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Cover

Detail of the upperside of the hind-wing of a Provence Chalkhill Blue *Polyommatus hispana* (photograph: A. Miquel).

Purple-shot Copper *Lycanea alciphron* on a Compositae (photograph: J.R. Salas).

Editorial

The practical applications of monitoring programmes

The holding of the first workshop on biodiversity monitoring in Catalonia in 2006 represented an important milestone for the CBMS and other similar monitoring programmes being carried out in this country. The workshop was very well attended, a fact that reflects the growing interest in today's world in the subject of bioindicators. For two days the auditorium of La Pedrera in Barcelona was home to a varied group of people, from the naturalists personally involved in the monitoring programmes being discussed, to university researchers and, above all, technical staff from the government departments that rely on the data generated by these programmes in their management decisions. The monitoring of bioindicator species aims to provide precise and trustworthy information on the evolution of our ecosystems in order to be able to correct negative trends that endanger the biodiversity of our natural systems.

The presentations made during the workshop made it clear that the data collected with such care and patience by all the collaborators in the monitoring programmes have practical applications at different territorial scales. At a local level, monitoring contributes enormously to our knowledge of the natural world and acts as an early warning system for types of land-use that might be harmful to our wildlife. At a larger scale, the results reveal more general trends that are related to territorial planning in a much broader sense. It is from this standpoint that we should recognise the importance of these so-called 'habitat indicators', to which we have dedicated an article on management and conservation in this edition of *Cynthia*. In order to construct these indicators, we first identified the habitat preferences of the commonest species of butterflies in Catalonia. We then combined the data from groups of species closely associated with particular habitats to obtain general trends for these habitats. The results are very interesting and worrying for one particular species-rich habitat – grasslands and open spaces. Over the last decade, the species of butterfly that are most closely linked to this habitat have declined and so it is in our hands now to investigate the causes of this fall and find solutions that will reverse this negative trend. We are convinced that over the coming years the CBMS and other monitoring programmes will help territorial planning become more compatible with the conservation of diversity within our ecosystems.

The CBMS network

Current situation (2006) of the Butterfly Monitoring Scheme in Catalonia, Andorra and the Balearic Islands

In all, 64 stations, 10 more than in 2005, participated actively in the thirteenth CBMS season. This figure includes six new stations in the Pyrenees, half of which also form part of the Andorran BMS network (BMSAnd). These stations will provide us henceforth with information on the state of a number of high-mountain species of butterfly that up to now have not been represented in the CBMS network. In all, 135,878 butterflies belonging to 157 species were counted in 2006.

During the 2006 season 64 butterfly walks were carried out, of which 58 managed to complete the annual counts (fig. 1). As well, regular censuses that will be incorporated into the CBMS network in the coming years were carried out at Les Alberes (600 m, Alt Empordà), Folgueroles (650 m, Osona) and Santa Catalina (50 m, Menorca), and, as part of the BMSAnd, at Fontaneda (850 m), Rec de l'Obac (1,500 m) and Pessons (2,300 m).

The available annual series are shown in figure 2: as of 2006, 47 stations have provided data for five or more years and 14 stations have done so for 10 or more years.

New transects

Vilert (Pla de l'Estany, 100 m). This transect runs through an area of intensive agriculture, but also includes sections of riparian woodland alongside the river Fluvià. Nevertheless, these sections are very degraded and plant communities are dominated by ruderal species. The final part of the transect includes two sections that pass through typical Mediterranean holm oak woodland.

Gerri de la Sal (Pallars Sobirà, 650 m). Located in a humid sub-Mediterranean upland area, this transect runs through an area dominated by dry oak and pine woodland and boasts an exceptionally rich butterfly fauna, to the point that it may be the richest of all CBMS transects. In the first year in operation 96 species were recorded, which included a spectacular mixture of typically Mediterranean elements and other species more characteristic of mid-altitude and even Pyrenean habitats. This enormous richness can be put down to a juxtaposition in a small area of sunny arid slopes, hay meadows and riparian vegetation in the valley bottom. Some of the rarer species detected in 2006 included Mountain Small White *Pieris ergane*, Spanish Purple Hairstreak *Laeosopis roboris*, Chequered Blue *Scolitantides orion*, Meleager's Blue *Polyommatus daphnis*, Lesser Spotted Fritillary *Melitaea trivia*, False Heath Fritillary *Melitaea diamina*, Chestnut Heath *Coenonympha glycerion* and a rich community of skippers. Iolas Blue *Iolana iolas*, Large Blue *Maculinea arion* and Duke of Burgundy Fritillary *Hamearis lucina* were also detected, but without entering into the counts.

Sant Maurici (Pallars Sobirà, 1,800 m). This subalpine itinerary runs through an area of pasture and hay meadows with fragments of broad-leaved woodland and European silver-fir forest in the vicinity of the lake of Sant Maurici. The area is very species-rich and 80 species of butterfly were detected in the first year in 2006. Some of the more typical Pyrenean species detected here included Apollo *Parnassius apollo*, Clouded Apollo *Parnassius mnemosyne*, Scarce Copper *Lycaena virgaureae*, Sooty Copper *Lycaena tityrus*, Large Blue *Maculinea arion*, Eros Blue *Polyommatus eros*, Small Tortoiseshell *Aglais urticae*, Niobe Fritillary *Argynnis niobe*, Pearl-bordered Fritillary *Boloria euphrosyne*, Small Pearl-bordered Fritillary *Boloria selene* and seven members of the genus *Erebia*.

Tremp (Pallars Jussà, 470 m). This transect lies in an area with a mix of holm and deciduous oak woodland and scrub showing a marked continental climate. This climate type is very poorly represented in the CBMS network and so this itinerary represents an important addition to the network. The butterflies detected on the transect are very diverse and include abundant populations of Spanish Festoon *Zerynthia rumina*, Blue-spot Hairstreak *Satyrium spini* and Grayling *Hipparchia semele*, as well as small populations of rare species such as Provence Hairstreak *Tomares ballus*, Short-tailed Blue *Cupido argiades*, Meleager's Blue *Polyommatus daphnis* and Spanish Fritillary *Euphydryas desfontainii*.

Olzinelles (Vallès Oriental, 250 m). This itinerary lies in the bottom of the small valley of the Riera d'Olzinelles. Currently, much of the itinerary is wooded with a combination of Mediterranean holm oak and riparian woodland, as well as plantations of non-native species (planes and poplars). Nevertheless, a project exists to restore the open spaces of the valley bottom by eliminating the plantations and transforming them into farmland and meadows. The data provided by this itinerary will allow us to document the changes that occur in the butterfly populations, which, presumably, will be enriched by the restoration of the open spaces.

Pineda (Maresme, 130 m). Situated in Mediterranean holm oak woodland on the seaward side of the coastal Serralada Litoral, this itinerary runs through woodland (holm oak and pines) in the vicinity of the church of Sant Pere de Riu. There

are also small areas of scrub and other open areas. Typical Mediterranean species fly here, including a number of interesting species such as Provence Hairstreak *Tomares ballus*.

Estoll (Cerdanya, 1,120 m). Lying in the plain of the river Segre in La Cerdanya, this transect largely passes through agricultural environments. However, the cereal fields and intensive pastureland are mixed in with small patches of deciduous woodland that ensure that the transect has a much greater specific richness. It is the first CBMS station in an agricultural environment in the Pyrenean foothills and as such will provide very interesting data. As yet, the counts are incomplete due to the recorder's lack of time, although they have already revealed the presence of species such as Clouded Apollo *Parnassius mnemosyne*, Spanish Purple Hairstreak *Laeosopis roboris*, Provençal Short-tailed Blue *Cupido alcetas*, Turquoise Blue *Polyommatus dorylas* and Map Butterfly *Araschnia levana*.

Sorteny (Andorra, 1,950 m). This transect is situated in an area of pastures and subalpine woodland in the parish of Ordino within Sorteny Natural Park. The habitats are well preserved and of particular interest are the water meadows with bistort *Polygonum bistorta*, home to populations of Bog Fritillary *Proclossiana eunomia*, one of the rarest butterflies in the Pyrenees. Other significant species include Apollo *Parnassius apollo*, Clouded Apollo *Parnassius mnemosyne*, Mountain Dappled White *Euchloe simplonia*, Purple-edged Copper *Lycaena hippothoe*, Scarce Copper *Lycaena virgaureae*, Geranium Argus *Eumedonia eumedon* and various species of the genus *Erebia*. The counts are carried out by the Natural Park guides.

Enclar (Andorra, 1,180 m). This itinerary follows an old trail, El Camí de Sant Vicenç d'Enclar, in the parish of Andorra La Vella. Mid-altitude Eurosiberian forests predominate, which provide for a good representation of Nymphalinae species. As well, typical Pyrenean species such as Apollo *Parnassius apollo*, Sooty Copper *Lycaena tityrus* and Pearl-bordered Fritillary *Boloria euphrosyne* are present. The counts are carried out by staff from the Andorran Centre for the Study of Snow and Mountains, part of the Institute for Andorran Studies.

Coma Pedrosa (Andorra, 1,825 m). This station is walked in the Valleys of Comapedrosa Communal Natural Park in an environment dominated by Scots pine forests and subalpine pastures. Species such as Apollo *Parnassius apollo*, Scarce Copper *Lycaena virgaureae*, Sooty Copper *Lycaena tityrus*, Large Ringlet *Erebia euryale* and de Prunner's Ringlet *Erebia triaria* that are very poorly represented in the CBMS have been detected here. The counts are carried out by staff from the Natural Park.

Margalef (Priorat, 400 m). This transect lies on the north-facing slopes of La Serra del Montsant and runs around the Margalef reservoir, passing through patches of sunny scrub, shady holm oak woodland and olive and peach groves. To date this part of Catalonia has been very poorly represented in the CBMS network and so this transect is of great value to the project as a whole. During the first year, around 40 species were recorded, including Spanish Festoon *Zerynthia rumina*, Provence Chalkhill Blue *Polyommatus hispana*, Adonis Blue *Polyommatus bellargus,* Dingy Skipper *Erynnis tages*, Sage Skipper *Muschampia proto* and Marbled Skipper *Carcharodus lavatherae*.

Compared to 2005, in 2006 the only transects that were not active were those of **Can Riera de Vilardell** (Vallès Oriental; substituted by the **Olzinelles** station) and **Alinyà** (Alt Urgell), which will be reactivated in 2007.

Habitats represented

The different habitats and plant communities covered by the CBMS in 2006 are shown in table 1. Although the stations in lowland areas still predominate (currently with a good cover of holm oak woodland and scrub formations), for the first time there is now a good representation of mid-altitude and subalpine habitats. For example, the CBMS network now includes itineraries in areas dominated by humid oak, ash and Scots pine woodland, as well as subalpine haymeadows.

Species represented

The list of species recorded in 2006 and in previous years can be consulted in table 2. In all, 157 species were detected in 2006, 17 more than the previous year and 26 more than the average for 1994-2005. This notable increase can be explained by the presence of more Pyrenean-type itineraries that have provided, for the first time, data on Clouded Apollo *Parnassius mnemosyne* (see drawing), Mountain Dappled White *Euchloe simplonia*, Purple-edged Copper *Lycaena hippothoe*, Geranium Argus *Eumedonia eumedon*, Silvery Argus *Aricia nicias*, Eros Blue *Polyommatus eros*, Niobe Fritillary *Argynnis niobe*, Bog Fritillary *Proclossiana eunomia*, Small Pearl-bordered Fritillary *Boloria selene*, Shepherd's Fritillary *Boloria pales*, Mountain Ringlet *Erebia epiphron* and Bright-eyed Ringlet *Erebia oeme*. As well, high-altitude species such as Apollo *Parnassius apollo*, Scarce Copper *Lycaena virgaurea*, Sooty Copper *Lycaena tityrus*, Large Blue *Maculinea arion*, Turquoise Blue *Polyommatus dorylas* and Esper's Marbled White *Melanargia russiae* that had appeared briefly in previous years were detected once again in 2006. The appearance again of Sooty Orange Tip *Zegris eupheme* at Timoneda d'Alfés is also worthy of note.

The number of species with data now amount to almost 80% of known Catalan butterfly species, a fact that demonstrates the degree to which the CBMS network covers the country. Moreover, 55% of these species fly in more than 10 stations (fig. 3), which thus enables us to draw solid conclusions regarding trends in the populations of a significant part of the butterflies that fly in Catalonia.

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

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

Fig. 1. Geographical situation of all the stations that have ever participated in the CBMS network (1994-2006), 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 1988-2006).

Fig. 3. The number of CBMS stations in which each of the 157 butterflies detected in 2006 have appeared.

Table 1. Habitats and plant communities represented in the CBMS in 2006, 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 period 1997-2006. 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 1997 and 1998, 30 in 1999 and 2000, 42 in 2001, 41 in 2002, 46 in 2003, 51 in 2004, 52 in 2005 and 64 in 2006). Taxonomy as per reference 2.

Photo 1. The 2006 season saw the definitive arrival of the CBMS network in the Catalan Pyrenees and Andorra. Although difficult environmental conditions well into the spring make counting difficult at first, the effort is more than compensated for by the presence of extremely rich and interesting butterfly populations throughout the summer. The photograph shows an unusual view of the CBMS itinerary at Sant Maurici at the beginning of the season (photograph: J. Piqué).

Photo 2. Within the BMSAnd network, the Sorteny station provides a combination of forests and subalpine meadows that is habitat for many high-altitude species of butterfly such as Clouded Apollo *Parnassius mnemosyne*, Pearl-bordered Fritillary *Proclossiana eunomia* and Purple-edged Copper *Lycaena hippothoe* (photograph: J. Jubany).

Drawing 1. The new Pyrenean stations provided data in 2006 on species that hitherto had not been represented in the CBMS. One such species is Clouded Apollo *Parnassius mnemosyne*, a rare butterfly protected by the Berne Convention and the Habitats Directive, which flies in May and June in association with its larval food plant, solid-tubered corydalis *Corydalis solida*. The species is abundant in the CBMS stations at Sant Maurici (Pallars Sobirà) and Estoll (Cerdanya), whilst at Sorteny (Andorra) it appears regularly in small numbers (drawing: M. Miró).

Thirteenth year of the CBMS
Summary of the 2006 season

The year 2006 was marked by a hot spring followed by a hot first half of the summer, as well as six months of extremely low rainfall. Nevertheless -and in spite of the second consecutive drought year- many butterfly populations increased notably in 2006, a year that, all in all, can be qualified as a reasonably good for these insects. At most stations more butterflies of more species were counted than in the previous year, above all of the Satyrinae and the commoner migrants. On the other hand and in contrast to 2005, counts of single-brooded species and those that winter as adults fell considerably.

Weather and butterfly counts

The 2006 season was marked by two meteorological phenomena: high spring and summer temperatures and a severe drought that had begun the previous winter. Nevertheless, both the drought and heat broke in August.

As had happened the previous season, the winter of 2005-2006 was long and cold, and characterised by north and north-easterly winds and cold anticyclonic weather that sent thermometers plunging to below-average levels. Both December and February were dry (with less than 70% of the average rainfall for these months), whilst January was very wet with more than double the average rainfall in some areas.

The arrival of spring marked a sudden change in the weather and during the following five months (March-July) temperatures were consistently high, peaking in the hottest July for at least 10 years, which was qualified as 'Exceptionally Hot' by the Catalan Meteorological Office. Rainfall was low over much of the country and in many places failed to reach 30% of average figures. Logically, the cumulative effects of the dry winter (except January) and a dry spring and early summer, as well as exceptional heat, led to one of the most severe droughts in recent history.

Fortunately, everything changed in August. First of all, winds began to blow from the north, which led to an increase in cloud cover and a fall in temperatures. Secondly, rain fell in the eastern part of the country and then continued in September, with two particularly intense periods of rain (12-15 September on the coast and hinterland, and 22-24 September in the pre-Pyrenees and Pyrenees) that left over 200 mm in many areas of the country.

Just as in 2005, this weather favoured butterfly counts and on average only 3.4 weekly counts were lost per itinerary (fig. 1a). The most critical period was the months of August and September at the beginning of the rainy periods (fig. 1b). The relatively high number of counts lost in March and April can be explained by the incorporation into the CBMS of a number of Pyrenean itineraries, which have to cope with adverse weather conditions well into spring.

Changes in abundances: general considerations

As a whole, a significant increase in butterfly numbers was observed during the 2006 season, a trend that contrasts with the fall in numbers recorded during the previous season. Of the 45 stations with comparable figures from 2005 and 2006, 38 recorded an increase in the total number of butterflies counted and only in seven were fewer butterflies counted. The average number of butterflies counted per itinerary in 2006 was 2,401.9 ± 1,552.3 (average ± standard deviation), compared to 1,905.4 ± 1,386.1 in 2005. A Student-t Test for paired samples indicates that this increase was statistically highly significant ($t = 4.55$, $P < 0.001$). Greater numbers of individuals were accompanied by more species per itinerary: 41.3 ± 17.8 species in 2006 compared to 40.0 ± 18.0 in 2005. This increase was also significant ($t = 2.58$, $P = 0.013$).

In general, 2006 was a good year for butterflies (fig. 2), with counts situating it in sixth place out of the 13 years the CBMS has been in operation. This relative bonanza may seem surprising in light of the severe drought that hit the country in spring and summer. Nevertheless, it is possible that the heavy rains in January were very beneficial for species whose larvae concentrate their feeding periods at the end of winter and beginning of spring (for example, most Satyrines).

Changes in abundance: fluctuations in populations

The general abundance of Satyrinae and of the commoner migrant species, as well as the recovery in False Ilex Hairstreak *Satyrium esculi* numbers (which had dropped spectacularly the previous year; table 1), explain for the most part the increase in the number of butterflies counted in 2006.

Throughout Catalonia there was a notable increase in Satyrinae numbers and some species such as Great Banded Grayling *Brintesia circe* and Striped Grayling *Hipparchia fidia* reached their highest ever figures for the 13 years of CBMS records (tables 1 and 2). Of the commonest Satyrinae, in 2006 decreases were only recorded in Gatekeeper *Pyronia tithonus*, Small Heath *Coenonympha pamphilus* and Pearly Heath *C. arcania*, all species that for unknown reasons seem to be in decline in recent years.

Another group of species that reached notable population levels in 2006 were migratory butterflies. With the exception of Lang's Short-tailed Blue *Leptotes pirithous*, all the commoner migratory species increased notably, above all Painted Lady *Cynthia cardui*, which appeared in spectacular numbers in many CBMS stations in April, May and June. As well, there were notable increases in numbers of Clouded Yellow *Colias crocea* and Bath White *Pontia daplidice*, species that were amongst the commonest in 2006, unlike 2005 (table 1).

Although not known as a true migratory species, the Cardinal *Argynnis pandora* was also unusually common in 2006 in many parts of Catalonia (see drawing).

In contrast, there were also species whose numbers dropped significantly in 2006. Of these, many were species whose numbers had clearly increased in 2005 and included both many single-brooded spring butterflies (Orange Tip *Anthocharis cardamines*, Moroccan Orange Tip *A. euphenoides,* Green Hairstreak *Callophrys rubi*, Green-underside Blue *Glaucopsyche alexis*, Black-eyed Blue *Glaucopsyche melanops* and Panoptes Blue *Pseudophilotes panoptes*) and species that hibernate as adults (Camberwell Beauty *Nymphalis antiopa*, Large Tortoiseshell *N. polychloros*, Peacock *Inachis io*, Comma *Polygonia c-album*, Nettle-tree Butterfly *Libythea celtis* and Brimstone *Gonepteryx rhamni*). The fall in numbers of single-brooded spring butterflies in 2006 may have been the result of the spring drought in 2005, which would have caused herbaceous larval food plants to whither at the exact moment that caterpillars were completing their development. As for the hibernating species, the heavy January rains in 2006 are a likely cause of low adult survival rates[2].

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[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.

[2] Pullin, A.S. & Bale, J.S., 1989. "Effects of low temperature on diapausing *Aglais urticae* and *Inachis io* (Lepidoptera: Nymphalidae): cold hardiness and overwintering survival". *J. Insect Physiol.*, 35: 277-281.

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 2006 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 and the annual indexes calculated with the TRIM programme.

Table 1. Sum of the annual indexes and ranking of abundance for the 20 commonest species from the 2006 CBMS network as compared with the corresponding figures from the 2005 season.

Table 2. Evolution of the overall annual indexes for the 63 commonest butterflies in the CBMS network (1997-2006), based on an arbitrary value of 1 for 1994. Annual indexes were calculated using the TRIM programme.

Drawing 1. The Cardinal *Argynnis pandora* is a scarce butterfly in Catalonia and flies in localised populations in the north (mountains in the Alt Empordà) and the south (mountains of Prades, Els Ports de Tortosa-Beseït and El Montsant). In some years the species disperses in great numbers and turns up unexpectedly in many areas. One of these irruptions occurred in 2006 and 132 Cardinals (more than five times than in 2005) were counted from the CBMS network from 19 different stations (some for the first time) in 12 different Catalan *comarques* (counties) (drawing: M. Miró).

Photo 1. During April and May 2006 large-scale migrations of Painted Ladies were detected, which coincided closely with the entry of synoptic winds from Africa. The close links between these two phenomena suggest that the migrations of this species mainly take place at great altitude (photograph: J. Jubany).

Habitat management and conservation

Butterflies as bioindicators in Catalonia

An initial analysis of the data from the CBMS network reveals the populational trends of the commonest butterflies in Catalonia are related to the type of habitat in which they are commonest. Species of grasslands and open areas have declined, whilst those found in wooded areas have increased. These trends seem to be related with changes in land-use.

One of the principal objectives of the CBMS (and all similar monitoring programmes) is the generation of data for constructing habitat indicators using multispecific indexes to synthesize the trends of a group of species that characterise a certain type of habitat. If the selected group of organisms are good bioindicators, as is the case of butterflies[1], this index will be able to reflect trends that are extrapolable to a wider segment of the ecosystem.

An example based on bird monitoring programmes in Europe is the Farmland Bird Index, adopted by the European Community as a structural and sustainable indicator for agricultural environments[2]. Nevertheless, some studies question or, at least, have certain misgivings regarding the capacity of birds to act as bioindicators in comparison with that of other organisms. For example, it has been shown that over the last hundred years butterflies have experienced a far greater decline than birds or plants in the United Kingdom[3]. Thus, any indicator constructed merely on the basis of data from bird surveys may well give a false impression of stability or imply the existence of, for example, just a slight decline, when in fact the essential components of the ecosystems (for example, insects) are undergoing a much more serious decline. It is for this reason that monitoring programmes such as the BMS are important for evaluating levels of biodiversity and for identifying negative trends that might otherwise remain hidden if studies are based on other taxonomic groups.

During 2006, data from the CBMS network was used to identify species closely associated with certain environments and to construct habitat indicators and analyse their population trends. First of all, a total of 626 sections with homogeneous habitat in 68 CBMS itineraries active in the period 1994-2005 were identified. Then, by using the Land-use Map of Catalonia and a GIS for each of these sections the percentage of cover of the following seven major habitat types within a radius of five metres from the census route was calculated: forest, scrub, cultivated land, natural unproductive land, artificial unproductive land, pastures and other types of grassland, and marshland. To correct for possible mapping errors, the data was compared to the CBMS data regarding the dominant plant communities of each section. Only those sections with a presence of 75% or more of one of these seven habitats were selected. Finally, to avoid pseudoreplication, all sections in one itinerary with the same habitat type were grouped as a single data item, thereby reducing the effective number of sections analysed to 150.

The next stage was to analyse the habitat preferences of the commonest 64 butterflies in the

CBMS network on the basis of their presence or absence from the 150 sections that represent pure habitat. The application of multivariance methods of analysis (cluster analyses and non-metric multidimensional scaling) on a matrix of frequency of appearance of the species for different habitats enabled us to identify four groups of indicator species for the following environments: (1) agricultural and ruderal environments; (2) grassland and open areas; (3) scrub; and (4) woodland (table 1). These 64 species form the base for the construction of the habitat indicators as per the methodology used for European birds. First, the population trends of these species for the period 1994-2005 were calculated using the TRIM programme[4], and then a multispecific index for each of the four habitats was calculated using a combination of the trends of each of their characteristic species.

The trends of the indicator species differ notably, a fact that is related to the changes occurring in each type of environment. The scrub indicators and, above all, the woodland indicators have undergone positive trends, whilst the indicators for agricultural and, above all, grasslands and open areas, have undergone negative trends (fig. 1). Despite the fact that some of the trends are not statistically significant and will have to be confirmed by future data, it is worth remarking that our conclusions coincide to a great extent with those obtained for other groups[5].

It is possible that the trends detected are related to the profound changes in land-use that have begun to affect the Catalan landscape in recent decades. One of the principal changes is the increase in the surface area covered by forest, which has been caused by the abandoning of the least productive land, above all the open areas that were once farmed or grazed using traditional methods and that are not viable for the practice of intensive agriculture. Secondly, the urban growth that has affected coastal and pre-coastal areas has led to an increase in ruderal habitats and the loss of other more species-rich habitats (for example, grassland with annual plants). These changes have led thus to an increase in the woodland indicator species and a decrease in the open space indicator species, a finding confirmed by an additional analysis of a group of 11 much rarer grassland species[6]. Scrub and agricultural indicator species lie somewhere in between the two extremes: the former seem to have increased slightly, perhaps as a result of colonising the first successional stages of abandoned open spaces or as a result of an increase in scrub surface area after the forest fires that occurred during the study period. The slight decline in the agricultural indicator species is hard to interpret, although it is possible that the gradual intensification of many agricultural areas is having a negative effect on some of these species despite their opportunistic abilities to adapt and to exploit these types of environments[7,8].

However reasonable it might seem to conclude that the trends of the indicator species reflect the influence of changes in land-use, other explanations are possible. For example, there is a close relationship between population trends and two of these species' ecological characteristics, the number of annual generations and the stage of the annual life cycle in which the species winters. Single-brooded and double-brooded species have tended to increase, whilst multi-brooded species have tended to decline (fig. 2a). On the other hand, as a group the species that winter as adults show positive trends, which are significantly different from the trends detected amongst the remaining species (fig. 2b). Taking into account the fact that the distribution, phenology and abundance of species are all highly affected by climate[9,10,11], one possible hypothesis is that population trends linked to phenological characteristics such as brood number and hibernation could be a response to climatic variation in Catalonia over the last decade (for example, the general increase in temperatures, the droughts and the recent cold winters). If this is the case, the predominance of species of one or another phenological category in each different habitat (as can be observed in some cases) could lead to general positive or negative trends in that particular habitat, which will not be directly related to changes in land-use, but, rather, to an interaction between habitat and climate. We believe that we should not rule out that the possibility that the trends in populations of indicator species are more a consequence of climate changes than changes in land-use, or a combination of the two. Whatever the full story, data from the coming years should enable us to provide a more precise answer to this question.

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[1] Thomas, J.A., 2005. "Monitoring change in the abundance and distribution of insects using butterflies and other indicator groups". *Phil. Trans. R. Soc. B*, 360: 339-357.

[2] Gregory, R.D., van Strien, A. va, 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.

[3] Thomas, J.A., Telfer, M.G., Roy, D.B., Preston, C.D., Greenwood, J.J.D., Asher, J., Fox, R., Clarke, R.T. & Lawton, J.H., 2004. "Comparative losses of British butterflies, birds, and plants and the global extinction crisis". *Science*, 303: 1879-1881.

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

[5] Brotons, Ll., Herrando, S., Estrada, J. & Pedrocchi, V., 2004. Patrons generals dels canvis en la distribució de les espècies i l'ús del sòl en el període entre els dos atles. *In*: *Atles dels ocells nidificants de Catalunya 1999-2002* (Estrada, J., Pedrocchi, V., Brotons, Ll. & Herrando, S., eds): 567-581. Institut Català d'Ornitologia/Lynx Edicions, Barcelona.

[6] These species are: Purple-shot Copper *Lycaena alciphron*, Provence Hairstreak *Tomares ballus*, Small Blue *Cupido minimus*, Provençal Short-tailed Blue *Cupido alcetas*, Large Blue *Maculinea arion*, Mazarine Blue *Polyommatus semiargus*, Escher's Blue *Polyommatus escheri*, Western Marbled White *Melanargia occitanica*, Chestnut Heath *Coenonympha glycerion*, Dingy Skipper *Erynnis tages* and Silver-spotted Skipper *Hesperia comma*. The choice was made on the basis that (a) these species are recognised grassland specialist butterflies at a European scale and (b) have a minimum representation of at least five stations in the CBMS network (average number of stations: 12.6; range: 5-22). Eight of the 11 species showed significant trends and in all cases these trends were negative. A significant difference exists between the trends for the commonest and most localised of these grassland species ($t = 2.93$; $P = 0.033$; $n = 24$); the most negative trend was found in the rarer species (-0.1113 *vs.* -0.0156).

[7] León-Cortés, J.L., Cowley, M.J.R. & Thomas, C.D., 1999. "Detecting decline in a formerly widespread species: how common is the common blue butterfly *Polyommatus icarus*?". *Ecography*, 22: 643-650.

[8] León-Cortés, J.L., Cowley, M.J.R. & Thomas, C.D., 2000. "The distribution and decline of a widespread butterfly *Lycaena phlaes* in a pastoral landscape". *Ecol. Entom.*, 25: 285-294.

[9] Parmesan, C., Ryrholm, N., Stefanescu, C. *et al.*, 1999. "Poleward shifts in geographical ranges of butterfly species associated with regional warming". *Nature*, 399: 579-583.

[10] Stefanescu, C., Peñuelas, J. & Filella, I., 2003. "Effects of climatic change on the phenology of butterflies in the northwest Mediterranean Basin". *Global Change Biol.*, 9: 1494-1506.

[11] Pollard, E., 1988. "Temperature, rainfall and butterfly numbers". *J. Appl. Ecol.*, 25: 819-828.

Table 1. Butterfly species identified as indicators of a certain type of environment on the basis of data from the CBMS network in the period 1994-2005.

Group 1: Agricultural and ruderal species
Swallowtail *Papilio machaon*, Large White *Pieris brassicae*, Small White *Pieris rapae*, Green-veined White *Pieris napi*, Bath White *Pontia daplidice*, Western Dappled White *Euchloe crameri*, Clouded Yellow *Colias crocea*, Small Copper *Lycaena phlaeas*, Long-tailed Blue *Lampides boeticus*, Lang's Short-tailed Blue *Leptotes pirithous*, Geranium Bronze *Cacyreus marshalli*, Brown Argus *Aricia cramera*, Common Blue *Polyommatus icarus*, Nettle-tree Butterfly *Libythea celtis*, Peacock *Inachis io*, Painted Lady *Cynthia cardui*, Southern Gatekeeper *Pyronia cecilia*, Mallow Skipper *Carcharodus alceae*, Lulworth Skipper *Thymelicus acteon*.
These species tend to live in humanised areas and are most abundant in habitats directly linked to human activity. Nevertheless, their excellent dispersive capacity and ability to colonise new areas means that they appear in almost all types of environment.

Group 2: Grassland and open space species
Spanish Festoon *Zerynthia rumina*, Berger's Clouded Yellow *Colias alfacariensis*, Green-underside Blue *Glaucopsyche alexis*, Black-eyed Blue *Glaucopsyche melanops*, Panoptes Blue *Pseudophilotes panoptes*, Adonis Blue *Polyommatus bellargus*, Glanville Fritillary *Melitaea cinxia*, Spotted Fritillary *Melitaea didyma*, Provençal Fritillary *Melitaea deione*, Marsh Fritillary *Euphydryas aurinia*, Tree Grayling *Hipparchia statilinus*, Striped Grayling *Hipparchia fidia*, Iberian Marbled White *Melanargia lachesis*, Small Heath *Coenonympha pamphilus*, Dusky Heath *Coenonympha dorus*.
These butterflies are associated with various types of grassland and open spaces. Most have limited dispersive abilities and live in local populations.

Group 3: Scrub species
Scarce Swallowtail *Iphiclides podalirius*, Black-veined White *Aporia crataegi*, Moroccan Orange Tip *Anthocharis euphenoides*, Cleopatra *Gonepteryx cleopatra*, False Ilex Hairstreak *Satyrium esculi*, Green Hairstreak *Callophrys rubi*, Queen of Spain Fritillary *Issoria lathonia*, Knapweed Fritillary *Melitaea phoebe*, Grayling *Hipparchia semele*, Great-banded Grayling *Brintesia circe*, Spanish Gatekeeper *Pyronia bathseba*, Wall Brown *Lasiommata megera*.
These species are characteristic of scrub and thickets, but are also present in grassland and woodland; some of these species are amongst the commonest butterflies in Catalonia.

Group 4: Woodland species
Orange Tip *Anthocharis cardamines*, Brimstone *Gonepteryx rhamni*, Wood White *Leptidea sinapis*, Purple Hairstreak *Neozephyrus quercus*, Holly Blue *Celastrina argiolus*, Two-tailed Pasha *Charaxes jasius*, Southern White Admiral *Limenitis reducta*, Camberwell Beauty *Nymphalis antiopa*, Large Tortoiseshell *Nymphalis polychloros*, Red Admiral *Vanessa atalanta*, Comma *Polygonia c-album*, Silver-washed Fritillary *Argynnis paphia*, Weaver's Fritillary *Boloria dia*, Meadow Brown *Maniola jurtina*, Gatekeeper *Pyronia tithonus*, Pearly Heath *Coenonympha arcania*, Speckled Wood *Pararge aegeria*, Large Skipper *Ochlodes venata*.
These butterflies are characteristic of different types of woodland habitats.

Fig. 1. Indicators of the different types of environments based on the population trends of the indicator species. The woodland indicator species have increased significantly during the study period ($P = 0.03$), whilst the grassland indicators have declined only marginally significantly ($P = 0.09$). The other two groups show no significant trends ($P > 0.1$).

Fig. 2. Population trends (average ± standard error) of the most abundant species in terms of (a) phenology (single-, double- and multi-brooded species) and (b) the stage in which the species overwinter (egg, larva, pupa or adult). In the first case the multi-brooded species have undergone a significantly different trend from the others, whilst in the second case the species that overwinter as adults have also undergone a significantly different trend.

Photo 1. Over the last few years there has been a spectacular increase in the numbers of species such as Large Tortoiseshell *Nymphalis polychloros*, a fact that has led to a significant positive trend in the indicators of forest areas (photograph: J. Jubany).

Photo 2. The Small Copper *Lycaena phlaeas* and other species associated with humanised areas exhibit negative trends that could be linked to increased agricultural intensification. (photograph: J. Jubany).

Photo 3. The fall in numbers of butterflies associated with pastures and grassland is exemplified by the Provence Hairstreak *Tomares ballus*. Populations of this species, which lives in dry calcareous areas, fell by 9.6% in the period 1994-2005 (photograph: R. Vila).

CBMS sites

Coll d'Estenalles, a 'classic' butterfly site in the Serralada Prelitoral

Located in the *comarca* of Bages in the heart of Sant Llorenç del Munt i Serra de l'Obach Natural Park, this transect passes through an interesting area of mid-altitude Mediterranean mountains covered by upland holm oak woodland and *codines* (areas of exposed conglomerate rocks). The butterfly communities found here are exceptionally diverse and include a number of fascinating species.

The transect

The Coll d'Estenalles itinerary lies wholly within Sant Llorenç del Munt i Serra de l'Obach Natural Park on the western side of the mountain pass (*coll*) that gives it its name, and in the proximity of a large farmhouse, La Mata. Located at 900 m a.s.l., the average annual temperature and rainfall in the area are 11 ºC and 798 mm, respectively. This part of the Natural Park is frequented by thousands of walkers from the nearby towns of Terrassa and Sabadell who, fortunately for the itinerary, tend to visit the peaks of Montcau and La Mola that rise to the east of the *coll*.

Located within an area of calcareous Mediterranean mountains, the itinerary passes through a mosaic of habitats that includes bare stony *codines* in sections 4 and 7, upland holm oak woodland in sections 5, 6, and 9, and abandoned farmland in sections 2, 3 and 10. Patches of rosemary, grey-leaved cistus and box scrub, along with grassland dominated by *Brachypodium phoenicoides* and therophyte communities, are scattered throughout much of the transect.

Worth highlighting is the abundance of plants that are important for specific butterflies: horseshoe vetch *Hippocrepis comosa* for Berger's Clouded Yellow *Colias alfacariensis*, Provence Chalkhill Blue *Polyommatus hispana* and Adonis Blue *P. bellargus*, Montpellier milkvetch *Astragalus monspessulanus* for Esher's Blue *Polyommatus escheri* and buckler mustard *Biscutella laevigata* for Moroccan Orange-tip *Anthocharis euphenoides*.

The butterfly fauna

The CBMS transects at Coll d'Estenalles began in 1997 and, after a hiatus in 2003 and 2004, were recontinued in 2005. The eight years of counts have revealed the presence of 84 species of butterflies, although the average annual number of species counted is around 65. In 2007 Iolas Blue *Iolana iolas* appeared for the first time, although it is likely that the two butterflies counted during the month of May had strayed from a nearby population, since, otherwise, it is hard to explain how such a large lycaenid could have gone unnoticed for so long. Nevertheless, the presence of a few bushes of *Colutea brevialata* along the transect may yet enable a small population of this spectacular 'blue' to establish itself in coming years.

The commonest species in the area (fig. 1) are the 'browns' Iberian Marbled White *Melanargia lachesis* and Wall Brown *Lasiommata megera*, and the 'blues' Panoptes Blue *Pseudophilotes panoptes* and Provence Chalkhill Blue *Polyommatus hispana*. Doubts remain whether the Provence Chalkhill Blue detected here is not in fact the much more widespread Chalkhill Blue *P. coridon*; this question is currently being studied by means of molecular analysis. The phenology of Provence Chalkhill Blue at Coll d'Estenalles is essentially bimodal, with a first poorly marked peak in abundance in May and at the beginning of June, followed by a more evident peak in July and August. Nevertheless, it is not clear whether these are two different generations (which would correspond to the phenological pattern of Provence Chalkhill Blue) or, rather, a prolonged emergence of a single generation (phenology of Chalkhill Blue). Other common species include Provençal Fritillary *Melitaea deione* and Lesser Spotted Fritillary *M. trivia*, which co-exist with other rarer species of the same genus (Glanville Fritillary *M. cinxia*, Knapweed Fritillary *M. phoebe* and Spotted Fritillary *M. didyma*).

Aside from a few notable exceptions, the population densities of the species that fly at Coll d'Estenalles are low and so some butterflies (for example Spanish Festoon *Zerynthia rumina*, Southern Small White *Pieris mannii*, Sloe Hairstreak *Satyrium acaciae*, Chapman's Green Hairstreak *Callophrys avis* and Western Marbled White *Melanargia occitanica*) are not recorded every year. In addition, very mobile species such as Peacock *Inachis io*, Small Tortoiseshell *Aglais urticae*, Comma *Polygonia c-album*, Cardinal *Argynnis pandora* and Queen of Spain Fritillary *Issoria lathonia* are only detected very occasionally, having dispersed possibly from far distant areas.

The transect also reveals an important presence of Species of European Conservation Concern (SPEC) mentioned in the Red Data Book of European Butterflies[1]. In fact, of all the 18 CBMS transects walked in the protected areas managed by the Barcelona Provincial Council (Diputació de Barcelona), the transect at Coll d'Estenelles has recorded the largest number of SPEC species, even more than the well-established transects in the Montseny such as El Puig, Pla de la Calma and Vallforners. Some of the transect's rarer species or with restricted biogeographical situations in Catalonia include Provence Hairstreak *Tomares ballus*, Green-underside Blue *Glaucopsyche alexis*, Dusky Heath *Coenonympha dorus*, Marbled Skipper *Carcharodus lavatherae* and Small Skipper *Thymelicus sylvestris*.

The need for management in open areas

The great diversity of butterfly species at Coll d'Estenalles can be explained by a number of factors: the size of the Natural Park and its buffer zone, which are both well respected, above all for historical reasons and due to the abrupt relief of the area, the distance of the transect from nearby populations centres, its altitude, which guarantees an above-average rainfall for the area, and the presence of formerly cultivated fields and terraces. These open areas are currently managed by the Natural Park, but not without certain problems. The fields are still ploughed every year and so scrub communities are unable to take root; as a result, the herbaceous vegetation of these fields has become dominated by ruderal species of plant. This means that the butterfly species found in mature pasturelands are restricted to the abandoned terraces that surround these fields. Nevertheless, these terraces are being rapidly invaded by scrub, which will eventually swallow up these open areas entirely if remedial action is not carried out soon. These questions relating to the conservation of these open spaces of such great biological interest must be reconsidered by the Natural Park's management teams in order to ensure the survival of one of the richest communities of mid-altitude Mediterranean butterflies in Catalonia.

Quim Muñoz

[1] Van Swaay, C. A. M. & Warren, M. S., 1999. *Red Data Book of European Butterflies (Rhopalocera)*. Nature and Environment, 99: 1-260. Council of Europe Publishing, Estrasburg.

Photo 1. Sections 2 and 3 of the itinerary, with the summit of the mountain of Montcau in the background and the Coll d'Estenalles information centre in the foreground (photograph: C. Gutiérrez).

Transect route at Coll d'Estenalles. It consists of 10 sections with a total length of 1,351 m and an average length of 135 m per section (range: 78-205 m).

Fig. 1. Average abundance (average of the annual indexes for the period 2005-2006) of the 15 commonest butterflies at the Coll d'Estenalles CBMS station.

Review

Vicente Arranz, J. C. & Hernández Roldán, J. L., 2007

Guía de las mariposas diurnas de Castilla y León

280 pag., format 13.6/21.5 cm, richly illustrated in colour. Náyade Editorial, Medina del Campo (Valladolid). Text: Spanish. ISBN: 84-93-52-32-1-6.

Unfortunately, new books on Iberian butterflies are few and far between. However, in this case it is a pleasure to be able to review a field guide of a region of Spain that combines a high quality text and excellent photographs.

This book deals with all the butterfly species (186) known to occur in the area of Castilla y León. The first part (prologue, introduction, how to use the guide, how to observe butterflies in the area) is followed by a richly illustrated presentation of the main butterfly habitats in the region accompanied by a map of all the Natura 2000 sites occurring in Castilla y León.

For each butterfly family, the systematic part of the book includes an interesting introduction of

two pages that begins with general aspects and then moves onto more particular topics related to the region of Castilla y León.

The butterfly species are presented in the following fashion: identification, biology and behaviour, habitat, distribution, conservation status, flight time and similar species. Each species is dealt with on a single page, although in some cases the allocated space is doubled due to the need to provide more comprehensive information. As well, the species fact sheets are accompanied by distribution maps for Castilla y León and excellent colour photographs depicting adults in the wild (often more than one picture per species) and their habitat. The authors also use original symbols (related to habitat types, protection, frequency, flight times and size) in order to transmit information in a practical fashion. It is worth mentioning the considerable amount of data related to the life histories of the species and the overall high scientific standard of the text.

A short final chapter discusses the species whose presence in Castilla y León is uncertain and erroneous records.

The final part of the book contains colour plates for all the species appearing in the text that consist of retouched photographs, generally depicting adults in natural positions with in many cases useful differentiation characters indicated by arrows. Three plates depicting preimaginal stages of various butterfly species are added at the end of the book.

All in all, the book is edited in a most attractive and pleasant manner and provides a detailed picture of the butterfly fauna of Castilla y León. The quality of the text and the excellent colour illustrations make it a 'must' for any entomologist with an interest in Iberian Lepidoptera.

Vlad Dinca

Photo 1. This highly recommendable book can be obtained directly from the publishers for 35 € (www.nayade.es).

News
Workshop on biodiversity monitoring programmes in Catalonia

On 21-22 November 2006 the first workshop on biodiversity monitoring in Catalonia was held under the title "Biodiversity Monitoring Programmes in Catalonia. Current situation and practical applications" in the auditorium of the Caixa de Catalunya in the wonderful setting of La Pedrera (house designed by Antoni Gaudí) on Passeig de Gràcia, Barcelona. Over 300 people attended and the success of the workshop reveals just how necessary an event such as this was.

The aim of the workshop was to discuss the various different long-term biological monitoring projects being carried out in Catalonia and debate questions such as how these schemes should be developed and integrated, and their practical applications. The workshop was organised by the Forest Technology Centre of Catalonia, the Catalan Institute of Ornithology and the Granollers Museum of Natural Sciences, three centres at the forefront of biological monitoring in Catalonia, with further support from the Department of the Environment and Housing, the Barcelona Provincial Government and the Foundation 'Territori i Paisatge'.

The first day of the workshop was centred on the presentation of the various monitoring programmes currently being carried out in Catalonia. The first part of the day concentrated on programmes monitoring specific groups of organisms and, just as occurs in other countries, it became clear that in Catalonia bird and butterfly monitoring projects are the most consolidated schemes, both in terms of methodology and the amount of time they have been operating. Monitoring programmes for amphibians, dragonflies, game species and specific threatened species were also presented. The second part the day was dedicated to multidisciplinary studies of the biodiversity of specific habitats such as forests (the Forest Ownership Centre), rivers (monitoring of the river Tordera carried out by the Observatory of the Tordera) and marine phanerogams on the Catalan coast (CRAM).

Day two concentrated on the practical applications of these monitoring programmes at local and national scales. Most monitoring schemes are being carried out in protected areas or in sites managed by the Foundation 'Territori i Paisatge'. After each group of presentations there was time for debate in which all were able to express their points of view.

It is worth highlighting the role played by the CBMS during the workshop as one of the oldest monitoring programmes in Catalonia, as well as its notable implantation throughout Catalonia and the practical use being made of its results.

From the debate and discussions that followed it became clear that the public and private institutions and bodies that are involved in biological monitoring schemes in Catalonia must work together if these projects are to function correctly and have practical applications. Furthermore, the future law of biodiversity will be a step forward in coordinating different monitoring programmes and for guaranteeing the conservation of our natural heritage.

Jordi Jubany

Photo 1. The workshop was an excellent setting for a debate involving many of the numerous participants.

The butterfly
The Nettle-tree Butterfly *Libythea celtis*, the only European 'snout'

With the warmth of the first days of spring, the southern nettle-trees growing in the northern half of Catalonia are visited by the Nettle-tree Butterfly. This species is unmistakable due to its behaviour, coloration and, above all, its palps that project beyond its head, which have earned this family of butterflies the nickname of 'snouts'.

Geographical distribution and situation within the CBMS

The subfamily Libytheinae includes a dozen species with largely tropical distributions. Although the genus *Libytheana* is found in the American continent, the genus *Libythea* lives in the Old World and the Nettle-tree Butterfly *Libythea celtis*, the only member of the family in Europe, flies from a small area of North Africa, through southern Europe and central and north-west Asia as far as China and Japan[1]. In Europe, it is found throughout the Mediterranean and its main islands (Corsica, Sardinia, Sicily, Crete and Cyprus), and also penetrates northwards in small numbers as far as Switzerland, Hungary, Slovakia and Romania[2].

The species is well distributed throughout the Iberian Peninsula, although it is unknown from the northern third of the Peninsula[3] and the Balearic Islands. Its distribution in Catalonia was recently revised on the basis of material from collections[4] and the resulting map shows that the species is widely spread throughout the northern half of the country, but is very rare in the southern half, where practically the only records are from the mountains of Prades and Ports de Tortosa-Beseït. The species also seems to be absent from the Empordà Plain, the Central Depression and the high Pyrenees, a distribution that is confirmed by data from the CBMS network (fig. 1). The Nettle-tree Butterfly is currently common in large areas of northern Catalonia, where it appears in high densities in the pre-coastal mountains of La Serralada Prelitoral (for example, El Montseny) and the coastal mountains of La Serralada Litoral (for example, El Montnegre and Collserola). It also flies in the pre-Pyrenees in the province of Lleida, but is absent from the high Pyrenees (individuals turn up occasionally), all of the Empordà Plain, the coast and arid inland areas. In the south, the species appears in the mountains of Prades and Ports de Tortosa-Beseït, while isolated records from areas such as Montmell and El Garraf should perhaps be attributed to the existence of individual butterflies in dispersion rather than the existence of stable populations (fig. 1).

Habitat and food plants

The Nettle-tree Butterfly is a specialist feeder on nettle-tree, *Celtis* spp., trees belonging to the family of the Ulmaceae. In Catalonia the species uses southern nettle-tree *Celtis australis*, although in north-east Asia Caucasian nettle-tree *Celtis caucasica* is also used[1]. The literature states that smooth-leaved elm *Ulmus minor* and wych elm *Ulmus glabra* are accepted with reservations by larvae in captivity[1], although we have on one occasion witnessed a female laying on the leaves of a smooth-leaved elm, which would seem to indicate that exceptionally elms may be used as an alternative to nettle-trees[5].

Although it is found in many different types of habitats, the Nettle-tree Butterfly is generally found in fairly humanised surroundings[6] due to its close association with the southern nettle-tree, a tree of oriental origin that has been planted for centuries in villages and farms as a source of shade and wood for making hayforks and the handles of agricultural instruments. Subspontaneous southern nettle-trees are also found growing some distance from inhabited areas.

In general, the Nettle-tree Butterfly is found in lowland and mid-altitude mountain areas and only occasionally flies at higher altitudes where low temperatures prevent its food plant from thriving. Nevertheless, the species is recorded at high altitudes, above all in summer, probably as a result of migratory or dispersive movements. For example, in El Montseny the breeding populations of the species are found to around 700 m a.s.l., but in June and July individual butterflies are frequently found above 1,000-1,300 m a.s.l.. Such movements also occur in the Pyrenees and in June 2007 a Nettle-tree Butterfly was recorded from Sant Maurici at 1,600 m a.s.l.

Biological cycle and phenology

The Nettle-tree Butterfly is a single-brooded species that hibernates as an adult. The first butterflies appear early in the season and in some years are on the wing in early February. The activity of these butterflies (that were born the previous year) increases throughout March and April and reaches a peak in the second half of the latter month (fig. 2a), which is when mating and egg-laying takes place.

When egg-laying, females choose southern nettle-trees of any size that are about to bud and fix their whitish oval-shaped eggs to the scales that

protect the bud or on a branch near the base of a bud. The eggs hatch after about one week. The caterpillars pass through five stages, living on either side of the leaves, and are cryptically coloured brown or green. They are usually to be found in line with the leaf-edge, although they will sometimes move into the centre of the leaf. After above 2-3 weeks of growth, the caterpillar pupates on the underside of a leaf. The adults emerge 7-10 days later, with the peak emergence concentrated in June and early July (fig. 2a).

In Mediterranean areas the recently emerged adults are hard to spot and most observations of the species are from the breeding period at the end of winter and beginning of spring (fig. 2b). On the other hand, in more humid areas the emergence of the adults in summer is much more apparent and is well reflected in the CBMS counts (fig. 2c). Nevertheless, the proportion of wintering butterflies compared to butterflies observed at the beginning of summer depends on meteorological factors: the drier the spring and summer, the greater the proportion of Nettle-tree Butterflies that are seen at the end of winter. For example, 80% of the butterflies observed at Can Riera de Vilardell in 2005 during an extremely hot and dry summer corresponded to hibernating adults during the breeding period, whilst in 2004 in an atypically wet and mild summer, the proportion was inverted and 62% of butterflies were counted at the beginning of summer. This phenomenon (which also occurs in other species such as Camberwell Beauty *Nymphalis antiopa* and Large Tortoiseshell *N. polychloros* with similar phenologies) undoubtedly indicates that the species will tend to enter into diapause more readily when the summer drought is more intense.

Adult behaviour

Adults visit a number of different nectar sources, as well as sap exuded from trees such as oak, aspen and fruit trees. When the adults emerge from hibernation, their favourite nectar source is that of willows (for example, common sallow *Salix atrocinerea*), but they will also visit tree heath (*Erica arborea*), sloe (*Prunus spinosa*) and common thyme (*Thymus vulgaris*). Freshly emerged butterflies in summer prefer brambles (*Rubus* spp.) and the flowers of trees such as large-leaved lime (*Tilia platyphyllos*) and sweet chestnut (*Castanea sativa*). More rarely, adults are observed feeding on buddleia (*Buddleia davidii*), lucerne (*Medicago sativa*) and other flowers, and are also attracted to mud and damp earth. This behaviour, however, is rare in butterflies emerging from hibernation and we have observed it, above all, in worn females. In summer, emerging butterflies frequently gather in spectacular numbers around pools of water, especially on hot mornings[7], although we do not know whether this behaviour is typical or not of both sexes.

During the breeding period, males can be seen waiting for females, often on the willow the females visit for nectar, or even on the very southern nettle-trees that the females use to lay their eggs. This behaviour suggests that the females may mate more than once, as happens in a related species, the Snout Butterfly *Libytheana bachmani*[8]. Males occupy the external branches of the southern nettle-trees and interact amongst themselves and any female that passes by. Males are mostly rejected by the females, who, to avoid further disturbance, take refuge on the ground. The very few observations of mating pairs that have ever been made suggest that copulation takes place on the ground[9].

Population trends

The association between Nettle-tree Butterfly and anthropic environments and the wide range of both it and its food plant suggests that the species is not under threat in Catalonia. In fact, since the CBMS has been in operation, numbers have increased significantly[6] (fig. 3). After a light fall in numbers in 1994-1999, the species began to become more common in various parts of the country and figures from 2004 and 2005 were ten times those of the first years of the CBMS. These increases were synchronised throughout the CBMS network in 1999-2000, 2001-2002 and 2002-2003, although in both 2004 and 2005 most populations in CBMS stations fluctuated independently. In 2006, numbers of the Nettle-tree Butterfly fell significantly throughout Catalonia and reached similar levels to those from first years of the CBMS project.

There is no obvious explanation for these marked fluctuations. It seems clear that there is no connection with changes in habitat, as no such changes have been recorded in the CBMS transects where the species is commonest. Climatic factors would seem to be the most plausible cause and it is possible that hard winters (such as those in the years before the synchronised increase in numbers) in some way favour the survival of hibernating adults. However, this hypothesis will have to be studied more formally. The impact of parasitoids and predators could also have had an effect on populations after two years of very high numbers. Nevertheless, no specific parasitoid to the Nettle-tree Butterfly is known that might act as a population regulator and the only records of parasitoids attacking the species are of two generalists that attack, respectively, larvae and pupae[10,11].

Constantí Stefanescu

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

[2] Kudrna, O., 2002. "The distribution Atlas of European butterflies". *Oedippus*, 20: 1-342.

[3] 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.

[4] Viader, J., 1992. "Papallones de Catalunya. *Libythea celtis* (Laicharting, [1782])". *Butll. Soc. Cat. Lep.*, 70: 47-59.

[5] Observation by C. Stefanescu, 4 March 1997, at Can Riera de Vilardell, Montnegre. On 31 March the young elm leaf on which oviposition had been noted was inspected again without there being any indication of the presence of a larva.

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

[7] It is worth highlighting a record by Santi Viader on 20 June 2004 of over 1,000 Nettle-tree Butterflies on the banks of the Vallforners reservoir in El Montseny.

[8] Rutowski, R.L., Terkanian, B. & Eitan, O., 1997. "Male mate-locating behavior and yearly population cycles in the snout butterfly, *Libytheana bachmani* (Libytheidae)". *J. Lepid. Soc.*, 51: 197-207.

[9] Observations by A. Miquel (El Pinetell, Prades mountains, 24 April 2004), A. Giró (Can Prat, El Montseny, 18 March 2005) and Q. Muñoz (Coll d'Estenalles, Sant Llorenç del Munt, 14 May 2005).

[10] The generalist tachinid fly *Bactromya aurulenta* has been reared from larvae collected at Can Liro, El Montseny (C. Stefanescu *leg.*, H.-P. Tchorsnig *det.*).

[11] Askew, R.R. & Shaw, M.R., 1997. "*Pteromalus apum* (Retzius) and other pteromalid (Hym.) primary parasitoids of butterfly pupae in Western Europe, with a key". *Entomologist's mon. Mag.*, 133: 67-72.

Fig. 1. Relative abundance of the Nettle-tree Butterfly *Libythea celtis* (expressed as the value of the annual index/100 m) in different CBMS sites (1994-2006).

Fig. 2. Phenologies of the Nettle-tree Butterfly *Libythea celtis* in (a) the network of CBMS stations (data from 42 stations and 2,702 butterflies), (b) Can Riera de Vilardell, El Montnegre (1994-2005, 510 butterflies) and (c) Vallforners (2001-2006, 791 butterflies).

Fig. 3. Fluctuations in the abundance of the Nettle-tree Butterfly in Catalonia in the period 1994-2006, calculated with the programme TRIM.

Photo 1. Owing to its short proboscis, the Nettle-tree Butterfly takes nectar from flowers such as brambles (*Rubus* spp.) that are open and have easily accessible nectaries (photograph: J. Dantart).

Colour photos. (a) Caterpillar in its final larval stage; (b) chrysalis fixed to leaf of a southern nettle-tree; (c) adult resting; its highly developed palps (the origin of the name 'The Snout', often used for this group of butterflies) are very visible; (d) male holding territory on a southern nettle-tree (photographs: a-c, J.R. Salas; d, J. Jubany).

Identification

How to separate the species of the genera *Pararge* and *Lasiommata*

The Speckled Wood *P. aegeria* and Wall Brown *L. megera* fly in practically all CBMS stations. Despite their similarity in flight, they are easy to identify when seen well and in terms of their chosen habitats. The Large Wall Brown *L. maera* is much rarer and more localised and only appears in some itineraries. The Northern Wall Brown *L. petropolitana*, on the other hand, has yet to be detected in the CBMS network.

The Speckled Wood *P. aegeria* and Wall Brown *L. megera* are found throughout Catalonia and in the Balearic Islands, from coastal areas to high mountains. Nevertheless, they are not normally found in the same habitats: Wall Browns prefer dry sunny spots, often even bare ground, such as banks and waysides, especially with some outstanding relief feature ('hill-topping' behaviour)[1]; Speckled Woods, on the other hand, fly in shady humid woodland, where males actively defend patches of sun[2]. The Large Wall Brown *L. maera* is found throughout the Pyrenees and the pre-Pyrenees and locally in the mountains of the Serralades Transversal, Prelitoral and Litoral and in the south of Catalonia. A recent exceptional record exists from Menorca[3]. This species flies in similar habitats to Wall Brown and has been recorded to date from 22% of CBMS stations. The Northern Wall Brown *L. petropolitana* is one of the rarest butterflies in Catalonia and has only been recorded from the Val d'Aran in the central Pyrenees. The Speckled Wood is a multi-brooded species that flies throughout the whole season (and even in mild winters) without any appreciable peaks in numbers. The Wall Brown is also multi-brooded and normally has three annual broods of decreasing abundance, from February through to October-November. The Large Wall Brown is, on the other hand, double-brooded (April-May and July-August), while the Northern Wall

Brown seems to be single-brooded, flying only at the beginning of summer. As in the other members of the Satyrinae, the larvae of these species feed on various species of grass[4].

Jordi Dantart

[1] Wickman, P.O., 1988. "Dynamics of mate-searching behaviour in a hilltopping butterfly, *Lasiommata megera* (L.): the effects of weather and male density". *Zool. J. Linn. Soc.*, 93: 357-377.

[2] Wickman, P.O. & Wiklund. C., 1983. "Territorial defence and its seasonal decline in the speckled wood butterfly (*Pararge aegeria*)". *Anim. Behav.*, 31: 1206-1216.

[3] Carreras, D., Jubany, J. & Stefanescu, C., 2004. "Noves cites de papallones diürnes per a Menorca i les illes Balears (Lepidoptera: Rhopalocera)". *Butll. Soc. Cat. Lep.*, 93: 35-41.

[4] 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.

Drawings

SPECKLED WOOD
Upperside: orange-brown background colour crossed by dark brown lines.
Underside: hind-wing brown with mottled rusty yellow markings.
Marked with line:
Fore-wing: outer margin concave; submarginal area orange.
Hind-wing: external margin dentate; line of very small eye-spots in the postdiscal area, often reduced to just spots; orange postdiscal patch outside cell.

WALL BROWN
Upperside: fore-wing golden orange with characteristic network of dark cross bars; hind-wing dark brown with golden postdiscal marks.
Underside: hind-wing grey, with dark sinuous transversal lines; series of small eye-spots, consisting of dark central spot with white pupil and a single external ring.
Marked with line:
Fore-wing (male): androconia (sex-brand) is very visible, more so than in the other species.
Fore-wing (female): two lines cross the cell, the second reaching the lower, internal margin of the wing.
Upperside of the hind-wing: golden postdiscal band (not found in the other species, just a single postdiscal mark in Speckled Wood).

LARGE WALL BROWN
Upperside (male): basal and discal areas dark brown; postdiscal band of orange marks.
Upperside (female): like male, but with discal area of fore-wing orange-brown.
Underside: hind-wing greyish; sinuous tranversal lines; long line of postdiscal eye-spots, consisting of black central spot with white pupil and two external concentric rings.
Marked with line:
Fore-wing: apical eye-spot with two pupils.
Fore-wing (female): band crosses cell without reaching the lower, internal margin of the wing.

NORTHERN WALL BROWN
Upperside: Basal and discal areas dark brown; postdiscal line of orange marks.
Underside: hind-wing dark grey; sinuous transversal lines; postdiscal line of large eye-spots, consisting of a black centre with white pupil and two external concentric rings.
Marked with line:
Hind-wing: orange mark with eye-spot in s1 (absent in Speckled Wood and Wall Brown)

The Speckled Wood can be separated from the three *Lasiommata* species by the following characteristics: the external margin of the fore-wing of the Speckled Wood is slightly concave and its hind wing dentate; the central part of the submarginal area is golden-coloured; the underside of the hind-wing is brown, rather than grey-coloured. Male Large Wall Browns and both sexes of North Wall Brown differ from Wall Brown in the uniformly brown basal and discal areas of their fore-wings. The separation of female Wall Brown and Large Wall Brown is possible on the basis of the discal line that crosses the whole wing in the former and only the cell in the latter, and by the apical eye-spot with a double pupil in Large Wall Brown. Males of Large and Northern Wall Browns can be separated by the small size of the latter and its darker colouration.

Identification

How to separate Holly *Celastrina argiolus*, Provençal Short-tailed *Cupido alcetas* and Short-tailed *Cupido argiades* Blues

In the northern half of Catalonia, Holly Blue *Celastrina argiolus* can only be confused with two much more localised species, Provençal Short-tailed Blue *Cupido alcetas* and Short-tailed Blue *C. argiades*. Differences in the colouration of the sexes and the morphology of the hind-wings, as well as behaviour and biology, are the basic keys to separating these three species.

The Holly Blue *C. argiolus* is a woodland species that is often found in areas of riparian woodland and thickets[1]. Nevertheless, as a mobile opportunistic species it can also turn up arid areas, high mountains and urban parks and gardens; it has to date been recorded from 84% of CBMS stations. It is multi-brooded and three generations normally fly annually, the first in February-March, and the two others through from the end of spring to the end of summer. This species uses many food plants[2], although in summer its preferred choice are brambles (*Rubus* spp.). Both Short-tailed and Provençal Short-tailed Blues are much rarer and are only found in the more humid areas of the north of the country, above all in areas at mid-altitudes[3]. The Provençal Short-tailed Blue has appeared in 18 CBMS stations (20%) and Short-tailed Blue in 15 stations (17%). They tend to co-exist in the same sites and habitats, that is, in humid pastures, woodland clearings and alongside rivers. Both fly in two or three annual generations: Provençal Short-tailed Blue lays its eggs on black medick *Medicago lupulina*, whilst Short-tailed Blue uses a far greater range of Leguminosae (for example, red clover *Trifolium pratense*, lucerne *Medicago sativa*, *Melilotus indica* and bird's-foot trefoil *Lotus corniculatus*)[4].

Constantí Stefanescu

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

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

[3] Stefanescu, C. & Miralles, M., 1989. "Distribució i biologia de *Strymonidia w-album* (Knoch, 1782), *Everes argiades* (Pallas, 1771) i *Everes alcetas* (Hoffmannsegg, 1804) (Lep. Lycaenidae Leach, 1815) a Catalunya". *Butll. Soc. Cat. Lep.*, 59(1988): 35-53.

[4] C. Stefanescu, dades no publicades

Drawings

HOLLY BLUE
Upperside: sky blue; females have a thick black border to the fore-wing and along the costa of the hind-wing.
Underside: white, with pale blue suffusion at the base of the wings; thin black spots forming arc on the fore-wing.
Marked with line:
Upperside of the fore-wing: thin white fringes interrupted by small black marks at the ends of the veins.

PROVENÇAL SHORT-TAILED BLUE
Upperside: male violet-blue, with a thin black marginal band; female dark brown; uniform white fringes.
Underside: greyish white, with small black spots.
Marked with line:
Underside of the hind-wing: short tail in space 2 with a small black spot at its base on the underside.

SHORT-TAILED BLUE
Upperside: male lilac-blue with a thin marginal band; female dark brown, often with blue basal suffusion of varying extent; small orange spot at base of tail.
Underside: grey to silvery-white with small black spots.
Marked with line:
Underside of the hind-wing: small tail in space 2 with two adjoining orange and black spots at its base on the underside.

The Holly Blue often flies at a certain distance above the ground, between the trees on river banks and around thickets with holly. The other two species, on the other hand, are found above all in humid pastures and generally fly close to the ground and the legumes on which they lay their eggs. The sky-blue coloration is typical of both sexes of Holly Blue, while the dark brown coloration of the females and their small tails separate both 'short-tailed' blues from their congener. In the Provençal Short-tailed Blue there is a small black spot at the base of the tail, while in the Short-tailed Blue in the same place there are two orange spots with adjoining black spots.

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