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## THREE NEW SPECIES AND ONE NEW SUBSPECIES IN THE *GRANNUS* COMPLEX OF HISPANIOLAN *CALISTO* (LEPIDOPTERA: SATYRIDAE)

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### INTRODUCTION

Presently, there are 30 species of the Antillean satyrid genus *Calisto* known from the island of Hispaniola (Munroe, 1950; Riley, 1975; Schwartz, 1983; Schwartz and Gali, 1984; Correa and Schwartz, 1986; Gali, 1985, Schwartz MSa). The number of species occurring on Hispaniola strikes one as normal, until one considers that there is only a total of 6 species on the neighboring Antillean Islands (Cuba and Bahamas, Jamaica, Puerto Rico). Such radiation would therefore indicate the likelihood of additional new taxa.

*Calisto grannus* Bates 1939, one of three species (*C. micrommata* Schwartz and Gali, *C. sommeri* Schwartz and Gali, *C. grannus*) from series B of Subgroup A in the Hysia group (Gonzalez and Schwartz, MSb), is characterized by having 2 white dots between 2 UNHW (underside hindwing) ocelli and the absence of a distinct red patch in the cell of the forewing. *Calisto grannus* is a high upland pine butterfly (1159-2288 m), occurring on the Cordillera Central massif (see Fig. 1). The type-series consists of the female holotype and a male paratopotype from Valle Nuevo (type-locality), and three males from Loma Rucilla, located about 36 km northwest of the type-locality (Schwartz, MSb). Bates (1939:49-50) noted that the specimens from Loma Rucilla differed from those of Valle Nuevo in that the underside patterns were more obscured and that the size of the FW (forewing) ocellus was slightly smaller. Schwartz (MSb) stated that: "Considering the hiatus between the two known populations of *C. grannus* (Valle Nuevo, Loma Rucilla) as well as the upland proclivities of the species, it is not unlikely that the Loma Rucilla material is a distinct subspecies." The critical factor in clarifying the situation was to secure additional specimens from the region of Loma Rucilla.

The predicament does not end here. In addition to the latter populations, *grannus*-like *Calisto* have been collected at 3 other localities. Two parties (Raburn and Schwartz, 1983, and Wisor and Schwartz, 1984) secured a series of 7 males and 4 females at La Palma (see Fig. 1), located (ca. 45 km) E of Loma Rucilla. The habitat at La Palma is very unlike that of the type-locality (Valle Nuevo). It is a *cafetal* in deciduous woods adjacent to the Río la Palma at a much lower elevation (1005 m) compared with the type-locality. The specimens from La Palma are likewise biocellate but have red in the basal

half of the UNFW (underside forewing) cell; this, of course, is not a character of *C. grannus*. Additionally, the anterior HW ocellus is extremely small to absent compared with "true" *C. grannus*.

Loma Leonor (see Fig. 1), located 19 km SW Monción, was another locality where, on 17.ii.1984, Wisor and Schwartz collected a series of 15 males and 2 females of what appeared to be *C. grannus*. Schwartz (MSb) noted that the *C. grannus*-like material from Loma Leonor had "two UNHW ocelli with a pair of conspicuous white dots in the spaces between the ocelli," and that the white dots were often "smudged." In the case of *C. grannus*, white smears are not typical. Loma Leonor is primarily pine-hardwoods and lies on the northern lower foothills of the Cordillera Central at an elevation of 610 m. Surprisingly, the *grannus*-like *Calisto* from Loma Leonor have greater affiliation with those of La Palma (which lies ca. 95 airline km SE of Loma Leonor), than with those from Loma Rucilla (which is ca. 54 airline km SSE of Loma Leonor).

Finally, 6-7 km SSE Constanza (see Fig. 1) (4 ♂, 8 ♀), 10 km SE Constanza (1 ♂, 1 ♀), and 12 km NE Constanza (1 ♂, 1 ♀, a total of 16 specimens), mainly from pine-hardwoods and at lower elevations, are localities of still other populations of *C. grannus*-like butterflies. All exhibit the key characters of *C. grannus* (biocellate with two white dots in the spaces between the ocelli). However, these specimens have some distinctive red on the UNFW cell, thus indicating closer affinities to the specimens from La Palma and Loma Leonor. This only increases the degree of complexity in the *C. grannus* situation; "typical" *C. grannus* were collected just (ca. 8 km) SE of the 6 km SSE Constanza locality. "True" *C. grannus* has no red on the UNFW cell. All of the morphological inconsistencies between the populations, in addition to their geographical localities and habitats, indicate the possibility that we are dealing with more than one species (*C. grannus*).

In the summer of 1985, I was given the opportunity by Schwartz to accompany him to the island of Hispaniola (specifically, República Dominicana) for field work. I was able to collect additional specimens from all the latter localities, including near Loma Rucilla near Pico Duarte. I have examined 227 specimens of all the *grannus*-like *Calisto* and "true" *C. grannus*, as well as their genitalia. The results, as predicted, strongly suggest that three populations (La Palma, Pico Duarte, and Loma Leonor) should be considered distinct species because of particular constant characters within each population. The samples from 6-7 km SSE Constanza, 10 km SE Constanza, and 12 km NE Constanza, although having some red in the UNFW cell (which is not typical of *C. grannus*), do agree in other characters with typical *C. grannus*. In addition, their close geographical location (ca. 16 km SE from the type-locality) but no syntopy with *C. grannus*, further suggest that the 6-7 km SSE Constanza population should be designated a subspecies of *C. grannus*. Since this is the case, a redescription of *C. grannus* is needed in order to accommodate this new subspecies.

In order to simplify the following redescription of *C. grannus* and the descriptions of the three new taxa, the genitalia will be discussed later, after all descriptions and comparisons have been made.

#### *Calisto grannus* Bates, 1939

*Males.* FW length 15-19 (all measurements in millimeters; AS = Albert Schwartz collection, FLG = Fernando L. Gonzalez collection) ( $\bar{x}$ =16.8; N=24); UPFW and UPHW dark brown, almost black, especially in high upland population, to slightly paler (Pl. 16C6; all color designations from Maerz and Paul, 1950); UN slightly paler (Pl. 15E7) than UP, with a fine dark discal line on UNFW extending from the costal to the inner margin; in addition, two wavy submarginal lines along the outer margin; basal part of cell with or without brick red; large black ocellus (♂ 2.2-3.7;  $\bar{x}$ =3.2) between  $M_1$  and  $M_2$ , ringed with yellow, with two white dots, the anterior displaced anteriorly of the center, the posterior adjacent to the yellow ring; postocellar reddish blush present in some specimens; UNHW reddish brown postdiscal and discal lines and two pale irregular submarginal lines with no distinctive color between them; two frequently equal-sized ocelli black, ringed with yellow, the posterior (♂ 1.5-2.6, ♀ 1.5-2.4) in  $Cu_1$ - $Cu_2$ , the anterior (♂ 1.1-2.5; ♀

1.1-2.2) in  $M_1$ - $M_2$ , each with a single central white dot; two symmetrical white dots intermediate between ocelli, one in  $M_2$ - $M_3$ , the other in  $M_3$ - $Cu_1$ , and former more proximal. Of 24 males, 12 (50%) have supernumerary UNHW ocelli in  $Rs$ - $M_1$ ,  $M_2$ ,  $M_3$  and  $Cu_2$ -2A. These supernumerary ocelli are both bilateral and unilateral.

*Females.* FW length 17-20 ( $\bar{x}$ =18.1;  $N$ =28); UPFW and UPHW generally slightly paler than males, frequently tinged with orange; UNFW basal portion of wing brick red, one individual with orange-red blush; UNFW ocellus 3.0-4.0;  $\bar{x}$ =3.6; UN submarginal and median lines like males; posterior UNHW ocelli similar; UNFW postocellar blush occurs in all but 2 females. UNHW supernumerary ocelli in 8 of 28 specimens:  $Rs$ - $M_1$  and  $M_2$ - $M_3$ .

#### **Calisto grannus grannus** Bates, 1939

##### **Fig. 2-A**

*Males.* FW length 15.5-19.0 ( $\bar{x}$ =17.0;  $N$ =20); UPFW and UPHW dark brown, almost black; androconial patch slightly darker, covering basal two-thirds of FW; UN slightly paler than UP; UNFW postdiscal line, located halfway between FW cell and FW ocellus, extending from costal to inner margin; two wavy submarginal lines along outer margin; no red present in basal part of cell; black UNFW ocellus ringed with yellow (2.2-3.7;  $\bar{x}$ =3.2) between  $M_1$ - $M_2$ , with two white dots, the anterior displaced anteriorly of the center, the posterior adjacent to the yellow ring; postocellar reddish blush present in some specimens; in addition, two equal-sized black UNHW ocelli, ringed with yellow, each with a single central pupil; two white dots, one in  $M_2$ - $M_3$ , the other in  $M_3$ - $Cu_1$ , the former more proximal; irregular reddish brown postdiscal and discal lines and two pale irregular submarginal lines with no distinctive color between them, extending from costa to inner margin. Of 20 males, 11 (55%) have supernumerary ocelli in  $Rs$ - $M_1$ ,  $M_2$ - $M_3$ , and  $Cu_2$ -2A. The supernumerary ocelli are bilateral and unilateral.

*Females.* FW length 17-20 ( $\bar{x}$ =18.2;  $N$ =20); UPFW and UPHW slightly paler than males; UN also slightly paler, with a UNFW black ocellus (3.0-4.0;  $\bar{x}$ =3.5), ringed with yellow, between  $M_1$ - $M_2$ ; no red present in cell; UN patterns like males but slightly obscure; some specimens have an orange tinge on the UPHW. Of 20 females, 7 (35%) have supernumerary ocelli in  $Rs$ - $M_1$ ,  $M_2$ - $M_3$ , and  $Cu_2$ -2A. The supernumerary ocelli are bilateral and unilateral.

*Remarks.* *Calisto g. grannus* is an inhabitant of high upland pines in the Cordillera Central massif (see Fig. 5); it occurs at elevations of 1159-2288 m. Weather conditions have no apparent effect on the species, which is active on bright and sunny days as well as overcast or rainy days, with temperatures varying from 16°C -34°C. *Calisto g. grannus* is very abundant on the Cordillera Central southeast of Constanza and can be found in open meadows as well as in deep pines, flying low to the ground and displaying a very slow "lazy" flight. These butterflies are fairly active throughout most of the day ( $T$ =0930-1530 h) and have been taken feeding on *Melilotus alba* (Fabaceae) and *Cynoglossum amabile* (Boraginaceae); both plants are fairly common along the side of the road that ascends the Cordillera Central up from the Valle de Constanza. *Calisto g. grannus* can be seen feeding along this road.

*Specimens examined* (all from Prov. de la Vega, Rep. Dom.): 21 km NW La Horma, 2290 m, 1 ♂, 1 ♀ (AS); 41 km SE Constanza, 1935 m, 1 ♂ (AS); La Nevera, 37 km SE Constanza, 2354 m, 1 ♂, 2 ♀ (AS); 32 km SE Constanza, 5 ♂, 1 ♀ (AS), 9 ♂ (FLG); 13 km SE Valle Nuevo, 2193 m, 5 ♂, 3 ♀ (AS); Valle Nuevo, 25 km SE Constanza, 2225 m, 3 ♂ (AS), 2 ♂ (FLG); 21 km SE Constanza, 2387 m, 2 ♀ (AS); 18 km SE Constanza, 1677 m, 4 ♂, 1 ♀ (AS); 16 km SE Constanza, 1 ♂ (AS); 14 km SE Constanza, 2032 m, 33 ♂, 13 ♀ (AS), 20 ♂, 5 ♀ (FLG).

#### **Calisto grannus dilemma**, new subspecies

##### **Fig. 2-B**

*Males.* FW length 15-17 ( $\bar{x}$ =16.5;  $N$ =4); UPFW and UPHW dark brown (Pl. 16C6); androconial patch darker, covering basal two-thirds of FW; UN slightly paler (Pl. 15E7)

than UP; thick irregular UNFW postdiscal line, located halfway between FW cell and FW ocellus, extending from costa to inner margin; two wavy submarginal lines along outer margin, with the inner submarginal line thicker and more distinctive than the outer submarginal line; additionally, brick red present in basal part of cell, cutting off sharply at about midcell; large black UNFW ocellus ringed with yellow (3.1-3.3;  $\bar{x}=3.2$ ) between  $M_1$ - $M_2$ , with two white dots, the anterior displaced anteriorly of the center, the posterior adjacent to the yellow ring; two UNHW ocelli black, ringed with yellow, the anterior (1.1-1.6;  $\bar{x}=1.3$ ) in  $M_1$ - $M_2$  frequently larger than the posterior (1.6-2.0;  $\bar{x}=1.8$ ) in  $Cu_1$ - $Cu_2$ , each with a single central pupil; two distinct white dots between ocelli, one in  $M_2$ - $M_3$ , the other in  $M_3$ - $Cu_1$ , the former more proximal; irregular dark reddish-brown discal and postdiscal lines, extending from the costa to the inner margin; two reddish-brown wavy submarginal lines along outer margin. Of 4 males, one (25%) has a supernumerary ocellus in  $Rs$ - $M_1$ . The supernumerary ocellus is unilateral.

*Females.* FW length 17.5-18.5 ( $\bar{x}=18.0$ ;  $N=8$ ); UPFW and UPHW much paler than males; UN also paler, with a UNFW black ocellus (3.6-3.8;  $\bar{x}=3.7$ ) ringed with yellow, in  $M_1$ - $M_2$ . A detailed description of other UN characters is impossible, because the female specimens are very worn. However, the presence of characters described in male specimens (e.g., two UNHW ocelli, discal-postdiscal line, and white dots between UNHW ocelli) are slightly noticeable in the females.

**HOLOTYPE** male: REPUBLICA DOMINICANA: PROVINCIA DE LA VEGA: 6 km SSE Constanza, 4600 ft. (1483 m), 23.vii.1985 (F.L. Gonzalez), ex colln. F.L. Gonzalez, now in the collection of the Allyn Museum of Entomology, Florida State Museum. Original number FLG 1149.

**PARATYPES:** 3 ♂, 5 ♀ (AS), type-locality, 1.vii.1982; 1 ♀, (AS), type-locality, 29.ix.1983; 2 ♀, (FLG), type-locality, 23.vii.1985.

*Associated specimens:* Rep. Dom.: La Vega: 10 km SE Constanza, 5400 ft. (1741 m), 1 ♂, 1 ♀ (AS); La Vega: 12 km NE Constanza, 4000 ft. (1290 m), 1 ♂, 1 ♀ (AS).

*Etymology.* The name *dilemma* is derived from the Greek for "choice, double proposition," in allusion to the rather questionable status of this population, which is here regarded as a subspecies of *C. grannus*, but which might more correctly be considered a full species.

*Comparisons:* The key character that distinguishes *C. g. grannus* from *C. g. dilemma* is the presence of red in the UNFW cell in the latter; such coloration is never present in the nominate subspecies. In addition, *C. g. dilemma* is slightly smaller in FW length (♂  $\bar{x}=16.5 \pm 0.25$  [twice standard error of mean], ♀  $\bar{x}=18.0 \pm 0.18$ ) than *C. g. grannus* (♂  $\bar{x}=17.0 \pm 0.06$ , ♀  $\bar{x}=18.2 \pm 0.06$ ). The differences are not statistically significant. The UNFW ocellus diameters have about the same means, and therefore do not differ significantly. The anterior and posterior UNHW ocelli in *C. g. grannus* are frequently of equal size, whereas in *C. g. dilemma*, the posterior UNHW ocellus is slightly larger than the anterior ocellus. This difference is obvious upon inspection. Supernumerary ocelli are less frequent in *C. g. dilemma* (25%) than in *C. g. grannus* (ca. 50%). In addition, supernumerary ocelli in *C. g. dilemma* are unilateral in  $Rs$ - $M_1$  and  $Cu_2$ -2A, whereas in *C. g. grannus* the ocelli are both bilateral and unilateral in  $Rs$ - $M_1$ ,  $M_2$ - $M_3$ , and  $Cu_2$ -2A.

*Remarks.* The holotype, 3 other males and 8 females were collected on a dirt road that takes off from the "new" road at a point 6 km SSE Constanza. The habitat is primarily mixed pine-hardwoods, in a moderately upland (1483 m) area, located in the eastern central portion of the Cordillera Central (see Fig. 5); collecting was carried on between 0930-1430 h (T 27-32°C). The day (23.vii.1985) was generally sunny with occasional cloud cover. *Calisto g. dilemma* was not abundant; only 1 male and 2 females were secured, flying relatively low (80 cm) along the edge of the road. A good explanation for their scarcity may be the paucity of flowers in the area. However, on 29.ix.1983, Schwartz collected 1 female feeding on a large bush of *Tournefortia hirsutissima* (Boraginaceae) along the side of the road. This is the only flowering plant in the area accessible for collecting; it also entertains a high concentration of butterfly activity on sunny days. The first specimens (3 ♂, 5 ♀) of *C. g. dilemma* were collected by Schwartz (1.vii.1982) at the type-locality, the longest series secured of *C. g. dilemma*. In addition, associated specimens

of *C. g. dilemma* have been collected by Schwartz at slightly lower and higher elevations (1290-1741 m) in the proximity of the type-locality.

**Calisto phoinix, new species**

Fig. 2-C

**Males.** FW length 15-17 ( $\bar{x}=16.0$ ;  $N=14$ ); UPFW and UPHW dark brown without distinctive markings; androconial patch very dark brown, almost black, covering basal two-thirds of FW; UN paler (Pl. 15C10) than UP; moderately jagged postdiscal line on UNFW extends distad from costa, barely reaching the inner margin; two brown wavy submarginal lines along the outer margin, almost joining postdiscal line at inner margin; in addition, basal two-thirds of cell with brick red cut off sharply at about midcell; large black ocellus ( $\delta$  2.6-3.8;  $\bar{x}=3.3$ ) between  $M_1$  and  $M_2$ , ringed with yellow, with two blue-white pupils, both located on mid-line of ocellus, the anterior displaced anteriorly of the center, the posterior displaced posteriorly of the center; no postocellar blush present on any specimen; distinctive UNHW wavy reddish brown discal and postdiscal lines, and two irregular reddish brown submarginal lines along the outer margin; two UNHW ocelli ringed with yellow, with the anterior ocellus ( $\delta$  0.1-2,  $\bar{x}=0.5$ ) in  $Cu_1$ - $Cu_2$ , extremely small to absent, and the posterior ocellus ( $\delta$  1.2-2.4,  $\bar{x}=1.8$ ) in  $M_1$ - $M_2$ , each with a single central white dot (if ocellus is present); two symmetrical white dots between ocelli, one in  $M_2$ - $M_3$ , the other in  $M_3$ - $Cu_1$ . Of 14 males, 1 (7%) has a supernumerary UNHW ocellus in  $M_2$ - $M_3$ . This supernumerary ocellus is unilateral.

**Females.** FW length 15-17 ( $\bar{x}=16$ ,  $N=7$ ) UPFW and UPHW lighter than males, UPHW tinged with dark orange near inner margin in 1 of 7 females; UNFW basal two-thirds of cell brick red, like males, cut off sharply; discal and postdiscal line same as males; UNFW ocellus 3.6-3.9 ( $\bar{x}=3.75$ ); UNHW discal line obscured, and postdiscal line paler than in males; HW posterior ocellus (1.1-1.2,  $\bar{x}=1.3$ ) larger than anterior ocellus ( $\delta$  0.1-3,  $\bar{x}=0.4$ ); of 7 females, one has supernumerary ocelli in  $M_2$ - $M_3$  (bilateral).

**HOLOTYPE** male: REPUBLICA DOMINICANA: PROVINCIA DE LA VEGA: La Palma, 19 km W Jayaco, 3300 ft. (1064 m), 7.viii.1985 (A. Schwartz), *ex colln.* A. Schwartz, now in the collection of the Allyn Museum of Entomology, Florida State Museum. Original number AS 11025.

**PARATYPES:** 1  $\delta$  (AS), type-locality, 13.viii.1980; 3  $\delta$  (AS), type-locality, 9.viii.1982; 1  $\delta$  (AS), type-locality, 21.vii.1983; 2  $\delta$ , 1  $\delta$  (AS), type-locality, 7.viii.1983; 1  $\delta$  (AS), type-locality, 12.iii.1984; 4  $\delta$ , 3  $\delta$  (AS), 10  $\delta$ , 4  $\delta$  (FLG), type-locality, 17.vii.1985.

**Etymology.** The trivial name *phoinix* is Greek for "palm," in allusion to the type-locality (Las Palmas). Although the Greek word is usually transliterated as "phoenix," as in the genus of date palm (*Phoenix*), I have adhered to a direct transliteration herein.

**Comparisons:** *Calisto phoinix* differs from *C. g. grannus* in the following ways. In the former, the anterior UNHW ocellus is much smaller ( $\delta$   $\bar{x}=0.5 \pm 0.05$ ,  $\delta$   $\bar{x}=0.4 \pm 0.30$ ) than in the latter ( $\delta$   $\bar{x}=1.8 \pm 0.16$ ,  $\delta$   $\bar{x}=1.8 \pm 0.04$ ), and in fact may be absent completely (a condition never observed in *C. g. grannus*). The FW length in *C. g. grannus* is longer ( $\delta$   $\bar{x}=17.0 \pm 0.61$ ,  $\delta$   $\bar{x}=18.2 \pm 0.05$ ) than in *C. phoinix* ( $\delta$   $\bar{x}=16.0 \pm 0.20$ ,  $\delta$   $\bar{x}=17.8 \pm 0.33$ ). The diameter of the UNFW ocellus is larger in *C. phoinix* ( $\delta$   $\bar{x}=3.3 \pm 0.04$ ,  $\delta$   $\bar{x}=3.8 \pm 0.06$ ) than in *C. g. grannus* ( $\delta$   $\bar{x}=3.2 \pm 0.04$ ,  $\delta$   $\bar{x}=3.5 \pm 0.04$ ). All these differences are statistically significant. *Calisto phoinix* is lighter (tan) than is *C. g. grannus* (very dark brown to almost black). In *C. phoinix*, the discal-postdiscal lines are pale brown in contrast to those of *C. g. grannus*, where these lines are reddish brown. Most strikingly, *C. g. grannus* lacks red in the UNFW cell, whereas in *C. phoinix* there is a distinctive brick red patch covering the basal two-thirds of the UNFW cell. Supernumerary ocelli are much more common in *C. g. grannus* (50%) than in *C. phoinix* (7%).

Compared with *C. g. dilemma*, *C. phoinix* differs in much the same ways as *C. phoinix* differs from *C. g. grannus*. The anterior UNHW ocellus in *C. g. dilemma* is larger ( $\delta$   $\bar{x}=1.3 \pm 0.33$ ,  $\delta$   $\bar{x}=1.4 \pm 0.27$ ) than in *C. phoinix*, but the posterior UNHW ocelli are identical in the two taxa ( $\delta$   $\bar{x}=1.8 \pm 0.21$ ,  $\delta$   $\bar{x}=1.7 \pm 0.17$ ). The FW length in *C. phoinix* is slightly smaller than that of *C. g. dilemma* ( $\delta$   $\bar{x}=16.5 \pm 0.25$ ,  $\delta$   $\bar{x}=18.0 \pm 0.18$ ).



The differences in FW length are barely significant statistically in males and not significant in females. The UNFW ocellus in *C. g. dilemma* is almost equal in diameter ( $\delta \bar{x} = 3.2 \pm 0.07$ ,  $\eta \bar{x} = 3.7 \pm 0.07$ ) to that of *C. phoinix*.

**Remarks.** Schwartz (MSb) stated that *C. g. grannus* is an inhabitant of upland pine forest in the Cordillera Central, where it occurs between elevations of 1159 m and 2288 m. As far as *C. phoinix* is concerned, Schwartz (MSb) stated that the habitat at La Palma is a riverside *cafetal* with deciduous forest canopy. Thus, the habitats of *C. g. grannus* and *C. phoinix* are strikingly different. *Calisto phoinix* has been collected only at the type-locality, at temperatures between 22°C and 32°C, between 0915 and 1445 h. On 17.vii.1985, Schwartz noted that, when the day became overcast, other species of *Calisto* (*C. obscura*, *C. confusa*, and *C. batesi*) were inactive, but *C. phoinix* continued to feed on roadside *Stachytarpheta cayennensis* (Verbenaceae). This appears to be a behavioral difference between this species and its local congeners. Additionally, *C. phoinix* has been taken in the well shaded woods adjacent to the Río la Palma, especially in stands of *Zantedeschia aethiopica* (Araceae), a habitat shunned by other local *Calisto*.

#### *Calisto amazona*, new species

Fig. 2-D

**Males.** FW length 15-17.5 ( $\bar{x} = 16.3$ ); UPFW and UPHW dark brown without distinctive markings; androconial patch distinctively darker brown, almost black, covering basal two-thirds of FW; UN brown (Pl. 15A12) with pale brown in Cu<sub>2</sub>-2A on UNFW; smooth postdiscal line on UNFW extends distad from costa and stops at Cu<sub>1</sub>-Cu<sub>2</sub>; two brown wavy submarginal lines along the outer margin maintaining equal distance with postdiscal line; in addition, cell without red; black ocellus (2.4-3.8,  $\bar{x} = 3.1$ ) between M<sub>1</sub>-M<sub>2</sub>, ringed with yellow, with two white pupils, the anterior located slightly above mid-line of ocellus, the posterior displaced posteriorly of the center, slightly above yellow ring; no postocellar red blush present on any specimen; distinctive UNHW wavy rusty red postdiscal line, and obscure discal line present or absent; two wavy submarginal lines along the margin, with distinctive rusty red between inner submarginal line and the margin; two UNHW ocelli ringed with yellow, with the anterior ocellus (1.3-2.1,  $\bar{x} = 1.8$ ) in Cu<sub>1</sub>-Cu<sub>2</sub>, usually smaller than posterior ocellus (1.7-2.6,  $\bar{x} = 2.2$ ) in M<sub>1</sub>-M<sub>2</sub>, each with a single central white dot; two distinctive symmetrical white dots between UNHW ocelli, one in M<sub>2</sub>-M<sub>3</sub>, the other in M<sub>3</sub>-Cu<sub>1</sub>. Of 28 males, 15 (54%) have a supernumerary UNHW ocellus in Rs-M<sub>1</sub> and Cu<sub>2</sub>-2A. All supernumerary ocelli present were bilateral.

**Females.** FW length 17-19 ( $\bar{x} = 18.5$ ; N=15); UPHW paler in area where androconial patch is present in males; UPHW tinged with orange in 3 of 15 (20%) specimens; UNFW cell with no red; UN same as males with a postocellar blush present in 5 of 15 (33%) specimens; UNFW ocellus 2.8-4.0,  $\bar{x} = 3.2$ ; UNHW ocelli similar with the posterior (1.8-2.9,  $\bar{x} = 2.4$ ) larger than the anterior (1.2-2.4,  $\bar{x} = 1.8$ ); UNHW supernumerary ocelli present in 9 of 15 (60%) specimens in Rs-M<sub>1</sub> and Cu<sub>2</sub>-2A.

**HOLOTYPE** male: REPUBLICA DOMINICANA: PROVINCIA DE SANTIAGO: entrance to Valle de Tetero, 6300 ft. (1922 m); 19.vii.1985 (F.L. Gonzalez), *ex colln.* A. Schwartz, now in collection of Allyn Museum of Entomology, Florida State Museum.

**PARATYPES.** 4 ♂, 5 ♀ (AS), 6 ♂ 2 ♀ (FLG), type locality, 19.vii. 1985; 4 ♂, 1 ♀ (AS), 5 ♂, 1 ♀ (FLG), Prov. de Santiago: La Laguna, 6000 ft. (1830 m), 19.vii.1985; 6 ♂, 6 ♀ (AS), 2 ♂, 1 ♀ (FLG), Prov. de Santiago: La Laguna, 6000 ft. (1830 m), 16.vii.1985.

**Etymology.** The name *amazona* is an allusion to the trail-stop on the path to Pico Duarte called La Cotorra (parrot). The generic name of all Antillean parrots is *Amazona*, from which the trivial name of this taxon derives. As far as records are concerned, *C. amazona* appears altitudinally between La Laguna (another trail-stop) and La Cotorra.

**Comparisons:** *Calisto amazona* differs from *C. g. grannus* in that the former has a longer FW length ( $\delta \bar{x} = 17.6 \pm 0.01$ ;  $\eta \bar{x} = 18.5 \pm 0.06$ ) than the latter ( $\delta \bar{x} = 17.0 \pm 0.61$ ;  $\eta \bar{x} = 18.2 \pm 0.06$ ). The UNHW posterior ocellus is larger in *C. amazona* ( $\delta 2.2 \pm 0.12$ ;  $\eta 2.4 \pm 0.15$ ) than in *C. g. grannus* ( $\delta 2.1 \pm 0.14$ ;  $\eta 2.0 \pm 0.12$ ). On the other hand, the UNFW ocellus is larger in *C. g. grannus* ( $\delta 3.2 \pm 0.04$ ;  $\eta 3.5 \pm 0.04$ ) than in *C.*

*amazona* ( $\delta$   $3.1 \pm 0.02$ ;  $\varphi$   $3.2 \pm 0.06$ ). The FW length is not statistically significant in males, but it is in females; female *C. amazona* are obviously larger by inspection, but males of the two species are very similar in size. UNFW ocellar measurements are statistically significant, whereas the posterior UNHW ocellus measurements are not statistically different in males but are in females. Both *C. amazona* and *C. g. grannus* occasionally show supernumerary ocelli, but *C. amazona* more often has these in Rs-M<sub>1</sub> and Cu<sub>2</sub>-2A, whereas *C. g. grannus* has them in Rs-M<sub>1</sub>, Cu<sub>2</sub>-2A, and M<sub>2</sub>-M<sub>3</sub>. The occurrences of supernumerary ocelli are about equal (ca. 50%).

*Calisto amazona* has an obscure discal line on the UNHW (very often absent), a feature that is distinct in *C. g. grannus*. Additionally, the basal color of the UN between the outer submarginal line and the margin is rusty red in *C. amazona*, whereas in *C. g. grannus*, this area is not differentiated chromatically from the remainder of the UN.

From *C. g. dilemma*, *C. amazona* differs in longer FW than *C. g. dilemma* ( $\delta$   $\bar{x}$  = 16.5  $\pm$  0.25;  $\varphi$   $\bar{x}$  = 18.0  $\pm$  0.18). The UNFW ocellus in *C. amazona* is smaller than it is in *C. g. dilemma* ( $\delta$   $\bar{x}$  = 3.2  $\pm$  0.07;  $\varphi$   $\bar{x}$  = 3.7  $\pm$  0.07). The anterior UNHW ocellus of *C. amazona* is much larger than that of *C. g. dilemma* ( $\delta$   $\bar{x}$  = 1.3  $\pm$  0.33;  $\varphi$   $\bar{x}$  = 1.4  $\pm$  0.27). The posterior UNHW ocellus is also larger in *C. amazona* than in *C. g. dilemma* ( $\delta$   $\bar{x}$  = 1.8  $\pm$  0.21;  $\varphi$   $\bar{x}$  = 1.7  $\pm$  0.17). Supernumerary ocelli are more frequent in *C. amazona* (ca. 50%) than in *C. g. dilemma* (ca. 17%). These occur in Rs-M<sub>1</sub> and Cu<sub>2</sub>-2A. In addition, the specimens examined of *C. g. dilemma* have supernumerary ocelli occurring unilaterally, whereas *C. amazona* has them bilaterally.

Although there are two pupils in the UNFW ocellus in both taxa, *C. amazona* has the posterior pupil practically on the yellow ocellar ring, whereas in *C. g. dilemma*, the posterior pupil is displaced slightly posteriad from the center of the ocellus.

The major chromatic way to differentiate *C. amazona* from *C. g. dilemma* is that there is no red in the UNFW cell. The UP color of *C. amazona* is as dark (almost black) as *C. g. grannus* and much darker than *C. g. dilemma* (comparing fresh specimens of all taxa).

*C. amazona* differs from *C. phoinix* in the following ways. *Calisto amazona* has the FW longer than *C. phoinix* ( $\delta$   $\bar{x}$  = 16.0  $\pm$  0.20;  $\varphi$   $\bar{x}$  = 17.8  $\pm$  0.33). The size of the UNFW ocellus is smaller in *C. amazona* compared with that of *C. phoinix* ( $\delta$   $\bar{x}$  = 3.3  $\pm$  0.04;  $\varphi$   $\bar{x}$  = 3.8  $\pm$  0.06). The anterior UNHW ocellus of *C. amazona* is distinctly larger than that of *C. phoinix* ( $\delta$   $\bar{x}$  = 0.5  $\pm$  0.05;  $\varphi$   $\bar{x}$  = 0.4  $\pm$  0.30). The posterior UNHW ocellus is larger in *C. amazona* than in *C. phoinix* ( $\delta$   $\bar{x}$  = 1.8  $\pm$  0.14;  $\varphi$   $\bar{x}$  = 1.7  $\pm$  0.28). Supernumerary ocelli are much more common in *C. amazona* (ca. 50%) than in *C. phoinix* (ca. 11%). Furthermore, supernumerary ocelli are found in M<sub>2</sub>-M<sub>3</sub> in *C. phoinix*, whereas *C. amazona* has supernumerary ocelli occurring in Rs-M<sub>1</sub> and Cu<sub>2</sub>-2A. All the above mensural characters are statistically significant.

As far as color differences are concerned, *C. phoinix* has the UNFW cell red; this condition does not occur in *C. amazona*. *Calisto amazona* has rusty red between the outer submarginal line and the margin, whereas *C. phoinix* does not. *C. amazona* has an obscure or absent discal line, which is present and obvious in *C. phoinix*.

**Remarks.** The two samples of *C. amazona* were collected on two visits to Pico Duarte in the Cordillera Central massif, the first on 16.vii.1985, the second on 19.vii.1985. *Calisto amazona* was in abundance from between La Cotorra and La Laguna (see Fig. 5) to the entrance to Valle de Tetero (1830-1922 m); none occurred below the latter elevation. Collecting was carried on between 1000-1345 h, on a small path leading up the mountain; collecting off the path was impossible, because it was very steep to the sides of the path. The path in the proximity of La Laguna was mostly surrounded by mixed pine-hardwoods, and the sides of the path were covered by various ferns; no obvious flowers were in bloom. The type-locality (entrance to Valle de Tetero), some hundred meters upward, was slightly more mesic. Here, the habitat was more pines than hardwoods, with tall grass covering the understory. On both occasions, the day was mostly overcast, very windy, and threatening, with temperatures varying slightly, from 24°C to 26°C. *Calisto amazona* was most active in the early morning and began disappearing as the day progressed. It was noted on the second visit at the type-locality, at 1115 h, all lepidopteran activity stopped.

*Calisto amazona* is an inhabitant of pine-hardwoods and is not restricted exclusively to pines like its relative *C. g. grannus*. Although *C. amazona* may also occur in pure pine woods, this cannot be definitely established until someone collects higher than the entrance to Valle de Tetero (i.e., Valle de Tetero itself), where pure pine forest occurs.

***Calisto dystacta*, new species**

Fig. 2-E

**Males.** FW length 15.5-17.5 ( $\bar{x}=16.3$ ); UPFW and UPHW dark brown (Pl. 16A12) without distinctive markings; androconial patch prominent and extending from  $M_2$  to 2A across the basal two-thirds of the FW cell; UNFW and UNHW slightly paler (Pl. 15E11); red scales present, covering basal two-thirds of UNFW cell and cut off sharply at about midcell; large black ocellus (2.6-4.0,  $\bar{x}=3.4$ ) ringed with yellow and with two blue-white dots, located in subapical portion of FW, extending from above  $M_1$  to below  $M_3$ , the anterior dot displaced anteriorly from center, and the posterior displaced posteriorly from center; relatively thick dark brown postdiscal line constricts around FW ocellus and extends distad from costa, barely reaching inner margin; two dark brown submarginal lines along outer margin, the inner submarginal line thicker and darker than the outer submarginal; in addition, submarginal lines maintain equal distance with postdiscal line as they extend distad from costa; no postocellar blush present on any specimen; UNHW more distinctive than UNFW, with irregular reddish brown discal and postdiscal lines; two UNHW ocelli ringed with yellow, with the anterior ocellus (0-1.5,  $\bar{x}=0.7$ ) in  $Cu_1$ - $Cu_2$ , and the posterior ocellus (1.2-2.1,  $\bar{x}=1.8$ ) in  $M_1$ - $M_2$ , each with a single central pupil (if ocellus is present); two symmetrical white dots between the ocelli, one in  $M_2$ - $M_3$ , the other in  $M_3$ - $Cu_1$ ; two of 20 (10%) males have the posterior white dot ( $M_3$ - $Cu_1$ ) smudged, and two other males have supernumerary ocelli in  $M_2$ - $M_3$  and  $Cu_2$ -2A (bilateral and unilateral).

**Females.** FW length 17.0-19.0 ( $\bar{x}=17.6$ ); UP about the same color as males; an orange tinge present on UPHW in three of six (50%); UN color same as males; UNFW ocellus large and black (3.4-4.0;  $\bar{x}=3.8$ ), otherwise like males; UNHW color slightly paler than in males from the margin to the inner submarginal line; two UNHW ocelli (anterior 0.4-1.4;  $\bar{x}=1.0$ ; posterior 1.4-2.2;  $\bar{x}=1.9$ ); UNFW postocellar blush present in one of six females; supernumerary ocelli present in two of six (33%) in  $Cu_2$ -2A bilaterally.

**HOLOTYPE** male: REPUBLICA DOMINICANA: PROVINCIA DE SANTIAGO RODRIGUEZ: Loma Leonor, 19 km SW Monción, 2000 ft. (645 m); 17.iii.1984 (R. W. Wisor), ex colln. A. Schwartz, now in collection of Allyn Museum of Entomology, Florida State Museum. Original number AS 12874.

**PARATYPES:** 13 ♂, 3 ♀, (AS) type-locality, 17.iii.1984; 3 ♂, 1 ♀ (AS), 1 ♂ 2 ♀ (FLG), 30.vi.1985.

**Etymology.** The name *dystacta* is from the Greek, meaning "irregular," in reference to the variable expression of the white dots, sometimes smudged, in  $M_2$ - $M_3$  and  $M_3$ - $Cu_1$  in this species.

**Comparisons:** *Calisto dystacta* most closely resembles *C. phoenix* in that both have red in the UNFW cell and also have relatively small to absent anterior UNHW ocellus. They can be distinguished, however, in that, in *C. dystacta*, the UNFW postdiscal line expands around the UNFW ocellus as the line extends from the costa to the inner margin and then passes marginad just behind the ocellus. In *C. phoenix*, the postdiscal line is farther basad and thus does not expand greatly to accommodate the UNFW ocellus and then also does not constrict posterior to that ocellus, thereby reaching the inner margin more basally than this line does in *C. dystacta*. Both species are about the same darkness on the UP and pale (tan) on the UN.

As far as measurements are concerned, FW lengths in the two species are comparable (*dystacta* ♂  $\bar{x}=16.3 \pm 0.06$ , ♀  $\bar{x}=17.6 \pm 0.22$ ; *phoenix* ♂  $\bar{x}=16.0 \pm 0.20$ , ♀  $\bar{x}=17.8 \pm 0.33$ ). Also comparable and not significantly different are UNFW ocellus size (*dystacta* ♂  $\bar{x}=3.4 \pm 0.04$ , ♀  $\bar{x}=3.8 \pm 0.10$ ; *phoenix* ♂  $\bar{x}=3.3 \pm 0.04$ , ♀  $\bar{x}=3.8 \pm 0.06$ ), anterior UNHW ocellus (*dystacta* ♂  $\bar{x}=0.7 \pm 0.13$ , ♀  $\bar{x}=1.0 \pm 0.13$ ; *phoenix* ♂  $\bar{x}=0.5 \pm 0.05$ , ♀  $\bar{x}=0.5 \pm 0.30$ ), and posterior UNHW ocellus (*dystacta* ♂  $\bar{x}=1.7 \pm 0.13$ , ♀  $\bar{x}=1.9$



$\pm 0.22$ ; *phoenix*  $\delta \bar{x}=1.8 \pm 0.14$ ,  $\varphi \bar{x}=1.7 \pm 0.28$ ). In *C. dystacta*, supernumerary ocelli are slightly more frequent (15%) than in *C. phoenix* (11%). But in *C. dystacta* these ocelli occur in  $M_2$ - $M_3$  and  $Cu_2$ -2A, whereas in *C. phoenix*, supernumerary ocelli occur only in  $M_2$ - $M_3$ .

Since *C. phoenix* has red in the UNFW cell, it is easily distinguished from those two taxa that lack red in that space: *C. g. grannus* and *C. amazona*. From *C. amazona*, *C. dystacta* differs in that the latter has the FW length less ( $\delta \bar{x}=16.3 \pm 0.06$ ,  $\varphi \bar{x}=17.6 \pm 0.22$ ) than *C. amazona* ( $\delta \bar{x}=17.6 \pm 0.01$ ,  $\varphi \bar{x}=18.5 \pm 0.06$ ). *Calisto dystacta* has the UNFW ocellus large ( $\delta \bar{x}=3.4 \pm 0.4$ ,  $\varphi \bar{x}=3.8 \pm 0.10$ ) in comparison with that of *C. amazona* ( $\delta \bar{x}=3.1 \pm 0.02$ ,  $\varphi \bar{x}=3.2 \pm 0.06$ ). As far as the UNHW anterior ocellus is concerned, that in *C. dystacta* is very small ( $\delta \bar{x}=0.7 \pm 0.13$ ,  $\varphi \bar{x}=1.0 \pm 0.13$ ) in comparison with that of *C. amazona* ( $\delta \bar{x}=1.8 \pm 0.02$ ,  $\varphi \bar{x}=1.8 \pm 0.04$ ). In fact, the UNHW posterior ocellus is larger than the anterior in *C. dystacta*, whereas in *C. amazona* the two UNHW ocelli are more or less equal in size, obvious even by mere inspection and without recourse to measurements. The color between the outer marginal line and the margin itself is rusty red in *C. amazona*, whereas in *C. dystacta* this area is concolor with the remainder of the UN. From *C. g. dilemma*, *C. dystacta* differs in that the latter has the FW length slightly smaller (not significantly different) than the former ( $\delta \bar{x}=16.5 \pm 0.25$ ,  $\varphi \bar{x}=18.0 \pm 0.18$ ). The UNFW ocellus in *C. dystacta* is slightly larger ( $\delta \bar{x}=3.4 \pm 0.04$ ,  $\varphi \bar{x}=3.8 \pm 0.10$ ), than in *C. g. dilemma* ( $\delta \bar{x}=3.2 \pm 0.07$ ,  $\varphi \bar{x}=3.7 \pm 0.07$ ); these differences are significant in males but not in females. The anterior UNHW ocellus is slightly larger in *C. g. dilemma* ( $\delta \bar{x}=1.3 \pm 0.33$ ,  $\varphi \bar{x}=1.4 \pm 0.27$ ), than in *C. dystacta* ( $\delta \bar{x}=0.7 \pm 0.13$ ,  $\varphi \bar{x}=1.0 \pm 0.13$ ). These differences are significant, but there are only seven female and four male *C. g. dilemma*. The posterior UNHW ocelli are almost the same size in both taxa, and thus there are no significant differences.

*Remarks.* *Calisto dystacta* can very easily be distinguished in the field from other local *Calisto* (*confusa*, *batesi*, *obscura*) by its large size. The holotype and 17  $\delta$  and 6  $\varphi$  were collected on two visits to the type-locality (17.iii.1984, 30.vi.1985); time of collecting was between 1025-1315 h, with temperatures varying slightly, between 26° C -31° C, in bright and sunny to overcast weather.

Although Schwartz had visited the Loma Leonor area 3 times (1981, 1982), it was not until he and Wisor visited the region in 1984 that the colony of *C. dystacta* was encountered. Previous collecting had been primarily in the vicinity of the *puesto* Loma Leonor and of the settlement itself. In 1984, Schwartz and Wisor traveled just beyond the town and collected in mixed pine-hardwoods (see Fig 5). Here they first encountered *C. dystacta*. On our 1985 visit, Schwartz noted that, in contrast to other locally syntopic species of *Calisto*, *C. dystacta* forages and flies along open paths and within the pines. When pressed, these butterflies, in contrast to their congeners, fly deliberately and directly into the underbrush and are shortly "lost" to the collector. Other local species do not demonstrate this behavior and instead continue on their deliberate course when pursued.

## DISCUSSION

The present paper offers a totally different perspective of *C. grannus*. Until now, *C. grannus* was the dominant satyrid of the Cordillera Central massif, occurring in upland pines and characterized by having two UNHW ocelli and two white dots in the spaces between them. The biocellate condition demonstrates its affinities with *C. micrommata* on the Sierra de Neiba on the north island and *C. sommeri* on the Massif de la Selle on the south island. Both also occur exclusively in upland pines. Therefore, being biocellate is a character which characterizes the *grannus* complex (Gonzalez and Schwartz, MS). The addition of the new taxa described in this paper (*C. g. dilemma*, *C. phoenix*, *C. amazona*, and *C. dystacta*) not only increases the number of members in the *grannus* complex but also indicates that the biocellate condition does not necessarily occur only in high upland *Calisto*. In addition, the habitats are also obviously different, with *C. phoenix* occurring in deciduous woods, and *C. amazona*, *C. dystacta*, and *C. g. dilemma*

occurring in mixed pine-hardwoods, thus broadening the ecological boundaries of the complex (see Figs. 1. and 5.)

It is perhaps pertinent that *C. g. grannus*, *C. g. dilemma*, *C. phoinix*, *C. amazona*, and *C. dystacta* can be divided into two groups, with *C. g. grannus* and *C. amazona* occurring in the high uplands (1159-2288 m) and *C. g. dilemma*, *C. phoinix*, and *C. dystacta* occurring at lower elevations (645-1741 m). *Calisto amazona* is much more similar to *C. g. grannus* in size and coloration than it is to *C. g. dilemma*, and both lack the brick red in the UNFW cell. They differ most obviously in the obscurity or absence of the discal line in *C. amazona*, a character that is distinctively present in *C. g. grannus*. The condition of having red in UNFW cell is typical of lower elevation *Calisto*, where color assumably plays an integral role in differentiation between other species. The lack of, or little, red in the UNFW cell is typical of higher elevation *Calisto*, where the diversity of Rhopalocera is far less. Therefore, it would seem reasonable that *C. amazona* is more closely related to *C. g. grannus* than is *C. g. dilemma*, which has brick red in the UNFW cell. Nevertheless, *C. g. dilemma* has been considered a subspecies of *C. g. grannus* because it is geographically closer (ca. 8 km) to the known range of *C. g. grannus* than is *C. amazona* (ca. 43 km) (see Fig. 1). More importantly, *C. g. dilemma*, although occurring very close geographically to *C. g. grannus*, is not syntopic with the latter. Unless proven otherwise, this evidence justifies designation of *C. g. dilemma* as a subspecies of *C. g. grannus*, and *C. amazona* as a new species.

The other "troublesome duo" (*C. phoinix* and *C. dystacta*) are morphologically very similar; they both have red in the UNFW cell, the UNHW anterior ocellus is extremely small to absent, and both are about equal in size. This leaves very few characters to distinguish them from each other (distance of UNFW postdiscal line from ocellus is greater in *C. phoinix* than in *C. dystacta*). *Calisto phoinix* has been found only at the type-locality (La Palma), a habitat of deciduous woods some 95 km SE of the type-locality (Loma Leonor) of *C. dystacta* (see Fig. 1). *Calisto dystacta* is an inhabitant of mixed pine-hardwoods and also is known only from the type-locality. Although habitat is not really a character, in this particular situation, where distances between the localities of *C. phoinix* and *C. g. dilemma* are so great, habitat plays an (apparently) minor role. Additionally, no collecting has been done in the 95 km stretch between the two type-localities. In fact, travel in the intervening region has revealed little or no "proper" habitat for either of these species. In addition, Eugenio de Js. Marcano F., of the Universidad Autónoma de Santo Domingo and former director of the Museo Nacional de Historia Natural de Santo Domingo, commented to Schwartz that the botany of the Loma Leonor region (precisely that area which is the type-locality of *C. dystacta*) is unique on these northern foothill slopes of the Cordillera Central. It seems possible that *C. dystacta* is in effect a relict population that is now completely separated from its related congeners.

## GENITALIA

The male genitalia of the new species and subspecies described place these taxa in Bates's (1935) *Hysia* group. Specifically, these taxa pertain to series B of subgroup A (Gonzalez and Schwartz, MS). The male genitalia in series B (= *Grannus* complex) are very similar, differing to only a slight degree in minor characters (see Fig. 2). The male genitalia of *C. g. dilemma*, *C. phoinix*, *C. amazona*, and *C. dystacta*, as would be expected, resemble most closely (if are not identical with) the male genitalia of *C. g. grannus*. All, including *C. g. grannus*, have slightly sinuate penes. The saci are short and bulbous, and the tegmina are extremely arched. The uncus all have the typical bird's head shape. This "revelation" further supports the statement made by Schwartz and Gali (1984) in that "although the species may be distinctive, the differences in male genitalia are much less so, in many species... it is a matter of evolution of one complex of characters more rapidly than another." In this case, however, the morphological characters of some of these new species and subspecies (e.g., *C. g. dilemma*, *C. phoinix*, and *C. dystacta*) are very similar and much care must be taken in determining the species on primarily external features.

The female genitalia of these members of the *grannus* complex, however, are quite distinctive from other members of the genus *Calisto*, with further distinguishing characters between each taxon. This fact is not new. Johnson, Quinter, and Matusik (in press) stated that "characters of the female genitalia apparently provide a far more useful reference for *Calisto* than those of males."

Some of the diagnostic features of the female genitalia (see Fig. 4) which are common to members of the *grannus* complex but differ from other members of the genus *Calisto* include: signae with minute spines present on left lateral view of corpus bursae; corpus bursae and ductus bursae membranous, transparent; sterigma (lamella postvaginalis and lamella antevaginalis) asymmetrical. In addition, lamella postvaginalis is sclerotized with anterior apophyses apparently absent; lamella antevaginalis lightly sclerotized.

Differences between the female genitalia of *C. grannus*, *C. phoinix*, *C. amazona*, and *C. dystacta* include: position of antrum one-fourth length of lamella antevaginalis in *C. grannus* (Fig. 4, A), whereas one-third to one-half length in *C. phoinix*, *C. amazona* and *C. dystacta* (Figs. 4, B, C, D); attachment of ductus seminalis closer to bursa copulatrix in *C. grannus* and *C. dystacta*, whereas approximately midway in *C. amazona* and *C. phoinix*. In addition, there are minute setae, possibly microtrichia, on the inner margin of lamella antevaginalis opposite the antrum in *C. phoinix*, but these minute setae are absent, in *C. grannus*, *C. amazona*, and *C. dystacta*.

In addition to the latter characters, there are some minor differences in the degree of sclerotization of the lamella postvaginalis: in *Calisto grannus* the lamella postvaginalis, heavily sclerotized, is broader than in *C. phoinix*, whereas *C. dystacta* is moderately to heavily sclerotized, and *C. amazona* and *C. phoinix* are moderately sclerotized. The degree of sclerotization may vary within a series of the same species and might be less reliable than the characters described above.

In summary, examination of the male genitalia will yield little success in differentiating *C. grannus*, *C. phoinix*, *C. amazona*, and *C. dystacta* from each other. The male genitalia of these four species are not reliable as a means of identification. However, examination of the female genitalia is a good means of identification. This is especially true of *C. phoinix* and *C. dystacta*. Their morphological differences are few, but their female genitalia are the most distinctive.

#### A Key to Four Species and One Subspecies in the *Calisto grannus* Complex

1. No red in UNFW ..... 4.
1. Some red in UNFW cell ..... 2.
2. UNHW anterior ocellus minute to absent ..... 3.
2. UNHW anterior ocellus present ..... *C. g. dilemma*
3. UNFW postdiscal line expands around the UNFW ocellus as the line extends from costa to inner margin and then passes marginad just behind the ocellus; UNHW white dots usually smeared ..... *C. dystacta*
3. Postdiscal line is farther basad and does not expand greatly to accommodate the UNFW ocellus and does not constrict posterior to that ocellus, thereby reaching the inner margin more basally; UNHW white dots discrete and not smeared ..... *C. phoinix*
4. UNHW with distinct basal line ..... *C. g. grannus*
4. UNHW basal line obscure or absent ..... *C. amazona*

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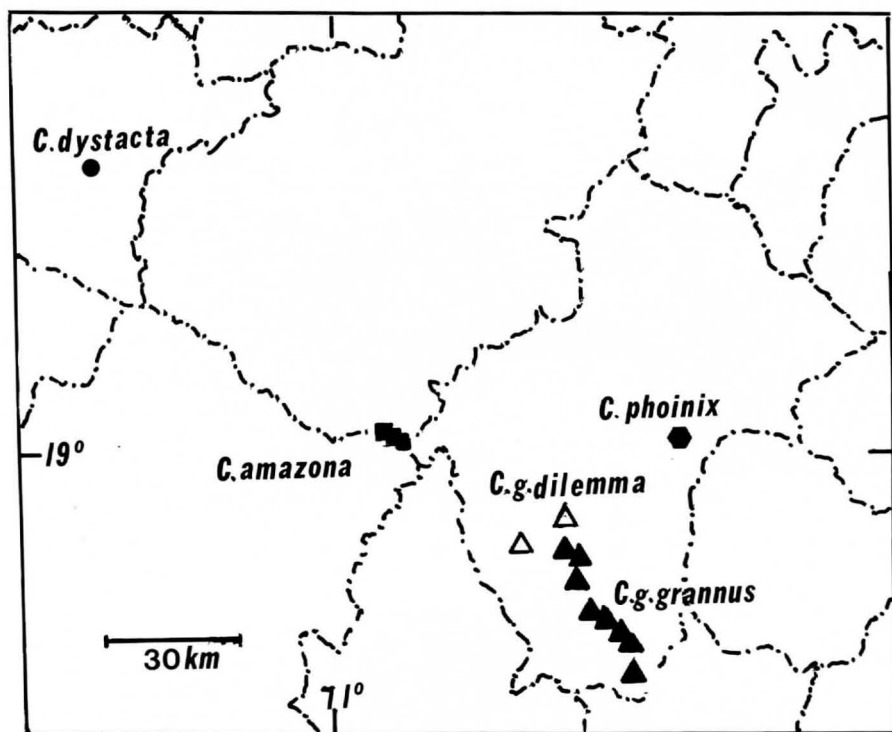


Figure 1. Map of west-central República Dominicana, showing the known distributions of the four species in the *Calisto grannus* complex, as follows: *C. grannus grannus* = solid triangles; *C. g. dilemma* = hollow triangles; *C. phoinix* = solid hexagon; *C. amazona* = solid squares; *C. dystacta* = solid circle.



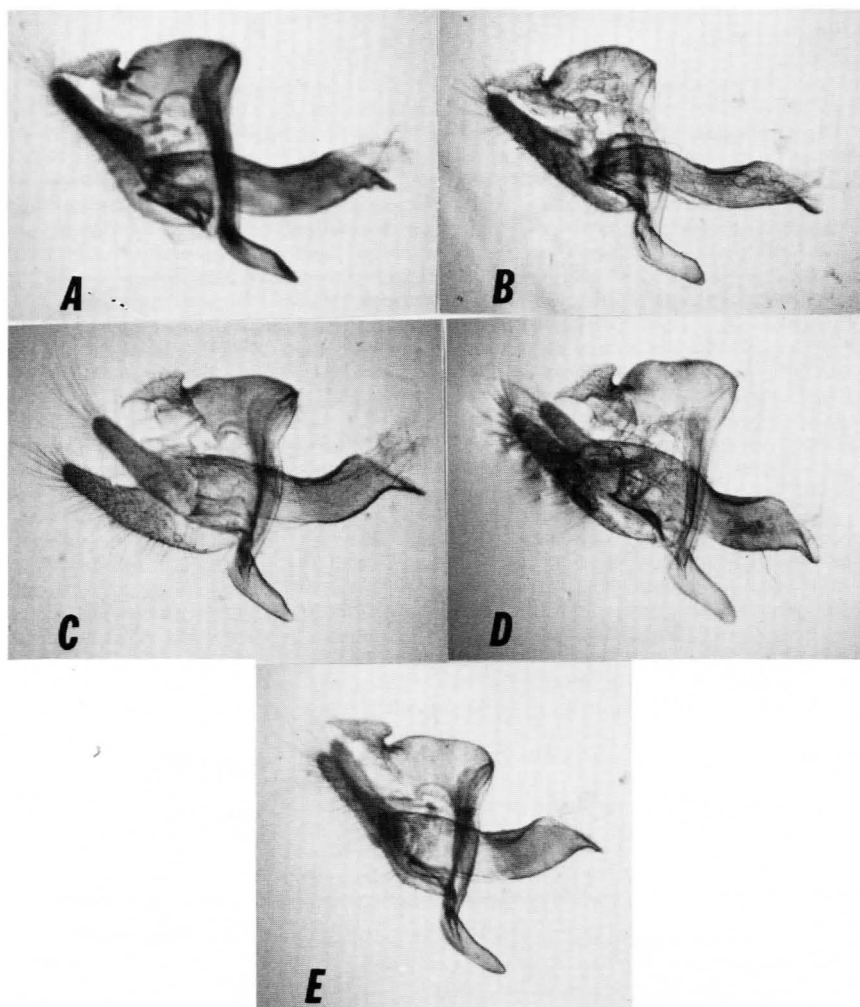


Figure 2. Male genitalia of members of the *grannus* complex. A. *C. g. grannus*, AS 4085, Rep. Dom.: La Vega: La Nevera, 37 km SE Constanza, 2354 m; B. *C. g. dilemma*, (PARATYPE) AS 7872, Rep. Dom.: 6 km SSE Constanza, 1483 m; C. *C. phoenix*, (PARATYPE) AS 8723, Rep. Dom.: La Vega: La Palma, 19 km W Jayaco, 1064 m; D. *C. amazona*, (PARATYPE) AS 14602, Rep. Dom.: Santiago: entrance to Valle de Tetero, ca. 2612 m; E. *C. dystacta*, (PARATYPE) AS 12879, Rep. Dom.: Santiago Rodriguez: Loma Leonor, 19 km SW Moncion, 645 m.

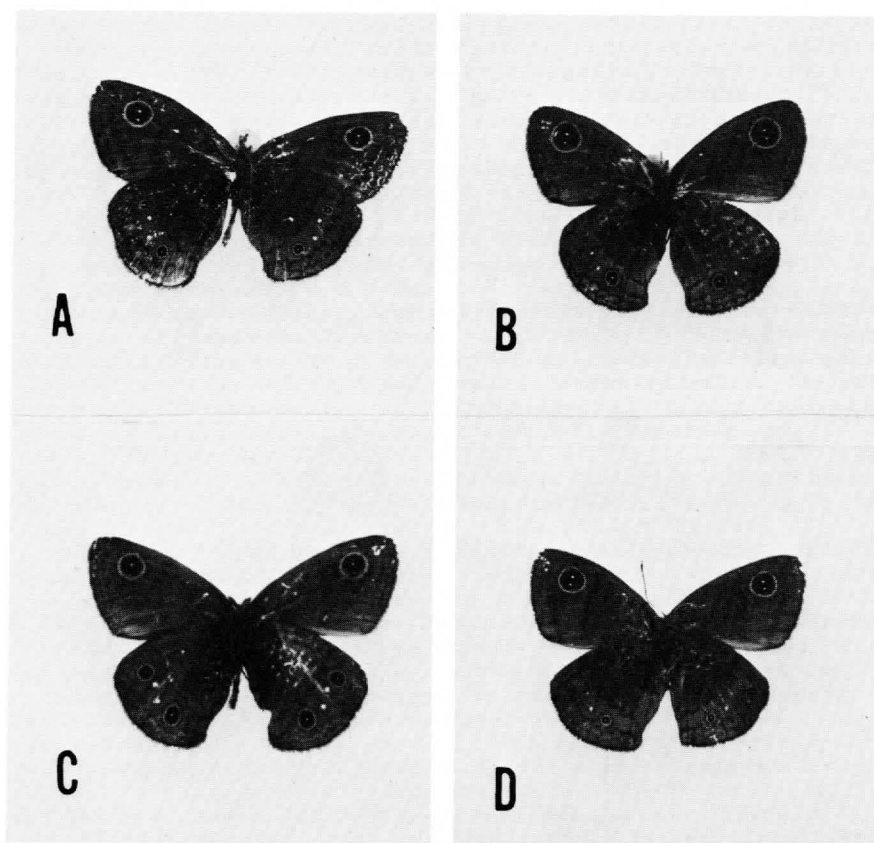


Figure 3. Ventral views of four taxa of the *Grannus* complex, as follow: A, *Calisto g. dilemma* (HOLOTYPE-FLG 1189); B, *Calisto phoinix* (HOLOTYPE-AS 11025); C, *Calisto amazona* (HOLOTYPE-AS 14601); D, *Calisto dystacta* (HOLOTYPE-AS 12874).

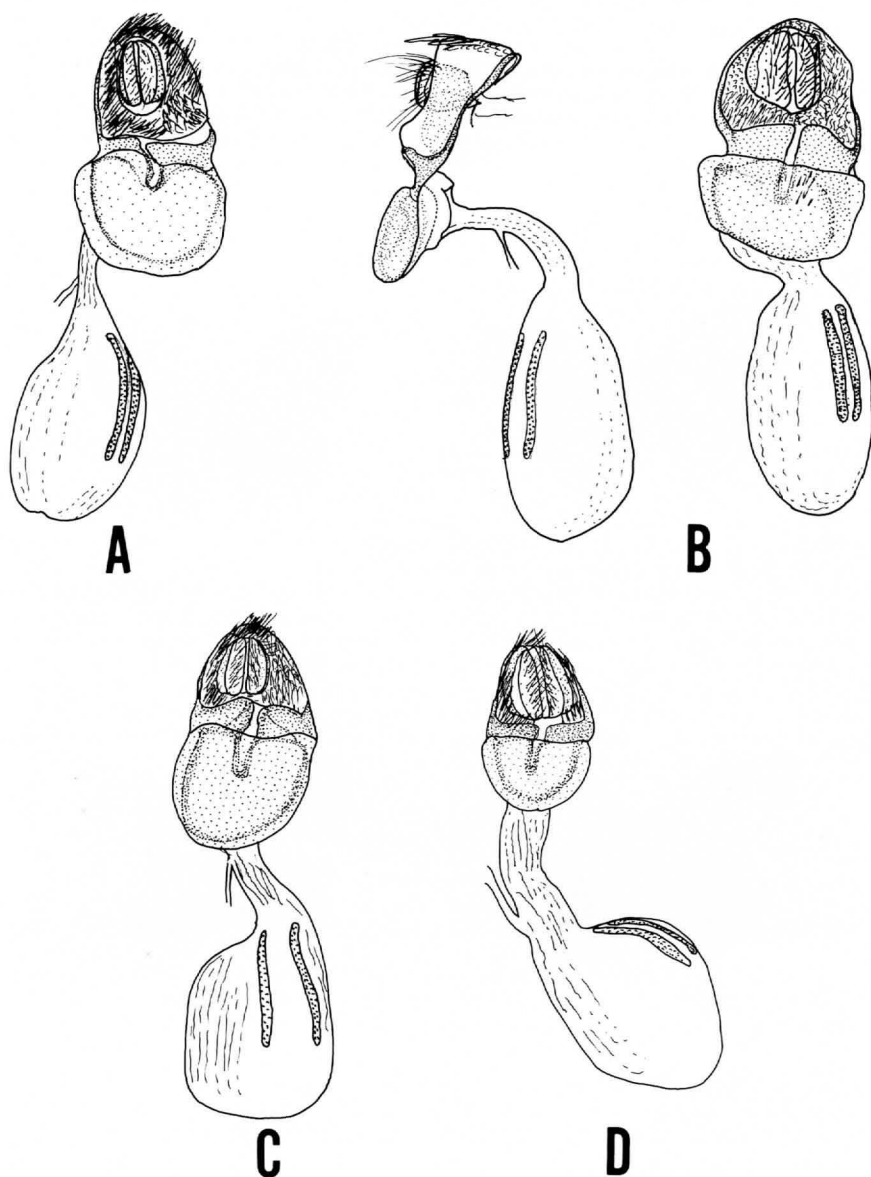


Figure 4. Female genitalia of members of the *grannus* complex. A, *C. g. dilemma*, AS 18667, Rep. Dom.: La Vega: 6 km SSE Constanza, 1403 m; B, *C. phoinix* (PARATYPE), AS 10600, Rep. Dom.: La Vega: La Palma, 19 km W Jayaco, 1006 m; C, *C. amazona* (PARATYPE), AS 14599, Rep. Dom.: Santiago: entrance to Valle de Tetero, 1922 m; D, *C. dystacta* (PARATYPE), AS 14324, Rep. Dom.: Santiago Rodriguez: Loma Leonor, 19 km SW Moncion, 610 m.



Figure 5. Habitats of four taxa of the *grannus* complex, as follow: A, *Calisto g. dilemma*: Rep. Dom.: La Vega: 6 km SSE Constanza, 1484 m (A. Schwartz, 11 March 1984); B, *Calisto dystacta*: Rep. Dom.: Santiago Rodriguez: Loma Leonor, 19 km SW Moncion, 645 m (A. Schwartz, 17 March 1984); C, *Calisto g. grannus*: Rep. Dom.: La Vega: 18 km SE Constanza, 2228 m (W.W. Sommer, 29 June 1981); D, *Calisto amazona*: Rep. Dom.: Santiago: between La Laguna and La Cotorra,  $\pm$  1615 m (F.L. Gonzalez, 19 July 1985).

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