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AN EXTRAORDINARY NEW SUBSPECIES OF *ANTHOCHARIS SARA* LUCAS (LEPIDOPTERA: PIERIDAE) FROM REDWOOD NATIONAL PARK, CALIFORNIA

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ABSTRACT: A new subspecies of *Anthocharis sara* is described from Redwood National Park, Humboldt County, California. It is characterized by females having a diffuse pale yellow ground color and most remarkably, the near absence in many specimens of the usual reddish orange apical patch which is replaced by a deep yellow patch. It is apparently geographically restricted to the Bald Hills area of Redwood National Park in Humboldt County and is univoltine in mid-May to mid-June, in contrast to nominotypical *sara* which normally has an early spring brood (form "*reakirtii*") and a late spring second brood (form "*sara*") in California populations.

KEY WORDS: endemic, biodiversity, old growth Redwood forest, Coast Redwood.

INTRODUCTION

Nominotypical *Anthocharis sara* Lucas (type locality: restricted by Emmel *et al.* (1998a) to Queen Lily Campground, near Belden, north fork Feather River, 2400' elevation, Plumas County, California) is widespread at low to mid elevations in cismontane California from the Sierra Nevada foothills to the North Coast Ranges, South Coast Ranges, and southern California. Early spring specimens of *A. sara* are smaller, more darkly marked ventrally, and are referred to as form "*reakirtii*"; this form is taken as early as late December or early January in southern California and more frequently in March and April in northern California and at slightly higher elevations. The more

“typical” form of *sara*, known as form “*sara*”, represents the second brood individuals, which are more abundant in years of above-normal winter precipitation and may be absent in dry years. The phenotype of these second brood individuals is larger than the spring phenotype, and more lightly marked ventrally but with the same degree of orange apical scaling dorsally in both sexes.

In 2003, Ken Hansen of McKinleyville, California, informed us of an extraordinary phenotype of *Anthocharis sara* which flew in the Bald Hills area of Redwood National Park in Humboldt County. As we were already in the process of making arrangements with Redwood National Park staff to conduct a survey of the butterfly fauna of the Park, we made plans to try to obtain additional specimens of this butterfly in the spring of 2004. The Park was visited in late May 2004, with adults collected at that time as well as eggs, and we visited again in May and June 2005 to collect additional material. This distinctive new subspecies is described as follows.

***Anthocharis sara sempervirens* J. Emmel, T. Emmel, & S. Mattoon,
new subspecies**

Figs. 1, 2 (♂), 3,4 (♀)

Description. MALE. Holotype forewing length = 21 mm. Dorsal surface white with a slight creamy cast, the creamy cast more pronounced on the hindwings in most specimens. Apical deep orange patch and black markings similar to nominotypical *sara*. Marginal black markings on hindwing similar to nominotypical *sara*. Black scaling in basal areas of both forewing and hindwing similar in extent to that of nominotypical *sara*.

Ventral surface with markings similar to *A. sara* form “*reakirtii*,” but with lighter olive green mottling on secondaries and on apical areas, still covering approximately the same extent as on nominotypical *sara* form “*reakirtii*”.

Head covered with mixture of long black and white scales, giving a dark gray appearance overall except for a white margin around sides and venter of each eye. Antennae with gray-tipped black clubs and grayish shafts. Thorax and abdomen black on dorsal surface, gray on ventral surface and sides. Legs basically tan in color with long light gray or whitish scales on leg segments above tarsi.

FEMALE. Allotype forewing length = 20 mm. Dorsal surface of forewing is a pale yellow ground color. Black bar at distal end of discal cell developed to same degree as in nominotypical *sara*. Black markings of marginal area on both forewing and hindwing similar in extent to nominotypical *sara*. Apical area of forewing which is normally covered with deep orange scaling in nominotypical *sara* is largely replaced by deep lemon yellow scaling, with a trace of medium orange scaling at the posterior edge of the deep lemon yellow apical patch; in some specimens, there is more extensive medium orange scaling in the apical patch area but only rarely developed to the same degree as nominotypical *sara*. In the specimens with more developed orange apical scaling, the wings are bordered distally with lemon yellow scaling. Wing veins are strongly yellow on both surfaces of hindwings and in yellow apical forewing patch.

Ventral surface. The olive green scaling on apical area of forewing and on hindwing is developed to almost the same degree as the slightly darker scaling in nominotypical *sara* form “*reakirtii*”. Area of apical orange scaling in nominotypical *sara* is replaced by medium yellow scaling in most specimens; in those females which have a greater degree of orange scaling in the apical area dorsally, there is a suffusion of medium orange scaling in the apical area of the ventral surface, but only rarely to the same degree as in

nominotypical *sara*; additionally, this orange scaling is of a paler hue than in nominotypical *sara*. Wing veins are strongly yellow on distal half of forewing and on entire hindwing, as compared to tan to pale orange venation in typical *sara*.

Head, thorax, abdomen, legs and antennae as in male. Reared adults in both sexes are identical to field-caught adults.



Figures 1-8. *Anthocharis sara* from northern California (D = dorsum, V= venter). **1-2)** *A. sara sempervirans*, holotype ♂, D, V, from Humboldt County type locality, data in text; **3-4)** *A. sara sempervirans*, allotype ♀, D, V, data in text; **5-6)** *A. sara* form “*reakirtii*” ♂, D, V, from Plumas County type locality, data in text, 25 March 1978; **7-8)** *A. sara* form “*sara*” ♀, D, V, data in text.

Types. HOLOTYPE male: California: Humboldt County; Redwood National Park; along Bald Hills Road, 16.3 road miles SE of Highway 101, 0.4-0.5 air mile west of Schoolhouse Peak, 2400-2600 feet elevation; SE 1/4 of S24, T9N, R2E.; 26 May 2005; *leg.* Ken Hansen. ALLOTYPE female: California: Humboldt County; Redwood National Park; along Bald Hills Road, 16.6 road miles SE of Highway 101, 0.4-0.5 air mile west of Schoolhouse Peak, 2400-2600 feet elevation; SE 1/4 of S24, T9N, R2E.; *ex* female taken 19 May 2004; reared on *Brassica geniculata*; emerged 17 March 2005; *leg.* John F. Emmel. PARATYPES (21 males, 22 females; all Humboldt County, California): 1 male, same data as holotype; 6 males, 7 females, same data as allotype, emergence dates in March 2005 and March 2007; 1 female, same locality data as allotype, 19 May, 2004, *leg.* John F. Emmel; 1 male, along Rock Fork Road, 1.1 road miles SSE of junction with Bald Hills Road, on SW-facing slopes of Coyote Peak, 2700-2800 feet elevation; S32, T9N, R3E; 13 June 2005; *leg.* John F. Emmel; 2 males, 2 females, same locality as previous, *ex* female 13 June 2005, emergence dates May 2006 and March 2007, *leg.* John F. Emmel; 2

males, 3 females, same data as previous, *ex ova* on *Arabis glabra*, emergence dates June 2006 to March 2007, *leg.* John F. Emmel; 1 male, same locality as previous, 13 June 2005, *leg.* S. O. Mattoon; 2 males, 1 female, same locality data as previous, 30 May 2007, *leg.* S.O. Mattoon; 2 males, 4 females, along Rock Fork Road 0.9 road mile S. of junction with Bald Hills Road, 0.2 air mile SW of Coyote Peak, 2640-2650 feet elevation; NW 1/4 of S32, T9N, R3E; *ex ova* on *Sisymbrium officinale* 19 May 2004, emergence dates March 2005 to March 2007, *leg.* John F. Emmel; 1 male, 1 female, SE end Bald Hills, along road crossing tributary of Coyote Creek, 1.2 air miles S. & 0.2 air mile E. of Schoolhouse Peak, 1830-1840 feet elevation; SE 1/4 of S30, T9N, R3E.; *ex ova* on *Arabis glabra* 19 May 2004, emergence dates February 2007, *leg.* John F. Emmel; 2 males, 2 females, same locality data as allotype, 19 May 2004, *leg.* S.O. Mattoon; 1 male, 1 female, Bald Hills Road 0.5-2.5 road miles E. of Redwood National Park boundary, 2 air miles SSE of Schoolhouse Peak, 2900 feet elevation, S28 & S29, T9N, R3E; 31 May 2007; *leg.* S.O. Mattoon.

Deposition of types. The holotype, allotype, and 35 paratypes will be deposited at the McGuire Center for Lepidoptera and Biodiversity, University of Florida, Gainesville, Florida. Six paratypes will be deposited in the following collections: Natural History Museum of Los Angeles County, Los Angeles, California; Redwood National Park collection, Humboldt County, California; two paratypes in collection of S.O. Mattoon, Chico, California.

Type locality. California: Humboldt County; Redwood National Park; along Bald Hills Road 16.3 road miles southeast of Highway 101, 0.4-0.5 air mile west of Schoolhouse Peak, 2400-2600 feet elevation; SE 1/4 of S24, T9N, R2E.

Etymology. The name of this subspecies is derived from the species name of the Coast Redwood, *Sequoia sempervirens*, which is locally common on the lower slopes just to the west of the type locality of this butterfly.

Distribution and phenology. Thus far, this taxon is known only from the Bald Hills area of Redwood National Park, within an elevation range of approximately 1800-3000 feet. The typical habitat is an open Kellogg Oak woodland with an open understory which includes the primary larval host plant, Tower Mustard, *Arabis glabra* (L.) Bernh. (Brassicaceae). Eggs are also deposited on *Sisymbrium officinale* (L.) Scop. (Brassicaceae), an introduced exotic mustard. This Kellogg Oak woodland is interdigitated with North Coastal Prairie and the areas where the butterflies fly include the edges of these grassland areas. Approximately 10 air miles to the east of the type locality, in the vicinity of the town of Weitchpec along the Trinity River, Ken Hansen has collected nominotypical *sara*. These nominotypical *sara* populations fly fully a month earlier than the Bald Hills *sempervirens* population. At the time that these more inland nominotypical *sara* are in flight, the Bald Hills area is still experiencing late winter conditions, and no butterflies are flying there.

The main flight of *A. s. sempervirens* is from mid-May to mid-June, with a peak in early June. In mid-April, the vegetation is still in late winter status; by July, the vegetation is dead and dried at this site. Hence, *A. sara sempervirens* appears to respond as a univoltine montane (Sierra-like) population at this relatively low coastal range elevation. This is the second species of pierid butterfly now known to be confined to the coastal redwoods zone (in addition to *Pieris marginalis sequoia* J. Emmel, T. Emmel & Mattoon, 1998b, changed from *napi* to *marginalis* in Pelham (2008)).

DIAGNOSIS AND DISCUSSION

We illustrate nominotypical *A. s. sara* form “*reakirtii*” (Figs. 5-8) from the Feather River Canyon (Queen Lily Campground), Plumas County, California, for comparison with the new subspecies. Females of *A. s. sempervirens* are readily distinguished from nominotypical *sara* by the great reduction of orange scaling in the apical area of the forewing, as well as the pale yellow ground color. Males of *sempervirens* generally resemble nominotypical *sara* dorsally. Both sexes of *sempervirens* are marked ventrally with lighter olive green blotches. The new subspecies is also distinguished from nominotypical *sara* by its univoltine phenology and relatively late flight period for the elevation at which it flies. It uses the same host, *Arabis glabra*, that is used by nominotypical *sara*. Nominotypical *sara* and *A. s. sempervirens* populations approach within approximately 10 miles of each other without any evidence of intergradation of phenotype or phenology.

The presence of this unique butterfly inside Redwood National Park, coupled with the concomitant loss of old growth Redwood forest and disturbance of the adjacent habitats by logging operations and environmental changes, show once again the importance of this federal park in setting aside land that protects not only the flagship species of the Coast Redwood, but also other unique organisms. This butterfly is a beautiful symbol of the uniqueness of the extreme northwestern coastal California biota, and undoubtedly other distinct butterflies and other undescribed organisms may yet be found. We note, for example, that in Smith and Wheeler (1992), *A Flora of the Vascular Plants of Mendocino County, California*, the authors marvel at the thought that some 2,746 plant taxa and 770 genera representing 127 families occur in the study area of a single northwestern California county. The rich possibilities that await further discovery in the North Coast ranges were discussed by Smith and Wheeler, who discovered five plants new to California as well as hundreds of new county records.

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