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A NEW SUBSPECIES OF *OENEIS CHRYXUS* (NYMPHALIDAE: SATYRINAE) FROM SOUTH CENTRAL NEW MEXICO

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ABSTRACT. The widely reported isolate population of *Oeneis chrysus* from Mt. Withington, Socorro County, New Mexico, is formally described as *Oeneis chryxus socorro*.

Additional key words: endemic, Arctic, insular biology, refugia antiquity

One of the great events in collecting where no one has gone before is the discovery of populations that initially seem to have no explanation for being there. Finding an isolated colony of *Oeneis chryxus* on a single ridge in Socorro County, New Mexico, is an intriguing example, and I describe this colony here.

The ridge mentioned above is about 9500' at its crest, is definitely in the aspen zone, and runs about 6.5 air miles from Mt. Withington (10,097', 33.881°, -107.486°) to Grassy Knoll (9662', 33.781°, -107.376°) in the SW. A forest Service road (USFS Rd. 330) runs along the ridge. In good years, the butterflies will fly down Monica Canyon on the north slope of Mt. Withington and out on the Plains of San Augustin around 7500'. This is the site of the rail-mounted radio-telescopes composing the Very Large Array (VLA). These hundred meter high mobile telescopes were used as a backdrop to shoot one of the movie sequels to *2001*, and in real life are a unique asset to the astrophysics world.

Although most *Oeneis* are biennial, *O. chryxus* flies equally every year at all New Mexican sites known to me. The present ridge comprises the northern half of the San Mateo Mountains—a granite formation of locally spectacular beauty. These mountains are dissected by East Red Canyon and West Red Canyon. *Oeneis chryxus* has never been observed in the southern half of the San Mateo Mts., or in any of the other six or eight ranges that ring the Plains of San Augustin and have been searched for Lepidoptera.

Small mountain top isolates are of considerable evolutionary and conservation interest for several reasons. First, they are relatively infrequent. Second, they may be very vulnerable to extermination by a small degree of global warming. Third, they are invaluable biological indicators that exist on unique geographical sites. Fourth, they may merit the special protection of a unique ecological habitat. (With an altitudinal spread of 2500', global warming may be less of an issue at this site.)

The nearest other population of *Oeneis chryxus* is *Oeneis chryxus chryxus* in the Jemez Mountains about 125 miles directly to the north. This population in the Jemez joins the Taos County populations and the Rocky Mountain branch of *O. chryxus*' nearctic distribution without major interruption. However, the Jemez Mts. and the San Mateo Mts. are today separated by some Chihuahuan Desert which is very inhospitable to *Oeneis*.

Oeneis chryxus is apparently the least boreal member of its genus, and seems to be restricted to North America. There are other population isolates elsewhere. I have seen *O. c. strigulosis* McDonough on Pre-Cambrian outcroppings on the Gaspe Peninsula of Quebec and *O. c. calais* Scudder in the Upper Peninsula of Michigan (Klots 1951). Until very recently, I had assumed all Colorado *Oeneis chryxus* were typical *chryxus*. However, in 2006, Scott described *Oeneis chryxus* (*calais*) *altacordillera* from some Front Range peaks in Colorado and New Mexico (Scott 2006). I would not be surprised if my high-altitude Taos Co. material keys out as *O. c. altacordillera*. Because *O. c. socorro* and *O. c. altacordillera* occur at opposite extremes of the *O. chryxus* altitudinal domain, I would expect to see and read little of their taxonomic and ecological interaction.

An astute reviewer has also pointed out that there are problems with the designation of a holotype in the original description of *Oeneis chryxus* (Doubleday 1847), and in the Shephard (1984) choice of the sex of his lectotype. I lack access to the resources to deal with these issues.

Oeneis chryxus is a plastic taxon, and a rather widespread one at that. The significant attribute of the Socorro Co. isolate is not its distinctiveness, but merely the fact that it exists at all. Describing such populations is probably not in keeping with the original intent of the ICZN—but then neither was documenting the impact of global warming on mountaintop ecology. In days of crisis, survival mandates use of all available tools, not blind obedience to their original function.

FIGS. 1–3. **1.** Prototype of Grade 3 dark scaling along forewing medial and cubital veins, essentially causing the limbal region to appear to be banded by a row of rounded spots. The hindwing eyespot in this individual is developed to Grade 3 also, with a white pupil present, as is that in cell M_1. The DFW spots in cells M_3 and Cu_1 are developed to Grade 2, or subjectively to Grade 2 1/2. **2.** Prototype of Grade 2 dark scaling along forewing medial and cubital veins, with only the scaling along M_3 extensive enough to cause the light spot in cells M_2 and M_3 to appear to have rounded corners. The forewing M_1 eyespot is typical of Grade 2, with size not reduced, but pupil unexpressed. The Cu_1 spot is Grade 1 or 1/2. **3.** Prototype of Grade 1 dark scaling along the forewing medial and cubital veins, with scaling limited to the veins themselves and not spreading into the adjacent cells. The forewing Cu_1 spot of this and the middle specimen are typical of grade 1 development, with size reduced and white pupil absent. This specimen also has a Grade 1 hindwing eyespot. The occasional eyespot which is reduced in size, but still clearly pupiled is classified as grade 3. The bottom specimen is typical of the Socorro County isolate; dark limbal scaling is reduced as is the DHW eyespot.

Thus, my intent here is not to break new ground in evolution, taxonomy or ecology, but to leave a written record of what I saw after it can no longer be seen. To do this, I merely need find a trait which is unique to the Socorro Co. isolate. In this paper, I shall do no less and no more than this. As I have done before, I shall buttress my arguments for the distinctiveness of this new subspecies by statistical factors, so that observation of a single insect may be inadequate to skewer it with a subspecific identity (Holland 1988, 1995).

MATERIAL STUDIED

All specimens examined, excluding the Socorro County material, fall into the *Oeneis chryxus chryxus* classification. The Socorro Co. material is *Oeneis chryxus socorro*. Where not noted, specimens were taken by the author.

San Mateo Mts., Socorro County, New Mexico: 3-vi-72, Beartrap Campground, ca. 2 mi. W of Mt. Withington, 8000', 6 ♂♂ (including holotype); 25-vi-71, same loc., 2 ♀♀; 19-vi-71, same loc., ♀; 4-vii-71, same loc., ♂ & ♀; 8-vii-72, same loc., ♂; 10-vi-72, same loc, 2 ♂♂, 4-vii-71, 1 mi. W of Mt. Withington, 8800', ♂ & ♀; 10-vi-72, Big Pigeon Can., NE slope, 8600', 2 ♂♂; 4-vii-71, 2 mi. down Big Pigeon Can. from Crest F.S. Road, NE slope, 8500', ♀; 19-vi-71, Big Pigeon Can., 9000', 3 ♂♂; 19-vi-71, bottom of Monica Can., N slope, 7500', ♂; 21-vi-97, Monica Can, at Switch Springs, N slope, 7500', 3 ♂♂.

Jemez Mts., Sandoval County, New Mexico: 4-vii-83, Beaver Dam near Seven Springs, 8200', ♂; 4-vi-77, Smokey Bear Hill, 8400', 7 ♂♂ & ♀; 4-vii-77, Sec. 29, T19N R1E, Rito La Cueva, 8300', ♂; 23-vi-97, Sec. 33, T 19N R1E, Rito La Cueva, 8400', ♂ & ♀; 28-vi-68, UNM Biology Cabin, near Seven Springs, ca. 8200', leg. W. Morrison, 2 ♀♀; 17-vi-84, Cerro Pelado, S slope, 10,000', 15-vii-84, 2 ♂♂ & 2 ♀♀, U.S. F.S. Road 144 at Road Can., 8500', ♂.

Jemez Mts., Rio Arriba County, New Mexico: 23-vii-84, Sec.27, Rito Café, 9000', ♀.

Jemez Mts., Los Alamos County, New Mexico: 7-vii-85, Pajarito Ski Area, 10,000', ♀.

Sangre de Cristo Mts., Taos County, New Mexico: 19-vi-66, near Twining & Wheeler Peak at treeline, 11,600, 9 ♂♂; 19-vi-66, near Twining, 10,400', 4 ♂♂ & 7 ♀♀; 28-vi-93, Cerro Vista, near Chacon, ca. 10,000, 3 ♂♂ & ♀; 3-vii-66, Bull of the Woods, 11,000', ♂.

Sangre de Cristo Mts., Costilla County, Colorado: 5-vii-66, Whiskey Creek Pass, 12,000', ♀.

Sangre de Cristo Mts., San Miguel County, New Mexico: 21-vi-87, Hamilton Mesa, 10,200', leg S.J. Cary, ♂.

The question now arises, can the Socorro County material be separated from the Jemez material without looking at the collection data; i.e., are the two populations phenotypically distinct? It quickly becomes apparent that this question does not have a resounding affirmative response. Consequently, I selected 11 wing features for the males, and assigned each feature on each insect a value of 0 to 3, depending on its development in each insect. Features selected included ocellus expression, (0 for absent, 1 for small and unoscellated, 2 for small but oscillated, and 3 for large and fully oscillated), suffusion with dark scales, (0 for no dark scales, 1 for dark scales on vein only, 2 for enough suffusion to reduce the apparent area of the bounded

Figs.4–7. *Oeneis chryxus socorro*. Type pair: **4 & 5.** Holotype male, 3-vi-72, Beartrap Campground, ca. 2 mi. W of Mt. Withington, San Mateo Mts., Socorro County, New Mexico, 8000', leg. R. Holland. **6 & 7.** Paratype female, 4-vii-71, 1 mi. W of Mt. Withington, San Mateo Mts., Socorro County, New Mexico, 8800', leg. R. Holland. Left. Dorsal surfaces. Right. Ventral surfaces. Both types have a weakly developed (Grade 1) VHW band but strongly developed (Grade 3) VHW striations. The female paratype has all three DFW ocelli fully developed (Grade 3). The holotype has two Grade 2 1/2 ocelli and a Grade 1 ocellus on the DFW.

light cells, and 3 for enough suffusion to alter the apparent shape of the bounded light cells), degree of light/dark contrast between the VHW transverse light band and the dark inner and outer thirds of the VHW (0 for the band not present to 3 for the white band lighter in the extreme), size, and degree of VHW transverse striation (0 for none to 3 for extreme).

Refer to Figures 1–3 for illustrations of these states, but bear in mind their taxonomic definition rests entirely with the above verbiage, not at all with the guideline pictures. Assigned values were not necessarily integers.

Specifically, the 11 features of state mentioned above were:

1. Wingspread
2. Intensity of striation on the ventral surface (see Figs. 5 & 7)
3. Contrast of the hind wing medial band ventrally (see Figs 5 & 7)
4. DFW suffusion of veins with dark scales in medial region (see Figs. 1–3)
5. Development of the ocellus in DFW cell M_1
6. Development of the ocellus in DFW cell M_2
7. Development of the ocellus in DFW cell M_3
8. Development of the ocellus in DFW cell Cu_1
9. Presence and intensity of additional dorsal ocelli
10. Development of the ocellus in DHW cell Cu_1
11. Total ocelli score dorsally

I had 23 Socorro County males and 13 Jemez Mountains males to work with. Additionally, I had 19 males from the Sangre de Cristo Mountains of Taos County. Many of the latter were extreme high-altitude specimens taken up to 13,000'. Even before the *altacordillera* issue was raised, I did not place any taxonomic importance on differences in specimens taken 5500' above the Socorro County isolates. Statistically positive results for separation of Taos Co, from Socorro or Sandoval counties were never used to infer a Socorro/Sandoval separation.

Oeneis chryxus socorro R. Holland **new subspecies**

Diagnosis and description. Two of the 11 features tested distinct between Socorro County and the Jemez Mountains using Fisher's t-test at the 99% level (Hodgeman et al. 1957; Turner & Thayer 2001) (see Table 1 for summary of all my statistical data, raw and manipulated). Two more tested positive at the 95% level—I am not persuaded to take these latter two as decisive. If I run 11 tests and get back two 95% positives (where I would have expected one anyway), I have not proved anything.

The most positive test considered the amount of dark scaling along the male DFW veins—this gave a t of 5.72 (df = 34), which is far into the realm of statistical significance (see Figs. 1–3). The significantly different result is that the dark scaling is REDUCED in the Socorro County specimens. The other apparently decisive test considered the development of the DHW ocellus—this yielded a t of 2.96, which corresponds to a p of about one in 300 that my observations were purely chance related. Socorro County specimens have the DHW ocellus LESS developed. These two features each separate *O. c. socorro* at least statistically from all populations with which it could be confused, geographic factors considered.

The Taos County specimens also differed significantly from the Socorro County isolates in the dorsal scaling along the veins (t = 4.00, df = 40). They also differed ventrally in having a bolder transverse medial band on the hindwing (t = 3.23) and in having more intense transverse striations lateral to the band (t = 3.10).

The Taos County specimen eyespots did not differ from the Socorro ones in any way, at any level of significance. This result led me to be skeptical of the apparent significance in the ocellus difference observed between Socorro Co. and the Jemez Mts. There are seven ocellus-based tests between each population, or a total of 21 in the study. The fact that one test out of 21 showed a chance factor of 1 in 300 does not do it for me.

I am thus left with a single feature that differs enough to set aside the Socorro Co. population: reduced DFW suffusion along the veins of the central area of the wing of males.

All factors involved here are so subtle and all available female counts are so low that I elect to disregard all female factors in describing this taxon.

DISCUSSION

In general, as one progresses to higher altitude the dark markings on all butterflies tend to become more pronounced and individuals become smaller. These are well-known thermoregulatory or resource adaptations. Thus, some of the statistically significant differences in Table 1, especially wingspread, indicate statistically different environments, not genomes. Separation of these differences is, and likely will remain, largely a judgment call far into the future of taxonomy.

However, the Socorro Co. isolates do come from a warmer environment than typical *O. chryxus*. Thus, the air inside these veins at the hottest point (wing center) needs less and will receive less solar heating. If the veins are hollow, basking insects will be injected with less warmed, convected air than typical specimens. This argument is just different enough that I like it.

Discussion of Types: Illustrations, Data, and Disposition

The above-mentioned difference and the clear reproductive isolation from other populations suggest a distinct subspecific status. I therefore name this taxon *Oeneis chryxus socorro* R. Holland. Type specimens include the 23 males and six females. The holotype will be placed in the CNC and paratypes will be placed in stable repositories, including the McGuire Center in Florida, the Colorado State University collection, the CNC collection in Ottawa, and the Smithsonian. All illustrated and typical individuals will be so labeled.

Figures 4–7 illustrate the holotype and a female paratype of *Oeneis chryxus socorro*. The reduced limbal DFW venal scaling on the male is the feature which separates this entity from Sangre de Cristo and Jemez populations. I have only six female paratypes to work with, plus 10 specimens each from the Jemez and the Sangre de Cristo Mountains. Socorro County females are distinguished from Jemez females with over 99% certainty (t = 4.1) by the reduced intensity of the VHW transverse band. It is the small female sample size which makes the female-associated separation criterion seem shaky and potentially accidental to me. Consequently, I do not add any female-based criteria to the taxon definition or analysis.

Flight period is at least the end of May to late July. Male wingspread is 49.3 mm (n = 23, std = 2.0 mm), female is 53.7 mm (n = 6, std = 1.6 mm). The corresponding statistics for the Jemez Mountains sample are 47.9 mm (n = 13, std = 2.2 mm) and 51.0 mm (n = 10, std = 1.8 mm). For Taos County, the are 45.1 mm (n = 19, std = 2.3 mm) and 48.5 mm (n = 10, std = 1.8 mm).

The correlation between the Jemez Mts. butterfly fauna and the San Mateo Mts. fauna is 0.45 (Holland

TABLE 1. Statistical data & analysis for 11 parameters of *Oeneis chryxus socorro* males ($t_{95\%}$ = 2.04 (italicized); $t_{99\%}$ = 2.70 (**boldface**)).

Feature		1	2	3	4	5	6	7	8	9	10	11
	Parameter	Wingspan	∨ Striation	∨ Band	DFW	O1	O2	O3	O4	OX	HO	ΣO
Jemez	Ave.	47.92	1.692	2.538	2.154	2.923	0.08	1.385	1.846	0.0	2.385	8.62
n = 13	St.D.	2.234	0.630	0.519	0.554	0.280	0.280	1.325	1.140	0.0	1.12	2.28
Taos	Ave.	45.16	2.00	2.00	1.842	2.684	0.0	0.263	1.474	0/0	1.158	5.579
n = 19	St. D.	2.302	0.745	0.7339	0.688	0.477	0.0	0.205	1.041	0.0	0.834	1.924
df = 30	ttaos, jem	**-5.198**	2.057	1.613	*2.365*	**-3.61**	-1.17	**3.573**	-1.37	0.0	**-4.62**	**-4.46**
Socorro	Ave.	49.20	1.391	2.043	1.087	2.652	0.04	0.565	1.565	0.04	1.087	5.956
n = 23	St. D.	2.02	0.488	0.624	0.503	0.699	0.205	0.867	1.279	0.205	1.283	3.277
df = 34	tsoc, jem	1.811	-1.531	*-2.358*	**5.721**	-1.30	-0.41	*2.166*	-0.64	0.735	**-2.96**	*-2.37*
df = 40	tsoc, taos	**6.019**	**-3.102**	**-3.234**	**4.000**	-0.17	0.893	1.328	0.245	0.893	-0.29	0.433

2009). Use of my recently published Antiquity Formula (a = 100,000$(1 - \rho)^{2.5}/(1 + \rho)^{1/2}$) (Holland 2009) yields 18,600 years for the age of this new taxon. The antiquity via direct colonization from the Sangre de Cristo Mts. is not much greater: ρ from Raton Mesa to the San Mateo Mts. is 0.42, implying a = 21,500 years.

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