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**A photographic record of the life history of *Chilades evorae* Libert, Baliteau & Baliteau, 2011 (Lepidoptera: Lycaenidae), endemic to the Cabo Verde Islands, with notes on ecology and distribution**

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RESUMO

Das cerca de 25 espécies de borboletas que ocorrem no arquipélago de Cabo Verde, apenas uma é endêmica: *Chilades evorae* (Lycaenidae). A espécie foi incubada pelos autores e fotografias a cores dos estágios iniciais de desenvolvimento desta espécie são apresentadas pela primeira vez. As plantas-hospedeiras das ilhas de Santo Antão, São Vicente, Santa Luzia são também ilustradas em fotografias. A borboleta é reportada no ilhéu Raso pela primeira vez, conjuntamente com a presumível planta-hospedeira da mesma. Uma mosca taquinídea *Cadurciella* sp. é também reportada como parasita de *C. evorae*.

**Palavras-chave:** Macaronésia, borboleta, plantas-hospedeiras *Lotus*, mosca parasitóide, desenvolvimento larvar

## ABSTRACT

Of the *circa* 25 species of butterfly species occurring in the Cabo Verde Archipelago, only one species is endemic: *Chilades evorae* (Lycaenidae). The species was reared by the authors and colour photographs of the early stages of this species are presented for the first time. The host-plants on the islands of Santo Antão, São Vicente, and Santa Luzia are illustrated with photographs. The butterfly is reported from Raso for the first time, together with a potential host-plant. A tachinid fly species *Cadurciella* sp. parasitising *C. evorae* is also reported.

**Keywords:** Macaronesia, butterfly, *Lotus* host-plants, parasitoid fly, larvae development

## INTRODUCTION

Our previous investigations confirmed 26 butterfly species occurring on the Cape Verde Islands; although the status of two species: *Vanessa vulcania* and *Danaus plexippus*, is not clear (Tennent & Russell 2015). The only endemic butterfly species known from Cabo Verde, *Chilades evorae* Libert, Baliteau & Baliteau, 2011, was recorded and described from five male specimens and one female collected on Santo Antão in January 2009 (Libert *et al.* 2011).

It is interesting that only three species of butterfly have been recorded from Raso (*Danaus chrysippus*, *Vanessa cardui*, *Colias croceus*); the status of *Chilades evorae* is not known. As Tennent & Russell (2015) suggested, the dry conditions and associated differences in abundance of vegetation on Raso suggest that none are permanent residents there, but may expand their ranges temporarily when conditions are particularly favourable. The authors stayed on Raso for several days in 2013, but recorded no butterflies, due probably to the dryness of the season. However, in that same year, the authors discovered *C. evorae* on the neighbouring island of São Vicente (one adult specimen at *ca* 350m. on Monte Verde), and found it to be abundant on Santa Luzia between sea level and 200m (Tennent & Russell 2015).

Baliteau & Baliteau (2016) described and illustrated with fine line drawings the life history of *C. evorae*, demonstrated its myrmecophilous association and extended its distribution to Fogo based on their observation of a single larva at Fernão Gomes, at *circa* 1500-1600 m in the crater, among large numbers of *Leptotes pirithous* (Linnaeus, 1767) larvae feeding on a plant species, resembling *Lotus jacobaeus*. The fact that it was recorded for the first time from Fogo – a first record from the southern group of islands – suggests the butterfly is more widely distributed in Cabo Verde than was at first thought.

The conservation status of the species is unknown, both at national and international level, but authors refer it has common, indeed widespread and abundant on both Santo Antão and Santa Luzia (Tennent & Russell 2015, Baliteau & Baliteau 2016). It is unlikely to be under any immediate threat.

Further fieldwork was carried out in 2017, with the aim of photographing the species' life history. This would enable future researchers to more easily identify larvae of *C. evorae* in the field among those of other Lycaenids which utilise *Lotus* sp. as their hostplants. We also aimed to improve the knowledge of its ecology and distribution.

## MATERIAL AND METHODS

On Santo Antão, on 8 July 2017, at *circa* 1100 m, the second author observed a female *C. evorae* ovipositing on the undersides of leaflets or on the stem close to leaflets of *Lotus* plants (Fabaceae). On close examination, two lycaenid larvae were found on the plant. These were placed in 59 x 38 x 27 mm plastic boxes and reared on return to the U.K. An angle poise lamp was placed above the pot containing the larvae to increase the temperature and thus their chances of pupating.

In a subsequent expedition to the Cabo Verde archipelago, eight larvae of *C. evorae* and a number of larvae of other polyommata lycaenids (*Lampides boeticus*, *Leptotes*

*pirithous*) were collected in various stages of development on the south side of the road between Lagoinha and Lagoa, Santo Antão at *circa* 1200 m, in mid-November 2017, and reared to adults.

A single Lycaenid butterfly was found and photographed on Raso in November 2017 by a member of the Cambridge University ornithological team (Brooke & Moss pers. comm.).

*Lotus* species were identified from descriptions and illustrations in Sandral *et al.* (2006); botanical nomenclature and island distributions of these species on Cabo Verde also follow those authors.

## RESULTS

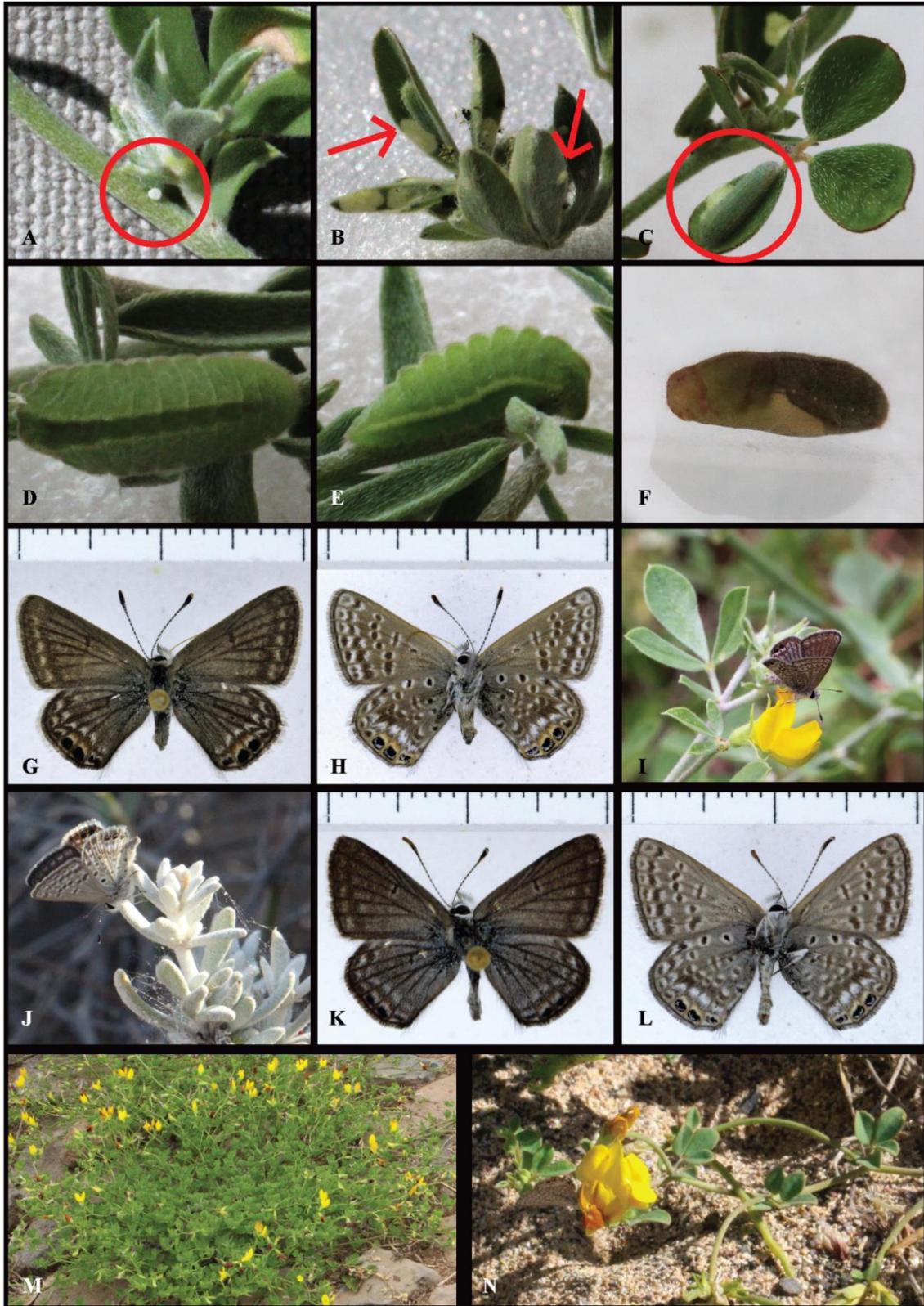
The life history of *C. evorae* and details on its ecology, including preferred host-plants, are illustrated in Fig. 1 (A–N).

Observations on oviposition and early stages, July/August 2017: The female observed laying eggs (Fig. 1A) in July used *Lotus latifolius* as host-plant (Fig. 1B), a species endemic to the higher reaches of Santo Antão (Sandral *et al.* 2006; Fig. 1 I). Young larvae were blue-green in colour, with a slightly darker dorsal median stripe and *circa* 1.5–2.0 mm in length (Fig. 1B & C). They fed on the upper leaflet surface, leaving small but obvious ‘windows’ in the leaves (Fig. 1B). By 10 July, the larger larvae had skin-changed and begun feeding again (Fig. 1C). The final instar larvae had a dark dorsal stripe (Fig. 1D) and yellowish lateral lines (Fig. 1E); it had finished feeding by 19 July; whilst the smaller one still appeared to be feeding. The first larva failed to pupate successfully. Following an induced change in temperature conditions of the rearing boxes, a larva (Fig. 1K and L) pupated and a male butterfly successfully emerged in August. The first author observed that although fresh *Lotus*

flowers were provided, none was eaten by either larva, whereas larvae of *Lampides boeticus* (Linnaeus, 1767) and *Leptotes pirithous* (Linnaeus, 1767), taken during the expedition from similar *Lotus* plants, devoured the flowers and not the leaves.

Observations on early stages, November 2017: as noted previously, females oviposited on the leaflets or stems but not on the flowers or calyx and larvae only consumed the leaves of their host-plant, leaving the flowers untouched. All eight larvae pupated successfully, the slightly hairy pupa was mottled brown with paler wing cases and a series of white spots representing the spiracles (Fig. 1F) becoming progressively darker, and almost black just prior to the emergence of the adult. Six adults emerged, the other two larvae had been parasitised by a parasitoid fly (Fig. 2), identified as *Cadurciella* sp. (Tachinidae).

The butterfly photographed on Raso (Fig. 3) was identified by the authors as *C. evorae*. The only known potential host-plant for this species seen on Raso was *Lotus purpureus* (Fig. 1M and N).



**Fig. 1.** Details of the life history of *Chilades evorae* (photographs by John Tennent). **A)** ovum on a leaf and stem of the host-plant *Lotus latifolius*, 8 July 2017, about 500 m, north of Selada do Alto Mira, Santo Antão, Cabo Verde; **B)** ‘windows’ in the leaflets of *L. latifolius* created by the larva, 8 July 2017 (an ovum can be seen on the edge of the underside of a leaflet to the right hand side of the larva); **C)** larva feeding on a leaflet of the host-plant, 11 July 2017; **D)** final instar larva dorsal and **E)** lateral views, 13 July 2017; **F)** pupa, lateral view, 20 November 2017; **G)** upper and **H)** underside of a female (ex larva 13 November 2017, emerged 23 November 2017), about 1050 m in Selada de Alto Mira, Santo Antão;

**I)** live females resting on the host-plant *L. latifolius*, Lagoa, 1200m, Santo Antão, 13 November 2017, and **J)** nectaring on *Polycarpaea nivea*, Santa Luzia, 18 November 2013; **K)** upper and **L)** underside of a male (ex larva 13 November 2017, emerged 24 November 2017), about 1200 m, Lagoinha, Santo Antão; **M)** the host-plant *Lotus purpureus* on Monte Verde, 350m, São Vicente, 7 July 2017 and **N)** in beachside scrub, Santa Luzia, 18 November 2013, illustrating the typical three rounded leaflets at the end of the rachis and the yellow flowers shading to orange with age.



**Fig. 2.** Tachinid fly parasitoid of *Chilades evorae* butterfly. A) Its pupa case next to an empty *C. evorae* pupa, 23 November 2017; B) emerged fly, 30 November 2017.



**Fig. 3.** First record of *Chilades evorae* on Raso, 18 November 2017 (photo by Jason Moss).

## DISCUSSION

Our observations suggest that *C. evorae* appears to have successfully evolved to avoid competition with the abundant and widely distributed *Lampides boeticus* (Linnaeus, 1767) and *Leptotes pirithous* (Linnaeus, 1767) by utilising the leaves of their host-plant, as opposed to the flowers and young seed pods, which are favoured by *L. boeticus* and *L. pirithous* (Lafranchis *et al.* 2015), both of which often occur in the same habitats as *C. evorae*. This observation is in direct contrast to those of Baliteau & Baliteau (2016), who suggested that both leaves and flowers were consumed by the larvae and that they would even agonistically expel *L. pirithous* in the latest stages of development. This may be the case if older larvae are under stress, for instance in the absence of sufficient leaflets; however, our reared larvae were supplied frequently with fresh leaflets and continued to ignore flowers. *Chilades evorae* larvae were never observed eating flowers in their natural habitat, a fact that enables a clear distinction to be made in the field between larvae of this species and those of the other Lycaenids. Although young larvae were well camouflaged whilst resting on the upper leaf surface, the windows in adjacent leaves often

indicated the presence of a nearby larva.

The fact that *C. evorae* occurs on São Vicente, Santa Luzia (Tennent & Russell 2015), and (possibly only sporadically, under favourable conditions) on Raso, indicates that the butterfly uses *Lotus purpureus* as a host-plant, which it may well also utilise at lower levels on Santo Antão, where *L. latifolius* (endemic at moderate to high altitudes) is absent. As we have said previously (Tennent & Russell, 2015), there is sufficient *Lotus* host-plant on Raso to support *C. evorae* when conditions are favourable, although it seems probable that long term persistence of the species is unlikely, for reasons not yet understood. The presence of this butterfly on Raso suggests it is likely to be also present on São Nicolau, only some 16 km to the east of Raso, which is approximately the same distance southeast of Santa Luzia. Further sampling effort is needed to fully understand the distribution and abundance of this species.

Discovery of Tachinidae (Diptera) parasitising *C. evorae* is unsurprising. Shaw *et al.* (2009) recorded tachinids as common parasitoids of Lepidoptera larvae and Baliteau & Baliteau (2016) recorded those as parasites of *C. evorae*.

## CONCLUDING REMARKS

Our successful efforts to discover new distribution data and aspects of the life history of the only endemic butterfly known from Cabo Verde highlighted the interesting fact that *C. evorae* is able to avoid direct competition with a number of common, widespread and successful Lycaenid species by utilizing a different part of the host-plant. At the times and in the seasons we visited Cabo Verde, we noted that *Lotus* species were common and widespread on almost all

islands, providing ideal circumstances for the long-term success of *C. evorae*. However, the conservation status of this endemic butterfly has not as yet been evaluated fully and thus we recommend that further studies are made. Although it may be sporadic on Raso and liable to extinction by volcanic activity on Fogo, due to its abundance on both Santo Antão and Santa Luzia, we consider that *C. evorae* is not threatened.

## ACKNOWLEDGEMENTS

The authors are grateful to Jason Moss for showing us his photographs of *C. evorae* taken on Raso, and to Mike Brooke for information from unpublished reports. We are also grateful to Mark Shaw, David Horsfield and Peter Tschorsnig for examining the tachinid fly and providing us with a genus name. We also thank Raquel Vasconcelos for drawing our attention to the publication of Baliteau & Baliteau (2016).

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Received 07 June 2018

Accepted 14 July 2018