

THE CLINAE OF RONDÔNIA, BRAZIL: ARCAS, WITH DESCRIPTIONS OF THREE NEW SPECIES (LEPIDOPTERA: LYCAENIDAE)

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ABSTRACT.— Three new species of *Arcas* are distinguished among samples of the genus from the lowland tropical rainforest in the western Amazon drainage of central Rondônia, Brazil: *Arcas magnifica* n. sp., *Arcas viriditas* n. sp., and *Arcas marginata* n. sp. Morphological distinctions of the genitalia corroborate superficial differences noted in wing pattern and androconial brands. Samples of other Eumaeini genera from this study area contain numerous examples of new species occurring in sympatry and/or synchrony with more well-known taxa. These afford an opportunity for study of ecological and biological differences separating these taxa.

KEY WORDS: Amazon, *Arcas magnifica* n. sp., *Arcas marginata* n. sp., *Arcas viriditas* n. sp., cryptic species, *Eiseliana*, Eumaeini, *Heoda*, Neotropical, South America, species diversity.

The state of Rondônia in western Brazil has a short history of biological exploration. Until recently, access to its more than 240,000 square kilometers was difficult except for the vicinity of its capital, Porto Velho. This city, at the limit of navigability of the Rio Madeira (a major Amazon tributary), was an important rubber port in the early twentieth century. Incentives for development of forested regions were initiated by the Brazilian government in the 1960's. This was facilitated by an extensive road system into a large part of Rondônia, diverging from the infamous highway BR-364. The influx of immigrants increased the population of Rondônia more than seven-fold in the fifteen years after 1970. Their development resulted in the clearing of vast stretches of rainforest (about 16% cleared in 20 years) as documented by Landsat images (e.g., see National Geographic Society 1990, pp. 5-6).

The first indications of the high diversity of butterflies in Rondônia were based upon studies by Brown (1976, 1984) near Jarú in the west-central portion of the state: 956 butterfly species were recorded and a total fauna of over 1300 species was estimated. This prediction cannot now be verified since the forests at Jarú are nearly destroyed. In 1987, Olaf Mielke, Tom Emmel, and others searched for another area in Rondônia which might contain the predicted diversity of the Jarú site. A likely site with comfortable accommodations was found in central Rondônia at Fazenda Rancho Grande owned and operated by the Harald Schmitz family. This ranch is located on road C-20, about 7km east of road B-65 and 5km northeast of Cacaúlândia at 10°18' S, 62°51' W and about 40km west-northwest of Jarú. Intensive studies have been conducted on the ranch proper and contiguous protected area consisting of 1000ha. Additional, less intensive, surveys were in forest tracts along road C-20 east of the ranch to road B-80, along B-80 between roads C-10 and

C-20, along road B-65 between roads C-0 and C-25, and to about 10 km west of B-65 along roads C-5, C-10, C-15, and C-20. The total area surveyed, consisting of about 65km of trails and roads, does not exceed 4000ha.

The region is relatively flat at an elevation of 200m interrupted by low hills with elevations less than 300m above the flats. One major river (Rio Pardo) transects the region and there are numerous additional smaller, often ephemeral, streams. Climatic data (daily minimum and maximum temperatures and rainfall) have been recorded at Fazenda Rancho Grande since 1984. These indicate a distinctly seasonal climate (Austin *et al.*, ms). A wet season occurs from October through April when over 85% of the annual precipitation falls (mean = 2250mm). The dry season extends from May to September with almost no precipitation in June and July. Extreme temperatures range from 9-43°C. The dry season averages several degrees cooler (mean temperature in June and July = 25°C) than the wet season (mean temperatures in October-April = 28-29°C). The vegetation is dominated by typical lowland tropical rainforest which is now a patchy continuum of continuing disturbance from pristine forest to completely cleared tracts.

In-depth investigations of the butterfly diversity near Cacaúlândia were initiated in March 1989 (Emmel, 1989; Emmel and Austin, 1990). Subsequently, Mielke, Emmel, Austin, and others in various combinations have visited the region. Additional observations have been made by the Schmitz family. Austin's thirteen visits have included the months of March, April, and June through December and nearly 200 field days. These studies have shown this to be the most diverse known butterfly fauna with well over 1500 species recorded (Austin *et al.*, ms). Among these are new taxa (Austin and Mielke, 1993) and about 10% of the Hesperiidae represent undescribed species (Austin, 1993;

Austin, Mielke, and Steinhauser, unpublished data).

The Theclinae (Lycaenidae) of the Cacaulândia area consists of more than 200 species, including a number of undescribed taxa. The only information on the subfamily for central Rondônia is a species count for Jarú (Brown, 1984) and provisional lists for Cacaulândia (Emmel and Austin, 1990; Austin *et al.*, ms). Sufficient material now exists for a critical evaluation of the Cacaulândia fauna. This is the first of a proposed series of papers in which we will discuss the diversity of this subfamily in central Rondônia and describe new taxa. Common among specimen series of various genera of Eumaeini taken in the study area are new species which stand out distinctly from well-known congeners also present in the region. Along with elaborating new groups of Eumaeini found in central Rondônia, we will describe such new taxa in a series of papers as is the case with the genus *Arcas* treated herein.

Theclinae in central Rondônia have an apparent peak of abundance from the mid dry season to the dry season-wet season transition from July to early November. Hairstreaks are found mainly in association with mature forests where they are encountered infrequently except in the afternoons of hot, sunny days. On such days, they commonly perch in the shade in the understory, at the edges of light gaps, and along shaded forest edges. This suggests that many are canopy dwelling species which descend to cooler microclimates to escape thermal stress. Various species are also attracted at daybreak to the small flowers of certain trees, shrubs, and vines which bloom in the dry and early wet seasons.

Forewing length is from base to apex. Terminology largely follows that used previously by the junior author (e.g., Johnson, 1989, 1991). Smithe (1975, 1981) color names are capitalized.

ARCAS Swainson

Arcas was proposed by Swainson (1832) for *Papilio imperialis* Cramer. This name was all but ignored until Nicolay (1971) revived the concept to include seven species of large and gaudy Neotropical Theclinae occurring from central Mexico to southern Brazil. The genus was well diagnosed by Nicolay (1971) and its description need not be repeated here.

We found five species of *Arcas* during our studies of the central Rondônia fauna. These were most often seen along trails at light gaps. None was encountered on hilltops although this was reported as a general behavior of the genus in other areas (Nicolay, 1971). The Rondônia taxa are discussed below, including the descriptions of three new species. The two previously described species were characterized and compared adequately by Nicolay (1971); comparisons are made here only when applicable to the newly described taxa. For completeness, we illustrate the five Rondônia species, including their genitalia, and revise Nicolay's (1971) species key.

The three new species described here makes it necessary to revise Nicolay's (1971) key to the species of *Arcas* as follows (male is unknown for *A. marginata*):

1. Ventral hindwing without discal black band 2
 - Ventral hindwing with discal black band 4
2. Forewing apex distinctly rounded, ventral hindwing with well-de-

- finer carmine disc and metallic yellow margin *ducalis*
- Forewing apex more angulate, ventral hindwing with or without rosy or coppery wash but no yellow margin 3
- 3. Valva broadly convex, vincular spur broad and blunt *magnifica*
 - Valva narrowly convex, vincular spur narrow and sharply pointed *imperialis*
- 4. Ventral hindwing discal black band shallowly N-shaped *cypria*
 - Ventral hindwing discal black band with anterior arm straight or slightly curved 5
- 5. Male with androconial brand small and distinctly separated from distal end of discal cell, Central America *delphia*
 - Male with androconial brand in contact with distal end of discal cell (or male unknown), various locations 6
- 6. Male dorsum blue, androconial brand large with proximal portion distinctly entering discal cell, female ventral forewing with or without black band, Central America or Ecuador 7
 - Male dorsum green, androconial brand small and largely outside discal cell (or male unknown), female ventral forewing without black band, variously from Peru southward 8
- 7. Androconial brand tear-drop shaped, only pointed tip within discal cell, female ventral forewing with black band *splendor*
 - Androconial brand very large, in distal half of discal cell and extending just distad of its end, female ventral forewing without black band *jivaro*
- 8. Female antrum narrow, male with saccus short, caudal extension of valva about 2/3 length of bilobed area *viriditas*
 - Female antrum broad 9
- 9. Dorsal wing margins of female diffuse, male saccus long, caudal extension of valva less than 1/2 length of bilobed area *tuneta*
 - Dorsal wing margins of female distinctly defined, male unknown *marginata*

Arcas imperialis (Cramer, 1775)

(Fig. 1, 3, 9, 14, 19, 23, 28)

This, the most widespread of the *Arcas* species, is the commonest member of the genus in central Rondônia with records for February, June through September, and November. The twenty males and nine females examined are sparsely to heavily marked with black striations on the ventral hindwing and, except for one female, lack any hint of the rose-pink to coppery iridescence noted in some more northern populations of the species (Nicolay, 1971). The shape, size, and placement of the androconial brand on the forewing of the male and the genitalia of both sexes exhibit little variation.

Among the specimens originally sorted with the *A. imperialis* series were three males and three females which, upon dissection, had quite different genitalia. Closer examination also revealed subtle differences in superficial characters. This taxon is described next.

Arcas magnifica Austin & Johnson, new sp.

(Fig. 2, 6, 10, 15, 20, 24, 29)

DIAGNOSIS.— This species is superficially very close to *A. imperialis* except for the more quadrate shape of the distal element of the bipartite forewing androconial brand. The male genitalia have a broader and more angulate vinculum than *A. imperialis*, the valva has the bilobed area more quadrate (that of *A. imperialis* is triangular and broadest caudad), and the vincular spur is broad and blunt (narrow and pointed on *A. imperialis*); in

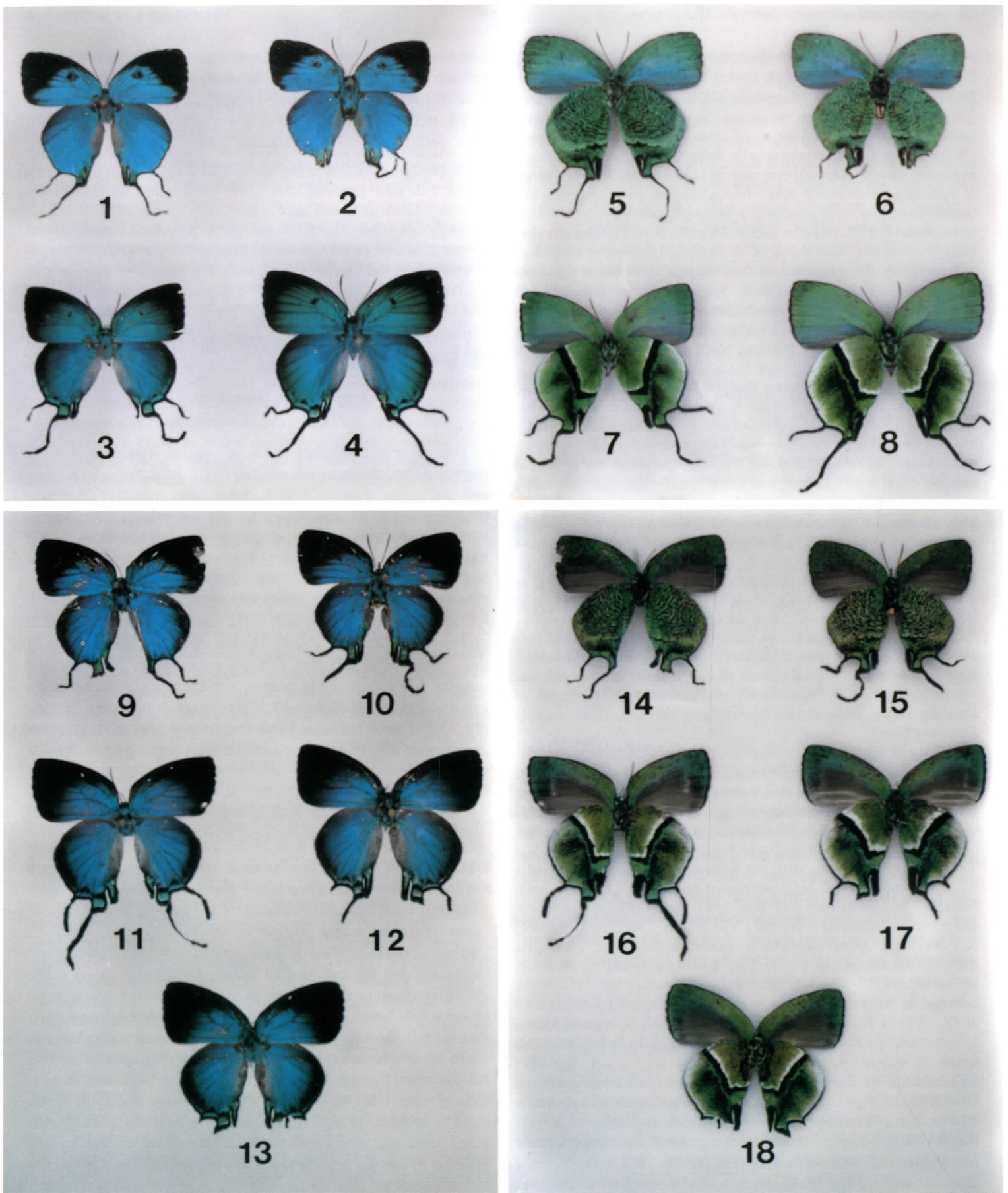


PLATE 1. Fig. 1-4. Males of *Arcas*, dorsal surface, all from BRAZIL (Rondônia): Fig. 1. *A. imperialis*, Fig. 2. *A. magnifica*, holotype, Fig. 3. *A. tuneta*, Fig. 4. *A. viriditas*, holotype. Fig. 5-8. Males of *Arcas*, ventral surface (same specimens as Fig. 1-4): Fig. 5. *A. imperialis*, Fig. 6. *A. magnifica*, Fig. 7. *A. tuneta*, Fig. 8. *A. viriditas*. Fig. 9-13. Females of *Arcas*, dorsal surface, all from BRAZIL (Rondônia): Fig. 9. *A. imperialis*, Fig. 10. *A. magnifica*, Fig. 11. *A. tuneta*, Fig. 12. *A. viriditas*, Fig. 13. *A. marginata*, holotype. Fig. 14-18. Females of *Arcas*, ventral surface (same specimens as Fig. 9-13): Fig. 14. *A. imperialis*, Fig. 15. *A. magnifica*, Fig. 16. *A. tuneta*, Fig. 17. *A. viriditas*, Fig. 18. *A. marginata*.

addition, the saccus is more elongate on *A. magnifica*, exceeding 2X valval length (about 1.6X valval length on *A. imperialis*).

DESCRIPTION.—MALE: forewing = 17.0mm (holotype), 17.0-17.9mm (paratypes); upper surface of wings iridescent blue (near Cyan), hindwing slightly deeper blue along costa and iridescent green (near Chartreuse) at tornus; forewing with margin black, narrow at tornus expanding broadly anteriorly and curving to narrow black costal margin at mid wing; androconial brand brown, in two parts, quadrate part outside discal cell, well separated from roughly kidney-shaped portion inside discal cell (this smaller than distal element on holotype); fringes iridescent blue with dark tip as on *A. imperialis*; hindwing with black limited to very thin terminal line; very long tail from end of CuA_2 and shorter tail at end of CuA_1 black; fringes iridescent blue. Venter iridescent green (near Apple Green), gray along anal margin, strong blue highlights just anterior to this; hindwing moderately striated with black, this slightly less dense in submargin; black postmedian line from CuA_2 to anal margin; large black lunule in CuA_1 - CuA_2 ; tornus black.

Genitalia: Saccus long, greater than 1/2 total length of genitalia and about 2X valval length, its terminal margin sculptured to accommodate the indentation apparent on the broad base of the paired valvae directly adjacent (note that the configuration of the upturned dorsal lobe of the valva which appears different for the two species in the figures is variable on *A. imperialis* and thus not a specific character); vinculum broad in ventral view, angular, vincular spur well-developed with broad and squared-off terminus; valva with bilobed area broadest in middle, narrowing to short (ca. 40% of valval length) and blunt-ended caudal extension.

FEMALE: forewing = 14.7-16.7mm; dorsum intense blue (Cobalt) with green iridescence, especially at hindwing tornus; forewing with well-defined black outer and costal margins, relatively narrow at tornus, curving proximad to distal end of discal cell and then extending to base along costa; hindwing with diffuse black outer margin; tails as on male; fringes as on male. Ventral surface similar to male; iridescence more yellow-green (near Olive-Yellow); non-iridescent anal margin of forewing brown, more extensive, extending into discal cell, without associated blue.

Genitalia: Lamella postvaginalis broad, caudal end slightly concave; antrum tubular, barely extending caudad of cephalad edge of lamella postvaginalis; ductus bursae thin, sharply curved ventro-laterad towards cephalad end where expanded before corpus bursae; corpus bursae oblong with pair of robust, triangular-shaped signa, thinnest caudad, that on right somewhat caudad of that on left.

TYPES.—Holotype male with the following labels: white, printed - BRAZIL: Rondonia / 62 km S Ariquemes / linea C-20, 7 km E / B-65, Fazenda / Rancho Grande / 18 Nov. 1991 / leg. G. T. Austin; white, printed and handprinted - Genitalia Vial / GTA - 4630; red, printed - HOLOTYPE / *Arcas magnifica* / Austin & Johnson. **Paratypes:** BRAZIL: Rondônia; Linea C-10, 5km S of Cacaúlândia, 11 Jul 1994, leg. O. Gomes (1 ♂), 14 Nov 1994, leg. O. Gomes (1 ♂).

Additional material: same data as paratypes except 12 Jul 1994 (2 ♀), 25 Oct 1994 (1 ♀). The holotype and a female will be deposited at the Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Brazil.

ETYMOLOGY.—The name means "magnificent," as are all *Arcas*.

DISTRIBUTION.—The species is known only from the vicinity of the type locality with records in July, October, and November.

REMARKS.—The color and markings of *Arcas magnifica* are nearly identical with those of *A. imperialis*. The section of the bipartite androconial brand distal to the discal cell is quadrate (more rounded and often irregularly-shaped on *A. imperialis*). It is further separated from the part inside the discal cell than on *A. imperialis* and does not have the noticeable upper extension basad as on that species. The broader male genitalia with a broad and

blunt-ended vincular spur are also distinctive; the spur is narrowly pointed and fishhook-like on *A. imperialis*. In addition, the saccus is relatively longer on *A. magnifica* than on *A. imperialis*.

The three apparent females of *A. magnifica* (not included in the type series) are nearly identical superficially to female *A. imperialis*. The ventral surface appears more yellow than on *A. imperialis* which is Yellow-Green to Apple Green on this surface. The genitalia, however, are distinctive. The antrum of *A. magnifica* is a little shorter and broader than on *A. imperialis* and does not extend as far caudad of the cephalad end of the lamella postvaginalis (extending nearly 1/3 the length of the lamella postvaginalis on *A. imperialis*). The curvature of the cephalad end of the ductus bursae is sharper on *A. magnifica* and the signa are much larger (almost 1/3 the length of the corpus bursae vs 1/4 the length on *A. imperialis*).

Arcas tuneta (Hewitson, 1865)

(Fig. 3, 7, 11, 12, 21, 25, 30)

This is less commonly seen in central Rondônia than *A. imperialis* and has been recorded in April, July, August, October, and November. Our material does not differ from that illustrated by Nicolay (1971). Although he did not mention the narrow white scaling at the ventral hindwing apex, this is shown in his figure of the male. Nicolay (1971) gave the distribution of *A. tuneta* as southeastern Brazil, central Bolivia, and northern Peru. Our records are the first from the Amazon Basin of Brazil.

Slight variation within our series first identified as *A. tuneta* prompted dissection of a male at each extreme. The genitalia of these were quite different and the entire series of males and females was subsequently examined. These included six males and five females with genitalia as shown for *A. tuneta* by Nicolay (1971) and three males and one female with the second type of genitalia which represents a previously unrecognized species described next.

Arcas viriditas Austin & Johnson, new sp.

(Fig. 4, 8, 12, 17, 22, 26, 31)

DIAGNOSIS.—This is similar to *A. tuneta* in color and pattern but the dorsum is more intensely green especially on the hindwing (this more blue on *A. tuneta*). The forewing termen is more convex than the nearly straight termen on *A. tuneta*. There is also more restricted black at the apices of both the forewings and hindwings and the androconial brand is somewhat larger. The ventral surface is likewise greener, the hindwing has a more obvious two-toned effect (area proximad of discal brand paler than distad), the hindwing margin is more extensively scaled with white along the outer margin especially at the apex (usually a narrow white line on *A. tuneta*). Also on the hindwing, there is usually more black overscaling distad of discal band, the discal band is broader, straighter, and distinctly and completely margined proximad with a narrow white line (narrower and incomplete on *A. tuneta*, usually restricted to proximad of the anterior and posterior portions only). The male genitalia of *A. viriditas* differ markedly from *A. tuneta*, the former with a proportionately longer saccus and valvae showing a distinctively elongate caudal extension contrasting with the abruptly truncated terminus of *A. tuneta*.

DESCRIPTION.— MALE: forewing = 20.1mm (holotype), 19.8mm (paratype); upper surface of wings iridescent green (near Spectrum Green), hindwing with blue (Turquoise Blue, color 64) highlights especially anteriorly; forewing with termen slightly convex; margin black, narrow at tornus expanding anteriorly and curving to costal margin where narrowing to above distal end of discal cell and then narrowly to base of costa; androconial band brown, completely distad of but touching distal end of discal cell; hindwing with very narrow black margin, slightly broader at apex, and extending along about half of anal margin; black submarginal lunules in CuA_1 - CuA_2 and CuA_2 -2A, vague darker submarginal line extending to apex, very long tail from end of CuA_2 and shorter tail at end of CuA_1 black; fringes of both wings (including edges of tails) iridescent silvery-blue. Ventral forewing iridescent green (near Apple Green), gray-brown along anal margin, outer margin narrowly black; hindwing two-toned green, Apple Green distad to discal band and Yellow-Green proximad; apex broadly and outer margin less broadly scaled with white; area between white and discal band overscaled with black leaving narrow pure green space adjacent to discal band anteriorly and a broader space posteriorly, black heaviest proximad, black discal band broad, relatively straight from costa to mid cell CuA_2 -2A where angled sharply to anal margin, proximal edge of band slightly irregular posteriorly, entire band margined proximad by narrow but distinct white band.

Genitalia: Saccus moderately long but less than 1/2 total length of genitalia; vinculum with vincular spur well-developed, valva long, bilobed area broad, narrowing to caudal extension comprising about 2/3 length of bilobed area.

FEMALE: forewing = 20.0mm; dorsum iridescent blue (near Cerulean Blue) with green highlights especially basad on both wings and iridescent green at hindwing tornus; forewing with black outer margin occupying outer 1/2 of wing, broadest at apex; outer margin of hindwing black to CuA_1 , diffuse; pale blue distad of black margin caudad; tornal macules as on male; tails apparently (broken) as on male; fringes as on male. Ventral surface similar to male; brown of forewing anal margin more extensive extending to posterior margin of discal cell and to M_3 ; hindwing discal band with broader white proximad.

Genitalia: Lamella postvaginalis broad; antrum narrow, cone-shaped, not flaring caudad; ductus bursae thin, expanded before joining corpus bursae; corpus bursae globular with pair of long, thin, triangular-shaped signa, pointed caudad, that on right caudad of that on left.

TYPES.— Holotype male with the following labels: white, printed - 19 Nov. 1991 / B-80, between rds. C - / 10 & C - 15, nr. Cacaú / landia, Rondonia, BRA- / ZIL, leg. Jim P. Brock; yellow, printed - photographed / G. T. Austin & / J. P. Brock / July 1992; white, printed and handprinted - Genitalia Vial / GTA - 4603; red, printed - HOLOTYPE / *Arcas viriditas* / Austin & Johnson.

Paratypes: Linea C-10 at Rio Pardo, 5km S Cacaúlândia, 16 Oct 1994, leg. O. Gomes (1 ♂), 26 Oct 1994, leg. O. Gomes (1 ♂). Additional material: BRAZIL: Rondônia; 67km S Ariquemes, Linea C-10, 5km S Cacaúlândia, 5 Jul 1993, leg. O. Gomes (1 ♀). The holotype will be deposited at the Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Brazil.

ETYMOLOGY.— The name means "greenness" and refers to the dorsal color of males and ventral color of both sexes.

DISTRIBUTION.— The four known specimens are from the type locality (about 15km E of Cacaúlândia) and vicinity in central Rondônia, Brazil and taken in July, October, and November.

REMARKS.— *Arcas viriditas* is very similar to *A. tuneta* and was originally included with that species. The superficial differences between the two species are subtle and, especially on worn specimens, not clearly seen until segregated by characteristics of the genitalia. The extent of white scaling at the apex of the ventral hindwing seems to be the most reliable wing character.

On *A. viriditas*, this is extensive compared with the narrow white area on *A. tuneta*.

The male genitalia are distinctive. The saccus of *A. viriditas* is less than 1/2 of the total length of the genitalia while on *A. tuneta* the saccus is slightly longer than 1/2 the total length. The bilobed area of the valva does not flare as broadly caudad as on *A. tuneta* and the caudal extension is much longer (comprising about 0.4 valval length). The caudal extension on *A. tuneta* is truncated abruptly, being less than 0.3 valval length.

The female assigned to this species (but not included in the type series) is also very similar to females of *A. tuneta*. The lamella postvaginalis is not as flared as on *A. tuneta*, the caudo-lateral edges of the antrum are less broadly separated, and the signa are somewhat narrower.

Four other described species of *Arcas* have a broad black discal band on the ventral hindwing. Two of these, *Arcas splendor* (Druce, 1907) known from southern Central America, and *Arcas jivaro* Nicolay, 1971, known only from Ecuador, are blue. Another, *Arcas cypria* (Geyer, 1837), ranging from Mexico to Colombia, is also blue and has the anterior, longer arm, of the discal band bent in the middle giving it a shallow "N"-shape. Finally, *Arcas delphia* Nicolay, 1971, occurring from Costa Rica to Colombia, has its androconial band distinctly separated distad from the vein at the end of the forewing discal cell. None of these have valvae like those of *A. viriditas*.

A female, similar to *A. tuneta* and *A. viriditas*, immediately stood out in color and crispness of dorsal markings. Dissection of its genitalia revealed additional differences. This is described next.

***Arcas marginata* Austin & Johnson, new sp.**

(Fig. 13, 18, 27)

DIAGNOSIS.— This is generally like *A. tuneta* and *A. viriditas* in color and pattern but the female dorsum is more green especially basad on both wings. The forewing termen is more convex than the nearly straight termen on female *A. tuneta* and more like *A. viriditas*. The forewing margins and apex are very broadly black and the hindwing has a well defined black margin (not diffuse as on *A. tuneta* and *A. viriditas*). The ventral surface is similar to *A. viriditas* but more strongly two-toned than that species and the discal band is narrower and straighter. The female genitalia of *A. marginata* have a broad lamella and antrum as on *A. tuneta* but a narrow ductus bursae as on *A. viriditas*. The curvature of the cephalad end of the ductus bursae is sharper than on any similar *Arcas* and is prominently scalloped at the cervix bursae.

DESCRIPTION.— MALE: unknown.

FEMALE: forewing = 19.8mm (holotype); upper surface of wings blue-green (near Turquoise Blue) with strong iridescent green at bases of both wings; forewing with termen convex; margin relatively well defined, broadly black, expanding anteriorly nearly to end of discal cell where narrowing to base of costa; hindwing with sharply defined and relatively broad black margin from apex to CuA_1 , separated distinctly posteriorly from black terminal line by line of blue; black submarginal lunules in CuA_1 - CuA_2 and CuA_2 -2A, tails from ends of CuA_2 and CuA_1 broken; fringes of both wings pale blue, tipped with blackish. Ventral forewing gray-brown with broad iridescent green along costal margin (near Chartreuse) and apex and outer margin (near Lime Green); hind-

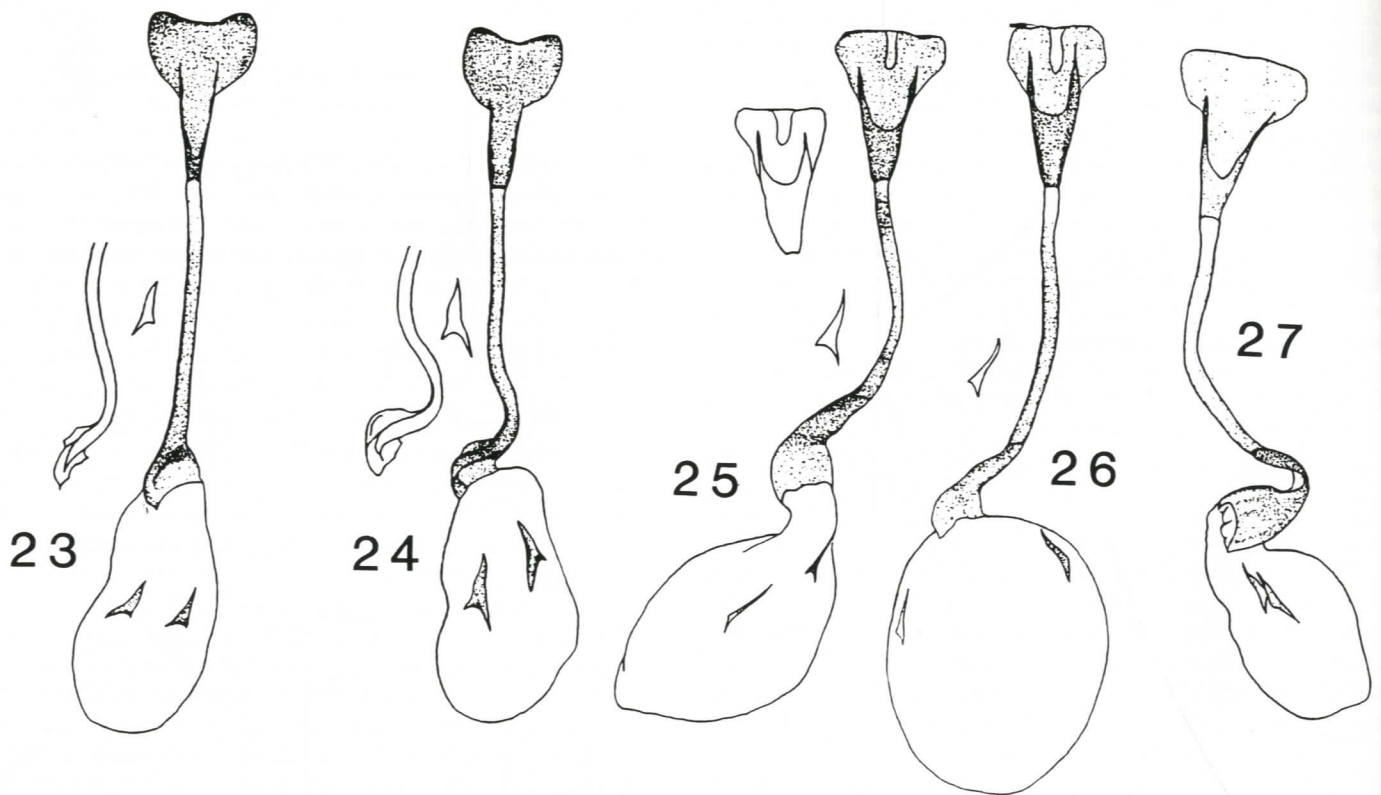
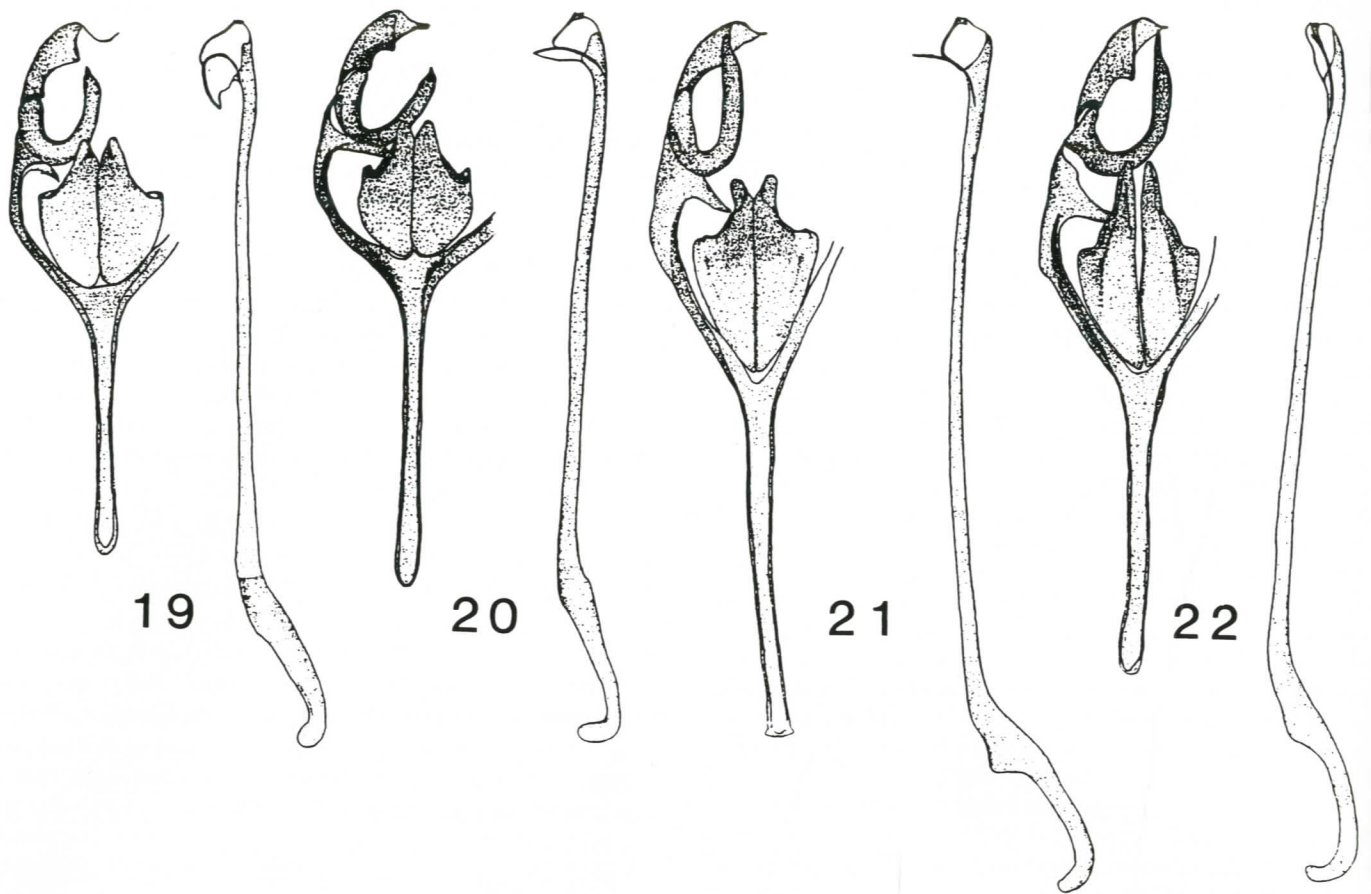


Fig. 19-22. Male genitalia of *Arcas* from BRAZIL: Rondônia (ventral view of genital capsule, lateral view of penis): Fig. 19. *A. imperialis* (GTA #4632), Fig. 20. *A. magnifica* (GTA #4630), Fig. 21. *A. tuneta* (GTA #4604), Fig. 22. *A. viriditas* (GTA #4603).

Fig. 23-27. Female genitalia of *Arcas* from BRAZIL: Rondônia (ventral view of lamella, antrum, ductus bursae, and corpus bursae, lateral view of signum): Fig. 23. *A. imperialis* with lateral view of cephalad end of ductus bursae (GTA #4917), Fig. 24. *A. magnifica* with lateral view of cephalad end of ductus bursae (GTA #4916), Fig. 25. *A. tuneta* (GTA #4639) showing variation of lamella and antrum (GTA #4633), Fig. 26. *A. viriditas* (GTA #4634), Fig. 27. *A. marginata* (GTA #4924).

wing distinctly two-toned green, lime green distad to discal band and Chartreuse proximad; apex broadly and outer margin narrowly scaled with white; area between white and discal band overscaled with black leaving very narrow pure green space adjacent to discal band anteriorly and a broader space posteriorly; black discal band narrow, nearly straight from costa to mid cell CuA₂-2A where angled to anal margin, entire band margined proximad by narrow but distinct white band.

Genitalia: Lamella postvaginalis very broad; antrum broad, cone-shaped, flaring caudad; ductus bursae thin, sharply curved and expanded before joining corpus bursae where distinctly scalloped; corpus bursae globular with pair of long, relatively broad, triangular-shaped signa, pointed caudad, that on right slightly caudad of that on left.

TYPES.— Holotype ♀ with the following labels: white, printed - BRAZIL: Rondonia / linha C-10 off B-65 / 5 km S Cacauplandia / 22 Dec. 1993 / leg. O. Gomes; white, printed and handprinted - Genitalia Vial / GTA - 4924; red, printed - HOLOTYPE / *Arcas marginata* / Austin & Johnson. The holotype will be deposited at the Departamento de Zoologia, Universidade Federal do Paraná, Curitiba, Brazil.

ETYMOLOGY.— The name refers to distinct black margin on the dorsal hindwing.

DISTRIBUTION.— The species is known only from the holotype.

REMARKS.— *Arcas marginata* is the seventh species of the genus with a black discal band on the ventral hindwing (see remarks above under *A. viriditas*). The female differs from the sympatric *A. tuneta* and *A. viriditas* by the greener color and more distinctly defined black margins of the dorsum (especially on the hindwing). The discal band on the ventral hindwing is narrow as on *A. tuneta*, is narrowly but completely outlined proximad with white, and is straighter than on either *A. tuneta* or *A. viriditas*. The white overscaling at the apex of the ventral hindwing is broad as on *A. viriditas* but narrow posteriorly along the margin as on *A. tuneta*. Female *A. splendor* have a black band on the ventral forewing, *A. cypria* has an "N"-shaped discal ventral hindwing band, and *A. delphia* has the ventral hindwing discal band somewhat more distad, less sharply angled to the anal margin, and outlined proximad by pale green rather than white. *Arcas jivaro* has less sharply defined margins on the dorsum and a more curved ventral hindwing discal band which is less sharply angled to the anal margin.

The genitalia of *A. marginata* are distinctive. The broad and lobate lamella and the broad antrum resembles those of *A. tuneta* and somewhat those of *A. splendor*, *A. cypria*, and *A. delphia* but are very different from the narrow and less flaring structures of *A. viriditas* and *A. jivaro*. The ductus bursae is thin (like *A. viriditas* and *A. jivaro*) but curved sharply at its cephalad end unlike other similar *Arcas*.

DISCUSSION

Arcas and Sibling Species Diversity in the Cacauplandia Fauna

The diverse and often extensive samples of Theclinae from the Cacauplandia area offer an unprecedented opportunity to examine the reality of sibling species diversity in lowland primary rainforest that characterize the Neotropics. Regarding this and the genus *Arcas*, it is useful to briefly discuss questions regarding the significance of "minor" superficial and morphological differences between certain *Arcas* species (and many other Theclinae genera and species of other taxa). This is primarily a systematics question and will arise again and again as poorly known groups are elaborated especially within local faunas. The problem reflects the ongoing tension between museum and field based systematics (Crowson, 1970) and the biological reality of the consistent differences observed between sympatric phenotypes. The quick and nearly universal acceptance is that variation is intraspecific. When variation is observed and noted in the taxonomic literature, there is usually no discussion of its nature, with no mention of its continuous or discontinuous expression or of its consilience in several morphological characters. In practice, the mention of variation is lost in descriptions and museum series. This is certainly proper if the variation is continuous and/or with no consilience among several characteristics. The converse, however, should be the recognition of potentially different taxa with a formal name and description. This serves as the proverbial "red flag" to other biologists that there is a high probability of more than individual variation and that sibling species may be involved. Sympatric phenotypes of this sort must be recognized as species

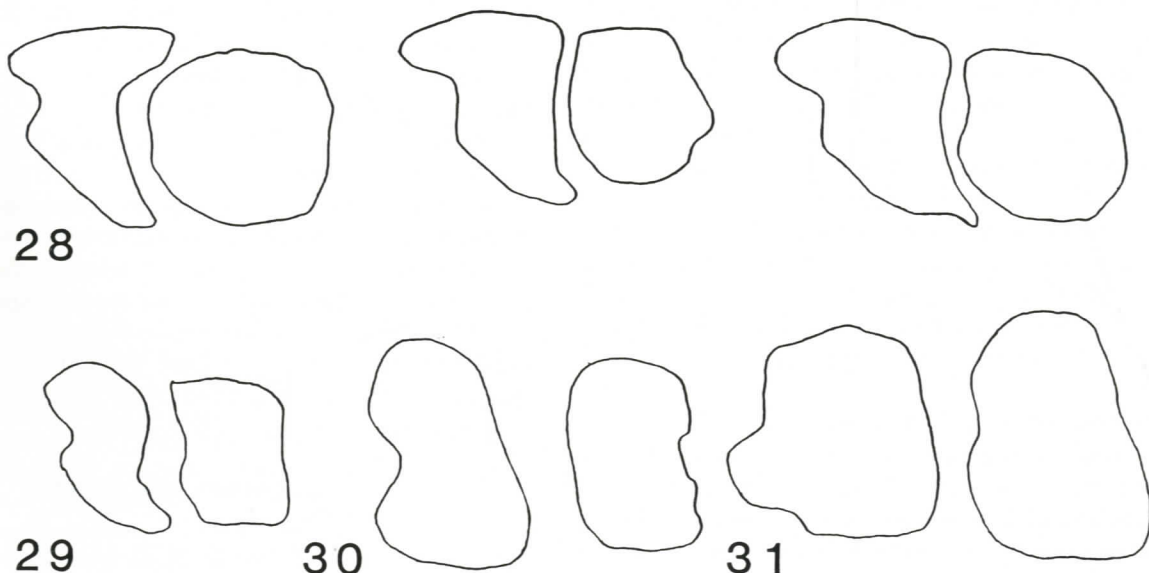


Fig. 28-31. Outlines of shapes and arrangements of right forewing androconial brands of *Arcas* from BRAZIL (Rondônia): Fig. 28. *A. imperialis*, Fig. 29. *A. magnifica*, Fig. 30. *A. tuneta*, Fig. 31. *A. viriditas*.

while such examples of differences in allopatry may be specific or subspecific.

Most dismissal of variation as intraspecific is due to the shotgun pattern of the geographical representation of available material. Rarely is there the luxury of known sympatric and synchronic series as with the material from the surveys in Rondônia. These contrasting situations impose different levels of taxonomic "conservatism", the local samples providing more compelling evidence to view hiatuses in character states as specific while the approach to random samples leads to views of intraspecific variation. At the local level, the observed hiatuses cannot easily be dismissed as intraspecific variation because the consistency of such differences is simply too apparent and the question would not arise if "intermediates" were known. Given consistent differences in a variety of characters and a background of conventional "common usage" in any group, but particularly among poorly studied taxa, the worker has two choices. The first is a "lumpers" option which favors the view that the differences are not taxonomically informative (apparently based, rightfully or not, on mostly random historical museum material) and prefers limitation of new taxa (apparently assuming that most species of a group are known and so called "minimal" expansion reflects biological reality even though, throughout the taxonomic literature, good species are known which cannot be distinguished by conventional taxonomic techniques). This option is difficult for workers who have studied material from well-studied local areas, both because of the consistency of the characters themselves and because a second alternative probably reflects biological reality. This second option considers that samples as the Rondônia material clearly suggest the reality of significant sibling species diversity in complex biotas like that of the lowland forests surrounding Cacaulândia. By "sibling species diversity" we mean not only additional biological species supported by complex ecological structure but the taxonomic reality of new species either previously unrecognized because of insufficient reference to type specimens or complexes of internal and external characters, or simply not previously seen because they represent local endemics.

Our views see taxonomy as functional, preferring to formally recognize apparent new entities and propose them as subjects for field studies to further enhance the biological knowledge of within these diverse ecosystems. In this regard it is worth noting that Chilean workers, after studying the life histories of populations of Polyommatae recognized by many new names (Bálint, 1992), not only documented the validity of these as species but discovered several additional new species (Benyamini, in press). These studies exhibit the value of conducting intensive local surveys, of assembling meaningful taxonomic collections to properly access intraspecific variation and interspecific differences, and of followup life history investigations.

Taxonomic Composition and Affinities

The three new species described above, *A. magnifica*, *A. viriditas*, and *A. marginata* may well occur within museum series currently identified as *A. imperialis* or *A. tuneta*, respectively. These should be carefully searched for their existence. Some of the "considerable individual variation" in the genitalia of *Arcas* (Nicolay, 1971) may well be specific differences.

The distribution of *Arcas* from Mexico to southern Brazil (Nicolay, 1971) consists of one widespread species (*A. imperialis*) encompassing nearly the entirety of this distribution, three additional species (*A. cypria*, *A. delphia*, and *A. splendor*) occurring variably from central Mexico to Colombia, one species (*A. jivaro*) known only from Ecuador, and two species (*A. tuneta* and *Arcas ducalis* [Westwood, 1852]) in southeastern Brazil with *A. tuneta* extending northward in western South America to northern Peru. Whether the absence of records of all except *A. imperialis* from most of the Amazon Basin is real or a reflection of insufficient sampling is unknown. In any event, the three new species described herein brings the number of "southern" restricted species to five. Of these, *A. viriditas* and *A. marginata* are the most distinctive in both superficial and morphological characters. *A. magnifica* is more subtle and suggests the need for field and biological study to further support the distinctions noted here. Johnson and Sourakov (1993) have recently emphasized the importance of elaborating biological distinctions between superficially similar Eumaeini otherwise differing widely in morphological characters. Benyamini and Johnson (ms.) found outstanding behavioral differences between some superficially similar austral taxa of *Eiseliana* and *Heoda* (including such notable behaviors as "feigning death"). Some of the taxa they studied were being observed for the first time in the field subsequent to description of museum material. In the case of *A. magnifica*, *A. viriditas*, and *A. marginata* distinguished in the present paper, the next logical step is detailed field studies which should elucidate their suspected biological and behavioral differences from their sympatric congeners.

The five species occurring sympatrically in central Rondônia are the most heretofore reported from a single locality. Four species occurring in Costa Rica and Panama are potentially sympatric but no more than two were reported by Nicolay (1971) from any one location (*A. imperialis* and *A. delphia* at Guápiles, Costa Rica; *A. imperialis* and *A. cypria* at Los Rio and Madden Forest, Canal Zone, Panama; and *A. cypria* and *A. splendor* at Cerro Campo, Panama). Three species (*A. imperialis*, *A. ducalis*, and *A. tuneta*) are known from several localities in southeastern Brazil (Rio de Janeiro: Independencia and Petropolis; Santa Catarina: Joinville and Massaranduba-Blumenau). Recent collections by Colombian lepidopterists have produced still additional species of *Arcas* from that region. These will be described in the near future, further embellishing the species diversity of this genus.

This paper further emphasizes the importance of carefully examining all Theclinae for cryptic species, even among well-studied and well-marked groups. Slight superficial variation is the first clue to the potential for unsuspected species but, often, lack of superficial variation does not preclude the existence of more than one species (or even genera) in specimen series visually similar in generalized wing characters. Too many dissections are no longer a viable option.

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LITERATURE CITED

- Austin, G. T.**
1993. A review of the *Phanus vitreus* group (Lepidoptera: Hesperidae: Pyrginae). *Trop. Lepid.* (Gainesville), 4 (Suppl. 2):21-36.
- Austin, G. T., T. C. Emmel, O. H. H. Mielke, and H. Schmitz**
[in prep.]. The tropical rainforest butterfly fauna of Rondônia, Brazil: current status of investigations and conservation.
- Austin, G. T., and O. H. H. Mielke**
1993. Two new nymphalid species from western Brazil (Lepidoptera: Nymphalidae). *Trop. Lepid.* (Gainesville), 4:123-126.
- Bálint, Z.**
1992. A catalogue of polyommata Lycaenidae (Lepidoptera) of the xeromontane oreol biome in the Neotropics as represented in European collections. *Rep. Mus. Nat. Hist. Univ. Wisc.* (Stevens Point), 29:1-43.
- Benyamini, D.**
1995. Studies of life history and myrmecophily in certain Chilean *Pseudolucia* Nabokov (Lepidoptera, Lycaenidae). *Rep. Mus. Nat. Hist. Univ. Wisc.* (Stevens Point), 51: [in press].
- Benyamini, D., and K. Johnson**
[in prep.]. Review of austral *Heoda* (Eumaeini, Strymonina) and description of a new species from Tarapacá, Chile.
- Brown, K. S., Jr.**
1976. Season's summary: South America. *News Lepid. Soc.* (Los Angeles), 1976(2):17-18.
1984. Species diversity and abundance in Jarú, Rondonia (Brazil). *News Lepid. Soc.* (Los Angeles), 1984(3):45-47.
- Crowson, R. A.**
1970. The species in biological systematics. In *Classification and Biology*. Chicago: Aldine Publ. Pp. 27-37.
- Emmel, T. C.**
1989. The incredible butterfly diversity of the Rondonian rain forest in Brazil: a phenomenon soon to disappear. *News Lepid. Soc.* (Los Angeles), 1989(4):53-55.
- Emmel, T. C., and G. T. Austin**
1990. The tropical rainforest butterfly fauna of Rondonia, Brazil: species diversity and conservation. *Trop. Lepid.* (Gainesville), 1:1-12.
- Johnson, K.**
1989. A revisionary study of the Neotropical hairstreak butterfly genus *Noreena* and its sister genus *Contrafacia* (Lepidoptera: Lycaenidae). *J. New York Ent. Soc.*, 97:11-46.
1991. Cladistics and the biogeography of two Trans-Caribbean hairstreak butterfly genera: *Nesiostrymon* and *Terra* (Lepidoptera, Lycaenidae). *Amer. Mus. Novit.* (New York), 3011:1-43.
- Johnson, K., and A. Sourakov**
1993. Hairstreak butterflies of the genus *Serratofalca* (Lepidoptera: Lycaenidae). *Trop. Lepid.* (Gainesville), 4:107-118.
- National Geographic Society**
1990. *National Geographic Atlas of the World* (6th ed.). Washington: Natl. Geogr. Soc. 138pp.
- Nicolay, S. S.**
1971. A review of the genus *Arcas* with descriptions of new species (Lycaenidae, Strymonini). *J. Lepid. Soc.* (Los Angeles), 25:87-108.
- Smithe, F. B.**
1975. *Naturalist's Color Guide*. New York: Amer. Mus. Nat. Hist. [pp. unnumbered]
1981. *Naturalist's Color Guide Part III*. New York: Amer. Mus. Nat. Hist. [pp. unnumbered]
- Swainson, W.**
1832. *Zoological Illustrations, or Original Figures and Descriptions of New, Rare, or Interesting Animals, Selected Chiefly from the Classes of Ornithology, Entomology and Conchology*. [series 2] Insects, pls. 97-136. London.