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Some observations on hybridisation between closely related species of Rhopalocera (Lepidoptera: Lycaenidae, Nymphalidae)

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Abstract

Details are provided of hybridisation between *Polyommatus icarus* (Rottemburg, 1775) from East Sussex (UK) and *P. celina* (Austaut, 1879) from Lanzarote (Canary Islands, Spain) under laboratory conditions. Comments are also made on natural hybrids between *Melitaea phoebe* and *M. ornata* occurring in Slovenia.
KEY WORDS: Lepidoptera, Lycaenidae, Nymphalidae, *Polyommatus*, *P. icarus*, *P. celina*, *Melitaea*, *M. phoebe*, *M. ornata*, hybridisation, Slovenia, Spain.

Algunas observaciones sobre hibridación entre especies relativamente próximas de Rhopalocera (Lepidoptera: Lycaenidae, Nymphalidae)

Resumen

Se proporcionan detalles sobre la hibridación entre *Polyommatus icarus* (Rottemburg, 1775) procedente de East Sussex (Reino Unido) y *P. celina* (Austaut, 1879) de Lanzarote (Islas Canarias, España) en condiciones de laboratorio. También se hacen comentarios sobre híbridos encontrados en la naturaleza entre *Melitaea phobe* y *M. ornata* que se dan en Eslovenia.
PALABRAS CLAVE: Lepidoptera, Lycaenidae, Nymphalidae, *Polyommatus*, *P. icarus*, *P. celina*, *Melitaea*, *M. phoebe*, *M. ornata*, hibridación, Eslovenia, España.

Introduction

Hybridisation in butterflies is not unusual (DESCIMON & MALLET, 2009). Hybrids between the two pierids *Pontia daplidice* (Linnaeus, 1758) and *P. edusa* (Fabricius, 1777) across a broad band in Italy have been known for some time (GEIGER *et al*., 1988; PORTER *et al*., 1997) and natural hybridisation events between species of Nymphalidae *sensu lato* have been reported relatively frequently. Recently, hybridisation between *Melitaea phoebe* ([Dennis & Schiffermüller], 1775) and *M. ornata* Christoph, 1893, in Hungary (VARGA, 1967; BÁLINT & ILONCZAI, 2001) and in Slovenia (RUSSELL *et al*., 2014) has been reported, although TÓTH *et al*. (2017: 276-277) suggested that hybridisation between these latter two species was unproven due to a lack of statistical analysis. Natural hybrids between *Brenthis daphne* ([Denis & Schiffermüller], 1775) and *B. ino* (Rottemburg, 1775) have also been recorded (KITAHARA, 2008).

In the Satyrinae, such events appear almost commonplace. They include *Melanargia lachesis* (Hübner, 1790) and *M. russiae* (Esper, 1783) (TAVOILLOT, 1967), *Maniola telmessia* (Zeller, 1847) and the endemic Turkish (geographically) *M. halicarnassus* Thomson, 1990 (THOMSON, 1990) and the Sardinian endemic *Maniola nurag* Ghiliani, 1852 and the widespread *M. jurtina* (Linnaeus, 1758) (GRILL *et al.,* 2007). In view of the rather frequent observations of interspecific coupling reported

(RUSSELL, 2013a, 2013b), it is surprising that more hybrids involving a *M. jurtina* parent have not been recorded.

In the Lycaenidae, hybridisation in polyommatine species has also been observed: between *Lysandra bellargus* (Rottemburg, 1775) and *L. albicans* (Gerhard, 1851) (GIL-T., 2007); *L. bellargus* and *L. hispana* (Herrich-Schäffer, [1851]) (CAMERON-CURRY *et al.,* 1987). So far as the authors are aware hybridisation between *Polyommatus icarus* (Rottemburg, 1775) and *P. celina* (Austaut, 1879) has not been reported previously; this is perhaps unsurprising as they were only recognised as distinct species fairly recently. DINCĂ *et al*. (2011: 3931) suggested that genitalic differences between the two species were weak enough to present the possibility of hybridisation in the contact zone in southeastern Spain.

Materials, methods and observations

Two fresh male *P. icarus* (see Figs 1-5), originating from Devil's Dyke, West Sussex. U.K., supplied by John Martin (Brighton, UK), and a single female *P. celina* (see Figs 6-9), reared by J. P. from stock originating from Playa Blanca, Lanzarote, Canary Islands, supplied by Martin Gascoigne-Pees (Stonesfield, UK) were released into a netted flower pot containing bird's foot trefoil (*Lotus corniculatus* L., Fabaceae), a known host-plant of *P. icarus* in the UK (TOLMAN 2008: 156); in Lanzarote *P. celina* utilises a similar *Lotus* species, *L. lancerottensis* Webb & Berthel (TOLMAN, 2008: 156) but this was not available. The pot was placed in the sunshine and after a few days a large number of ova were deposited; however, viability proved to be very low. To avoid potential cannibalism, larvae were separated on emergence into small individual plastic boxes with a leaf of crown vetch (*Securigera varia* (L.) Lassen, previously known as *Coronilla varia* L.). The first author has reared both *P. icarus* and *P. celina* successfully on this plant, which has the advantage that, unlike *Lotus corniculatus* L., it does not produce toxins lethal to larvae if it is eaten extensively (pers. obs., first author). Twenty larvae were reared through to pupation and adults emerged successfully from all. A representative three pairs of hybrid butterflies were retained and are figured (see Figs 10-15).

The remaining individuals were placed in a netted pot of bird's foot trefoil and a very large number of ova resulted, almost covering the plant. In this case viability was extremely poor and only six larvae of this F2 generation hatched (from an estimated 1,000+ eggs). The larvae were placed individually into plastic pots each containing a leaf of crown vetch. However, none survived beyond the 1st instar. The plant used for ovipositing was searched several times over a period to see if any larvae had survived on the plant from unobserved ova; none were found. Thus the F1 hybrids were effectively infertile, demonstrating a post-copulative barrier.

Comments on hybrids between *Melitaea phoebe* and *M. ornata*

Offspring produced from a wild caught female *M. ornata* (RUSSELL *et al.*, 2014: 137, fig. 2) from a population northwest of Rakitovec, Koper, Slovenia were considered by RUSSELL *et al*. (2014) to be naturally occurring hybrids with *M. phoebe*. TÓTH *et al*. (2017: 276-277) considered this had not been proven and that statistical analysis was required to confirm this was the case. We believe this to be unnecessary: the morphology of the larvae and adult butterflies place a hybrid source beyond doubt.

Larval survival was poor, the few surviving final instar larvae resulting from an egg batch of an estimated 60 ova produced by the female *M. ornata* had black head carapaces, suggestive of *M. phoebe* (Fig. 16); those of L4 + *M. ornata* larvae have brick red carapaces (Fig. 17). Two other females from the same *M. ornata* population also produced egg batches, from which the final instar larvae had the predicted brick red heads and from which the resultant butterflies had all the characteristics of *M. ornata* (RUSSELL *et al*., 2014: 137, figs 3-4). Underside hindwing characters of the hybrid adults displayed a mixture of characters between those of typical *M. phoebe* and typical *M. ornata*; antennae varied between the usual club shaped typical of *M. phoebe* (Fig. 18) and spatulate typical of *M. ornata* (Fig. 19). Only a single larva entered diapause; it began feeding the following spring and a vigorous

female emerged (see Fig. 20), with wing and antennal morphology intermediate between its parents (RUSSELL *et al*., 2014: 140, fig. 9).

It was noted (RUSSELL *et al*., 2014: 137) that there were at least three populations of *M. phoebe* within a few kilometres of and surrounding the studied *M. ornata* population: 2 km south of Rakitovec, 3.5 km north of Rakitovec and just south of Podpec; the last site being less than 2km distant from the *M. ornata* population under study. It is noteworthy that the flight time of *M. phoebe* is approximately two weeks later than *M. ornata* and males of *M. phoebe* were captured from these three locations at the same time that freshly emerged *M. ornata* females were present at the study site. Thus, we believe that *M. phoebe* males from any of these surrounding populations are quite likely to have encountered a female *M. ornata* whilst searching for a mate. The authors are confident that hybrids between *M. phoebe* and *M. ornata* were the result of a female *M. ornata* impregnated by a *M. phoebe* male at this Slovenian locality.

Discussion and conclusion

Part 1. *Polyommatus*

Distribution of *P. celina* includes the Canary Islands, North Africa (Morocco, Algeria, Tunisia and Libya(?)), southern Portugal, southern Spain (including the Balearic Islands), Malta, Sardinia and Sicily; the widespread *P. icarus* is present in both Spain and Portugal but not in other areas where *P. celina* flies. Thus there is potential for natural hybridisation only on the Iberian Peninsula; particularly in an area near Madrid where the species are sympatric (CARRILLO *et al*., 2017). The results of this experiment suggest that F1 hybrids are quite likely to occur naturally in the zone of sympatry, where emergences of the two species are at least partially synchronic. Confirmation of such a hybridisation event is unlikely from casual field observation due to the fact that separation of the two species, let alone hybrids, is virtually impossible in the field. Separation can only be made with certainty by genitalic dissection and/or molecular analysis (DINCĂ *et al.*, 2011).

Part 2. *Melitaea*

We consider it possible that the close proximity of these two species, coupled with the fact that *M. phoebe* males must often emerge at a time when the only females available are those of *M. ornata*, may regularly present the opportunity for natural hybridisation. Further, we consider that natural hybridisation between a male *M. ornata* and a female *M. phoebe* is unlikely in the populations studied because when female *M. phoebe* emerge most male *M. ornata* will have already mated and died. However, if both species were reared in captivity and *M. ornata* males introduced to a female *M. phoebe*, then hybridisation is conceivable, even probable. Considering that natural hybrids between closely related species have been recorded so frequently, it is a mystery why the unmistakably hybrid offspring obtained from a female *M. ornata* taken from the colony near Rakitovec should be questioned (TÓTH *et al*., 2017: 276-277). Particulary when those authors agreed that the two species hybridised previously (TÓTH *et al*., 2017: 277), resulting in shared COI haplotypes between western populations of *M. ornata* and *M. phoebe occitanica* Staudinger, 1871 [Type Locality: Barcelona; cf. VERITY (1928: 163), VAN OORSCHOT & COUTSIS (2014: 60) and RUSSELL *et al*., 2020: 500-501 and Figs 5-7]. The distribution of *M. phoebe occitanica*, distinguishable from *M. phoebe phoebe* by its later instar larvae (RUSSELL & TENNENT, 2016: 43) and in adults using electrophoresis (PELTZ, 1995) is established.

Historical distribution and identification is somewhat confused since *M. ornata* was recently "discovered" in Spain (SÁNCHEZ-MESA & MUÑOZ-SARIOT, 2017), although it occurred there previously at least from the early part of last century. Specimens taken by Romei in 1925 in the Sierra Nevada and given subspecific status, as *M. phoebe bethunebakeri* by De Sagarra in 1926, were in fact *M. ornata* (see RUSSELL *et al.*, 2020: 196 and figs 14a, b and c). The proximity of some populations of *M. ornata* to those of *M. phoebe* in Spain certainly provides the potential for hybridisation.

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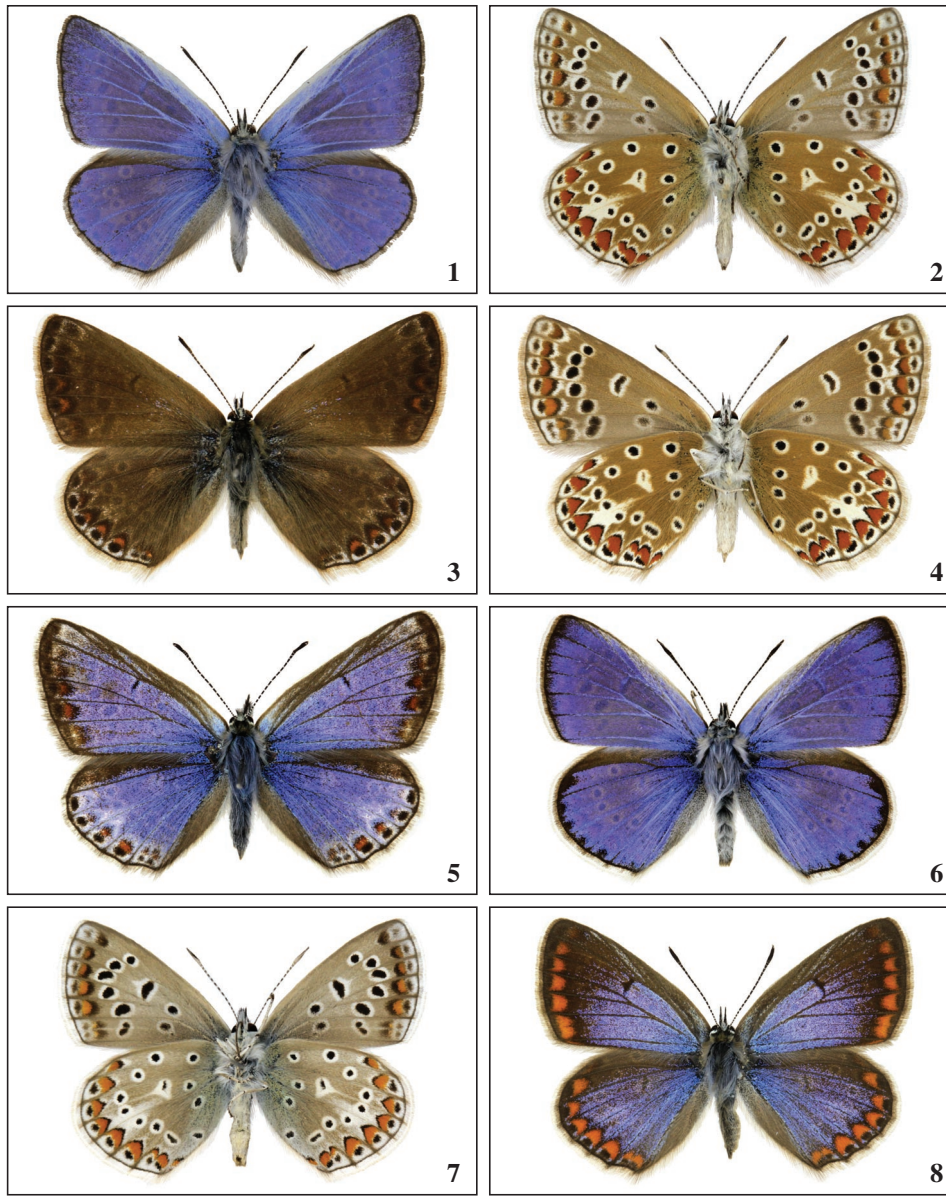
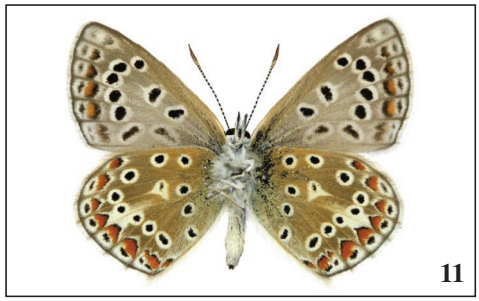
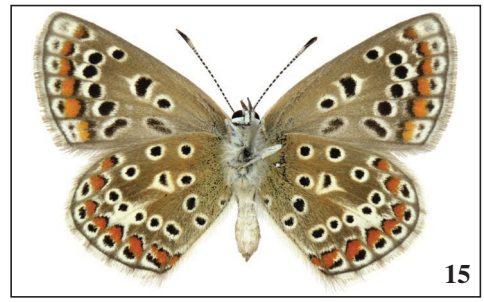


Figs 1-8.– 1. *P. icarus* male upperside, Devil's Dyke, West Sussex, U. K. **2.** *P. icarus* male underside, Devil's Dyke, West Sussex, U. K. **3.** *P. icarus* female upperside, Devil's Dyke, West Sussex, U. K. **4.** *P. icarus* female underside, Devil's Dyke, West Sussex, U. K. **5.** *P. icarus* extended blue female, upperside, Devil's Dyke, West Sussex, U. K. **6.** *P. celina* male upperside, ex stock Playa Blanca, Lanzarote, Canary Islands. **7.** *P. celina* male underside, ex stock Playa Blanca, Lanzarote, Canary Islands. **8.** *P. celina* female upperside, ex stock Playa Blanca, Lanzarote, Canary Islands.





Figs 9-15.– 9. *P. celina* female underside, ex stock Playa Blanca, Lanzarote, Canary Islands. **10.** *P. icarus* ♂ x *P. celina* ♀ F1 hybrid male upperside. **11.** *P. icarus* ♂ x *P. celina* ♀ F1 hybrid male underside. **12.** *P. icarus* ♂ x *P. celina* ♀ F1 hybrid female upperside. **13.** *P. icarus* ♂ x *P. celina* ♀ F1 hybrid female underside. **14.** *P. icarus* ♂ x *P. celina* ♀ F1 hybrid female upperside. **15.** *P. icarus* ♂ x *P. celina* ♀ F1 hybrid female underside.

Figs 16-20.– 16. *M. phoebe* larva on *Centaurea scabiosa* Istria, Croatia, 27 July 2010. **17.** *M. ornata* larva on *Carduus collinus* 2 km NW. of Rakitovec, Koper, Slovenia 30 April 2012. RV. **18.** *M. phoebe* male underside, 2 km S. of Rakitovec, Koper, Slovenia (captured 17 May 2011). **19.** *M. ornata* female underside, *circa* 2 km NW. of Rakitovec, Koper, Slovenia (captured 17 May 2011). **20.** *M. phoebe* ♂ x *M. ornata* ♀ female hybrid underside, reared ex *M. ornata* female from Rakitovec, Slovenia, emerged 17 May 2012.