BUTTERFLIES OF SIX CENTRAL NEW MEXICO MOUNTAINS, WITH NOTES ON *CALLOPHRYS* (*SANDIA*) *MACFARLANDI* (LYCAENIDAE)

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Since 1964 I have resided in Albuquerque, New Mexico, and devoted much time to investigating the butterflies and moths of the surrounding mountains. The purpose of this article is to describe some of the observations made during these nine seasons.

Localities

Albuquerque itself is located a mile above sea level at the crossing of the Rio Grande Valley and U. S. Highway 66. The Valley is about 25 miles wide throughout this part of the state. About 75 miles north of Albuquerque, the New Mexican extensions of the high Colorado ranges begin dropping off into desert country. These northern mountains typically have 12,000–14,000 ft. peaks and 7000–8000 ft. valleys. However, the lower desert surrounding Albuquerque itself is only 4000–7000 ft. in elevation.

Scattered ranges rise from the desert at numerous points around Albuquerque (Fig. 1). These mountains are on both sides of the Rio Grande Valley, and have peaks of up to 11,000 ft. On the east side of Albuquerque, the **Sandia Mts.** begin at the edge of town; a bit southeast of Albuquerque, the **Manzano Mts.** begin. U. S. Highway 66 and Tijeras Canyon partially isolate the Sandias from the Manzanos. The bottom of the Albqueraue side of the Sandias and Manzanos is about 6000 ft. and fairly arid: about 8 in. of rain falls each year, mostly in the form of summer thundershowers. The bottom of these mountains on the side opposite Albuquerque averages 7500 ft., and is much more moist. Rainfall at the bottom on that side probably approaches 20 in. annually. To the east of the Sandias and Manzanos the Great Plains begin, and roll across the shallow Estancia and Pecos Valleys, gradually sloping down to 4000 ft. at the Texas state line. Peaks in the Sandias and the Manzanos are around 10,000 ft. The upper portions of both these ranges are heavily forested, but have Canadian zone meadows at the very summits.

To the west of the Rio Grande, the New Mexico desert rises gently up to 7000 ft. or 8000 ft. on the Continental Divide east of the Arizona line. In this area in the central latitudes of New Mexico, six or seven mountain ranges project above the desert to exceed 9000 ft.; the four easternmost are **Mt. Taylor, Ladron Peak,** the **Magdalena Mts.,** and the **San Mateo Mts.** The high desert west of Albuquerque is considerably drier than the Great Plains to the east.

Mt. Taylor is a fairly recent volcano of 11,000 ft. surrounded by a vast level plateau, especially to the northeast, which is uniformly just over 8000 ft. Most of this plateau is at least lightly forested. The top of Mt. Taylor proper breaks out into a large pseudo-arctic meadow of several square miles extent. Ladron Peak is a small, rugged monument which juts to just above 9000 ft. from the very low surrounding desert floor of 5000 ft. Ladron Peak is completely unforested, although the upper gorges with a northern exposure have scattered aspen (*Populus tremuloides* Michx.) and ponderosa (*Pinus ponderosa* Lawson). The Magdalena Mts. tend to resemble the Sandias and Manzanos, except that they run east-west instead of north-south and are Lower Sonoran rather than Upper Sonoran at the base. Large Canadian-zone meadows also cover the tops of the Magdalenas, which reach nearly 11,000 ft. The San Mateo Mts. are isolated from the Magdalenas by the very arid Mulligan Valley and unpaved N. M. Route 107. They are less isolated from the Gila Mts. of southwestern New Mexico, at least in terms of possible dispersal routes not interrupted by broad, dry valleys.

Generally speaking, each range has been studied by intensive collecting for one season, preceded and followed by two seasons of occasional visitation.

The Colorado mountain extensions into northern New Mexico—the Jemez and Chuska on the west of the Rio Grande and the Sangre de Cristo on the east—have not been included in this work. I hope to examine these ranges in detail in future years. Also, the high Sacramento Mts. and the Guadalupe Ridge in southeastern New Mexico; and the Gila, Black Range, Animas, Zuni, and Datil mountains in the southwest are areas I want to probe eventually. Finally, the eastern plains and the Rio Grande riverbottom remain to be examined. (Obviously our very few resident New Mexican collectors will require quite a number of seasons to come to know a state nearly the size of California with a very complex life-zone pattern. For this reason, I would greatly appreciate correspondence with any outsiders who have done serious collecting here. Perhaps, with the help of outsiders, our study of the 12 previously-mentioned virgin areas can be greatly accelerated.)

RESULTS

Abundance Tabulation

My findings concerning occurrences and abundances of butterfly species in the six mountain ranges surrounding Albuquerque are summarized in Table 1. In this table, the following symbols and abbreviations are used:

TL—Mt. Taylor
SD—Sandia Mts.
MZ—Manzano Mts.
LD—Ladron Peak
MG—Magdalena Mts.
SM—San Mateo Mts.
A—abundant (over 100 per hour)
C—common (over 15 per year)
U—uncommon (2–15 per year)
S—single record
V—visual record
X—insufficient observation to distinguish between S, U or C
Q—record not observed by author

?—of uncertain determination or unknown collector
MT—Mike Toliver, collector
KR—Kilian Roever, collector
HK—Harry Clench, collector
JB—John Burns, collector
OS—Oakley Shields, collector
!—major range extension
(M)—migratory, either solitary or in numbers
(L)—intensely local
(D)—species often found on desert floor, away from mountains and permanent water

Species numbers and names are as given by dos Passos (1964), except where revised: *Philotes* (Beuret, 1958) and (Langston, 1969); Melitaeinae (dos Passos, 1969); *Vanessa* (Field, 1971); *Erynnis* (Burns, 1964); *Cercyonis* (Emmel, 1969); Theclinae (dos Passos, 1970); and Megathymidae (Freeman, 1969).

Correlation Coefficients of Species with Ranges

On the map (Fig. 1) and in Lines 1 of Table 2, correlation coefficients ρ_{jk} are shown of the species occurrence in the six ranges studied. These coefficients are computed by assigning a value X_{ij} of

1 to species i if it occurs in range j,
0 to species i if it does not occur in j,

and then calculating:

$$\rho_{jk} = \frac{\frac{1}{N}\sum_{i=1}^{N}(X_{ij} - n_j/N)(X_{ik} - n_k/N)}{\left[\frac{1}{N}\sum_{i=1}^{N}(X_{ij} - n_j/N)^2\right]^{1/2}\left[\frac{1}{N}\sum_{i=1}^{N}(X_{ik} - n_k/N)^2\right]^{1/2}}$$

Here, n_j $(= \Sigma_i X_{ij})$ and n_k $(= \Sigma_i X_{ik})$ are the total number of species occurring in ranges j and k, respectively, while N is the total number of species found in all six ranges. If ranges j and k have exactly the same species, ρ_{jk} would be 1. If all the species which occur in either range do not occur in the other, ρ_{jk} would be –1. If one were to release in a room two live specimens of each of 100 species, and then permit two collectors to catch 100 random specimens each, ρ_{jk} between collectors j and k would be, on the average, 0. Thus, the ρ_{jk} are measures of the faunal similarities of the different ranges. The surprising aspect con-

TABLE 1. Abundances of butterflies in the six mountain ranges surrounding Albuquerque, New Mexico.

dos Passos Nos.	Butterflies	Mount Taylor (TL)	Sandia Mts. (SD)	Manzano Mts. (MZ)	Ladron Peak (LD)	Magdalena Mts. (MG)	San Mateo Mts. (SM)
	MEGATHYMIDAE						
13d.	*Megathymus coloradensis coloradensis* (Riley) (D)		C	C	C		C
13f.	*Megathymus coloradensis navajo* Skinner	U_{MT}					
16.	*Megathymus streckeri* (Skinner)		U				
17b.	*Megathymus violae* Stallings & Turner			S_{HK}!			
	HESPERIIDAE						
32.	*Amblyscirtes simius* Edwards		U				
33.	*Amblyscirtes cassus* Edwards			S!			S
34a.	*Amblyscirtes aenus aenus* Edwards		U_{KR}	C	C	C	U
35.	*Amblyscirtes oslari* (Skinner)			U			
36.	*Amblyscirtes fluonia* Godman			Q_{HK+JB}			
44.	*Amblyscirtes eos* (Edwards)			S			C
48.	*Amblyscirtes phylace* (Edwards)			C			
53.	*Atrytonopsis vierecki* (Skinner) (D)	S	C	C	C	C	C
56.	*Atrytonopsis python* (Edwards)		U	U	U	C	C
67a.	*Euphyes vestris vestris* (Boisduval)		C	C			
75.	*Poanes taxiles* (Edwards)	C	C	C	U	A	C
81.	*Ochlodes snowi* (Edwards)	C				U	
87.	*Atalopedes campestris* (Boisduval) (M,D)		C_{MT}		U		
93.	*Polites draco* (Edwards)	C				Q_{KR}	
100a.	*Hesperia uncas uncas* Edwards (D)	C	C	U	U	U	
108a.	*Hesperia pahaska pahaska* Leussler (D)[1]	C	C	C		U	S
109.	*Hesperia viridis* (Edwards) (D)[1]	C	C	C		U	

Table 1. (*Continued*)

dos Passos Nos.	Butterflies	Mount Taylor (TL)	Sandia Mts. (SD)	Manzano Mts. (MZ)	Ladron Peak (LD)	Magdalena Mts. (MG)	San Mateo Mts. (SM)
118.	*Stinga morrisoni* (Edwards)	C		C_{JB}		C	A
120.	*Yvretta rhesus* (Edwards)	U					
121.	*Yvretta carus* (Edwards)		U_{MT}				
122.	*Hylephila phyleus* (Drury) (M)		A_{MT}		U		
125.	*Copaeodes aurantiaca* (Hewiston) (D)		S_{MT}		C	C	U
128.	*Oarisma garita* (Reakirt)	C		Q_{OS}		C	
129.	*Oarisma edwardsii* (Barnes)	C		U		C	
144.	*Piruna pirus* (Edwards)		C	U		C	
148.	*Pholisora catullus* (Fabricius) (D)[1]				U	C	C
149.	*Pholisora mejicana* (Reakirt) (D)[1]		C	C			
151.	*Pholisora alpheus* (Edwards) (D)	C	S	S	U	C	
152.	*Celotes nessus* (Edwards) (L)				C		
159.	*Pyrgus xanthus* Edwards						S
160.	*Pyrgus scriptura* (Boisduval)	U		S	U	S	U
161.	*Pyrgus communis* (Grote) (D)	C	C	C	C	C	A
163.	*Erynnis icelus* (Scudder & Burgess)			S			
164c.	*Erynnis brizo burgessi* (Skinner)	C	C	C	C	C	C
166b.	*Erynnis afranius* (Lintner)[2]	C	C	C		C	C
168b.	*Erynnis funeralis* (Scudder & Burgess) (M)	S	U_{MT}	C	U	U	C
170.	*Erynnis pacuvius pacuvius* (Lintner)	U		U			U
172b.	*Erynnis tristis tatius* (Edwards)						U
173.	*Erynnis horatius* (Scudder & Burgess)		S	S	U		C
175½.	*Erynnis telemachus* Burns	C	C	C	C	C	C

TABLE 1. (*Continued*)

dos Passos Nos.	Butterflies	Mount Taylor (TL)	Sandia Mts. (SD)	Manzano Mts. (MZ)	Ladron Peak (LD)	Magdalena Mts. (MG)	San Mateo Mts. (SM)
187.	*Staphylus ceos* (Edwards)		$Q_?$				
201.	*Thorybes pylades* (Scudder)	C	C	C		C	A
203c.	*Thorybes mexicana dobra* Evans		U_{MT}				
227.	*Zestusa dorus* (Edwards)		C	C		U	C
236b.	*Epargyreus clarus huachuca* (Dixon)		U_{MT}	C		C	U
	PAPILIONIDAE						
246.	*Battus philenor* (Linnaeus) (M)	S	S_{MT}	V		U	S
248.	*Papilio polyxenes asterius* Stoll (D)		U	U	C	U	S
250.	*Papilio bairdii* Edwards	U		U	U		U
252.	*Papilio zelicaon* Lucas[3]	C	U	U			
256.	*Papilio cresphontes cresphontes* Cramer (M)			S	V		
263.	*Papilio rutulus* Lucas	C	U	C		C	C
264.	*Papilio multicaudata* Kirby	C	C	C	C	C	
	PIERIDAE						
272.	*Neophasia menapia menapia* (Felder & Felder)		U	C			U
276c.	*Pieris sisymbrii elivata* (Barnes & Benjamin)	U	C	U	U	C	C
277a.	*Pieris protodice* Boisduval & Le Conte (D)	C	C	C	C	C	C
277b.	*Pieris occidentalis* Reakirt (D)	X	X	S	C	C	C
278g.	*Pieris napi macdunnoughii* Remington		C				
280.	*Pieris rapae* (Linnaeus)		A_{MT}	U			S
286a.	*Colias eurytheme* Boisduval	C	C	C	U	C	C
286c.	*Colias philodice eriphyle* Edwards		U	C	U	U	U
293.	*Colias alexandra* Edwards ssp.			C!			

TABLE 1. (*Continued*)

dos Passos Nos.	Butterflies	Mount Taylor (TL)	Sandia Mts. (SD)	Manzano Mts. (MZ)	Ladron Peak (LD)	Magdalena Mts. (MG)	San Mateo Mts. (SM)
299.	*Colias caesonia* (Stoll) (M)	V	U	C	C	C	U
302c.	*Phoebis sennae marcellina* (Cramer) (M)						U
312.	*Eurema mexicana* (Boisduval) (M)	U	S_{MT}	C	C	C	
319.	*Eurema nicippe* (Cramer) (M)	U	C	C	C	C	C
320.	*Nathalis iole* Boisduval (M)	U	C	C	C	C	C
324f.	*Anthocaris sara inghami* Gunder	U	C	U	C	C	C
	RIODINIADE						
334.	*Apodemia mormo* (Felder & Felder) ssp. (D)		C	U	C	C	U
335.	*Apodemia palmerii palmerii* (Edwards)				U!		
338.	*Apodemia nais* (Edwards)	U		U			
	LYCAENIDAE						
350.	*Hypaurotis crysalus* (Edwards)		C	C		U	S
355.	*Harkenclenus titus mopsus* (Hübner)			U			
357b.	*Satyrium behrii crossi* (Field)		U	S!			
363c.	*Satyrium calanus godarti* (Field)		U				
389a.	*Callophrys* (*Incisalia*) *eryphon eryphon* (Boisduval)	U					Q_{KR}
390.	*Callophrys* (*Sandia*) *macfarlandi* Ehrlich & Clench[4]		A	C	C!	C!	
395.	*Callophrys* (*Mitoura*) *spinetorum* (Hewiston)	C	C	C		U	C
396a.	*Callophrys* (*Mitoura*) *siva siva* (Edwards)	C	C	C	U	U	U
408a.	*Atlides halesus halesus* (Cramer) (M)		U	U	S	U	C
417c.	*Strymon melinus franki* Field (D)	C	C	C	C	C	C
427.	*Erora quaderna sanfordi* dos Passos			S!		C!	A

TABLE 1. (*Continued*)

dos Passos Nos.	Butterflies	Mount Taylor (TL)	Sandia Mts. (SD)	Manzano Mts. (MZ)	Ladron Peak (LD)	Magdalena Mts. (MG)	San Mateo Mts. (SM)
430d.	*Lycaena arota schellbachi* Tilden	U	C	C			
446.	*Brephidium exilis exilis* (Boisduval) (D)	C	C	U	C	U	C
449.	*Leptotes marina* (Reakirt) (D)	U	C	C	C	C	C
453b.	*Hemiargus isola alce* (Edwards) (D)	X	C	C	C	C	C
455a.	*Lycaeides melissa melissa* (Edwards)	C	U	C		C	U
458g.	*Plebejus icarioides lycea* (Edwards)	C					
462d.	*Plebejus acmon texanus* Goodpasture	S	C_{MT}	C	C	C	C
468e.	*Plebejus* (*Agriades*) *glandon rustica* (Edwards)	C	S	U!			C
470.	*Everes amyntula* (Boisduval) (D)	C	C	C		U	C
471d.	*Pseudophilotes battoides centralis* (Barnes & McDunnough) (L)	S	C	S		U	U
474a.	*Pseudophilotes rita rita* (Barnes & McDunnough)		C_{MT}		C_{MT}	U	C
475.	*Pseudophilotes spaldingi* (Barnes & McDunnough)			S!			
479.	*Glaucopsyche lygdamus oro* Scudder	C	U_{MT}	U			C
481f.	*Celastrina argiolus cinerea* (Edwards)	U	U	C	C	A	C
	LIBYTHEIDAE						
482.	*Libytheana bachmanii* (Kirtland) (M,D)	S	U_{MT}	U			U
	NYMPHALIDAE						
484.	*Anaea andria* Scudder (L)			U!			
492c.	*Asterocampa celtis antonia* (Edwards)		C				
492d.	*Asterocampa celtis montis* (Edwards) (L)				C	C	C
517b.	*Limenitis astyanax arizonensis* Edwards					U!	
518a.	*Limenitis archippus archippus* (Cramer)			C![5]			

Table 1. (*Continued*)

dos Passos Nos.	Butterflies	Mount Taylor (TL)	Sandia Mts. (SD)	Manzano Mts. (MZ)	Ladron Peak (LD)	Magdalena Mts. (MG)	San Mateo Mts. (SM)
519.	*Limenitis weidemeyerii weidemeyerii* Edwards	C[6]	C	C		C[6]	C[6]
522.	*Limenitis* (*Adelpha*) *bredowii eulalia* (Doubleday)	C	U	C	C	C	A
527.	*Vanessa atalanta rubria* (Frustorfer)	S	U	U	U	U	U
528.	*Cynthia virginiensis* (Drury)	S	C	C	U	C	C
529.	*Cynthia cardui* (Linnaeus) (M,D)	C	A	A	C	C	A
530.	*Cynthia annabella* Field	U	U	U	S	C	S
531.	*Precis coenia* (Hübner)						S
534.	*Nymphalis californica californica* (Boisduval) (M)			S_{KR}			
535.	*Nymphalis milberti furcillata* (Say)	U				S	
536.	*Nymphalis antiopa* (Linnaeus)	C	C	C	C	C	C
537.	*Polygonia interrogationis* (Fabricius)		U_{MT}	Q_{KR}		V	
539.	*Polygonia satyrus* (Edwards)		U_{MT}	U_{KR}		U	C
543.	*Polygonia zephyrus* (Edwards)	C	C	C		C	C
551b.	*Chlosyne gabbii sabina* (Wright)					S	C
552.	*Chlosyne acastus* (Edwards)	U					
561.	*Chlosyne lacinia* (Geyer) (M)[7]		S_{MT}		S	A	C
563.	*Phyciodes texana texana* (Edwards)			S	S		
566.	*Phyciodes tharos* (Drury) ssp.		U_{MT}	S_{KR}			
569b.	*Phyciodes campestris camillus* Edwards	C	C	C			S
570.	*Phyciodes picta canace* Edwards	C_{MT}	U		S_{MT}		
571.	*Phyciodes vesta* (Edwards)			S_{KR}!	S!		
572.	*Phyciodes mylitta* (Edwards) ssp.	C	C	C	V	C	C
576.	*Thessalia alma* (Strecker)—*fulvia* (Edwards)		C	U_{MT}		C	
578.	*Dymasia dymas* (Edwards)				C_{MT}!	C!	C

TABLE 1. (*Continued*)

dos Passos Nos.	Butterflies	Mount Taylor (TL)	Sandia Mts. (SD)	Manzano Mts. (MZ)	Ladron Peak (LD)	Magdalena Mts. (MG)	San Mateo Mts. (SM)
582.	*Poladryas arachne* (Edwards)	S					U
618f.	*Speyeria atlantis dorothea* Moeck	C	C	C		C	A
624.	*Euptoieta claudia* (Cramer) (M,D)	U	C	C	C	C	C
630b.	*Agraulis vanillae incarnata* (Riley) (M)		U_{MT}				
	DANAIDAE						
631.	*Danaus plexippus plexippus* (Linnaeus) (M,D)	V	U	U	C	C	C
633b.	*Danaus gilippus strigosus* (Bates) (M,D)	U	U	U	C	C	C
	SATYRIDAE						
640.	*Euptychia dorothea* (Nabakov)	U	C	C	C	C	A
647.	*Euptychia rubricata cheneyorum* R. L. Chermock					C!	U
652.	*Coenonympha ochracea ochracea* Edwards			C!			
655a.	*Neominois ridingsii ridingsii* (Edwards)	C					
656d.	*Cercyonis pegala boopis* (Behr)		C	C			
657.	*Cercyonis meadi meadi* (Edwards)		U	U	U	C	S
660.	*Cercyonis oetus charon* (Edwards)		C	C		A	C
665.	*Oeneis chryxus chryxus* (Doubleday)						C!
	"endemics"/total species[8]	5/73	9/95	12/105	2/62	1/82	5/86

[1] determined by genitalia.
[2] includes *persius* (Scudder).
[3] univoltine population.
[4] see appendix.
[5] occurs in Rio Grande Valley only; does not actually reach Manzano Mts.
[6] intergrades with *angustifascia* (Barnes & McDunnough) towards western part of study area.
[7] phenotypes of *adjutrix* Scudder and *crocale* (Edwards) occur together.
[8] an "endemic" is a species which has been found in only one range of the six.

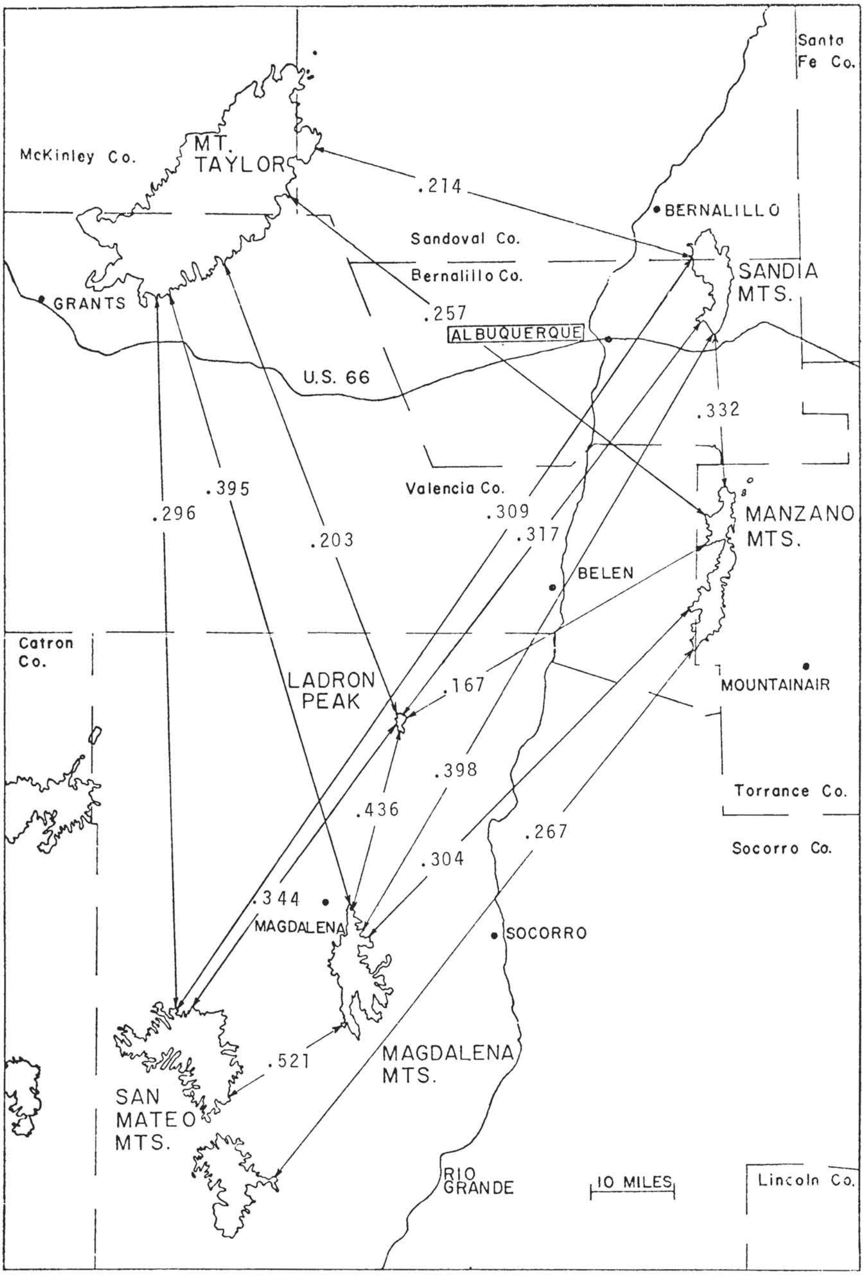

Fig. 1. Map of study area, showing mountain areas over 8000 ft. Numerical values indicate correlation coefficients of species occurrence.

cerning the species distribution correlation coefficients appearing on the map is their very low values. Even for the Sandias and the Manzanos, which are only 20 air miles apart with a 7000 ft. "bridge" connecting them, ρ_{jk} is just 0.3. This is about the correlation coefficient which relates the species of New York and South Carolina!

Several alternative procedures were also used for computing species distribution correlation coefficients. First of all, ρ_{jk} was re-evaluated by letting

$X_{ij} = 4$ if species i is abundant (A) in range j,
3 if species i is common (C) in range j,
2 if species i is uncommon (U or X) in range j,
1 if species i is of dubious occurrence (S, V, X, Q or ?) in range j,
0 if species i is unreported from range j.

Lines 2 of Table 2 give the results of this computation. Next, ρ_{jk} was determined by the same process, but with X_{ij} reduced to 1 for all species indicated in Table 1 as showing tendencies to migrate or to reside on the desert. The effect of this modification on X_{ij} is to de-emphasize the occurrence of free-moving species in computing the correlation coefficients. Lines 3 of Table 2 show the values of ρ_{ij} found by this altered assignment of X_{ij}.

Additionally, ρ_{ij} was calculated with $X_{ij} = 0$ for all desert or migratory species. Here, the contribution of free-moving species is totally eliminated from the faunal similarity measurement. Lines 4 of Table 2 give these ρ_{ij}.

From the results shown in Lines 1–4 of Table 2, the following generalizations may be drawn:

a. Lines 4 are always greater than Lines 1–3. In statistical terminology, this means total suppression of frequency data on free-moving species gives the highest species distribution correlation coefficients. In other words, in comparing the characterizing fauna of isolated areas, it is best to ignore records of species which may frequently cross the isolating barriers. To do otherwise, at least on a sampling period of only nine years injects short-term dispersal effects. As these short-term effects are apparently fairly random, they cause the fauna of the various areas to appear more distinct than they truly are.

b. Lines 4 are always greater than Lines 3. Statistically, this means partial suppression of frequency data on free-moving species gives lower species correlations than total suppression of these data. In simpler language, if one wants to ignore effects of short-term dispersal in measuring faunal similarity, one should exclude totally the records of free-moving species. They should not be included with emphasis merely reduced.

TABLE 2. Correlation coefficients of butterfly species with mountain range.

	MT	SD	MZ	LP	MG	SM
MT		.214	.257	.203	.395	.296
		.253	.383	.162	.376	.310
		.233	.361	.112	.375	.348
		.356	.465	.233	.459	.448
		.761	.813	.656	.766	.656
SD			.332	.317	.398	.309
			.553	.357	.433	.340
			.554	.260	.493	.357
			.660	.381	.586	.481
			.880	.798	.747	.755
MZ				.167	.304	.267
				.282	.475	.423
				.204	.524	.448
				.353	.617	.563
				.768	.783	.778
LP					.436	.344
					.541	.447
					.460	.368
					.544	.472
					.862	.811
MG						.521
						.620
						.632
						.695
						.840

Lines 1: X_{ij} constrained to 1 or 0 for all species.
Lines 2: X_{ij} variable from 4 to 0 for all species.
Lines 3: X_{ij} constrained to 1 or 0 for desert-migratory species, otherwise variable from 4 to 0.
Lines 4: X_{ji} constrained to 0 for desert-migratory species, otherwise variable from 4 to 0.
Lines 5: X_{ij} variable from 4 to 0 for desert-migratory species, otherwise constrained to 0.

c. Lines 2 are usually greater than Lines 1. Mathematically, this means data on abundance of species in different areas will correlate more highly than a simple yes-no declaration as to occurrence of each species in each area. Ecologically, this is a rewording of the phenomenon that an organism which is common (successful) in one area is likely to be common in another area if it is found there at all.

d. Ladron Peak fauna correlates highly with only the Magdalena Mountains, although the converse is not true. Thus, Ladron Peak is biologically a depauperate island of the Magdalenas.

e. The Manzano Mts., which have the most "endemic" records, do not have noticeably low faunal correlations with the other ranges. A situation such as this may develop when foreign insects may drift into a new area more easily than they can drift out, or when an area has an unusually diverse foodplant flora relative to other areas in the study.

f. Early in this study, it was anticipated that more collecting in each range would raise the species distribution correlations. This anticipation seems not to have been borne out by annual re-evaluation of the correlations.

Correlation coefficients were also computed with data suppressed on desert species but not on migratory species. No unexpected trends appeared. Reversing desert and migratory species in this procedure also produced no surprises.

As a final computation, correlation coefficients were evaluated for the desert and migratory species only: the X_{ij} were reduced to zero for all other species. These values are given in the last lines of Table 2. In each range except Ladron Peak, about ⅓ of the observed species are considered either desert or migratory. For Ladron Peak, the fraction is ½. One can see that, as expected, free-moving species have much higher correlations than other species. This statement is, in fact, almost a tautology: Species which can readily cross barriers are more likely to turn up on both sides of the barriers than species which cannot.

SUMMARY

I have described briefly the topography of the area around Albuquerque, New Mexico, and presented a table which summarizes the occurrence and abundance of butterflies in six surrounding mountain ranges as observed over nine seasons. The data included in this table enable computation of species-distribution correlation coefficients between ranges. These coefficients are measures of the faunal similarities of the butterfly populations in the six ranges.

Appendix: Notes on *Callophrys* (*Sandia*) *macfarlandi*

Due to the considerable interest in this recently discovered "critter," the following previously unpublished records seem worthy of immediate dissemination. *Sandia macfarlandi* has now been recorded in New Mexico from: (a) virtually all points on the north, west, and south sides of the Sandia and Manzano Mts. between 5800 and 6400 ft. in Sandoval, Bernalillo, Valencia, Torrance, and Socorro counties; (b) White Oaks and an adjacent colony about 10 miles to the southwest both in Lincoln County, and both around 5500 ft. (RH & MT); (c) Alamogordo Lake in De Baca

County, 4200 ft. (MT); (d) Conchas Lake State Park in San Miguel County, 4200 ft., and nearby in Guadalupe County on N. M. Route 129 (MT); (e) on the eastern side of the Sacramento Mts., near Hondo, Lincoln County (Bruce Harris); (f) on the western side of the Sacramento Mts., near High Rolls, 6000 ft., Otero County (RH & MT); (g) 3 miles west of Cimarron, 6500 ft., Colfax County (MT); (h) on all sides of Ladron Peak around 5800 ft., in Socorro County (RH); (i) on the northeast face of the Magdalena Mts., around 6000 ft., in Socorro County (RH); and (j) 1 mile NW of Acoma Pueblo, 5500 ft., Valencia County (RH). The last three of these records are the only known U. S. occurrences west of the Rio Grande. The foodplant of *macfarlandi*, *Nolina texana* Wats., does not seem to occur on Mt. Taylor or in the San Mateo Mts. Flight season in the Sandias has been found to extend from 15 February to 2 July. This makes *macfarlandi* the first non-hibernator to fly in the spring. Average annual temperature low in Albuquerque after 15 February is 10°F. Under proper conditions, *macfarlandi* is the most abundant butterfly in New Mexico. I have taken 42 with a single swing of a net at the composite *Senecio longilobus* Benth.

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