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VARIAION IN *EUREMA DAIRA* (LEPIDOPTERA: PIERIDAE) AND THE STATUS OF *PALMIRA* IN SOUTHERN FLORIDA¹

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ABSTRACT

The pierid *Eurema daira palmira* has frequently been reported from south Florida. After examination of over 350 specimens of *E. daira daira* we conclude that most, if not all, purported Floridian *palmira* fall within the normal range of variation of *daira*. *Eurema daira daira* is sexually dimorphic and seasonally polymorphic. The males show a balanced polymorphism in both seasonal forms, ca. 7 per cent having white hindwings above, others varying continuously to match the yellow forewing. Females in which the ground color is white on both wings above (a characteristic of true *palmira*) were never found. All so-called hybrids between the two subspecies may also be accounted for within the range of variation of south Florida *daira daira*. The intermediate seasonal variety *delioides* we regard as coming within the range of dry season form *daira*.

INTRODUCTION

The small pierid *Eurema diara* (Godart), in its nominate subspecies, is widespread in the eastern United States. Klots (1951) gave the range as Florida north to Virginia and west through Mississippi and Arkansas to Louisiana and, rarely, to Texas. It also occurs on Andros and New Providence, Bahamas (Leston and Smith, 1980). The more familiar forms are the so-called winter (or dry season) f. "*daira*" and the summer (or wet season) f. "*jucunda*" (Table 1). In both sexes, the hindwing beneath is tan-pale brown in f. "*daira*" (Fig. 2) and white in f. "*jucunda*" (Fig. 1).

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An intermediate, f. "delioides," was named by Haskin (1933) from spring and fall populations but recent practice, for example Howe (1975), has been to disregard this morph though Harris (1972) retains all three forms in his study of the species in Georgia. In all three both fore- and hindwings above are yellow in ground color with black or dark brown marginal markings and a dark brown to black posterior forewing bar, much reduced in females especially in f. "daira."

Another butterfly, *E. daira palmira* (Poey), occurs in the Exuma Cays, Bahamas (Rindge, 1955), Cuba, Jamaica, Hispaniola and Puerto Rico as well as the Lesser Antilles down to Grenada and Barbados (Riley, 1975). This insect also exhibits apparently seasonal variation in hindwing coloration: f. "palmira" and f. "ebriola" occurring respectively in the summer (wet season) and winter (dry season). However, the ground color is markedly different from that of *daira daira*: both fore- and hindwings are white in females while in males the forewings are yellow and the hindwings white (Figs. 3-6; Table 1). Klots (1951) and others have never doubted the conspecificity of *daira* (*sensu stricto*) and *palmira*.

Kimball (1965) lists a few records of *palmira* from southern Florida including specimens from both Dade County and the Keys (Monroe County), from 1933 onwards. Of these, Klots determined one captured in March 1954 as *palmira* f. "ebriola." Earlier, Klots (1951) had concluded that *palmira* was "rare and spasmodic in southern Florida (Miami area and Keys, July)." These identifications raised the possibility that two subspecies of *E. daira* overlap in the extreme south of Florida, though with *daira* far more common than *palmira*.

Clench (1970) compared Cuban and United States specimens of the complex and, in finding both ssp. *daira* and ssp. *palmira* together at Chokoloskee, Collier County, in December 1967, concluded: "The possibility that *daira* and *palmira* are specifically distinct is suggested with no evidence of interbreeding...." But he hedged: "The conventional view, that *palmira* is only a subspecies of *daira*, is still possible." As for possible hybridization, Howe (1975; Pl. 72, Fig. 15) shows a purported hybrid female from Key Largo and mentions the capture of "many intermediates."

The present study stems from our finding *palmira*-like individuals to be far from rare in Dade County and aims to throw light upon the questions raised by Clench and the apparent anomaly of two subspecies of *daira* being sympatric. We have considered details of coloration in Antillean *palmira*, color variation in S. Florida *daira* populations and have also considered seasonal variability.

MATERIAL

- A 100 individuals caught as seen, 11 May 1979, at the Agricultural Research and Education Center, Homestead, Dade County. *Eurema daira* was abundant along open grassy tracks between citrus and mango plots, adjacent to rich weedy areas.
- B 21 individuals caught as seen, at the same site, 16 May 1979.
- C 90 pale individuals collected selectively at the same site, 14 May 1979. Worn specimens in which through wear the original color could not be assessed were discarded, leaving a total of 90.
- D 90 individuals caught as seen collected between November 1979 and April 1980, at various Dade and Monroe County localities including Everglades National Park.
- E 53 individuals caught as seen, 10 January 1980, same site as A, B and C.

RESULTS

All individuals of samples A, B and C were of f. "jucunda," with the hindwings white beneath. In sample A, the color of the hindwings above was distributed thus:

	♂ ♂	♀ ♀	Total
Hindwing white	5	0	5
Hindwing not white	56	39	95
Totals	61	39	100

The females, whether yellowish or cream in ground color, had fore- and hindwings above the same color. The forewing ground color of males was consistently deeper yellow than in females, but in five specimens the upper surface was markedly bicolored, i.e. 5 percent of the total sample and 8.2 percent of the males.

Sample B provided a broadly similar picture:

	♂ ♂	♀ ♀	Total
Hindwing white	1	0	1
Hindwing not white	12	8	20
Totals	13	8	21

The sex ratio (♂ : ♀) in these two May samples was 1:0.62.

The object of the selective sample C was to obtain as large a number as possible of males with white hindwings above and to determine the presence or absence of *palmira*-like females, with uniformly white ground color above. The characters used by Clench (1970) for comparing Cuban and Floridian spp. *palmira* and *daira* -- the extent of the dark bars on fore- and hindwings-- were also scored. The results are as follows:

Males

Forewing yellow, hindwing white	10 (Figs 7, 8)
Forewing yellow, hindwing intermediate	19 (Fig. 9)
Forewing yellow, hindwing yellow	32 (Fig. 10)
Total	61

Females

Both wings white	0
Both wings intermediate	6 (Fig. 11)
Both wings yellow	23 (Fig. 12)
Total	29

Posterior bar of forewing greatly reduced or absent (compare Figs. 6 and 11) in females: 4 of 29 specimens. No correlation was noted between reduction of the bar and the ground color.

Sample D was analyzed to establish the dates of the transition from f. "jucunda" to f. "daira" and *vice versa*. The earliest male f. "daira" was collected at Lignumvitae Key, Monroe County on 13 November 1979 and the earliest female at Matheson Hammock, Dade County, on 10 November 1978. After mid-November the ratio of f. "daira" to f. "jucunda" increased, to about 50:50 at the end of the month and reaching 100 percent by mid-January (see sample E below). Specimens we have scored as f. "daira" vary (hindwing beneath) from a uniform tan-brown to speckled gray. The swing back to f. "jucunda" in our area commences in early to mid-April: our earliest male records of this form are Castellow Hammock, Dade County, 6 April 1980 and Lignumvitae Key, 20 April 1979, and the earliest female was recorded A.R.E.C., 11 May 1979. The upper surface characters, notably the extent of black markings, show parallel seasonal variation (Klots, 1951), though less readily scored in a sample than the brown-to-white underside change used above.

Sample E comprised only f. "daira," collected within the winter (dry period) and conforming in the hindwing coloration beneath. Specimens were categorized as follows:

	♂ ♂	♀ ♀	Total
Hindwing above white	2 (Fig. 13)	0	2
Hindwing above not white	28	23	51
Totals	30	23	53

The upper surface of the forewings in females match the hindwings in a variable but generally cream-yellow ground color (Fig. 14, 15) and no uniformly white females were noted, as in samples A-C. Included in the count of males with 'not white' hindwings above were 26 individuals with yellow ground color and two with an intermediate coloration (Fig. 16). The 'white hindwing' males comprised 6.7 percent of the males sampled, a figure not significantly different from the corresponding values in samples A and B, taken at a different season. The sex ratio in the sample was (σ : φ) 1:0.77.

DISCUSSION

The 'winter' in south Florida is a relatively dry period while from May through October there is effective rainfall — a mean monthly precipitation in excess of 10 cm — in each month. As the mean monthly temperature in the period from November through April is never below 20°C there is no climatological winter. Therefore we use the terms wet and dry seasons in this discussion as more befitting the observed periodicities.

Seasonal variation in Floridian and Antillean populations of *Eurema daira* follows a comparable course. In the wet season we have ssp. *daira* f. "jucunda" in the former and ssp. *palmira* f. "palmira" in the latter; in the dry season *daira* f. "daira" and *palmira* f. "ebriola." Through an error, Brown and Heineman (1972:274) describe *jucunda* and *palmira* as "summer or dry-season" forms in Jamaica and *daira* and *ebriola* as "winter or wet-season" forms in their discussion of seasonality. However, the Jamaican pattern is in no way anomalous.

As in all such season-associated phenomena the forms "daira" and "jucunda" are the opposite ends of a spectrum: intermediates occur and in the past f. "delioides" has been used as a label for them, as by Mather (1956), Harris (1972) and others. The switch to f. "daira" occurs in southern Florida around mid-November whereas in Mississippi Mather found this form as early as mid-September. The reverse switch, noted by us from mid-April on, takes place a week or two earlier in Mississippi, but there, according to Mather, the butterfly is not found in December and January, indicative of a resting stage. Since both pre-rest and post-rest populations are of f. "daira," overwintering must be a facultatively controlled resting stage of adult life. In southern Florida no such stage has been detected and adults are present throughout the year. In Georgia, the form "daira," 'can be found sparingly throughout the winter months' (Harris, 1972).

A similar alternation of wet and dry season forms occurs in several other Antillean *Eurema* species: *venusta*, *elathea*, *lucina*, *albula* etc. (Riley, 1975). We regard the phenomenon, in these as well as in south Florida *daira daira*, as a response primarily to rainfall factors rather than temperature but, in the absence of experimental data, remain open to correction.

Clench (1970) listed differences between, on the one hand, typical mainland *daira daira* and, on the other, Cuban *daira palmira* together with the occasional Floridian specimens that were superficially similar. He did not suggest that the two subspecies were entitled to species status but tended towards that viewpoint. We ask: do the *palmira*-like south Florida specimens support the idea of two subspecies coexisting and each therefore worthy of a higher status? Sympatry of two subspecies, other than temporary, is of course unlikely.

Bicolored males, more or less closely resembling Antillean ssp. *palmira*, account for 8 percent of the males in our wet season f. "jucunda" and 7 percent in the dry season f. "daira" samples: the differences are not significant, and a constant percentage indicates that we are dealing with balanced polymorphism. The bicolored males are extremes, and although easy to recognize are accompanied by intermediates in the population that intergrade continuously with normal unicolored males at the other end of the variability spectrum. Even in specimens most closely resembling Antillean *palmira* the latter are distinguishable by the clarity of the white ground color above and by the absence of anterior gray scaling. In females, while both seasonal forms vary in ground color in our south Florida examples, they never approach the predominantly

white coloration of Antillean *palmira*. We do not, therefore, accept the idea of coexistence of two subspecies in our area.

Nevertheless Klots (1951) reported captures of ssp. *palmira* in Miami and the Keys (July) and Clench (1970) recorded a few specimens from Collier County (December). Other examples are listed by Kimball (1965). It is probable that the majority of the above are the result of misidentification: for example, Kimball lists two *palmira* from Toms Harbor, in the Keys, which Clench later determined as *daira*. We believe that any large *E. daira* sample from southern Florida will include individuals which, without close examination, could be reported wrongly as *daira palmira*. It remains possible that Cuban *palmira* may occasionally reach Florida as vagrants, but evidence of their establishment is lacking. The various "intermediate" or "hybrid" individuals figured and mentioned by Howe (1975) are not, we suggest, the result of crosses between the two subspecies but fall within the range of variation we document for *daira daira*.

In conclusion, we regard *E. daira daira* as a valid subspecies and the only subspecies resident in south Florida. It exhibits 1, sexual dimorphism; 2, seasonal polymorphism in both sexes; 3, individual variation in females and a balanced polymorphism in males.

TABLE 1. THE MAJOR COLOR FORMS OF *EUREMA DAIRA DAIRA* AND *EUREMA DAIRA PALMIRA*

WING SURFACE	MALES			FEMALES		
	FW ABOVE	HW ABOVE	HW BENEATH	FW ABOVE	HW ABOVE	HW BENEATH
<i>daira f. jucunda</i> (South Florida)	YELLOW	YELLOW-WHITE*	WHITE	YELLOW-CREAM**	YELLOW-CREAM**	WHITE
<i>daira f. daira</i> (South Florida)	YELLOW	YELLOW-WHITE+	TAN#	YELLOW-CREAM++	YELLOW-CREAM++	TAN#
<i>palmira f. palmira</i> (Antilles)	YELLOW	WHITE	WHITE	WHITE	WHITE	WHITE
<i>palmira f. ebriola</i> (Antilles)	YELLOW	WHITE	TAN	WHITE	WHITE	TAN

NOTE: Details of FW coloration beneath vary seasonally, but offer no special diagnostic characters and are omitted from the Table.

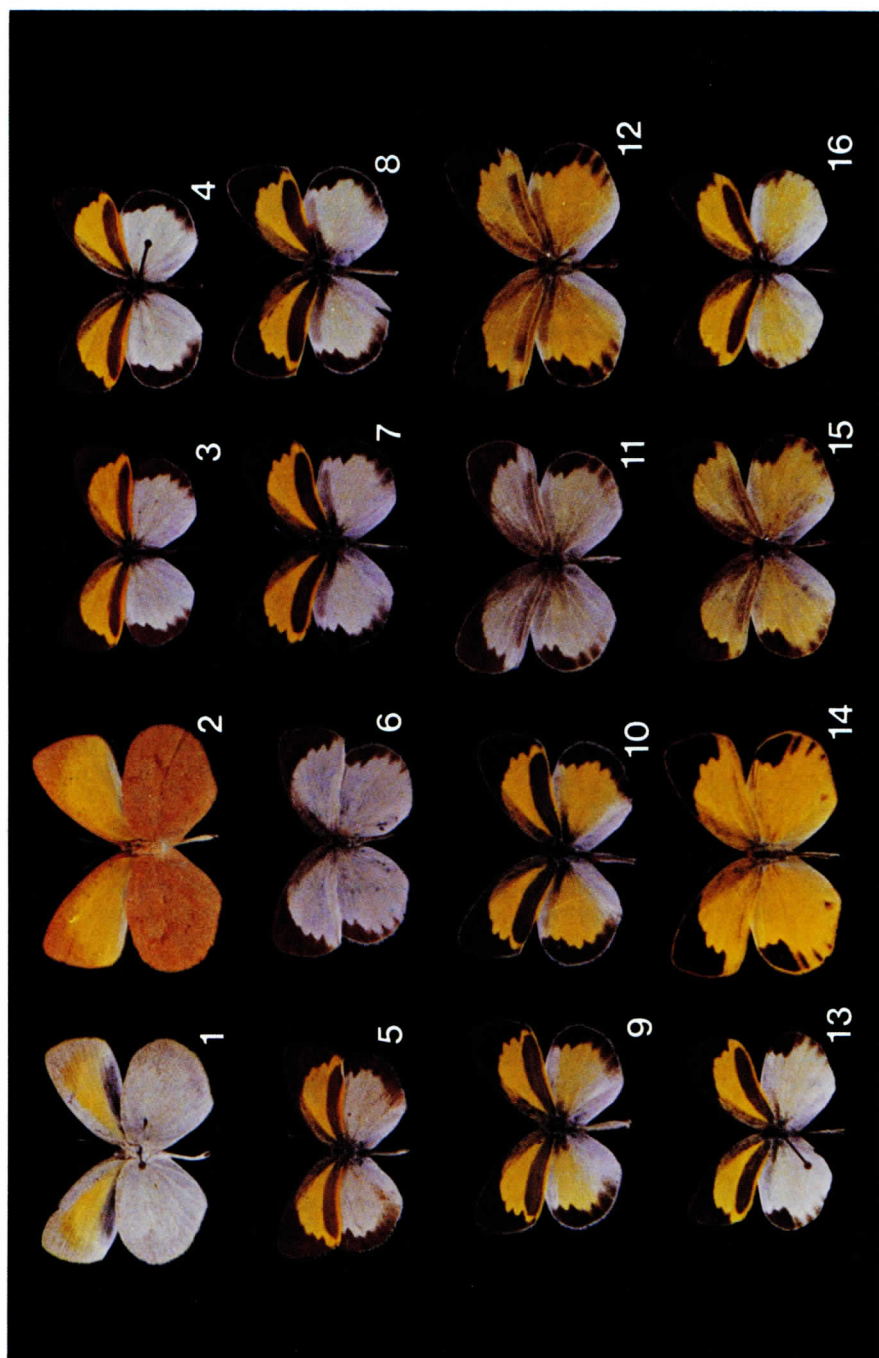
*WHITE in 8% of males in our material. Others range continuously from yellow to pale cream.

**Varies continuously from yellow to pale cream.

+ WHITE in 7% of males in our material. Others range continuously from yellow to pale cream.

++Varies continuously from yellow to pale cream.

- In our material, in both sexes, the ground color varies from tan-brown to light grey flecking.



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We are sad to announce the death of Dr. Dennis Leston in October, 1981.

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FIGURES 1-16, *EUREMA DAIRA* VARIATION. 1. *Eurema daira daira* f. "jucunda." Male, Everglades National Park, 28. ix. 1979. Note the white/cream HW color beneath. 2. *E. daira daira* f. "daira." Female, Lignumvitae Key, 13. xi. 1979. Note the tan-brown HW color beneath. 3. *E. daira palmira* f. "palmira." Male, St. Kitts (Lesser Antilles), 16. iii. 1929. (Courtesy of the Allyn Museum). 4. *E. daira palmira* f. "palmira." Male, another specimen, same data as Fig. 3 (Courtesy of the Allyn Museum). 5. *E. daira palmira* f. "palmira". Male, Matanzas, Cuba, 17. xi. 1950. HW of this specimen beneath, and Figs. 3, 4, are white. (Courtesy of the Allyn Museum). 6. *E. daira palmira* f. "palmira". Female, Matanzas, Cuba, 1. xi. 1948. HW beneath are white. (Courtesy of the Allyn Museum). 7. *E. daira daira* f. "jucunda." Male, A.R.E.C., Homestead 14. v. 1979. A *palmira*-like specimen, with little or no trace of yellow on the HW above (cf. Figs. 3, 4) but with gray scaling on the anterior edge of the HW. 8. *E. daira daira* f. "jucunda." Male, another specimen, same data as Fig. 7. 9. *E. daira daira* f. "jucunda." Male, A.R.E.C., Homestead, 14. v. 1979. A specimen with intermediate HW coloration (cf. Figs. 7, 8). 10. *E. daira daira* f. *jucunda*. Male, A.R.E.C., Homestead, 14. v. 1979. A normal specimen with similar HW and FW ground color above. 11. *E. daira daira* f. "jucunda." Female, A.R.E.C., Homestead, 11. v. 1979. A very pale individual, but note the gray scaling especially on the posterior edge of the FW and anterior edge of the HW (cf. Fig. 6). 12. *E. daira daira* f. "jucunda." Female, A.R.E.C., Homestead, 14. v. 1979. A typical wet/summer season example. 13. *E. daira daira* f. "daira." Male, A.R.E.C., Homestead, 10. i. 1980. A dry/winter season example, markedly bicolored above with whitish HW and resembling the Antillean *daira palmira* f. "ebriola." The HW are pale brown beneath. 14. *E. daira daira* f. "daira." Female, Big Pine Key, Monroe County, 23. xi. 1980. A typical example of the dry season form; note the reduction of HW marginal markings above and of the FW posterior scaling (cf. Fig. 12). 15. *E. daira daira* f. "daira". Female, A.R.E.C., Homestead, 10. i. 1980. A pale dry season example (cf. Fig. 14). 16. *E. daira daira* f. "daira". Male, A.R.E.C., Homestead, 11. ii. 1980. A specimen with intermediate HW coloration above (cf. Fig. 13).

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