CBMS
Catalan Butterfly Monitoring Scheme

cynthia

Bulletin of the Catalan Butterfly Monitoring Scheme 2007 - no. 7

Cover

Detail of the underside of the hind-wing of a Spanish Festoon *Zerynthia rumina* (photograph: A. Miquel).

Furry Blue *Polyommatus fulgens* resting on a spike (photograph: J.M. Sesma).

Editorial

The BMS as a tool for studying our butterflies

In 2005 we celebrated the start of the BMS in Andorra (BMSAnd) in the hope that this new network would quickly become as established as the CBMS. As you will see from the articles included in the following pages, this wish has come true and in 2007 six Andorran stations have provided complete data as part of the BMSAnd. Likewise, in other areas of the Pyrenees, new itineraries have been and will be established and consequently we are now finally beginning to have solid information on one of the richest and most interesting areas in the whole of Europe. Soon we will be able to confirm our suspicions that high-mountain species such as the well-known Apollo *Parnassius apollo* and Small Tortoiseshell *Aglais urticae* are undergoing climate-change-related declines.

In fact, the effects of climate change on our butterfly populations seem to be ever more obvious. In the last few years lowland CBMS stations have recorded for the first time ever or in unusually large numbers species that are essentially North African. Two examples suffice: the discovery of Desert Orange Tip *Colotis evagore* for the first time in the *comarca* of El Segrià and the massive arrival of Plain Tiger *Danaus chrysippus* in the Ebro Delta and other areas along the Catalan coast and the Balearic Islands. The year 2007 coincided with one of the largest ever migrations of Plain Tiger seen in Catalonia and also saw the appearance of Green-striped White *Euchloe belemia*, a common species in the south of the Iberian Peninsula but never before recorded in Catalonia.

These finds indicate that the BMS contributes to improving and extending our knowledge of Catalan butterflies. In an applied sense, the BMS provides new information on a wide range of aspects linked to the distribution and ecology of these insects. The weekly repetition of the transects reveals biological and behavioural information that more irregular surveying cannot provide. The following pages include a good example of this type of work in the articles on the habitat preferences of our butterflies, ecology of the Comma *Polygonia c-album* and the migration of the Painted Lady *Cynthia cardui*. We hope that you will see your perserverance and efforts in the field and your valuable contribution to the knowledge of the butterflies of Catalonia fully reflected in the articles that we have chosen.

The CBMS network

Current situation (2007) of the Butterfly Monitoring Scheme in Catalonia, Andorra and the Balearic Islands

In all, 70 stations, 6 more than in 2006, participated actively in the fourteenth CBMS season. Three stations also form part of the Andorran BMS and monitor true Pyrenean habitats. The other new stations are all situated in north-east Catalonia (*comarques* of Pla de l'Estany, Alta Garrotxa, Alt Empordà and Vallès Oriental) or in the agroforestal part of the island of Menorca. In total 129,078 butterflies belonging to 162 species were counted in 2007.

During the 2007 season 70 butterfly itineraries were walked, of which 64 managed to complete the annual counts (fig. 1). As well, regular censuses to be incorporated into the CBMS network in coming years were carried out at Argentona (100 m, Maresme), Folgueroles (650 m, Osona), Viladrau (900 m, Osona), Tren de Sang, near Berga (900 m, Berguedà), Alinyà (1,200 m, Alt Urgell), Planes de Son (1,400 m, Pallars Sobirà) and, as part of the BMSAnd network in Andorra, at Rec de l'Obac (1,500 m).

The available annual series are shown in figure 2; as of 2007, more than 50 stations have provided data for five or more years and 14 stations have provided data for 10 or more years.

New transects

Torre Negra (Vallès Occidental, 140 m). This transect is situated in the Torre Negra Rural Park and lies near the transect walked in the Barcelona Autonomous University (nº 76), between the Vallès plain and the Serra de Collserola. The predominant land-use is abandoned fields, which are ploughed up or pastured periodically to control scrub encroachment and maintain open areas. Although the site's butterfly community is fairly poor, in 2007 Green-striped White *Euchloe belemia* was observed, the first ever record for Catalonia[2]. This butterfly walk is financed by the Sant Cugat del Vallès Town Council.

Fontaneda (Andorra, 953 m). Situated in Sant Julià de Lòria, this is the lowest of the itineraries walked in Andorra and passes through essentially Mediterranean habitats. It follows a river downstream along its right-bank, passing through a number of abandoned agricultural terraces now given over to grazing, and woods of downy and holm oaks. The Mediterranean influence is revealed by the presence of locally scarce species such as Spanish Festoon *Zerynthia rumina*, Southern Small White *Pieris mannii*, False Ilex Hairstreak *Satyrium esculi*, Nettle-tree Butterfly *Libythea celtis*, Striped Grayling *Hipparchia fidia*, Dusky Meadow Brown *Hyponephele lycaon* and Dusky Heath *Coenonympha dorus*. Outside the actual itinerary, Spanish Purple Hairstreak *Laeosopis roboris*, a very poorly represented Lycaenidae in the CBMS, has been detected. The butterfly counts are carried out by staff from the Andorran Centre for the Study of Snow and Mountains (CENMA).

Pessons (Andorra, 2,243 m). This station is the highest of any in either the BMSAnd or CBMS and monitors alpine pastures with populations of high-level species (as yet unrepresented in the network of itineraries) such as Mountain Clouded Yellow *Colias phicomone*, Mountain *Erebia epiphron* and Common Brassy *E. cassioides* Ringlets and Shepherd's or Mountain Fritillary *Boloria pales/napaea* (the exact identity of the species will be confirmed in coming seasons), as well as commoner species such as Small Tortoiseshell *Aglais urticae* and Pearl-bordered *Boloria euphrosyne* and Small Pearl-bordered *B. selene* Fritillaries. In 2007, the whole area was covered in snow until mid-May, a situation that is probably atypical and led to a concentration of butterfly activity in the summer months. In its first year of operation, 32 species were detected, although it is likely that many others –either alpine (e.g. *Erebia* and *Pyrgus* spp.) or generalist- will appear in the future. Despite the great difficulties involved in operating such an itinerary, it is important to highlight the exceptionally interesting data it provides from a strictly alpine habitat. The butterfly counts are carried out by staff from CENMA.

Rec del Solà (Andorra, 1,109 m). The third new itinerary in Andorra, this walk lies in the peri-urban area of the town of Andorra la Vella and is of interest to the CBMS network as a transect situated in a predominantly agricultural context within a typically Pyrenean environment. The walk is dominated by small market gardens and oak (both deciduous and evergreen), poplar and ash woodland. In all, 32 species were recorded during the first season, a relatively low figure that can be explained in part by the poor weather during the counting period. Nevertheless, both Apollo *Parnassius apollo* and Spanish Purple Hairstreak *Laeosopis roboris* were recorded. The walk is coordinated by CENMA.

Sadernes (Garrotxa, 300 m). This walk is coordinated and carried out by the Consortium for the Protection and Management of the Alta Garrotxa Area of Natural Interest. The itinerary passes through very Mediterranean habitats near the Rectoria de Sadernes that include holm-oak and pine woodland and abandoned pastures undergoing a process of secondary succession. The butterfly community of the site is relatively diverse and is dominated by species such as False Ilex Hairstreak *Satyrium esculi*, Cleopatra *Gonepteryx cleopatra*, Wood White *Leptidea sinapis* and Southern White Admiral *Limenitis reducta*. Other species include Two-tailed Pasha *Charaxes jasius* and Woodland Grayling *Hipparchia fidia*. Rather scarcer are more montane elements such as Black-veined White *Aporia crataegi*, Provençal Short-tailed Blue *Cupido alcetas*, White Admiral *Limenitis camilla*, Glanville Fritillary *Melitaea cinxia*, Large Wall Brown *Lasiommata maera* and Silver-studded Skipper *Hesperia comma*. The Consortium hopes to be able to restore some of the grazing areas along the transect, which should have a beneficial effect on the butterflies found along the walk.

Banyoles (Pla de l'Estany, 200 m). This walk takes place north-west of the Lake of Banyoles on private land managed jointly by the Consortium of the Lake of Banyoles and the Fundació Caixa Catalunya. Wetland areas have been restored and it is hoped that a number of fields will be transformed into hay mead-

ows to favour the site's biodiversity. Currently, the walk passes through largely agricultural and ruderal habitats and it will be interesting to see how the site evolves and whether it will be possible to consolidate a rich and diverse butterfly fauna. Generalist species predominated during the first year of the butterfly walk, although species such as Short-tailed *Cupido argiades* and Silver-studded *Plebejus argus* Blues, indicators of damp meadows, also appeared.

Santa Catalina (Menorca). Set in the north-eastern part of Menorca, this walk passes through various habitats –above all, forest with scrub and agricultural land- near the transect site walked in the S'Albufera des Grau Natural Park. Although counts began here three years ago, 2007 was only the second year with complete data. The results from Santa Catalina complement data from the two other Menorcan stations and help provide a more complete picture of the butterflies of the island. The walk is coordinated by the S'Albufera des Grau Natural Park in collaboration with the Institute of Menorcan Studies

Alberes-1 (Alt Empordà, 450 m). This walk takes place around the farm of La Llosa near the town of Espolla in an area dominated by Mediterranean holm-oak forest. The butterfly fauna is fairly diverse and is dominated by typically Mediterranean elements, with a representation of other species that are generally scarce in Catalonia. These additional interesting species include an enormous population of Cardinal *Argynnis pandora*, which is the dominant species, and Spanish Purple Hairstreak *Laeosopis roboris*, poorly represented to date in the CBMS network. The counts receive support from Les Alberes Natural Park.

Alberes-2 (Alt Empordà, 400 m). The second of two new walks in Les Alberes, this walk is conducted around the church of Sant Genís d'Esparc (Espolla) near the previous walk in an area where cattle grazing is still an important activity. Its interest lies in documenting the butterfly fauna associated with this locally relictual habitat. The counts receive support from Les Alberes Natural Park.

La Roca (Vallès Oriental, 200 m). This walk takes place in an agricultural area near the Vallès plain. Its butterfly fauna is poor and consists of generalist species. Nevertheless, the data it provides are of interest as they document the evolution of a butterfly community in an area of intensive agriculture. The year 2007 was the second with complete data.

In 2007 counts were discontinued at **Timoneda d'Alfés** (Segrià), **Can Prat** (Vallès Oriental), **Olivella** (Garraf, in operation on a rotational basis with the stations of Vallgrassa and Olesa de Bonesvalls), **Rabós** (Alt Empordà), **Godomar** (Garrotxa), **Cal Carro** (Vallès Oriental) and **Pineda de Mar** (Maresme).

Habitats represented

The different habitats and plant communities represented in the CBMS walks are shown in table 1. With the inclusion of the BMSAnd walks, the number of stations in montane and subalpine and alpine pastures has increased notably and will provide information on the tendencies of species that thus far have only appeared occasionally in the counts. It is hoped that in coming seasons more high-level stations will be incorporated into the CBMS network.

Species represented

The list of species recorded in 2007 and in previous years can be consulted in table 2. In total, 162 species were detected in 2007, five more than the previous year and 29 more than the average for the period 1994-2006 (Fig. 3). Five species appeared for the first time: Iolas Blue *Iolana iolas*, Green-striped White *Euchloe belemia*, Mountain Clouded Yellow *Colias phicomone*, Purple Emperor *Apatura iris* and Lefèbvre's Ringlet *Erebia lefebvrei*. The latter three species are restricted to the Pyrenees in Catalonia and, in the case of the Mountain Clouded Yellow and Lefèbvre's Ringlet, are usually only found above 2,000 m. An analysis of table 2 reveals the growing importance of these and other alpine elements in the CBMS network, above all in the form of the presence of *Erebia* spp. (eight species identified in 2007), Lycaenidae such as Scarce *Lycaena virgaurea*, Sooty *L. tityrus* and Purple-edged *L. hippothoe* Coppers, Geranium *Eumedonia eumedon* and Silvery *Aricia nicias* Arguses and Eros Blue *Polyommatus eros*, Nympalinae such as Bog *Proclossiana eunomia* and Shepherd's/Mountain Fritillaries and the emblematic Apollo *Parnassius apollo* and Clouded Apollo *P. mnemosyne*.

The case of Green-veined White *Euchloe belemia* (see photo) and Iolas Blue *Iolana iolas* are very different. Both are very rare in Catalonia and of the former there are as yet no records of stable populations of the species in Catalonia[2]. On the other hand, Iolas Blue is one of the rarest and most localised of all Lycaenidae in Catalonia, as a couple of recent publications have revealed[4,5]. This species is totally dependent on the shrubs of the genus *Colutea*, since its larvae feed inside their seed pods. Owing to its relatively good dispersive ability[6], Iolas Blue is an excellent species with which to carry out conservation work aimed at strengthen populations on a local level. One such task is the planting of bladder senna *Colutea arborescens*, which was carried out by volunteers from the group Friends of the Natural Parks around Coll d'Estenalles in the Sant Llorenç del Munt Natural Park[5]. This site is near the CBMS itinerary 24 and not far from the two places on this itinerary where in spring 2007 two Iolas Blues were recorded.

Constantí Stefanescu

[1] Folch i Guillèn, R., 1981. *La vegetació dels Països Catalans*. Ketres Editora, Barcelona.

[2] Anton-Recasens, M., Jubany, J & Stefanescu, C., 2007. "*Euchloe belemia* (Esper, [1800]), espècie nova per a Catalunya (Lepidoptera: Pieridae)". *Butll. Soc. Cat. Lep.*, 98: 87-90.

[3] Karsholt, O. & Razowski, J., 1996. *The Lepidoptera of Europe. A Distributional Checklist*. Apollo Books, Stenstrup.

[4] Vila, R. & Viader, S., 2008. "Distribució, estatus i conservació de *Iolana iolas* (Ochsenheimer, 1816) a Catalunya (Lepidoptera: Lycaenidae)". *Butll. Soc. Cat. Lep.*, 99: 97-114.

[5] Torrentó, J., Miño, A., Agenjo, A., Muñoz, J., Sesma, J.M. & Stefanescu, C., 2008. "Actuació amb voluntaris per a la millora de l'hàbitat de la papallona *Iolana iolas* (Ochsenheimer, 1816) al Parc Natural de Sant Llorenç del Munt i l'Obac". *Butll. Soc. Cat. Lep.*, 99: 121-122.

[6] García Rabasa, S., 2007. "Dinámica espacial de un herbívoro especialista, *Iolana iolas*, y su planta huésped *Colutea hispanica*". Tesi doctoral, Universidad Rey Juan Carlos de Madrid. 130 pp.

Fig. 1. Geographical situations of all the stations that have ever participated in the CBMS network (1994-2007), with their official number and name. Also shown are the generally accepted boundaries of the biogeographical regions present in Catalonia[1].

Fig. 2. Distribution of the complete annual series available for all the different stations that have participated in the project (period 1988-2007).

Fig. 3. The number of species detected annually in the CBMS network (1994-2007).

Table 1. Habitats and plant communities represented in the CBMS in 2007, with the number of stations they appear in. Classification of the vegetation zones and plant communities as per reference 1.

Table 2. Butterfly species recorded in any of the CBMS stations during the last ten years 1998-2007. Also indicated is the number of localities from which each species has been recorded during the CBMS monitoring (out of a total possible number of sites of 25 in 1998, 30 in 1999 and 2000, 42 in 2001, 41 in 2002, 46 in 2003, 51 in 2004, 52 in 2005, 64 in 2006 and 70 in 2007). Taxonomy as per reference 3.

Photo 1. View of one of the sections of the itinerary, dominated by Aleppo pine (*Pinus halepensis*), at Santa Catalina on the island of Menorca (photo: S. Estradé).

Photo 2. The alpine landscape around the area in Pessons (Andorra). At 2,250 m, it represents the highest itinerary in the CBMS and BMSAnd (fotografia: M. Mases).

Photo 3. First and to date only example of Green-striped White *Euchloe belemia* known from Catalonia, captured on 31 March 2007 during the CBMS count at Torre Negra (see details in ref. 2). This record is surprising because the nearest known records of this non-migratory species are 250-300 km away in Zaragoza and Valencia provinces. It is possible, nevertheless, that the species has been under-recorded due to confusion with Dappled White *Euchloe crameri* (photo: M. Anton-Recasens).

Fourteenth year of the CBMS
Summary of the 2007 season

The most remarkable aspect of the 2007 season was the lack of rain: less than 30% of average monthly rainfall fell over much of Catalonia and caused a serious drought. As a result, the year was a poor one for butterflies, with marked decreases in numbers in many areas. Taking into account the abundances of the commonest species, 2007 was the third-worst year since the CBMS began. The areas that suffered most were alpine habitats and the semi-arid habitats of the western half of the Central Depression. The univoltine Satyrinae, as well as most of the localised species associated with calcareous grasslands, were hardest hit; on the other hand, spring butterfly numbers increased slightly with respect to the previous year. A strong migration of Plain Tiger *Danaus chrysippus* was also detected at various CBMS stations.

Weather and butterfly counts

The 2007 season was marked by two meteorological phenomena: high spring and summer temperatures and, above all, an extreme drought that began in winter and continued through to spring 2008. For example, in the driest area of Catalonia (*comarques* of Segrià and the extreme south-west of La Noguera) less than 250 mm of rain fell during the year, while most sites in the Pyrenees received less than 900 mm. In general, rainfall was 30-50% lower throughout Catalonia than historical averages (see www.meteocat.com), the only exception being the southern-most part (Els Ports and surrounding areas), where 2007 was an especially rainy year.

In stark contrast to the two previous years, the winter of 2006/07 was mild everywhere except for the interior plains, where there were prolonged periods of thermal inversion. February was particularly warm and dry over most of Catalonia, a fact that led many of the species that overwinter as adults to appear somewhat earlier than usual. However, the situation changed in March (a couple of periods of strong winds, above all in the Pyrenees, the Alt Empordà and the Ebro Depression) and the first week of April with the arrival of a front that brought heavy rain to many areas and snow to the Pyrenees (the first snowfalls of the winter in some areas). This precipitation relieved the hydric stress that many areas were suffering. August saw the weather change and during the second half of the year temperatures were below normal; there was also heavy rainfall during this month in north-east Catalonia.

Overall, the wind and rain in April and the storms in August meant that the weather in 2007 was less favourable for CBMS counts than in previous years. An average of 4.6 counts was lost per itinerary, 1.2 more than in 2006 (fig. 1a). The most critical peri-

ods were the second half of March, the first fortnight of April and the first and third weeks of August (fig. 1b). Above all in the Pyrenees, these periods were particularly unfavourable and the weather made it all but impossible to carry out the CBMS counts.

Changes in abundances: general considerations

As a whole, a serious decrease in butterfly numbers was observed in 2007 compared to 2006. In 50 stations with comparable data from 2006 and 2007, densities per itinerary were 2,286.9 ± 1,570.4 and 2,067.0 ± 1,628.4, respectively. A Student t-test for paired samples indicates that this fall was marginally significant ($t = 1.74$, $P = 0.088$) and was most evident in the number of species detected per itinerary: 44.3 ± 18.4 in 2006 compared to 42.2 ± 17.9 in 2007 ($t = 3.19$, $P = 0.003$). Nevertheless, these changes had a marked geographical bias: the most negative tendencies were recorded in sites of extreme climate, that is, in true alpine habitats with high rainfall, or in semi-arid habitats in the western half of the Central Depression, where the populations of a number of species collapsed alarmingly. On the other hand, itineraries in areas of subhumid and humid climates (as defined by the Thornwaite's Humidity Index), which essentially correspond to montane environments in the Prelitoral and Transversal Mountains, saw little change or even in some cases slight increases in butterfly numbers.

In general, 2007 was a bad year for butterflies and ranks the third worst of all the 14 CBMS seasons to date (fig. 2). We believe that the underlying cause of this fall is the cumulative effects of the drought that Catalonia has been suffering for the last three years. In the Pyrenees, the combination of a mild winter with a cold and windy month of March and a wet beginning to April had negative repercussions for spring species and the summer generations of a number of polyvoltine species, possibly because their biological cycles were unbalanced.

Changes in abundance: fluctuations in populations

One of the clearest patterns to emerge from 2007 was the fall in numbers in almost all univoltine Satyrinae, both amongst the spring-early summer species (for example, Pearly *Coenonympha arcania* and Dusky *C. dorus* Heaths [see drawing], Meadow Brown *Maniola jurtina* and Great Banded Grayling *Brintesia circe*) and summer species (Striped *Hipparchia fidia* and Tree *H. statilinus* Graylings) (table 2). These falls, which were quite possibly related to the drought, were most apparent in species such as Iberian Marbled White *Melanargia lachesis* and Spanish Gatekeeper *Pyronia bathseba* that under normal conditions are dominant, but which in 2007 were ranked in much lower positions in the table of commonest butterflies (table 1).

On the other hand, some of the common generalist species such as Large *Pieris brassicae* and Small *P. rapae* Whites and Holly Blue *Celastrina argiolus* increased their numbers notably in 2007 and reached levels near to their all-time maximums. The increase in numbers in the majority of species that winter as adults (Camberwell Beauty *Nymphalis antiopa*, Large Tortoiseshell *N. polychloros*, Comma *Polygonia c-album* and Nettle-tree Butterfly *Libythea celtis*) was possibly due to their presence during the first weeks of March, when, after a mild winter, all were very active. An exception to this rule was the Small Tortoiseshell *Aglais urticae*, which seems to be undergoing a negative regression throughout Catalonia (see drawing). The fine weather in March also benefited species such as Orange-tip *Anthocharis cardamines*, Moroccan Orange-tip *A. euphenoides*, Green Hairstreak *Callophrys rubi*, Black-eyed Blue *Glaucopsyche melanops* and Spanish Festoon *Zerynthia rumina*, which overall increased their numbers slightly compared to 2006.

There were serious drops in the numbers of migratory species such as Painted Lady *Cynthia cardui* and Bath White *Pontia daplidice*, in contrast to increases in numbers of both Lang's Short-tailed Blue *Leptotes pirithous* and Long-tailed Blue *Lampides boeticus* (table 2). Nevertheless, it is worth highlighting the spectacular migration of the Plain Tiger *Danaus chrysippus*, one of the most significant ever recorded in Catalonia. The first of these butterflies were seen very early on in the year at the end of May on the island of Menorca (S. Estradé, obs. pers.) and in the Ebro Delta (P. Luque, obs. pers.). Then, either the descendents of the first butterflies observed or, possibly, a new wave of migrants, began to appear in the CBMS itineraries in mid-July (La Tancada and El Remolar). Whatever their origin, these summer Plain Tigers produced two or more generations and led to high densities in sites such as the Ebro Delta. The species then began to spread to different parts of Catalonia and was recorded in areas in which the species is habitual (Els Aiguamolls de l'Empordà) and others in which it is not (itineraries at Santa Susanna in El Montseny and Cal Puntarrí in Massif de Montmell).

Finally, the generalised fall in numbers in the *Melitaea* and associated species group is worrying, as is that of localised species linked to calcareous grasslands (e.g. Berger's Clouded Yellow *Colias alfacariensis*, Green-underside Blue *Glaucopsyche alexis*, Adonis *Polyommatus bellargus*, Chalkhill *P. coridon* and Provence Chalkhill *P. hispana* Blues and Dingy Skipper *Erynnis tages*). These tendencies, which in some cases are very negative, may be the result of the interaction between the drought and a deterioration in habitats (i.e. the abandoning of grazing).

Constantí Stefanescu

[1] Greatorex-Davies, J.N. & Roy, D.B., 2001. *The Butterfly Monitoring Scheme. Report to recorders, 2000*. 76 pp. Centre for Ecology and Hydrology, Natural Environment Research Council, Huntingdon.

Fig. 1. (a) Coverage of the counts at the different CBMS stations, and (b) distribution of the lost counts during the official 30 weeks of the 2007 counting season (1 March – 26 September).

Fig. 2. Ranking of the CBMS seasons in terms of the general abundance of the 63 commonest butterflies in the CBMS network. The best year to date was 2002 and the worst 1998. Calculations were carried out using the methodology described in reference 1; annual indexes were calculated with the TRIM programme.

Table 1. Sum of the annual indexes and ranking of abundance for the 20 commonest species from the 2007 CBMS network compared to the corresponding figures from the 2006 season.

Table 2. Evolution of the overall annual indexes for the 63 commonest butterflies in the CBMS network (1998-2007), based on an arbitrary value of 1 for the 1994. Annual indexes were calculated using the TRIM programme.

Drawing 1. Dusky Heath *Coenonympha dorus* is a common and at times even abundant species in arid parts of the Serralada Litoral mountains and central Catalonia. Over the last decade, however, it has declined significantly and in 2007 reached its lowest-ever population levels since the CBMS began. Successive years of drought and the deterioration of the pastures that are its main habitat are the main causes of this decline, which also affects other species such as Southern Gatekeeper *Pyronia cecilia* and Western Marbled White *Melanargia occitanica* that live in these habitats (drawing: M. Miró).

Drawing 2. Small Tortoiseshell *Aglais urticae* is one of the most characteristic butterflies of the high mountains of Catalonia. Unfortunately, climate change will probably negatively affect this species, as seems to have been confirmed by CBMS and BMSAnd data. The decline in this species is in sharp contrast to the population increases in other closely related Nymphalinae that are not linked to subalpine or alpine environments (drawing: M. Miró).

Habitat management and conservation

Habitat preferences and population trends in Catalan butterflies

The previous edition of *Cynthia* contained a first approximation of the ability of Catalan butterflies to act as bioindicators[1]. Using qualitative data regarding the presence/absence of species in sections of the CBMS itineraries and two different methods of multivariant analysis, groups of common species were defined in terms of their associations with four environments: 'agricultural and ruderal', 'grasslands and open areas', 'scrub' and 'woodland'. Subsequently, a habitat indicator was constructed for each of these four environments based on population trends in the species that live there. The results showed a serious decline in the indicators for 'grassland and open areas', and an increase in the indicators for 'woodland'. The indicators for the other two environments showed no significant trends.

The previous edition of *Cynthia* contained a first approximation of the ability of Catalan butterflies to act as bioindicators[1]. Using qualitative data regarding the presence/absence of species in sections of the CBMS itineraries and two different methods of multivariant analysis, groups of common species were defined in terms of their associations with four environments: 'agricultural and ruderal', 'grasslands and open areas', 'scrub' and 'woodland'. Subsequently, a habitat indicator was constructed for each of these four environments based on population trends in the species that live there. The results showed a serious decline in the indicators for 'grassland and open areas', and an increase in the indicators for 'woodland'. The indicators for the other two environments showed no significant trends.

For various reasons, we believe that the results of our initial analysis should only be regarded as orientative and provisional, above all because the classification of the species was based on qualitative data and lacked the robustness provided by quantitative data. During the past 12 months we have continued working on this question in order to improve and refine our construction of habitat bioindicators and to achieve more reliable results. The following is a new analysis based on density data for all species present in the main CORINE[2] habitats that occur in the CBMS network. Despite the fact that some of the species are classified differently in this new analysis, the trends noted 12 months ago still coincide essentially with those we highlight here.

Habitat preferences of Catalan butterflies

In order to define these preferences we used the same data source as in the qualitative analysis, that is, the CBMS counts from the period 1994-2007 from 323 sections of 69 itineraries corresponding to the 17 habitats described in table 1. To avoid pseudoreplications, all sections from an itinerary representing the same habitat were grouped together and treated as a single unit, thereby reducing the number of sections to 173. In each of these independent sections we calculated the density of species present expressed as the number of individuals/100 m per year. This parameter encompasses the data available from 59,362 metres of transects and 888 monitoring seasons (taking into account all possible combinations of 'section x season with data') and we believe that it is as such an accurate reflection of the habitat preferences of the butterflies of a broad area of Catalonia.

First of all, we ordered the species along a gradient of specialization in habitat use by defining an 'index of habitat specialisation' or 'IHS' (ref. 3), which measures the coefficient of variation in the distribution of the densities of a species between different habitat categories. The lowest values of this index indicate a strong

tendency towards generalism (ubiquitous species), while higher values reveal the species that are strongly specialised towards one particular habitat. Figure 1 shows three types of butterflies: Red Admiral *Vanessa atalanta*, an extreme generalist without any clear preference for any particular habitat (IHS: 0.49) and two woodland specialists, Speckled Wood *Pararge aegeria* and White Admiral *Limenitis camilla*. Of these two species, the White Admiral is more specialized than the Speckled Wood (IHS: 2.60 and 1.42, respectively) as it is associated almost exclusively with deciduous woodland.

The next step was to group the CORINE habitats into the same four environments -'grasslands and open areas', 'scrub', 'woodland' and 'agricultural and ruderal'- as used in our previous analysis. Data corresponding to 'bare rock' (no vegetation cover) and 'wetland vegetation' were excluded due to the fact that no Catalan butterfly species specialize in these habitats and because they are very poorly represented in the CBMS network (table 1). Finally, we calculated the average density of each species in the four main environments and we took those species that concentrate over 50 per cent of their density in one particular habitat to be specialists[4]; the remaining species were considered as generalists.

Habitat indicators

To ensure that the habitat indicators reflect real trends in a wide geographical scale and not merely a localised tendency occurring in a few itineraries, we only used the species that were (1) relatively simple to identify, (2) appeared in a minimum of 10 CBMS stations, and (3) had data from a minimum of 10 independent sections.

In all, we classified nine scrub specialists, 15 grassland and open-area specialists, seven woodland specialists and four agricultural and ruderal specialists (table 2). Of these species, four -Knapweed Fritillary *Melitaea phoebe*, Dusky Heath *Coenonympha dorus*, Silver-washed Fritillary *Argynnis paphia* and Camberwell Beauty *Nymphalis antiopa*- did not surpass the 50 per cent density threshold in a specific habitat but were considered as specialists (the first two in grasslands and open spaces, the latter two in woodlands), following van Swaay *et al.* (2006), their relatively high IHS value and our knowledge of their biology in Catalonia.

In order to construct the indicators we followed the methodology developed for European birds[5]. We thus calculated the population trends for each species with the TRIM programme[6] and then calculated the multi-specific index for each of the four environments by combining the trends of their characteristic species. For an indicator to be representative of the group of taxons present in the environment in question, it must be based on a sufficient number of species; otherwise, it may only be a reflection of very localized trends (for example, those related to the presence of specific parasitoids or to the effects of the weather on a specific phenological pattern). This problem may affect the indicator of agricultural and ruderal environments since only four species were classified as being characteristic of these types of habitats. Of these four, two are very closely related and have similar biological cycles (Small White *Pieris rapae* and Bath White *Pontia daplidice*), whilst another, Geranium Bronze *Cacyreus marshalli*, has very particular and unstable population dynamics given that it has only recently colonised Catalonia[7]. Thus, in the end we decided not to construct an indicator for the agricultural environment.

It has been discovered in various European countries in recent years that specialist butterflies are suffering greater declines than those of more opportunistic species whose trends tend to be stable or even slightly positive[4,8]. This phenomenon implies changes in the composition of butterfly communities, which are gradually becoming dominated by common species with fewer habitat requirements to the detriment of species associated with more valuable habitats[9]. In order to test whether this trend is also occurring in Catalonia we developed a new indicator that synthesizes all the information regarding the most generalist species and defines them in terms of a IHS threshold of 1 (table 2). Within this group we included Small White *Pieris rapae* (IHS = 0.852), but excluded Red Admiral *Vanessa atalanta* (IHS = 0.489) and Painted Lady *Cynthia cardui* (IHS = 0.668), two migrant species whose population dynamics are totally dependent on the environmental situation in their areas of origin[10,11]. The indicator of generalist species is based on a total of 13 species.

The tendencies detected for the four indicators are shown in figure 2 and it is worth highlighting in particular the very significant decline ($P = 0.004$) in the grassland and open areas indicator, which fully confirms the existence of a generalised regression in the butterflies associated with this environment, as we reported in our previous analysis[1]. Likewise, our new analysis confirms the increase in woodland species whose trends are both positive and significant ($P = 0.028$). In future analyses we will try to include White Admiral *Limenitis camilla*, a species that is very common in woodland in northern Catalonia, but which is easily confused with Southern White Admiral *L. reducta*, in order to achieve a greater degree of generalisation. However, the forest indicator is the only that has increased, a finding that reinforces the idea that the typical butterflies of these environments are undergoing a trend that is quite different from the other butterflies in Catalonia.

The greatest difference between this analysis and the previous one is the significant fall in the scrub indicator ($P = 0.036$), which initially seemed to have increased (but not significantly). To a certain extent it is difficult to define this indicator since 'scrub' habitats are an intermediate stage between grassland and woodland and, depending on the species in question, the habitat could be considered either as open scrub resembling grassland or closed scrub resembling woodland. Here, however, our scrub indicator includes for the most part species with a definite preference for open scrub (for example, Black-eyed Blue *Glaucopsyche melanops*, Purple-shot Copper *Lycaena alciphron*, Knapweed Fritillary *Melitaea cinxia*, Grayling *Hipparchia semele* and Small Skipper *Thymelicus sylvestris*) and this almost certainly explains why this indicator has a negative trend, as in the case of the grassland and open areas indicator.

Finally, it is interesting to note that the indicator for generalist species has no specific tendency ($P = 0.793$) and fluctuates around the initial value. This result coincides with those from central Europe and suggests that the decline in some specialist species is related to specific problems with the habitats that they occupy.

Constantí Stefanescu, Jordi Jubany, Ignasi Torre & Ferran Pàramo

[1] Stefanescu, C., Jubany, J., Torre, I. & Páramo, F., 2007. "El paper bioindicador de les papallones a Catalunya". *Cynthia*, 6: 11-14.

[2] Moss, D., Wyatt, B., Cornaert, M.H. & Roekaerts, M., 1990. "CORINE Biotopes. The design, compilation and use of an inventory of sites of major importance for nature conservation in the European Community". Directorate-General Environment, Nuclear Safety and Civil Protection.

[3] Julliard, R., Clavel, J., Devictor, V., Jiguet, F. & Couvet, D., 2006. "Spatial segregation of specialists and generalists in bird communities". *Ecol. Lett.*, 9: 1237-1244.

[4] Van Swaay, C.A.M., Warren, M.S. & Loïs, G., 2006. "Biotope use and trends of European butterflies". *J. Insect Conserv.*, 10: 189-209.

[5] Gregory, R.D., van Strien, A., Vorisek, P., Gmelig Meyling, A.W., Noble, D.G., Foppen, R.P.B. & Gibbons, D.W., 2005. "Developing indicators for European birds". *Phil. Trans. R. Soc. B*, 360: 269 288.

[6] Pannekoek, J. & van Strien, A.J., 2006. TRIM 3 Manual (Trends & Indices for Monitoring data). Statistics Netherlands, The Netherlands. http://www.ebcc.info.

[7] Masó, A. & Sarto i Monteys, V., 1997. "Estat actual de la dispersió de *Cacyreus marshalli* Butler, 1898 (Lepidoptera: Lycaenidae) a la península Ibèrica". *Ses. Entom. ICHN-SCL*, 9(1995): 175-185.

[8] Greatorex-Davies, J.N., Brereton, T.B., Roy, D.B., Middlebrook, I. & Cruickshanks, K.L., 2007. "United Kingdom Butterfly Monitoring Scheme report for 2006". CEH Monks Wood.

[9] González-Megías, A., Menéndez, R., Roy, D., Brereton, T. & Thomas, C.D., 2008. "Changes in the composition of British butterfly assemblages over two decades". *Global Change Biol.*, 14: 1464-1474.

[10] Pollard, E., van Swaay, C.A.M., Stefanescu, C., Lundsten, K.E., Maes, D. & Greatorex-Davies, J.N., 1998. "Migration of the painted lady butterfly *Cynthia cardui* in Europe: evidence from monitoring". *Div. & Distrib.*, 4: 243-253.

[11] Stefanescu, C., 2001. "The nature of migration in the red admiral butterfly*Vanessa atalanta*: evidence from the population ecology in its southern range". *Ecol. Entom.*, 26: 525-536.

Fig. 1. Distribution of the population densities (ex./100 m) of three species of butterfly in 17 types of habitats in the CBMS. The value of the Index of Habitat Specialisation (IHS) calculated according to the methodology described in reference 3 is shown.

Fig. 2. Environmental indicators based on population trends occurring in the most characteristic butterflies in the CBMS. The woodland indicator has increased significantly during the study period, whilst that of the grassland and open areas and scrub have declined significantly. In contrast, the indicator for generalist species has not followed any specific trend.

Table 1. Distribution of the main habitat types in the CBMS sections (1994-2006) that contain pure habitat (with cover of >75%). The CORINE code and the number of sections (total and grouped in independent units) used to calculate the density of species in the different habitats is shown.

Table 2. The characteristic butterfly species of four environments (grasslands, scrub, woodland, and agricultural and ruderal areas) and generalist species without clear preferences. The value of the Index of Habitat Specialisation (IHS) and the number of sections grouped into independent units used in the calculation is indicated. Generalist species excluded because of their migratory behaviour are marked with an asterisk.

CBMS sites

Can Ferriol, a site of great butterfly diversity near Barcelona

The Collserola Park has been part of the CBMS network from the beginning and, currently, three stations there are active. The oldest of the three, Can Ferriol, has one of the most diverse butterfly faunas in the whole of the Serralada Litoral mountains.

The transect

The systematic study of the butterflies of Collserola began in 1992 as part of the programme studying the fauna of the park. However, it was not until 1994 and the beginning of the CBMS network that the methodology used was adapted to that of the CBMS. A circular transect was established around the farm of Can Ferriol in the valley of Sant Feliu near the church of Santa Creu d'Olorda. Initially, the butterfly walk consisted of nine sections, but in 1995 it

was extended to 12 sections to include all the habitats situated within the Collserola Park[1]. Exceptionally, the counting period is extended into mid-October to record data on returning migrant species.

The transect lies at an average of 235 m a.s.l. and is characterised by average annual rainfall and temperature of, respectively, 706.5 mm and 14.8 ºC. The potential vegetation of the site consists of Mediterranean holm-oak forests, although the majority of the sections coincide with a track passing through mixed holm-oak and pine woodland. The most interesting sections follow a footpath through abandoned agricultural terraces invaded by rosemary and shrubby globularia *Globularia alypum* with the grass *Brachypodium retusum,* brambles and isolated trees (carobs and pines). All but no cereal cultivation is present at the site.

The butterfly fauna

In all, 64 species of butterfly have been recorded at Can Ferriol, the majority of which are sedentary. Over the period 1994-2007, 41,056 butterflies were counted, with an annual average of 2,821 individuals and 50 species per year, giving a density of 114 butterflies/100 m.

The phenology of the butterflies of the site is trimodal, with a peak in late June and early July of both species and, above all, individuals (coinciding with the peak flight periods of Southern Gatekeeper *Pyronia cecilia* and Spanish Gatekeeper *P. bathseba*). The other two peaks occur in spring and autumn and vary in terms of the year's weather conditions.

Especially well represented at family and sub-family levels are the Satyrinae, which account for almost 45% of all butterflies counted, and the Lycaenidae, with 18 species. The commonest species are the Satyrinae Southern *P. cecilia* and Spanish *P. bathseba* Gatekeepers, Striped Grayling *Hipparchia fidia* and Small White *Pieris rapae* (fig. 1). The first three of these species are found in open areas (grassy pastures, scrub and even cultivated fields) and avoid woodland. The Small White, on the other hand, has a wider distribution and is found above all in the most ruderal sections such as the fields and around the farm. Another characteristic butterfly is False Ilex Hairstreak *Satyrium esculi*, a species that is typically Mediterranean and linked to holm-oak and holly-oak formations. The abundance of these plants in Catalonia gives rise to strong populations of this butterfly, which increase notably in seasons such as 2004 with wet springs.

Another interesting feature of this transect are the migrant butterflies that are recorded. This is the case of Painted Lady *Cynthia cardui*, Bath White *Pontia daplidice*, Large White *Pieris brassicae*, Clouded Yellow *Colias crocea* and Long-tailed *Lampides boeticus* and Lang's Short-tailed *Leptotes pirithous* Blues; numbers of the latter two species peak in late September and early October.

In all, 20 species of conservation concern (SPEC species) have been recorded at Can Ferriol, of which some have undergone the greatest fall in numbers of all the species detected since the counts began. These species include Green-underside *Glaucopsyche alexis*, Black-eyed *G. melanops*, Panoptes *Pseudophilotes panoptes* and Provence Chalkhill *Polyommatus hispana* Blues and Iberian Marbled White *Melanargia lachesis*. All are concentrated in areas dominated by *Brachypodium retusum*, where also present are Provence Hairstreak *Tomares ballus* and Western Marbled White *Melanargia occitanica*. The former of these two species flies in low but seemingly stable numbers, while the latter dropped in numbers in the period 1994-2007.

Management of the site

The transect has undergone important changes since the CBMS began that have seriously affected its butterfly fauna. The most important alterations have occurred in the forested part of the walk, where the main track has been widened and the verges are regularly cleared to a width of 5-10 metres. These activities have altered the structure of the vegetation in the transect area and led to an increase in ruderal species, scrub and grassy areas in detriment of the holm-oak and pine woodland. As well, two flocks of sheep are used to maintain the tracks open as firebreaks.

As part of the Park's fauna management programme, in spring 2000 a series of abandoned terraces (sections 4 and 5), gradually being overwhelmed by *Brachypodium retusum* and Spanish broom (*Spartium junceum*), were ploughed up. This transformation has meant the recovery of a former open area and has led to an increase in butterfly numbers (fig. 2), although it is difficult to quantify to what extent this rise in numbers is the direct result of these drastic management measures, since other factors such as the planting of alfalfa and haricot beans and the weather may also have had an effect. Since 2003, a part of section 4 is cleared at the end of summer to ensure that it remains open as a meadow.

Jordi Jubany

[1] Jubany, J. & Rovira, S. 2000. Butterfly Monitoring Scheme (Pla de seguiment de ropalòcers) en el Parc Metropolità de Collserola. In: *I Jornades sobre la recerca en els sistemes naturals de Collserola: aplicacions a la gestió del Parc* (F. Llimona, J.M. Espelta, J.C. Guix, E. Mateos, J.D. Rodríguez-Teijeiro, eds.): 243-254. Consorci del Parc de Collserola.

Aerial photograph. The itinerary at Can Ferriol consists of 12 sections. Its total length is 2,510 m with an average length per section of 209 m (range: 43-783 m).

Photo 2. General aspect of the terraces near the farm of Can Ferriol, surrounded by a Mediterranean holm-oak forest and rosemary and shrubby globularia scrub (Photo: J. Jubany).

Fig. 1. Average abundance (average of the annual indexes for the period 1995-2007) of the commonest 15 butterflies in the CBMS counts at the Can Ferriol station.

Fig. 2. Evolution over time of the number of butterflies in section 4 at Can Ferriol. The arrow indicates the beginning of spring 2000 when the section was totally cleared. The years 2001 and 2005 were the worst ever for Collserola and two of the worst for the whole of Catalonia.

Review

Stefanescu, C., Alarcón, M. & Àvila, A., 2007

Migration of the painted lady butterfly, *Vanessa cardui*, to north-eastern Spain is aided by African wind currents

Journal of Animal Ecology, 76: 888-898.

Amongst our regular migrant butterflies, Vanessa cardui is the most common and the one arriving in the greatest numbers. In this article, CBMS data have been analysed to help to understand how the migrations of this butterfly work.

Many people have heard or seen pictures of the spectacular migration of the Monarch butterfly *Danaus plexippus* in North and Central America. Given its size, beauty and gregariousness, it is not surprising that many of us knew of this phenomenon before joining the CBMS scheme. Nevertheless, we know that there are other butterflies that reach the coasts of Catalonia having migrated from far away lands. Of these, we might mention Lang's Short-tailed *Leptotes pirithous* and Long-tailed *Lampides boeticus* Blues, Bath White *Pontia daplidice*, Clouded Yellow *Colias crocea*, Red Admiral *Vanessa atalanta* and Painted Lady *Vanessa cardui*. This paper studies the mechanisms which Painted Ladies use to migrate from North Africa to Catalonia during the spring.

Like so many other migratory species, the Painted Lady takes advantage of locally favourable conditions to thrive (in this case in North Africa in autumn and in early spring): then, once summer approaches and the possibilities of survival decreases, the species moves north. Up to recently, observations of Painted Ladies flying close to the ground in a single direction made people think that migration in this species was essentially active and independent of air currents. Nevertheless, the authors of this work use CBMS data to show that the massive arrivals of Painted Ladies in spring in Catalonia coincide with certain meteorological conditions, a finding that suggests that the wind is to a large degree the mechanism that makes these migrations possible.

In the period 1997-2006 there were 32 weeks in spring (March-June) in which a significant increase occurred in the numbers of Painted Ladies counted compared to the previous week. These episodes coincided significantly with the presence of winds blowing from Africa at a height of 500 – 1,500 m in association with low pressure systems originating over Africa or the Iberian Peninsula: in the former case, the position of the low pressure system ensured that winds took Painted Ladies from Western Sahara and Morocco northwards, while in the latter case butterflies were windborne from Algeria and Tunisia. These situations also coincide with the arrival of large amounts of dust in suspension from the deserts of North Africa, which may give some of us a new perspective on the effects of the 'dirty' rains that often fall when these meteorological situations occur.

In terms simply of weather data, these southerly winds transport butterflies at an average speed of 30 km/h, which, added to the butterflies' flying speed (around 15 km/h), means that the journey from North Africa to Catalonia only takes a matter of 20-36 hours. Nevertheless, these favourable meteorological conditions are truncated when the associated high pressure systems cross the Western Mediterranean and are obliged to give way to more northerly winds. When this occurs, butterflies are forced to drop to land to avoid being blown back south by the northerly winds and it is under these conditions that we see Painted Ladies hugging the ground as they struggle northwards against a headwind.

The available data suggest that spring migration in the Painted Lady has two well-differentiated components: one is closely linked to the presence of favourable winds at a certain altitude and the other –and surely much less important in terms of the distance covered– to active, close-to-the-ground migration.

Sergi Herrando

Review

Vila, R. & Viader, S., 2008

Distribució, ecologia i conservació de *Iolana iolas* (Ochsenheimer, 1816) a Catalunya (Lepidoptera: Lycaenidae)

Butlletí de la Societat Catalana de Lepidopterologia, 99: 97-114

This article, published in the most recent number of the *Butlletí de la Societat Catalana de Lepidopterologia*, is a review of all the data on the Iolas Blue *Iolana iolas* in Catalonia, with special attention given to aspects of population conservation.

Although they do not concentrate specifically on taxonomic questions, the authors briefly revise the current specific and subspecific status of the genus *Iolana*, paying special attention to the five subspecies

described in the Iberian Peninsula (including ssp. *farriolsi* Sagarra, the subspecies that flies in Catalonia) and their morphological characteristics.

The authors examine data published on the biology and ecology of Iolas Blue and highlight the close relationship between the species and the shrubs of the genus *Colutea*, which act as a foodplant for larvae and a nectar-source for adults. The majority of Catalan Iolas Blues seems to associate with *Colutea brevialata*, the commonest *Colutea* species in the country. The biological cycle of the butterfly is described, whose larvae, on hatching, immediately enter the young seed-pods of their host-plant to begin feeding on the seeds. Other related questions are discussed, including preferences in egg-laying, variation in colour of the larvae and the time the larvae take to develop. The authors also touch on the controversial subject of this species' relationship with ants and comment that such a relationship in this species is unlikely because larvae normally seal up their entrance hole once they are inside the seed-pod. Nevertheless, recent data show that cases of mutualism between the larvae of Iolas Blue and ants do occur.

The authors also provide data regarding the hypothesis that some pupae may overwinter twice, a phenomenon that has to date been little studied. As well, they discuss interesting information regarding parasitoid wasps (specialists of the genus *Anisobas* and generalists of the genus *Cotesia*) that attack the larvae of the species. Finally, there is a section of data on adult behaviour in relation to their mobility and rhythms of diurnal activity and, as part of a discussion of the species' phenology, the authors analyse data from Catalonia and show that the species flies in a single short generation with maximum numbers in the month of May.

A particularly relevant aspect of this article is the description of the species' distribution in Catalonia. The data provided in a map with UTM 10 x 10 km squares includes all reliable bibliographic data and personal records from many lepidopterists. As a result, Iolas Blue has been identified in 24 UTM squares (18 since 1975), a significant increase from the 18 squares cited in the last review of the species in 2003.

Iolas Blue should be considered as Vulnerable in Catalonia as it has been seriously affected by the disappearance of its foodplant due to the loss of open spaces (forest encroachment) and, in general, a degradation and urbanisation of its habitats. The recommended conservation measures include the maintenance of a good network of populations of *Colutea* spp., combined with the planting of this attractive, eye-catching plant in areas such as roadsides and parks[1].

All in all, this article is one of the most complete monographs dedicated to any Catalan butterfly. It is well documented and provides much interesting data on the ecology of Iolas Blue that will be of great interest to lepidopterists and conservationists alike. Congratulations are in order to the authors and we hope that we will see other similar articles in the future.

Vlad Dinca

[1] See also the commentaries on this species in Cynthia, 7: 6.

Photo 1. Female Iolas Blue Iolana iolas egg-laying at the base of a seed-pod of bladder senna *Colutea breviolata,* within which the caterpillar will feed on the young seeds (Photograph: Marc Robert Jané).

The butterfly

The Comma *Polygonia c-album*, the scalloped-winged butterfly

One of the commonest butterflies of our woods, the Comma *Polygonia c-album* is easily identifiable at rest by its spectacular scalloped-edged wings. It is best seen on spring and summer afternoons when male Commas establish territories on woodland edges and in woodland glades. With luck, a female may pass by, flying somewhat more hesitantly as she searches for nettles on which to lay her eggs.

Geographical distribution and situation within the CBMS

The Comma *P. c-album* is a widely distributed butterfly with known populations in much of the Palaearctic and north Africa and only absent in Europe from Ireland and the northern-most reaches of Scandinavia[1]. It is widespread in the Iberian Peninsula, above all in upland areas, although in the south-west only a few populations are known[2]. It has never been recorded from the Balearic Islands. In Catalonia it is common in the north, from sea-level to around 2,000 m, although in the southern half of the country it is much scarcer and more localised, being restricted basically to upland areas.

In Catalonia, the maximum abundances of Commas are recorded in humid upland areas such as the Prelitoral, Litoral and Transversal and pre-Pyrenean mountains (fig. 1), whilst in central Catalonia, in areas of more continental climate, population densities are noticeably lower. Likewise, near the coast densities are generally poorer, although the Alt Empordà, where there is still plenty of riparian woodland and the Comma is abundant, is an exception. With altitude, the species becomes scarcer and disappears altogether above the tree-line. In southern Catalonia it is absent from most areas (fig. 1), being limited principally to the relatively humid mountains of Els Ports de Tortosa i Beseit and Prades, where it is very scarce and present only in low densities. For example, despite thorough monitoring since 2001, the lack of observations from the Pinetell itinerary in the Prades mountains is significant. By the same token, this species has never been recorded from any of the three stations in the Garraf mountains, and only occasionally from the Montmell massif. We should thus consider that the Comma is totally absent from the most arid areas of the Central Depression and only found exceptionally in the coastal mountains of the province of Tarragona.

Habitat and food plants

The Comma is polyphagous, its larvae feeding on a variety of plants belonging to plant families such as Urticaceae, Cannabaceae, Ulmaceae, Betulaceae, Salicaceae and Grossulariaceae[1,3]. In Catalonia it is only moderately polyphagous and seems to use above all the common nettle (*Urtica dioica*), as well as wild hop (*Humulus lupulus*), smooth-leaved elm (*Ulmus minor*) and, much more rarely, hazel (*Corylus avellana*); exceptionally, egg-laying has been witnessed on southern nettle-tree (*Celtis australis*)[4]. Although it is possible that further species such as sallow (*Salix caprea*) or downy birch (*Betula pubescens*) are also potential foodplants in the Pyrenees, it is likely that Catalan Commas are genetically more specialized in their use of nettles than Commas from central and northern Europe[5]. One of the factors behind this specialisation in the Mediterranean may be the existence of additional late-summer generations, which avoid using deciduous trees and shrubs (whose quality declines rapidly as the summer advances) as a foodplant[6,7].

The Comma is a forest species, whose greatest densities are found in deciduous forests and, secondarily, in riparian woodland and holm-oak forests. It seems to avoid almost completely coniferous forests (fig. 2). Despite these habitat preferences, the species is a moderate generalist and it is not rare to see it in other habitats such as montane pastures and even ruderal and agricultural landscapes, and will visit meadows fairly frequently in search of nectar sources (fig. 2). This ability to exploit different environments is related to the adults' great mobility and the open nature of its populations.

Biological cycle and phenology

The Comma is polyvoltine and winters as an adult, the number of generations varying according to locality (fig. 3). The first butterflies emerge from hibernation in March (or April if the end of winter is cold) and mating and egg-laying then take place. Observations of active adults in February are rare and only occur in very mild winters. At the end of the season, most butterflies begin to hibernate in October and few active butterflies are ever seen in November.

The first new generation of the year emerges from between the end of May and the beginning of July, with a peak in June (fig. 3a-c). Butterflies from this generation can be separated morphologically from hibernators by their paler coloration of the upper- and undersides, and also by their less deeply scalloped wings. The butterflies of this first generation never enter diapause; rather, they mate and produce a second generation that appears in July-August. From this moment onwards, it is much harder to determine with precision the exact phenology of the species. In coastal and Mediterranean areas butterflies of the second generation are normally paler and are sexually active and produce a third generation, which emerges at the end of August-beginning of September (figs. 3a i b). In this third generation, sexually inactive dark-coloured butterflies predominate and these individuals begin hibernation almost straight away. However, there are a few pale-coloured butterflies that are sexually active and mate, and which give rise to a partial fourth generation in October. The limitations that the colder climate of upland areas impose on larvae mean that in these areas the phenology of the species is essentially bivoltine (fig. 3c). In these areas, the second generation that emerges at the end of July and beginning of August consists of a mixture of sexually active pale butterflies and sexually inactive darker individuals that begin hibernation almost straight away. Paler butterflies produce a partial, often hard-to-detect third generation in August-September composed entirely of dark individuals that quickly begin to hibernate.

The proportion of pale and dark butterflies in the partial generations depends on the photoperiod that the larvae coincide with as they develop. Beyond a certain critical threshold, shorter daylight signals the arrival of autumn and the larvae produce dark adults in order to minimise the risk of having to complete an additional generation during a period of adverse weather[8].

Eggs are laid individually, usually on the edge of a nettle leaf or on a young elm leaf. They are green, dome-shaped and measure 0.8 x 0.65 mm and have 10-11 longitudinal ribs. Depending on temperature, they hatch 1-2 weeks later and the larvae then pass through five instars until they measure 3.5 cm. The first three instars are generally black, with contrastingly white dorsal spines and white colouration on the back of the first abdominal segments that gives them the appearance of a bird excrement. In the last two instars the larvae assume a much brighter coloration that some authors believe to be aposematic[9]: head and ground colour are black, while the back is orange from the second thoracic segment to the second abdominal segment, and then white from the third to the seventh abdominal segments. As well, the larvae have a series of fine orange longitudinal lines and conspicuous branched white and orange spines that possibly act as a defence mechanism against avian predators. The change in coloration coincides with a change in behaviour: during the first instars, the larvae spend almost all of their time on the underside of leaves, but subsequently they also rest very visibly on the uppersides. Larval development takes 3-4 weeks, although takes longer in the dark form[8]. The pupa measures around 2 cm and is angular with a pointed head. It is brown with two characteristic silver spots on the third tho-

racic and first abdominal segments. Depending on temperature, the adult emerges from the pupa after 1-2 weeks.

Adult behaviour

Although they visit a wide range of plants in their search for nectar, adults essentially behave as specialists and have a definite preference for bramble (*Rubus* spp.) flowers[10]. They will also feed on rotting fruit, sap from various species of trees and substances of animal origin, including the excretions produced by aphids, mammal excrement and urine and human sweat. Both hibernating adults and subsequent generations are also attracted by mud and sand on river banks.

During the breeding period, males are very territorial, above all after midday, when they establish territories in clearings and on sunny woodland edges[11]. Males wait from the tips of mid-height branches for the arrival of other butterflies and, as is common in other territorial Nymphalinae, interaction between males is easy to witness. Sexual interaction –above all, mating- is, nevertheless, much harder to observe. By dissecting females and counting the number of spermatophores, it has been shown that females are polyandrous, that is, they mate more than once during their lives (on average, 2.4 times in a Swedish population, with a range of 1-5 times)[12].

Despite the amount of existing information on the ecology of this species, little accurate data has ever been recorded regarding the places adults choose to hibernate. Isolated observations seem to indicate that butterflies remain in exposed positions on tree-trunks or roots without any type of protection other than the excellent camouflage their wing colour and shape provide[13].

Natural enemies

A number of different parasitoids attack the larvae and pupae of the Comma[14], although all are generalist and are unlikely to act as regulators of Comma populations. Larvae are frequently attacked by tachinid flies (e.g. *Sturmia bella*) and, more rarely, by Ichneumonidae and Braconidae Hymenoptera. Pupae are frequently parasitized by *Pteromalus puparum* (Ichneumonidae: Chalcidoidea: Pteromalidae). The perfect camouflage of the species when it rests on a tree-trunk or leaf is very possibly an adaptive response originating from the selective pressure put on hibernating adults by insectivorous birds[13].

Population trends

Over the 14 years of CBMS monitoring, the Comma has shown a certain increase in its populations (fig. 4), although, according to analyses with the programme TRIM, without reaching statistically significant levels. This increase, though, coincides with the positive tendencies shown by forest butterflies in recent years in Catalonia and Andorra as a result of the generalised increase in forest cover[15].

It is also worth remarking that the Comma is showing positive tendencies in parts of central and northern Europe, a phenomenon that has been especially well documented in Great Britain[16], where BMS data clearly indicate that the species is increasing in abundance and expanding its range northwards[17]. Climate change would seem to be the most probable cause of this expansion, facilitated by an increase in the degree of polyphagy in expanding populations[18].

Constantí Stefanescu

[1] Tolman, T. & Lewington, R., 2002. *Guía de las mariposas de España y Europa*. 320 pàg. + 104 pl. Lynx Edicions, Bellaterra.

[2] García-Barros, E., Munguira, M. L., Martín Cano, J., Romo Benito, H., Garcia-Pereira, P. & Maravalhas, E. S., 2004. "Atlas de las mariposas diurnas de la Península Ibérica e islas Baleares (Lepidoptera: Papilionoidea & Hesperioidea) ". *Monografías Soc. ent. aragon.*, 11: 1-228.

[3] Nylin, S., 1988. "Host plant specialization and seasonality in a polyphagous butterfly, *Polygonia c-album* (Nymphalidae)". *Oikos*, 53: 381-386.

[4] Observation by C. Stefanescu, el 24/III/2001 at Can Riera de Vilardell, Montnegre.

[5] Nygren, G.H., Nylin, S. & Stefanescu, C., 2006. "Genetics of host plant use and life history in the comma butterfly across Europe: varying modes of inheritance as a potential reproductive barrier". *J. Evol. Biol.*, 19: 1882-1893.

[6] Nylin, S., Nygren, G.H., Söderlind, L. & Stefanescu, C., en premsa. "Geographical variation in host plant utilization in the comma butterfly: the roles of time constraints and plant phenology". *Evol. Ecol.*

[7] Cizek, L., Fric, Z. & Konvicka, M., 2006. "Host plant defences and voltinism in European butterflies". *Ecol. Entom.*, 31: 337-344.

[8] Nylin, S., 1989. "Effects of changing photoperiods in the life cycle regulation of the comma butterfly, *Polygonia c-album* (Nymphalidae)". *Ecol. Entom.*, 14: 209-218.

[9] Nylin, S., Gamberale-Stille, G. & Sillén-Tullberg, B., 2001. "Ontogeny of defense and adaptive coloration in larvae of the comma butterfly, *Polygonia c-album* (Nymphalidae)". *J. Lepid. Soc.*, 55: 69-73.

[10] The Comma *P. c-album* is classified as a specialist in its use of nectar sources in the article by Stefanescu & Traveset (under revision), in which 286 visits by this butterfly to 28 different species of plant are analysed.

[11] Dennis, R.L.H., 2004. "Landform resources for territorial nettle-feeding Nymphalid butterflies: biases at different spatial scales". *Anim. Biodiv. & Conserv.*, 27.2: 37-45.

[12] Wiklund, C., Gotthard, K. & Nylin, S., 2003. "Mating system and the evolution of sex-specific mortality rates in two nymphalid butterflies". *Proc. R. Soc. London B*, 270: 1823-1828.

[13] Wiklund, C. & Tullberg, B.S., 2004. "Seasonal polyphenism and leaf mimicry in the comma butterfly". *Anim. Behav.*, 68: 621-627.

[14] Shaw, M.R., Stefanescu, C. & van Nouhuys, S., in press. "Parasitism of European butterflies (Hesperioidea and Papilionoidea)". Cambridge University Press.

[15] Stefanescu, C., Jubany, J., Torre, I. & Páramo, F., 2007. "El paper bioindicador de les papallones a Catalunya". *Cynthia*, 6: 11-14.

[16] Warren, M.S., Hill, J.K., Thomas, J.A., Asher, J., Fox, R., Huntley, B., Roy, D.B., Telfer, M.G., Jeffcoate, S., Harding, P., Jeffcoate, G., Willis, S.G., Greatorex-Davies, J.N., Moss, D. & Thomas, C.D., 2001. "Rapid responses of British butterflies to opposing forces of climate and habitat change". *Nature*, 414: 65-69.

[17] Pollard, E. & Yates, T.J., 1992. "The extinction and foundation of local butterfly populations in relation to population variability and other factors". *Ecol. Entom.*, 17: 249-254.

[18] Braschler, B. & Hill, J.K., 2007. "Role of larval host plants in the climate-driven range expansion of the butterfly *Polygonia c-album*". *J. Anim. Ecol.*, 76: 415-423.

Fig. 1. Relative abundance of the Comma *Polygonia c-album* (expressed as the value of the annual index /100 m) at different CBMS stations (1994-2007).

Fig. 2. Population densities of the Comma *Polygonia c-album* (nº individuals/100 m of transect) in the main habitats represented in the CBMS network; calculations carried out with data from 314 sections (1994-2007) from 69 different stations.

Fig. 3. Phenology of the Comma *Polygonia c-album* in (a) a coastal site in northern Catalonia (el Cortalet: 1988-2007, 630 butterflies), (b) a Mediterranean forest in the Litoral and Prelitoral mountains (Can Riera de Vilardell and Olzinelles in the Montnegre; Can Liro, Can Prat and Vallforners in the Montseny: 1994-2007, 771 butterflies), and (c) in deciduous woodland in a montane area (Can Jordà in the Garrotxa Volcanic Zone and El Puig in the Montseny: 2001-2006, 791 butterflies).

Fig. 4. Population fluctuations in the Comma *Polygonia c-album* in Catalonia and Andorra in the period 1994-2007 calculated with the programme TRIM.

Colour photos. (a) Eggs, (b) last instar larva, (c) pupa, and adults of Polygonia c-album of (d, f) the pale morph , and (e) of the dark morh (photographs: a, J. Jubany; b-d, J.M. Sesma; e, J.R. Salas; f. M. Miralles).

Identification

How to separate the 'whites' of the genus *Pieris*

Five species of 'whites' belonging to the genus *Pieris* fly in Catalonia and all are present in the CBMS network. Large *P. brassicae* and Small *P. rapae* Whites are practically ubiquitous and are easy to identify. Nevertheless, the latter can be confused with Green-veined White *P. napi*, which flies in more humid sites, and Southern Small *P. mannii* and Mountain Small *P. ergane* Whites, two scarce and localised species that can be identified by the size and shapes of the black marks on their forewings.

Large, Small and Green-veined Whites fly throughout Catalonia and also appear in the Balearic islands[1]. The first two are highly opportunistic and prone to disperse; as such they can appear in any CBMS station and reach greatest densities in humanised and agricultural environments. Green-veined White has appeared in 80% of stations, but is only abundant in humid lowland and montane sites. Southern Small and Mountain Small Whites are both thermophile species that fly in dry stony areas: the first has appeared in 20% of stations and is found in coastal mountains and a few places in the Pyrenees and pre-Pyrenees, while the latter is very rare in Catalonia and flies in just a few areas of the Pyrenees and pre-Pyrenees in the province of Lleida[2]. To date it has only appeared in the CBMS at Gerri de la Sal. All species are polyvoltine and fly from spring through to summer in generations whose number varies according to the site and year. The larvae feed on crucifers and are gregarious and aposematic in Large White, but solitary and cryptically camouflaged in the rest. Both Large and Small Whites use a variety of foodplants, above all cultivated varieties that they may seriously damage[3]. The other species all use wild crucifer species: in Catalonia Green-veined White uses a variety of species[4], Southern Small White feeds above all on candytufts *Iberis* spp., sweet alyssum *Alyssum maritimum* and swinecress *Coronopus squamatus*[4,5], while Mountain Small White uses burnt candytuft *Aethionema saxatile*[5]. All spend the winter as pupae.

Jordi Dantart

[1] García-Barros, E., Munguira, M. L., Martín Cano, J., Romo Benito, H., Garcia Pereira, P. & Maravalhas, E. S., 2004. "Atlas de las mariposas diurnas de la Península Ibèrica e islas Baleares (Lepidoptera: Papilionoidea & Hesperioidea)". *Monografías Soc. ent. aragon.*, 11: 1-228.

[2] Bellavista, J., Martí, J. & Moliné, A., 1997. "Noves dades sobre *Pieris* (*Artogeia*) *ergane* (Geyer, 1828) a Catalunya (Lepidoptera: Pieridae)". *Butll. Soc. Cat. Lep.*, 79: 30-33.

[3] Feltwell, J., 1982. *Large white butterfly; the biology, biochemistry and physiology of Pieris brassicae (Linnaeus)*. W. Junk, The Hague, 535 pp.

[4] Stefanescu, C., Peñuelas, J. & Filella, I., 2007. "Les papallones com a bioindicadors dels hàbitats a Catalunya: l'exemple dels prats de dall i les pastures del Parc Natural dels Aiguamolls de l'Empordà". *Butll. Inst. Hist. Nat.*, 73: 139-162.

[5] J. Dantart i C. Stefanescu, unpublished data.

Drawings

LARGE WHITE
Upperside: male without spots; females with two black post-discal spots.
Underside: fore-wing with yellow apical spot; male and female with two large black post-discal spots; hind-wing yellow with grey dusting.
Marked with line:
Fore-wing: black concave apical marking reaching over halfway down the wing margin.

SMALL WHITE
Underside: fore-wing white with yellowish apex and two black post-discal spots; hind-wing yellow with extensive grey dusting.
Marked with lines:
Fore-wing: black sub-triangular apical border normally does not reach beyond vein 5; square or round black post-discal spot in S3.

SOUTHERN SMALL WHITE
Underside: similar to Small White, but with black post-discal spot in S3 with concave external margin.
Marked with lines:
Fore-wing: sub-rectangular black apical border reaches beyond vein 5; in both sexes the black post-discal spot in S3 has a concave external margin.

MOUNTAIN SMALL WHITE
Underside: fore-wing white with yellowish apex, but with no visible post-discal spots; hind-wing yellow with extensive grey dusting.
Marked with line:
Fore-wing: black apical spot almost square.

GREEN-VEINED WHITE
Upperside: veins lined with black scales giving wing a darker appearance (above all in females).
Underside: fore-wing white with yellowish apex and one or two black post-discal spots; hind-wing yellowish with veines highlighted with grey-green scales.
Marked with lines:
Upperside fore-wing: black apical border discontinuous along wing margin.
Underside hind-wing (2nd generation): veins generally only darker on inner half.

Large, Small and Green-veined Whites often fly together and their propensity to disperse also means that they may be found together with both Southern and Mountain Small Whites, which usually fly in different habitats. Large White is distinguished by its size and by its scythe-shaped apical border; Green-veined White has darkened veins on the underside of its hind-wings (a character that is much less evident in summer generations); Mountain Small White has a square apical spot and no black post-discal spots on the underside of the fore-wings; Small and Southern Small Whites can be separated by the shape of the black apical marking and by the post-medial black spot in S3 that has a concave external margin in the latter. All five species exhibit sexual dimorphism on the upperside of the fore-wings: males with no spots (Large White) or with a single black post-discal spot and females with two such spots. Male Green-veined Whites smell strongly of lemon.

Identification

How to separate Common *Polyommatus icarus*, Chapman's *P. thersites* and Escher's *P. escheri* Blues

Within the group of the 'blues', the very common Common Blue is often confused with Chapman's and Escher's Blues, two much more localised species. The arrangement of the black spots on the underside of the wings and various aspects of their life-cycles are the most useful characters for reliably separating these three species.

The Common Blue is possibly the commonest 'blue' in Catalonia, appearing in all kinds of habitats in all CBMS itineraries. It is an opportunistic species that is adapted to live in ruderal and very humanised environments. On the other hand, Chapman's and Escher's Blues are much more localised and often fly together in upland limestone areas; to date, they have appeared in 20-30% of CBMS stations with maximum densities in central Catalonia and dry mountain ranges (for example, Montmell, Garraf, Sant Llorenç del Munt and dry areas of the pre-Pyrenees and Pyrenees). Both Common and Chapman's Blues are polyvoltine and fly in three generations (or even four in the case of Common Blue) from March-April to September-October. Escher's Blue is essentially univoltine with a single generation peaking in June-July (according to locality), although a few individuals fly earlier and later in the year. Common Blues use a large number of Papilionaceae to lay their eggs, although they have a preference for clovers, medicks and trefoils (genera *Trifolium*, *Medicago* and *Lotus*)[1,2]. Escher's Blue, on the other hand, is a specialist feeder on Montpellier milkvetch *Astragalus monspessulanus*, whilst Chapman's Blue is likewise on sainfoins (*Onobrychis* spp.)[1]. The larvae of all three species frequently associate with a number of different ant species and winter when half-grown[3].

Constantí Stefanescu

[1] Munguira, M.L., García-Barros, E. & Martín, J., 1997. "Plantas nutricias de los licénidos y satirinos españoles (Lepidoptera: Lycaenidae y Nymphalidae)". *Boln Asoc. esp. Ent.*, 21: 29-53.

[2] Stefanescu, C., Peñuelas, J. & Filella, I., 2007. "Les papallones com a bioindicadors dels hàbitats a Catalunya: l'exemple dels prats de dall i les pastures del Parc Natural dels Aiguamolls de l'Empordà". *Butll. Inst. Hist. Nat.*, 73: 139-162.

[3] Tolman, T. & Lewington, R., 2002. *Guía de las mariposas de España y Europa*. 320 pàg. + 104 pl. Lynx Edicions, Bellaterra.

COMMON BLUE
Upperside: male dark sky blue; female brown, with a variable diffusion of blue scales, above all at the base of the wings.
Underside: male grey or brown, with grey-blue basal scales and submarginal orange markings, poorly marked on the fore-wing; female brown, with the submarginal markings more evident.
Marked with line:
Underside hind-wing: two black post-discal spots (sometimes just one).

ESCHER'S BLUE
Upperside: male electric sky blue; female brown, sometimes with blue basal scales, and generally with a complete series of very visible orange submarginal markings.
Underside: male pale grey, with contrasting conspicuous black and orange spots; females brown, with submarginal orange markings bordered internally and externally by black spots.
Marked with lines:
Upperside hind-wing (male): end of veins coloured black, penetrating somewhat into the white wing fringes.
Upperside hind-wing (female): 'V'-shaped orange submarginal marks and well-marked black spots.
Underside fore-wing: no black post-discal spots.

CHAPMAN'S BLUE
Upperside: male dark sky blue; female brown with a variable number of blue scales at the base of the wings.
Underside: male grey or brown; female brown; submarginal orange markings well developed and bright, above all on hind-wing.
Marked with lines:
Upperside fore-wing: the male's sex-brand gives a velvety-white appearance to the base of wings and discal area.
Underside hind-wing: no black post-discal spots.

Although the Common Blue is a highly ubiquitous species, both Escher's and Chapman's Blues are rare and live in localised populations in dryish open areas on calcareous substrata. The presence of one or two black spots in the discal area of the underside of the fore-wing only occurs in Common Blue (exceptionally individuals without these spots appear). Common and Chapman's Blues are very similar in size and colouration, while Escher's Blue is generally larger with (in males) a distinctive electric blue colour to the upperside of the wings; as well, the black and orange spots on the underside of the wings tend to be much clearer and larger than in Chapman's Blue. Escher's Blue is always found in association with Montpellier milkvetch and, more than Chapman's Blue, flies in subalpine and even alpine environments. Males of all three species mud-puddle, a behaviour especially common in Escher's Blue.

Ajuntament Granollers
Museu de Granollers Ciències Naturals
Monitoring programme with the support of:
Generalitat de Catalunya Departament de Medi Ambient i Habitatge