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DICERATOBASIS MELANOGASTER SPEC. NOV., A NEW DAMSELFLY FROM THE DOMINICAN REPUBLIC (ZYGOPTERA: COENAGRIONIDAE), WITH TAXONOMIC AND DISTRIBUTIONAL NOTES ON THE ODONATA OF HISPANIOLA AND PUERTO RICO

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D. melanogaster sp. n., *Ischnura capreola, Anax amazili, Tholymis citrina, Tramea binotata* are newly recorded for Hispaniola; *Coryphaeschna viriditas, Miathyria simplex, Tauriphila australis, Tholymis citrina, Tramea binotata,* and *T. calverti* are new for Puerto Rico. — *D. melanogaster* sp. n. (Dom. Rep.: La Vega Prov., roadside cuts along Constanza Rd, 15 km E of Autopista Duarte, elev. 1000 m, 8 Aug. 1983, R.W. Garrison) differs from *D. macrogaster* in lacking horns on the basal segment of the penis and in having IR_2 recessed to the third or fourth crossvein of the second series just proximal to the pterostigma in both wings (recessed to first or second in *D. macrogaster*). The generic status of *Diceratobasis* is discussed, and a key is presented for most neotropical coenagrionids which lack postocular spots. — Extended discussions are given on inter-island variability of *Telebasis dominicana* and *T. vulnerata,* as well as the validity of the subspecies *Cannaphila insularis funerea.*

INTRODUCTION

From 1979 to 1982, I lived in Puerto Rico and collected there and in Hispaniola. The odonate fauna of Puerto Rico is relatively well known and has been documented in detail by KLOTS (1932) and GARCIA-DIAZ (1938). Hispaniola is still poorly known. No works specifically treat its Odonata, but certain species from the Dominican Republic were discussed by NEEDHAM (1941a, 1941b) and WESTFALL (1964b, 1976). PAULSON (1982) tabulated 54 species for Hispaniola and 42 for Puerto Rico and the Virgin Islands, respectively, based on literature records and material in his collection. My purpose here is twofold: (1) to describe a new species of *Diceratobasis,* give extended comments on the genus,

and provide a key for most neotropical coenagrionids lacking postocular spots, and (2) to supplement Paulson's list with new records, in some cases elaborating on poorly known species from the two islands.

DICERATOBASIS MELANOGASTER SPEC. NOV.

Figures 1, 3, 5, 7, 8, 10, 12, 14

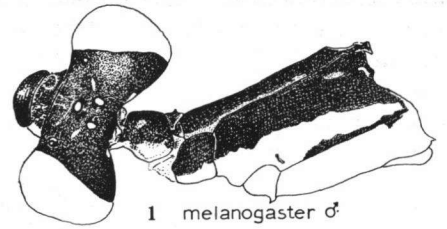
Material — **Holotype** ♂: DOM. REP.: La Vega Prov., roadside cuts along Constanza Rd, 15 km E of Autopista Duarte, elev. 1000 m, 8 August 1983 (R.W. Garrison). — **Allotype** ♀. Same data as holotype. — **Paratype** ♀. Same data as holotype. Holotype and allotype in collection of United States National Museum, Washington, D.C. Paratype in author's collection.

Male. — Head: Labrum, clypeus, frons and vertex entirely matte black with slight cupreous luster, a small orange tear-shaped spot advancing 45° anteriorly distad between median and posterior ocelli (Fig. 1); labium pale ivory, rear of head black except for small pale yellow area directly behind occiput; antennae black.

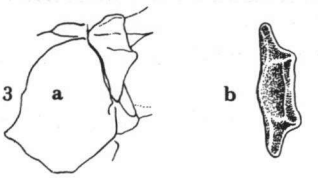
Thorax: Dorsum of prothorax matte black with slight cupreous luster and with small red spot on lateral margin of anterior lobe and at anterolateral margin of middle lobe, posterior lobe as shown in Fig. 3; sides of prothorax ivory with slight reddish cast. Dorsum of synthorax entirely matte black with metallic overtones (Fig. 1) and with small trace of red-yellow along humeral suture; all of mesepimeron and anterior part of mesinfraepisternum black, rest of thorax ivory but with black from mesepimeron extending over to distal anterior margin of metepisternum and along second lateral suture. Metasternum pale ivory with narrow black line running between metacoxae halfway to base of abdomen, a touch of black also present along posterior distal margin of metepimeron. Coxae and trochanters ivory; exterior surfaces of femora washed with brown, especially at apices, inner surfaces paler, tibiae smoky yellow with lateral margins brown; armature and tarsi black. Wings hyaline; venation black, pterostigma dark brown, paler along inside borders. Wings petioled to just beyond Ac (Fig. 7), arculus slightly distal to 2nd antenodal in all wings; postnodals: $\frac{14}{13} \cdot \frac{14}{13}$; R_3 arising just before 5th antenodal in forewings, beyond 4th and just before 3rd antenodal in hind wings; vein IR_2 arising at 4th antenodal of second series before pterostigma in forewings; at 4th and 3.5 before pterostigma in hind wings.

Abdomen: Segments 1-2 metallic black on dorsum, pale ivory along sides with distinct reddish cast along black margin; segments 3-7 like 1 and 2 but with ivory extending dorsally along anterior margin of segment, not quite meeting ivory

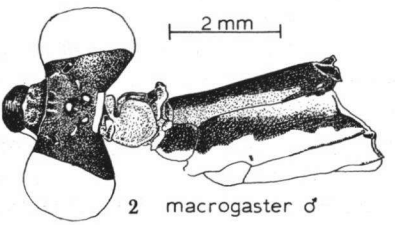
Figs 1-9. (Figs 1, 3, 5, 7-8): *Diceratobasis melanogaster* sp. n.: (1) Thorax and head, lateral view (holotype); — (3a) prothorax, dorsolateral view, (3b) posterior lobe of prothorax, dorsal view; — (5a, b) same as 3a, b. but for paratype ♀; — (7a) base of forewing (paratype), (7b) forewing (paratype); — (8a) ♂caudal appendages, lateral view, (8b) same, dorsal view. — (Figs 2, 4, 6, 9): *D. macrogaster* (Selys), ♂ & ♀: Jamaica, Trelawney Parish, Windsor Estate about 12 mi S of Falmouth, 20 August 1960, M.J. Westfall, Jr and P. Drummond (FSCA): Figure legends as for *D. melanogaster*.



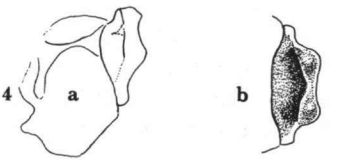
1 melanogaster ♂



melanogaster ♂

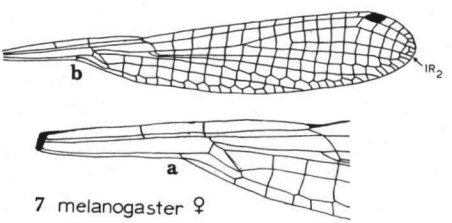


2 macrogaster ♂

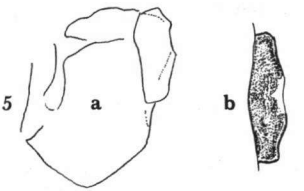


macrogaster ♂

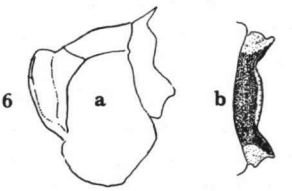
1 mm



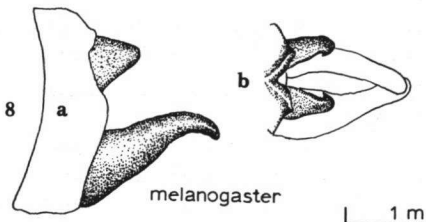
7 melanogaster ♀



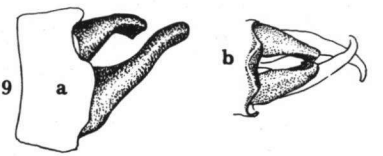
melanogaster ♀



macrogaster ♀



melanogaster



macrogaster

1 mm

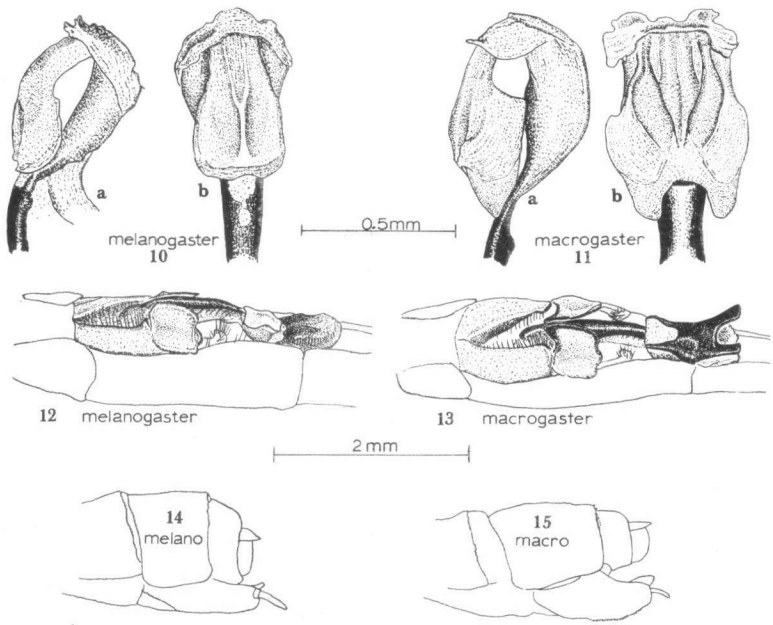
from other side; segments 8-10 similar to segments 1 and 2. Appendages (Fig. 8) smoky brown; superior appendages small, blunt, conical, with decurved tips when viewed dorsally (Fig. 8b); inferior appendages about twice as long as superiors, curvilinear and slightly bent ventrally toward tip.

Penis (Fig. 10) similar to that of *D. macrogaster* (Selys) (Fig. 11) but with distal end less concave and emarginate. In ventral view, penis of *D. melanogaster* with sides more parallel than those of *D. macrogaster*. Basal segment of penis (Fig. 12) entire and lacking the divergent horns present in *D. macrogaster* (Fig. 13).

Measurements (in mm). — Holotype: abdomen 37, hind wing 23.

Female. — Overall coloration and pattern as in male. Hind lobe of prothorax as shown in Figure 5. Ovipositor (Fig. 14) similar to that of *D. macrogaster* (Fig. 15) but more slender and extending beyond cerci.

Postnodals: allotype: $\frac{13}{11} \cdot \frac{14}{13}$; paratype: $\frac{13}{11} \cdot \frac{13}{12}$; R_3 (allotype) arising just before 5th antenodal in forewings, before 4th in hind wings, same for paratype; vein IR_2 (allotype) arising at 4th antenodal of second series in forewings, at 4th and 3rd in hind wings; in paratype, IR_2 arising at 5th antenodal of second series proximal to pterostigma in forewings, at 4th and 3rd postnodals in hind wings.



Figs 10-15. (Figs 10, 12, 14): *Diceratobasis melanogaster* sp. n.: (10a) Penis, lateral view, (10b) same, ventral view; — (12) abdominal segments 1-3, ventrolateral view; — (14) abdominal segments 8-10, lateral view. — (Figs 11, 13, 15): *D. macrogaster* (Selys): Figure legends as for *D. melanogaster*.

Measurements (in mm). — Allotype and paratype: abdomen 37, hindwing 24.

Etymology: "melanogaster": Greek for black abdomen. The name alludes to the large amount of black present on the body, including the abdomen.

DISCUSSION

The male of *D. melanogaster* is easily distinguished from its only congener, *D. macrogaster,* by the absence of the forked process at the base of the penis vesicle (Figs 12, 13). *D. melanogaster* has only a small, thin pale humeral stripe, while the entire humeral area in *D. macrogaster* is reddish-brown (Figs 1, 2). The prothoracic hind lobe of the males (Figs 3, 4) and females (Figs 5, 6) is also diagnostic: these structures are not as ornate in *D. melanogaster.* The caudal appendages of the males are similar, but the superior appendages are, in lateral view, blunter and thicker in *D. melanogaster* than in *D. macrogaster.* A most distinctive venation difference is the location of the origin of IR_2. In *D. melanogaster,* its origin is recessed to the 3rd or 4th crossvein of the second series just proximal to the pterostigma in both fore and hind wings (Fig. 7). In the pair of *D. macrogaster* I have examined, this vein recesses to the 1st or 2nd postnodal crossveins of the second series just proximal to the pterostigma in fore and hind wings.

Diceratobasis melanogaster is thus far known only from the type locality, and I presume it is endemic to Hispaniola. I encountered this species unexpectedly as I was collecting and photographing specimens of the endemic satyrid butterfly, *Calisto chrysaoros* Bates. The butterflies were alighting on fern tips by a road cut, and I soon saw my first specimen of *D. melanogaster.* Because it did not hang pendant with its wings outspread, I recognized it as new. I discovered another specimen, but after an extensive search, found only one more female. The species perched on fern tips or grass. No water nor other odonates were observed in the vicinity. The life history of *D. melanogaster* is unknown, but the larva may be bromeliadicolous, as is the larva of *D. macrogaster.*

THE GENUS *DICERATOBASIS*

Originally described by Selys as *Agrion macrogaster* in 1857, the species was transferred to *Leptobasis?* by SELYS in 1877, to *Agrion (Nehalennia)* by GUNDLACH in 1888, to *Telebasis* by CARPENTER in 1896 and 1897; and finally KENNEDY (1920) erected a new genus, *Diceratobasis,* to include this unusual species. KENNEDY (1920) defined the genus briefly: "Characters as in *Metaleptobasis,* but male without thoracic horns, while a large pair of horns occur on the seminal vesicle". However, an undescribed species of *Metaleptobasis* I have from Ecuador has minute thoracic horns uncharacteristic of the genus. The inclusion of *D. melanogaster,* which, in my opinion, represents the more generalized form of the two species in the genus, also invalidates the use of the horns of the seminal

vesicle as a generic character. The two genera differ principally in two characters: *Metaleptobasis* lacks a supplementary tarsal claw, while *Diceratobasis* possesses one; and *Metaleptobasis* possesses mesepisternal horns, while *Diceratobasis* lacks them.

When I began to study *D. melanogaster,* I seriously doubted the validity of the genus despite the fact that WESTFALL (1964a, 1976) had no doubts about its validity after studying the larva of *D. macrogaster.* After my study, I thought that *D. melanogaster* was very close to *Metaleptobasis,* but differed primarily in the tarsal claw structure. KENNEDY (1919) stated that *Diceratobasis* "is placed in this series (VIII, including *Palaeobasis, Ceriagrion, Telebasis, Metaleptobasis,* and *Aceratobasis*) because of its close resemblance to *Metaleptobasis* in venation, in size, sharp frons, and in the form of the appendages and penis".

Diceratobasis melanogaster, with its overall generalized morphology, may provide a link to the small horned species of *Metaleptobasis.* Interesting also are the thoracic designs of members of these two genera: all *Metaleptobasis* I have examined (including the generotype, *M. bovilla* Calvert) are pale. My field experience with them indicates species which perch on or near the forest floor: they apparently shun direct sunlight. Minter J. Westfall, Jr, has discovered larvae of at least one species (*M. westfalli* Cumming), which do not occur in bromeliads as do larvae of *D. macrogaster* (M.J. Westfall, pers. comm., 1984). Adults of *D. melanogaster* are the most melanic of the *Metaleptobasis-Diceratobasis* series; and I found my specimens at high, cool elevations in completely open areas in direct sunlight. Could this tendency toward melanism be a thermoregulatory mechanism for the more arboreal habits of *Diceratobasis?*

I also compared the penes of both species of *Diceratobasis* with the generotype, *Metaleptobasis bovilla,* and they are strikingly similar. The peculiar horns on the seminal vesicle and the ornate morphology of the prothoracic hind margin of *D. macrogaster* are unique and are probably cladistically derived. If so, then *D. macrogaster* is a derivative of its sister taxon, *D. melanogaster.*

The family Coenagrionidae is so speciose that no satisfactory classification has been proposed. FRASER (1957) recognized six subfamilies, but did not key them, nor did he indicate a placement for *Diceratobasis.* ST. QUENTIN & BEIER (1968) followed Fraser but provided a key for the six groups. According to his arrangement, *Diceratobasis* would fall under the Amphicneminae. The latest revision, by DAVIES & TOBIN (1984), reorganized the six subfamilies slightly from the previous works. *Diceratobasis* is included under the new subfamily Leptobasinae with *Antiagrion, Chrysobasis, Inpabasis, Leptobasis, Leucobasis, Mesoleptobasis,* and *Metaleptobasis,* but it is not clear how this subfamily is distinguished from the others.

With much trepidation, I offer a key to all neotropical coenagrionid genera whose members lack postocular spots. I did not include: (1) *Skiallagma,* because it is poorly known, nor (2) *Argia,* because it is readily identifiable, nor (3)

Antiagrion, whose members are restricted to Chile. As far as possible, I checked all species and original descriptions with the result that a few genera will key out more than once. Exceptions noted in the key suggest that some species may be improperly placed, and that some genera may be synonymous. The key includes: *Aeolagrion, Chrysobasis, Diceratobasis. Helveciagrion, Hylaeonympha, Inpabasis, Leptagrion, Leptobasis, Leucobasis, Mesoleptobasis, Metaleptobasis, Minagrion, Nehalennia, Telagrion,* and *Telebasis.*

KEY TO NEOTROPICAL COENAGRIONIDAE LACKING POSTOCULAR SPOTS

1 Both sexes with a small to robust tubercle on venter of abdominal segment 1 ***Minagrion***

1′ Both sexes without such a tubercle 2

2(1′) A_1 short, only 4-5 cells long, and ending distally before 1st postnodal; no supplementary tooth on tarsal claw ..... ***Mesoleptobasis***

2′ A_1 longer, 5-6 or more cells long and ending beyond 1st postnodal; with or without supplementary tooth on tarsal claw 3

3(2′) A_1 extending only 5-6 cells, ending at level between 1st and 2nd postnodal; dorsum of abdominal segment 10 in ♂ with a forked dorsal projection ..... ***Chrysobasis***

3′ A_1 at least 7 cells long and ending at level of 3rd postnodal or beyond; dorsum of abdominal segment 10 of ♂ without a forked dorsal process 4

4(3′) Tarsal claw without a supplementary tooth, its inner side concave throughout or, at most, with a small notch 5

4′ Tarsal claw with a distinct supplementary tooth, though it may be smaller than apical tooth 9

5(4′) Both sexes with anterior portion of mesepisternum with a tubercle or, more often, a distinct anteriorly or anterolaterally directed horn; ♂ inferior appendages curvilinear, longer than superior appendages; superior appendages of various shapes but never bent ventrad at almost a right angle near apical half; abdomen at least 33 mm ..... ***Metaleptobasis***

5′ Anterior portion of mesepisternum with no tubercle or horn; if such a tubercle or horn is present, then either superior appendages of ♂ are longer than inferior appendages (*Telagrion diceras* (Selys), or superior appendages are bent ventrad at almost a right angle near apical half; abdomen 30 mm or less 6

6(5′) Frons angulate, with an acute transverse ridge in front of ocelli; male with apex of abdominal segment 10 prolonged to form a decumbent bifid process which lies between the superior appendages ..... ***Inpabasis***

6′ Frons not angulate, smoothly rounded, without indication of a continuous transverse ridge in front of ocelli; male with apex of abdominal segment 10 entire or emarginate 7

7(6′) Superior appendages of male longer than or equal in length to inferior appendages, superior appendages of various forms but never bent at a right angle as in *Leptobasis* . ***Telagrion***

7′ Superior appendages of male shorter (*Leptobasis*) or longer (*Leucobasis*) than inferior appendages; superior appendages bent ventrad at almost a right angle near apical half (includes *"Telagrion" raineyi*) 8

8(7′) R_3 originating at 4th or 5th postnodal in forewing, at 3rd to 4th in hind wing; A_1 7-9 cells long, ending at level of 3rd or 4th postnodal; IR_2 usually recessed only 1 postnodal cell of second series proximal to pterostigma; genital valves extending well beyond hind margin of abdominal segment 10 (except in *"Telagrion" raineyi*); some specimens with a small supplementary tooth on tarsal claw ..... ***Leptobasis***

8′ R_3 originating at 5th-6th postnodal in forewing, at 4th to 5th in hind wing; A_1 10 or more

cells long, ending at level of 4th to 5th postnodal; IR_2 recessed to 2-3 postnodal cells of second series proximal to pterostigma; genital valves just barely extending beyond abdominal segment 10; inner surface of tarsal claw entire, never with a supplementary tooth ..... ***Leucobasis***

9(4') Wings stalked before level of Ac so that petiolation ceases as far before it as Ac is long 10

9' Wings stalked at or beyond Ac; if stalked before Ac, then that distance less than length of Ac 11

10(9) Larger species, abdomen 26 mm or more; body with some red, superior and inferior appendages of ♂ as long as abdominal segment 10 or longer ..... ***Hylaeonympha***

10' Smaller species, abdomen less than 25 mm long; body blue and black, appendages of ♂ inconspicuous, shorter than abdominal segment 10 ..... ***Nehalennia***

11(9') Frons not angulate, smoothly rounded, without indication of a continuous transverse ridge in front of ocelli 12

11' Frons angulate, with an acute transverse ridge in front of ocelli 15

12(11) Supplementary tooth of tarsal claw small, forming not much more than a notch 13

12' Supplementary tooth of tarsal claw well developed, almost as large as tarsal claw ... 14

13(12) Inferior appendages of ♂ shorter than or subequal to superior appendages; superior appendages never bent ventrad at almost a right angle near apical half; vein descending from subnodus usually not forming a straight line to wing margin ..... ***Telagrion***

13' Inferior appendages of ♂ longer than superior appendages; superior appendages bent ventrad at almost a right angle near apical half; vein descending from subnodus usually forming a straight line to wing margin (includes *"Telagrion" raineyi*) ..... ***Leptobasis***

14(12') Wings stalked beyond Ac; inferior appendages of ♂ present and at least 0.25 the length of superior appendages; smaller species, abdomen 32 mm or less ..... ***Aeolagrion***

14' Wings stalked to or before Ac; inferior appendages of ♂ rudimentary, not ordinarily visible in lateral view (♂ of *Leptagrion beebeanum* Calvert, *L. fernandezianum* Racenis, and *L. obsoletum* Selys have visible inferior appendages and may belong in *Telagrion*); larger species, abdomen 34 mm or more ..... ***Leptagrion***

15(11') Inferior appendages of ♂ rudimentary, not visible in lateral view (♂ of *Leptagrion beebeanum, L. fernandezianum,* and *L. obsoletum* have visible inferior appendages and may belong in *Telagrion*); larger species, abdomen 36 mm or more ..... ***Leptagrion***

15' Inferior appendages of ♂ visible in lateral view, usually 0.25 or more the length of superior appendages; smaller species, abdomen 35 mm or less, or if longer, then inferior appendages of ♂ longer than superior appendages 16

16(15') Large species, abdomen 36 mm or more; inferior appendages of ♂ similar to *Metaleptobasis* ..... ***Diceratobasis***

16' Smaller species, abdomen 35 mm or less; appendages of ♂ variously shaped, but never with inferior appendages resembling those of *Metaleptobasis* 17

17(16') Body usually with some red, top of head black ..... ***Telebasis***

17' Blue species; if red, then top of head not black 18

18(17') Top of head mostly blue; or if black, with postocular spots ..... ***Helveciagrion***

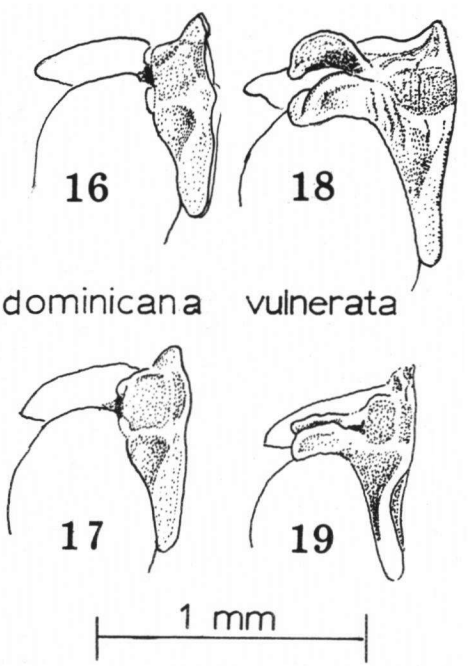
18' Top of head black; or if pale, then body is red ..... ***Aeolagrion***

NEW DISTRIBUTION RECORDS

PROTONEURIDAE

On 10 Aug. 1983, I collected 31 males and 34 females of an undescribed metallic red *Protoneura* at Arroyo Bermejo, 4 km NNE of Hatillo and Autopista

Duarte, Distrito Nacional, Dominican Republic. Almost all specimens were taken in tandem as they oviposited in grass near the water's edge. Further details of the species will be published by M.J. Westfall, who will describe it. The species is thus far known only from a few localities in the Dominican Republic, and it is the second protoneurid known from that island.



Figs 16-19. (Figs 16-17): *Telebasis dominicana* (Selys), ♀, prothorax, dorsolateral view: (16) Puerto Rico: Mun. Vega Baja, Laguna Tortuguero, SE end at Hwy 587, 18 Dec. 1979 (R.W. & J.A. Garrison); — (17) Dominican Republic: La Vega Prov., pond 4.5 km S of La Vega, by Autopista Duarte, 16 April 1981 (R.W. & J.A. Garrison). — (Figs 18-19): *T. vulnerata* (Hagen) ♀, prothorax, dorsolateral view: (18) Puerto Rico, Mun. Rio Grande, El Toro Trail, just below top of El Toro Peak, elev. about 1000 m, 18 June 1982 (R.W. Garrison); — (19) Dominican Republic, La Vega Prov., small shaded stream and pasture with small wet areas, 19.5 km NE of Jarabacoa, 200 m, 3 Aug. 1983 (R.W. Garrison).

COENAGRIONIDAE

Ischnura capreola (Hagen) — Dominican Republic, San Cristobal Prov., La Toma, nr San Cristobal, 5 June 1940, 1 ♂, 1 ♀, FSCA. New for Hispaniola.

Neoerythromma cultellatum (Hagen) — PAULSON (1982) does not mention this species from Puerto Rico. However, NEEDHAM (1941b) found it at Laguna Tortuguero in 1935. I also found it there in 1979-1981, and at the western end of the island at Mun. Hormigueros, Rio Guanajibo at jct. of Hwy 311 and 587 on 27 July 1980.

Telebasis dominicana (Selys) and *T. vulnerata* (Hagen) — Both species are known from Puerto Rico and Hispaniola. However, I have seen a few specimens from Hispaniola incorrectly identified. The differences between males of the two species are illustrated by KLOTS (1932), but she did not illustrate the best diagnostic character for females. Females of *T. dominicana* from both islands are similar: the prothorax (Figs 16, 17) is unmodified. The prothorax of *T. vulnerata* possesses a pair of anteriorly directed flaps which overlie most of the median lobe. The flaps are large and conspicuous in females from Puerto Rico (Fig. 18), but they are

diminutive in females from Hispaniola (Fig. 19). Thus, specimens from Hispaniola can easily be confused with *T. dominicana*. I have collected both species at many localities in Puerto Rico, but have never encountered them syntopically there. *T. dominicana* prefers open, sunny areas and tends to be a lowland species, while *T. vulnerata* is a forest insect and prefers partially shaded streams, inhabiting the numerous mountain rivulets and streams in Puerto Rico. *T. vulnerata* may be found near sea level (about 50 m) but is also found in the mountains. The largest specimens I have seen are from near El Toro peak in the Luquillo Mountains at 1000 m. Not surprisingly, there is considerable variation in size in *T. vulnerata* from Puerto Rico. Hind wing length for males ranges from 17.1 to 23.4 mm (N = 73). In Puerto Rico, one can almost predict which species will occur at a given aquatic locality on the basis of habitat alone.

In Hispaniola, not only do females of the two species resemble each other more closely, but they often coexist at the same locality. I have found both species just north of Santo Domingo (Arroyo Bermejo, 4 km NNE of Hatillo and Autopista Duarte), and at a small shaded stream 19.5 km NE of Jarabacoa.

Table I

Hind wing measurements for males and females of *Telebasis dominicana* and *T. vulnerata* from Puerto Rico and Hispaniola — (N = sample size, $\bar{Y}$ = mean (mm), s^2 = variance)

Species	Sex	Locality	N	$\bar{Y}$	s^2
dominicana	♂	Puerto Rico	50	17.4	0.36
dominicana	♂	Hispaniola	13	18.1	0.50
vulnerata	♂	Puerto Rico	73	19.6	2.09
vulnerata	♂	Hispaniola	29	17.8	1.26
dominicana	♀	Puerto Rico	15	18.8	0.62
dominicana	♀	Hispaniola	3	18.7	0.06
vulnerata	♀	Puerto Rico	11	21.0	2.99
vulnerata	♀	Hispaniola	5	19.8	1.66

From my collection, I measured the hind wing length of males and females of both species from both islands, with the results shown in Table I. Using Bartlett's test (SOKAL & ROHLF, 1981), variances within each sex were found not to be equal, with *T. vulnerata* more variable in wing length than *T. dominicana*. This is probably due to the greater variability in size of *T. vulnerata* associated with different altitudes, or to a greater variability of size within each deme due to local ecological conditions not experienced by *T. dominicana*. I tested for regression of wing length data using 42 males from eastern Puerto Rico representing six different altitudes from 50 m to 1000 m (top of El Toro trail). I found no significant regression of wing length on altitude. There were significant deviations from a linear regression, which would support the idea that local ecological factors such as food conditions for larvae or competition among larvae

Table II

Games and Howell test for equality of means for ♂ hind wing length data from Table I. Values below diagonal are differences between means. Values above diagonal are critical mean significant difference (MSD) values. A pair of means is significantly different at the 0.05 level if the difference in means equals or is greater than the corresponding MSD

Species	N	$\bar{Y}$	*dominicana* Puerto Rico	*vulnerata* Hispaniola	*dominicana* Hispaniola	*vulnerata* Puerto Rico
dominicana (Puerto Rico)	50	17.4	0	0.9	0.9	0.7
vulnerata (Hispaniola)	29	17.8	0.4	0	1.1	1.0
dominicana (Hispaniola)	13	18.1	0.7	0.3	0	1.0
vulnerata (Puerto Rico)	73	19.6	2.1*	1.7*	1.4*	0

* $P < 0.05$

may be more important than altitude in producing the variability of *T. vulnerata.*

From the data shown for males in Table I, I suspected that wing length of *T. vulnerata* from Puerto Rico would be significantly different from the other three groups (*T. vulnerata* from Hispaniola, *T. dominicana* from both Puerto Rico and Hispaniola). Results of a Games and Howell test (SOKAL & ROHLF, 1981) for differences among means (Tab. II) confirm this. The same data tested for females showed no significant differences between any two pairs, perhaps because the sample sizes were too small.

In conclusion, (1) *T. dominicana* and *T. vulnerata* are allotopic in Puerto Rico, but are often syntopic in Hispaniola, (2) Females of both species are more similar to one another in Hispaniola than in Puerto Rico, (3) Based on hind wing length, *T. vulnerata* is more variable in size than *T. dominicana,* (4) Mean hind wing length is significantly longer in Puerto Rican *T. vulnerata* than in Hispaniolan *T. vulnerata* and *T. dominicana* from both islands, (5) An increase in hind wing length with elevation was observed among 42 male *T. vulnerata,* but no significant regression of wing length on altitude was observed.

AESHNIDAE

Aeshna psilus Calvert — Its occurrence in Puerto Rico dates from an old record (Adjuntas 8 June 1913, 1 ♂, CALVERT 1956), but I can add the following new records: Mun. Jayuya: dirt road just S of Hwy 143, about 5 mi W of Divisoria, 1100 m, 17 Feb. 1980, 1 ♂; Mun. Rio Grande, El Verde Field Station Lab, off Hwy 186, Luquillo Mtns., 350 m, 22 July 1981, 1 ♂ (R.W. Garrison).

Anax amazili (Burmeister) — Dominican Republic, La Vega Prov., pond 4.5 km S of La Vega, by Autopista Duarte, 16 April 1981, 1 ♀ (R.W. Garrison).

Haiti, Dept. de L'Ouest, Vallee Heureuse nr. Petionville, 26 Aug. 1960, 1 ♀ (FSCA). New for Hispaniola.

Coryphaeschna viriditas (Calvert) — Puerto Rico, Mun. Coamo, Rio Descalabrado at town of Rio Cañas by Hwy 14, elev. 70 m, 1,6, 20 Jan. 1980, 2 ♂, 5 ♀; Mun. Manati, Laguna Tortuguero, west end, at Hwy 666, 7 Jan. 1980, 1 ♂, 2 ♀; Mun. Rio Grande, El Verde Field Station, off Hwy 186, Luquillo Mtns., 350 m, 3 June 1982, 1 ♂; Mun. Vega Baja, Laguna Tortuguero, SE end nr Hwy 587, 16 May 1982, 5 ♂, 3 ♀ (all R.W. Garrison). New for Puerto Rico. This common species probably occurs all over the island.

LIBELLULIDAE

Cannaphila insularis Kirby — CALVERT (1906) and later RIS (1910) recognized two subspecies of *C. insularis:* a mainland and Cuban form, *C. insularis funerea* Carpenter, and the nominate subspecies from Hispaniola and Jamaica. RIS (1910) stated the following (translated):

"The separation of *C. insularis* into 2 forms is not always clear, nevertheless, from our material, I am of the same opinion as Calvert [1906]. Karsch's investigation of the forms is probably not the same as ours. Those from Cuba and the mainland appear the same while a peculiar insular form occurs in Haiti and Jamaica.

a. Labium wholly yellow (exceptionally — Calvert — with a small spot of black). Hind wing very narrow with meager development of anal loop. Mainland and Cuba ..... *C. insularis funerea*

b. Labium with a broad quadrangular spot of black covering its middle lobe and adjacent edges of the lateral lobes; hind wing a little broader, as is also the end of its anal loop. Jamaica, Haiti ..... *C. insularis insularis.*"

CALVERT (1906) had only 4 ♂ and 3 ♀, and RIS (1910) only 3 ♂ and 5 ♀ (including Kirby's type) of *C. i. insularis* when they recognized *C. i. funerea* as distinct. Calvert's diagnostic measurements, which were presented in a table, were: (1) Width of hind wing at first antenodal to width of hind wing at nodus, (2) Width of hind wing at arculus to width of hind wing at nodus, (3) Number of cells along hind wing margin between MA and Cu_2, (4) Number of cells on sole of anal loop, and (5) Color of labium.

On 4 Aug. 1983 and 30 June 1984, I collected 20 *C. i. insularis* in the Dominican Republic (La Vega Prov., small pasture and arroyo just SE of Jarabacoa, 500 m). Through the kindness of Oliver S. Flint, Jr, of the U.S. National Museum, I was able to include a ♂ from 0.5 km E of San Cristobal, Dominican Republic, collected 8 June 1969, making a total of 21 *C. i. insularis.* Using the same measurements used by Calvert, I statistically compared the significance of these measurements against a series of 40 *C. i. funerea* in my collection ranging from S Texas (Hidalgo Co., Santa Ana Wildlife Refuge, 29 July 1972, John Hafernik, Jr) through the states of Veracruz and Chiapas, Mexico, south through Guatemala (Dept. El Progreso, San Agustin Ac., 30 Aug. 1965, T.W. Donnelly),

Panama (Canal Zone, forest road at Gaillard Hwy, at milepost 12, 7.4 km SE of Gamboa, 4 Aug. 1979, R.W. and J.A. Garrison), and Colombia (Choco, Quebrada Pichinde, 2 km E of San Pablo, 19 Feb. 1983, O.S. Flint, Jr). My purpose was to see if the statistical results support the separation of these forms, as I had noticed extreme variability of wing coloration in a long series of *C. i. funerea* collected from S Veracruz, Mexico. Several of these have highly infumated wings not described for this species. This condition is not due to ontogenesis, because I have both hyaline and infumated tenerals.

WIDTH OF HIND WING AT FIRST ANTENODAL AND AT ARCULUS TO WIDTH OF HIND WING AT NODUS — From a Bartlett's test (SOKAL & ROHLF, 1981), the ratios of both sets of data were found to have equal variances, so I compared the means via a t-test. The results (Tab. III) show that the hind wing width of *C. i. insularis* is significantly wider than that of *C. i. funerea*. These data support Calvert's assertion that the two subspecies are taxonomically distinct.

Table III

Sample sizes (N), means ($\bar{Y}$), variances (s^2), and t-test results of two sets of ratio data for *Cannaphila insularis*

Subspecies	Wing width at 1st anx to width at nodus				Wing width at arculus to width at nodus			
	N	$\bar{Y}$	s^2	t_s	N	$\bar{Y}$	s^2	t_s
i. insularis	21	0.81	0.003		21	0.91	0.00005	
				22.759***				30.123***
i. funerea	40	0.71	0.004		40	0.83	0.002	

*** $P < 0.001$

NUMBER OF CELLS ALONG HIND WING MARGIN BETWEEN MA AND Cu_2 AND NUMBER OF CELLS ON THE SOLE OF ANAL LOOP — Because these data sets were not continuous measurements, I analyzed the results using a non-parametric test, the Wilcoxon two-sample test (SOKAL & ROHLF, 1981) (Tab IV). The MA-Cu_2 cell data sets are highly significant, but not so the anal loop data. Thus, *C. i. funerea* contains, on the average, more marginal cells between MA and Cu_2 than does *C. i. insularis*. However, no significant difference was detected among means of anal loop data.

Table IV

Sample sizes (N), means ($\bar{Y}$), variances (s^2), and Wilcoxon two-sample test statistics (t_s) for two data sets for *Cannaphila insularis*

Subspecies	Marginal cells between MA & Cu_2				Number of cells along sole			
	N*	$\bar{Y}$	s^2	t_s	N*	$\bar{Y}$	s^2	t_s
i. insularis	42	12.6	1.56		42	2.6	0.48	
				7.38***				1.40 ns
i. funerea	79	16.0	1.95		80	2.8	0.62	

* Right and left wings used; — *** $P < 0.001$; — ns = not significant

BLACK SPOT ON LABIUM — This character is probably the most important used by Calvert and Ris in distinguishing between the two subspecies. All 21 specimens from Hispaniola contain a

large black spot as described by those authors. However, 8 of 40 (20%) of the mainland *C. i. funerea* also possess a labial black spot. Though some of these specimens do not have as extensive a black spot as the island subspecies, others in my samples were indistinguishable on this basis. In my opinion, the hind wing width and marginal cell data are better characters to separate the two subspecies than the spot on labium. However, overlap exists for all data sets, and there is no one character that will always separate *C. i. funerea* from *C. i. insularis*.

Miathyria simplex (Rambur) — Puerto Rico: Mun. Manati, Laguna Tortuguero, west end at Hwy 686, 7 Jan. 1980, 1 ♂; 13 Jan. 1980, 13 ♂; 27 July 1980, 1 ♂; 21 June 1981, 3 ♂ (all R.W. and J.A. Garrison); Mun. Vega Baja, Laguna Tortuguero, SE end nr Hwy 687, 25 April 1982, 5 ♂; 5 June 1982, 5 ♂ (all R.W. Garrison). New for Puerto Rico. All specimens have reduced basal wing spots so that in the hand, the insect is suggestive of a *Celithemis bertha* Williamson. However, I have compared the Puerto Rican individuals with Rambur's types in the Selys collection (IRSN) and with Kirby's type of *M. pusilla* in the BMNH: and I believe them all to be conspecific. I have the following field notes for 25 April 1982: "This is the first time I've seen *M. simplex* here [at Mun. Vega Baja, Laguna Tortuguero]; at one [locality there] must have been 15-20 swarming about 30 feet in the air; species likes to fly high; rarely comes in reach of net". I did not find females of this species in Puerto Rico.

Tauriphila australis (Hagen) — Puerto Rico: Mun. Cidra, Embalse de Cidra at dam by Hwy 783, 29 Dec. 1979, 1 ♂; Mun. Santa Isabel, Lago Coamo at dam, nr Hwy 52 and 545, elev. 48 m, 1 Jan. 1980, 1 ♂; Mun. Lajas, Hwy 306 just W of Laguna Cartagena, S of Hwy 101, elev. 20 m, 30 Aug. 1980, 6 ♂, 2 ♀; Mun. Vega Baja, Laguna Tortuguero, SE end at Hwy 587, 7 June 1981, 1 ♂ (all R.W. and J.A. Garrison). New for Puerto Rico. Probably occurs over the entire island.

Tholymis citrina Hagen — Puerto Rico: Mun. Salinas, Rio Majada at jct. of Hwy 52 and 712, elev. 100 m, 3 Aug. 1980; 1 ♀; Mun. Coamo, Rio Descalabrado at town of Rio Cañas, by Hwy 14, elev. 70 m, 6 Jan. 1980, 1 ♂; 20 Jan. 1980, 1 ♂; Mun. Lajas, Hwy 306 just W of Laguna Cartagena, S of Hwy 101, elev. 20 m, 30 Aug. 1980, 4 ♂, 3 ♀ (all R.W. and J.A. Garrison); Dominican Republic: Santiago Prov., Rio Janico at Janico, elev. 480 m, 5 Aug. 1983, 1 ♀; 7 Aug. 1983, 2 ♀; (all R.W. Garrison). New for Puerto Rico and Hispaniola.

Tramea binotata (Rambur) — This species is the black *Tramea* that has gone under the name of *T. walkeri* Whitehouse. I have examined the types of *Libellula binotata* and am preparing a paper on that species and *T. insularis*. PAULSON (1982) does not list *T. binotata* from Puerto Rico or Hispaniola, probably because of the taxonomic confusion, but I have found it on both islands. It often coexists with *T. insularis*. All records for *T. binotata* are limited to a few localities around Laguna Tortuguero, but it is probably found elsewhere on the island. New records for Hispaniola: Dominican Republic: Guerra, 11 June 1969, 5 ♂ (O.S. Flint, Jr and S. Gomez) (USNM): Samana Bay, McLachlan Coll. BM 1938-674, det. as *"insularis"*, 2 ♂ (BMNH); La Vega Prov., Rio Yaque del Norte, 3.5 km N of Jarabacoa, elev. 500 m, 15 April 1981, 1 ♀ (R.W.

Garrison); Samana, Frazar, det. as *T. insularis,* P.P. Calvert, B.C.A., 1 ♂, (BMNH).

Tramea calverti Muttkowski — Puerto Rico: Mun. Santa Isabel, Lago Coamo at dam, nr Hwy 52 and 545, elev. 48 m, 1 Jan. 1980, 1 ♂; Mun. Manati, Laguna Tortuguero, W end at Hwy 686, 7 Jan. 1980, 1 ♂, 21 June 1981, 1 ♂; Mun. Vega Baja, Laguna Tortuguero, SE end at Hwy 587, 7 June 1981, 1 ♀, (all R.W. and J.A. Garrison); Mun. Cabo Rojo, Cabo Rojo, 6 Dec. 1981, 1 ♂, (in coll. R.W. Garrison). New for Puerto Rico.

Tramea insularis Hagen — Recorded from Puerto Rico and Hispaniola by PAULSON (1982). As stated above, I believe *T. insularis* to be a distinct species. I have several records of it from Puerto Rico. Records for Hispaniola: Dominican Republic: Guerra, 11 June 1969, 2♂; ponds nr. Rio Nizao, E of Bani, 9 June 1969, 1 ♂, 1 ♀ in copula, (all O.S. Flint, Jr and S. Gomez) (USNM). Although the species is otherwise restricted to the West Indies and southern Florida, I have found one specimen, a ♂, from Mexico: Campeche, Carmen, 4 Sept. 1936 (H. Devlin Thomas) (UMAA).

CONCLUSIONS

The first records of six species from Hispaniola and seven from Puerto Rico increase these island faunas to 60 and 49, respectively. Some other species probably occur but are not yet recorded. For example, I expect *Erythrodiplax berenice* (Drury), *Miathyria marcella* (Selys), and *M. simplex* to be found in Hispaniola because they are known from Puerto Rico and Cuba. *Pantala hymenaea* (Say), a strong flier known from Cuba and Hispaniola, should also occur in Puerto Rico. A remote possibility exists that a third as yet undescribed *Diceratobasis* occurs in Puerto Rico. That island is mountainous and supports habitats conducive to *D. macrogaster* and *D. melanogaster.* Collecting in the El Yunque or El Toro region of Puerto Rico may reward the collector with a new discovery.

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With pleasure, I dedicate this paper to Dr M.J. WESTFALL, Jr, on his 70th birthday.

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