	1	0	0
26	Plagiomerus diaspidis	9	0	4	0	2	3	2	3	0	1	0	0
27	Plagiomerus hospes	9	0	4	0	2	3	1	3	0	1	0	0
28	Pseudhomalopoda prima	0	0	3	0	2	3	3	2	0	1	0	1
29	Ruskiniana sexguttatipenis	E	2	3	0	2	5	5	1	1	1	0	0
30	Spaniopterus crucifer	B	0	2	1	2	6	1	2	0	1	0	0
31	Anthemus inconspicuous	C	0	0	2	2	2	1	0	0	1	0	0
32	Arrenophagoidea coloripes	B	1	0	1	2	2	1	3	0	1	0	0
33	Arrenophagus albitibiae	B	0	0	1	2	2	1	3	0	1	0	0
34	Arrenophagus chionaspidis	B	3	0	1	1	0	1	3	0	1	0	0
35	Thompsonisca amathus	B	0	1	4	2	2	1	1	1	1	2	0
36	Thompsonisca pakistanensis	B	2	3	6	2	3	1	0	1	0	4	0
37	Zaomma cestus	9	0	4	1	2	5	1	4	0	1	0	0
38	Anicetus sp.3	D	0	5	1	2	3	1	2	0	1	0	0
39	Cheiloneurus sp. 9	8	0	4	3	0	3	0	4	0	0	1	0
40	Microterys sp. 4	6	0	6	1	2	4	1	4	0	1	0	0

		13	14	15	16	17	18	19	20	21	22	23	24
		Setae	Head	Sculp	Mand	Mand	Antel	Antel	Scap	Pedic	Clava	First	Sec
1	Adelencyrtus mayurai	0	0	0	0	1	0	3	4	1	2	0	3
2	Adelencyrtus moderatus	0	0	0	1	1	0	3	4	1	2	1	3
3	Adelencyrtus odonaspidis	0	0	0	1	1	0	3	4	1	3	0	1
4	Adelencyrtus simmondsi	0	0	0	0	1	0	3	5	1	1	0	1
5	Caenohomalopoda guamensis	0	0	0	1	1	1	1	3	1	2	0	1
6	Ceraptroceroideus idahoensis	0	1	0	0	1	2	3	1	0	2	1	3
7	Coccidencyrtus ochraceipes	0	0	0	0	1	3	3	4	1	3	0	1
8	Comperiella bifasciata	0	1	0	0	1	2	3	1	0	1	0	3
9	Comperiella indica	0	1	0	0	1	2	3	1	0	1	2	4
10	Comperiella lemniscata	0	1	0	0	1	2	3	1	0	1	1	5
11	Comperiella unifasciata	0	1	0	0	1	2	3	1	0	1	1	4
12	Epitetracnemus comis	1	0	0	2	1	1	3	4	1	2	0	1
13	Epitetracnemus zetterstedtii	1	0	0	1	1	1	3	4	1	2	1	3
14	Epitetralophidea bicinctipes	0	0	0	0	1	7	3	4	1	2	0	1
15	Habrolepis aspidioti	0	0	0	0	1	1	3	3	1	1	1	3
16	Habrolepis dalmani	0	0	0	0	1	1	3	3	1	2	0	1
17	Habrolepis occidua	0	0	0	0	1	1	3	4	1	2	0	1
18	Habrolepis pascuarum	0	0	0	0	1	1	3	4	1	1	1	3
19	Habrolepis rouxi	0	0	0	0	1	4	3	6	1	2	0	1
20	Homalopoda cristata	0	0	0	1	1	2	1	4	1	4	0	0
21	Neococcidencyrtus alula	0	0	0	0	1	5	3	3	2	2	0	1
22	Neococcidencyrtus crouzelae	0	0	0	5	1	1	3	5	1	2	0	1
23	Neococcidencyrtus dryslydis	0	0	0	0	1	6	3	4	1	2	0	1
24	Neococcidencyrtus pudaspidis	0	0	0	0	1	5	3	5	1	2	0	0
25	Paraschedius caudatus	0	0	?	0	1	7	3	4	1	3	0	0
26	Plagiomerus diaspidis	0	0	0	1	1	1	1	4	1	2	0	3
27	Plagiomerus hospes	0	0	0	1	1	1	1	4	1	2	0	1
28	Pseudhomalopoda prima	0	0	0	0	1	2	1	2	0	2	2	4
29	Ruskiniana sexguttatipenis	2	0	0	0	1	7	3	2	0	1	3	5
30	Spaniopterus crucifer	0	?	0	0	1	2	1	0	0	1	2	4
31	Anthemus inconspicuous	0	0	0	6	1	7	2	3	1	3	0	0
32	Arrenophagoidea coloripes	0	0	2	7	0	3	0	4	1	1	2	4
33	Arrenophagus albitibiae	0	0	1	3	0	3	0	4	1	1	1	5
34	Arrenophagus chionaspidis	0	0	1	4	0	3	0	4	1	1	2	5
35	Thompsonisca amathus	0	0	0	0	1	7	3	4	1	4	0	0
36	Thompsonisca pakistanensis	0	0	0	0	1	7	3	3	0	4	0	0
37	Zaomma cestus	0	0	0	0	1	1	3	4	1	2	0	2
38	Anicetus sp.3	0	1	0	8	0	3	3	1	0	0	2	4
39	Cheiloneurus sp. 9	0	0	0	9	0	8	3	7	1	1	0	0
40	Microterys sp. 4	0	0	0	A	0	4	3	4	1	0	0	1

		25	26	27	28	29	30	31	32	33	34	35	
		Third	Four	Fifth	Sixth	Scap	Scap	Scap	Funic	Clava	Funic	Mesc	S
1	Adelencyrtus mayurai	1	3	1	1	2	0	0	1	1	1	0	
2	Adelencyrtus moderatus	1	3	1	1	1	0	0	1	1	1	1	
3	Adelencyrtus odonaspidis	0	2	1	1	2	0	0	2	2	1	3	
4	Adelencyrtus simmondsi	0	1	1	1	2	0	0	2	1	1	3	
5	Caenohomalopoda guamensis	0	1	0	0	2	0	0	2	2	1	0	
6	Ceraptroceroideus idahoensis	1	3	2	2	3	0	0	4	1	1	1	
7	Coccidencyrtus ochraceipes	0	1	1	1	2	0	0	4	1	1	1	
8	Comperiella bifasciata	2	4	3	3	1	0	0	1	1	1	2	
9	Comperiella indica	2	5	3	3	1	0	0	1	1	1	2	
10	Comperiella lemniscata	2	5	3	3	1	0	0	1	1	1	2	
11	Comperiella unifasciata	2	4	3	3	1	0	0	1	1	1	2	
12	Epitetracnemus comis	0	1	1	1	2	0	0	2	1	1	3	
13	Epitetracnemus zetterstedtii	1	4	1	1	2	0	0	1	1	1	3	
14	Epitetralophidea bicinctipes	0	1	1	1	3	0	0	5	1	1	7	
15	Habrolepis aspidioti	1	4	3	1	3	0	0	1	1	1	4	
16	Habrolepis dalmani	0	2	1	1	2	0	0	2	1	1	4	
17	Habrolepis occidua	0	2	1	1	2	0	0	1	1	1	4	
18	Habrolepis pascuarum	2	4	3	2	2	0	0	1	1	1	4	
19	Habrolepis rouxi	0	2	1	1	2	0	0	1	1	1	4	
20	Homalopoda cristata	0	1	0	0	3	0	0	3	2	1	3	
21	Neococcidencyrtus alula	0	1	1	1	2	0	0	2	1	1	5	
22	Neococcidencyrtus crouzelae	0	1	1	1	4	0	0	4	2	1	3	
23	Neococcidencyrtus dryslydis	0	1	1	1	2	0	0	2	1	1	6	
24	Neococcidencyrtus pudaspidis	0	1	1	1	3	0	0	5	1	2	5	
25	Paraschedius caudatus	0	1	1	1	2	0	0	5	1	2	7	
26	Plagiomerus diaspidis	0	1	0	0	1	0	0	1	1	1	4	
27	Plagiomerus hospes	0	1	0	0	3	0	0	2	2	1	4	
28	Pseudhomalopoda prima	1	2	0	0	2	0	0	1	1	1	4	
29	Ruskiniana sexguttatipenis	4	4	3	2	2	0	0	2	1	1	2	
30	Spaniopterus crucifer	3	3	0	0	0	0	1	2	2	1	1	
31	Anthemus inconspicuous	0	1	1	0	1	0	0	2	1	1	8	
32	Arrenophagoidea coloripes	4	0	0	0	2	2	0	0	0	0	1	
33	Arrenophagus albitibiae	4	0	0	0	2	2	0	0	2	0	1	
34	Arrenophagus chionaspidis	4	0	0	0	2	2	0	0	1	0	1	
35	Thompsonisca amathus	0	1	1	1	2	1	0	7	3	2	1	
36	Thompsonisca pakistanensis	0	1	1	1	2	1	0	8	3	2	1	
37	Zaomma cestus	0	3	2	1	2	0	0	1	2	1	1	
38	Anicetus sp.3	5	6	4	4	2	0	0	1	1	1	5	
39	Cheiloneurus sp. 9	0	2	1	2	2	0	0	6	1	3	6	
40	Microterys sp. 4	0	1	2	2	3	0	0	4	1	2	6	

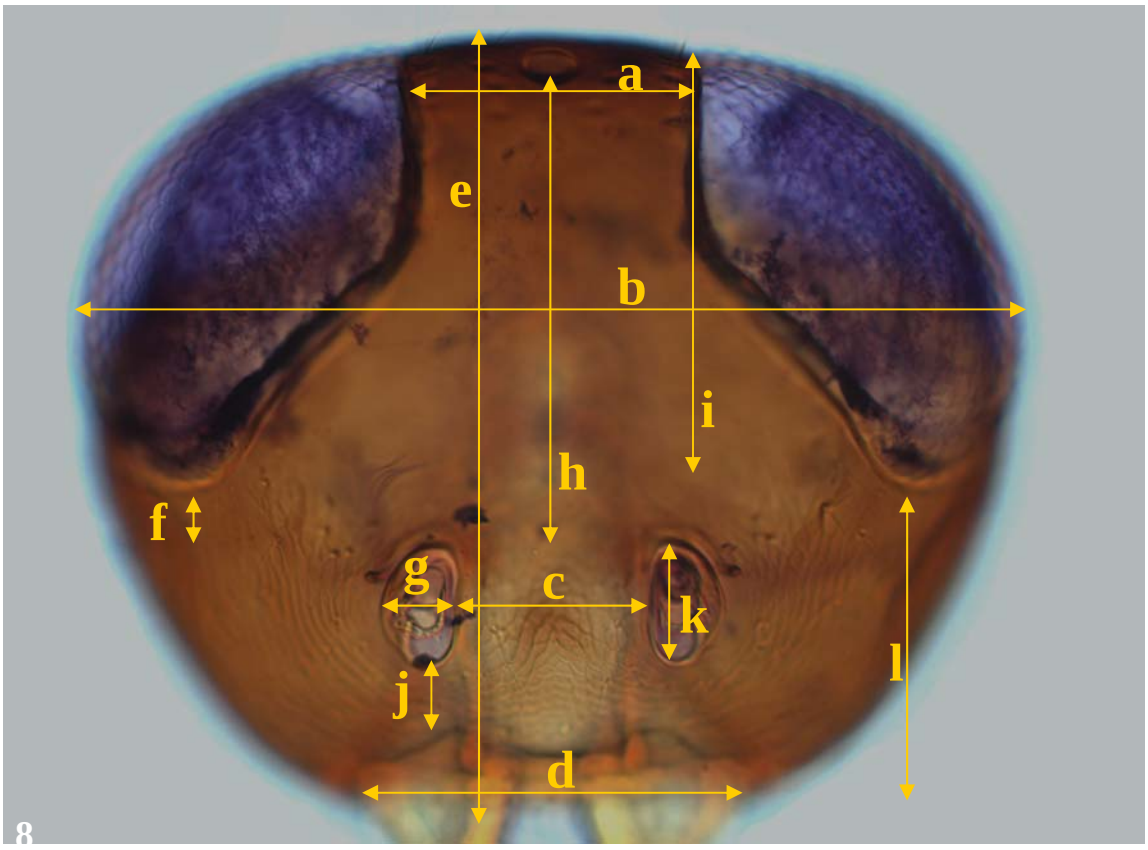
		37	38	39	40	41	42	43	44	45	46	47
		Mesc	Mesc	Scute	Tuft	Tegu	Mesc	Axilla	Pron	Pron	Meta	Tarsi
1	Adelencyrtus mayurai	0	0	7	0	0	0	0	0	1	0	1
2	Adelencyrtus moderatus	1	1	1	0	0	0	1	0	0	0	1
3	Adelencyrtus odonaspidis	1	1	7	0	0	0	0	0	3	0	1
4	Adelencyrtus simmondsi	2	0	7	0	1	0	1	0	3	0	1
5	Caenohomalopoda guamensis	0	1	2	1	0	0	1	1	0	0	1
6	Ceraptroceroideus idahoensis	0	2	3	0	0	1	1	0	0	0	1
7	Coccidencyrtus ochraceipes	0	0	1	0	0	0	1	2	0	0	1
8	Comperiella bifasciata	0	2	4	0	0	0	1	2	2	0	1
9	Comperiella indica	0	2	5	0	0	0	1	2	2	0	1
10	Comperiella lemniscata	0	2	5	0	0	0	1	2	2	0	1
11	Comperiella unifasciata	0	2	5	0	0	0	1	2	2	0	1
12	Epitetracnemus comis	0	0	0	0	0	0	0	0	3	0	1
13	Epitetracnemus zetterstedtii	0	0	0	0	0	0	0	0	3	0	1
14	Epitetralophidea bicinctipes	0	0	0	0	0	3	3	0	4	0	1
15	Habrolepis aspidioti	1	0	6	1	0	0	1	0	4	0	1
16	Habrolepis dalmani	1	0	6	1	0	0	1	0	4	0	1
17	Habrolepis occidua	0	0	6	1	0	0	1	0	4	0	1
18	Habrolepis pascuarum	0	1	6	1	0	0	1	0	4	0	1
19	Habrolepis rouxi	0	1	6	1	0	0	1	0	3	0	1
20	Homalopoda cristata	0	0	7	2	0	0	1	0	3	2	1
21	Neococcidencyrtus alula	1	1	7	0	2	2	2	3	5	3	1
22	Neococcidencyrtus crouzelae	0	1	8	0	0	0	1	0	3	0	1
23	Neococcidencyrtus dryslydis	0	2	8	0	3	2	2	0	5	0	1
24	Neococcidencyrtus pudaspidis	2	0	7	0	2	2	2	0	5	3	1
25	Paraschedius caudatus	?	1	1	0	4	3	3	3	6	4	1
26	Plagiomerus diaspidis	0	1	7	3	0	0	1	2	3	0	1
27	Plagiomerus hospes	0	1	7	3	0	0	1	0	3	0	1
28	Pseudhomalopoda prima	0	1	7	4	2	0	1	0	4	0	1
29	Ruskiniana sexguttatipenis	0	1	7	5	1	0	1	0	2	?	1
30	Spaniopterus crucifer	0	1	7	0	0	1	1	2	0	0	1
31	Anthemus inconspicuous	0	1	1	0	2	1	2	3	7	1	0
32	Arrenophagoidea coloripes	0	1	9	0	0	0	1	0	0	0	1
33	Arrenophagus albitibiae	0	1	9	0	0	0	1	4	0	0	0
34	Arrenophagus chionaspidis	0	1	9	0	0	1	1	4	0	1	0
35	Thompsonisca amathus	0	1	0	0	0	0	1	0	0	0	1
36	Thompsonisca pakistanensis	0	1	0	0	0	0	1	0	0	0	1
37	Zaomma cestus	0	1	1	0	0	0	1	0	0	0	1
38	Anicetus sp.3	1	1	0	0	2	2	2	2	5	3	1
39	Cheiloneurus sp. 9	3	0	7	7	2	2	2	1	5	3	1
40	Microterys sp. 4	1	1	0	0	2	2	2	0	5	3	1

		49	50	51	52	53	54	55	56	57	58	59
		Profe	Protil	Mesc	Mesc	Mesc	Meta	Meta	Meta	Hairs	Hairs	Forel
1	Adelencyrtus mayurai	1	1	1	1	0	1	1	1	0	1	0
2	Adelencyrtus moderatus	0	0	1	0	0	1	4	0	0	1	0
3	Adelencyrtus odonaspidis	0	0	1	0	0	1	1	8	0	1	0
4	Adelencyrtus simmondsi	0	0	1	0	0	1	0	4	0	1	0
5	Caenohomalopoda guamensis	1	1	1	1	2	1	1	3	0	1	1
6	Ceraptroceroideus idahoensis	1	1	1	1	1	1	1	2	0	1	2
7	Coccidencyrtus ochraceipes	0	0	0	0	0	0	0	0	0	1	0
8	Comperiella bifasciata	1	1	1	1	2	1	1	3	0	1	1
9	Comperiella indica	1	1	1	1	2	1	1	3	0	1	1
10	Comperiella lemniscata	1	1	1	1	2	1	1	3	0	1	1
11	Comperiella unifasciata	1	1	1	1	2	1	1	3	0	1	1
12	Epitetracnemus comis	0	0	1	0	3	1	1	4	0	1	1
13	Epitetracnemus zetterstedtii	1	1	1	1	2	1	1	5	0	1	1
14	Epitetralophidea bicinctipes	1	1	1	1	3	1	2	8	0	1	0
15	Habrolepis aspidioti	1	1	1	1	2	1	1	3	0	1	1
16	Habrolepis dalmani	1	1	1	3	2	1	1	3	0	1	1
17	Habrolepis occidua	1	1	1	3	4	1	1	3	0	1	1
18	Habrolepis pascuarum	1	1	1	1	2	1	1	3	0	1	1
19	Habrolepis rouxi	1	1	1	1	2	1	1	3	0	1	1
20	Homalopoda cristata	1	1	1	1	5	1	1	3	0	1	1
21	Neococcidencyrtus alula	0	0	0	0	0	0	0	5	0	0	1
22	Neococcidencyrtus crouzelae	1	1	1	4	6	1	1	5	0	1	0
23	Neococcidencyrtus dryslydis	0	0	0	5	6	1	3	6	0	1	1
24	Neococcidencyrtus pudaspidis	0	0	0	0	6	0	2	6	0	1	1
25	Paraschedius caudatus	0	0	0	0	3	0	2	7	0	1	1
26	Plagiomerus diaspidis	1	1	1	2	3	1	1	4	0	1	0
27	Plagiomerus hospes	1	1	1	2	3	1	1	4	0	1	0
28	Pseudhomalopoda prima	1	1	1	1	2	1	1	3	0	1	1
29	Ruskiniana sexguttatipenis	1	1	1	1	5	1	1	3	0	1	1
30	Spaniopterus crucifer	1	1	1	1	4	1	1	5	0	1	2
31	Anthemus inconspicuous	1	0	1	2	0	1	3	0	1	2	0
32	Arrenophagoidea coloripes	1	1	1	2	0	1	1	4	1	1	0
33	Arrenophagus albitibiae	0	0	0	0	0	1	0	0	1	1	0
34	Arrenophagus chionaspidis	0	0	0	0	0	0	0	0	1	1	0
35	Thompsonisca amathus	1	1	1	1	3	1	1	3	0	1	0
36	Thompsonisca pakistanensis	1	1	1	1	3	1	1	4	0	1	0
37	Zaomma cestus	2	2	1	2	3	1	3	4	0	1	0
38	Anicetus sp.3	0	0	0	0	0	0	0	0	0	1	1
39	Cheiloneurus sp. 9	0	0	0	0	0	0	3	3	0	1	1
40	Microterys sp. 4	0	0	0	0	0	0	0	0	0	1	1

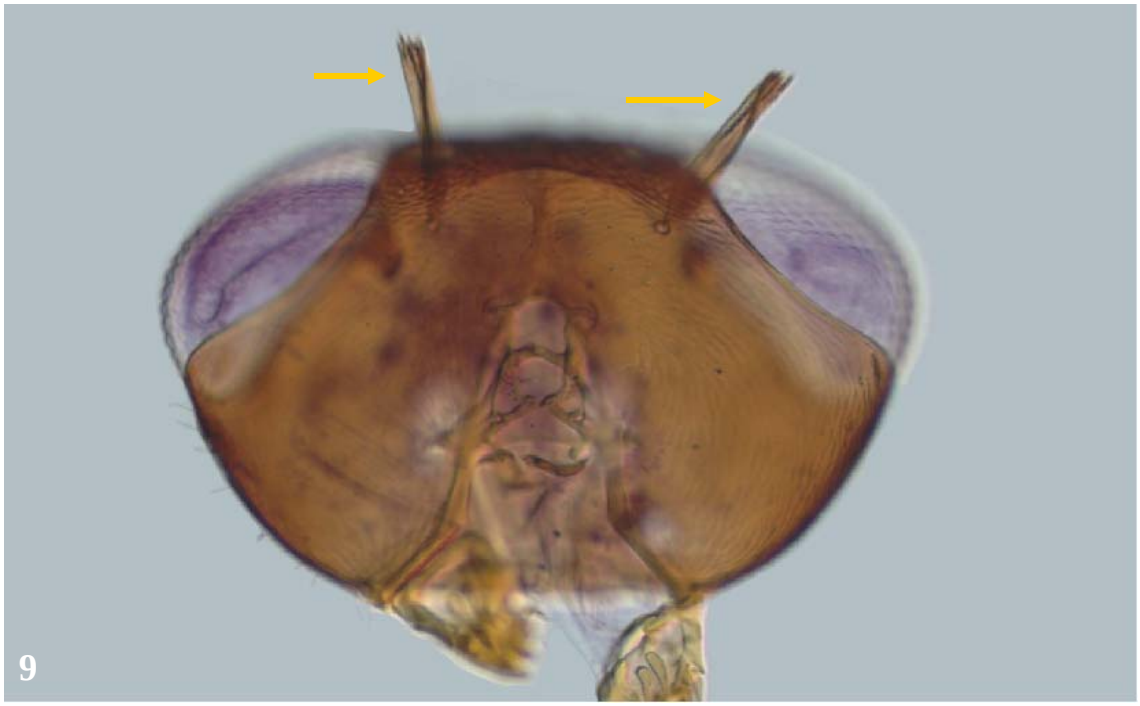
		61	62	63	64	65	66	67
		Forel	Forel	Forel	Linea	Sens	Abdo	Geni
1	Adelencyrtus mayurai	0	1	1	0	0	0	2
2	Adelencyrtus moderatus	0	1	0	1	0	0	2
3	Adelencyrtus odonaspidis	0	1	2	2	0	0	2
4	Adelencyrtus simmondsi	0	1	3	0	1	0	4
5	Caenohomalopoda guamensis	0	1	4	3	0	2	2
6	Ceraptroceroideus idahoensis	0	1	5	0	0	2	2
7	Coccidencyrtus ochraceipes	0	1	0	2	2	1	2
8	Comperiella bifasciata	0	1	6	2	0	2	2
9	Comperiella indica	0	1	7	2	0	2	2
10	Comperiella lemniscata	0	1	6	2	0	2	2
11	Comperiella unifasciata	1	1	7	2	0	2	5
12	Epitetracnemus comis	0	1	8	0	0	2	2
13	Epitetracnemus zetterstedtii	0	1	9	0	0	2	2
14	Epitetralophidea bicinctipes	0	1	0	0	?	0	1
15	Habrolepis aspidioti	0	1	A	0	0	2	2
16	Habrolepis dalmani	0	1	A	0	0	0	2
17	Habrolepis occidua	0	1	B	0	0	2	2
18	Habrolepis pascuarum	0	1	A	0	0	2	2
19	Habrolepis rouxi	0	1	A	2	0	2	2
20	Homalopoda cristata	0	1	9	0	0	2	2
21	Neococcidencyrtus alula	1	0	C	0	0	3	2
22	Neococcidencyrtus crouzelae	0	1	0	4	0	0	3
23	Neococcidencyrtus dryslydis	0	1	D	1	0	0	2
24	Neococcidencyrtus pudaspidis	0	1	D	1	0	4	2
25	Paraschedius caudatus	?	1	0	0	0	4	?
26	Plagiomerus diaspidis	0	1	0	4	0	0	3
27	Plagiomerus hospes	0	1	0	0	3	0	2
28	Pseudhomalopoda prima	0	1	8	4	0	2	2
29	Ruskiniana sexguttatipenis	0	1	E	0	0	2	2
30	Spaniopterus crucifer	0	1	F	0	4	2	1
31	Anthemus inconspicuous	2	1	J	0	0	0	0
32	Arrenophagoidea coloripes	0	1	0	0	2	0	?
33	Arrenophagus albitibiae	0	1	0	0	2&5	0	1
34	Arrenophagus chionaspidis	0	1	0	0	0	0	2
35	Thompsonisca amathus	0	1	0	2	2	0	2
36	Thompsonisca pakistanensis	0	1	0	2	2	0	2
37	Zaomma cestus	0	1	0	1	0	0	3
38	Anicetus sp.3	0	1	L	2	2	3	1
39	Cheiloneurus sp. 9	0	1	H	0	2	0	2
40	Microterys sp. 4	0	1	G	0	2	3	2

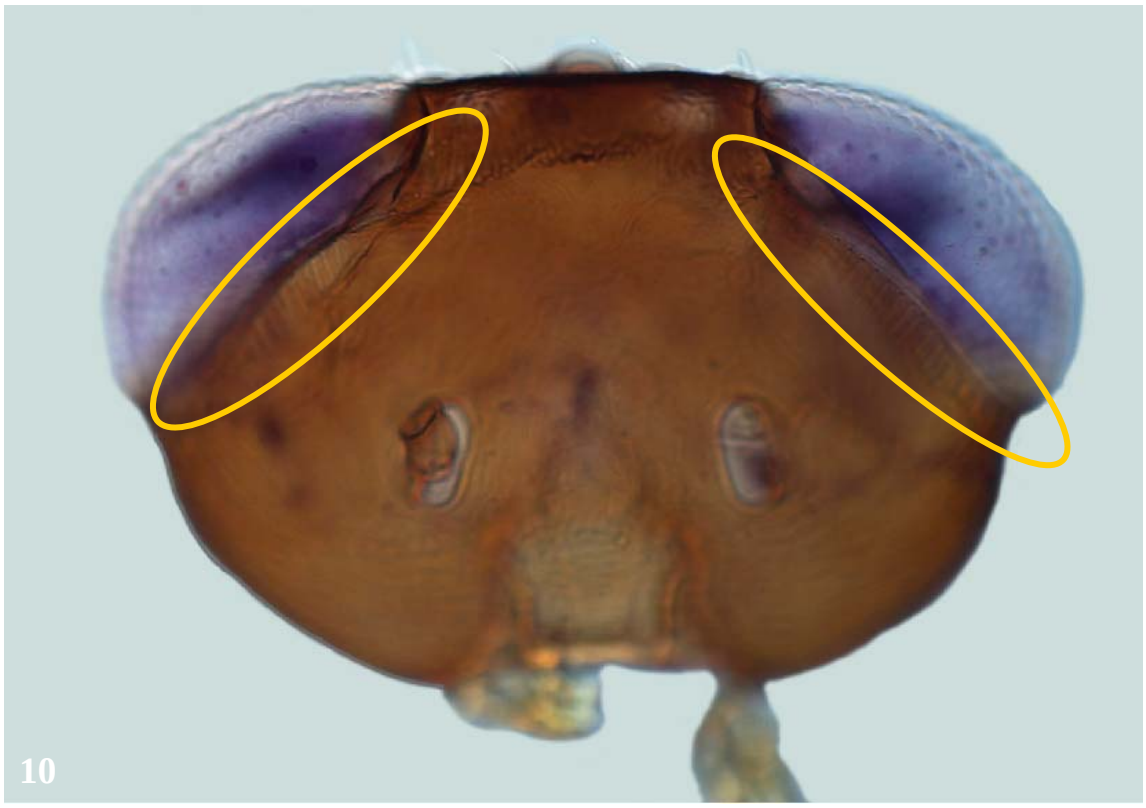
APPENDIX 3

Figs. 1-6. 1,*Ceraptroceroideus idahoensis*, face. 2, *Comperiella lemniscata*, frontovertex. 3, *Comperiella indica*, frontovertex. 4, *Neococcidencyrtus alula*, face. 5, *Microterys* spp, face. 6, *Neococcidencyrtus dryslydis*, face.

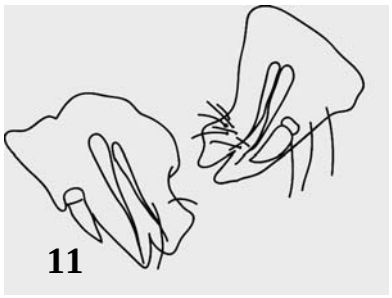


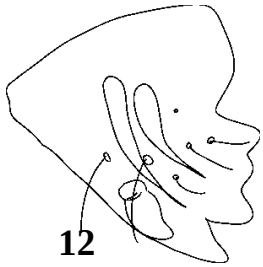
Figs. 7-8. 7, *Anicetus* spp., face. 8, *Adelencyrtus odonaspidis*, face a) frontovertex width; b) head width; c) distance between the toruli; d) mouth width; e) head high; f) distance between ventral eye margin and dorsal torulus margin; g) turulus's widest area h) distance between the middle ocelli and the dorsal torulus margin; i) eye high; j) distance between ventral torulus margin and mouth margin; k) turulus high; l) malar space high.

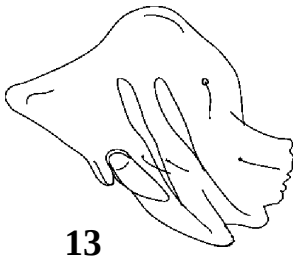


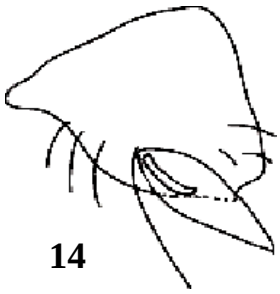


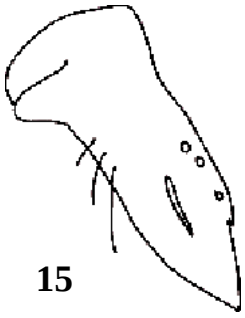
Figs. 9- 10. 9, *Caenohomalopoda guamensis,* head back side scales. 10, *Ruskiniana sexguttatipennis*, scales bordering the eyes.

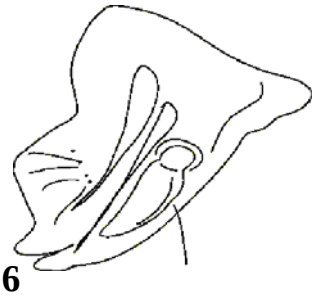


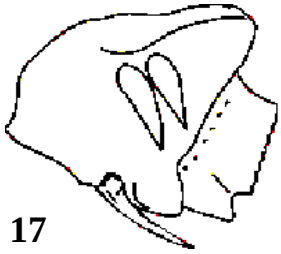


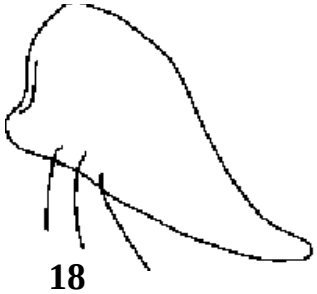


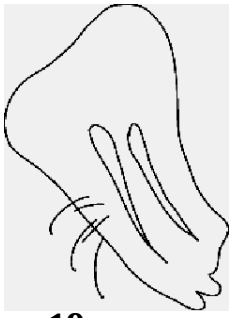


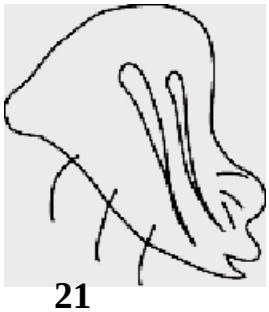




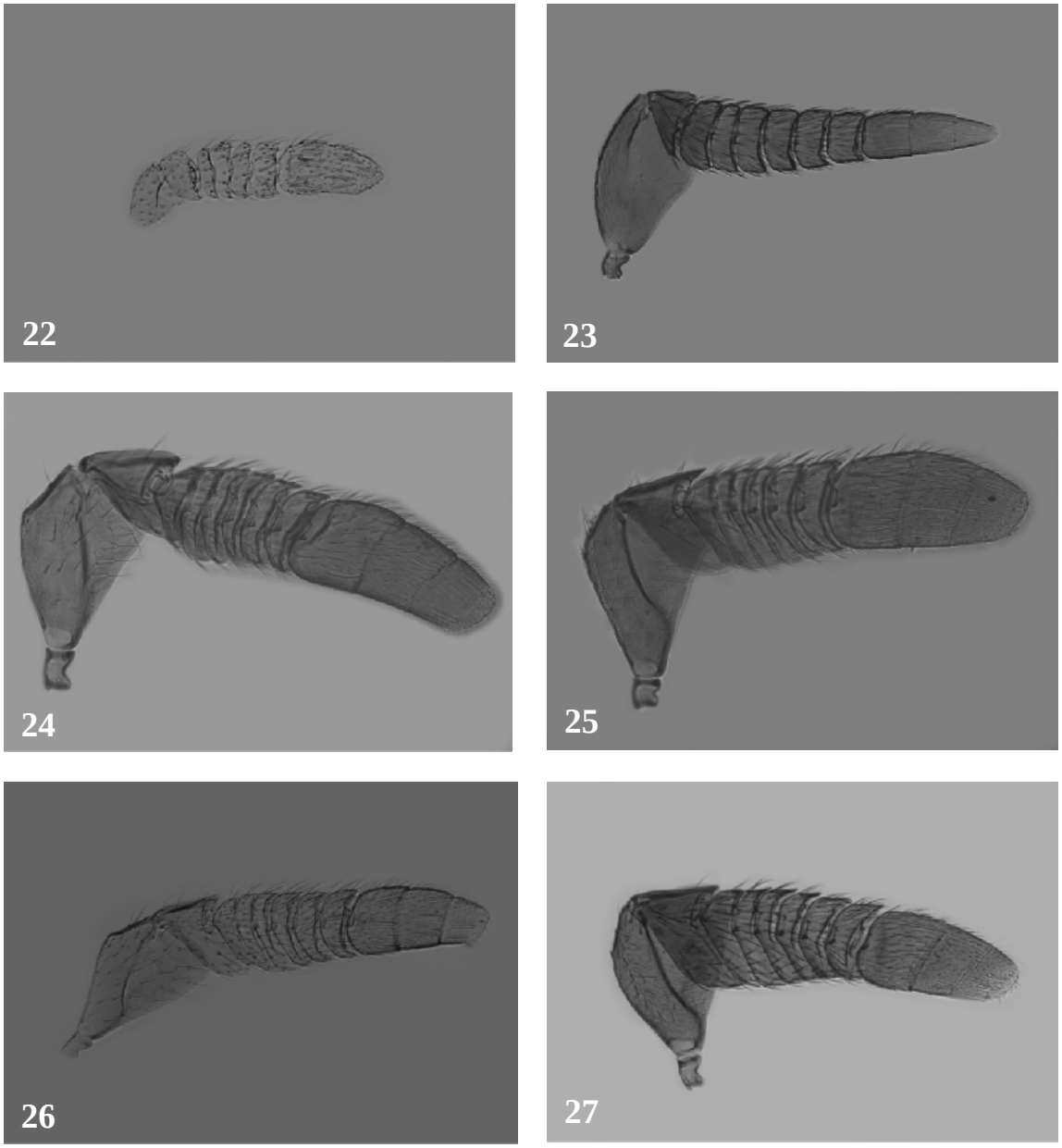




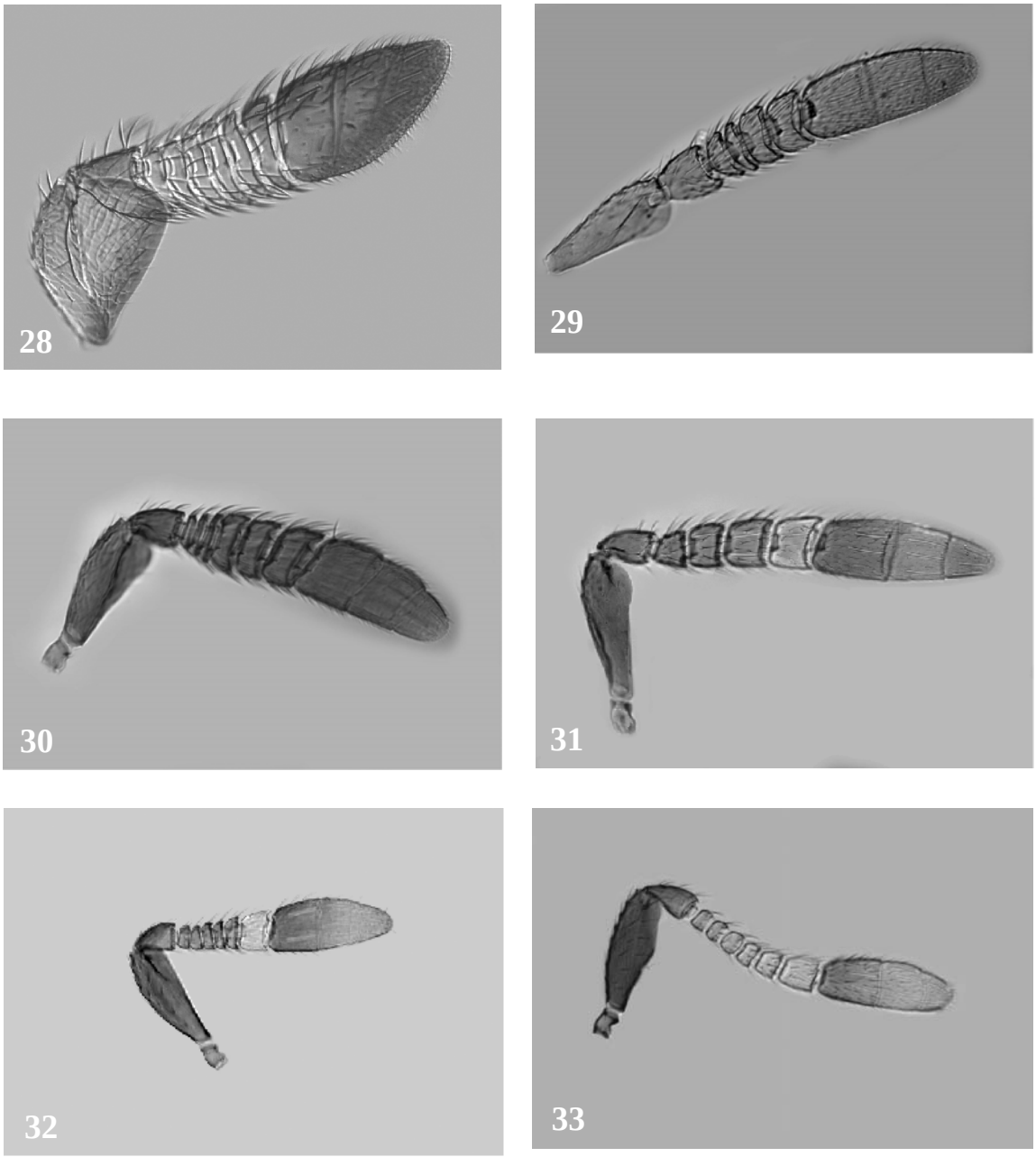




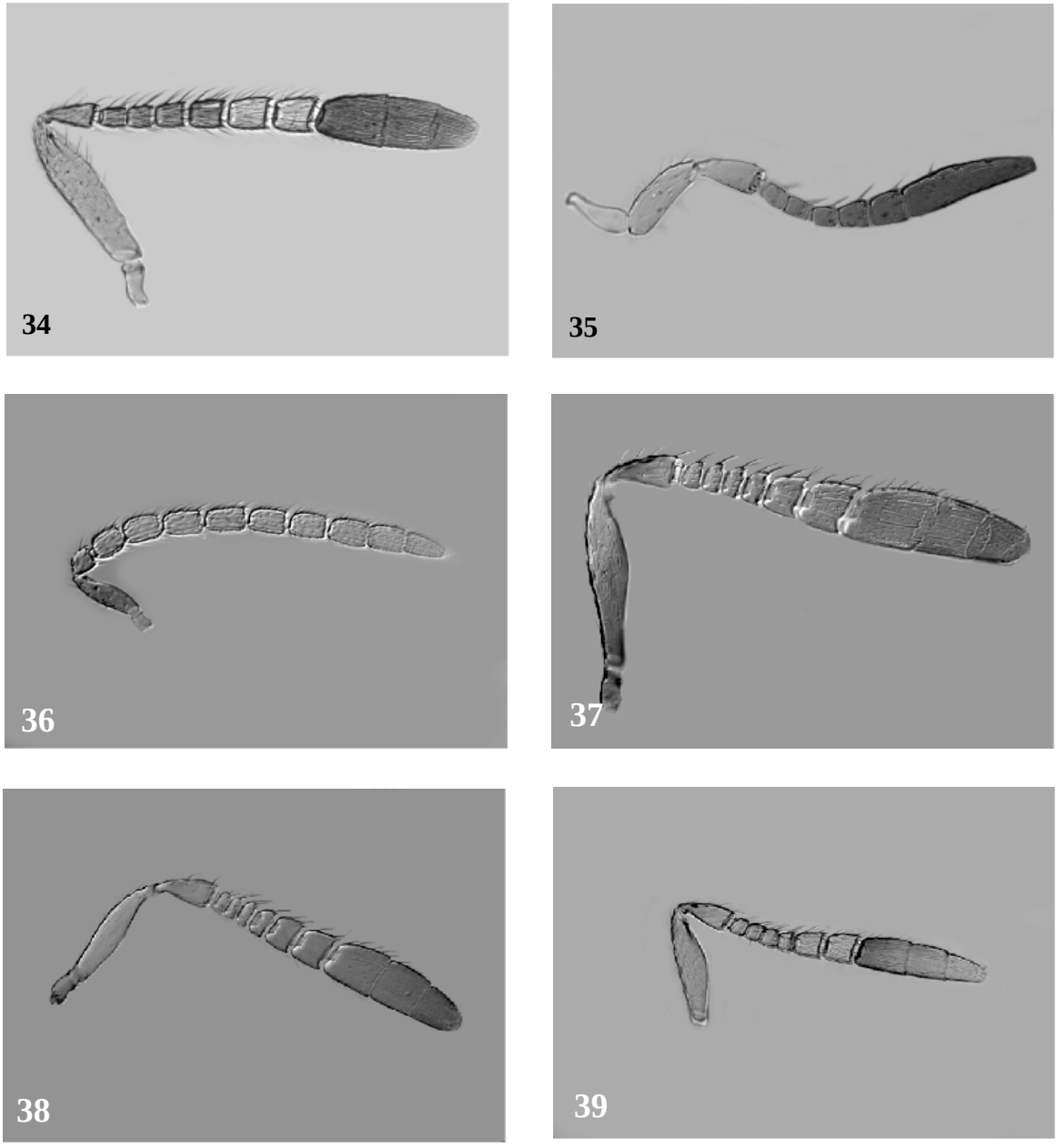
Figs. 11-21. Mandibles. 11, *Ceraptroceroideus idahoensis*. 12, *Homalopoda cristata.* 13, *Epitetracnemus comis.* 14, *Arrenophagus albitibia*. 15, *Arrenophagus chionaspidis*. 16, *Neococcidencyrtus crouzelae*. 17, *Anthemus inconspicuous*. 18, *Arrenophagoidea coloripes*. 19, *Anicetus* spp. 20, *Cheiloneurus* spp. 21, *Microterys* spp.



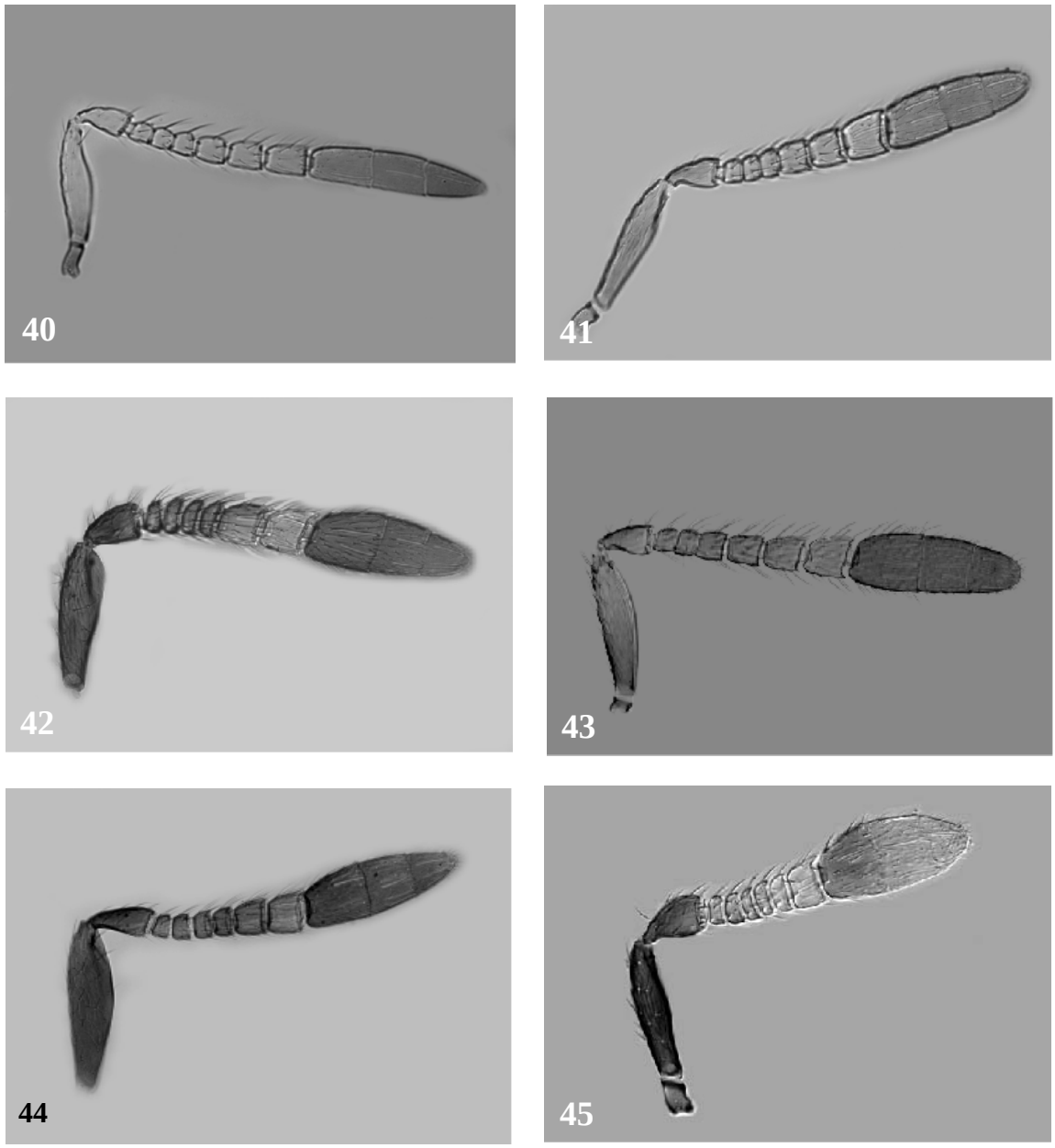
Figs. 22-27. Antennae. 22, *Spaniopterus crucifer*, 23, *Ceraptroceroideus idahoensis*. 24, *Comperiella bifasciata*. 25, *C. indica*. 26, *C. lemniscata*. 27, *C. unifasciata*.



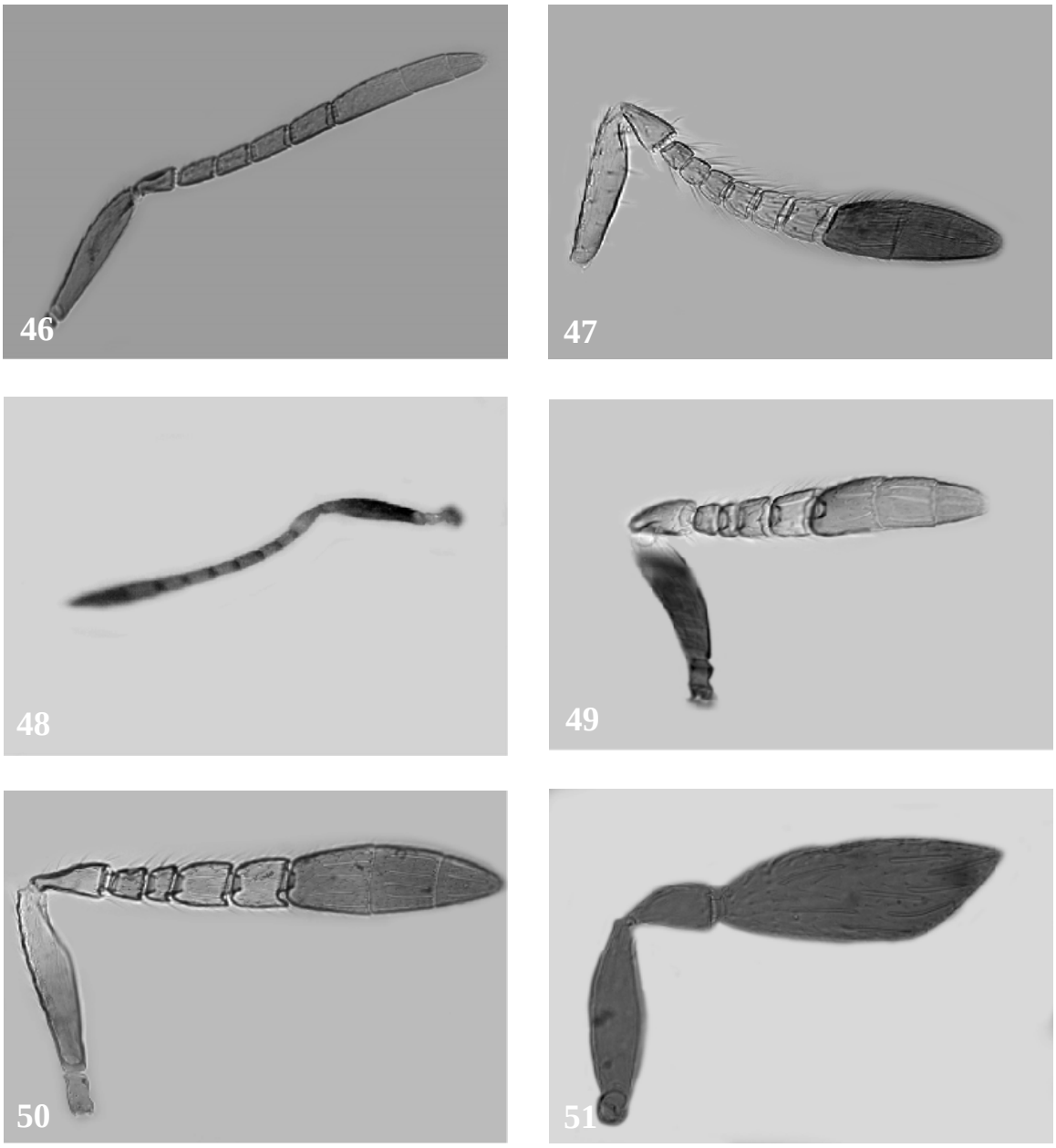
Figs. 28-33. Antennae. 28, *Anicetus* sp. 29, *Pseudhomalopoda prima*. 30, *Ruskiniana sexguttatipenis*. 31, *Caenohomalopoda guamensis*. 32, *Habrolepis aspidioti*. 33, *H. dalmani*.



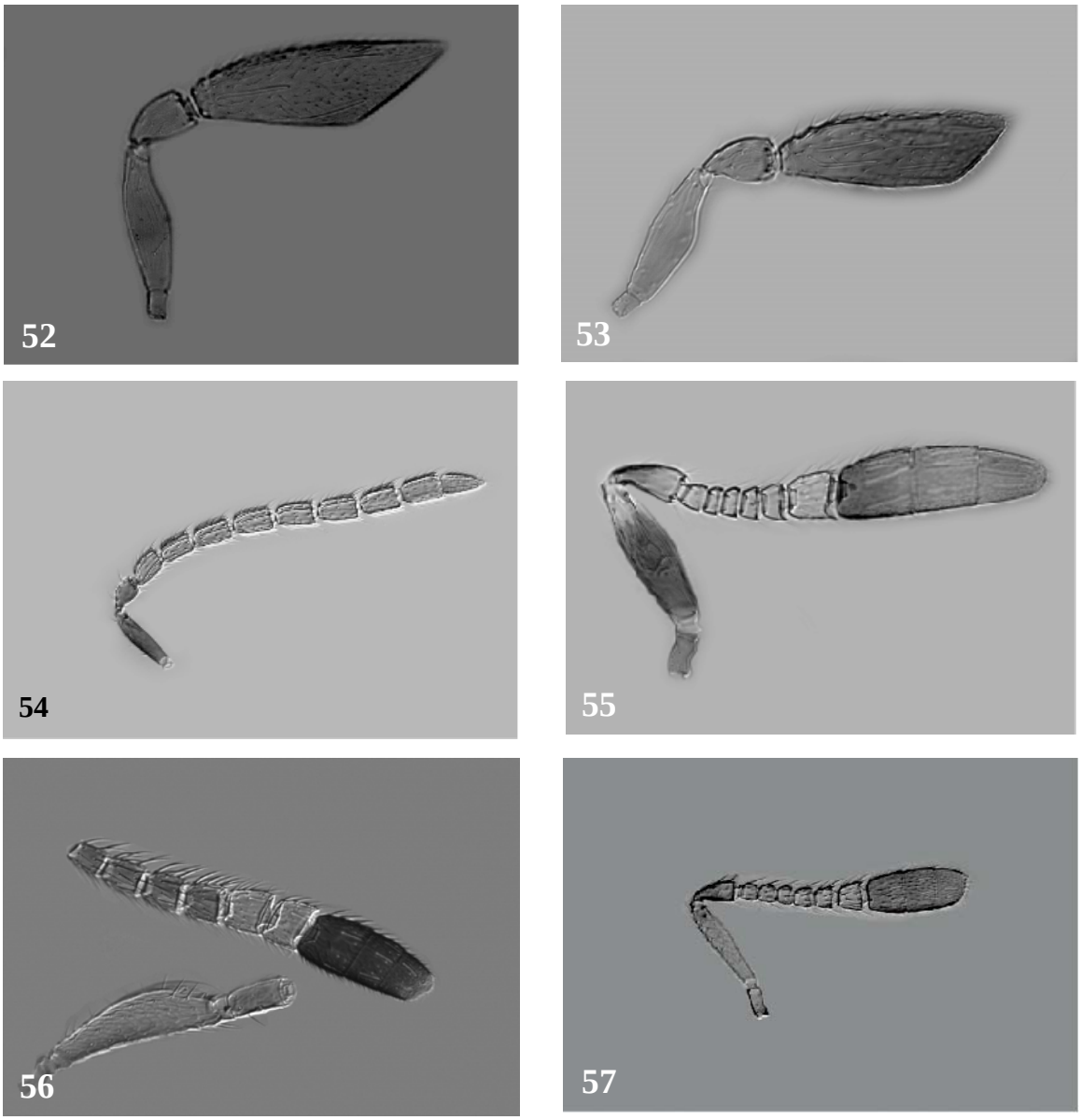
Figs. 34-39. Antennae. 34, *Neococcidencyrtus alula*. 35, *Anthemus inconspicuous*. 36, *Thomsonisca pakistanensis*. 37, *Adelencyrtus mayurai*. 38, *A. moderatus*. 39, *A. odonaspidis*.



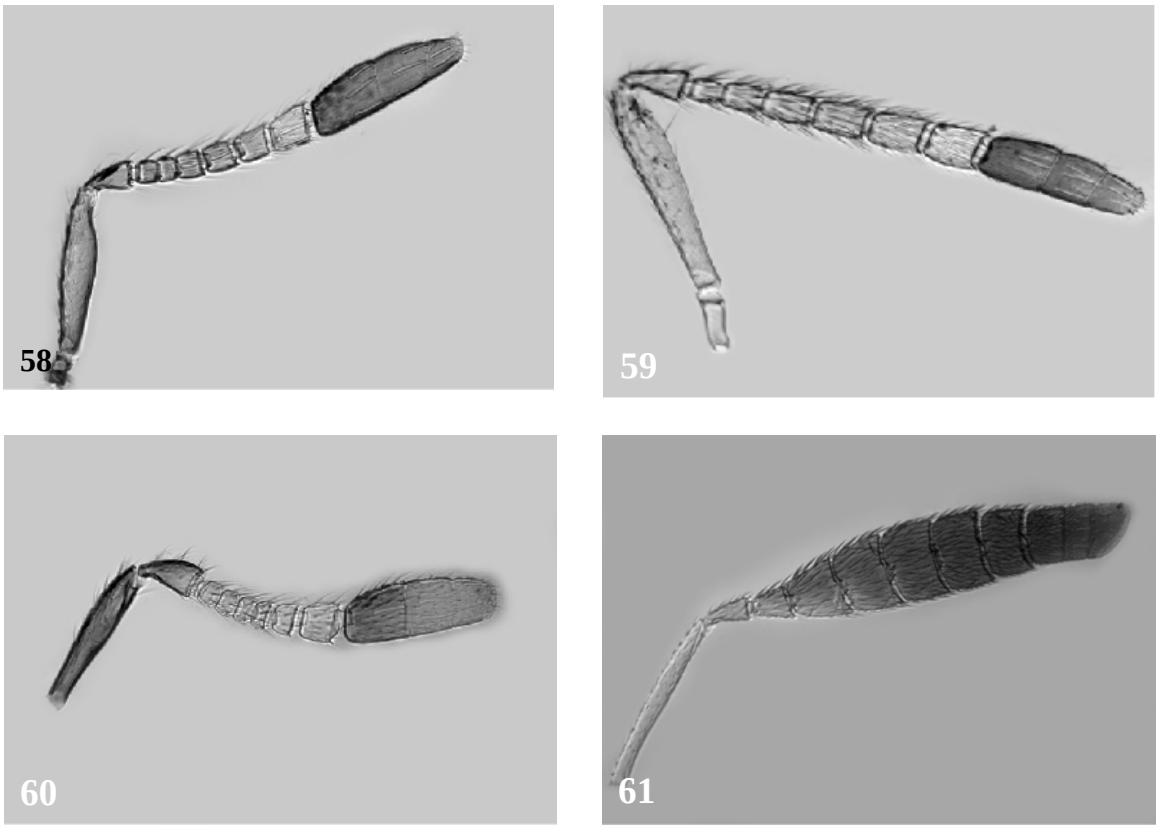
Figs. 40-45. Antennae. 40, *Coccidencyrtus ochraceipes*. 41, *Epitetracnemus comis*. 42, *E. zetterstedtii*. 43, *Epitetralophidea bicinctipes*. 44, *Habrolepis occidua*. 45, *H. pascuarum*.



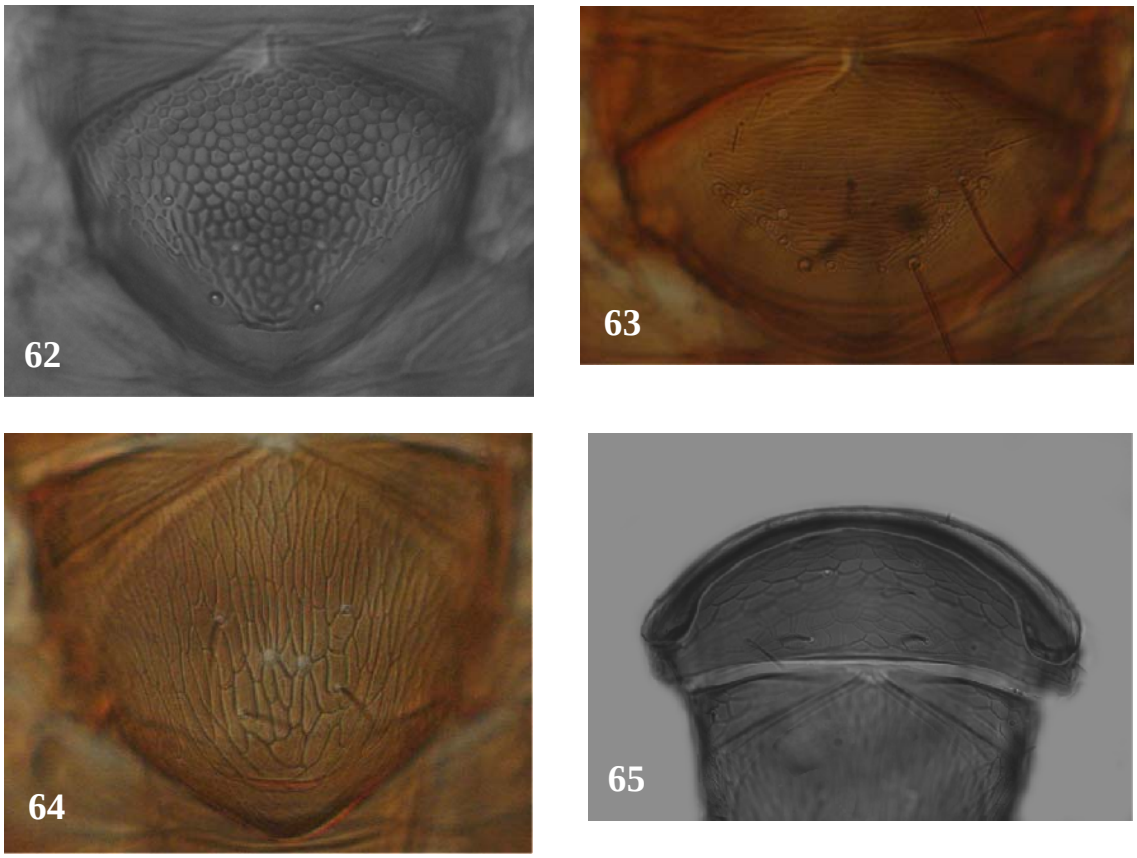
Figs. 46-51. Antennae. 46, *Homalopoda cristata*. 47, *Neococcidencyrtus dryslydis*. 48, *Xenostryxis caudatus*. 49, *Plagiomerus diaspidis*. 50, *P. hospes*. 521 *Arrenophagoidea coloripes*.



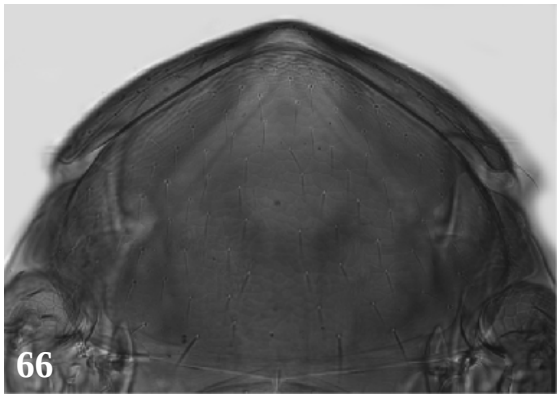
Figs. 52-57. Antennae. 52, *Arrenophagus albitibiae*. 53, *A. chionaspidis*. 54, *Thomsonisca amathus*. 55, *Zaomma cestus*. 56, *Microterys* sp. 57, *Adelencyrtus simmondsi*.

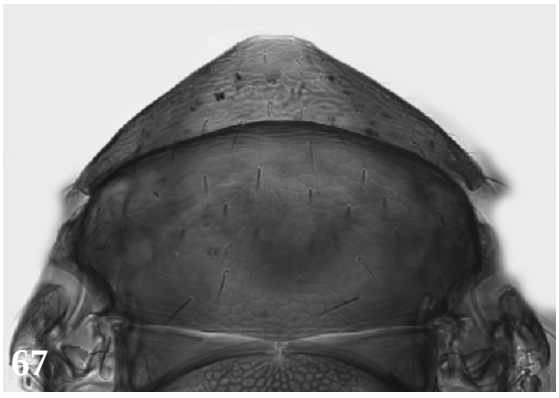


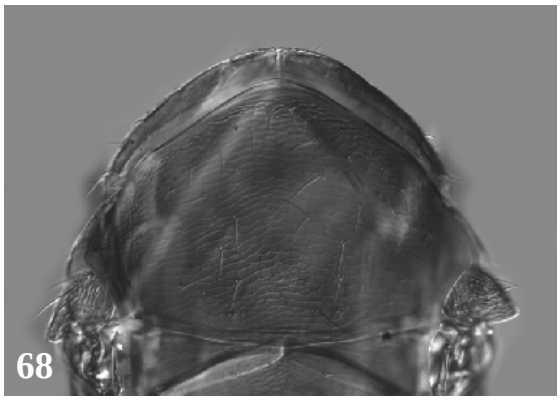
Figs. 58-61. Antennae. 58, *Neococcidencyrtus crouzelae*. 59, *N pudaspidis*. 60, *Habrolepis rouxi*. 61 *Cheiloneurus* spp.

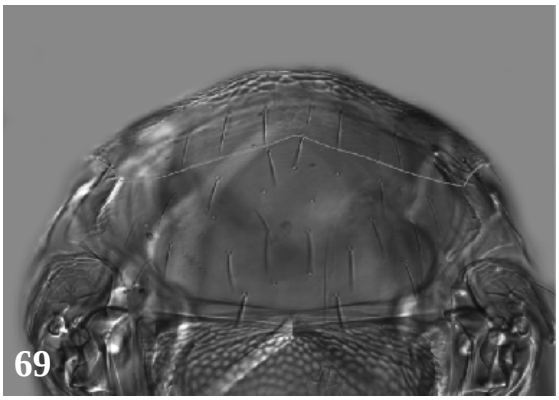


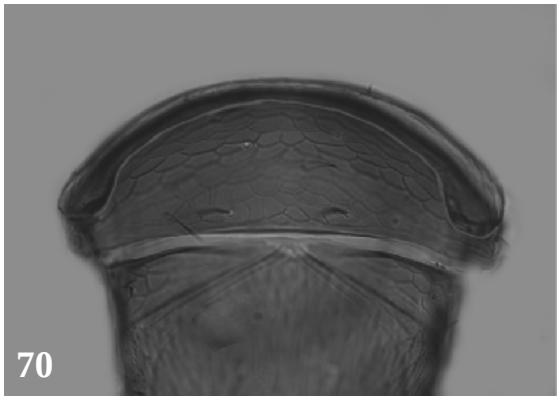
Figs. 62-64. Sculpture of scutellum. 62, *Adelencyrtus mayurai*. 63, *Comperiella indica*. 64, *Arrenophagus chionaspidis*. 65, *Arrenophagoidea coloripes*.

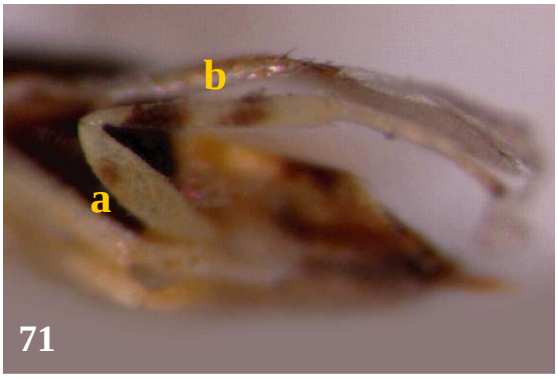




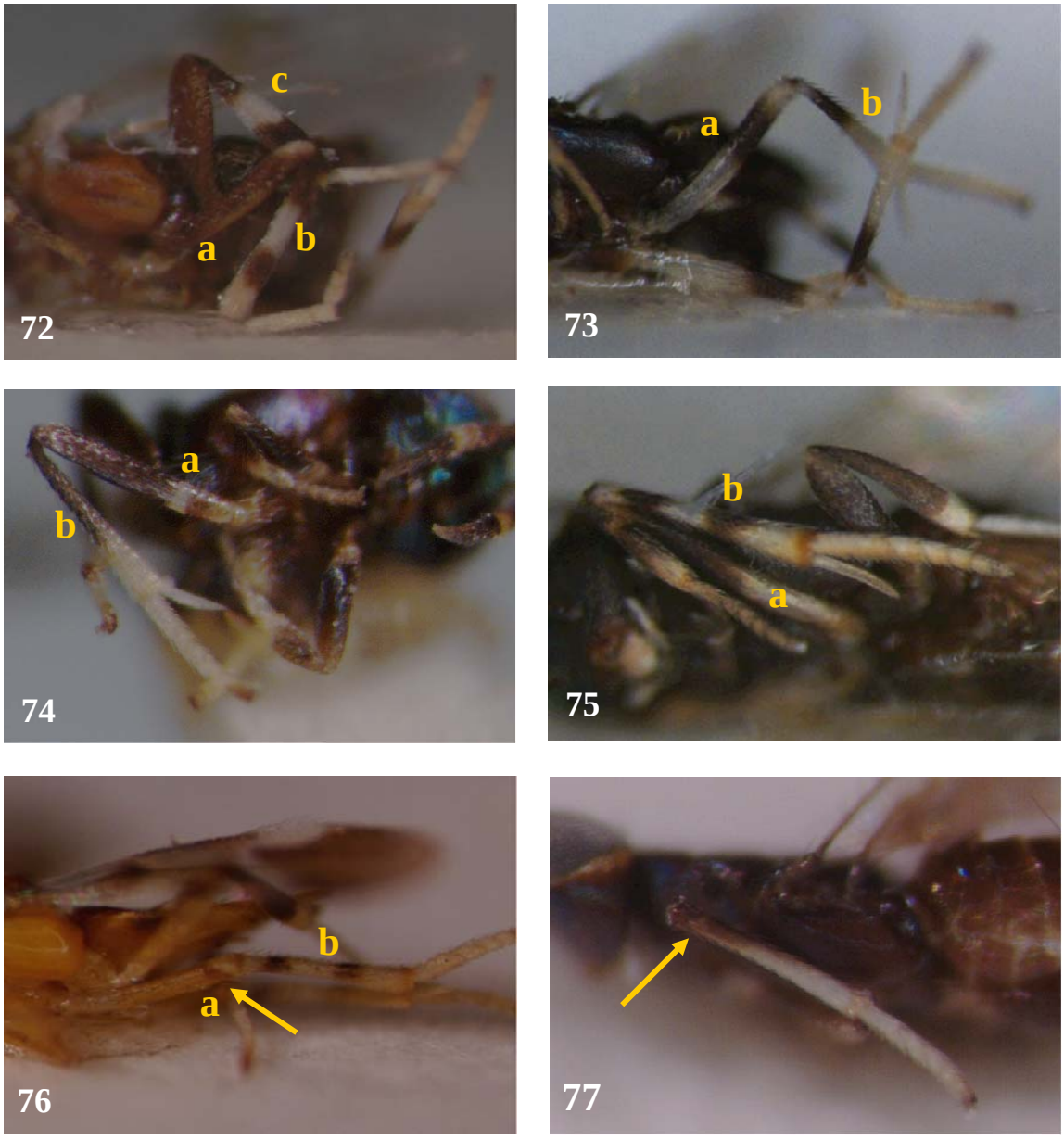




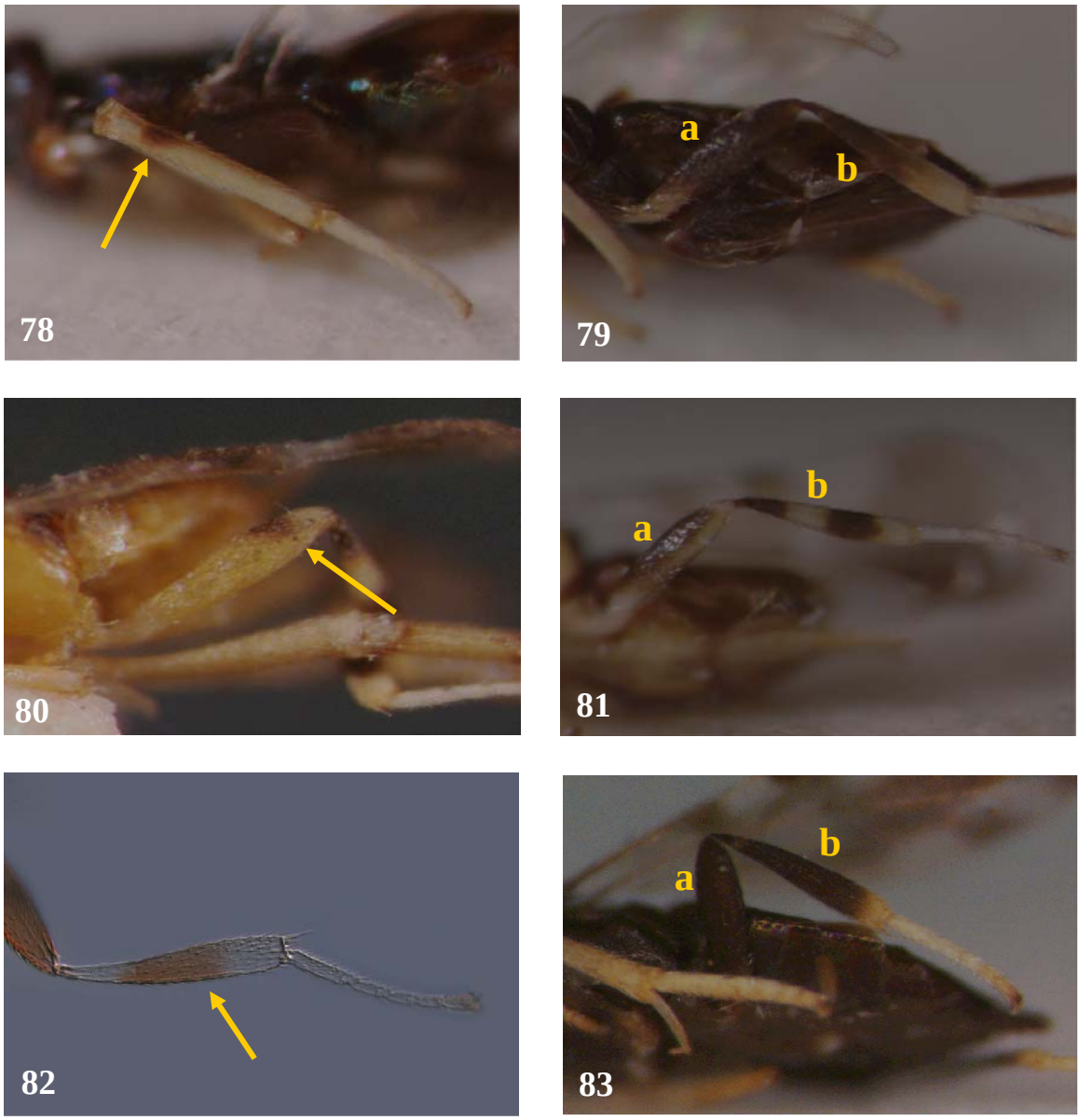




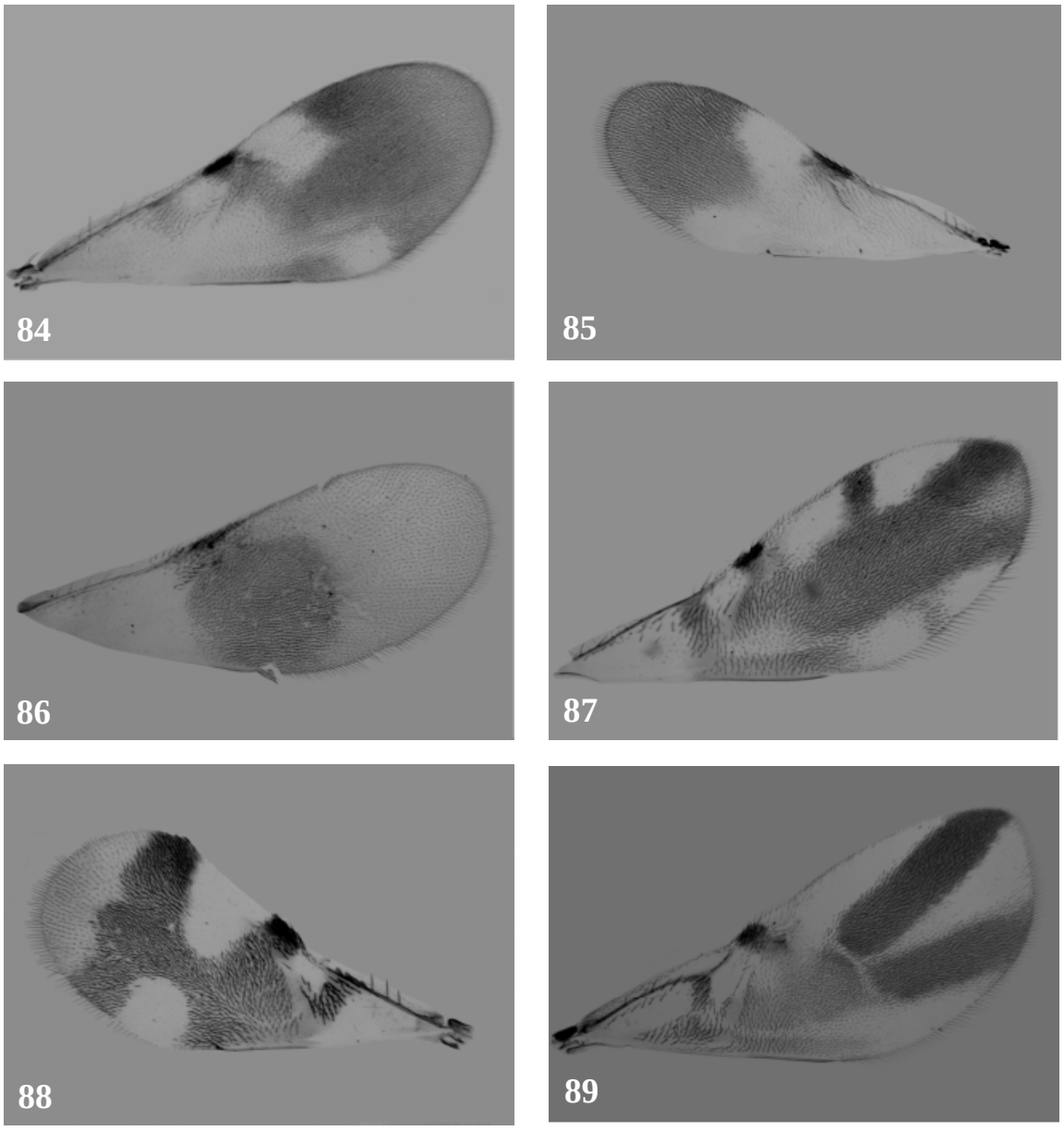
66-71. 66-70, pronotum shape. 66, *Adelencyrtus mayurai*. 67, *Caenohomalopoda guamensis*. 68, *Comperiella bifasciata*. 69, *Neococcidencyrtus alula.* 70, *Arrenophagus albitibiae.* 71, *Xenostryxis caudatus*, leg color pattern.



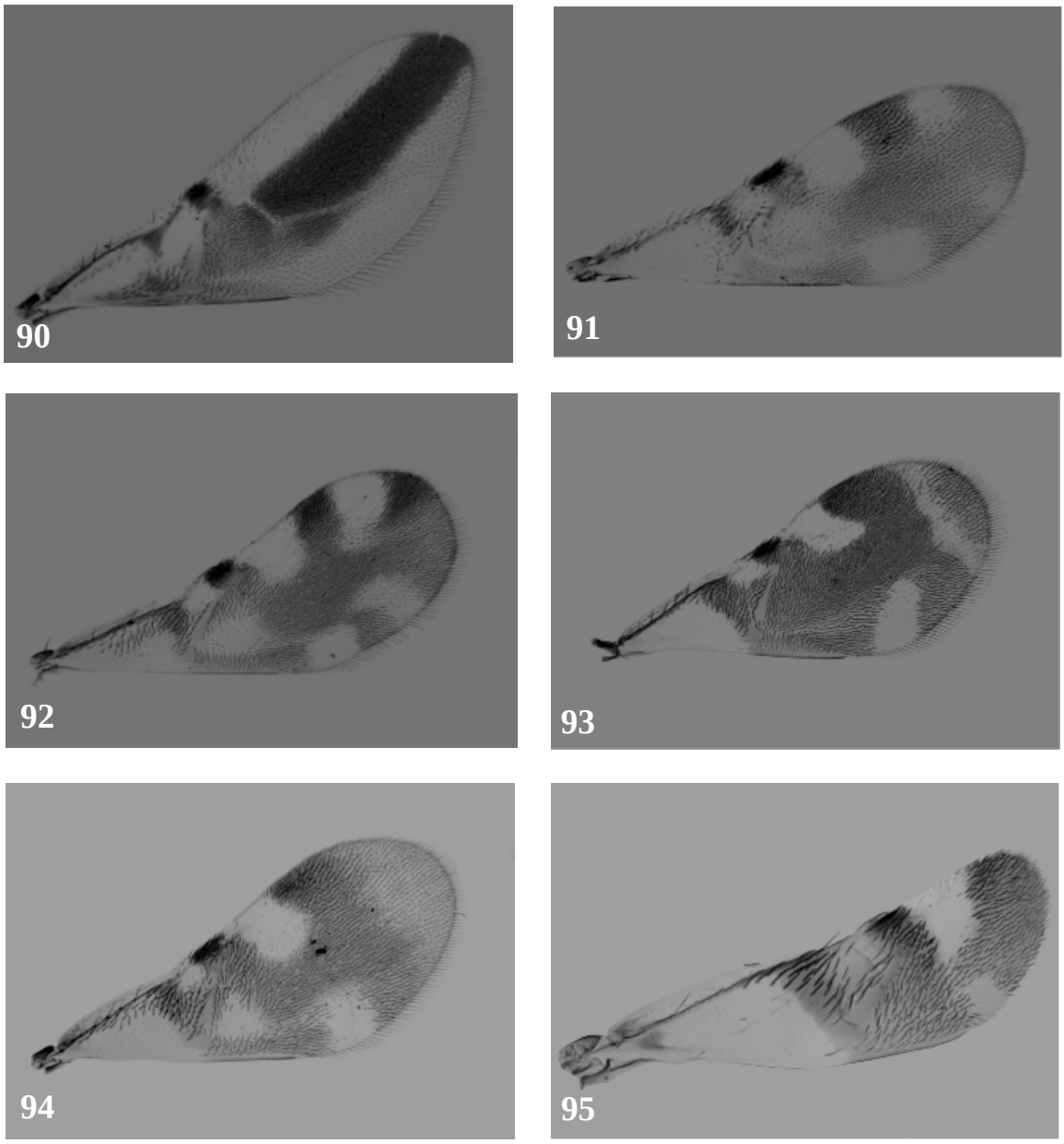
Figs. 72-77. Leg color pattern. 72, *Ceraptroceroideus idahoensis.* 73, *Plagiomeros hospes*. 74, *Habrolepis occidua*. 75, *Neococcidencyrtus crouzelae*. 76, *N. dryslydis*. 77, *Comperiella lemniscata*.



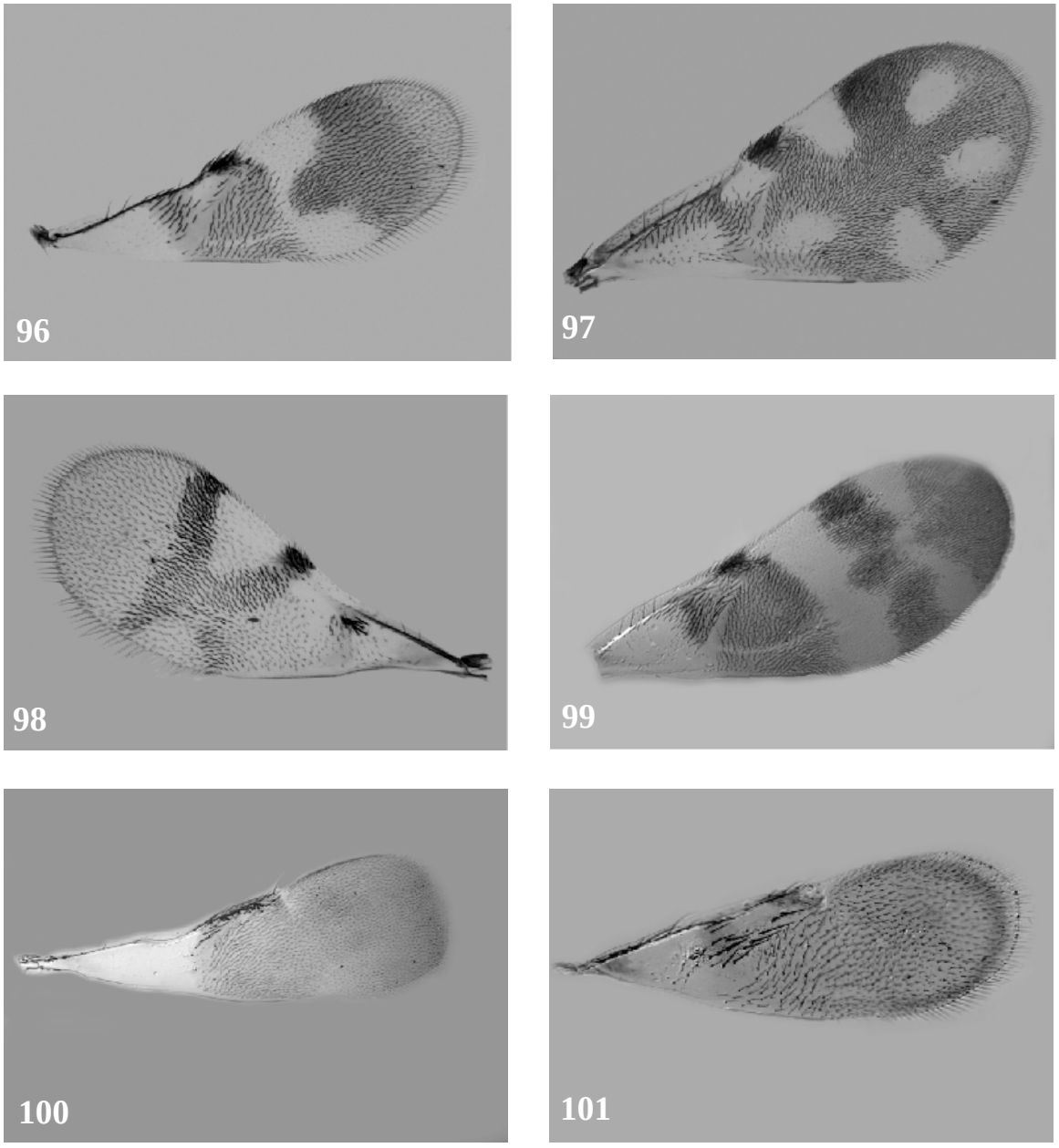
Figs. 78-83. Leg color pattern. 78, *Epitetracnemus comis*. 79, *Adelencyrtus mayurai*. 80, *Neococcidencyrtus pudaspidis*. 81, *N. dryslydis*. 82, *Adelencyrtus simmondsi*. 83, *Epitetracnemus zetterstedtii*.



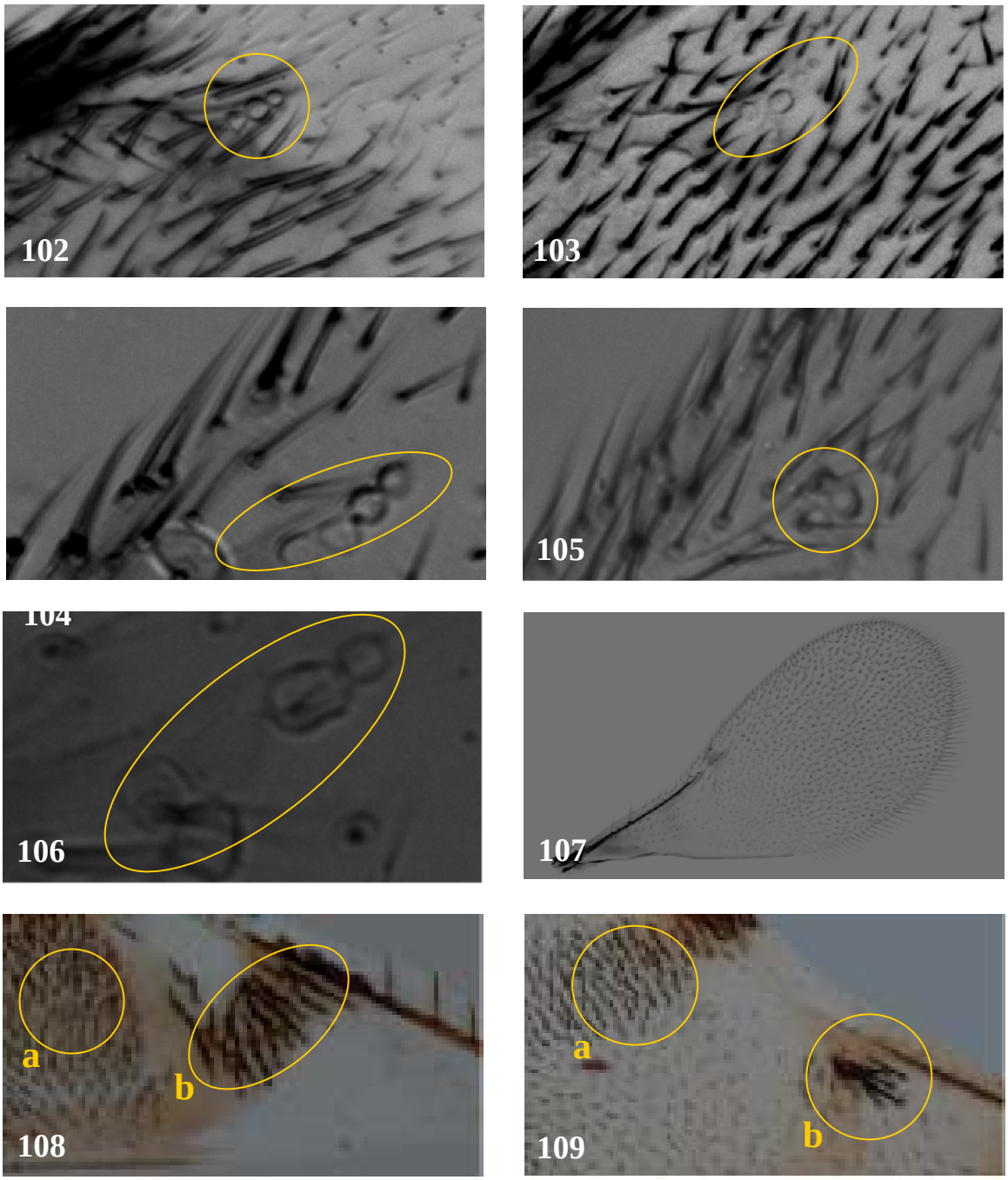
Figs. 84-89. Forewing. 84, *Adelencyrtus mayurai*. 85, *A. odonaspidis*. 86, *A. simmondsi*. 87, *Caenohomalopoda guamensis*. 88, *Ceraptroceroideus idahoensis*. 89, *Comperiella bifasciata*.



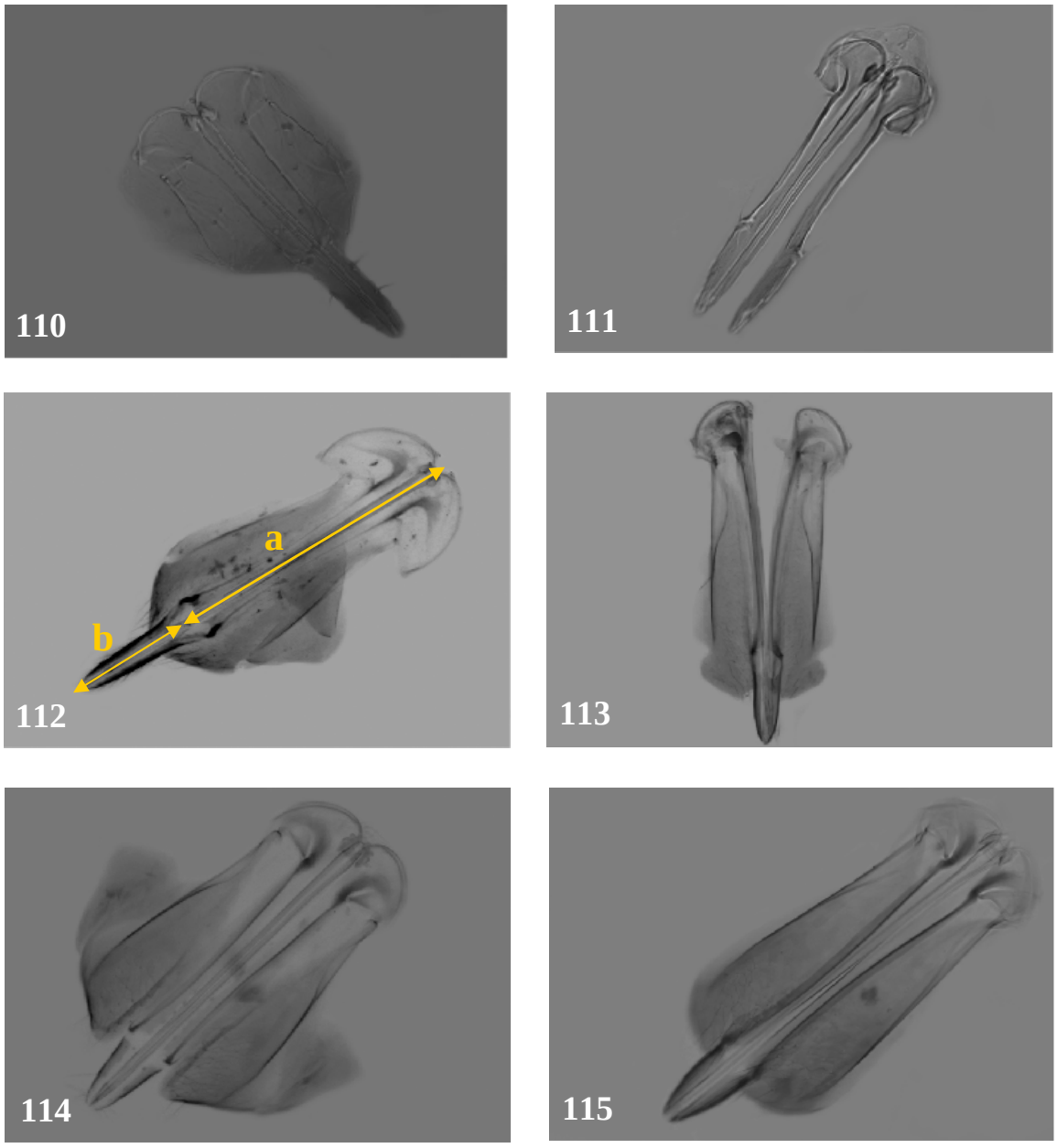
Figs. 90-95. Forewing. 90, *Comperiella indica*. 91, *Epitetracnemus comis*. 92 *Epitetracnemus zetterstedtii*. 93, *Habrolepis aspidioti*. 94, *H. occidua*. 95, *Neococcidencyrtus poutiersi*.



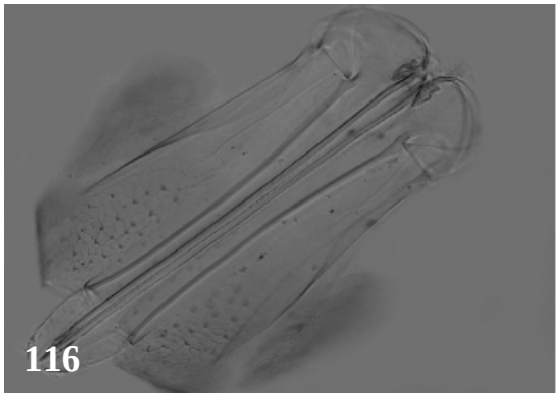
Figs. 96-101. Forewing. 96, *Neococcidencyrtus drysydis*. 97, *Ruskiniana sexguttatipenis*. 98, *Spaniopterus crucifer*. 99, *Microterys* spp. 100, *Cheiloneurus* spp. 101, *Anicetus* spp.

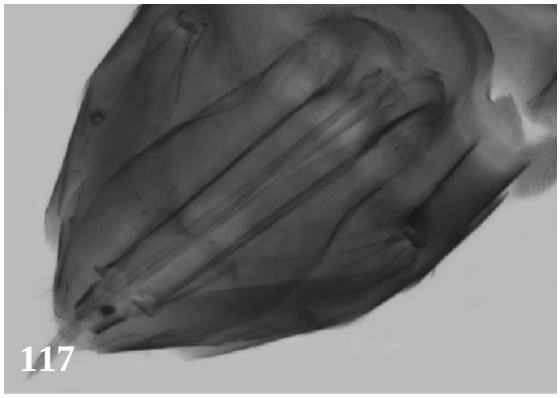


Figs. 102-109. 102-106, sensilla. 102, *Adelencyrtus mayurai*. 103, *A. simmondsi*. 104, *Coccidencyrtus ochraceipes* . 105, *Plagiomerus hospes*. 106, *Spaniopterus crucifer*. 107-109, forewing scales. 107, *Arrenophagoidea coloripes*, thin scales. 108, *Ceraptroceroideus idahoensis*; (a) thin scales, (b) thick scales. 109, *Spaniopterus crucifer*; (a) thin scales, (b) thick scales.



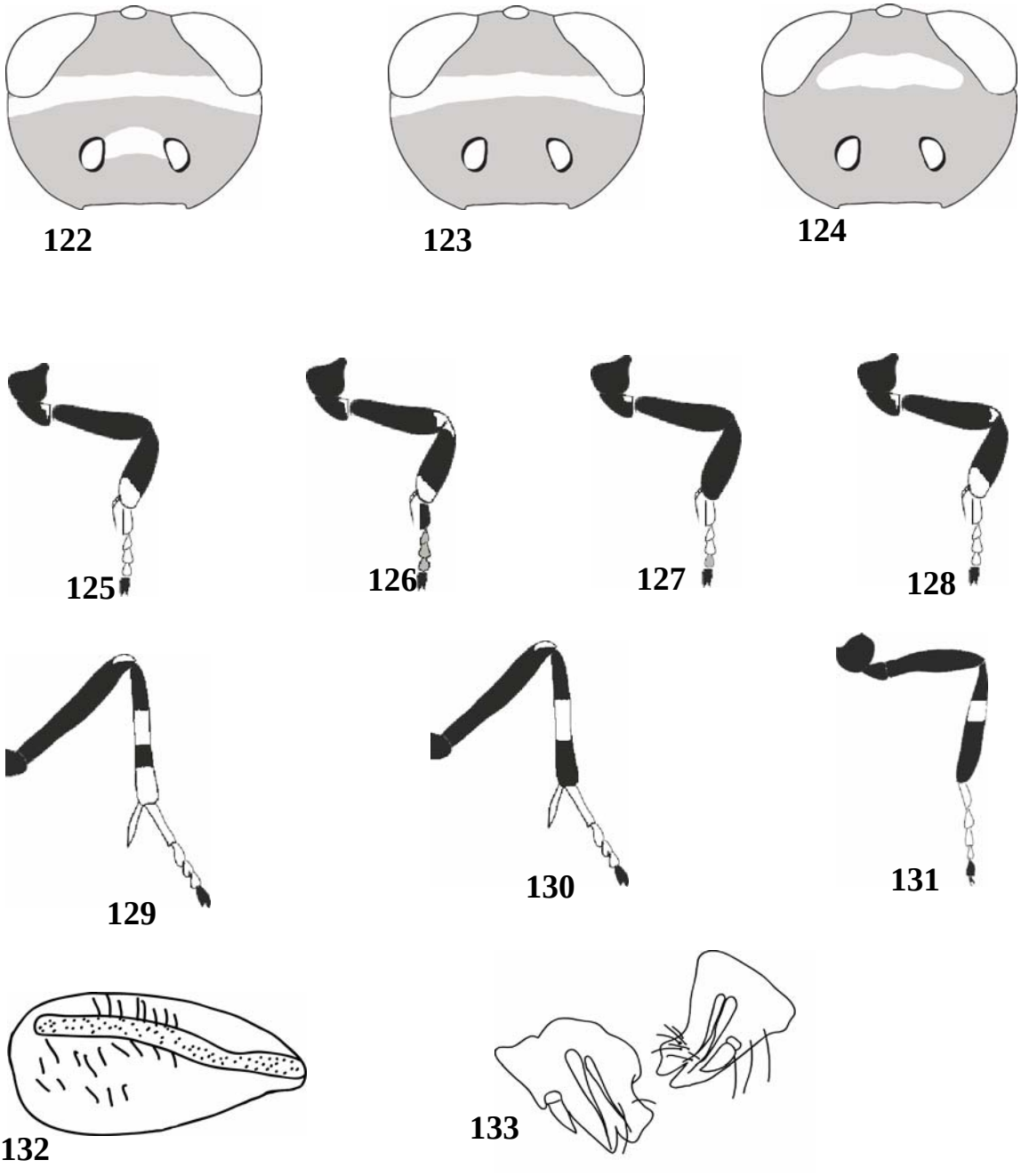
Figs. 110-115. Ovipositors. 110 *Anthemus inconspicuous*. 111 *Anicetus* spp. 112, *Adelencyrtus mayurai*. 113, *Caenohomalopoda guamensis*. 114, *Neococcidencyrtus crouzelae*. 115, *Zaomma cestus*.





Figures 116- 117. Ovipositors. 116, *Adelencyrtus simmondsi*. 117, *Comperiella unifasciata*.

Figs 118-121. 118, *Ceraptroceroideus idahoensis*, antenna. 119, *C.* sp. C, dorsal view. 120, *C. idahoensis*, forewing. 121, *C. idahoensis*, ovipositor.



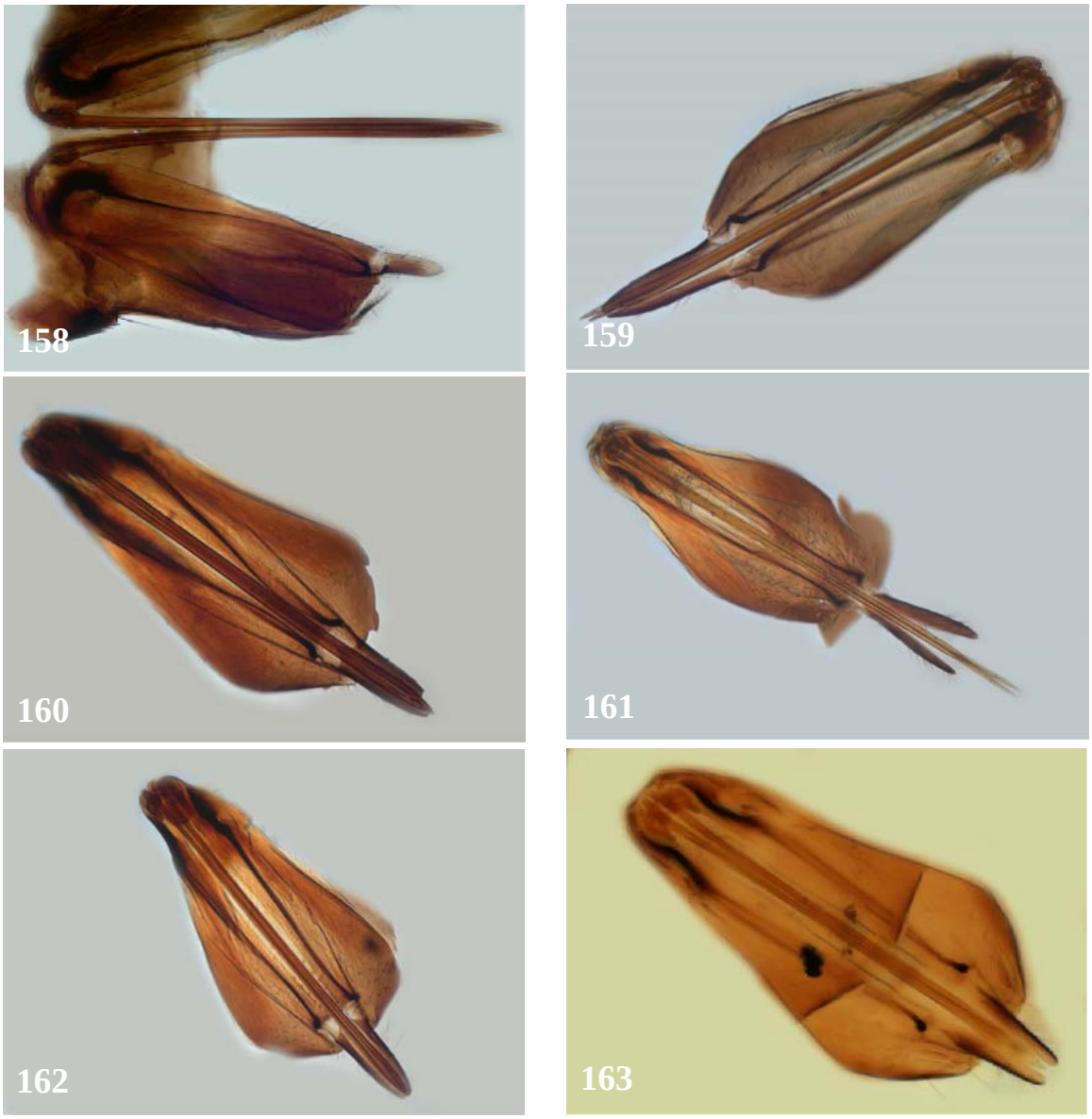
Figs. 122 -133. 122 -124, head color pattern. 122, *Ceraptroceroideus* cinctipes. 123, *C*. sp. C. 124, *C*. sp. A. 125-128. Foreleg color pattern. 125, *C*. sp. C. 126, *C. idahoensis*. 127, *C*. sp. A. 128, *C*. sp. B. 129 – 130. Middle leg color pattern. 129, *C*. sp. B. 130, *C*. sp. A. 131, *C*. sp. A, hind leg color pattern 132, *C. cinctipes*, reduced wings. 133, *C. idahoensis*, mandibles.

Figs. 134-139. Antennae. 134, *Homalopoda sp. A.* 135, *H. sp. B.* 136, *H. sp. C.* 137, *H. sp. D.* 138, *H. sp. D.* 139, *H. sp. E.*

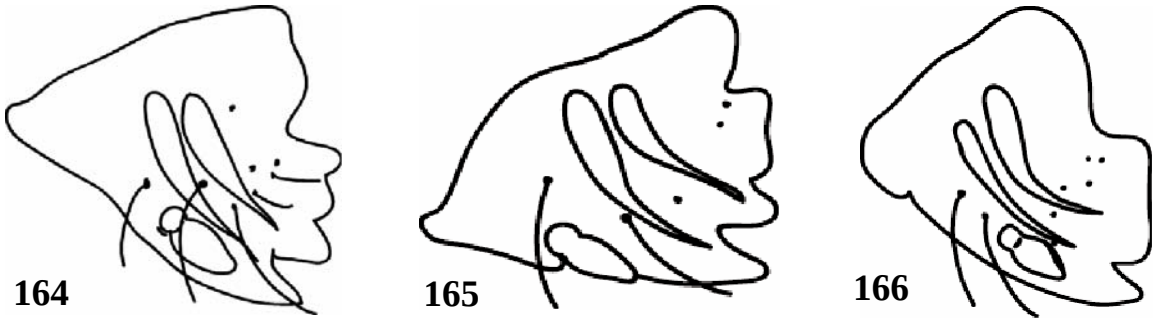
Figs. 140-145. 140-143, antennae. 140, *Homalopoda. sp. F*. 141, *H. sp. G*. 142, *H.* sp. H. 143, *H*. *cristata*. 144-145, forewings. 144, *H*. sp. A. 145, *H*. sp. B.

Figs. 146-151. Antennae. 146, *H*omalopoda sp. C. 147, *H*. sp. D. 148, *H*. sp. D. 149, *H*. sp. E. 150, *H*. sp. F. 151, *H*. sp. G.

Figs. 152-157. 152-153, forewings. 152, *Homalopoda* sp. H. 153, *H. cristata*. 154-157, ovipositors. 154, *H.* sp. A. 155, *H.* sp. B. 156, *H.* sp. C. 157, *H.* sp. D.



Figs. 158-163. Ovipositor. 158, *Homalopoda* sp. D. 159, *H*. sp. E. 160, *H*. sp. F. 161, *H*. sp. G. 162, *H*. sp. H. 163, *H. cristata*.



Figs. 164-166. Mandibles. 164, *Homalopoda cristata*. 165, *H*. sp. C. 166, *H*. sp. D

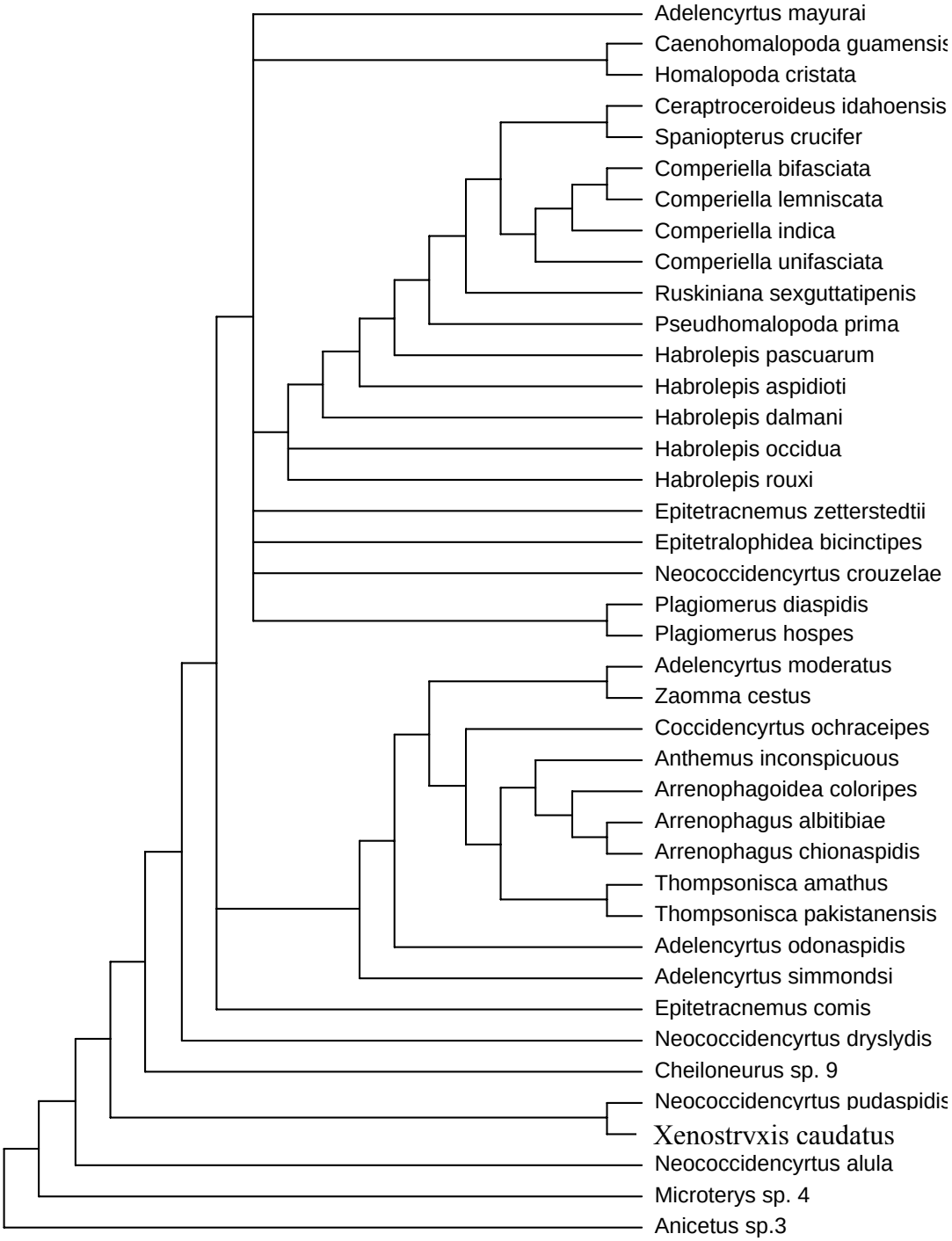


Fig. 167. Strict consensos of three trees obtained from single parsimony análisis of equally weighted characters, each of which had length of 576 steps, CI of 0.502 and RI of 0.594.

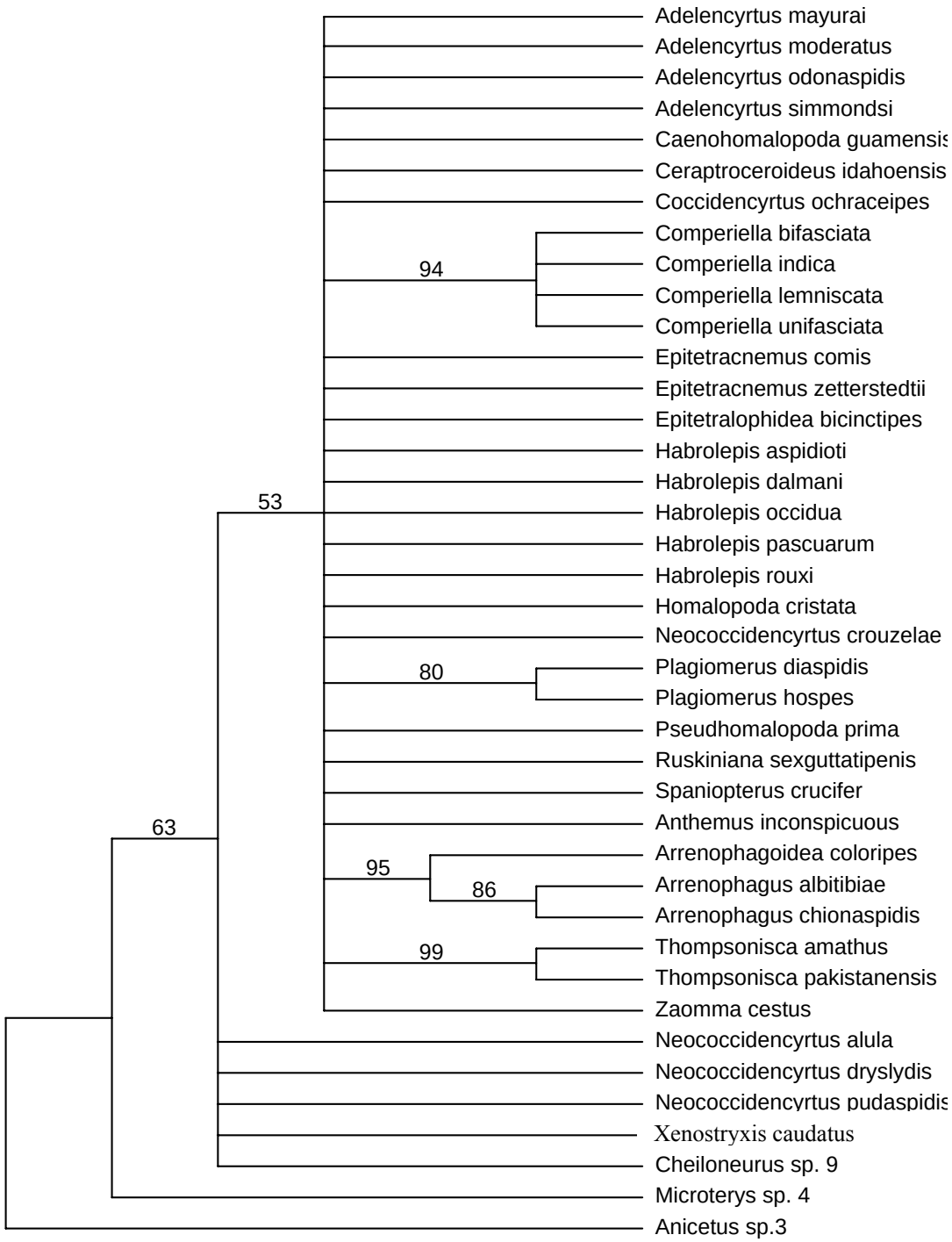


Fig. 168. Boostrap support tree resulting from 1000 bootstrap pseudoreplications.

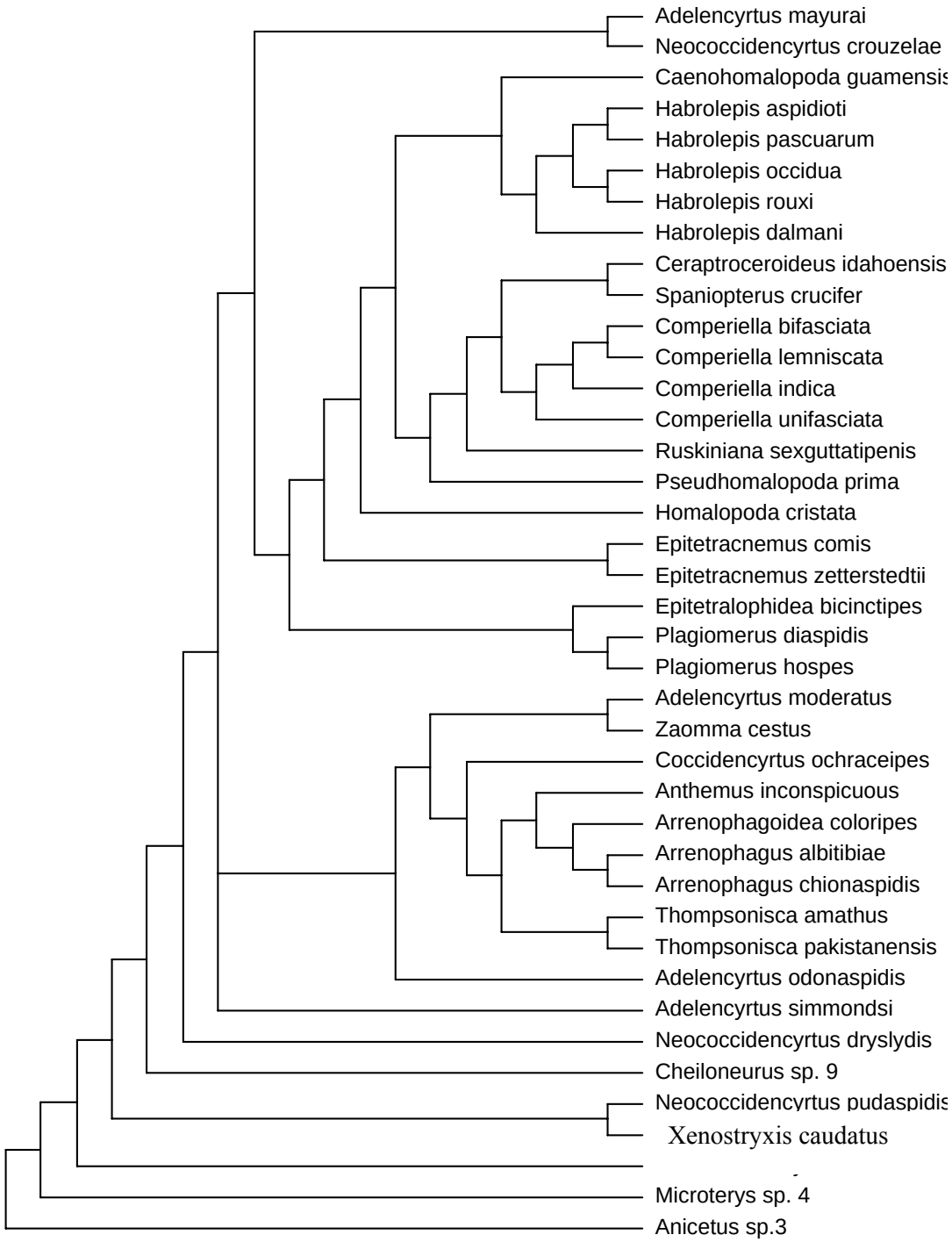


Fig. 169. Successive approximation tree using rescaled consistency index, length of 582

VITA

Name:	Beatriz Rodríguez Velez
Address:	Department of Entomology. Texas A&M University, 77843.
	College Station, Texas.
Email Address:	beatriz rv@yahoo.com
Education:	B.S., Biology, Universidad de Guadalajara, 1993
	Ph.D. Entomology, Texas A&M University, 2005