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A new subspecies of *Colias flaveola* BLANCHARD, 1852 from Central Peru (Lepidoptera: Pieridae, Coliadinae)

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Abstract

A new subspecies of *Colias flaveola* BLANCHARD, 1852, which is white in both sexes, is described from the mountain massif Cordillera de la Viuda of the Andes of Central Peru: *Colias flaveola viuda* ssp. n.

Introduction

Colias flaveola BLANCHARD, 1852, is a small Andean clouded yellow with colouration varying from almost white to almost black; so far a few subspecies of *C. flaveola* have been described: *weberbaueri* STRAND, 1912, *mossi* ROTHSCHILD, 1913, *nigerrima* FASSL, 1915, *blameyi* JÖRGENSEN, 1916, *mendozina* BREYER, 1939, *erika* LAMAS, 1981, *benyaminii* VERHULST, 2016, *cora* KIR'YANOV, 2017, *laura* KIR'YANOV, 2017, and *harai* KIR'YANOV & VALENCIA, 2018. All of these *C. flaveola* subspecies occur only in the high Andes, following the meridional extent of this mountain system, at altitudes of 3100 to 4700 m.a.s.l. Of the listed subspecies, males of the first five taxa are dark overall and the last five plus the nominotypical subspecies are pale, tending to a white ground colour (females of the latter group of subspecies are also white and females of the former group are of a variable shade of gray). Interestingly, the pale subspecies of *C. flaveola* are endemic to the western slopes of the Andes, inhabiting higher altitudes (above 3900–4000 m.a.s.l.) whereas the dark ones are endemic to the eastern slopes, inhabiting altitudes from 3100 to 3900 m.a.s.l. (Fig. 1). Note that I consider herein all the taxa listed above as *bona* subspecies of a single species ('superspecies'), *C. flaveola*, whereas some authors accept *flaveola*, *weberbaueri*, *mossi*, *blameyi*, *mendozina*, and *erika* as full species (VERHULST 2013, BENYAMINI *et al.* 2014).

Results

Having made a series of trips to South America, resulting in descriptions of a few new *Colias* taxa (KIR'YANOV 2017a, KIR'YANOV 2017b; KIR'YANOV & VALENCIA 2018; KIR'YANOV 2019), I undertook one more expedition, from April 28 to May 2, 2019 to the high Andes northeast of Lima, namely, in the vicinity of Cordillera de la Viuda, a mountain massif ~50 km in length with a maximum height of ~5500 m.a.s.l. (Figs. 1 and 2a). Nowadays easily accessible, this place was infrequently visited in the past by specialists in Lepidoptera and collectors. *Colias* specimens from this area were virtually unknown, with the sole reported exception of a series of *C. euxanthe* FELDER & FELDER, 1865, from the vicinity of Canta, referred to in (REISSINGER 1972). During a one-week exploration of the highlands (2600–4300 m.a.s.l.) of Cordillera de la Viuda, among plenty of *C. euxanthe* (the commonest *Colias* in the place; Fig. 3), three specimens (all females) of a clouded Sulphur of different habitus were collected (one of them is shown in Fig. 4). At a glance, these specimens somewhat recall (by the wing-shape and ground colour) the pale subspecies of the *C. flaveola* complex, which ocurr to the south. However, the area explored is ~700 km distant from the type localities of the nearest 'white' subspecies of *C. flaveola* (Fig. 1). On the other hand, they are different from the very dark *C. flaveola mossi*, a well-known subspecies (or *bona* species as considered by some authors) from the adjacent area farther north, from Cerro de Pasco to Tarma. Despite a feeling that this small set of four white females might represent a new entity, the absence of males casted doubt on this theory. So, I decided to return to the area six months later, November 10–15, 2019, with the idea that this entity might be bivoltine.

Fig. 1. (**left**) Distribution of pale (white asterisks: western slopes of the Andes) and dark (black circles: eastern slopes of the Andes) subspecies of *C. flaveola*. (**right**) Distribution of *C. flaveola viuda* (two white asterisks) and *C. flaveola mossi* (dashed black ellipse): western and eastern sides of the Central Andes, respectively.

Fig. 2a. A valley on the southern slopes of Cordillera de la Viuda where *C. flaveola viuda* occurs; **2b.** Biotope of *C. flaveola viuda*; 4000–4200 m.a.s.l. The photographs were taken November 10–15, 2019.

This new search was successful. As the result of fieldwork, a series of white males (see the lower panel in Fig. 5 and Fig. 6) and females (Fig. 7) was obtained. Notably, the figured specimens are quite different from the geographically close dark *C. flaveola mossi* (its holotype is reproduced in the upper panel in Fig. 5) and any of the pale subspecies of *C. flaveola* from the southern Andes (KIR'YANOV & VALENCIA 2018), and, also, from the sympatric *C. euxanthe*. All specimens of the new clouded Sulphur referred to above were collected in a locality near the Cordillera de la Viuda, on the southern slopes of the massif, inside a small valley (Fig. 2b) at 4000–4100 m.a.s.l. Photographs of live adults (male and female) representing the new taxon are presented in Fig. 9. Further investigations have revealed that this *Colias* is also encountered – in considerably lower numbers – ~30 km to the northwest, in the *altiplano* (highland steppe) at 4200–4300 m.a.s.l.; two yellowish specimens collected there are shown in Fig. 8. In my opinion, the reported data warrant the description of a new taxon, apparently belonging to the *C. flaveola* complex, named herein:

Colias flaveola viuda ssp. n.

Type material, type locality, and depository

♂ holotype (see the lower panel in Fig. 5), 5 ♂♂ paratypes (of which 3 are shown in Fig. 6) and 9 ♀♀ paratypes (of which 3 are shown in Fig. 7 and 1 – in Fig. 4); one of these specimens is chosen to be the ♀ allotype (shown in the upper panel in Fig. 7). Central Peru, frontier between Lima and Junín departments, Canta province, ~100 km northeast of Lima, ~30 km north of Canta, massif Cordillera de la Viuda (southwestern slopes), high Andes of Central Peru; 11°38'S, 76°45'W; 4000–4100 m.a.s.l.; 29.04.2019–02.05.2019 & 10.11.2019–14.11.2019. The type material is currently preserved in the author's collection (Moscow, Russia); of it, ♂ holotype and one of the ♀♀ paratypes will be deposited in the State Darwin Museum, Moscow (SDMM), Russia.

Etymology

The new subspecies of *C. flaveola* is a toponym, named in accordance with its provenance: Cordillera de la Viuda of the Central Andes, Peru; note that the Spanish 'viuda' means 'widow'.

Description

Males (lower panel in Fig. 5 & Fig. 6):

The wingspan is 29–35 mm (the holotype: 33 mm). Antennae are dark (almost black). The ground colour of both the fore- and hindwings on the dorsal surface is whitish, varying from snow-white to pale-yellowish (the latter tinge is slightly more pronounced on the hindwings). The black marginal bands on the forewings are narrow close to the anal angle but considerably wider towards the apex. In the apical area, there is a row of 4 to 5 pale-yellow spots in this marginal band (in the holotype these spots are slightly reduced). The discal ocelli on the forewings are black, moderately expressed. On the hindwings, the black marginal bands are barely expressed, becoming perceptible only towards the costal area. In the lower part of the hindwings, a

Fig. 3. *C. euxanthe*: ♂ (on the **left**) and ♀ (on the **right**); dorsal view. Southern slopes of Cordillera de la Viuda; 4000–4100 m.a.s.l.; April 30 – May 1, 2019.

Fig. 4. ♀ paratype of *C. flaveola viuda* (on the **left** – dorsal view; on the **right** – ventral view). Southern slopes of Cordillera de la Viuda; 4000–4100 m.a.s.l.; April 30 - May 1, 2019.

chain of 5 large, highly perceptible, nearly rectangular, pale (white to yellowish) spots, separated by clearly eye-catching black veins, is seen. The discal ocelli on the hindwings are white (small but well perceptible). The ground colour of both the fore- and hindwings on the ventral surface is whitish but appears darker than that on the dorsal surface given the higher degree of dusting with gray scales. The hindwings, more strongly suffused with grey scales, appear darker than the forewings; there is slight greenish tinge under sunlight (Fig. 9a). Between the postdiscal and submarginal areas of both the fore- and hindwings, there is a row of brown, highly perceptible, irregular spots, a diagnostic feature for *C. flaveola viuda*. These spots sometimes show through the dorsal surface of the hindwings. The discal ocelli on the ventral surface of the hindwings are white as on the dorsal surface, but superimposed with dark, strongly elongated bars. No androconial patches are found in either male specimen. Cilia are whitish (e.g. in the holotype) to pinkish. The holotype of *C. flaveola viuda* has a small piece of the wing missing on the outer margin of the right hindwing close to the anal angle.

Females (Fig. 4 & Fig. 7):

The wingspan is 27–33 mm (the allotype: 29 mm). Antennae are dark (almost black with a slight purple tinge). Cilia are more pinkish than in males. The ground colour of both the fore- and hindwings on both surfaces is similar to that of males; a pronounced difference is that the ventral surface of the hindwings appears generally darker than in males, with a more pronounced yellow-greenish tinge under sunlight (Fig. 9b). Another difference is that the row of dark spots between the postdiscal and submarginal areas on the ventral surface of the wings is generally less pronounced than in males. Along with the smaller average size of females of *C. flaveola viuda*, the key feature is the shape of the wings (especially in the forewings) which are much more elongated towards the apex than in males.

Differential diagnosis

Firstly, *C. flaveola viuda* ought to be compared to its closest geographical neighbor *C. flaveola mossi* (compare the lower and upper panels in Fig. 5). Whilst males of *C. flaveola viuda* have an overall whitish

Fig. 5. Upper panel: *C. flaveola mossi*: holotype (♂) (BMNH, London, UK – photo taken by ROBERT WORTHY and reproduced here with permission, © Trustees of the Natural History Museum). **Lower panel**: *C. flaveola viuda*: holotype (♂). On the **left** – dorsal view; on the **right** – ventral view. Collecting data for *C. flaveola viuda*: Southern slopes of Cordillera de la Viuda; 4000–4100 m.a.s.l.; November 10–15, 2019.

ground colour (demonstrating various shades of light-greyish and yellowish), the ground colour of *C. flaveola mossi* is olive-brown to dark-greyish; this applies to both surfaces of the fore- and hindwings. Females of the two taxa show similar differences (*C. flaveola viuda* and *C. flaveola mossi* are both sexually barely differentiable). Besides, whereas in both sexes of *C. flaveola viuda* there are rows of large, highly perceptible brown spots in the submarginal areas of both the fore- and hindwings, such spots are absent in both sexes of *C. flaveola mossi.* Also note that adults of *C. flaveola mossi* have a larger average wingspan than those of *C. flaveola viuda*.

Secondly, *C. flaveola viuda* can be compared with the rest of the pale southern subspecies of *C. flaveola* (refer to Fig. 8). Overall, the new subspecies recalls – in ground colour and wing-shape – subspecies *C. flaveola erika*, *C. flaveola cora*, and *C. flaveola laura*, all from South Peru. Veins on both surfaces of the fore- and hindwings are dusted with black scales much stronger in *C. flaveola viuda* than in the rest of pale subspecies of *C. flaveola*. Note that males of *C. flaveola viuda* do not bear androconia on the hindwings; in this regard, the new subspecies is analogous to *C. flaveola erika* (of which males never bear androconia) but differs from the rest of the *C. flaveola* subspecies, males of which demonstrate such sexual characters.

Fig. 6. *C. flaveola viuda*: 3 ♂♂ paratypes. On the **left** – dorsal view; on the **right** – ventral view. Collecting data: southern slopes of Cordillera de la Viuda; 4000–4100 m.a.s.l.; November 10–15, 2019.

Bionomics

Bivoltine; preimaginal stages unknown; hostplant unknown but probably a local *Astragalus*; biotope is illustrated in Fig. 2b; adults take nectar from the white flowers (Fig. 9b), abundant in the type locality near waterflows and small bogs; sympatric with *C. euxanthe*.

Notes

(1) As established for females only, spring brood *C. flaveola viuda* (Fig 4) are generally darker and larger than those of the autumn brood (Fig. 7) due to the humidity of the former season with accordingly more vegetation.

(2) A few yellowish specimens of *C. flaveola viuda*, belonging to a remote population outside the type locality (see above), most probably represent a separate ecological form.

(3) Differences in phenotypes in both males and females of *C. flaveola viuda* (compare the individuals illustrated in Figs. 6, 7, and 8) are seemingly due to the known effect of greater variability of a species at the edge of its range (GRIESHUBER *et al.* 2012) (refer to Fig. 1a).

(4) Interestingly, in the localities where *C. flaveola viuda* is abundant, *C. euxanthe* is almost absent, and *vice versa*; a tentative explanation of this is the locally unequal distribution of hostplants of the two taxa (presumably, different *Astragalus* species) or/and competitive exclusion between them.

Fig. 7. *C. flaveola viuda*: 3 ♀♀ paratypes (♀ allotype is shown in the upper panel). On the **left** – dorsal view; on the **right** – ventral view. Collecting data: southern slopes of Cordillera de la Viuda; 4000–4100 m.a.s.l.; November 10–15, 2019.

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Zusammenfassung

Eine neue Unterart von *Colias flaveola* BLANCHARD, 1852, die in beiden Geschlechtern weiß gefärbt ist, wird aus dem Bergmassiv Cordillera de la Viuda in den peruanischen Anden beschrieben: *Colias flaveola viuda* ssp. n.

Fig. 8. Top (all ♂♂).
Lower row – *C. flaveola viuda* holotype (**left**) and paratype (**centre**) (both from southern slopes of Cordillera de la Viuda; 4000–4100 m.a.s.l.); paratype (**right**; from *altiplano* ~30 km northwest of Cordillera de la Viuda; 4300 m.a.s.l.). **Upper row** – topotype of *C. flaveola erika* (**left**; Laguna de Salinas, vicinity of Arequipa city, South Peru, 4200 m.a.s.l.); topotype of *C. flaveola laura* (**centre**; from Lauripampa, vicinity of Coropuna volcano, South Peru, 4300 m.a.s.l.); paratype of *C. flaveola cora* (**right**; from Coropuna volcano, South Peru, 4600 m.a.s.l.).

Bottom (all ♀♀).
Lower row – *C. flaveola viuda*: two paratypes (**left** and **centre**) (both from southern slopes of Cordillera de la Viuda; 4000–4100 m.a.s.l.); paratype (**right**; from *altiplano* ~30 km northwest from Cordillera de la Viuda; 4300 m.a.s.l.). **Upper row** – topotype of *C. flaveola erika* (**left**; Laguna de Salinas, vicinity of Arequipa city, South Peru, 4200 m.a.s.l.); paratype of *C. flaveola laura* (**centre**; from Lauripampa, vicinity of Coropuna volcano, South Peru, 4300 m.a.s.l.); paratype of *C. flaveola cora* (**right**; from Coropuna volcano, South Peru, 4600 m.a.s.l.). Coll. A. KIR'YANOV (Moscow, Russia).

Fig. 9. *C. flaveola viuda*: ♂ (a, **left**) and ♀ (b, **right**) (living examples). Southern slopes of Cordillera de la Viuda; 4000–4100 m.a.s.l.; November 10–15, 2019.

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