

A review of Mediterranean records of *Catopsilia florella* (Lepidoptera: Pieridae, Coliadinae), with notes on the spring 2019 arrival in Cyprus of this Afrotropical migrant

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Abstract. The authors review early reports of *Catopsilia florella* (Fabricius, 1775) from central areas of the Mediterranean and comment on the first recorded spring arrival of *C. florella* in Cyprus. The species' appearance coincided with a substantial migration of *Vanessa cardui* (Linnaeus, 1758) and other insects across the eastern Mediterranean in spring 2019, in which *C. florella* was most likely a participant. With increasing temperatures in the region and the incursion of other Afrotropical butterfly species into the eastern Mediterranean in recent decades, the possibilities for future establishment of *C. florella* are discussed.

Samenvatting. De auteurs bespreken eerdere meldingen van *Catopsilia florella* (Fabricius, 1775) uit het centraal Middellands Zeegebied en lichten de eerste bevestigde vernale waarneming van *C. florella* in Cyprus toe. Het voorkomen van de soort viel samen met een substantiële migratie van *Vanessa cardui* (Linnaeus, 1758) en andere insecten in het oostelijk Middellands Zeegebied in het voorjaar van 2019, waarbij *C. florella* hoogstwaarschijnlijk betrokken was. Gezien de temperatuurstijging in de regio en de instroom van andere Afrotropische vlindersoorten in het Oostelijk Middellands Zeegebied in de laatste decaden worden de toekomstige vestigingsmogelijkheden van *C. florella* besproken.

Résumé. Les auteurs discutent des rapports précédents de *Catopsilia florella* (Fabricius, 1775) dans les régions centrales de la Méditerranée et commentent la première observation vernale confirmée de *C. florella* à Chypre. L'occurrence de l'espèce a coïncidé avec une migration substantielle de *Vanessa cardui* (Linnaeus, 1758) et d'autres insectes à travers la Méditerranée orientale au printemps 2019, dans laquelle *C. florella* était probablement impliqué. Compte tenu de la hausse de température dans la région et de l'incursion d'autres espèces de papillons afrotropicaux dans l'est de la Méditerranée au cours des dernières décennies, les possibilités d'établissement futur de *C. florella* sont examinées.

Key words: Lepidoptera – Pieridae – *Catopsilia florella* – Afrotropical – migration – host plants – Fabaceae – *Senna* – Straits of Messina – Malta – Cyprus.

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Introduction

Catopsilia florella (Fabricius, 1775) Type Locality: Sierra Leone ("Sierra Leon Africae"), commonly known as the African migrant or African emigrant, is widely distributed throughout sub-Saharan Africa, Arabia, the Indian sub-continent and southern China (Larsen & Nakamura 1983, Larsen 1990, Hesselbarth, van Oorschot & Wagener 1995: 337). Larsen (2005: 86, 2015), however, later expressed the view that records for Indo-China and southern China probably refer to *Catopsilia pyranthe* (Linnaeus, 1758). *C. florella* is known to have colonised Cape Verde Islands (Mendes & Bivar de Sousa 2010, Tennent & Russell 2015), reached the Canary Islands in 1964 (Wiemers 1995, Tennent 1996: 18) and Madeira in 1999 (Aguir 2000, Aguir & Wakeham-Dawson 2001), on which island it became relatively common for a few years but has since disappeared (Tennent *et al.* 2013). Absence from western Mediterranean regions of north-west Africa probably accounts for this vigorous migrant not being listed for the Iberian Peninsula (Gil-T 2019) and for western Europe in general. A report of *C. florella* being taken in Malta in 1963 (Valletta 1974, 1986, Larsen 1986, Tolman & Lewington 1997: 50, Haahtela *et al.* 2011: 76) has since been shown to be erroneous; further evidence in support of this is discussed later. In his 1986 paper, Larsen also referred to "a stray specimen" of *C. florella* being recorded in Germany, unfortunately without citing a reference. Efforts to find the source of this highly

unlikely record have been unsuccessful (Ulf Eitschberger, Jürgen Hensle and Martin Wiemers, pers. comms. to the first author) but, if accurately identified at the time, this seems likely to have been a release of a reared specimen.

C. florella, the only member of the genus known in mainland Africa (Ackery, Smith & Vane-Wright 1995), is a large butterfly (wingspan of both sexes, ca. 55–60 mm) and is moderately sexually dimorphic. Dorsally, the male is greenish-white, whereas the female may be of the white form (f. "pyrene" Swainson, 1821), a yellowish-white form (f. "hyblaea" Boisduval, 1836), or typically yellow – the last mentioned being much more frequent in the dry season in parts of Africa (Owen 1971: 77). See also illustrations in Makris (2003: 304) and Williams (2019). In the Afrotropical Region (i.e., sub-Saharan Africa, Madagascar and other offshore islands, and the southern Arabian Peninsula), *Catopsilia thaurama* (Reakirt, 1866) occurs in Mauritius and Madagascar (Williams 2019) and *Catopsilia pyranthe* has recently appeared (probably as an adventive) in the UAE (Feulner & Roobas 2018), but these are not found in Mediterranean regions.

Host plants

Members of the genera *Cassia* and *Senna* (Fabaceae, subf. Caesalpinioideae) provide the principal host plants for *C. florella* – see key in Fawzi, Hanan & Mohamed (2015). These are often treated synonymously ("*Cassia* = *Senna*") in the literature, although the genus name *Senna*

now has priority for the majority of those species discussed here. *Senna* can be deciduous or evergreen, taking the form of perennials, shrubs or trees. In nearby Israel (the country nearest to Cyprus having permanent populations of *C. florella*), the host plant of choice is *Senna didymobotrya* (Fresen.) H. S. Irwin & Barneby (syn. *Cassia didymobotrya* Fresen.), a plant of tropical African origin. Ornamental members of the genus are also used in Israel, including *Senna artemisioides* ssp. *x sturtii* (R. Br) Randell (= *Cassia sturtii* R. Br.); *Senna corymbosa* (Lam.) H. S. Irwin & Barneby (= *Cassia corymbosa* Lam.); *Senna auriculata* (L.) Roxb. (= *Cassia auriculata* (L.)) and possibly other ornamentals, in addition to two wild species: *Senna italica* Mill. (= *Cassia italica* (Mill.) Lam. ex F. W. Andrews) and *Senna alexandrina* Mill. (= *Cassia alexandrina* (Garsault) Thell.) (Dubi Benyamini pers. comm.).

In Saudi Arabia, Pittaway (1985) additionally gave as host plants *Cassia* (*Senna*) *alata* (L.) Roxb., originally from South America, adding that *C. florella* did less well on *Cassia fistula* (L.) and did not do at all well on *Cassia* (= *Senna*) *multijuga* (Rich.) H. S. Irwin & Barneby, *Cassia* (= *Senna*) *occidentalis* (L.) Link and *Cassia* (= *Senna*) *corymbosa*.

Tennent (1996: 18) listed *Senna* (= *Cassia*) *odorata* (R. Morris) Randell; *Senna* (= *Cassia*) *occidentalis*; *Senna* (= *Cassia*) *petersiana* (Bolle) Lock and *Cassia aschrek* Forssk. Other spp. of *Cassia* and *Senna* are listed as host plants by Williams (2019).

In addition to the foregoing, Gilbert & Zalut (2007: 19) included *Albizia lebbeck* (L.) Benth. (syn. *Acacia lebbeck* (L.) Willd.) (Fabaceae), and in Lebanon species of *Acacia* are also given as potential host plants by Zorkot (2016: 103). *Sesbania* spp. (Fabaceae) are listed by Larsen (1996: 120). Kielland (1990: 51) listed *Gossypium* spp. (Malvaceae), but this is considered an unlikely host plant by Gorbunov (2017). *Spermacoce* spp. (Rubiaceae) are given as host plants by Zorkot (2016: 160) and listed in HOSTS (2019).

Several varieties of ornamental *Senna/Cassia* have been introduced into Cyprus, one of which, *Senna* (= *Cassia*) *corymbosa*, a plant of the Central Americas, is illustrated in Makris (2003: 131). *Senna* (= *Cassia*) *artemisioides* (Gaudich ex DC.) Randell, native to Australia, is listed for Cyprus by Meikle (1977: 589) and by Christofides (2017: 170) who referred to it as a casual escapee. *Senna* (= *Cassia*) *didymobotrya*, native to Africa, is also grown as an ornamental. Although perhaps not widely grown, all are potential host plants for *C. florella* in Cyprus.

Migration into the eastern Mediterranean

Described by Larsen (1984: 38) as “one of the most powerful fliers among the Arabian butterflies”, *C. florella* has a strong, bounding flight, and on the wing is unmistakable for any other species (Larsen 1974: 101). With a wide distribution in the African tropics, *C. florella* is strongly migratory, “timed from the car at just under 30 km/hour”, and covering “about 200 km on a good day” (Larsen 1992). The same author noted that migratory flight is at a height of 1–3 metres, obstacles being sur-

mounted rather than circumvented, as noted with migrant *Vanessa cardui* (Linnaeus, 1758) that are also seen migrating (over land) at a similar height range (John 2001).

In the eastern Mediterranean, *C. florella* is a regular visitor to Egypt, reaching into the Nile Delta (Larsen 1978, 1990: 34) where temporary breeding may occur (e.g. Williams 1926). However, other than perhaps in Gebel Elba, an area of territory disputed by Egypt and Sudan, *C. florella* may have no permanent populations in Egypt (Larsen 1990: 34, Gilbert & Zalut 2007:19). Levant representation is generally sparse: in Eilat (Israel), at the northern end of the Red Sea a breeding population, present from 1980 to 1987, was not seen again until 1996 (Benyamini 2000), but is now regarded as having established a permanent population there (Benyamini & John in prep.). Nevertheless, the early arrival of migrants may enable the build-up of substantial populations in Israel by the autumn, as reported by Ichiro Nakamura in Tel Aviv in 1974 (pers. comm. in Larsen 1976, Dubi Benyamini pers. comm. to the first author).

Katbeh-Bader, Amr & Isma'el (1998) reported the finding in Jordan of only two specimens in fifty years, but this appears to have been revised in Katbeh-Bader *et al.* (2004) in which a single specimen is referred to – that of a female observed by Graves on 22 March 1918 near Aqaba on the Red Sea, opposite Eilat and reported in Graves (1919).

Observations to the north of Israel are notably fewer. For Lebanon, Larsen (1978), writing on his finding of a single female *C. florella* on 3 May 1977 in Beirut, stated the earliest record to be that by “LEDERER (1855, as *Callimorpha dryas*)” adding that “CREMONA caught a few in Beirut in the 1920s... and I did not see it during five years in the country [1970–1974]”. Zerny (1932) and Ellison & Wiltshire (1939) failed to record *C. florella* in Lebanon, the latter reporting on observations from 1927 to 1934 when one or other of the authors was stationed in Beirut throughout this eight-year period. Larsen's 1977 *C. florella* record remains the latest known for Lebanon (Husein Zorkot pers. comm. to the first author – see also Zorkot 2016: 160).

Based on these few records for Lebanon, occasional singletons might have reached Syria in the past, but no substantive literature records can be found and *C. florella* remains unknown there (Mudar Salimeh pers. comm. to the first author).

For Turkey, *C. florella* received no mention in Atahan *et al.* (2018), a book on the butterflies of Hatay, the Mediterranean Turkish province immediately to the north of Syria. Hesselbarth, van Oorschot & Wagener (1995: 337) noted a single record for *C. florella* (sex not stated) on 8 June 1986, 45 km east of Bingöl, Bingöl Province (1200 m), with no other records listed for the country by Koçak & Kemal (2018). As explained below, the timing of the Turkish record appears of relevance to observations in Cyprus in the same year, although it is more likely that migrants arriving into Bingöl Province in central eastern Turkey originated from a different source, these possibly arising from breeding areas in the Persian Gulf (rather than western Arabia), and taking a near parallel, but more easterly, migratory route than those arriving in Cyprus.

Records of migrant *C. florella* on Mediterranean islands

Straits of Messina. In 1937, a brief note by Prof G. D. Hale Carpenter (a former Hope Professor of Zoology at Oxford University) conveyed an observation on 29 July 1936 by Mr. C. N. White (Balliol College, Oxford) of “a considerable number of butterflies... flying from Italy to Sicily. None came on board, but they appeared about the size of a large White [*Pieris brassicae* (Linnaeus, 1758)] but more sulphur, and I concluded that they might be brimstones [*Gonepteryx rhamni* (Linnaeus, 1758)]” (Carpenter 1937). White, when later shown specimens of *C. florella*, remarked that the species seen in the Straits of Messina “was more like that than any of the species mentioned by Dr. Williams in the letter quoted below”. Carpenter continued: “It is therefore quite possible that that the species was *C. florella*, and the observation is the first on its appearance in Europe.” However, in C. B. Williams’s response (reproduced in full in Carpenter 1937), he (Williams) refers to just two other migratory records from the area – those of *Aporia crataegi* (Linnaeus, 1758) and *Pieris brassicae* and is dismissive of the possibility of White’s observations being of *C. florella*. Absence of any reports of *C. florella* in the central Mediterranean in more than 80 years since White’s unconfirmed observation supports this view, but might have been regarded more sympathetically by the authors of this paper if an account of *C. florella* in Malta (discussed below) had proved reliable, as the Straits of Messina are just a short distance NNE of Malta.

Malta/Cyprus 1963–1964. Valletta (1974) reported on the receipt of wing “bits and pieces” from four species of butterfly (including *C. florella*) considered new to Malta, that had been sent to him by Flight Lieutenant K. A. (Jack) Harrison. These were stated as having been taken in July 1963 in the gardens of the RAF Officers’ Mess at Luqa, Malta and during the intervening period had been stored for ten years in an old tobacco tin by Harrison (Valletta 1974, 1986). Referring specifically to *C. florella*, Valletta (1986) wrote that “This capture was passed on to me in 1973...”, thereby strongly suggesting that an entire specimen had been provided. However, his earlier reference to wing fragments indicates that this was clearly not the case. Anthony Valletta died nearly 30 years ago, but his collection is not known to have included *C. florella* nor has any specimen of *C. florella* been donated to the National Museum of Natural History, Mdina, Malta (Paul Sammut & John Borg pers. comms. to first author).

Discussing Valletta’s 1974 paper, Sammut & Borg (2008) stated: “this species [a reference to *Euchloe ausonia* (Hübner, 1804)], together with three others, the pierid, *Catopsilia florella* Fabricius, 1775, and two lycaenids, *Tarucus theophrastus* Fabricius [sic], 1793 and *Pseudophilotes baton* Bergstrasser [sic], 1779, all reported by Valletta... as new records for Malta, were actually collected by Harrison in Cyprus, and not Malta (Harrison pers. comm.). This error was communicated by Harrison to Valletta soon after the latter’s publication appeared in ‘The Entomologist’ [sic – see Valletta 1974 in references], but has to date not been rectified.” In his revision of the

butterfly fauna of the Maltese islands, Cassar (2018) also drew attention to these records, regarding each as a misidentification or as a mislabelling of a specimen.

In fact, neither *Tarucus theophrastus* (Fabricius, 1793) nor *Pseudophilotes baton* Bergstrasser, 1779) (reported by Valletta 1974 as *Philotes baton*) are present on Cyprus. The genera *Tarucus* and *Pseudophilotes* are, however, represented there by the very similar *Tarucus balkanicus* (Freyer, 1844) (see descriptions of Mediterranean *Tarucus* spp. in Tennent 1996: 31 & Plate 10) and *Pseudophilotes vicrama* (Moore, 1865) respectively. In the Mediterranean, the latter is restricted to eastern areas, but Harrison (and possibly Valletta) based his determination of the species on data in Higgins & Riley (1970: 267, plate 53, map 281) wherein *Pseudophilotes baton* is shown to be pan-Mediterranean.

Tarucus balkanicus and *Pseudophilotes vicrama* are known from the Akrotiri area in Cyprus (into which RAF base Harrison regularly flew), as is *Euchloe ausonia*, another of the butterflies described as new to Malta by Valletta in 1974. Therefore, together with the history as described, this surely eliminates any remaining doubt that all were collected in Cyprus, not Malta.

Recent correspondence with Harrison confirmed that the specimen of *C. florella* (sex not recorded) was taken in either 1963 or 1964, probably in the grounds of RAF Akrotiri, Cyprus (Jack Harrison pers. comm. to the first author), representing the first known record of *C. florella* in Cyprus.

Cyprus 1986. On 25 and 27 October 1986, the late Pavlos Neofytou collected eleven specimens of *C. florella* (one female and ten males) at Liopetri, Frenaros and Ayia Napa in the south-east of Cyprus; these were thought at the time to be the first recorded specimens to arrive on the island (Makris 2003: 130). The locations form a triangle, with Liopetri and Frenaros (both inland) ca. 10 km distant from coastal Ayia Napa. The number caught and the distances between the observations indicates that many more *C. florella* were likely to have been present in the general area despite this being largely agricultural. The specimens were reasonably fresh in appearance, although slight damage was evident on one hindwing of the female illustrated in Makris (2003: 131, 304). Most of the collected specimens, along with invertebrate collections from other sources, later formed part a large wall display at the Municipal Museum of Natural History, Larnaka. Regrettably, the display was seen to be under attack from (probable) *Anthrenus* sp. (Dermestidae), when the first author visited the museum in 2007. Following advice from Martin Honey (NHMUK) and with guidance from local entomologists Aristos Aristophanous and Christodoulos Makris, the museum transferred these and other entomological specimens to (non-specialist designed) cabinets, and without heeding advice about prior deep-freezing of specimens or the need to ensure that the cabinets were insect proof. The current state of the Neofytou collection is not known (an enquiry to the museum remained unanswered), but by 2010 at least one specimen of *C. florella* had been reduced to dust, as had many other insect specimens (Aristos Aristophanous pers. comm. to the first author).



Fig. 1. *C. florella* ♀ nectaring on *Limonium sinuatum*. Photo © Will Hawkes.

Fig. 2. Coastal location of sighting near Apóstolos Andreas Monastery, 8.iv.2019. Photo © Will Hawkes.

Fig. 3. *Senna artemisioides*, Agios Theodoros Soleas (450 m), 1.v.2015. Photo © Eddie John.

Fig. 4. *Senna didymobotrya*, near Trachypedoula (300 m) 20.x.2007. Photo © Eddie John.

Fig. 1. *C. florella* ♀ nectarzuigend op *Limonium sinuatum*. Foto © Will Hawkes.

Fig. 2. Plaats van de waarneming nabij het Apostolos Andreasklooster, 8.iv.2019. Foto © Will Hawkes.

Fig. 3. *Senna artemisioides*, Agios Theodoros Soleas (450 m), 1.v.2015. Foto © Eddie John.

Fig. 4. *Senna didymobotrya*, nabij Trachypedoula (300 m) 20.x.2007. Foto © Eddie John.

There can be little if any doubt that the appearance of *C. florella* in Cyprus was due to migration. The Turkish sighting in June of the same year points to the possibility that both originated from a common (spring) migration earlier that year, Arabia (via Israel) being a likely source – at least for the migrants arriving in Cyprus. In support of this hypothesis, Dubi Benyamini (pers. comm. to the first author) informed that migrant *C. florella* established temporary colonies in several areas of Israel in 1986, including Ramat Hasharon and Beit Arye, to the north and east of Tel Aviv, respectively. Presence at Beit Arye from March to the end of August in that year is indicative of the usual early (spring) migration. Later, migrant *C. florella* were seen heading northwards in June 1986 in the central Negev and were again seen in July, migrating along Mount Arbel cliffs overlooking the western coast of the Sea of Galilee in northern Israel.

Although the species has not formally been recorded

as breeding on Cyprus, the most likely explanation for the presence of *C. florella* in late autumn of 1986 is that of an undetected arrival in spring – possibly as participants in a mixed migration with *Vanessa cardui* that occurred in Israel during spring of the same year (Dubi Benyamini pers. comm. to the first author). Breeding on introduced *Senna/Cassia* might then have followed throughout the summer, with *C. florella* remaining undetected until the autumn in an agricultural area of Cyprus far less frequently visited by lepidopterists. It seems highly unlikely that a north-westwards migration from Israel would have occurred late in the year.

Cyprus 2019. At the time of the third, known appearance in Cyprus of *C. florella* (reported here), the second and third authors (W. H. and E. W.), in company with fellow PhD/Masters students from Exeter University, were monitoring invertebrate migratory activity at Cape Apóstolos Andreas at the tip of the Karpaz Peninsula in

northern Cyprus. The spring of 2019 was exceptional in this respect, with the appearance of very large numbers of a variety of migrating invertebrates arriving across the island, with huge numbers of *Vanessa cardui* being especially evident. As with the 2014 migration into Cyprus (John, Sparrow & Sparrow 2015), large numbers of the noctuid moth *Heliothis peltigera* ([Denis & Schiffmüller, 1775] were present, as there were of the diurnal arctiid moth *Utetheisa pulchella* (Linnaeus, 1758) (Alison McArthur pers. comm. to the first author; W. H. and E. W. pers. obs.).

On 8 April, a white form female *C. florella* (fig. 1) was observed nectaring on *Limonium sinuatum* (L.) Mill. (Plumbaginaceae) at a location ca. 250 m from the eastern shoreline of the cape at 35°40.412'N, 34°34.668'E (fig. 2) some 1.7 km north of Apóstolos Andreas Monastery. Although a major migration of *Vanessa cardui* was underway over the period, the sighting of *C. florella* coincided with much reduced signs of *V. cardui* activity that day and, *C. florella* excepted, no other species of butterfly were seen in the immediate area. However, *C. florella*, as well as migrating as a single species, is known to participate in mixed migrations (Larsen 1992 and references therein). Unfortunately, neither the identity nor the significance of the specimen was appreciated at the time, resulting in the taking of a hurried photograph on the assumption that the butterfly was a species of *Gonepteryx* Leach, [1815]. Only later was the specimen confirmed as *C. florella*, the first recorded sighting of this species in Cyprus for over 30 years. However, no further sightings of *C. florella* were made despite many weeks being spent in the study area. It is interesting, although possibly coincidental, to note that the migrant *C. florella* singletons, 1) reported by Graves (1919) at Aqaba, 2) seen in Beirut by Larsen (1978) and 3) that reported here, were female – although the last mentioned was not of the yellow form characteristic of migrant populations in Ethiopia and Kenya (Larsen 1992).

Discussion

While acknowledging the infrequent nature of the arrival of *C. florella* in Cyprus to date, the number of tropical butterfly species penetrating northwards into the eastern Mediterranean is increasing, coincidental with rising average annual temperatures in Cyprus (Department of Meteorology 2019). Some, such as *Danaus chrysippus* (Linnaeus, 1758), are being seen more frequently than hitherto and have established temporary colonies in, for example, Croatia (Koren *et al.* 2019) and Cyprus (John, Hardman & Smith *in press*) – see also Larsen (2015) where, in relation to Cyprus, the author noted that thirteen species (ca. 25%) have tropical affinities.

C. florella may become a more frequent visitor to the island in the future, but the species is vulnerable to low winter temperatures, and local breeding is likely to be further restricted by the absence of any native *Senna/Cassia* host plants and therefore confined to ornamentals such as *Senna artemisioides* (fig. 3) and *Senna didymobotrya* (fig. 4). Cultivated varieties may not be present in sufficient quantity to sustain colonisation;

indeed, Tennent *et al.* (2013) gave the species' reliance on ornamentals as a possible contributory reason for the demise of *C. florella* on Madeira, where it had been first observed in 1999 (Aguiar 2000). On the other hand, Pittaway (1985), in referring to his observations of *C. florella* in Saudi Arabia, stated "the cultivation of ornamental *Cassia* [*Senna*] species in towns had had a profound effect on local populations". Similarly, despite heavy larval losses due to parasitism by braconids and tachinids (Wiemers 1995), *C. florella* was reported still to be present on all Canary Islands, where it remained restricted to ornamental *Cassia* (*Senna*) grown in parks and gardens (Wiemers, Acosta-Fernández & Larsen 2013).

Another factor possibly needs to be taken into account when considering opportunities for establishment. Owen (1971: 80), in noting that eggs are laid only on new leaves, stated the need for adults to move from one host plant species to another throughout the season in order to find suitably acceptable young leaves on which to oviposit. To a degree, this view is contradicted by Dubi Benyamini and Steve Collins (pers. comms. to the first author), the latter stating that *C. florella* "will lay on flowers, leaves [and] seed (young)". The limited availability of host plant varieties in Cyprus *might* therefore be another factor adversely influencing chances of the species' establishment.

Summary and Conclusions

Although *C. florella* is a regular visitor to central Israel, the species' customary arrival there in the spring of 2019 was delayed by unseasonably cold weather, resulting in there being no observations reported during March or early April (Dubi Benyamini pers. comm. to the first author). Similarly, *C. florella* had not been reported in Lebanon (Magda Bou Dagher Kharrat and Husein Zorkot pers. comms. to the first author) prior to its arrival in Cyprus on 8 April, although for the reasons discussed earlier, this is unsurprising. We conclude, therefore, that the appearance in Cyprus in early April arose from insignificant (and undetected) numbers of *C. florella* migrating northwards direct from southern Israel, Sinai or western Arabia. It seems highly likely that these accompanied the estimated billions of *Vanessa cardui* in a mixed migration flying northwest across the eastern Mediterranean from Israel and Lebanon during late March and into May 2019 (John *et al.* *in prep.*). Although *C. florella* was not seen in migratory flight in Cyprus, many thousands of *Vanessa cardui* had passed through Cape Apóstolos Andreas prior to and after the observation of *C. florella* (W. H. and E. W. pers. obs.).

Permanent establishment of *C. florella* in Cyprus appears improbable in the near future. The absence of native *Senna/Cassia* and a possibly limited number of ornamental host plant species (and specifically in the sparsely populated Karpaz Peninsula), suggests that breeding of *C. florella* is unlikely in the peninsula. Of course, we cannot rule out the (likely) possibility that others arrived undetected in other parts of Cyprus and have since bred successfully, but if so, the superficial similarity to *Gonepteryx cleopatra* (Linnaeus, 1967) may

result in *C. florella* being overlooked and hence unreported.

Nevertheless, susceptibility to low winter temperatures will remain a factor that will hinder establishment of this and future migrations, at least for the present. However, three factors: 1) the (now) permanent presence of *C. florella* in Eilat on the Red Sea, 2) the regular appearance of *C. florella* migrants into central Israel, and 3) a warming climate, suggest that migrant *C. florella* are likely to reach Cyprus with greater frequency in future years. Should that occur, establishment of temporary colonies on *Senna* ornamentals grown in parks and gardens in sheltered coastal areas, as appears to have happened in 1986, seems increasingly likely.

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