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Cover

Detail of the upper side of the hind wing of the male of the Berger's clouded yellow, *Colias alfariensis* (photo: Jordi Jubany)

Large blue, *Phengaris arion* (photo: Jordi Jubany)

Editorial

The growing impact of climate change on our butterfly fauna

In 2021–2023 Catalonia suffered from the most severe recorded drought in recent times. Furthermore, this scarcity of rain was exacerbated by extreme temperatures, as 2022 and 2023 turned out to be the two hottest years in Catalonia since records began. According to predictive climatic models, in coming years we can expect to experience similar – or even more extreme – weather conditions. A glance at the graphs published by the Catalan Meteorological Service is enough to appreciate the magnitude of the changes in the climate that have been moving apace since the 1980s.

Ever since the phenomenon of global warming was first described, ecologists have been attempting to document and understand how it is affecting natural systems. There can be no doubt that butterflies have played a key role in research into this question ever since relevant studies began. The pioneering work by Camille Parmesan at the end of the 1990s focussing on butterflies showed how certain species have been expanding their distributions into higher latitudes and incorporating into their ranges areas that were once beyond their climatic niches. Other researchers have provided further evidence using data on altitudinal changes in butterfly populations and today records from the mountains of the Iberian Peninsula (Sierra Nevada, Sistema Central, Picos de Europa and Pyrenees) generated by teams of Spanish researchers are providing much relevant and valuable information. The abundance of historical data collated from entomological collections, along with information generated by citizen-science projects, are two further key sources of information that these studies can make use of.

The BMS monitoring programmes are ideal for documenting the impact of climate change on biodiversity. The systematic repetition of counts throughout the flight season provides researchers with a precise tool for investigating changes in butterfly phenology (e.g. advanc-

es in flight times and increases in the number of annual generations) and how they relate to changes in temperatures. Additionally, these monitoring programmes have paved the way for analyses of the impact of climate change and extreme meteorological phenomena on butterfly abundances. An important part of the research engendered by the CBMS data focusses on this question, as we have highlighted in past editions of *Cynthia*. In this edition, the section *The Butterfly* looks at the Plain Tiger, *Danaus chrysippus*, one of the species that has most benefitted from global warming. The presence of this subtropical species at our more northerly latitudes is a recent phenomenon that only dates back to the beginning of the 1980s. Since then, this butterfly has become a regular visitor to our shores and in many years at the end of summer and beginning of autumn it appears in remarkable numbers in certain parts of the country. Even though climate change has become one of the most serious threats to many of our butterfly populations, the natural world is so complex that there will always be exceptions to the general rules!

The CBMS and BMSAnd network

Situation of the Butterfly Monitoring Scheme in Catalonia, Andorra and the Balearic Islands in the years 2023 and 2024

During the thirtieth and thirty-first seasons there were, respectively, 168 and 175 active CBMS stations. In all, 26 new stations were incorporated, including a number of alpine stations that have produced records of species previously unrecorded in the CBMS network. During these two seasons, 453,092 butterflies belonging to 182 species were recorded.

The CBMS network has continued to grow and now reaches parts of Catalonia that were hitherto poorly monitored such that in 2024 there were 175 active stations giving an accumulated total of 252 stations since the beginning of the scheme (figs. 1 and 2). Despite being a less pronounced increase than in the two previous years, the 26 new stations (15 in 2023 and 11 in 2024) do in fact represent a substantial improvement in the knowledge of many species of Catalan butterflies.

The new stations include a variety of environments that have boosted the diversity included in the CBMS network (table 1).

Firstly, it is worth highlighting the increase in the number of walks over 2,000 m in the Pyrenees from just one (itinerary 97 - Pessons) to four (Covil – 2500 m in the Alt Pirineu Natural Park, Serra de la Canya – 2136 m in the Capçaleres del Ter i Freser Natural Park, and Pui Pla – 2010 m in the Aigüestortes National Park). Despite not being areas of great butterfly diversity, the species present represent an enormous advance in the study of alpine butterflies that to date were underrepresented in the CBMS network. This is the case of the ringlets, *Erebia* spp., that are abundant at these altitudes: to date eight ringlet species have appeared in these new butterfly transects: Mountain Ringlet (*Erebia epiphron*), Gavarnie Ringlet (*E. gorgone*), Piedmont Ringlet (*E. melans*), Autumn Ringlet (*E. neoridas*), Dewy Ringlet (*E. pandrose*), Bright-eyed Ringlet (*E. oeme*), Spanish Brassy Ringlet (*E. rondoui*) and De Prunner's Ringlet (*E. triarius*).

The situation of Dewy Ringlet is of great interest as, aside from being considered as Endangered in Catalonia, its appearance at Covil represents a new species for the CBMS network. The same applies to Glandon Blue (*Agriades glandon*), considered as Vulnerable in Catalonia, while at La Serra de la Canya there is a population of Marsh Fritillary (*Euphydryas aurinia pyrenesdebilis*), for which previously there were practically no data available. In Aigüestortes National Park, along with Pui Pla, a new walk has been started on the western edge of the park at Pletiu de Riumalo at 1863 m, in a series of subalpine pastures whose butterflies include an abundant population of Silver-spotted Skipper (*Hesperia comma*).

Of great interest too is the incorporation into the network of a series of walks in montane habitats in the Pyrenees and pre-Pyrenees that are some of the most species-rich of all transects in Catalonia. Senyús and La Muntanya d'Alinyà in L'Alt Urgell, a county with few itineraries but highly diverse butterfly communities, are good examples. Senyús, for example, after just two years of counts is already one of the 10 most diverse walks in the whole CBMS network and harbours populations of some of Catalonia's rarest butterflies such as Ripart's Anomalous Blue (*Polyommatus ripartii*), Dusky Meadow Brown (*Hyponephele lycaon*), Niobe (*Fabriciana niobe*) and The Hermit (*Chazara briseis*). Font de l'Arc and Campelles are two other new itineraries in the county of El Ripollès, the former in an area modified by human activity surrounded by deciduous woodland, and the latter in an area of hay meadows with a population of Alcon Blue (*Phengaris alcon*).

In central Catalonia a number of very varied sites have been added to the network. At El Torrent de la Teuleria in the county of El Moianès the clearing of swaths of forest under power lines has favoured the survival of a large number of species, including Large Blue (*Phengaris arion*). At Maians, in a mosaic of continental Mediterranean woodland and cereal cultivation habitats, the butterfly population is essentially generalist, while at Riberes de Vic in what is basically an urban walk, over 40 species have been counted including the greatest abundance of Green-veined White (*Pieris napi*) in the whole CBMS network. Further south in the county of El Priorat two new walks at the foot of the mountains of the Montsant Natural Park (Ermites de Sant Joan and Barranc de Sant Joan) have revealed the rich butterfly communities present in these calcareous mountains, including Spanish (*Melanargia ines*) and Western (*M. occitanica*) Marbled Whites, and Mother-of-pearl (*Polyommatus nivescens*) and Chequered (*Scolitantides orion*) Blues.

A number of walks in the coastal range complete the new additions to the network. Some like Celrà, Vall de Biert and Ruta de les Fonts are located in the more humid areas of Girona province, while in Barcelona province the new walks are Sant Muç, Hortus, Font de l'Alzina, Torre Salvana, Esparreguera, Riera de Sant Cugat, Céllecs and Pantà de Vallvidrera. The coastal and pre-coastal areas of Tarragona province are still underrepresented in the network, although the Parc del Mussol walk in the municipality of Amposta is a welcome addition to the network in this area. All these latter incorporations will help us understand the state of health of the butterfly populations in these Mediterranean areas.

Annual series and species represented

After 31 years of counts, many itineraries can now boast long uninterrupted annual series. In all, 85 walks now provide over 10 years of records (fig. 3), while 122 have at least eight years of records and are now used to calculate local species trends. Currently, the CBMS network monitors 5,161 populations of butterflies that are regularly present, and 2,477 that are considered to be only occasional.

The wide scope of the network provides us with records for almost all Catalan butterfly species (table 2) and to date we have data for 193 species out of the 205 recorded in Catalonia, Andorra and the Balearic Islands. An addition in 2023 was Pygmy Skipper (*Gegenes pumilio*) from the Jardí d'en Perelló walk on Mallorca. The number of species detected annually has increased regularly ever since the project began, above all in 2024 when a total of 183 species were recorded (fig. 4).

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Fig. 1. Geographical situation of all the stations that have ever participated in the CBMS (1994–2024) network, with their official number and name. Also shown are the three climatic regions used in the analysis of regional trends in Catalonia.

Fig. 2. Evolution in 1994–2024 of the number of active stations in the CBMS network.

Fig. 3. Distribution of the complete annual

series available for all the stations that have ever participated in the project. Also included are data from the stations of Rubina and Vilaut, active in 1988 and 1989, respectively, before the official start of the CBMS counts.

Fig. 4. Number of species of butterfly detected in each year of the CBMS counts.

Table 1. New stations incorporated into the CBMS network during the 2023 and 2024 seasons.

Table 2. All the butterfly species recorded from any of the CBMS stations in the past 10 years (2015–2024). Also indicated is the number of stations in which each species was recorded each year. Taxonomic order follows the criteria suggested by Fauna Europaea (www.fauna-eu.org).

Photo 1. At the foot of Montsant, abandoned vineyards have become exceptionally rich grasslands, where the Barranc de Sant Joan and Ermita de Sant Joan transects run (photo: Toni Lluçh).

Thirtieth and thirty-first years of the CBMS

Balance of the 2023 and 2024 seasons

The weather differed greatly between the years 2023 and 2024; while both were very warm, 2024 welcomed an end to the severe drought that had been afflicting the country since 2021. Although butterfly communities in general recovered from the historically low numbers recorded in 2021 and 2022, numbers still remained well below the levels recorded three decades ago at the beginning of the CBMS project. Climate change is having an obvious consequence for our butterflies and very few are actually benefitting. By contrast, many of the declines that have been recorded in recent years can probably be explained by the negative effects of the heatwaves and droughts that are having such an impact on Catalonia.

Weather and counts

The year 2023 was both the second hottest since records began and very dry, and in places accumulated rainfall totals only reached 50–70% of the annual average (see www.meteocat.com). The thermal anomaly of 1°C was easily beaten and in parts of the eastern Pyrenees and the coastal and pre-coastal mountains this anomaly approached 2°C. Winter was generally warm due, above all, to the exceedingly warm month of December 2022, but there were cold snaps in both January and February. Spring and the summer were both very warm and record temperatures were recorded in the Ebro and Fabra observatories (the second and third hottest ever recorded, respectively), both with over 100 years of data. This tendency continued throughout the summer and into the autumn, when thermal anomalies of 1.5–3°C were recorded in Catalonia. The most extreme temperatures were recorded at the beginning of March, at the end of April, in mid-July, at the end of August, and at the beginning of October. On 18 July a historical high of 45°C was recorded in parts of the Em-

pordà region. In terms of precipitation, 2023 was even drier than the previous year, above all on the coast (e.g. in the counties of El Garraf and L'Alt Empordà) where rainfall totals only reached around 30–50% of the annual average. Of note was the widespread deficit in rainfall in spring that led to a poor flowering season for many plants. For many weather stations 2023 was one of the three driest years since records began to be kept.

In 2024 the drought that had started in 2021 broke; this year was for most of the country a wet year and in parts of Tarragona even a very wet year. There was widespread rain in March, in April (coastal and pre-coastal areas in Barcelona and Girona provinces), in May (in L'Alt Empordà), in June (everywhere) and in September and October (everywhere except the north-east). Furthermore, 2024 was the third hottest year ever after 2022 and 2023, with high temperatures in mid-April (including the highest-ever April temperatures in many places), at the end of July and at the beginning of August (with heatwave temperatures over 40°C in the hottest parts of Catalonia).

In 2023 and 2024, 7.4 and 8 counts, respectively, on average were lost per station (these figures include the low-effort stations where counts are fortnightly) (fig. 1a i b). For transects walked every week (127 in 2023 and 132 in 2024), the average number of weeks per station lost was much lower, specifically 4.4 and 4.9, respectively. The lost weeks were well spread out throughout the year, above all in 2023. In 2024 there were more obvious peaks in the number of lost weeks coinciding with the rainy periods in week 1 (first week of March), week 5 (last few days of March and first days of April), week 9 (last week of April) and 30 (last week of September) (fig. 2a i b).

Changes in abundancies and species of interest

The years 2023 and 2024 saw a notable recovery in Catalan butterfly communities, which had reached all-time lows in the previous two years (Fig. 3). The recovery in 2023 compared to 2022 came as a surprise given that the drought continued for the third year in a row and extreme temperatures were constant throughout the counting period. Even so, the years 2023 and 2024 were still the seventh and eighth worst years, respectively, in the 29 years of butterfly counts (1995–2024) and overall numbers were still way below those that were recorded at the beginning of the project.

Table 1 is a summary of the data for 154 species for which population tendencies have been calculated; it also includes the number of stations where each species was counted, the time period for which the tendency was calculated, and the rate of change observed in that period. It is clear from this table that the overarching tendency is one of decline, which explains the overall poor numbers of butterflies counted in the years 2023 and 2024 (fig. 3).

For a group of around 25 species (about 15% of the species for which tendencies have been calculated), the counts in these two years were the lowest ever. These species include some that are otherwise very common in the CBMS network such as Lulworth Skipper

(*Thymelicus acteon*), Green Hairstreak (*Callophrys rubi*), Provençal Chalkhill (*Lysandra hispana*) and Common (*Polyommatus icarus*) Blues, Berger's Clouded Yellow (*Colias alfacariensis*) and all three Gatekeeper species (Spanish *Pyronia bathseba*, Southern *P. cecilia* and Common *P. tithonus*). The case of these three Gatekeepers is especially worrying since they are undergoing an obvious decline throughout Catalonia that has led to unusually low annual numbers in places where they were abundant just a couple of decades ago.

Alongside these commoner species, there are other rarer ones whose numbers in these two years also dropped to historic lows and that are also experiencing worrying regressions: Large (*Phengaris arion*), Amanda (*Polyommatus amandus*), Meleager's (*Polyommatus daphnis*), Escher's (*Polyommatus escheri*) and Ripart's Anomalous (*Polyommatus ripartii*) Blues, Marsh Fritillary (*Euphydryas aurinia*) and Western Marbled White (*Melanargia ocitania*). The numbers of all these species have fallen alarmingly in the past 10 years, a fact that shows that the factors that are negatively affecting their abundances are still operating today.

One good example is that of the Map Butterfly (*Araschnia levana*) whose numbers have fallen dramatically and continually, to the extent that 2024 was the first year in which this butterfly failed to appear in any CBMS transect. At the beginning of the CBMS project such a decline would have been considered inconceivable at a walk such as Can Jordà (La Garrotxa), where this butterfly was once one of the commonest species in the shady parts of this walk.

Just three butterflies bucked the trend in 2023 and 2024 and increased in number to reach their best-ever totals: Small White (*Pieris rapae*), Cleopatra (*Gonepteryx cleopatra*) and Mediterranean Skipper (*Gegenes nostrodamus*). All three have become much commoner than they were at the beginning of the CBMS project. The case of the latter is paradigmatic since over the past 10 years it has colonised a number of transects in both the arid and more humid Mediterranean regions and in some it may have established stable populations.

It is becoming increasingly clear that the main factor behind many of these tendencies is climate change. Habitat loss due to forest encroachment and the abandoning of traditional agricultural techniques have also played a part, even though in many cases population declines are occurring in species that are well-adapted to scrub or are found in areas in which, apparently, habitats have not suffered any change. The severe long-term droughts engendered by climate change are one of the most probable cause of these declines. Thus, the data from 2024, which saw the end to the longest and most severe drought ever recorded in Catalonia, are highly revealing. Of the 495 local extinctions that have been recorded in the CBMS network over the years, 210 occurred in 2024, an increase in the rate of extinction per butterfly walk of 2.8 to 4.4 in just one year! These calculations are based on the criterion that a species is declared extinct if it fails to appear in the counts four years in a row after having been present previously for at least four years. This figure thus cannot be

calculated until at least eight years of counts have been undertaken.

Details of the 20 dominant species in the counts in the network in 2023 and 2024 are given in Table 2. The commonest species are the generalists that appear in great number every year, and include Small White (*Pieris rapae*), Speckled Wood (*Pararge aegeria*), Iberian Marbled White (*Melanargia lachesis*), Wall Brown (*Lasiommata megera*) and Meadow Brown (*Maniola jurtina*). The Small White is on the increase in Catalonia and was for the third year in a row the commonest species in the counts. Also of note is the Wall Brown, a thermophile species that has probably been favoured by the succession of warm dry years. The situation of this species in Catalonia differs radically from its situation in central and northern Europe, where it has been on the decline for a number of years. The cause of this decline has been linked to the increase in levels of nitrogen deposition in the environment, which leads to greater density of grasses. This in turn causes a cooling of the micro-habitats in which its larvae live and eventually to a fall in survival rates.³

In comparison with the situation at the beginning of the CBMS project, the loss of the Satyrinae belonging to the genus *Pyronia* is noteworthy, as commented above. Similarly significant is the fall in the number of False Ilex Hairstreaks (*Satyrrium esculi*), a species that at the beginning of the project was often the commonest in Catalonia. The dry springs in recent years are the most probable cause of this decline given that the great surges in this hairstreak's numbers invariably occur in the wet springs that encourage sprouting in the holm and holly oaks on which its caterpillars feed.

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¹ Schmucki, R.; Harrower, C.A. & Dennis E.B., 2021. rbms: Computing generalised abundance indices for butterfly monitoring count data. R package version 1.1.0. <https://github.com/RetoSchmucki/rbms>

² Greatorex-Davies, J.N. & Roy, D.B., 2001. *The Butterfly Monitoring Scheme. Report to recorders, 2000*. 76 pg. Centre for Ecology and Hydrology, Natural Environment Research Council, Huntingdon.

³ Klop, E., Omon, B. & WallisDeVries, M., 2015. Impact of nitrogen deposition on larval habitats: the case of the Wall Brown butterfly *Lasiommata megera*. *J. Insect Conserv.*, 19: 393-402.

Fig. 1. Coverage of the counts at the different CBMS stations in (a) 2023 and (b) 2024. The 'low-effort' stations, which due to their fortnightly cycle (or monthly in initial trial years) lose up to half of the possible 30 counts, are also included.

Fig. 2. Distribution of the lost counts during the official 30 weeks (1 March–26 September) of counts in (c) 2023 and (d) 2024.

Fig. 3. Ranking of the CBMS seasons in terms of the general abundance of the 66 commonest butterflies in the CBMS network. The best season was 2002 and worst (in descending order) 2021, 2022 and 2016. Calculations were carried out using the methodology described by Greatorex-Davies & Roy (2001)² using species' annual indices calculated with the rBMS program¹.

Table 1. Evolution of the overall annual indices for 154 butterflies recorded in the CBMS network calculated using the rBMS program.¹ Also indicated are the number of stations that provided data for

each species, the initial year of the data series used to calculate trends, the annual rates of change calculated for 2023 and 2024 and for the whole period, and the population trends detected by the program.

Table 2. Number of butterflies counted and ranking of abundance of the 20 commonest species in the CBMS network in the 2023 and 2024 seasons.

Drawing 1. In the last two seasons, the population levels of Escher's blue (*Polyommatus escheri*) have been the lowest since the CBMS began (drawing: M. Franch).

Drawing 2. Some butterflies experienced high levels of population extinctions in 2024. One example is the Silver-spotted skipper (*Hesperia comma*), with 10 local extinctions in a single year (drawing: M. Franch).

Situation of the Butterfly Monitoring Scheme in the Balearic Islands in 2023 and 2024

During the thirtieth and thirty-first seasons, 21 itineraries were walked in the Balearic Islands as part of the CBMS network, on which 52,875 butterflies and 27 species were counted.

Despite the growth of the CBMS network in the Balearic Islands, no new walks were inaugurated in either 2023 or 2024. Nevertheless, 21 walks continued to be active, 12 on Mallorca, 7 on Menorca and 1 each on Eivissa and Formentera. On Menorca, two walks, Turmadèn and Son Boter, undertaken as part of a project that has since been completed, have been discontinued, while on Mallorca, the Puig d'Inca walk was inactive in 2024 but is expected to be reactivated in coming years.

The butterfly populations of the Balearic Islands (part of the arid Mediterranean region of the CBMS network) often display dynamics that differ from continental areas. For example, the effects of third successive year of severe drought that Catalonia suffered in 2023 were not as severe on the Balearic Islands and some species there even partially recovered from declines in previous years. The 'blues' are a good example: in Catalonia 2023 was the worst-ever year for the Common Blue (*Polyommatus icarus*), whilst in the Balearic Islands its sister species, the Southern Blue (*Polyommatus cecilia*), increased in number compared to the previous year. This shows how important it is to analyse trends specifically for these islands. Nevertheless, long-term data reveal declines in the populations of sedentary species such as Southern Gatekeeper (*Pyronia cecilia*), Spanish Brown Argus (*Aricia cramera*) and Meadow Brown (*Maniola jurtina*), whilst migrant and generalist species including Lang's Short-tailed Blue (*Leptotes pirithous*), Painted Lady (*Vanesa cardui*), Bath White (*Pontia daplidice*) and Holly Blue (*Celastrina argiolus*) have all increased in number over the past decade.

One of the most interesting novelties from these two years was the spread of the two *Danaus* species. In 2023 and 2024 the Monarch (*Danaus plexippus*) was noted on six itineraries in Mallorca and the Plain Tiger (*D. chrysipus*) on five in Mallorca and three in Menorca. In the Balearic Islands these two species are closely associated with the narrow-leaved cotton bush (*Gomphocarpus fruticosus*), a tropical

plant that has colonised wetland and agricultural habitats. Although the Plain Tiger had already often been recorded in the Balearic Islands, in 2022 there was a sudden increase in the number of Monarchs recorded and in 2023 at least two populations were found to have survived the winter and completed their life cycle on Mallorca.¹ Since then, whilst the Plain Tiger continues to reach the shores of the Balearic Islands in spring and summer but without establishing resident populations, the Monarch is now present throughout the year. This process is a clear example of how subtropical species, favoured by milder winters and longer summers, are spreading to more northerly latitudes.

Another highlight in the Balearic Islands in 2023 and 2024 was the observation of Pygmy Skipper (*Gegenes pumilio*), a migrant from Africa, on three walks in Mallorca: Raixa, es Jardí d'en Perelló and es Comú de Muro (the latter not during the transect counts). This species is present on Mallorca but not in Catalonia or the rest of the Spanish state and is morphologically almost identical to the Mediterranean Skipper (*Gegenes nostradamus*). Thus, some of the specimens caught on Mallorca had to be analysed genetically to confirm their identification. The Pygmy Skipper was once abundant on Mallorca² but today is extremely rare and has recently been catalogued as Endangered in Spain. Recent sporadic records suggest that small populations survive in a variety of habitats including extensive agricultural areas, marshes and even periurban areas, always at low altitudes.

Overall, the balance of this two-year period reveals the existence of a stable and increasingly well-established butterfly counting network in the Balearic Islands. The dynamics of island butterfly populations differ from their counterparts in the rest of the CBMS network, above all due to the lesser impact of drought in the Balearic Islands, the growing number of migrant butterflies that reach their shores, and the expansion of populations of subtropical species. In the future, the aim is to consolidate existing butterfly walks in the Balearics and to set up new ones, above all on Eivissa and Formentera and in areas where rare species such as Wood White (*Leptidea sinapis*), Cardinal (*Argynnis pandora*) and Pygmy Skipper, three species poorly represented in the local BMS network, are known to fly.

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¹ Rebassa, M., Tysoe, M. & Colom, P., 2023. Establiment de la papallona monarca (*Danaus plexippus* L.; Danaidae; Lepidoptera) a les Illes Balears. *Boll. Soc. Hist. Nat. Balears*, 66: 103-109.

² Fernández-Vidal, E.H., 1987. Sobre la presencia de *Gegenes pumilio* (Hoffmannsegg, 1804) en España (Lepidoptera. Hesperiiidae). *SHILAP Revista lepid.*, 15(60): 321-367.

News

Celebrating 20 years of BMS counts in Andorra

On 4 July 2025 in Sant Julià de Lòria an act was held to celebrate the twentieth anniversary of the Andorra butterfly monitoring scheme (BMSAnd). It was an emotive occasion as almost all those who have helped the project were present, along with others with an interest in the subject.

The act began with a brief talk by Andorra Recerca + Innovació (AR+I) explaining the origins and development of the BMS network, with special emphasis on those who in one way or another have helped promote the BMSAnd. Next, two experts, Jordi Dantart and Jordi Jubany, described from a scientific standpoint the diversity of butterflies in Andorra and the trends operating in their populations based on 20 years of data. Finally, the scientific coordinator of the CBMS project, Constantí Stefanescu, explained in detail the scientific value of the data obtained by the CBMS network.

The Andorran network, which began in 2006 with just three walks, has grown to incorporate 10 active walks encompassing many different habitats at a broad altitudinal gradient ranging from 900 m (Fontaneda) to 2,300 m (Pessons). This range has enabled the butterfly counters to detect 95% of the species known to fly in Andorra. From a more analytic angle, as reflected in the 2024 annual report on the BMSAnd drawn up by the Natural Sciences Museum of Granollers, the overall balance of all the years of fieldwork provides enough information for an evaluation of the local butterfly populations. In terms of abundance, butterfly numbers in Andorra have fallen by 39%, with a clear difference between open areas (fall of 51%) and more forested areas (fall of 23%). The data has also facilitated an analysis of trends in the populations of 73 species present in Andorra, of which almost 70% have declined, a drop that mirrors the patterns that have been detected in the Catalan BMS network.

The project, in which the protected natural areas in Andorra have also collaborated, has played a key part in the drafting of an initial Red List of the Butterflies of Andorra, which in turn has been instrumental in the drafting of protection plans for the most threatened species. Increasing public awareness is another keystone of this monitoring scheme. In 2012, the then Institute of Andorran Studies (now the AR+I) published the book *Les papallones diürnes d'Andorra* by J. Dantart and J. Jubany. As well, numerous excursions and walks open to all have been organized to widen knowledge of this group of insects and to explain the importance of their role as pollinators.

From AR+I we extend our sincere thanks to all those who have collaborated with the BMSAnd week in, week out over so many years. We would also like to thank the CBMS scientific assessors for helping provide this programme with a robust structure and full sci-

entific rigour. We hope to continue counting butterflies for many years to come!

Roger Carity, Clara Pladevall
and Meritxell Dalmau

Photo. Group photo during the celebration of 20 years of the BMS network in Andorra.

Habitat management and conservation

The management of Mediterranean grasslands affects the composition of butterfly communities

Processes of global change such as land abandonment and agricultural intensification that are currently affecting rural communities in Europe are an increasingly serious threat to the continent's biodiversity. Butterflies are excellent bioindicators of environmental change and help us evaluate how these processes are having an impact on traditional agricultural ecosystems, above all in agroforestry mosaics in the north-west Mediterranean where land management and nature go hand-in-hand. An analysis of the CBMS data, combined with data from a study in the Catalan Pyrenees, enables us to quantify how the intensity of management practices affect the composition and response of both plants and butterflies to these changes.

Introduction

Extensive grazing in Europe by both domestic herds and wild animals has helped configure over time a dynamic mosaic of semi-natural agroforestry habitats that experience considerable spatial and temporal change.¹ During the Neolithic, the domestication of wild animals created pastures as cattle grazed in forests and woodland was cleared near settlements. Ever since, these pastures have been subject to many significant pressures including climate change, the arrival of exotic species² and, above all, the recent expansion of forests and scrubland, the latter a consequence of both the rural abandonment initiated in the 1960s in many upland areas,³ and agricultural intensification in accessible lowland areas stimulated by technological advances.⁴ In this context of landscape transformation, traditional management based on extensive pasturing has been shown to be key in the preservation of agroforestry systems. The results of a number of studies show that the most beneficial management strategies for conserving biodiversity are those that ensure an intermediate level of impact – in agreement with the Intermediate Disturbance Hypothesis (IDH)⁵⁻⁶ – since species-richness is optimal when both competitive exclusion due to land abandonment and environmental stress provoked by overgrazing are minimised.

To understand the impact of these practices on biodiversity it is important to appreciate how butterfly populations act as bioindicators given their close relationship with the

plants they use to complete their life cycles. As adults, butterflies depend on nectar from flowers, whilst their larvae are highly specialist feeders on their chosen host plants. Moreover, vegetation structure plays a crucial role in the viability of all phases of the butterfly life cycle, a fact that makes them especially sensitive to changes in land management.⁷⁻⁹

To determine just how grazing and its intensity affects biodiversity in Catalonia, the CBMS team has recently undertaken a number of different projects whose aim is to study conjointly plant and butterfly populations. To begin, the team analysed 30 years of CBMS data on butterflies and impacts in an attempt to discern patterns in how butterflies respond to pasture management. In parallel, the team has undertaken a diagnosis of four protected areas in the Catalan Pyrenees in an attempt to analyse how different grazing intensities (using a gradient of abandonment as pastures become swallowed up by scrub and forest) affect plant and butterfly communities. Aside from management practices, another variable considered are the landscape features in the vicinity of the studied pastures, which are known to have a significant impact on both plant and butterfly communities.

Below we present two separate but complementary approximations that explain the effects of grazing on biodiversity in pastures at functional and at structural and temporal scales.

Analysis CBMS: long-term responses to grazing management

Methodology

This study used data from 1994–2021 from CBMS butterfly walks running through grazing land (fig. 1) in two climatic regions: **subalpine** (average annual temperature 9.9°C and average annual precipitation 694 mm) and **Mediterranean** (average annual temperature 16.9°C and average annual precipitation 450 mm). In these walks a total of 182 species were observed that represent most of the species present in Catalonia.

A number of annual indicators were calculated for each section of the walks using the butterfly counts. Indicators of diversity such as richness (number of species) and abundance (number of butterflies/100 m) were calculated, along with two indicators related to habitat: the TAO index (with scores running from -1 for forest species to +1 for grassland species) and the SSI index, an index that measures the degree of habitat specialization. Then, two community indices were derived for each section and each year: the CSI (Community Specialization Index) and the TAOc (community index of open vs. closed).

A number of variables were considered in order to relate these indicators to the environmental context. In terms of management, a pasture index was calculated that reflects the percentage of CBMS counting weeks with the presence of herds of cattle, and a mowing index that includes the frequency and extent that grasslands are mowed. For the vegetation, an openness index (Aperture Index or AI) was developed, which reflects the degree of openness of the habitat in terms of its plant cover.

Results and discussion

This study reveals the close ties between butterfly communities and grazing intensity (fig. 2). In general, the results partially confirm the Intermediate Disturbance Hypothesis,^{5,6,9} which predicts a fall in diversity when grazing intensity is high.¹⁰ Nevertheless, the study failed to register a decline in diversity when grazing pressure was light, possibly because none of the studied monitoring sections were completely isolated and butterflies were able to move from one area to another.

The history of land use and traditional management techniques also affects biodiversity and in Europe extensive grazing has favoured specialised butterfly communities.^{1,7} This study, undertaken in medium-to-low intensity grazing systems, detected a positive correlation between grazing and the CSI index, above all in upland areas where specialist butterfly species fly.¹¹ A decrease in grazing seems to favour more generalist species and lead to a loss of the most specialist species (i.e. those with the highest SSI and TAO values).¹¹ This positive effect of grazing on the presence of rarer species of butterflies may be due to the fact that grazing enhances structural heterogeneity and warmer microclimates, which favour these specialist species.¹² Thus, well-managed extensive grazing could be a vital element in the conservation of these butterfly communities in semi-natural pastures.

As well, butterfly responses are dependent on habitat (fig. 3). Open pastures (high AI index) have greater butterfly species-richness and abundances than forest areas (low AI levels), just as Mediterranean butterflies have a general preference for more open areas.¹³ Nevertheless, under similar grazing pressure, forest areas have suffered more obvious declines in species-richness and abundances than open areas, possibly due to a lack of trophic resources and the effects of overgrazing. This thus shows that the interaction between grazing intensity and vegetation structure is key for understanding the dynamics operating in butterfly populations and for planning conservation measures.

For more information, go to: De Gracia, C., Oro, D., Ubach, A., Jubany, J. & Stefanescu, C., 2025. Grazing and mowing practices drive complex dynamics in the structure of butterfly communities in semi-natural grasslands. *Insect Conserv. Div.*, 1-13. Available from: <https://doi.org/10.1111/icad.12828>

Pyrenean analysis: spatial response to different grazing intensities and management

Methodology

This study was performed in four areas of the Natura 2000 network in the Catalan Pyrenees: Isil, Burg-Civís, Cadí-Moixeró, and Capçaleres del Ter i del Freser. In each area three valleys were selected, and in each valley four 60 x 60-m plots (0.36 ha) were established along a gradient of plant succession reflecting the historical grazing pressure (fig. 4). Four categories of succession were established:

- OP (Overgrazing): bare soil; continued high grazing pressure.
- PR (Grazing): open pastures; moderately grazed.

- MO (Mosaic): plots with tall plants and some scrub; recently abandoned or little grazing.
- EN (Encroached): scrub-dominated; almost no grazing.

In all, 48 plots at 1,500–2,000 m a.s.l. were sampled. In each plot, plants and butterflies were studied, the latter surveyed using 500-m-long zig-zag transects in June, July and August following the CBMS methodology. Eight plots were sampled in 2022 and the remaining 40 in 2023. Plants were recorded along a 500 x 50-m transect at peak flowering time (July) and classified in terms of their abundance.¹⁴ The butterfly species detected were grouped into four ecological groups (generalists, woodland specialists, grassland specialists and nitrophiles). The plant groups included a fifth group, substrate preference (although the results from Cadí-Moixeró were excluded from this analysis due to its different geological substrata).

Results and discussion

The results of this study (fig. 5) strengthen and broaden the Intermediate Disturbance Hypothesis patterns observed in the temporal analysis. In this case, maximum butterfly and plant diversity was found in the plots managed as mosaics where the spatial heterogeneity (bare earth, low and tall vegetation, presence of bushes) creates a great variety of microhabitats suitable for species with different ecological requirements.^{9,15}

In this study, disturbance levels were found to be acting at different temporal scales: in the short term (seasonal) and in the long term (accumulated impact of grazing). It is important to note that the long-term grazing mosaic (MO) does not necessarily imply current moderate grazing but, rather, that compared to other grazing regimes the degree of disturbance is intermediate. This reinforces the idea that mosaic landscapes are ideal for conservation since they favour diversity and the coexistence of common species with others of greater conservation concern. Thus, the regulation of grazing in the long term is vital if the ecological integrity of subalpine grasslands – true biodiversity hotspots – is to be maintained.¹⁶

Conversely, both overgrazed plots (OP) and in areas encroached by vegetation due to grazing having been abandoned (EN) had lower diversity values. Overgrazing can alter the trophic interactions between larvae and adult butterflies, favour exotic species, and modify the plant composition both mechanically (trampling) and biologically (excrements).¹⁵ Grazing abandonment eventually leads to a homogenization of the biome, as tall plants (grasses and bushes) displace the specialists and grazing-resistant species,¹⁷ thereby provoking a decline in butterfly diversity.¹⁸

The overgrazing regime (OP; fig. 5) emerged as the main factor determining plant and butterfly communities and their habitat preferences since this type of disturbance tends to homogenise and simplify plant communities through selective pressures, thereby favouring ruderal, nitrophilous and grazing-resistant species.¹⁶ This type of grazing pressure has led to less plant diversity and the persistence of spe-

cies adapted to grazing (e.g. grassland and nitrophilous species).¹⁹ Conversely, in plots that have been abandoned for a long time (EN: fig. 5), grassland specialists gradually disappear and are replaced by tall shrubs and generalist species. The longer there is no management, the more these shrubs will colonise the spaces and provoke a structural change resulting in a scrub-dominated plant community.²⁰

Although these changes are clearly reflected in plant communities and their ecological groups, their effect on the butterflies was much less evident (fig. 5). The low explicative power of the models for butterflies suggests that the mobility of these species plays an important role, and species are detected outside their preferred habitats. In this study, the proximity of the plots in each valley (often just a few metres away) could have diluted the expected differences between grazing regimes. Nevertheless, the composition of butterfly communities did differ according to habitat: the mosaic and encroached plots were favoured by forest species such as Pearly Heath (*Coenonympha arcania*), whilst the mosaic but grazed pastures favoured grassland species such as Silver-studded Blue (*Plebejus argus*). These patterns reveal the cascade effect of functional plant diversity on higher trophic levels, given that butterfly diversity is closely related to plant richness, nectar availability and structural complexity.

For more information, go to: De Gracia, C., Oro, D., Ubach, A., Guardiola, M., Sanaosa-Cols, P. & Stefanescu, C., 2025. Grazing legacy shapes biodiversity: impacts on plant and butterfly communities across successional stages in subalpine ecosystems. *J. Environ. Manag.* (under revision).

Cristina De Gracia

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Fig. 1. Location of the 11 butterfly transects used in the analysis. The shape of the symbols distinguishes between the places that are only grazed (circles) and those that are grazed and mowed (triangles). The shading on the maps indicates different types of habitat. On the left, the colour of the lines indicates the percentage of grazing in each section in 2021, with different colours representing different percentages. The numbers given for each transect coincide with the original codes used in the CBMS network.

Fig. 2. Effects of grazing on species-richness and abundance, and the TAOc and CSI indices. These associations were obtained using Generalized Linear Mixed Models (GLMM) and show both linear and non-linear relationships (quadratic and logarithmic).

Fig. 3. Interaction between grazing index and the AI for species-richness, abundance and the TAOc (with its confidence interval). For richness and abundance, the relationship is quadratic, whilst for the TAOc it is linear. The dark purple colour corresponds to closed sections and the pale purple to open sections.

Fig. 4. General view of the study system, with a map of the sampling areas and a more detailed view of the

sampling sites. The grazing intensity was classified according to the structure of the vegetation (see text for more details).

Fig. 5. Box diagrams showing the effect of treatments on (a) butterfly abundance, (b) butterfly species-richness and (c) plant species-richness. The different regimes are ordered from left to right and show how the effects of herbivory decline (the regime codes are the same as in figure 4). The red dot represents the average value. The p values are taken from the pairwise comparison performed with Dunn's Test and adjusted using the Benjamini-Hochberg method. Significance: * adjusted p < 0.05, adjusted p < 0.1.

Fig. 6. Non-metric Multi-Dimensional Scaling (NMDS) diagrams showing the composition of the (a) butterfly and (b) plant communities, analysed (1) at community level and (2) at ecological group level. The grazing regimes are distinguished by colour and the valleys by shape. Data from the Cadí valley were not considered due to the composition of its substrata. The ellipses illustrate the 95% confidence level for each treatment. The stress levels are shown for each ordination (the treatment codes are the same as in figure 4).

The station

Les Planes de Son, a Pyrenean station on the edge of the Aigüestortes i Estany de Sant Maurici National Park

Located in the buffer zone around the Aigüestortes i Estany de Sant Maurici National Park in the municipality of Alt Àneu (Pallars Sobirà), this itinerary is rich in subalpine grassland species.

The walk

The Planes de Son station (CBMS-117) lies at 1,550 m a.s.l. in a basin carved out by glacial erosion. The climate is typical of upland areas, with average temperatures that range from -10.3°C in January (average minimum temperature) to 29.2°C in July (average maximum temperature), and average annual precipitation of 892 mm. The walk takes place around the installations of the MónNatura Pirineus nature centre.

This station has been active continuously since 2011 and so has accumulated 15 years of data. An initial pilot season was walked three years before data were officially started to be recorded but, given the complexity and diversity of the butterfly populations that fly in the area, it was decided that this learning period should last for longer.

Section 1 runs through a thicket of hazel bushes along the old Pussiera drover's trail, lined by dry-stone walls, in an area that has been colonised over the years by stands of Scots pine (*Pinus sylvestris*). Sections 2 and 3 pass through marshy grassland (known locally as *patamolls*), with pools of standing water and vegetation dominated by tufts of purple moor-grass (*Molinia caerulea*). Section 4 is a hay meadow, while section 5 follows a wide path bordering small areas of pasture. Sections 6 and 7 are the most disturbed; the latter follows a cement path but, nevertheless, its verges are home to many of the plants that act as food plants or sources of nectar for local butterflies. After crossing the access road to the centre,

section 8 runs along the track that ascends to the village of Son, passing across a granitoid moraine deposit covered by a stand of Scots pine on the south-facing slope. On the opposite slope one of the tributaries of the Barranc de Cabaneres is lined by riparian woodland consisting mainly of alders (*Alnus glutinosa*) and willows (*Salix* sp.), which explains the presence here of the typical butterfly species of this type of habitat. Section 9 samples a large open hay meadow. The final section runs through a large, well-preserved north-facing hay meadow with bird cherries (*Prunus padus*) whose flowers attract numerous species of insects. All in all, this walk passes through a diversity of habitats that harbour a highly interesting representation of the butterflies of this area of the Pyrenees.

The butterflies

During the 15 years of counts, a total of 102 species have been recorded, with an annual average of 57 species and 1,484 butterflies. The maximum diversity and relative abundance occur from mid-June onwards, with a peak in the weeks 21–25, when densities reach over 115 butterflies/1,000 m with on average almost 30 species on the wing simultaneously during the periods of greatest activity. The abundance of butterflies in this period is apparent from the graph in figure 1.

The dominant species include Meadow Brown (*Maniola jurtina*), generally with annual counts of over 300 butterflies, and the Iberian Marbled White (*Melanargia lachesis*), with regularly high numbers that demonstrate its importance in the local butterfly community.

A second level of abundance (over 50 butterflies per season) includes Idas Blue (*Plebejus idas*), Large White (*Pieris brassicae*) and Silver-washed Fritillary (*Argynnis paphia*). Less common but of great interest from a biogeographical and conservationist standpoint are a series of species that include Lesser Marbled Fritillary (*Brenthis ino*).

Over the past four seasons a number of occasional species have been added to the site's species list. These include Brown Hairstreak (*Thecla betulae*), an arboreal species whose presence is generally underestimated on lineal transects; Eros Blue (*Polyommatus eros*), a single male, probably originating from the alpine habitats of Tèsol where it is frequently observed; Large Ringlet (*Erebia euryale*), likewise a species originating from alpine areas; and White Admiral (*Limenitis camilla*), another arboreal species linked to deciduous forests and riparian woodland.

Grassland: how to manage for butterfly

Upland grasslands, which occupy around 58% of the area covered by this walk, are this station's most species-rich habitat. This walk passes through two types of grassland: marshy grassland, often semi-flooded and interspersed with pools of water, and hay meadows.

The phenological cycle of the butterflies is necessarily affected by the presence of snow, patches of which sometimes remain until the beginning of March. This cover gives way to an explosion of flowers, with a great diversity and abundance of taxa well-adapted to the condi-

tions at this altitude, in May-June. This abundance favours the presence of a broad range of pollinators, including many butterflies.

The extensive grazing regime also plays an important part in the ecology of the area. From May onwards, these grasslands are occupied by a small herds of cows – generally no more than 40 – that as summer progresses move uphill to graze in subalpine and alpine areas. They return in mid-September as temperatures fall. This altitudinal migration plays a key role in maintaining the structure and functional stability of these grasslands. In the case of the hay meadows (sections 5 and 6), the hay is cut by machine in the second week of August, from which point onwards there is a notable drop in the number of butterflies; nevertheless, this practice is essential if the ecological balance of the area is to be conserved. It ensures that the biodiversity of these open areas is preserved and halts scrub and forest encroachment, as is occurring in other areas where traditional practices have been abandoned.

Thus, the future of the butterfly populations in these grasslands depend on maintaining the appropriate agroecological management techniques that play such a key role in conserving the biodiversity of these upland habitats.

Francesc Rodríguez

Fig. 1. Abundance (average annual indices in 2011–2024) of the 15 commonest butterflies at the Planes de Son CBM station.

Photo. Section 9 of the walk, showing the large open hay meadow with the peaks of Tèsol and Rocablanca in the (photo: F. Rodríguez).

The station

Vallforners, a hidden gem amidst a holm-oak forest

Situated on the south-west face of the Montseny Natural Park in the municipality of Tagamanent, this butterfly walk takes in holm-oak woodland, sub-nitrophilous pastures and a series of abandoned agricultural terraces, a leftover from more intense human activity in the past. In the 12 years of butterfly counts, a total of 95 butterfly species have been registered. Nevertheless, despite this richness, in 2024 12 local extinctions were noted, which means that this is the butterfly walk in the Montseny that has lost most species.

The walk

The Vallforners station (CBMS-53) is situated at an average altitude of 661 m a.s.l. on the south-west slopes of the Montseny Natural Park Natural in the municipality of Tagamanent. It has been walked in two different periods: first in 2001–2008 but, after a long hiatus, was reactivated in 2021 and has been walked ever since. Thus, in total there are 12 years of data. The walk is 1,515 m in length and is divided into nine sections.

Vallforners is characterized by a humid Mediterranean climate, typical of montane regions, with cold winters and mild summers. The average annual rainfall is 839 mm and the average annual temperature is around 12°C, although in the hottest months of the year the maximum temperatures reach around 30°C.

The walk begins at the farmhouse of Vallforners and heads down towards the river and into the terraces, gradually being swallowed up by the encroaching forest, around Forn de Vidre, the most open area of the itinerary. Nevertheless, a number of flowering plants are still present, including marjoram (*Origanum vulgare*) and bloody cranesbill (*Geranium sanguineum*), even though brambles (*Rubus ulmifolius*) are beginning to spread and dominate.

This slope is covered by sclerophyllous woodland dominated by holm oaks (*Quercus ilex*), along with stands of ash and sweet chestnut. The scrub is dominated by tree heath (*Erica arborea*), broom (*Sarothamnus scoparius*), sage-leaved cistus (*Cistus salviifolius*), *Brachypodium phoenicoides* and therophyte grassland, along with sub-nitrophilous pastures with ovate goatgrass (*Aegilops geniculata*) and compact brome (*Bromus rubens*).

On the highest and stoniest parts of the walk appear stands of French lavender (*Lavandula stoechas*) and pioneer communities with stonecrops (*Sempervivum* sp. and *Sedum* sp.), interspersed with areas of sparse vegetation and rocky siliceous outcrops colonised by lichens. In the bottom of the valley and in humid areas near the river, there are stands of grey willow (*Salix atrocinerea*), with great horsetail (*Equisetum telmateia*), pendulous sedge (*Carex pendula*) and waysides with mesophyll herbaceous plant communities. In sections 7 and 9 there are two mud patches where butterflies come to mudpuddle. Overall, Vallforners is characterized by a mix of ruderal habitats and abandoned terraces, a reflection of the natural vegetation and traditional land use in this part of the mountains of El Montseny.

The butterflies

During the 12 years of butterfly counts at Vallforners a total of 95 species have been recorded, with an annual average of 64 species. In all, 53,495 butterflies have been counted with an annual average of 4,458.

At the beginning of the season, the temperatures are still quite low, which acts as a limiting factor for many species. The first species on the wing are some of the large overwintering Nymphalinae such as Large Tortoiseshell (*Nymphalis polychloros*) and Comma (*Polygonia c-album*). By April the first spring species appear: Green Hairstreak (*Callophrys rubi*), Panoptes Blue (*Pseudophilotes panoptes*) and Orange-tip (*Anthocharis cardamines*).

Peak abundances occur from mid-June to the end of July coinciding with the greatest species richness and the maximum availability of nectar-giving plants. Commonest is the False Ilex Hairstreak (*Satyrrium esculi*), whose exceptional densities here are some of the highest in the whole CBMS network. Other abundant species include Meadow Brown (*Maniola jurtina*), Purple Hairstreak (*Favonius quercus*), Iberian Marbled White (*Melanargia*

lachesis), Gatekeeper (*Pyronia tithonus*), Small White (*Pieris rapae*) and Silver-washed Fritillary (*Argynnis paphia*).

At times the mud patches along the walk attract numerous mud-puddling butterflies, including good numbers of Nettle-tree Butterfly (*Libythea celtis*) and Holly Blue (*Celastrina argiolus*), as well as Lesser Purple Emperors (*Apatura ilia*) in July.

Extinctions since the walk was reactivated

A notable loss of species has taken place in the past few years. Since the counts were reactivated in 2021, after a gap of 13 years, a total of 12 local extinctions have been registered. These include species such as Tufted Marbled Skipper (*Carcharodus floccifera*), Provence Orange-tip (*Anthocharis euphenoides*), Silver-spotted Skipper (*Hesperia comma*), Large Grizzled Skipper (*Pyrgus alveus*), Small Blue (*Cupido minimus*), Purple-shot Copper (*Lycaena alciphron*), Spanish Purple Hairstreak (*Laesopis roboris*), Chalkhill Blue (*Lysandra coridon*), Chequered Blue (*Scolitantides orion*), High Brown Fritillary (*Fabriciana adippe*), Marbled Fritillary (*Brenthis daphne*) and Large Wall Brown (*Lasiommata maera*).

These losses reveal a significant decline in specialist species, above all those that depend on open spaces, although some have made timid come-backs since the terraces at Forn de Vidre were cleared in 2023. Despite these management measures, a fall in both the diversity and abundance of butterflies has occurred at Vallforners, at the same time as there has been an increase in more thermophile species. The recent drought years have contributed to the regression of species such as Camberwell Beauty (*Nymphalis antiopa*) and Peacock (*Aglais io*) that are associated with more humid habitats.

These recent results place Vallforners as one of the itineraries in El Montseny with most local extinctions, a fact that highlights the need to maintain and promote the management of open spaces.

Laia Moret

Fig. 1. Abundance (without standardising to 100 m) (average annual indices in 2023–2024) of the 15 commonest butterflies counted at the Vallforners station.

Photo. The recovery of the terraces of the Forn de Vidre has been transitory. The lack of pasture has caused its closure again in just two years, making it impossible for the butterflies to truly recover on this route (photo: Laia Moret).

Projects

Butterfly gardens: how to attract butterflies to your garden

The project *Butterfly Gardens*, set up in 2023, aims to reverse the fall in numbers of butterflies and other pollinators in our gardens and, at the same time, raise awareness about the loss of biodiversity. After three years of surveying, the project now has almost 300 registered users. Butterflies have been counted in nearly 165 gardens, during which time 12,500 pollinators have been recorded, of which almost 9,500 are butterflies belonging to 87 species.

The project

World biodiversity in general and the numbers of pollinating insects in Catalonia in particular are declining. Urbanisation, habitat destruction, climate change, agricultural intensification and the arrival of exotic invasive species are just some of the causes of this fall. This phenomenon is especially evident in built-up areas, which is also where public concern about this trend has been most voiced in recent years.

For many years, gardens have been seen merely as ornamental and decorative spaces with no natural value or role to play in local ecosystems. Pesticides and herbicides are often used and exotic plants that alter the surrounding ecosystems are freely planted. However, despite this, gardens can function as key allies in connecting and creating faunal refuges in urban and periurban areas. The project *Butterfly Gardens* aims to create a network of active gardens throughout Catalonia that will boost biodiversity in built-up areas and help reverse the decline in butterfly populations in Catalonia and the Balearic Islands.

The project also contemplates monitoring the butterflies and other pollinators present in gardens, thereby contributing to improving knowledge of these insects in our towns and cities. It provides volunteers with resources and recommendations including (a) not using insecticides and herbicides in gardens; (b) not cutting the grass too often — given that long grass and the so-called ‘weeds’ favour the creation of micro-habitats that are refuges and food for many butterflies and other insects; (c) planting local species of plant to avoid the spread of invasive exotic species; and (d) diversifying the choice of plants to guarantee the presence of flowers and thus food for pollinators throughout the year. A list of food plants for both adults and larvae that are most used by the commonest butterflies in our gardens — based on CBMS data from the past 30 years — has been prepared.

Coordinated by the Natural Sciences Museum of Granollers, the project was initiated in 2023 with a pilot programme in 37 schools and colleges as part of the Catalan government’s *Escoles Verdes* (‘Green Schools’) programme. The following spring the project was opened up to the general public. Currently, the project also receives support from Àltima,

the Ballena Alegre campsite and the Foundation Beta of the University of Vic.

How to take part

This project is open to everyone and all participants can decide on their degree of commitment. The first step is to create a butterfly garden by developing or even starting from scratch a space favourable for butterflies and other pollinators following the recommendations of the project. You can then register it on our web site. These gardens can be as big or as small as you wish, although the minimum recommended size is 20 m². Nevertheless, even a small balcony or terrace can take part in the project. Every little space helps!

Next, you should monitor all the butterflies in your garden by counting them for a period of just 15 minutes. As well, you should note down all the interactions you observe between butterflies and plants, and the plants in flower at that moment. This protocol is an adaptation of the 15-minute counts promoted by the European BMS network but does not use the mobile application that this organisation has developed.

The monitoring frequency can be as often as you wish depending on the time of year. Nevertheless, we recommend weekly counts whenever possible between March and September. Just as in the CBMS butterfly counts, you should count in the morning on a sunny day, between 9 a.m. and 3 p.m. (depending on the time of year). You can also note down casual observations without needing to do a 15-minute count. The organizers of the project will validate your sightings once they are uploaded onto the web site and help resolve any doubts regarding identification that may occur during your surveys. Finally, the project also provides volunteers with plenty of material and training to encourage people to get involved and help with identification.

Thus, whether you have just a small garden or work for a large university or a town council, why not get involved and help favour the biodiversity of our towns and cities?

The network: results 2023–2024

By the end of 2024 there were 156 people and 96 gardens registered on the project’s web site: 42 gardens in educational establishments, 44 private gardens and 10 public gardens (fig. 1). In all, 48 surveys took place in these 96 spaces registering a total of 4,244 pollinators corresponding to 71 species, of which 3,712 were butterflies (62 species), 498 Hymenoptera (7 species), 10 Diptera and 6 Coleoptera. The most observed species were Small White (*Pieris rapae*, n=919 in 32 gardens), Speckled Wood (*Pararge aegeria*, n=566 in 23 gardens), Large White (*Pieris brassicae*, n=421 in 20 gardens) and honey-bee (*Apis mellifera*, n=260 in 6 gardens).

The garden with most counts and interaction with plants was that of Can Planes, where 25 surveys, during which 600 insects belonging to 55 species were recorded, were carried out in 2024. For 578 insects, behaviour of interest was recorded and, for example, 380 insects were noted to be taking nectar from flowers. Data from this garden regarding butterfly-plant interactions show that statistically

the most popular plants for butterflies were purple-coloured flowers ($p=0.0039$) such as marjoram (*Origanum vulgare*) and lavender (*Lavandula latifolia*).

Caterpillars were also found in some gardens, which shows that certain butterflies complete their life cycles there. Examples include eggs laid by Lesser Purple Emperor (*Apatura ilia*), Two-tailed Pasha (*Charaxes jasius*) and Southern Scarce Swallowtail (*Iphiclides feisthamelii*), and caterpillars belonging to Large White and Common Swallowtail (*Papilio machaon*) found in various different gardens.

The project celebrated its third birthday in September 2025 and during these initial three years 165 gardens were registered with the project and 12,500 pollinators were counted, of which almost 9,500 were butterflies belonging to a total of 87 species.

The project continues to grow and we hope to derive interesting results in coming years. Why not join in? For more information, go to the website of the project: www.jardinsdepallones.org.

Clàudia Pla-Narbona

Fig. 1. Gardens taking part in the project in 2024.

Drawing. Model butterfly garden, from the guide "How to Design a Butterfly Garden" (Drawing by David Riera).

The butterfly

The Plain Tiger *Danaus chrysippus*, a tropical butterfly that has become ever commoner on our shores

Two of the most spectacular butterflies present in our region are, without doubt, the two members of the genus *Danaus*, the Plain Tiger (*D. chrysippus*) and the Monarch (*D. plexippus*). Although observations of the Monarch – which has now become established on the island of Mallorca – have become more frequent, it is the Plain Tiger that is observed almost every year in our coastal wetlands, often abundantly so in the months of August, September and October. Benefitting from climate change, this butterfly of tropical origin has become a regular visitor to our shores and is able to establish temporary populations using both native and exotic invasive plants as their host plants.

Geographical distribution and situation in the CBMS

The Plain Tiger is widely distributed in subtropical and tropical regions of the Old World¹ and in recent decades has been recorded increasingly frequently on the northern shores of the Mediterranean. In the Iberian Peninsula, where the first observations of this species date back to the 1980s,^{2,3} it has become a habitual visitor to parts of the Spanish Mediterranean coast, including Catalonia and the Balearic Islands.⁴ In other parts of the northern Mediterranean in France, Italy, Croatia, Albania and Greece, it has taken longer to be detected

but is now also regarded as a regular visitor.⁵ Its northwards expansion in the Mediterranean region is related to its powerful dispersal capacity and its migratory behaviour.^{6,7} This expansion has also been given an impulse by climate change, which has widened the thermal niche in which tropical species can survive nearer the poles⁸ and modified habitats (i.e. colonisation by invasive host plants⁹).

Most of the Plain Tigers that reach the Iberian coast and the Balearic Islands originate from where this butterfly is well-established in North Africa (Morocco, Algeria and Tunisia), both along the coast and inland, even in isolated oases in the middle of the Sahara. Throughout this region – and also in the Canary Islands – this species has permanent populations that survive year-round.¹⁰⁻¹² By contrast, in the Iberian Peninsula and the Balearic Islands it only appears regularly in the summer and autumn, where its numbers depend on the annual arrival of butterflies from its African populations. Nevertheless, this situation could change in the future as winters become milder due to the effects of climate change.⁴

In the CBMS counts, the Plain Tiger has been detected at 16 stations, half in Catalonia and half in Mallorca and Menorca (fig. 1). It appears most regularly on itineraries walked in the main coastal wetlands (Ebro Delta, Aiguamolls del Delta del Llobregat, Aiguamolls de l'Empordà and S'Albufera de Mallorca). Depending on the year, in these areas the Plain Tiger can be abundant and may even be the commonest species in the months of September and October. Beyond these areas, it is far more irregular and only appears when dispersing at the end of summer (see below).

Habitats and food plants

The Plain Tiger is an extremely mobile opportunist species that has a great capacity for finding sites where its food plants grow. In the western Mediterranean and north-west Africa as many as nine larval food plants have been documented, all belonging to the subfamily Asclepiadoideae of the family Apocynaceae.⁴ Of these nine species, four have been recorded in the Iberian Peninsula and the Balearic Islands, the other five being only found in desert habitats in North Africa. In Catalonia, its main food plant is a vine swallowwort *Cynanchum acutum*. This climber is native to the Mediterranean, where it lives in humid sandy habitats, above all in coastal marshes where it can be locally abundant, and penetrates inland along rivers, canals and other water courses. This species is the main food plant of this species in Catalonia, both in the Ebro Delta and the Aiguamolls de l'Empordà. Occasionally, it also uses the narrow-leaved cotton bush *Gomphocarpus fruticosus*, an exotic invasive plant originating in southern Africa and well-established in the outskirts of Barcelona. This species is the main food plant used in the Llobregat Delta and on Mallorca, generally in abandoned fields. On Mallorca there are also observations of larvae on tropical milkweed *Asclepias curassavica*, another exotic species originating from tropical America but which is rare in Catalonia. This plant, nevertheless, is the main trophic resource for the Plain Tiger populations in Andalusia¹³ and northern Mo-

rocco,¹⁴ where it is common in wadis and humid coastal pastures. The fourth documented food plant in Catalonia is bladderflower *Araujia sericifera*, another invasive plant originating in South America that has become abundant in some areas of the coast and hinterland in Catalonia. However, despite its abundance, the observations of the Plain Tiger on this species are rare, which suggest that it is only a secondary resource used by this butterfly.

Phenology and biological cycle

The Plain Tiger is a polyvoltine species with a continuous biological cycle. In North Africa and the Canary Islands adults are on the wing throughout the year.⁴ Nevertheless, there are peaks of abundance in autumn and then in winter in the most desert-like habitats, and in spring in northern Morocco (fig. 2). The first observations of the year in Catalonia often coincide with an influx of warm winds blowing from Africa, which suggest that these butterflies use tailwinds to disperse from their birthplaces.¹⁵ Subsequently, in summer and at the beginning of autumn there are a further two or three peaks in numbers (more marked in some years than others) that correspond to local emergences. Nevertheless, these generations are never completely temporally separate from one another and clearly overlap.

The period of maximum abundance at the end of summer and beginning of autumn coincides with a characteristic feature of the biology of this species in Catalonia and in the rest of the Iberian Peninsula, that is, the increase in dispersive phenomena within the territory. This dispersal, which takes place inland from the coast, gives rise to temporary colonies strongly associated with river valleys,⁴ as has been repeatedly observed in both the Ebro and Guadalquivir rivers.¹⁶⁻¹⁷ This phenomenon is probably due to the fact that the species' main food plant in the Iberian Peninsula, *C. acutum*, tends to be commonest in ruderal habitats along rivers, canals and in marshes adjoining cultivated areas. Thus, the appearance of the Plain Tiger in valleys probably reflects the distribution of the species' food plant. Something similar occurs in northern Morocco where many populations of the Plain Tiger are found in wadis where *A. curassavica* is abundant.

This late summer and autumn dispersal is also a characteristic of the Monarch *Danaus plexippus* populations in the south of the Iberian Peninsula, which depend above all on *A. curassavica* and *G. fruticosus*.^{7,13,18} At the end of summer the density of larvae can be so high that plants are left completely defoliated, which obliges the adults to disperse to secondary areas in search of food plants.^{13,18} A similar phenomenon occurs with the large Monarch population in the Ullals de Baltasar in the Ebro Delta that is associated with the plant *C. acutum*.¹⁹

Once the female has chosen a suitable food plant, she places her eggs one-by-one on the leaves or stems, often laying more than one egg on each plant (Plate 1b). The caterpillars hatch after a few days (Plate 1c) and, during their development (Plate 1d), they go through five different instars. Typically, they have black and white transverse bands, with yellow spots; however, we also find very dark, yellowish or even completely green individuals (Plate 1e).

Next, the exclusive consumption of plants from the subfamily Asclepiadaceae, which contain toxic sap, induces remarkable feeding behaviors in the caterpillars. For example, before feeding on the leaf, they position themselves at its base and cut off part of the petiole with the aim of limiting the entry of toxic sap into the leaf tissue.²⁰ This behaviour is not exclusive to the genus *Danaus* as it has been observed in other Lepidoptera that also feed on toxic plants.

Once fully grown, the caterpillars often abandon their food plant and search for somewhere well-hidden to pupate, even though in populations with abundant trophic resources it is relatively easy to find the chrysalis on the plant on which the caterpillar has fed or on the nearby vegetation. Pupae also have a variable coloration, ranging from light brown to green, with golden dots and black and golden lines (Plate 1f). It has been hypothesized that the color of the pupa is determined by the environment in which the larva pupates, but future studies are needed to confirm or deny this. The adult butterflies, which emerge a few weeks later, appear as one of two morphs: the form *chrysippus*, which is the most abundant in Catalonia, the Iberian Peninsula and North Africa (Photo 1) or the form *alcippus*, much rarer in Catalonia and originating in central-west Africa, which is distinguished by its white hindwings (Plate 1g).¹ This species may have other morphs as yet not recorded in the Iberian Peninsula that are restricted to regions such as southern Africa and Asia.

Adult behaviour

In Catalonia, adults nectar on a wide range of plants including alfalfa (*Medicago sativa*) and the flowers of their larval food plants such as *C. acutum* and *G. fruticosus*. Conversely, when few nectar-bearing flowers are available (and in summer and autumn), yellow fleabane (*Inula viscosa*) is the main plant used, above all in coastal wetlands. As well as nectaring, male Plain Tigers spend many hours looking to acquire plant compounds known as pyrrolizidine alkaloids (PA) that they need to be able to synthesize their sexual hormones (crucial for breeding) and for protection against predators (see below).¹ They obtain these substances by nectaring certain flowers that have nectar enriched with PA, but also by feeding on decomposing plant matter or, even, dead insects. For example, in the Ebro Delta groups of various males have been observed feeding on the withered flowers of the plant European heliotrope (*Heliotropium europaeum*).¹⁹ Males combine patrolling (Plate 1a) and territorial behaviour when searching for females. Once mating begins (which can last up to five hours), the male transmits the pyrrolizidine alkaloids to the female via his spermatophores.¹ Likewise, they can also exhibit aggressive behaviour towards other Lepidoptera species. An example is the observation of a group of tiger butterfly individuals surrounding a single monarch butterfly, which was deprived of feeding on flowers and moved away from the area with nectar resources.²¹

Natural enemies

The vivid colouration of both adult butterfly and the caterpillar are aposematic, that is, they warn potential predators that they are poisonous. This mechanism is especially effective when predators have the ability to learn, as is the case of insectivore birds. After an unpleasant experience with a butterfly, the bird will remember its colour and pattern and not attempt to feed on another. For this reason, the Plain Tiger has a slow, relaxed flight that gives birds time to recognize and so avoid them.

The caterpillars acquire their toxicity via their food plants that contain cardenolides, substances that some plants synthesize as a protection against herbivory.²² When the larvae feed on these plants, they retain these compounds, which act as a chemical defence against predators. Nevertheless, in the adult butterfly these compounds are lost quickly and the pyrrolizidine alkaloids assume the role of defending the butterfly and its eggs.^{1,22} Thanks to this combination of chemical defence and visual signals, this butterfly has few potential predators compared to other non-aposematic species. Possibly, the Plain Tiger's main enemies are arthropods such as certain parasitoid dipters.²³ In Catalonia, parasitism has been detected both in the egg, by hymenoptera (Hymenoptera: Trichogrammatidae), as in the larva, caused by tachinids (Diptera: Tachinidae).²¹

Conservation

The Plain Tiger is one of the few species that currently seems to be favoured by climate change on the northern shores of the Mediterranean. The CBMS data do not show any clear tendency in its populations, essentially because there is great interannual variation in the number of Plain Tigers that establish themselves in breeding areas in Catalonia and the Balearic Islands. Nevertheless, the frequency of arrivals has increased enormously since the 1980s, which indicates that the species has become commoner in our region. Today, its disappearance in winter in Catalonia is due to two factors: the loss of trophic resources when the aerial parts of *C. acutum* wilt, and the low winter temperatures that hinder its survival at these latitudes. However, the combination of two novel elements – the presence of naturalized *G. fruticosus* plants in some areas and the trend towards ever-milder winters – could in the future allow some butterflies to survive beyond summer and autumn. Indeed, the first evidence of this change is the discovery of larvae in different stages of development on *G. fruticosus* in winter in the Llobregat Delta, and the finding of a chrysalis in March 2024 and the hatching of an adult two weeks later.⁴ This new ecological context should not pose any serious problems for the conservation of this species given that the main areas in which it establishes its colonies are all protected areas (Ebro Delta Natural Park, Llobregat Delta Natural Area and Aiguamolls de l'Empordà Natural Park). Despite this, an obvious environmental conflict arises in winter given that *G. fruticosus* is an exotic invasive plant that is expressly eradicated in some protected areas. It is thus important to rethink strategies that – to the extent that it is possible – will both

enhance the conservation of naturally arriving species and control the spread of invasive plant species.

Laura Blas, Jordi Jubany and Constantí Stefanescu

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Fig. 1. Distribution of the Plain Tiger *Danaus chrysiptus* in Catalonia and the Balearic Islands. The map has been drawn based on data from the CBMS network (up to 2024) and data the citizen-science platform *Ornitho.cat* (up to 2025).

Fig. 2. Phenology of the Plain Tiger a: (a) in North Africa and the Canary Islands (n = 3,757 butterflies, 1978–2025) using the sources compiled in Blas *et al.* (in press); (b) in Catalonia and the Balearic Islands (n = 17,671 butterflies, 1983–2024) according to records from the citizen-science platforms compiled by Blas *et al.* (2025); (c) in Catalonia and the Balearic Islands (n = 2,538 butterflies, 1996–2023) according to CBMS data.

Photo 1. Male tiger butterfly nectaring on *Lythrum salicaria*, in the Ullals de Baltasar emergency area, in the Ebro Delta Natural Park, one of the main breeding areas of the species on the Iberian Mediterranean coast. At this site, *Cynanchum acutum*, a climbing vine typical of coastal flooded areas, is the resource used by the larvae (photo: J. Jubany).

Photo 2. In Catalonia, the tiger butterfly is capable of feeding on exotic plants both in the immature stage (e.g., using narrow-leaved cotton bush, *Gomphocarpus fruticosus*) and in the adult stage (e.g., nectaring on Jerusalem artichoke, *Helianthus tuberosus*, as in the photograph). The presence of pollen grains on the proboscis and legs of this male is remarkable (photo: J. Jubany).

Plate 1. (a) two patrolling males chasing a female; (b) Egg on the underside of a *Cynanchum acutum* leaf; first- and second-instar caterpillars (c and d), with the characteristic feeding marks on *C. acutum* leaves; (e) fifth- and last-instar caterpillars, with the normal form (top photo) and two forms with other coloration; (f) pupae of the green and brown forms; (g) male of *f. alcippus* (photos: J. Jubany).

Article review

Ubach, A. & Stefanescu, C., 2025. Multispecies indicators that weight species' contribution to habitat preference: a case study using Mediterranean butterflies. *Biodiversity and Conservation*. <https://doi.org/10.1007/s1>

Grassland and woodland butterfly indicator: changes in abundances based on species' habitat preference

Multi-species indicators are able to synthesise information on tendencies in species into a value that can be used to measure long-term changes in biodiversity. The need to develop robust but informative indicators of the changes occurring in biodiversity has been demonstrated by their use in a European context in recent years. The *Grassland Butterfly Indicator* (GBI) is one of the most frequently employed and best-established such indicators and, based on data from all European BMS programmes for 17 grassland species chosen by expert criteria, is used to monitor the state of health of grassland habitats in Europe. Nevertheless, the GBI methodology has a number of methodological problems that make it difficult to apply at regional scale in EU countries: for example, the list of species does not include most of the continent's butterflies, while some of the 17 chosen species are not in fact true grassland specialists. This study, published in *Biodiversity and Conservation*, uses data from the CBMS in an attempt to resolve these difficulties and construct indicators that measure much more precisely changes occurring in butterfly abundances in Catalonia.

Since 2018 CBMS data has been used to calculate the TAO, an indicator of butterfly preference for open or closed habitats. This indicator is now available for over 150 species and is updated every year as new species are added as this counting network continues to grow. It places species along a gradient of habitat preference from open to closed, with grassland at one extreme and woodland at the other. This indicator can be used in itineraries to detect changes in butterfly populations related to scrub and forest encroachment and has been used by a number of researchers in the Iberian Peninsula to compare butterflies found in different habitats. In this article the values of this indicator – based on regional tendencies in the butterflies counted in the CBMS network – are used to weight the contribution species make to a multispecies indicator that provides information on the state of health of grassland habitats at a regional level. Specifically, data from a total of 143 species up to 2023 are used. First, the overall changes in abundance were calculated using a geometrical average of each species (each with the same weight) in a similar way to the calculations made in the GBI for just 17 species. Next, the TAO index is used to recalculate the indicator for all species but with greater weight given to species with a preference for open areas and less to those that prefer woodland habitats.

The results show declines over the past three decades in all cases, with an overall fall in global butterfly numbers of 39% if habitat is not

corrected for and 54.6% if habitat is corrected for based on a preference for open habitats (fig. 1). This process was repeated to calculate the forest indicator for all species, this time with the TAO index giving greater weight to woodland species and less to grassland species. This indicator also showed a decline but to a lesser extent, just 18.1%.

The 143 species used encompass a large part of the spectrum of Catalan butterfly species, which range from generalists to habitat specialists, and also includes endemic species and others that play a key role in understanding the dynamics of change occurring in ecosystems in the north-east Iberian Peninsula. This methodology is viable thanks to periodical and detailed botanical characterisations undertaken of the CBMS walks. Nevertheless, the TAO index only requires that butterfly data correspond to counting sections classified as either 'open' or 'closed'. This type of classification can be carried out easily and reliably by the volunteer counters as shown by a simple comparison between the TAO indices based on the detailed botanical survey and those based on the simple classification made by the counters. This implies that the methodology used can be applied to any butterfly monitoring project that establishes simple habitat categories for the areas they study, which is essential if areas throughout Europe are to solve the problems arising from the limitations inherent in the GBI. Currently, the GBI is one of the indicators that the EU member states are obliged to use in their reporting under the terms of the Nature Restoration Law. This methodological article represents a step forward towards constructing robust biodiversity indicators that can be used throughout Europe whatever the context

Andreu Ubach

Fig. 1. Results of the CBMS multi-species indicators.

Identification

How to separate the species of the genus *Pyrgus* (1)

There are 10 species of the genus *Pyrgus* in Catalonia. Despite the confusion they can provoke, there are a series of unmistakable features that, along with habitat and phenological considerations, can greatly help separate these species. In this first datasheet, we look at the only three species that are present in true Mediterranean environments: Common (*Pyrgus malvoides*), Oberthür's (*Pyrgus armoricanus*) and Rosy (*Pyrgus onopordi*) Grizzled Skippers. The remaining species are found in and around the Pyrenees, pre-Pyrenees and other mountainous areas where, nevertheless, the first two of the species described here can also appear.

The Southern Grizzled Skipper (*Pyrgus malvoides*) is widely distributed in Catalonia and is only absent from the large agricultural plains (Plana de Lleida, Empordà and Camp de Tarragona/Ebro Delta). It flies in sunny but somewhat humid habitats, being com-

mon in both woodland clearings as well as in more ruderal areas wherever its main food plant, creeping cinquefoil (*Potentilla reptans*), is found (it may use other food plants such as bramble *Rubus* spp.). It is polyvoltine and is the only *Pyrgus* that flies in the month of March. Oberthür's Grizzled Skipper (*Pyrgus armoricanus*) is also found in lowland habitats, although there are few records at over 1,000 m. It inhabits open areas including pastures, croplands and ruderal areas. Its known distribution probably underestimates its real presence as it can be difficult to identify. It too uses creeping cinquefoil as a food plant, as well as other cinquefoil species (*Potentilla* spp.). It has various annual generations but is commonest in summer. Finally, the Rosy Grizzled Skipper (*Pyrgus onopordi*) is found in open xerophile habitats in both lowland and more mountainous areas. There are local populations in the Montsant-Prades mountains and in various places in the pre-Pyrenees, and has occasionally appeared in other areas. Its larvae feed mainly on rock-roses of the genus *Helianthemum* but will also use creeping cinquefoil and certain species of mallow. It has more than one annual generation depending on the area and has been recorded from the end of April to September.

Jordi Faus and Andreu Ubach

Drawings

PYRGUS MALVOIDES

No apparent sexual dimorphism in any species of the genus

Marked with a line

- Obvious white post-discal spots
- Dark background that makes the white markings stand out
- White mark with oblique proximal edge
- Reddish ground

PYRGUS ARMORICANUS

Marked with a line

- Post-discal spots visible but not completely white
- Pale background colour with numerous grey scales
- Clear veins and straw-coloured background
- White mark with straight proximal edge

PYRGUS ONOPORDI

Marked with a line

- Generally large white mark
- Generally conspicuous white markings
- Sinuous mark
- Anvil-shaped mark
- Dark background with grey hairs at base of wing
- Pale veins, straw-coloured background

Pyrgus (Hesperiidae) species are characterized by patterns of white spots and markings on a dark background with chequered wing edgings. The Southern Grizzled Skipper has on its upperwing bright white markings that are relatively large compared to the size of the small white post-discal spots that almost join into a line. The submarginal band of white spots is often very evident on both fore- and hindwings. The underside is usually red-brown, with

clearly marked veins. The white mark on the hindwing in the discal area usually has an oblique proximal edge and is slightly pointed.

Oberthür's Grizzled Skipper has a greyish upperside, with large discal markings on the hindwing that are not completely white. The submarginal band of white marks is usually present on the hindwings but not on the forewings. The underside ground colour is yellowish with clearly marked veins and a discal mark with a straight proximal edge. The underside of the hindwing has a mark in E2 that leans slightly towards the basal area.

Rosy Grizzled Skipper has white hairs on the upperside, above all in females. The spots are generally conspicuous with a large postdiscal mark in E7 on the hindwing, although this may be poorly marked in some butterflies. The underside is orange-yellow, with an anvil-shaped discal mark, often outlined in black. On the underside of the hindwing, there is a sinuous discal mark in space E1, also often outlined in black.

Identification

How to separate the species of the genus *Euphydryas*

In Catalonia there are two *Euphydryas* species, Marsh Fritillary (*E. aurinia*) and Spanish Fritillary (*E. desfontainii*). The former has two well differentiated subspecies, one found in Mediterranean areas and the other flying in the Pyrenees. Despite being well widely distributed in Catalonia and Andorra, the Marsh Fritillary is declining rapidly throughout and is becoming ever scarcer. The Spanish Fritillary is a much more local species and is found above all in central Catalonia.

The Marsh Fritillary is found from sea level up to alpine habitats at almost 2,500 m a.s.l.¹⁻² There are, however, notable habitat-dependent differences in its morphology and ecology. The subspecies *beckeri*, characterised by its bright orange colour, lives in Mediterranean environments where it lays its eggs on honeysuckles (mainly Mediterranean *Lonicera implexa* and Etruscan *L. etrusca* honeysuckles). The subspecies *pyrenesdebilis*, smaller, darker and less brightly coloured, is found in subalpine and alpine habitats in the Pyrenees where it flies in both humid pastures (feeding on devil's-bit scabious *Succisa pratensis*) and higher dry pastures (feeding on trumpet gentian *Gentiana acaulis*). Occasionally, it lays its eggs on other food plants including field scabious *Knautia arvensis* and small scabious *Scabiosa columbaria*. Despite being known from many Catalan counties and Andorra, it has seriously declined in recent years and is currently much rarer than it once was. The Spanish Fritillary is a specialist feeder on the calcicole white scabious *Cephalaria leucantha*, generally at 500–1000 m in the Lleida and Barcelona pre-Pyrenees, the Central Altiplains, and a few

pre-coastal ranges in Tarragona province.³ Both species are univoltine and fly in May and June (more rarely in April and July in the case of Marsh Fritillary). They lay batches of up to a few hundred eggs and the caterpillars that hatch initially live gregariously in obvious silken webs. They begin hibernation in their fourth instar at the base of their food plants but reappear at the end of winter/beginning of spring and adopt a solitary lifestyle whilst they complete their final two instars.

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¹ Stefanescu, C., 2010. "Euphydryas aurinia, una papallona amb adaptacions ecològiques diverses". *Cynthia*, 9: 18-22.

² Stefanescu, C., 2019. "Ondas rojas europea (*Euphydryas aurinia* (Rottemburg, 1775)). In: Bases para la conservación de los lepidópteros amenazados en España (Jubete, F., coord.). Asociación de Naturalistas Palentinos, pp. 67-82.

³ Vila, R., Stefanescu, C. & Sesma, J.M., 2018. *Guía de camp de les papallones de Catalunya*. Lynx edicions.

Drawings

EUPHYDRYAS AURINIA BECKERI

Upperside: orange, with black and yellow bands; females slightly bigger than males

Underside: similar to the upperside but with numerous pale yellow spots

Marked with a line

- Orange marginal spots
- Marginal spots are paler orange or even pale-yellow.

EUPHYDRYAS AURINIA PYRENESDEBILIS

Upperside: less bright, with broader black bands; clearly smaller than *E. a. beckeri*

Underside: like the upperside, but less bright and poorly contrasting tones

Marked with a line

- More obvious dark bands.

EUPHYDRYAS DESFONTAINII

Upperside: orange with prominent black and yellow bands; the female is bigger than the male

Underside: like the upperside but with larger, more obvious yellow spots

Marked with a line

- Very evident, black-bordered yellow marginal spots
- Very visible black post-discal spots

The Spanish Fritillary is similar to the *beckeri* subspecies of the Marsh Fritillary but can be separated by the characteristic black post-discal spots on the underside of the fore-wing, and by the evident black-bordered yellow spots on the upperside of the fore-wing. The two species can share habitat on calcareous substrata where white scabious and honeysuckle grow together, and may be on the wing at the same time. The *pyrenesdebilis* subspecies of the Marsh Fritillary only flies in upland habitats in the Pyrenees at the end of spring/beginning of summer. Its small size and dark appearance are distinctive. Nevertheless, in some montane and subalpine areas butterflies occur possessing intermediate characteristics between *beckeri* and *pyrenesdebilis*.