

Distribution analysis of two similar *Colias* species in the Rhône département of France

Pale Clouded Yellow (*Colias hyale*) and Berger's Clouded Yellow (*Colias alfacariensis*) are acknowledged by the majority of experienced lepidopterists as being inseparable from observations of imagoes in the natural position in the wild. Whilst uppersides may be glimpsed or photographed during courtship rituals, otherwise the butterflies always settle with wings closed. With the forewing raised it is usually possible to separate females from males, but with the forewing tucked down it may not even be possible to separate from a third species, Clouded Yellow (*Colias crocea*.) In flight, confusion with *C.crocea* is eradicated for all males and most females as the orange-yellow uppersides are easily distinguishable. A small percentage of females of *C.crocea* have whitish uppersides, form *helice*, and are thus prone to be identified as females of either *C.hyale* or *C.alfacariensis*.

From a photograph of *C.hyale/C.alfacariensis* with wings closed, the only frequently used criterion for identification concerns the shape of the outer margin of the forewing to the apex; an ensemble considered as overall more rounded for *C.alfacariensis*. There is much debate as to whether this feature is reliable in the identification of random individuals. Netting butterflies and manipulating in the hand to scrutinize markings and colouration of uppersides is also supposed to provide identification clues. However, doubt will inevitably subsist in the analysis of random individuals. It should also be noted that a butterfly should not be handled unless the release of the insect unharmed can be guaranteed.

In France the species *C.hyale* and *C.alfacariensis* are shown as being fairly widespread on distribution maps at département level (Lafranchis, 2000.) There are therefore many départements where both species are potentially present. For local lepidopterists, evaluating the genuine distribution pattern of each species within a single département poses a significant challenge. It should of course be noted that the relative presence of each species may be extremely variable from one département to another, and conclusions relating to variations in climate and altitude may not be constant.

I have been recording butterflies in the Rhône département of France since the year 2000. As I do not use a net, butterflies are observed in their natural positions and photographed for subsequent inspection.

In 2009 I decided it was necessary to prove the existence of both species. This seems a logical procedure for all local studies. At the same time it appeared that *C.alfacariensis* was relatively easy to observe but that *C.hyale* was a rare species.

There are two fundamental stages of analysis:

1. evaluation of habitat
2. rearing an egg through to imago

Only the second stage is absolute proof of identity of any individual.

Resolving the identification problem required three steps:

Step 1, confirming *Colias alfacariensis*

C.alfacariensis has quite exact habitat requirements. It is usually reported as using two larval host plants, *Hippocrepis comosa* and *Coronilla varia*. These plants are most common in dry, calcareous terrain although they may occur occasionally in dry situations on other soil types. In the Rhône département *C.varia* is the commoner plant.

I compared the distribution pattern of the calcareous terrain in the Rhône with that of observations of the butterfly, and I found that the two were similar. Furthermore, I found that the distribution maps for Adonis Blue (*Lysandra bellargus*) whose host plant is *Hippocrepis comosa*, and Reverdin's Blue (*Plebejus argyrognomon*) whose host plant is *Coronilla varia*, were equally similar. [See figure 1.]

Males observed within this distribution range are usually a vivid, lemon yellow in flight. In contrast the females are clearly whitish. The sexes are thus clearly distinguishable in flight. Females have been observed laying on both *C.varia* and *H.comosa*. There have been no other eye witness accounts of egg laying on any other plants.

In April 2009, after witnessing egg laying on *C.varia* I reared two caterpillars through to imagos. As expected, the livery of the larvae confirmed the species as *C.alfacariensis*, the rows of black markings being very distinctive [See figure 2.] These markings are perceptible from third instar [See figure 3.] This experiment produced one male and one female butterfly, the male emerging 48 hours before the female. Both were released back into the wild into suitable habitat.

In the future, within this habitat structure, it is reasonable to record flying individuals as *C.alfacariensis*. It should be noted, however, that any egg laid on a different plant should be reared through to imago to find out if *C.alfacariensis* accepts other varieties of *fabaceae* or if in fact *C.hyale* is cohabiting with *C.alfacariensis*. There is also no harm in carrying out occasional further rearing on *C.varia* or *H.comosa* to check whether the larvae are always *C.alfacariensis* or if *C.hyale* also accepts one or both of these plants too.

Step 2, removing doubt with *Colias crocea*

C.crocea is a very common species, potentially present in every situation where either *C.alfacariensis* or *C.hyale* fly. It is most abundant in late summer and autumn when migrations are at a maximum, but it may be observed at any time from early spring onwards. The females are reported laying on a variety of *fabaceae* covering most open habitat situations.

When only a single, white female *Colias* is observed at any site, much care must be taken not to confuse the *helice* form of *C.crocea* with either of the other two species. This is particularly important when the observation is in an area where neither of the other two species have been previously reported. Recording errors could therefore give the impression that the other two species are more widespread. In flight *helice* is usually distinguishable from the more extensive dark areas on the uppersides.

It also occurred to me that the mature larvae of *C.crocea* and *C.hyale* are similar. It seemed important to rear caterpillars of *C.crocea* in order to check the appearance of the final instar and also any other changes during larval growth. During 2009 I was fortunate enough to observe *helice* females egg laying on two separate occasions; the first time on *Lotus corniculatus* and the second on *Trifolium pratense*. I was able to rear from egg to imago on both occasions; the two butterflies which emerged were females of the usual orange-yellow form. Both were released back into the wild. The final instar caterpillars develop a row of little, black spots along the lateral stripe [**See figure 2.**] At third instar the lateral stripe is distinctly visible and the caterpillar is already showing resemblance to the final instar [**See figure 3.**]

Step 3, confirming *Colias hyale*

In the Rhône département, any observations of butterflies identifiable as either *C.hyale* or *C.alfacariensis* are rare outside of calcareous situations.

In terms of the presence of *C.hyale* two conclusions seem possible:

- either *C.hyale* is mostly cohabiting with *C.alfacariensis* but is remaining undetected
- or *C.hyale* is a rare species

C.hyale is reported as using various species of *fabaceae* as larval host plants, especially lucerne and clovers. In France, two species are mentioned in particular: *Medicago sativa* and *Trifolium repens* (Lafranchis, 2000.) These species are generally widespread and common.

In terms of host plant requirements therefore, there is no particular reason to suppose:

- either that *C.hyale* is mostly cohabiting with *C.alfacariensis*
- or that *C.hyale* is a rare species

*The apparent scarcity of *C.hyale* may then be due to some other ecological requirement?

We had few data for *C.hyale*. These had been attributed through analysis of wing shape or habitat. I discovered that several data entries concerned observations on the fringes of confirmed habitat areas for *C.alfacariensis*, so these looked like errors. After elimination of those entries only four remained, and three of these were of 'singles'. Confirmation of the species from a single butterfly seemed unreliable, and revisiting sites where only singles had been recorded previously provided little guarantee of further observations.

Only one data entry remained; several individuals observed, including a courtship ritual, at a site in the Monts du Lyonnais at around 650m altitude on 3rd September, 2003. The site is an open, noncalcareous area with some permanent grassland and pasture with clovers, as well as some fields of cultivated clover and lucerne. There are sweetcorn crops in between.

On 30th August, 2009 I revisited this site and found eight individuals flying; 7 males and 1 female. These adults were very active, nectaring in the areas of cultivated lucerne and clover, but also flying across the permanent grassland and nectaring on composites. I was immediately struck by the somewhat smaller size and paler appearance of the males in comparison to confirmed sites for *C.alfacariensis*. It was also very difficult to confirm the female in flight amongst the males, all the butterflies appearing pale [See figure 4.] There was no evidence of any *C.varia* or *H.comosa* growing in this area.

After this visit I was convinced that I was looking at a colony of *C.hyale*. The habitat situation looked perfect and the appearance of the adult males in flight looked like something unfamiliar. It was necessary to observe an egg laying female at this site and rear the egg through to imago to prove the identity of the species.

I revisited the site on 27/09/2009 (3 males), 12/09/2010 (3 males), 19/09/2010 (3 males), 21/08/2011 (7 pale males), 21/09/2011 (12 butterflies, including courtship - males and females difficult to separate), 04/10/2011 (12 butterflies, including courtship), 16/10/2011 (5 males, 2 females - the females appearing rather white on this occasion, it occurred to me that when the sex was in doubt in flight the butterflies were probably males and that observations of females had been very few), 05/09/2012 (14 males, 2 females - including a mating pair.)

Whilst it appeared that a permanent breeding colony occupied this site, I had been unable to observe an egg laying female on any of these visits. I decided it was necessary to search neighbouring areas for evidence of other colonies.

On 8th September, 2012 I discovered another good colony, approximately 10km as the crow flies from the original site, slightly lower down at around 550m. After observing 9 males flying across a cultivated lucerne field, I wandered into some adjacent, permanent grassland. The presence of a female on the ground closeby was betrayed by a male who appeared and 'buzzed' her into the air. The pair rose upwards performing the usual energetic courtship ritual, the female always flying behind the male. I watched them for a couple of minutes before they inevitably disappeared from view. Instead of moving on I sat down for a ponder, and lo and behold the female returned to her initial resting spot in front of me. She remained motionless for a while, then deposited an egg on the upperside of a *Trifolium repens* leaf and flew away. At last I was able to rear an egg through to imago.

The egg stages and first instar caterpillar were literally identical to those of *C.alfacariensis* and *C.crocea*. In all three cases the egg was pale yellow when laid, turning to a pinkish colour and finally dark green. This dark green colouration is in fact the caterpillar itself showing through the roughly transparent egg shell. The freshly emerged caterpillar is greenish-brown with a black head and proceeds to consume the chorion for its first meal. The caterpillar then turns a brighter green with a black head.

At the beginning of the third instar there was a significant change. The caterpillar had become a rather dark green with a much lighter head [See figure 3.] Furthermore, this colouration reappeared at the beginning of the fourth and final instars [See figure 4.] This was different to the experiences of rearing *C.alfacariensis* and

C. crocea and looked to be an important diagnostic characteristic for determining *C. hyale* during larval development. The final livery of the caterpillar was similar to that of *C. crocea*, but without the small row of black spots along the flanks [See figure 2.]

When the butterfly emerged from the chrysalis I was fortunate enough to be present. As the freshly hatched female clambered for a foothold I was lucky to be able to take photographs of the uppersides [See figure 5.] With all the evidence already stacked in favour of *C. hyale*, this was the final, absolute confirmation of the species.

I was also able to take a photograph of the butterfly in profile. It is noteworthy that the outer margin is relatively rounded to the apex, thus throwing considerable doubt over the usefulness of this feature with regard to *C. alfacariensis* [See figure 5.]

The butterfly was released an hour or so after emergence, at the site where the egg was laid.

Conclusion

The conclusion from this study in particular is that identifying *C. alfacariensis* or *C. hyale* in this geographical area is not a matter of identifying individual imagos. It is a question of detailed knowledge of habitat in the distribution area and observation of behaviour and appearance of colonies of butterflies moving within that structure. Ultimately, rearing from egg to imago is essential in order to remove any possible doubt. However, it is satisfying to note that the ecological theories had already provided substantial evidence towards correct identification.

*Bearing in mind the widespread distribution of the larval host plants of *C. hyale*, it is assumed that in the Rhône département it is an ecological requirement for the butterfly to exist in the relatively cooler climate at altitudes mostly above 500m.

References:

Lafranchis, T., 2000 - *Les papillons de jour de France, Belgique et Luxembourg et leurs chenilles*. Collection Parthénope, Editions Biotope, Mèze (France). 448p.

Timothy Cowles, timothy.cowles@wanadoo.fr

Figure 1

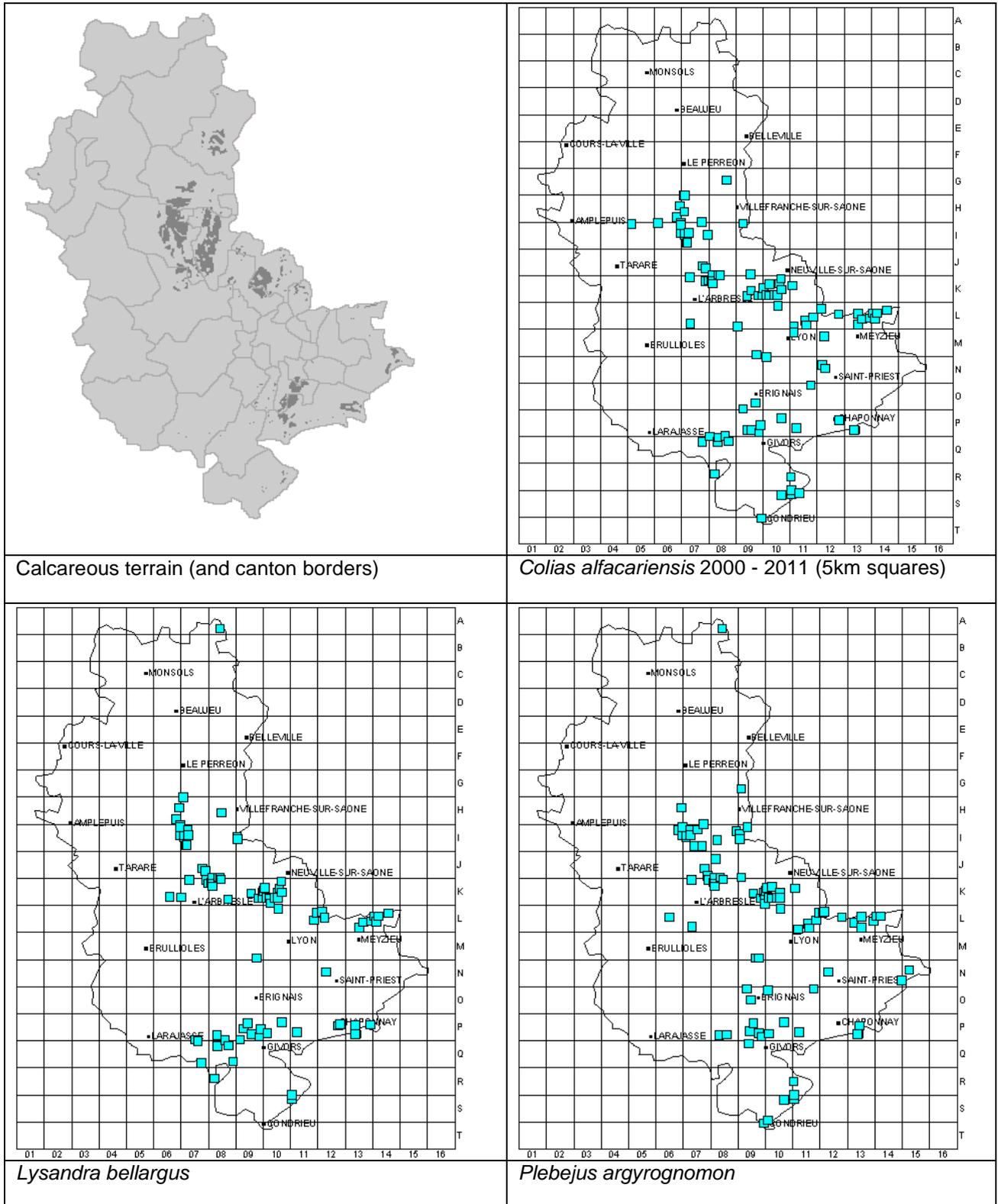


Figure 2

Final instar caterpillars, reared in captivity in the Rhône département (69), France.

Final instar

Colias hyale, 2012 - on *Trifolium repens*



Colias crocea, 2009 - on *Lotus corniculatus*



Colias alfacariensis, 2009 - on *Coronilla varia*



Figure 3

Immature caterpillars, reared in captivity in the Rhône département (69), France.

Third instar

Colias hyale, 2012 - on *Trifolium repens*



Colias crocea, 2009 - on *Lotus corniculatus*



Colias alfacariensis, 2009 - on *Coronilla varia*



Figure 4



Colias hyale, 2011, Monts du lyonnais - male on the right



Colias hyale, 2012, early fourth instar



Colias hyale, 2012, early final instar

Figure 5



Colias hyale, 2012 - female showing upperside markings



Colias hyale, 2012 - female showing inconclusive outer forewing shape for separation with *C.alfacariensis*