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Examination of the status of *Phyciodes tharos distincta* Bauer, 1975, confirming it as a valid subspecies.

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ABSTRACT. The subspecific status of *Phyciodes tharos distincta* is reexamined. A specimen series from southern Arizona reveals that *distincta* shows a distinct, unique phenotype dissimilar from eastern North American nominotypical *P. t. tharos.* Subspecies *distincta* occupies a very limited range in extreme southeastern California, southern Arizona, and northwestern Mexico. A lectotype is designated.

Additional key words: Lectotype, subspecies, RGB and HSB color analysis.

INTRODUCTION

From its original description (Bauer, 1975), *Phyciodes tharos distincta* was recognized as a subspecies inhabiting the far southwestern corner of the United States and parts of northwestern Mexico. In recent treatments on the *Phyciodes tharos* complex, Scott (1992, 1994, 1998) asserted that *distincta* is a mere synonym of eastern, nominotypical *P. tharos tharos*, or at best, a "weak subspecies". Having myself spent a lifetime among hordes of *tharos* in field habitats throughout the eastern U.S., I dispute Scott's assertion that *distincta* is nothing more than a synonym of nominotypical *tharos*. Specimens in my possession from southern Arizona show a unique phenotype, clearly differentiated from nominotypical *tharos* by size, ground color and expression of wing pattern. This paper makes the comparison and demonstrates the difference between nominotypical *tharos* and *distincta* (**Fig. 5**). The suggestion that *distincta* is a "weak" subspecies (Scott, 1994) appears to be one of personal interpretation.

PRIOR PUBLISHED OBSERVATION OF INTEREST

Emmel & Emmel (1973), prior to the description of *distincta*, provided some interesting observations on *tharos* in southeastern California. The authors list *tharos* instead as "near *pulchella*", noting that Gunder (circa 1930) found the species in the Imperial Valley being phenotypically different from typical *tharos.* There are no published records of *pulchella* in the Imperial Valley to date, thus this previous reference applies to *P. t. distincta*. The historical presence of *tharos* in the Imperial Valley is attributed to the introduction of irrigation and *tharos* doubtfully previously resided in the area's natural desert habitat.

PHYCIODES THAROS DISTINCTA BAUER (1975), ORIGINAL DESCRIPTION

Miller & Brown (1981) stated, quite eloquently: "This name is another proposed by Bauer in a rather unsatisfactory manner. In this instance the type-locality is given, but no types are designated, nor are they figured." The original description by Bauer (in Howe, 1975) follows:

> (b) **distincta** Bauer. This subspecies has a complete pattern of fine lines on the upper surface, is very constant in wing pattern above, and rarely has the blotchy, irregular appearance so common in individuals of *tharos tharos.* The cool weather form is scarce and appears only during midwinter over most of its range. Similar individuals appear in colonies of typical *tharos*, and there is a broad blend zone of the two populations in Texas and northeastern Mexico.
>
> *Distribution:* The type locality is Calexico, Imperial county, California. This is a predominantly Mexican subspecies, ranging south to the Sierra Madre del Sur and occurring in the United States along the lower Colorado River north to Moab, Utah, and in a blend zone with nominate *tharos* from southeastern Arizona into Texas.

A holotype was not designated in the original description of *P. tharos distincta* (ref. ICZN Article 73.1.3). The supposed holotype reportedly residing in the collection of the Natural History Museum of Los Angeles County (Ferris, 1989, Scott, 1998) was not found per Weiping Xie, Collections Manager, Natural History Museum of Los Angeles County (pers. comm.), though there is a unit tray labelled as all "paratypes" (**Fig. 1**). However, these cannot be treated as paratypes as the yellow note indicates they were designated by Bauer on 4-13-1982; and at least 8 of the males (rows 2-4 from top) cannot be paratypes as they were collected during the period of Sept. 12-15, 1982. The older specimens in row 1 may be syntypes. No specimens in the unit tray actually bear "paratype" labels. However, Nick Grishin (pers. corr.) photographed two specimens labelled as "paratypes" (**Figs. 2 & 3**) in the collection of the McGuire Center for Lepidoptera and Biodiversity. Discussion with Crispin Guppy (pers. corr.) suggests that, since no holotype was designated in the original description of *distincta*, these are all syntypes (ICZN Article 73.2) from which a lectotype can be designated (ICZN Article 74.1).

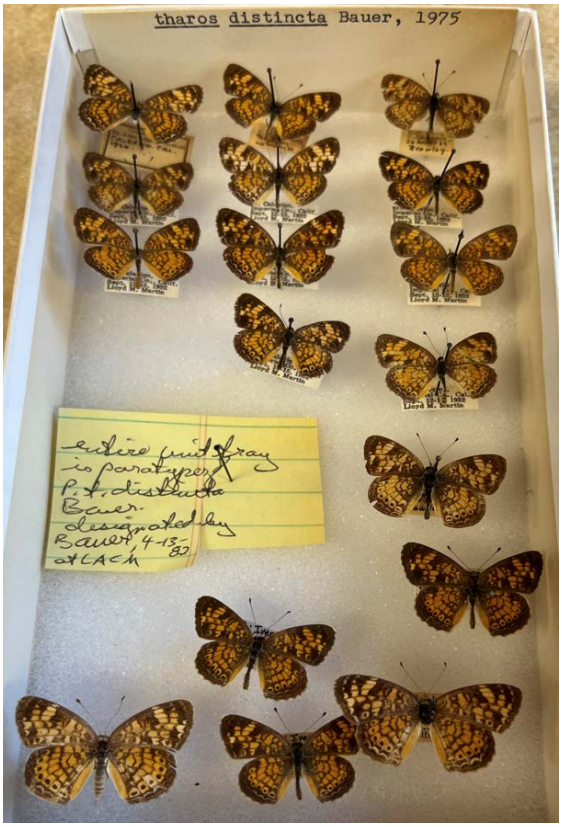

Fig. 1. Unit tray of *P. t. distincta* in the Natural History Museum of Los Angeles County. Photo courtesy of Weiping Xei, Collections Manager of Entomology.

Fig. 2. *Phyciodes tharos distincta* male "paratype". Now designated as lectotype. Photo courtesy Nick Grishin and McGuire Center for Lepidoptera and Biodiversity.

Fig. 3. *Phyciodes tharos distincta* female "paratype". Now designated as paralectotype. Photo courtesy Nick Grishin and McGuire Center for Lepidoptera and Biodiversity.

I designate the specimen in Fig. 2 as LECTOTYPE of *Phyciodes tharos distincta* Bauer, 1975 with the following data: California, Imperial County, Calexico, May 5, 1934, leg Lloyd M. Martin; det. D. L. Bauer; ex-D. Bauer collection via J.D. Turner collection; MGCL Accession #2010-29; DNA sample ID: NVG-21067H12, c/o Nick V. Grishin. The specimen resides in the McGuire Center for Lepidoptera and Biodiversity.

SUBSEQUENT (POST-1975) TREATMENT IN THE LITERATURE

Miller & Brown (1981) treated *distincta* at subspecies rank.

Hodges (1983) treated *distincta* at subspecies rank but emended the name to *distinctus* per the ICZN.

Tilden & Smith (1986) interestingly, did not include *P. tharos* for the western states. Rather, they treated populations in southeastern California east to western Texas and Mexico as subspecies *P. pascoensis distinctus.*

Ferris (1989), under species entry 161:623c commented: "To conform to the CODE, emend spelling to: **distinctus**." [This emendation has not been adopted by some subsequent authors.] Ferris treated *distinctus* at subspecific rank. However, Ferris made an interesting comment: "In south-central Wyoming and along the Arizona-New Mexico border, there are *tharos* populations that will probably prove to be distinct species (C. G. Oliver, *in litt.*)."

Bailowitz & Brock (1991) treated southeastern Arizona *tharos* as ssp. *tharos*, but commented: "True *tharos*, which occurs at least in southern Arizona, has its subspecific taxonomy in confusion as well. Material from the region appears most like nominotypical *tharos* and less like *distincta* Bauer." They give the habitat as "agricultural and riparian areas, occasionally from the more wooded canyons". Early/late flight dates are Mar. 22 to 13 Nov.

Brown, et al. (1992) treated *distincta* at subspecies rank.

Scott (1992) stated: "…distincta Bauer (type locality Calexico, Imperial Co., Calif.) is a synonym of tharos (unless distincta is used for the southern populations with white-and-black antenna clubs, tharos for northern populations with orange-and-black antenna clubs), and even tharos from central Mexico do not differ appreciably from SE U.S. tharos." [The present paper opts to follow Scott's assertion: "…distincta is used for the southern populations with white-and-black antenna clubs", though the range is more restricted to the SW U.S.].

Scott (1994) stated: "The name distincta Bauer (1975) (figs. 86-89), type loc. Calexico, Imperial Valley Calif., is a synonym of tharos based on the series of adults I examined. The unf black spots appear to be a little smaller than typical tharos, and one female (fig. 89) has somewhat less black ups markings than typical tharos, and one female has the tip of lamella paraostialis a little more rounded than tharos and more like riocolorado, but distincta is closer to tharos than to riocolorado in wing pattern and genitalia, so I treat distincta as a synonym of tharos; at best it is a weak ssp. for splitters." Scott illustrated "syn. "distincta"" with specimens from Calexico and Brawley, CA., on page 113. [The few male specimens of Utah *riocolorado* in my possession are practically identical to ssp. *tharos* males (**Fig. 7**), contrary to Scott's assertion, whereas *distincta* is recognizably different from both. See comments below.] Scott, citing Bailowitz & Brock (1991) listed the host as *A. subulatus* var. *ligulatus* in Arizona. However, Bailowitz & Brock (1991) listed the host as *Aster exilis*, a *nomen dubium* revised as *Symphyotrichum divaricatum* (USDA, 2022).

Scott (1998) simply listed, in the synonymy of *tharos* species-group: "=distincta Bauer, 1975, type LACM (=Natural History Museum Los Angeles County) (Ferris, ed., 1989)."

Emmel, *et al.* (1998) listed *distinctus* at subspecific rank in their California checklist.

Austin (1998) listed *distinctus* at subspecific rank in the Nevada checklist.

Bailowitz & Brodkin (2007) gave the following habitat description for *P. tharos*: "This is a species of riparian areas, predominantly in the southern reaches of the state. It frequents permanent watercourse edges, lakesides, and cienegas [permanently saturated, alkaline, freshwater, spongy, wet meadows], especially those with asters, beggarticks, and buttonbush."

Pelham (2008-2023) listed *distincta* as a junior synonym of *P. t. tharos* and comments: "Location of holotype not known".

METHODOLOGY

Color analysis was performed using the Color Grab™ cellphone application (www.loomatix.com), version 3.9.2, to establish exacting RGB and HSB color codes under "daylight" fluorescent lighting, in combination with the Colblindor™ application (www.color-blindness.com/color-name-hue/) to produce refined color swatches rather than giving generalized color descriptions as is traditional with taxon descriptions. Two different areas of the wings were measured for their red/green/blue (RGB) and hue/saturation/brightness (HSB) color codes. Ground color was measured on the dorsal hindwings, which showed a more consistent, stable color in each of the two series (dorsal forewing color showed slight variation between the postmedian ground color vs. remainder of the dorsal wings, on different specimens). Darkness of the black

pattern in each series was performed on the outer portion of the forewings either near the apex or tornus. The ventral surfaces were not analyzed, due to considerable variation across both subspecies. 300 males and 196 females of subspecies *tharos* from many areas of eastern North America (N.C., VA., W.V., MD., N.Y. and R.I.) were analyzed, while 50 males and 31 females of subspecies *distincta* (all from Santa Cruz Co., AZ.) were analyzed. All specimens were of summer phenotypes [sufficient numbers of spring specimens of *distincta* were not available]. Color codes of individual specimens were then averaged to produce results for each subspecies (**Fig. 4**). Color names in the description of each of the four species references the color names given in the Color Grab™ and Colblindor™ applications. Of particular interest are the differing results of the color analysis vs. visual comparisons. While the human eye perceives a decidedly paler overall appearance in *distincta* (**Fig. 5**), the color analysis tools show fairly similar colors in the two areas examined (**Fig. 4**). The color analysis tools do, however, reveal a difference in ground color and slight difference in "blackness" of the wing patterns, between series of females. Males of both subspecies are fairly similar. The comparisons are made between specimens of "fresh" condition.

Additionally, wing measurements were made from the examined series. Measurements were made of forewing length (**Fig. 4**). These were then averaged and a range and mode for each was determined. Interestingly, specimens of *distincta* showed more consistent measurements, while *tharos* showed considerably more variation in wing measurements.

PHENOTYPIC COMPARISON

Southern Arizona *distincta* differs from eastern nominotypical *tharos* as follows:

Size. Male *distincta* are slightly smaller than nominotypical *tharos* (**Fig. 4**). The length of the male forewings of the examined *distincta* series ranges 13-16 mm, averaging 14.5 mm, whereas eastern U.S. *tharos* males averaged larger, ranging 12-19 mm, averaging 15.6 mm. The mode was, interestingly, similar at 15 mm for both subspecies. Female *distincta* are larger than males, ranging 15-18 mm, averaging 16.5 mm, whereas eastern U.S. *tharos* females averaged slightly larger, ranging 15-20 mm, averaging 17 mm. The mode was also similar at 17 mm for both subspecies.

Dorsal ground color. The ground color of *distincta* males and females is generally a concolorous brown-orange ("Peru" in males, "Golden Bell" in females) (**Fig. 4)**, whereas the ground color of *tharos* males and females is generally more orange than brown ("Ochre" in males, "Fire Bush" in females). Some females show a very slight amount of lighter ground coloration in the postmedian area of the forewings. Visually, the ground color of nominotypical *tharos* in the eastern U.S. is a brighter orange than *distincta*, which has a paler look (**Fig. 5)**. This is less apparent in the males, but more apparent between females of both subspecies. [Interestingly, the color analysis tools did not pick up the intensity of the dark patterns, rather just the base color.

Dorsal pattern and color of markings. The wing markings of *distincta* males and females are dark ("Cocoa") brown (**Fig. 4)**. Males of nominotypical *tharos* are similarly dark ("Cocoa") brown, whereas females are a blackish ("Livid") brown. Visual comparison of the wings reveals that the wing markings of *distincta* are distinctly paler, giving a more brownish look compared to nominotypical *tharos*, on which the wing markings are black and sharp. In *distincta*, the postmedian orange band in the males is generally more broken than in *tharos*, whereas *tharos*

males have a more continuous band. In *distincta* the pattern of markings is more consistent, and not as variable as in *tharos*. In nominotypical *tharos*, the postmedian line on the male hindwings is variably developed and often broken in mid-section, washed out by the orange ground color. *Distincta* males always have this postmedian line fully-developed. In nominotypical *tharos*, the males have a wider marginal wing pattern, giving a darker appearance, whereas, in *distincta* the outer wing pattern is narrower, giving specimens a lighter overall appearance. The contrast between females of both subspecies is striking (**Fig. 5**). Nominotypical *tharos* females generally have heavier infuscation on the basal portion of the forewings, giving specimens a considerably darker appearance, whereas in *distincta* females, this infuscation is generally lacking and the underlying pattern is more visible, giving them a lighter appearance. In general, *distincta* has a pallid appearance, compared to nominotypical *tharos*.

Ventral color and pattern. The general appearance of the ventral hindwings of *distincta* males is somewhat paler than in nominotypical *tharos*, though coloration is highly variable in both (**Fig. 6**). Male *tharos* have a more extensive, brighter orange wash on the forewings, whereas in *distincta* this feature is somewhat broken up by a subdued, weblike pattern. The black pattern on the outer portion of the ventral forewings is darker and more developed in nominotypical *tharos*. The females of both subspecies display similar, highly variable coloration and pattern. The only appreciable difference between adults of nominotypical *tharos* and *distincta* is in the brown marginal patch of the hindwings. In *distincta* this patch is of a paler browner shade, whereas in nominotypical *tharos* it is generally darker brown. This is more evident in the males.

Species	Dorsal HW ground color	Dorsal HW ground color RGB color code HSB color code	Dorsal FW patch	Dorsal FW patch RGB color code HSB color code	FW length average (mm)	FW length range (mm)	FW length mode (mm)
P. t. tharos males		207, 131, 33 33, 84, 81		21, 14, 11 18, 47, 8	15.6	12-19	15.0
P. t. distincta males		206, 139, 59 32, 71, 80		49, 35, 27 21, 44, 19	14.5	13-16	15.0
P. t. tharos females		226, 157, 62 34, 72, 88		49, 41, 39 12, 20, 19	17.0	15-20	17.0
P. t. distincta females		201, 134, 54 32, 73, 78		56, 39, 31 19, 44, 21	16.5	15-18	17.0

Fig. 4. Color analysis results (average colors) and wing measurements of *P. t. tharos* and *P. t. distincta.*

Wing shape. While variable, the outer margin of the forewings of nominotypical *tharos* tend to be more rounded, whereas the outer margin of *distincta* is straighter, appearing slightly concave in some specimens. This is more noticeable in series of males (**Fig. 5**).

Fig. 5. Comparison of *P. tharos tharos* and *P. tharos distincta*. Males in left panel, females in right panel. ***P. t. tharos*** males (column 1), top to bottom: Pendleton Co., W.V.; Tucker Co., W.V.; Union Co., N.C.; Fauquier Co., VA.; Frederick Co., VA.; Frederick Co., VA. ***P. t. distincta*** males (column 2): all Santa Cruz Co, AZ. ***P. t. tharos*** females (column 3), top to bottom: Randolph Co., W.V.; Fauquier Co., VA.; Fairfax Co., VA.; Randolph Co., W.V.; Randolph Co., W.V.; Fauquier Co., VA. ***P. t. distincta*** females (column 4): all Santa Cruz Co, AZ.

Fig. 6. Comparison of *P. tharos distincta* (left side) and *P. tharos tharos* (right side) venters. Males in upper row, females in lower row. Male and female *P. t. distincta* from Santa Cruz Co., AZ. Male *P. t. tharos* from Haywood Co., N.C.; female from Fairfax Co., VA.

DISTRIBUTION

The range of *distincta* has yet to be refined and requires further study. Based on literature sources, specimen series and images posted to butterfliesofamerica.com (accessed 16 Jan. 2023) and iNaturalist.org (accessed 16 Jan. 2023), the range in the United States can be defined primarily as extreme southeastern California (Imperial, Riverside and San Bernardino Counties) and south-central Arizona (Pima, Santa Cruz and Yuma Counties). Most records are clustered south of Tucson to the Mexican border. In Arizona, individuals in Cochise and Graham Counties show intergradation to nominotypical *tharos*. All New Mexico records appear to be nominotypical *tharos* with some individuals appearing slightly intermediate to *distincta*. All of Texas appears to be within the range of nominotypical *tharos*. In Mexico, *distincta* is reported from the state of Baja California (Baja California Norte). Images posted to butterfliesofamerica.com show candidate *distincta* specimens down the west side of the northern half of Mexico, in Sonora and Nayarit states, essentially west of the Sierra Madre Occidental. However, examined images in iNaturalist indicate all other Mexican populations east of the Sierra Madre Occidental and in the southern half of Mexico are closer to nominotypical *tharos*. Thus, *distincta* is confined to a very small range along the California and Arizona border with Mexico, and possibly south along the Mexican Pacific Coast region, and may be considered an endemic of the region.

COMMENT ON *P. THAROS RIOCOLORADO*

Scott (1992) described *Phyciodes tharos riocolorado* (initially as *Phyciodes tharos/morpheus riocolorado*): "Adults…are characterized by having the same pattern of dark lines as typical Phyciodes tharos/morpheus tharos but the black borders are narrower, and the overall upperside color is more ochre-orange (less reddish-orange) than other tharos populations (adults vary little in upperside color)…This subspecies is not enormously different from ssp. tharos." In agreeing with Scott's latter point, a series of reared male specimens from Grand County, UT. in my possession, as well as images in iNaturalist from Utah, are essentially indistinguishable from reared nominotypical male *tharos* (**Fig. 7**), by shade of orange and by extent of markings, and fall well within the range of variation of nominotypical *tharos*. Females in the Utah series differ from nom. *tharos* mainly by having less extensive and less heavy black infuscation on the basal half of the dorsal forewing (**Fig. 7**), as Scott (1994) noted, which characterizes many *tharos* females. This gives *riocolorado* females a "paler" look, and fairly similar to *distincta*. Thus, I am inclined to view *riocolorado* as a weak subspecies based on a single female character (basal dorsal infuscation). A better set of character differences need to be identified, especially for the males [outside the scope of this paper].

Scott (1994) asserted: "This ssp. has blackish antenna clubs, whereas the clubs are orange on E. Colo. tharos, indicating that riocolorado derived from lower Colorado River (W Arizona/SE Calif.) stock rather than western Great Plains stock which has orange antennae." [Western Great Plains orange-antenna populations are now deemed to be species-level *Phyciodes orantain* (Zhang, et. al., 2022)]. Due to extreme similarity to nominotypical *tharos* males (**Fig. 7**), I contend that *riocolorado* is likely derived from nominotypical *tharos* stock, with females appearing more like *distincta*. Thus, *riocolorado* can be viewed as an intermediate population. Scott continued: "When I named riocolorado I described the wings are oranger, but actually the orange seems to be about the same tint as ssp. tharos but the wings appear paler because the black markings are much

smaller, even on unf the black spots are smaller." [See comments above, regarding dorsal differences in females.] Scott goes on to describe other minor differences from nom. *tharos*, mainly in the shape of the genitalia and differences in the larvae and pupae. I consider *riocolorado* a weak subspecies but propose no changes to nomenclature here.

Fig. 7. Comparison of three subspecies of *P. tharos*. Subspecies *distincta* (left side), Santa Cruz Co., AZ.; subspecies *riocolorado* (middle), ex-ova, Grand Co., UT.; subspecies *tharos* (right side), Pendleton Co., W.V. Males in top row, females in bottom row.

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