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Subspecies versus Geographic Variation in Caribbean Populations of *Anartia jatrophae* Johansson (Lepidoptera, Nymphalidae)

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In 1942 E. G. Munroe published a revision of the Caribbean races of *Anartia jatrophae*. The present paper covers the same material dealt with by Munroe with the purpose of discovering whether Munroe's subspecific classification really delineates distinct population groups in this species or serves only to confuse the details of geographic variation. Several easily quantified characters were chosen for study, and the bulk of this paper deals with their variation. This variation may be seasonal, sexual, geographical, or a combination of these. Geographic variation is, of course, the really important kind in this case, as it is on this type that the modern subspecies concept has been founded. Therefore, this study is largely directed at determining whether the geographic variation between populations of this species delimits them as discrete entities or different characters show patterns of variation more or less independent of one another. Obviously, if the latter is the case, then the subspecies is in *Anartia* a descriptive fallacy the arbitrary boundaries of which may describe the variation of one or a few characters but cut across the variation of others.

CHARACTERS

All the characters studied except one are wing-pattern characters. The exception is forewing length, as measured from base to apex with a vernier caliper or millimeter rule. Variation in other characters is

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broken down into several categories to which individual specimens can easily be classed by eye. One character is the color of the three most apical pairs of submarginal-marginal spots on the upper side of the forewings. These spots may be orange or white. A second character is the degree of fusion between the component spots of each of these pairs. The first pair (A) lies between R_3 and R_4, the second (B) between R_4 and R_5, and the third (C) between R_5 and M_1. Another character classed for the left forewing is the presence, indication, or absence of a small black ocellar spot located between M_2 and M_3 near the submarginal row of spots. The last character considered is the color of the reticulate pattern on the under side of the hind wings (classed for the right hind wing). This may be red, red-brown, or brown.

Three of the characters dealt with are the same as those used by Munroe. These are size, color of the marginal-submarginal spots, and color of the reticulate pattern ("transverse line" color of Munroe). The characters that he does not mention are the presence or absence of a spot between M_2 and M_3, and the fusion of the marginal-submarginal spots. Munroe also uses other characters in his diagnoses which are not dealt with here. However, these diagnoses are of a descriptive nature and emphasize differences between populations. They do not treat the total geographic variation of each character individually. Thus it is impossible to determine the degree of concordance between characters from his paper.

SEXUAL DIMORPHISM

Males and females are dimorphic in some degree for most of the characters studied. They are noticeably dimorphic in size (table 1), fusion of spot pairs A, B, and C (table 2, fig. 2), and the presence or absence of the spot between M_2 and M_3 on the upper side of the left forewing

TABLE 1

LENGTH (IN MILLIMETERS) OF THE LEFT FOREWING

Population	*N*	*M*	*R*	$2S.E._m$	*S.D.*
MALES					
Florida					
Winter	22	24.9	20.8–27.9	0.68	1.59
Summer	20	26.4	23.2–28.4	0.66	1.50
Cuba					
Winter	36	25.6	22.9–27.8	0.42	1.24
Summer	29	26.8	24.1–28.9	0.46	1.25

TABLE 1 — (*Continued*)

Population	*N*	*M*	*R*	$2S.E._m$	*S.D.*
Jamaica, winter	55	26.3	23.9–29.0	0.28	1.02
Hispaniola					
Winter	29	26.6	16.4–28.6	0.86	2.30
Summer	48	28.6	24.3–31.8	0.42	1.44
Puerto Rico					
Winter	18	26.4	24.2–29.0	0.56	1.17
Summer	11	26.7	25.0–28.0	0.52	0.86
St. Croix					
Winter	4	25.8	23.6–27.2	1.58	1.59
Summer	7	27.2	25.7–28.6	0.78	1.02
St. Thomas, winter	10	24.3	23.5–25.9	0.56	0.90
Dominica					
Winter	17	27.9	25.9–29.5	0.52	1.10
Summer	17	28.6	26.5–30.9	0.68	1.94
British Guiana					
Winter	4	27.9	25.1–29.4	1.96	1.97
Summer	6	29.4	25.8–31.9	1.80	2.16
Colombia, winter	10	27.6	26.7–28.7	0.42	0.68
Panama, winter	20	29.0	26.0–31.2	0.64	1.43
Central America					
Winter	9	27.7	24.9–30.0	1.14	1.72
Summer	17	27.4	25.3–29.2	0.50	1.03
Mexico					
Winter	9	27.7	22.9–28.6	1.14	1.72
Summer	17	27.4	24.5–31.2	0.50	1.03
FEMALES					
Florida					
Winter	9	27.4	23.7–29.9	1.34	2.02
Summer	24	29.4	27.2–33.0	0.70	1.73
Cuba					
Winter	18	28.9	24.6–33.2	0.98	2.05
Summer	19	29.4	25.3–30.8	0.60	1.34
Jamaica, winter	14	29.0	26.4–31.8	0.80	1.48
Hispaniola					
Winter	9	30.4	27.8–32.8	0.96	1.45
Summer	18	31.9	27.8–36.2	0.92	1.95
St. Thomas and Tortola, winter	5	27.6	25.1–30.9	2.06	2.30
Puerto Rico, lumped	7	28.9	27.4–30.6	1.06	1.41
Dominica, winter	9	31.3	29.3–32.2	0.60	0.89
British Guiana, lumped	11	31.4	28.7–36.2	1.44	2.39
Colombia, lumped	19	30.4	24.4–34.0	0.98	2.12
Panama, winter	5	30.5	28.4–31.4	1.12	1.26
Honduras, summer	6	29.9	27.0–31.4	1.42	1.73

TABLE 1 — (*Continued*)

Populatiom	*N*	*M*	*R*	$2S.E._m$	*S.D.*
Mexico					
Winter	6	28.3	26.1–32.0	1.88	2.30
Lumped	20	31.3	26.1–35.0	1.30	2.90

N, number.
M, mean.
R, range of variation of the sample.
$2S.E._m$, twice the standard error of the mean.
S.D., standard deviation.

(table 4, fig. 3). This dimorphism shows uncorrelated variation among the three characters concerned. The Mexican series, for example, is strongly dimorphic for forewing length (table 1), but is only very slightly dimorphic for spot-pair fusion (table 2, fig. 2). On the other hand, sexual dimorphism for spot-pair fusion is very great in samples from the Greater Antilles, but the forewings are only slightly dimorphic. It becomes evident, therefore, that in the characters studied sexual dimorphism occurs only in terms of the separate characters.

SEASONAL VARIATION

Size and the color of the reticulate pattern are both markedly variable from winter to summer. Males and females taken in summer are larger than those collected in the winter (table 1, fig. 1), and summer males have a redder pattern on the under sides of the hind wings than winter males (table 3, fig. 4). A similar seasonal coloration trend cannot be established for the females, however, because of scarcity of data.

Spot fusion in the males also shows a seasonal trend, but this trend does not affect the geographic variation of this character in any marked way. It is also of interest that seasonal change does not appear to effect the variation in color of spot pairs A, B, and C, or the presence or absence of the ocellus between M_2 and M_3 on the upper side of the left forewing.

The environmental basis of the seasonal variation is not clear. It cannot be clearly correlated with either the warm-cool cycle in Florida or the wet-dry cycle of many of the tropical areas.

GEOGRAPHIC VARIATION

MALES: The color of spot pairs A, B, and C shows a similar pattern

of variation (table 5, fig. 5). From Florida south through Puerto Rico these spot pairs are almost always orange. On St. Thomas, pairs A and B continue to remain orange, but in the case of pair C five out of the 11 males examined had the inner member of the pair white. In samples from St. Croix, and southward through the Lesser Antilles, and in

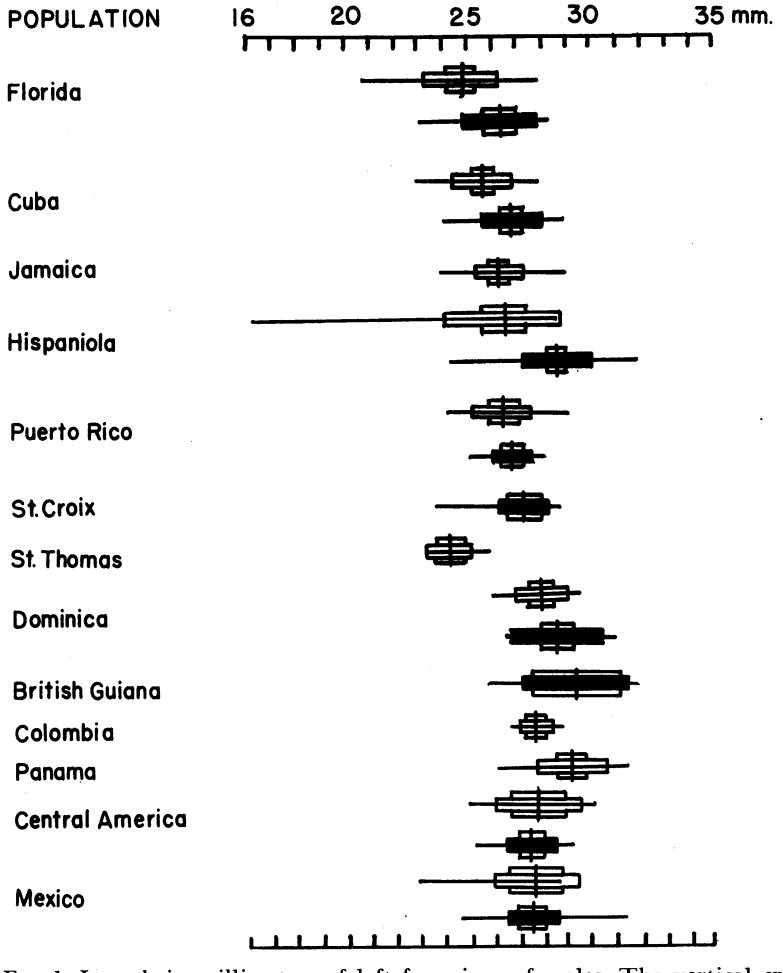

FIG. 1. Length in millimeters of left forewings of males. The vertical cross line indicates the mean of the sample studied; the elongate rectangle, one standard deviation on each side of the mean; the small rectangle, twice the standard error on each side of the mean; and the horizontal line, the full range of variation of the population. In summer samples the standard deviation is a solid rectangle; in winter samples it is hollow.

TABLE 2

AMOUNT OF SPOT-PAIR FUSSION IN DIFFERENT POPULATIONS OF *Anartia jatrophae* EXPRESSED AS A PERCENTAGE

Population		UF[a]	PF[b]	FC[c]	AO[d]	*N*
PAIR A						
Florida	♂	97.8	2.2	0.0	0.0	45
	♀	100.0	0.0	0.0	0.0	34
Cuba	♂	72.3	23.1	4.6	0.0	65
	♀	100.0	0.0	0.0	0.0	37
Jamaica	♂	73.2	14.1	12.7	0.0	71
	♀	90.0	5.0	5.0	0.0	20
Hispaniola	♂	57.0	23.8	18.2	0.0	88
	♀	100.0	0.0	0.0	0.0	30
Puerto Rico	♂	63.3	16.7	20.0	0.0	30
	♀	100.0	0.0	0.0	0.0	6
St. Thomas and	♂	54.6	45.4	0.0	0.0	11
Tortola	♀	80.0	0.0	20.0	0.0	5
St. Croix	♂	81.0	19.0	0.0	0.0	10
	♀	100.0	0.0	0.0	0.0	5
Guadeloupe	♂	100.0	0.0	0.0	0.0	9
	♀	100.0	0.0	0.0	0.0	5
Martinique	♂	91.6	8.4	0.0	0.0	12
Dominica	♂	97.1	2.9	0.0	0.0	34
	♀	100.0	0.0	0.0	0.0	13
British Guiana	♂	96.8	3.2	0.0	0.0	32
	♀	100.0	0.0	0.0	0.0	12
Colombia	♂	87.0	4.3	0.0	8.7	23
	♀	81.0	0.0	0.0	19.0	21
Panama	♂	100.0	0.0	0.0	0.0	23
	♀	100.0	0.0	0.0	0.0	5
Costa Rica	♂	66.7	0.0	0.0	33.3	9
Honduras	♂	94.1	0.0	0.0	5.9	17
	♀	100.0	0.0	0.0	0.0	8
Mexico	♂	65.8	0.0	0.0	34.2	41
	♀	70.0	0.0	0.0	30.0	20
PAIR B						
Florida	♂	95.6	2.7	2.7	0.0	45
	♀	100.0	0.0	0.0	0.0	35
Cuba	♂	36.8	40.0	23.2	0.0	65
	♀	100.0	0.0	0.0	0.0	37
Jamaica	♂	26.1	29.0	44.9	0.0	69
	♀	100.0	0.0	0.0	0.0	20
Hispaniola	♂	19.5	24.1	57.4	0.0	87
	♀	89.3	10.7	0.0	0.0	28
Puerto Rico	♂	30.0	20.0	50.0	0.0	30
	♀	100.0	0.0	0.0	0.0	6

TABLE 2 — (*Continued*)

Population		UF	PF	FF	AO	*N*
St. Thomas and	♂	27.3	27.3	45.4	0.0	11
Tortola	♀	100.0	0.0	0.0	0.0	5
St. Croix	♂	72.8	27.2	0.0	0.0	11
	♀	100.0	0.0	0.0	0.0	5
Guadeloupe	♂	77.8	22.2	0.0	0.0	9
	♀	100.0	0.0	0.0	0.0	5
Martinique	♂	66.7	25.0	8.3	0.0	12
Dominica	♂	82.4	14.7	2.9	0.0	34
	♀	100.0	0.0	0.0	0.0	14
British Guiana	♂	84.4	15.6	0.0	0.0	32
	♀	91.7	8.3	0.0	0.0	12
Colombia	♂	91.0	0.0	4.5	4.5	22
	♀	81.0	0.0	0.0	19.0	21
Panama	♂	95.7	4.3	0.0	0.0	23
	♀	100.0	0.0	0.0	0.0	6
Costa Rica	♂	55.6	11.1	11.1	22.2	9
Honduras	♂	82.3	16.7	0.0	0.0	17
	♀	100.0	0.0	0.0	0.0	8
Mexico	♂	58.5	17.2	2.4	21.9	41
	♀	75.0	5.0	0.0	20.0	20
PAIR C						
Florida	♂	93.4	4.4	2.2	0.0	45
	♀	100.0	0.0	0.0	0.0	35
Cuba	♂	72.3	23.1	4.6	0.0	65
	♀	100.0	0.0	0.0	0.0	37
Jamaica	♂	53.7	31.8	14.5	0.0	69
	♀	95.0	5.0	0.0	0.0	20
Hispaniola	♂	43.2	29.6	27.2	0.0	88
	♀	96.4	3.6	0.0	0.0	28
Puerto Rico	♂	60.0	30.0	10.0	0.0	30
	♀	100.0	0.0	0.0	0.0	6
St. Thomas and	♂	45.5	54.5	0.0	0.0	11
Tortola	♀	100.0	0.0	0.0	0.0	5
St. Croix	♂	72.7	0.0	27.3	0.0	11
	♀	100.0	0.0	0.0	0.0	5
Guadeloupe	♂	100.0	0.0	0.0	0.0	9
	♀	100.0	0.0	0.0	0.0	5
Martinique	♂	100.0	0.0	0.0	0.0	12
Dominica	♂	94.1	5.9	0.0	0.0	34
	♀	100.0	0.0	0.0	0.0	14
British Guiana	♂	100.0	0.0	0.0	0.0	32
	♀	100.0	0.0	0.0	0.0	13
Colombia	♂	100.0	0.0	0.0	0.0	23
	♀	100.0	0.0	0.0	0.0	20

TABLE 2 — (*Continued*)

Population		UF	PF	FF	AO	*N*
Panama	♂	100.0	0.0	0.0	0.0	23
	♀	100.0	0.0	0.0	0.0	5
Costa Rica	♂	100.0	0.0	0.0	0.0	9
Honduras	♂	100.0	0.0	0.0	0.0	17
	♀	100.0	0.0	0.0	0.0	8
Mexico	♂	92.7	4.9	0.0	2.4	41
	♀	100.0	0.0	0.0	0.0	20

[a] UF, unfused.
[b] PF, partly fused.
[c] FF, fully fused.
[d] AO, percentage of individuals with outer spot of a pair absent.

northern South America, Central America, and Mexico the inner member is usually white. In fact, in certain of these populations some individuals have both members of a particular pair white. The extreme in this condition is found among Mexican males 37 per cent of which have both members of pair A white and 56 per cent have both members of pair C white. Spot color is difficult to assess in some South American and Central American specimens, as the outer spot of a pair may become so heavily suffused with melanic scales that it is nearly obliterated. This trend shows its greatest expression in Mexico where the outer spot of pair A is absent over 30 per cent of the time (table 2).

Geographic variation in spot-pair fusion is markedly different from the variation exhibited by color (table 2, fig. 2). All three pairs are almost always separated in Florida, often fused in Cuba, and frequently fused in Jamaica, Hispaniola, and Puerto Rico. Fusion is less apparent in the Virgin Islands, and rare in the Lesser Antilles, northern South America, Central America, and Mexico.

Size (table 1, fig. 1) is a clinal character which increases from Florida south through the Antilles to northern South America. This is generally true of both winter and summer series. The cline is not entirely smooth, however, and noticeable interruptions in trend are found between Hispaniola and the island of Dominica, and also in Panama.

In males, the spot between M_2 and M_3 is rarely fully developed, although a trace of it is often seen. North of St. Croix, even a trace is rare (table 4, fig. 3), but south of there, and in Central America and Mexico, the spot is often partially developed. It is particularly frequent in samples from Martinique, Guadeloupe, and Mexico.

The color of the reticulate pattern on the under side of the hind wing, a seasonal as well as geographically variable character, demonstrates a type of variation reminiscent of the kind seen in the color of spot pairs A, B, and C. In both summer and winter series from Florida south through St. Thomas, the majority of specimens have a red pattern, with red-browns less frequent and browns rare. South of St. Thomas, and also in Central America and Mexico, red-browns become much more common in both summer and winter series. In northern South American samples they form the dominant category. Brown patterns also become much more common and are particularly frequent in St. Croix winter specimens, and in specimens of the island of Dominica summer series, the Panama winter series, and both summer and winter series from Central America.

FEMALES: Unfortunately, many fewer females than males were available for this study. Therefore, the following consideration is necessarily more limited than in the case of the males.

The color of spot pairs A and B (table 5, fig. 5) is orange from Florida south through Puerto Rico. On St. Thomas and Tortola four out of the five specimens examined had the inner spot of each pair white and the outer orange. In the case of pair C both members were orange in all five cases. On St. Croix all three pairs possessed two orange members in two cases, one white and one orange in two cases, and both white in one case. Thus in the Virgin Islands color variation is not correlated between sexes. St. Thomas males have both members of pairs A and B orange, while the inner member of pair C is often white. The opposite is true in St. Thomas females, although more specimens of both sexes are needed to confirm this definitely. In samples from the Lesser Antilles, northern South America, and Central America, the inner member of pairs A and B is generally white and the outer orange. In the island of Dominica and particularly Mexico, a high percentage of specimens have both members of these pairs white. Spot pair C shows a similar type of variation, but both members are more often white than in the other two pairs (samples from Guadeloupe, the island of Dominica, and Mexico are notable in this respect). In general, color variation in the females approximates that in the males, with the exceptions of the St. Thomas and the island of Dominica populations.

Spot fusion is very rare among females in all three pairs. As already mentioned the sexes are strongly dimorphic for this character.

An ocellus between M_2 and M_3 is much more frequently present in females than in males, but there is a great deal of variation from popu-

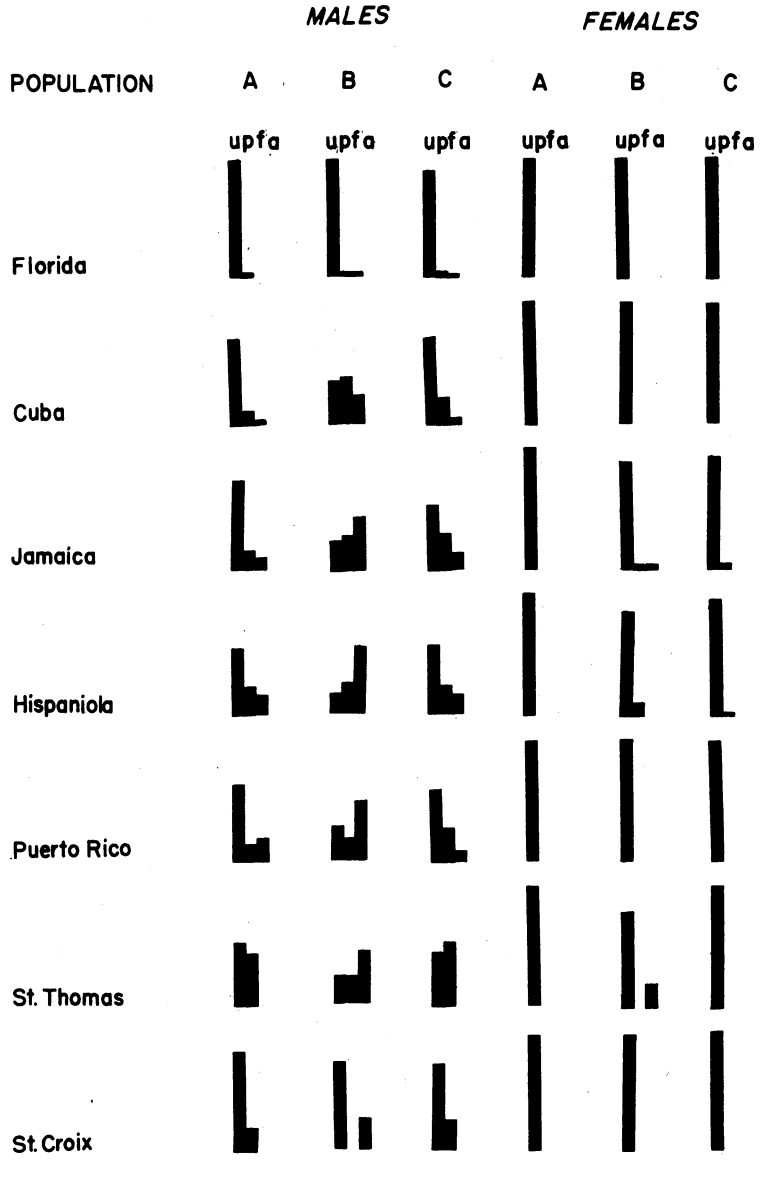

FIG. 2 (*continued on next page*). Variation in apical-spot fusion on the upper side of the left forewing. Histograms are placed on a percentage scale. A, B, and C indicate spot pairs A, B, and C, respectively. *Symbols:* u, no fusion; p, partial fusion; f, full fusion; a, outer spot absent.

lation to population (table 4, fig. 3). Samples from Florida, Cuba, and Jamaica are similar in that specimens are generally fully spotted or unspotted in roughly equal numbers. Occasionally, specimens showing

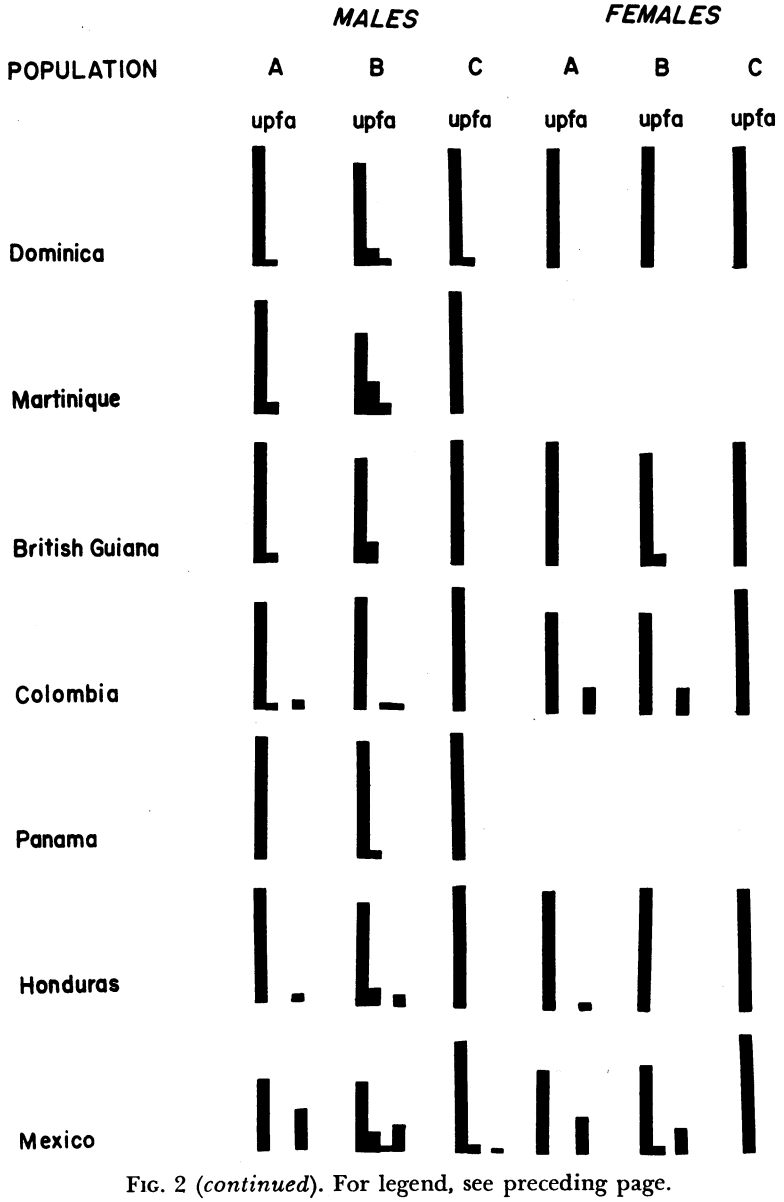

FIG. 2 (*continued*). For legend, see preceding page.

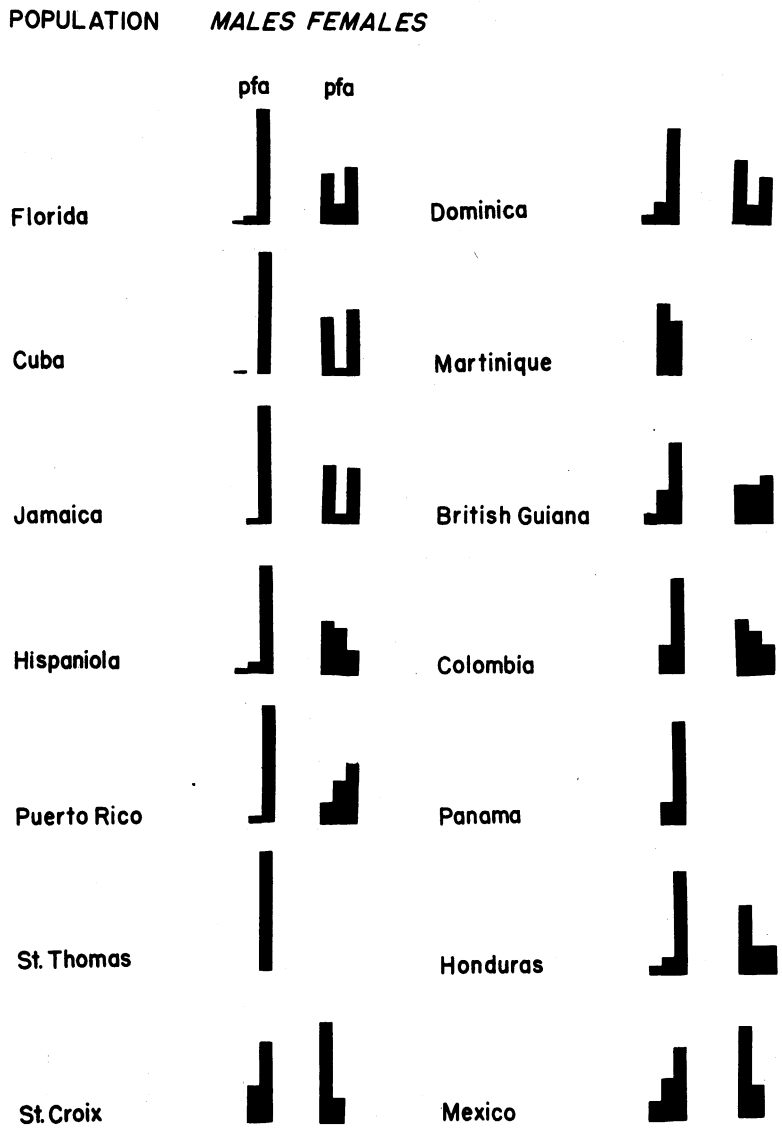

FIG. 3. Presence or absence of a spot between M_2 and M_3 on the upper side of the left forewing. Histograms are placed on a percentage scale. *Symbols:* p, spot well defined; f, spot faintly defined; a, spot absent.

only an indication of a spot do occur, and this condition is much more frequent in other populations. On Hispaniola completely unspotted females are rare, but on Puerto Rico they appear to be common. Variation in the Guadeloupe and the island of Dominica samples is similar to the kind seen in the samples from Florida, Cuba, and Jamaica. A trend towards greater frequency of spotting can be seen in the histograms (fig. 3) as one moves northward from British Guiana and Colombia through Honduras to Mexico.

The available data for size variation (table 1) are not satisfactory. What few data are available indicate that a cline similar to that found in the males occurs in the winter females. Data on summer females are too scanty to allow proper evaluation.

TABLE 3

COLOR OF THE RETICULATE PATTERN ON THE UNDER SIDE OF THE RIGHT HIND WING EXPRESSED AS A PERCENTAGE

Population	Winter				Summer			
	Red	Red-Brown	Brown	*N*	Red	Red-Brown	Brown	*N*
MALES								
Florida	60.7	28.6	10.7	28	84.6	25.4	0.0	13
Cuba	66.7	19.4	13.9	36	79.3	10.3	10.3	29
Jamaica	66.0	30.2	3.8	53	—	—	—	—
Hispaniola	58.6	31.0	10.4	29	81.8	11.4	6.8	44
Puerto Rico	72.2	22.2	5.6	18	81.7	0.0	18.3	11
St. Thomas	70.0	30.0	0.0	10	—	—	—	—
St. Croix	25.0	0.0	75.0	4	57.2	0.0	42.8	7
Guadeloupe	25.0	0.0	75.0	4	40.0	0.0	60.0	5
Dominica	46.1	38.5	15.4	13	21.4	42.8	35.8	14
British Guiana	0.0	75.0	25.0	4	42.8	57.2	0.0	7
Colombia	10.0	70.0	20.0	10	0.0	100.0	0.0	2
Panama	30.0	40.0	30.0	20	—	—	—	—
Central America	50.0	0.0	50.0	6	55.6	11.1	33.3	18
Mexico	38.9	44.4	16.7	18	37.5	37.5	25.0	8
FEMALES								
Florida	0.0	66.6	33.3	9	17.2	65.6	17.2	29
Cuba	16.7	55.5	27.8	18	5.3	63.1	31.6	19
Jamaica	14.3	85.7	0.0	14	—	—	—	—
Hispaniola	50.0	37.5	12.5	8	33.3	55.5	11.2	18
Dominica	0.0	100.0	0.0	9	0.0	100.0	0.0	5
Panama	0.0	20.0	80.0	5	—	—	—	—
Central America	14.3	42.8	42.8	7	—	—	—	—
Mexico	0.0	100.0	0.0	6	0.0	75.0	25.0	4

The color of the reticulate pattern in winter females (fig. 4) shows a cline of increasing redness from Florida south to Hispaniola. South of this island the available winter series become browner again. A second cline is suggested among winter specimens from Central America. In this case redness increases from Panama north to Mexico, as contrasted with the Antillean cline. The variation picture in summer specimens is very unclear because of the paucity of samples. If there is a north-

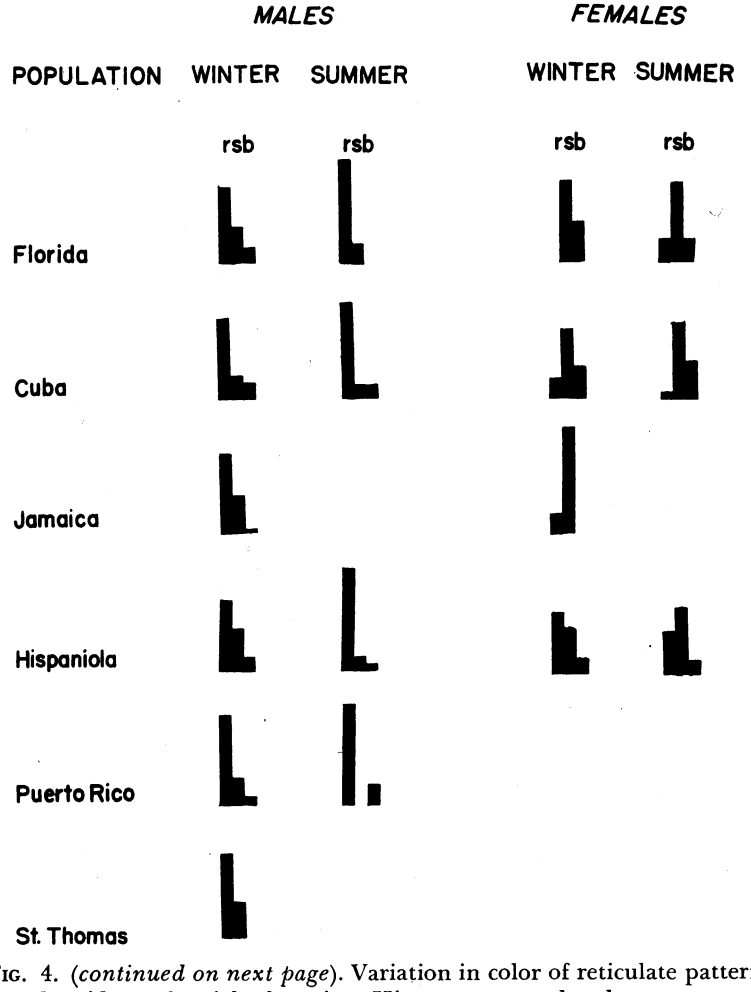

FIG. 4. (*continued on next page*). Variation in color of reticulate pattern on the under side of the right forewing. Histograms are placed on a percentage scale. *Symbols:* r, red color pattern; s, red-brown color pattern; b, brown color pattern.

south cline for redness in Antillean summer females, it is not clearly defined in these data.

DISCUSSION

It is evident that the characters studied may be subject to seasonal, sexual, and geographical variation, or a combination of these. The

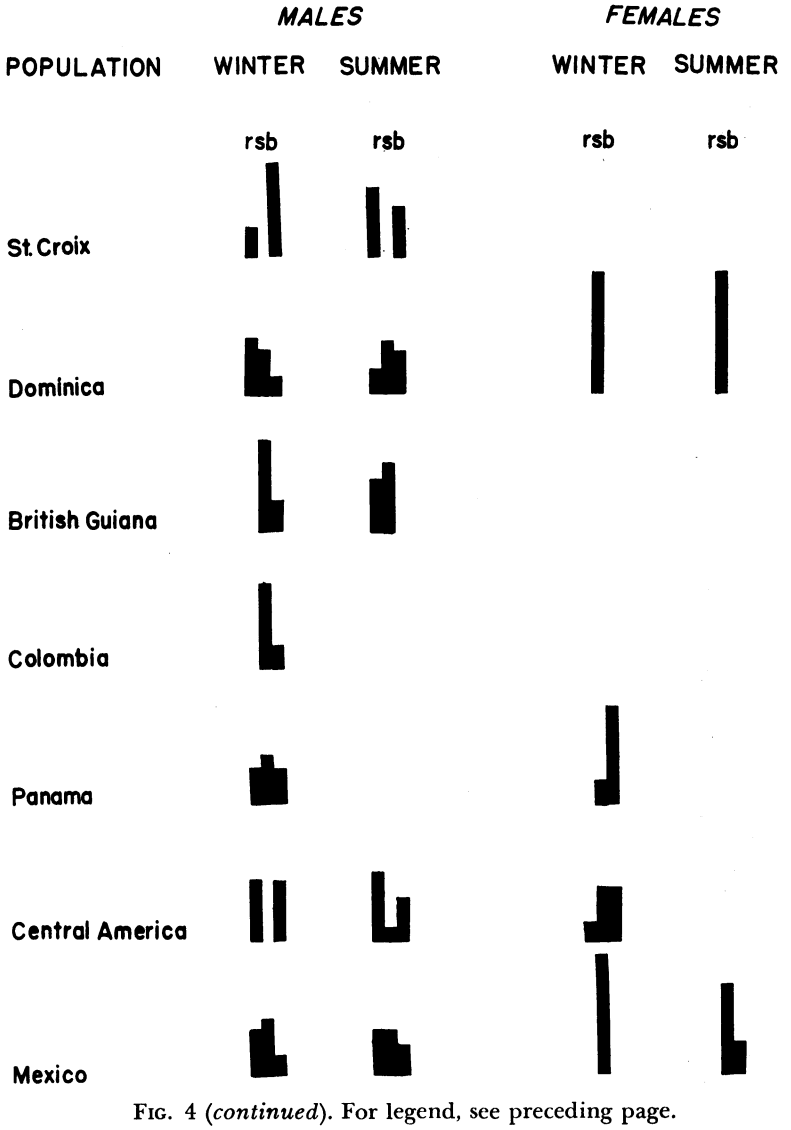

FIG. 4 (*continued*). For legend, see preceding page.

third type is the most important for the purposes of the present paper, because in present-day taxonomy it is variation of this type that is considered to produce subspecies. However, the characters subject to the other two types of variation may also show geographic variation.

It would be repetitious to discuss variation in the different characters further. It should be sufficient to point out that a number of different groupings of populations could be developed for practically every one.

TABLE 4

PRESENCE OR ABSENCE OF THE SPOT BETWEEN M_2 AND M_3 ON THE UPPER SIDE OF THE LEFT FOREWING EXPRESSED AS A PERCENTAGE

Population	Present	Present but Faint	Absent	*N*
MALES				
Florida	2.2	4.5	93.3	45
Cuba	1.5	0.0	98.5	65
Jamaica	0.0	4.4	95.6	68
Hispaniola	4.6	8.0	87.4	87
Puerto Rico	0.0	6.7	93.3	30
St. Thomas	0.0	0.0	100.0	11
St. Croix	0.0	30.0	70.0	10
Gaudeloupe	22.2	0.0	77.8	9
Dominica	6.2	18.8	75.0	32
Martinique	0.0	54.6	45.4	11
British Guiana	9.4	25.0	65.6	32
Colombia	0.0	22.7	77.3	22
Panama	0.0	17.4	82.6	23
Costa Rica	0.0	0.0	100.0	8
Honduras	5.9	11.7	82.4	17
Mexico	12.4	31.6	56.0	41
FEMALES				
Florida	40.0	4.5	45.7	35
Cuba	44.4	2.8	52.8	36
Jamaica	47.6	9.5	42.9	21
Hispaniola	41.3	38.0	20.7	29
Puerto Rico	16.7	33.3	50.0	6
St. Croix	80.0	20.0	0.0	5
Guadeloupe	40.0	20.0	40.0	5
Dominica	50.0	14.3	35.7	14
British Guiana	30.8	30.8	38.4	13
Colombia	42.9	33.3	23.8	21
Panama	33.3	33.3	33.3	6
Honduras	55.6	22.2	22.2	9
Mexico	75.0	15.0	10.0	20

TABLE 5

SPOT-PAIR COLORS IN DIFFERENT POPULATIONS OF *Anartia jatrophae* EXPRESSED AS PERCENTAGES

Population		Pair A				Pair B				Pair C			
		A[a]	B[b]	C[c]	*N*	A	B	C	*N*	A	B	C	*N*
Florida	♂	97.8	2.2	0.0	45	95.6	5.4	0.0	45	91.2	8.8	0.0	45
	♀	100.0	0.0	0.0	34	100.0	0.0	0.0	35	100.0	0.0	0.0	35
Cuba	♂	100.0	0.0	0.0	65	100.0	0.0	0.0	65	100.0	0.0	0.0	65
	♀	100.0	0.0	0.0	37	100.0	0.0	0.0	37	100.0	0.0	0.0	37
Jamaica	♂	100.0	0.0	0.0	71	100.0	0.0	0.0	69	98.5	1.5	0.0	69
	♀	100.0	0.0	0.0	20	100.0	0.0	0.0	20	100.0	0.0	0.0	20
Hispaniola	♂	100.0	0.0	0.0	86	100.0	0.0	0.0	86	100.0	0.0	0.0	86
	♀	100.0	0.0	0.0	30	100.0	0.0	0.0	28	100.0	0.0	0.0	28
Puerto Rico	♂	89.3	10.7	0.0	28	89.3	11.7	0.0	28	85.7	14.3	0.0	28
	♀	100.0	0.0	0.0	6	100.0	0.0	0.0	6	100.0	0.0	0.0	6
St. Thomas and Tortola	♂	91.0	9.0	0.0	11	91.0	9.0	0.0	11	54.5	45.5	0.0	11
	♀	20.0	80.0	0.0	5	20.0	80.0	0.0	5	0.0	100.0	0.0	5
St. Croix	♂	30.0	70.0	0.0	10	30.0	70.0	0.0	10	18.2	72.2	9.1	11
	♀	40.0	40.0	20.0	5	40.0	40.0	20.0	5	40.0	40.0	20.0	5
Guadeloupe	♂	11.1	89.9	0.0	9	0.0	100.0	0.0	9	0.0	88.9	11.1	9
Dominica	♂	0.0	100.0	0.0	34	0.0	94.1	5.9	34	0.0	73.6	26.4	34
	♀	0.0	46.2	53.8	13	0.0	50.0	50.0	14	0.0	28.6	71.4	14

TABLE 5—(*Continued*)

Population		Pair A				Pair B				Pair C			
		A	B	C	*N*	A	B	C	*N*	A	B	C	*N*
Martinique	♂	0.0	100.0	0.0	12	0.0	100.0	0.0	12	0.0	100.0	0.0	12
British Guiana	♂	12.5	87.5	0.0	32	9.4	90.6	0.0	32	0.0	100.0	0.0	31
	♀	0.0	100.0	0.0	12	0.0	100.0	0.0	12	0.0	100.0	0.0	12
Colombia	♂	0.0	100.0	0.0	20	0.0	90.0	10.0	20	0.0	91.0	9.0	22
	♀	5.9	88.2	5.9	17	5.9	82.3	11.8	17	5.0	75.0	25.0	20
Panama	♂	0.0	91.3	8.7	23	0.0	91.3	8.7	23	0.0	91.3	8.7	23
	♀	0.0	20.0	80.0	5	0.0	33.3	66.7	6	0.0	20.0	80.0	5
Honduras	♂	18.8	75.0	6.2	16	25.0	62.5	12.5	16	11.8	64.7	23.5	17
	♀	0.0	75.0	25.0	8	0.0	75.0	25.0	8	0.0	62.5	37.5	8
Mexico	♂	0.0	63.0	37.0	27	0.0	58.1	41.9	31	0.0	35.0	65.0	40
	♀	0.0	7.1	92.9	14	0.0	12.5	87.5	16	0.0	5.0	95.0	20

[a] Both spots orange.
[b] Outer spot orange and inner spot white.
[c] Both spots white.

Size, for example, is clinal and, with the exception of the small males and females from St. Thomas, no clear-cut differences are present from population to population. On the other hand, three separate groups of populations could be recognized on the basis of coloration of the apical spot in the males. One of these extends from Florida to the Virgin Islands, the second is the Mexican population, and the third includes all the other populations studied. In the case of spot-pair fusion in the males, still other population alignments could be made. In short, any designation of subspecies among Caribbean populations of *Anartia jatrophae* is bound to cut across the variation of several of the characters considered. Because of this it seems that the previously described subspecies of this species do not really properly describe the geographic variation of this species. I therefore propose the following synonymy for *A. jatrophae.*

Anartia jatrophae (Johansson)

Papilio jatrophae JOHANSSON, 1763, Centuria insectorum, amoenitates academicae, Stockholm, vol. 6, p. 408. Type locality: Surinam, by selection of Munroe (1942).

Anartia jatrophae var. *saturata* STAUDINGER, 1884, Exotische Tagfalter, vol. 1, p. 105, pl. 39. Type locality: Port au Prince, Haiti, by selection of Munroe (1942). New synonymy.

Anartia jatrophae var. *jamaicensis* MÖSCHLER, 1886, Abhandl. Senckenbergische Naturfor. Gesell. Frankfurt, vol. 14, p. 27. Type locality: Jamaica. New synonymy.

Anartia jatrophae luteopicta FRUHSTORFER, 1907, Int. Ent. Zeitschr. Guben, vol. 1, p. 112. Type locality: Honduras. New synonymy.

Anartia jatrophae guantanamo MUNROE, 1942, Amer. Mus. Novitates, no. 1179, p. 2. Type locality: San Carlos Estate, Guantanamo, Oriente, Cuba. New synonymy.

Anartia jatrophae semifusca MUNROE, 1942, Amer. Mus. Novitates, No. 1179, p. 3. Type locality: San Juan, Puerto Rico. New synonymy.

Anartia jatrophae intermedia MUNROE, 1942, Amer. Mus. Novitates, no. 1179, p. 4. Type locality: St. Croix, Virgin Islands. New synonymy.

Independent variation of different characters is, of course, not a property of this species alone. Wilson and Brown (1954) and Gillham (1956) give examples of this which apply to a number of animal groups. Probably the most important reason why discordant variation has not been widely recognized before is the fact that few people have actually tried to make unbiased character-by-character analyses of infraspecific variation. The emphasis has instead fallen on the utilization of this variation for the proliferation of subspecific and varietal names. These serve only to describe the variation of the characters considered

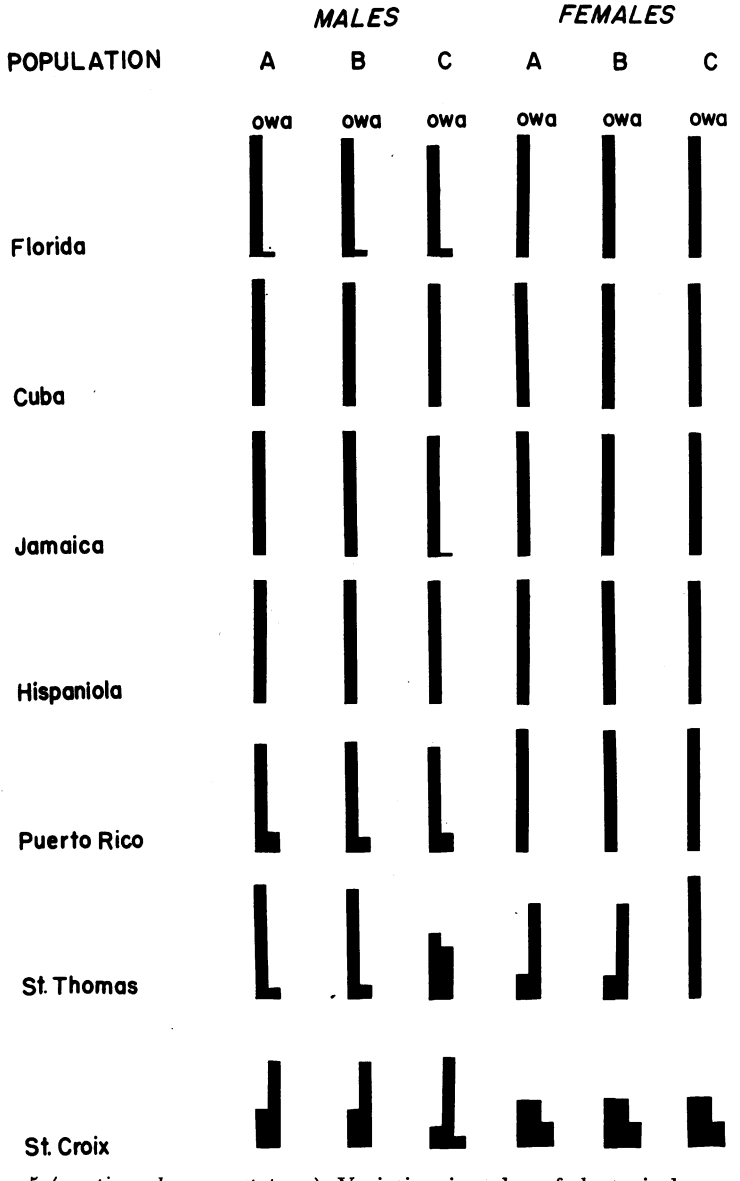

FIG. 5 (*continued on next page*). Variation in color of the apical-spot pairs on the upper side of the left forewing. Histograms are placed on a percentage scale. A, B, and C indicate spot pairs A, B, and C, respectively. *Symbols:* o, both spots orange; w, outer spot orange and inner one white; a, both spots white.

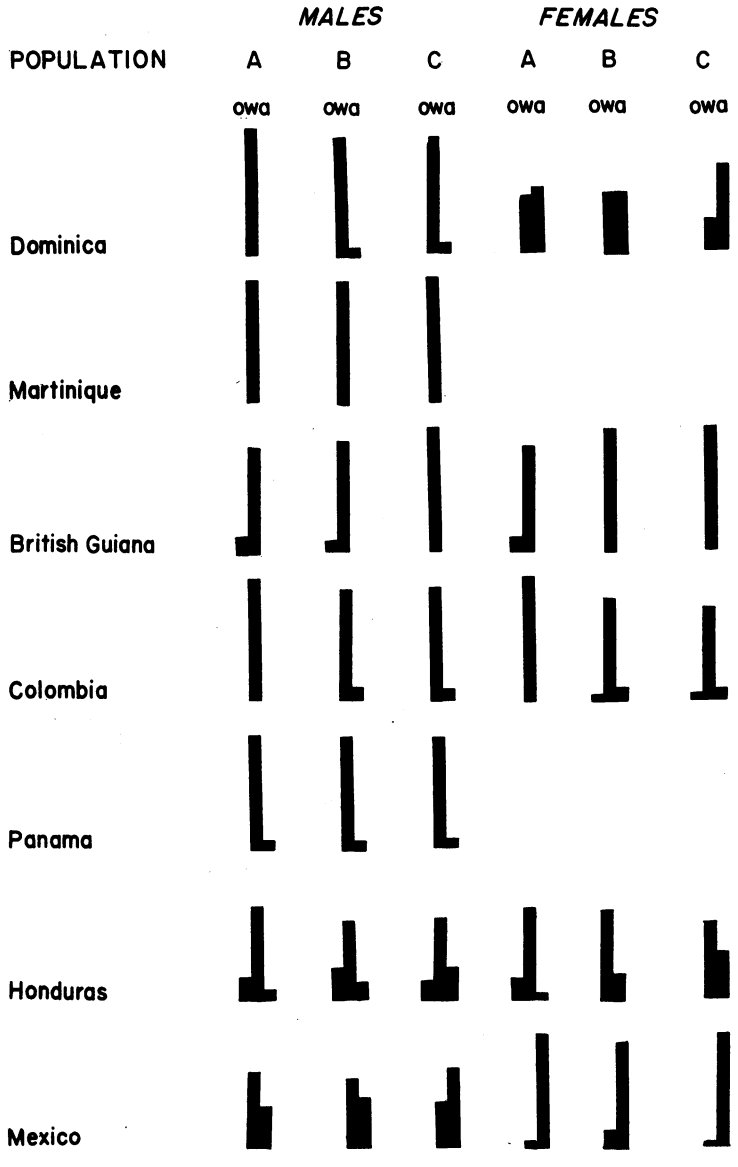

FIG. 5 (*continued*). For legend, see preceding page.

within arbitrarily defined geographical limits. Thus, natural variation is biased by man-made boundaries, and it cannot be said, at least in many groups, that subspecies describe geographic variation adequately.

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