

RECOVERY PLAN
FOR THE ANDALUSIAN ANOMALOUS BLUE
Polyommatus violetae



Butterfly Conservation Europe

SPECIES RECOVERY PLAN

FOR THE ANDALUSIAN ANOMALOUS BLUE

Polyommatus violetae

Miguel L. Munguira^{1,2}, José Miguel Barea-Azcón³, Sara Castro¹, Javier Olivares⁴ & Svetlana Miteva²

1. Universidad Autónoma de Madrid
2. Butterfly Conservation Europe
3. Agencia de Medio Ambiente y Agua, Andalusia
4. IES Vega de Atarfe, Granada

Butterfly Conservation Europe
P.O. Box 506, NL-6700 AM Wageningen
Telephone: +31-317-467320
Email: info@bc-europe.eu
Homepage: www.bc-europe.eu



This project is implemented in cooperation with :

University of Madrid / Universidad Autónoma de Madrid
Facultad de Ciencias, Departamento de Biología
Cantoblanco, 28049-Madrid
Telephone: +34-91-4978282
Email: munguira@uam.es
Homepage: www.uam.es



Dutch Butterfly Conservation / De Vlinderstichting
Postbus 506, 6700 AM Wageningen
Telephone: 0317-467346
Email: info@vlinderstichting.nl
Homepage: www.vlinderstichting.nl



Parque Nacional y Parque Natural de Sierra Nevada
Ctra. Antigua de Sierra Nevada, Km. 7
18071 Pinos Genil (Granada)
Telephone: +34- 958 980 238
Fax: 958 026 310
E-mail: pn.snevada.cma@juntadeandalucia.es



Preferred citation:

Munguira, ML, Barea-Azcón, JM, Castro, S., Olivares, J., Miteva, S. 2015. Species Recovery Plan for the Andalusian Anomalous Blue (*Polyommatus violetae*) . Butterfly Conservation Europe.

Keywords: Conservation, threats, Spain, endemic species, endangered species.

With the financial support of MAVA FONDATION POUR LA NATURE



Contents

INTRODUCTION	7
IDENTIFICATION	8
IMMATURE STAGES	9
TAXONOMY	10
DISTRIBUTION	10
HABITAT	11
BIOLOGY	13
POPULATION	15
COSERVATION	16
THREATS	17
SPECIES ACTION PLAN	20
LEGAL PROTECTION	20
CONSERVATION MEASURES	20
ACKNOWLEDGEMENTS	28
LITERATURE	28

Introduction

This document presents a summary of all the information available for *Polyommatus violetae* and the results of the field studies carried out during the field seasons of 2012 and 2013. It includes also unpublished data from the authors and collaborators.

Species Recovery Plans (SRPs) are documents which bring together relevant information about a given endangered species, present an analysis of the threats that the species is facing, and list actions needed to reverse these threatening factors. If successful these actions will help protect the species from extinction and greatly improve its conservation status. SRPs are vital tools for the conservation of highly threatened animal and plant species. However, in Spain, recovery plans have never been produced for species of the Lepidoptera order, and therefore one of the aims of this document is to fill this gap and provide for the first time guidance for the conservation of threatened endemic butterflies.

This Species Recovery Plan is part of the Species Recovery Program of Butterfly Conservation Europe. The work on *Polyommatus violetae* has received the financial support from MAVA Fondation pour la Nature within a project to produce a SRP for the endangered endemic species living in Spain: *Euchloe bazae*, *Agriades zullichi*, *Polyommatus (Plebicula) golgus* and *Polyommatus violetae*.

The production of this SRP involved three steps. First, we gathered all the information available for the species in the form of scientific papers, distribution records and chapters of Red Data Books or reports. Second, fieldwork was planned to visit most of the habitats of the species and record information about threats and the ecology of the species. Finally, we discussed possible conservation actions with conservation experts and landscape managers during a workshop in 2013 and visited relevant National and Natural Parks, in which we developed measures with park officials. During the fieldwork the following data were recorded for each population of the species: name of the locality, date, geographic coordinates, altitude, geological substrate, number of adults on transect counts, larval food plant density, aspect, threats and vegetation type. Photographs were also made from all the places where the presence of the butterfly was detected and from any relevant habitat feature.

The document is divided into three main sections. The first section summarizes the available information for the species and shows new data gathered during the project. A second section deals with information that is relevant for the conservation of the species, particularly an analysis of the threats that have been mentioned for the species and those that were detected during fieldwork. The final section explains in detail the specific actions that are proposed for an improvement of the species' conservation status. At the end of the document there is a comprehensive list of references and an acknowledgement section.

Identification

Wing morphology

The length of the forewing is 12-18 mm.

The male has a brown upperside, with darker veins and paler fimbriae. The underside is pale brown or greyish, with very visible postdiscal spots in subspecies *subbaeticus*, but that can be reduced in some specimens of subspecies *violetae*, especially in the hindwing. Both submarginal marks and the postdiscal spot in E6 can be absent or poorly defined. In many individuals there is a white stripe along the vein M3.

The *upperside* of the wings has a similar colour in females and males. In the hindwings, females have dark marginal spots bordered by light orange lunules (Fig. 1). The underside is darker than in the male. In the forewings, the postdiscal spots can be quite large, and the submarginal marks, as in the males, are reduced in the forewing and can be absent in the hindwing. The white stripe on M3 can be present also in females, but is more pronounced in males.

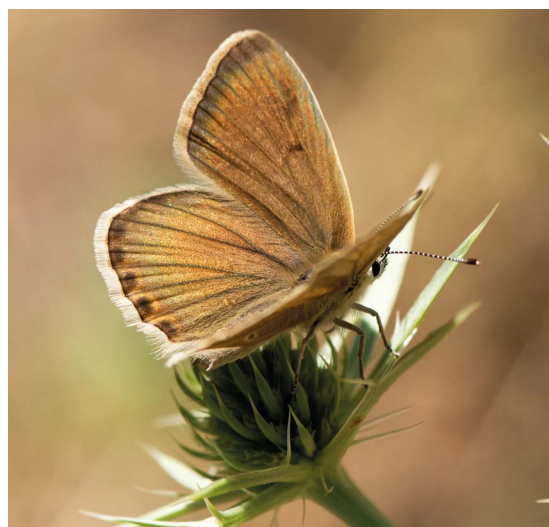
Morphologically *P. violetae* is very similar to *P. fabressei*, but a molecular study (Vila et al. 2010) shows that they are not conspecific and not even closely related species. *P. violetae* can be distinguished from *P. fabressei* in most cases by the following characters:

- Black spots in the upperside of the hindwing are larger in *P. fabressei*, while they are smaller or vestigial in *P. violetae*.
- The white stripe in the underside of the hindwing is less marked in *P. fabressei* than in *P. violetae*.
- The upperside and underside colour in females is lighter in *P. violetae* than in *P. fabressei*.

Polyommatus violetae has two subspecies:

- *P. violetae violetae* in which the spots on the underside of the hindwings are reduced and the white stripe is noticeable in 70-80% of the specimens. Postdiscal spots on the underside can be absent or vestigial, especially in the hindwing.
- *P. violetae subbaeticus* the white stripe is noticeable in most specimens, but in many of them it is dim. Postdiscal spots on the underside are patent.

Figure 1. A. Female *Polyommatus violetae subbaeticus* from the Sierra de Alcaraz showing the upperside of the wings (photo R Pérez). B. Mating pair of *P. v. subbaeticus* from La Sagra (Granada) in which the female (left) lacks the white band of the hindwing underside (photo JP Cancela). C. Mating pair (female on the right) of *P. v. violetae* in Sierra Nevada (photo JM Barea-Azcón).



A



B



C

Genitalia

The male genitalia do not show distinctive characters and has a morphology that is very similar to other *Polyommatus* species. The female genitalia have not been properly compared with other close relatives.

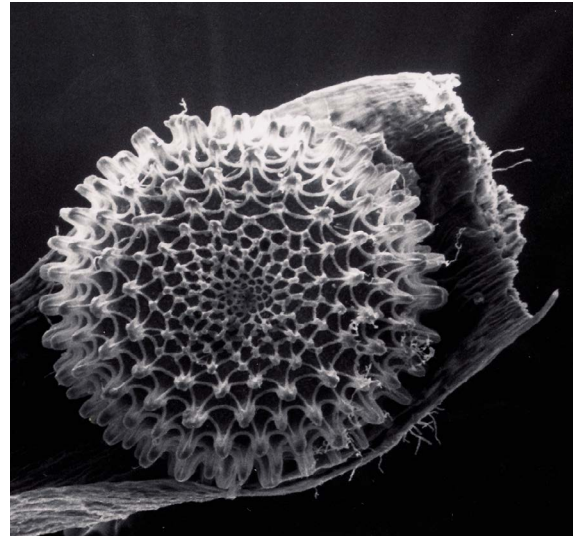
Haplotype

Haplotype has been studied from populations in La Sagra, Almirajara and Cazorla and has $n = 90$, with two large and one medium-sized bivalent chromosomes. This haplotype is similar to *Polyommatus fabressei*.

Immature stages

The average size of THE EGG is 0.68 mm. It is very pale green when laid, but later turns to white and its micropylar pole is flattened. The annular zone surrounding the micropylar rosette is reduced, and the tubercle-aeropyle area is formed by triangular cells forming hexagonal patterns (Fig. 2) and large tubercles of star section.

Figure 2. Scanning electron microscope photograph of the egg of Polyommatus violetae from Sierra de Cazorla, Jaén (photo ML Munguira & J Martín).



There are five larval instars. The larva, in THE FIRST AND SECOND INSTARS, has a black head and is about 1 mm long, with a dorsal black dotting. In THE THIRD INSTAR its length reaches 5 mm and shows faint yellowish lateral stripes and hairy appearance. FOURTH AND FIFTH INSTARS have a pale green colour with a dorsal band of darker green surrounded by yellow stripes and several oblique bands that alternate dark and pale green. The lateral bands are composed by three stripes: a central line of cream colour, surrounded by two pink lines, being the upper line wider than the lower (Fig. 3).

THE PUPA is pale green with the dorsal area of the abdomen yellowish. On each side of the abdomen there are two red lines, visible only until the pupae turns to an almost uniform brown colour. The average size is 11 mm long and 4 mm wide.

Figure 3. Final larval instar of Polyommatus violetae attended by ants of the species Plagiolepis pygmaea in La Sagra, Granada (Photo MG Muñoz-Sariot).



Taxonomy

Common name: Andalusian Anomalous Blue (English) or Velludita Parda Bética (Spanish)

Latin name: *Polyommatus (Agrodiaetus) violetae* (Gómez Bustillo, Expósito & Martínez, 1979)

Phylum: Arthropoda

Class: Insecta

Order: Lepidoptera

Family: Lycaenidae

What was previously considered a distinct genus (*Agrodiaetus*), is currently considered a subgenus of *Polyommatus*. The species was previously identified as *P. fabressei* by some authors and it shares a very similar morphology with this species. Within the genus *Polyommatus* it is included in the *P. dolus* lineage, which groups together the species *P. dolus*, *P. fulgens*, *P. fabressei*, *P. violetae*, and *P. humedasae* (Vila et al. 2010).

Two subspecies have been described:

- *P. violetae violetae* (Gómez Bustillo, Expósito & Martínez, 1979)
- *P. violetae subbaeticus* (Gil-T. & Gil-Uceda, 2005)

Distribution

The species is endemic to the Iberian Peninsula and has been recorded in Albacete, Almería, Granada, Jaén, Málaga, and Murcia provinces (Fig. 4). Comparing these data with the Atlas published in 2004 (García-Barros et al., 2004) the number of cited 10 x 10 km UTM squares has increased from 13 to 26 as a result of an increasing sampling effort. This is important from the conservation point of view, because what we thought was a species with a very restricted distribution range has proved to be present in a wider range of sites. Southern populations in the provinces of Málaga, Granada and Almería and the sierras of Tejeda, Almijara, Nevada, and Gádor have been assigned to subspecies *A. violetae violetae*. On the other hand the northern populations in the provinces of Granada, Jaén, Albacete and Murcia, present in the subbetic sierras of Cazorla, Segura, Alcaraz, La Sagra, Las Cabras, and Los Álamos are of subspecies *A. v. subbaeticus* (Fig. 4).

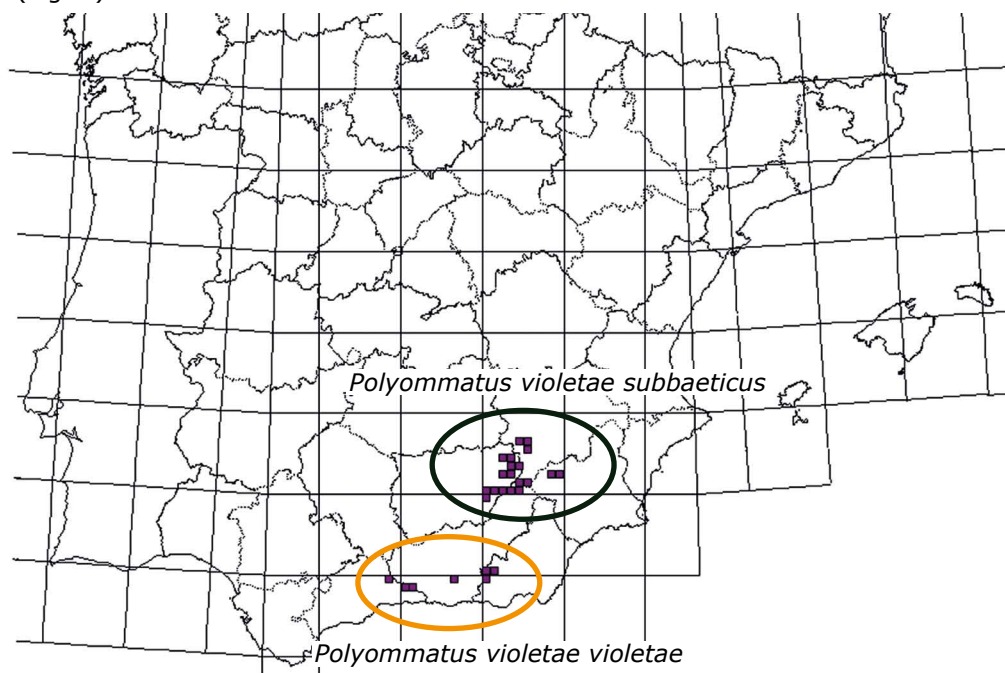


Figure 4. Distribution of *Polyommatus violetae*. Squares represent the presence of the species in 10 x 10 km UTM squares. The limits of the two described subspecies are also shown in the map.

Habitat

The altitudinal range of the visited locations is from 733 up to 2,104 m, with an average altitude of 1,460 m (data from 23 localities). The lowest locations are in Sierra de Segura, while the highest are in the southern slopes of Sierra Nevada (Fig. 5).



Figure 5. The habitat of *Polyommatus violetae violetae* in the slopes of El Almiraz, Laujar de Andarax, Almería, where open grassland is the dominant vegetation and the substrate is formed by schists (photo JM Barea-Azcón).

The habitat of the species consists in grassy areas usually surrounded by natural or planted woodlands. Only two (9%) of the 23 visited localities are open grassland areas with no tree cover, and this kind of habitat is restricted to the high areas of the eastern part of Sierra Nevada in the Province of Almería. Pines are present in 74% (Fig. 6) and holly oak (*Quercus ilex*) in 48% of the sites (Fig. 7). Nine of the localities are clearings of pine woodlands where *Pinus pinaster*, a planted species in the area, was the most frequent species (Fig. 6). Natural pine woodlands (*P. halepensis* and *P. nigra*) and a mixture of pines and holly oaks are also frequent. Almost half of the sites have a high proportion of shrubs covering the area as part of the habitat (usually *Erinacea anthyllis*) or invading the grasslands (*Genista scorpius*). The most abundant plant community is *Berberidi hispanicae* - *Querceto rotundifoliae* which is frequent in the sierras of Cazorla, Segura, La Sagra, Alcaraz, and Nevada. Communities of the *Paeonio coriacea* - *Querceto rotundifoliae* series are also present in Sierra Nevada and Sierra de Segura, while the highest localities of Sierra Nevada at around 2,000 m are covered by communities of *Genisto baticae* - *Junipereto nanae*.



Figure 6. *Polyommatus violetae subbaeticus* habitat in La Vegallera, Riópar, Albacete, where grasslands are surrounded by *Pinus pinaster* woodlands (photo ML Munguira).

The substrate of these habitats is predominantly calcareous, with 34% of the sites on limestone, 4% on marble and 35% on marl and limestone. However, the studied sites in Sierra Nevada (22% of the sites) are on a schist substrate (Fig. 5). This is an interesting finding as the species has always been regarded to live in calcareous habitats (see for example García-Barros et al., 2013). The reason for this is that warmer climate in southern areas may allow the typically calcicolous larval foodplant (species of the genus *Onobrychis*) to live on the usually poorer soils resulting from acid substrates.



Figure 7. Habitat of *Polyommatus violetae* in *Quercus ilex* woodland, Sierra de las Cabras, Albacete (photo R Pérez).

Biology

PHENOLOGY AND BEHAVIOUR: *Polyommatus violetae* is a univoltine species. The adults congregate in large groups in perches on grasses to spend the night in these aggregations. The flight period lasts for about a month, during the months of July and August. Females oviposit, at the end of the season, inside the bracts of floral stems of the larval food plant.

LARVAL FOODPLANT of the species is *Onobrychis argentea* in the Sierras of Tejeda, Almijara, Nevada, and Cazorla (Fig. 8); while in the Sierra de Alcaraz the species eaten by the larva is *O. matritensis*, an endemic plant from central and southern Spain (Fig. 9). During the fieldwork carried out for this project R. Pérez identified *O. matritensis* as a new larval food plant for the species. Previous studies only recorded *O. argentea* as larval food plant.



Figure 8. *Onobrychis argentea* the larval foodplant of *Polyommatus violetae* in La Sagra, Granada (photo JP Cancela).

LARVA: The hatching occurs during October and the caterpillars feed only from the parenchyma of the lower leaves of the larval food plant. They overwinter as third instar larva, from October to April of the next year. During the spring, it feeds again on the parenchyma of the leaves and the fifth larval instar can be found in May and June. Fourth and fifth instars eat the flowers of *O. argentea*.



Figure 9. Detail of the distinctive fruits of *Onobrychis matritensis*, the newly recorded larval foodplant of *Polyommatus violetae* in the Sierra de Alcaraz, Albacete (photo R Pérez).

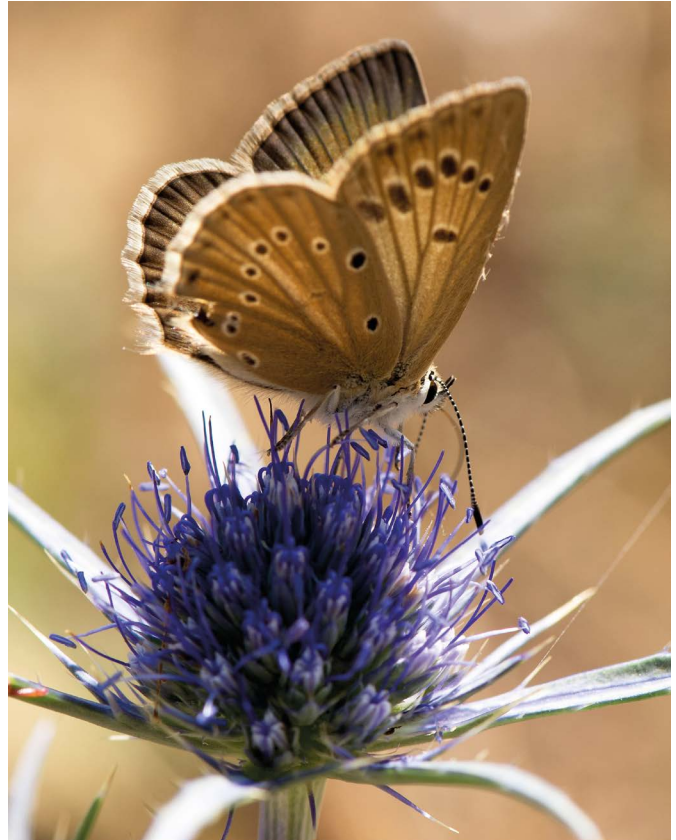


Figure 10. A female *Polyommatus violetae* feeding on one of the several nectar plants used by the adults: *Eryngium* sp. (photo R Pérez).

Figure 8. *Onobrychis argentea* the larval foodplant of *Polyommatus violetae* in La Sagra, Granada (photo JP Cancela).

PUPATION takes place in June, and the pupal phase lasts for around 15 days under laboratory conditions (Gil-T., 2008).

Depending on the location, up to 60-80% of the larvae in the late instars are attended by ANTS of the species *Camponotus piceus*, *C. cruentatus*, *Crematogaster sordidula*, and *Plagiolepis pygmaea*.

NECTAR SOURCES are not used by the adults in a specialized way, and include plants of the following genera: *Carduus*, *Centaurea*, *Eryngium* (Fig. 10), *Lavandula*, *Medicago*, *Onobrychis*, *Scabiosa*, and *Sideritis*. An adult male has been observed in Sierra Nevada sipping the liquids secreted by a hemipteran of the family Pentatomidae (cover picture, JM Barea-Azcón). This behaviour has probably the same function as mud puddling.

NATURAL ENEMIES of *Polyommatus violetae* are not well known apart from the parasitoid ichneumonids *Ichneumon exilicornis*, which emerges from the pupae around 20 days after pupation inside the pupa of the butterfly, and *Hyposoter notatus* (Muñoz Sarios, 2011).

Population

The adult population was estimated using the transect method on fixed routes of around 1 km. In the populations on sites smaller than 1 km, a shorter distance was recorded and the results extrapolated to 1 km. The figures obtained by this method are only rough estimates of adult density, and only produce data that are useful for comparison, as the total population size cannot be inferred from these results (Fig. 11). Average estimates of adult density per hectare were 54 adults in 2012 (counts in eight populations) and 32 adults/ha in 2013 (nine counts). The average of the 15 studied populations in the two years was 43 adults/ha. The differences between the two years are probably due to the climate conditions, the spring of 2012 being unusually hot and dry.

The estimates obtained are quite typical for lycaenid mountain species of our area, and averages are remarkably similar to those obtained for *Polyommatus golgus* and *Agriades zullichi*, which were also studied during this project.

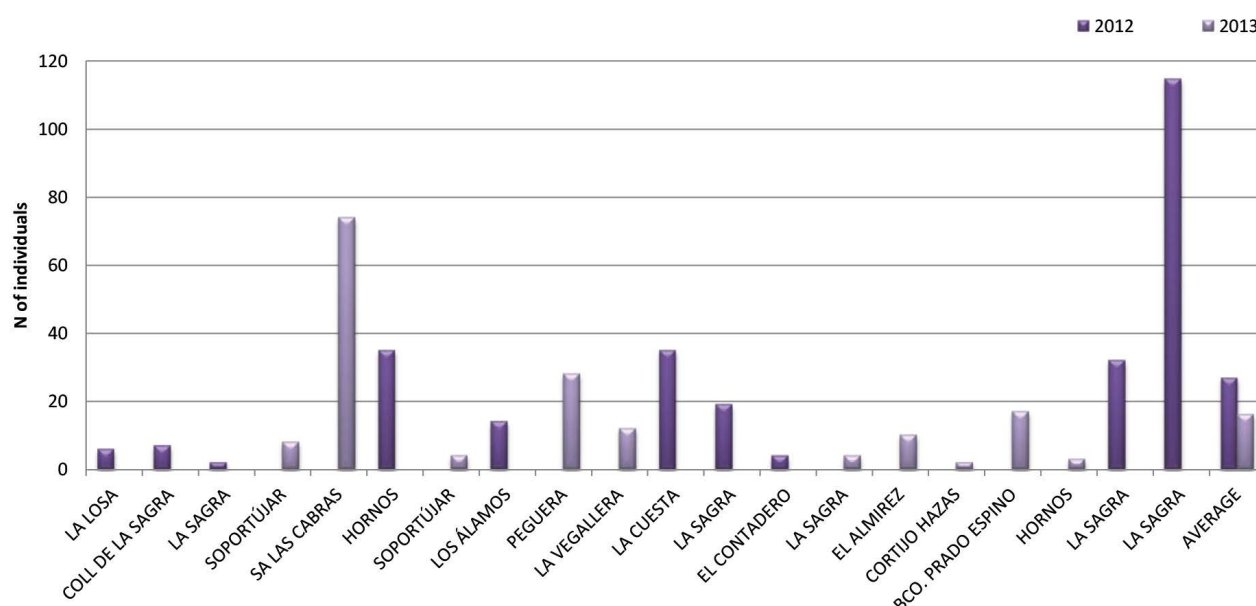


Figure 11. Adult densities of *Polyommatus violetae* obtained from 1 km linear transects, for the different localities (15 sites) studied during the years 2012 and 2013. Values represent the density of adults on transects of variable length extrapolated to a length of 1km.

Conservation

Legal protection

Spain recognises the responsibility towards this species and therefore in 2012 it has been included in the Andalusian Catalogue of Threatened Species (Catálogo Andaluz de Especies Amenazadas), with a Vulnerable (VU) IUCN category.

Conservation status

According to the International Union for Conservation of the Nature, the global conservation status of *Polyommatus violetae* is Vulnerable (VU D2; The IUCN Red List of Threatened Species, Version 2014.3, www.iucnredlist.org, Downloaded on 27 February 2015).

Polyommatus violetae has also been listed in the following Red Data Books and Endangered Species Lists:

- Revision of the Red List of the Iberian Lepidoptera (Revisión del libro rojo de los lepidópteros ibéricos) (1985): VU
- Red List of Andalusian Invertebrates (Libro Rojo de los Invertebrados de Andalucía)(2008): CR B2ab (I, ii, iii, iv)
- The European Red List of Butterflies (van Swaay et al., 2010) also considers the species as Vulnerable.

The Andalusian Red List considers the species to be critically endangered (CR) because at that moment it was thought to be restricted exclusively to the Sierra de Aljara, but recent studies have increased the records in the area close to Málaga and proved that locations in the Subbetic Sierras also belong to the species. Therefore it may be more realistic to reclassify the species as vulnerable (VU).

Protected areas

Only four of the 23 studied locations (17%) were outside protected areas. These are the populations in Murcia and one population in Albacete and another one in Almería. The protected areas that host populations of *P. violetae* are: Parque Nacional de Sierra Nevada, Parque Natural de las Sierras de Cazorla, Segura y las Villas, Parque Natural de las Sierras de Tejeda, Aljara y Alhama, Parque Natural de la Sierra de Alcaraz, Reserva Natural de la Sierra de las Cabras, and Natura 2000 site ES6140005 Sierras del Nordeste.

Threats

The threats to populations of *Polyommatus violetae* that were recorded during the fieldwork in the years 2012 and 2013 are shown in Fig. 12 and Table 1. Of the 23 visited localities, 22% did not have evident threatening factors. The threats observed in the rest of the sites are in order of importance:

- **Abandonment** of fields that were previously grazed. After abandonment scrub invades the fields and the habitat becomes unsuitable (Fig. 13). 39% of the 23 visited sites have lost the traditional grazing regimes and are losing habitat quality because of this threat. Locations where we detected this problem are: Hornos, Río Madera, and Mirabueno in Jaén province; Sierra de los Álamos and Collado de los Álamos in Moratalla (Murcia); Collado de la Peguera (Albacete); Barranco de Prado Espino (Almería); and La Sagra and Sopotújar (Granada).
- **Afforestation:** large areas within the distribution range of *P. violetae* have been planted with pines. This has considerably reduced the habitat size in those areas. This threat was recorded in 26% of the sites: La Sagra, Casa de la Virgen, Cortijo de las Hoyas and El Contadero in Granada province; Falda del Almirez (Almería); and Sierra de las Cabras and La Vegallera (Albacete).
- **Overgrazing** by goats and sheep takes place in 17% of the localities: La Sagra and Sierra Almijara (Granada); Cortijo de Hazas (Almería); and Sierra de las Cabras (Albacete).
- **Crops** planted within the habitat for the species reduce the size of suitable areas. Two (9%) of the studied sites had this problem: La Sagra and Cortijo de las Hoyas, both in the province of Granada.
- **Roads:** area inhabited by the species is crossed by a new road with wide verges, which considerably reduces the available open areas suitable for the species in a forested zone. Affected localities are Hornos and Mirabueno in Jaén province (9% of the localities).
- **Wildfires:** the effect of wildfires was only recorded in one site (4%): El Contadero in Sierra de Tejeda (Granada). Officers from Sierra de Tejeda, Almijara y Alhama Natural Park devote an important part of their time to keep fires under control, which helps the populations of the butterfly in this park.

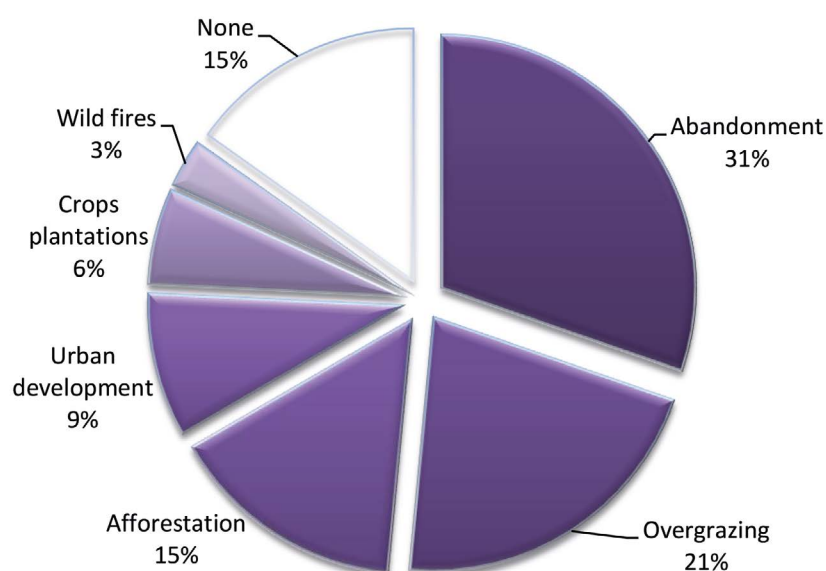


Figure 12. Percentages in which threats were detected in the habitats of *Polyommatus violetae* in the 23 localities that were studied during fieldwork in 2012 and 2013.

LOCATION	UTM COORDINATE	ALTITUDE (m)	THREATS
COLLADO DE LOS ÁLAMOS	30SWH82	1243	Abandonment, scrub covering fields
SIERRA DE LOS ÁLAMOS	30SWH92	1168	Abandonment
CORTIJO DE LA CUESTA	30SWH41	1362	None
COLLADO PEGUERA	30SWH56	1294	Abandonment
LA VEGALLERA	30SWH56	1235	Afforestation
SIERRA DE LAS CABRAS I	30SWH51	1318	Overgrazing
SIERRA DE LAS CABRAS II	30SWH51	1619	Afforestation
HORNOS	30SWH22	733	Abandonment, roads
HORNOS, A317	30SWH33	1461	None
MIRABUENO	30SWH22	1062	Abandonment, roads
RÍO MADERA	30SWH32	1095	Abandonment
SIERRA DE SEGURA	30SWH22	1462	None
LA SAGRA	30SWH30	1615	Crops, abandonment, overgrazing
CASA DE LA VIRGEN	30SWH40	1340	Afforestation
CORTIJO DE LAS HOYAS	30SWH40	1367	Afforestation, crops
COLLADOS DE LA SAGRA	30SWH30	1579	None
LA LOSA	30SWH30	1239	None
SIERRA TEJEDA	30SVF08	1488	Afforestation, fires, overgrazing
SOPORTÚJAR	30SVF69	1879	Abandonment
LAUJAR DE ANDARAX	30SWG00	2104	Overgrazing
EL ALMIREZ	30SWG00	2003	Afforestation
PATERNA DEL RÍO	30SWG00	1742	Abandonment

Table 1. Threats detected during fieldwork on the different locations in which Polyommatus violetae was studied during the project in the years 2012-2013. Data were compiled from the different years of sampling.



Figure 13. Scrub with Genista scorpius as a predominant species invading a previous grassland area in the Collado de los Álamos, Murcia province. Polyommatus violetae lives in the boundaries of these abandoned fields (photo JP Cancela).

Threats registered in the literature are: fires, low population numbers, restricted distribution range, isolation, overgrazing and urban development. Fires are the most mentioned threat, although this problem is only linked with the populations in the Sierra de Tejada and Almjara. Some of the mentioned threats, like isolation, restricted distribution and small population size, only refer to the populations in Sierra de Almjara and have not been considered in our study.

The threats registered during fieldwork differ significantly from those in the literature. Threats are not broadly discussed in the references and the main problem recognised is the destruction caused by wildfires. Our data clearly show that currently the abandonment of grazing areas is the main threat, followed by afforestation. Abandonment is also one of the main causes of decline for grassland habitats throughout Europe.

Species action plan

This chapter discusses the possible actions, which, if conducted, will significantly improve the survival chances of the species. In each chapter we discuss the actions that are necessary and describe them for the different areas in which the species is found. The actions have been discussed with officials and directors of the parks (National Parks, Natural Parks) where the species is present.

It is essential to monitor the populations of the species because the effectiveness of the proposed measures would only be evident if the butterfly population trends are positive. In general, the conservation actions are related to the habitat. The main goal is to avoid negative interventions such as afforestation, overgrazing, new crop plantations and construction of new roads and to enhance extensive grazing in those places that have been abandoned. Public awareness actions are also important to inform the general public about the importance of the species and the main goals of conservation measures.

Legal protection

The populations of *Polyommatus violetae* in Sierra de la Sagra need some special attention. This sierra is part of a recovery plan envisaged for the high peaks of Andalusia (Plan de Recuperación y Conservación de Especies de Altas Cumbres de Andalucía) and the actions within this plan will benefit the high areas. The idea of upgrading the conservation status, based on the remarkable natural values of this sierra, by creating a Natural Park will benefit the populations of many other species with high conservation importance living in there. Special care should be taken in the lower areas of the sierra where *P. violetae* breeds and this species should be taken into account when considering the management plans for the protected area. Extensive grazing should be favoured and the plantation of new crops restricted or avoided in the area.

Proposed action: declare La Sagra a Natural Park.

This action is considered of **high** priority, but will be implemented when resources are available at the regional government.

Conservation measures

The main actions for the conservation of the species can be summarized in the following proposals:

High priority:

- Enhance extensive grazing of abandoned grasslands.
- Create clearings in the tree plantations and reinforce them with larval food plants to increase the suitable habitat for the species.

Medium priority:

- Control grazing regimes to prevent overgrazing.
- Public awareness campaigns including the production of leaflets and information panels with information about the species close to key populations in protected areas.

Low priority:

- Restrict the extension of new crop plantations.
- Limit the construction of new infrastructures such as roads crossing the habitat of the butterfly.

EXTENSIVE GRAZING OF GRASSLANDS

About 40% of the habitats visited for this study were not grazed, or had a grazing regime that is too low for the optimal conservation of the grasslands, and therefore the species - *Polyommatus violetae*.

Abandonment was detected in some of the populations in Sierra de Cazorla and Segura, Sierra de Alcaraz, La Sagra, and Sierra Nevada, all of them protected areas.

The most severe situation was detected in the Sierra de los Álamos, a non-protected mountain range in the province of Murcia, where scrub is invading some of the areas of the species habitat (Fig. 13). Therefore, the recommendation would be to enhance the extensive grazing in key populations: such as La Sagra, Sierras of Cazorla and Segura, Sierra Nevada, and Sierra de los Álamos. Officers from the parks in Sierra de Cazorla and Segura and Sierra Nevada already keep control on grazing regimes and could enhance grazing in areas where the butterfly is present. However, if the causes for abandonment are not reverted this would need financial support from the parks. We suggest that extensive grazing should be enhanced in those areas with the presence of the butterfly. Protected areas which have grazing recommendations to balance the grazing regimes in their management plans, could select sites where the butterfly is present and secure that the convenient regimes are implemented in those areas. This is already being done in some of the parks (e.g. Sierras de Tejeda, Almijara y Alhama).

The priority of this action is **high** as it would address the most serious threat for the species.

WOODLAND AND SCRUB CLEARING

Afforestation has already reduced habitats of *Polyommatus violetae* in 26% of the sites studied in several sierras in the provinces of Granada, Almería, and Albacete. Pine plantations usually alter the habitat during their plantation by exposing the soil to erosion and when setting the terraces (Fig. 14). Later, when the pines grow they form dense forest and become unsuitable for animals living in open areas (Fig. 15).



Figure 14. Pine plantations in the area where populations of *Polyommatus violetae* were found in Sierra de las Cabras, Albacete province. Soil removal and terraces cause erosion and limit the habitat of the butterfly (photo R Pérez).

Actions to reverse this situation have been planned for the following areas. They are considered of **high** priority:

- Clear the pine forest areas on the slopes of El Almirez, Sierra Nevada. They are surrounded by open areas where a population of *Polyommatus violetae* lives. An example of these areas can be seen in the pine plots in Fig. 5. The clearings in this area will start in 2015 and will be carried out by INFOCA, a public management body that belongs to the Andalusian Government.
- In Sierra de Cazorla Segura y Las Villas, where some areas will be cleared from pines to increase the area that can be used by the species. This can be done in areas affected by the development of a road, such as the populations in Hornos (Jaén). This action will also be implemented by INFOCA and coordinated by the park officers.
- In the Sierra de Tejeda, Almijara y Alhama scrub is being removed to favour partridge populations. Officials from this park have already been informed of the location of *P. violetae* populations. In some of these sites the actions will take place, aiming to enlarge the areas with the populations of the butterfly such as the one seen in Fig. 15. The pines seen in the background will partially be removed to favour the formation of grasslands in which the butterfly could live.

Areas that have been cleared from planted or invading vegetation need to be managed to support the presence of the butterfly. We recommend **planting seeds** of the larval food plant in such areas. This action can be undertaken with the help of the park's volunteers and will involve collecting the seeds in natural populations of the plant (*Onobrychis argentea* in the three sites) and planting them in the cleared areas. Cazorla, Segura y Las Villas Natural Park has a Botanic Garden that can coordinate these activities in Torre del Vinagre. Sierra Nevada National Park also has a Botanic Garden in Hoya de Pedraza that could be involved with the plots that will be cleared in the eastern part of the national park. The Botanic Gardens can also grow plants that can then be planted in the sites for a better success in their development.



Figure 15. Habitat of *Polyommatus violetae* in the Sierra de Almijara. Pine plantations limit the open areas where the species lives (photo R Travesí).

OVERGRAZING

Some localities in La Sagra and Sierra Almijara (Granada province), Sierra de las Cabras (Albacete), and the southern slopes of Sierra Nevada in Almería have been reported to be overgrazed. In the Sierra de Almijara and Sierra Nevada grazing regimes of the parks include regulations regarding livestock loads and only in isolated cases overgrazing can pose a real threat for large areas. However, grazing pressure should be avoided in those areas where the butterfly is present. Knowledge of the sites where the butterfly is present is vital to link our recommendation to the grazing plans of the parks. The priority of this recommendation is **medium** and the park officials are already well aware of the problem and know which sites need adaptations in the grazing regimes.

NEW CROP PLANTATIONS

Crop cultivation has been observed in two locations close to La Sagra (Granada, Fig. 16). The effect of this practice is the reduction of the suitable habitat for the species in this key site. If La Sagra becomes a Natural Park in the future, as we have recommended in the *Polyommatus golgus* and this Species Recovery Plans, the extension of these crops will be limited and therefore the survival and the favourable conservation status of the species supported. The pressure to extend the already existing crops is not evident, and therefore the priority of this action is **low**.



Figure 16. Cereal crops in the area where one of the largest populations of *Polyommatus violetae* lives in La Sagra, Granada province (photo JP Cancela).

ROAD DEVELOPMENT

A large road has been built crossing the habitat of *P. violetae* to the south of the village of Hornos considerably reducing the suitable habitat of the species in two populations -Hornos and Mirabueno in Jaén province. The road and its verges have destroyed approximately 20% of the size of the population of Hornos, which now has only 2 ha of habitat as a result of this action (Fig. 17). New roads crossing the habitat of the species should be avoided in an area where the network of roads is enough for the low traffic taking place during most of the year. The priority of this action is **low**.

On the other hand, a dirt road in Soportújar has been in some way beneficial for the species, because its construction favoured open areas with low vegetation cover that have been good for the species. Part of the habitat in this area is restricted to road verges because most of the fields have been abandoned following livestock reduction in the area.

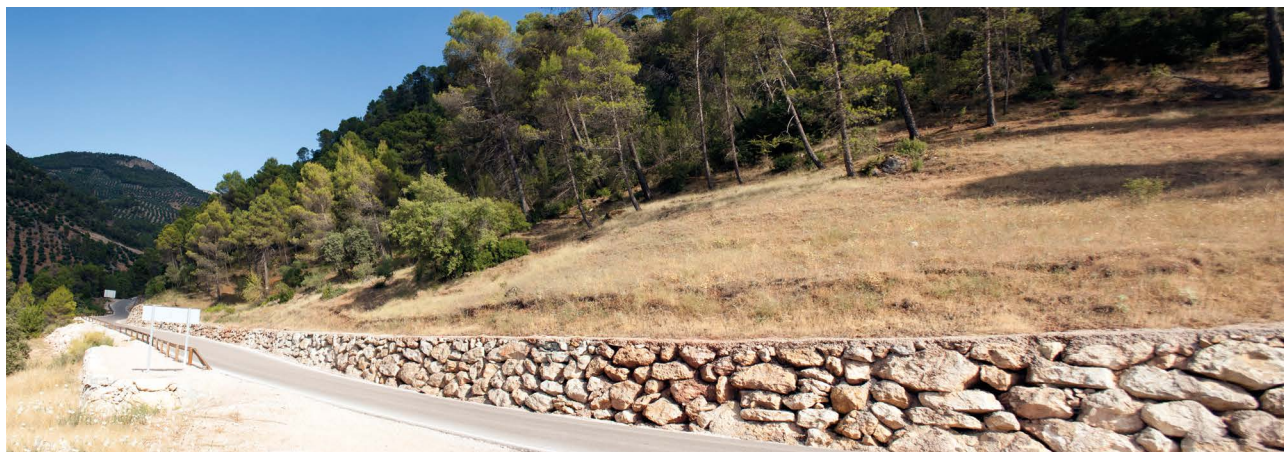


Figure 17. A new road built near Hornos in the province of Jaén considerably reduced the habitat of two populations in the area. The road has cut the suitable area and destroyed 20% of the available habitat in the site (photo JP Cancela).

Research

Research is still needed to understand different aspects of the biology and genetics of the species. The main topics that should be studied in the following years are:

- Continue with adult censuses to monitor the success of the recovery plan and cover more areas of potential distribution, to produce a more complete picture of the distribution of the species. Adult censuses need to be made once a year in each locality: Sierra de Almijara, Hornos in Sierra de Segura, and the slopes of El Almirez in Sierra Nevada. This could be done by local entomologists on a volunteer basis.
- Perform a thorough study of the genetics of the species to confirm if the populations of Sierra Nevada are related to those from the type locality of Sierra de Almijara. This study should be carried out by research institutes and funded by national or regional governments.
- Food plant use is still poorly known and more studies are needed to have a better idea of which plants are used in the different areas. Personnel from the protected areas could help with this topic using the resources from each park.



Figure 18. Field study work in Sierra Tejada (photo R Travesí).

Public awareness

General information about the species and its conservation would encourage involvement of the public and visitors to the areas where the species lives. This will help support other conservation actions, because the people visiting these areas are usually emotionally linked with nature conservation.

- Information leaflets with information about the importance of the species and its conservation will be produced in 2015. Actions for the recovery of the species that are already taking place will be specified. They will use non-technical language to describe the species and its habitat. The leaflets, in English and Spanish, will be available in the information centres of the parks of Sierra Nevada, Sierra de Tejada, Almajara and Alhama, Sierra de Castril, and Sierra de Cazorla, Segura y Las Villas. This action is of **medium** priority and will be realized as part of the current BCE project.
- Publish information on websites. A digital version of the leaflets will also be produced and distributed widely to amateur and scientific organizations (butterfly conservation organizations, entomological societies and park webpages). The priority is **intermediate** can take place over the next few years.
- Information panels in Sierra Nevada, La Sagra and Sierra de Cazorla, with information about the importance of the species and its conservation will be produced and placed. The panels will also contain information about the value of the butterfly fauna in each area. We envisage at least four of these panels: one in Sierra Nevada Visitor Centre, one in La Sagra and two in the Visitor Centres of Sierra de Cazorla (Torre del Vinagre and Sequeros). Together with the information leaflets this action is considered of **medium** priority and will be implemented in 2015.
- Power Point presentations for training courses will be available. They will include information about the species already gathered during the project and would be available upon request. Priority of this action is **low**. In the Natural Park of Sierra de Tejada, Almajara y Alhama yearly seminars make the knowledge gathered by experts available to the public from the area. In the following years we will use these seminars to present leaflets and give talks to make people from the area around the park aware of the value of *Polyommatus violetae* and the other species present in the park.
- Media releases (newspapers) with contents related to the recovery of *P. violetae*, have already taken place during the project and will be produced at its end and in the future. Priority is **medium** and this action needs to continue to take place in the long term.



This project and the work further would not be possible without the voluntary help of all the specialists who took part in the project by collecting and providing data and advises, and will continue to do it in the future. Many thanks again for your devotion to saving some of the incredible biodiversity of Spain.

Acknowledgements

The Species Recovery Plan of *Polyommatus violetae* is part of the Species Recovery Program of Butterfly Conservation Europe and has been financed by MAVA Fondation pour la Nature.

Support was also given by Dutch Butterfly Conservation (De Vlinderstichting), the University of Madrid (Universidad Autónoma de Madrid), the regional authorities in Andalusia (Junta de Andalucía), the National and Natural Park of Sierra Nevada, and the Natural Parks of Cazorla, Segura y Las Villas and Sierra de Tejeda, Almijara y Alhama.

Together with the authors the following persons helped in the mentioned ways to the development of the project in relation to *P. violetae* and their contribution is very much acknowledged:

Fieldwork: Arturo Iglesias, Carlos Antonietty, David Paz, Enrique García-Barros, Irene Lacalle, Juan Carlos Moreno, Juan Pablo Cancela, María Pelayo, Rafael Pérez, Roberto Travesí, and Rocío Fernández. Members of the European Interest Group of Butterfly Conservation (UK) significantly contributed to the fieldwork carried out for this species: Hugo Brooke, Mike Prentice, Neil Thompson, Peter Cawdell, and Richard Davidson.

Meetings to develop conservation actions: Blanca Ramos, María Teresa Moro, David Cuerda, Ignacio Henares, José María Irurita, and Ricardo Salas.


Project workshops: Alberto Tinaut, Arturo Iglesias, Blanca Ramos, Carlos Antonietty, Catherine Numa, Chris van Swaay, David Cuerda, David Paz, Dirk Maes, Enrique García-Barros, Francisco Javier Pérez, Helena Romo, Ignacio Henares, Irma Wynhoff, José María Irurita, José Martín Cano, Juan Gabriel Martínez, Martin Warren, Martin Wiemers, Martina Sasic, Miguel Ginés Muñoz, Oscar Moreno, Roberto Travesí, Rudi Verovnik, Simon Spencer, Sue Collins, Titia Wolterbeek, and Yeray Monasterio.

Revision of manuscripts: Martin Warren.

Literature

- Aistleitner, E. 1988. Datos nuevos e interesantes para la fauna de Ropalóceros en la Península Ibérica (Lepidoptera: Rhopalocera). *SHILAP Revista de Lepidopterología*, 16, 71-775.
- Calle, J.A., Lencina, F., González, F., Ortiz, A.S. 2000. Las mariposas de la Región de Murcia. *Macrolepidópteros diurnos y nocturnos*. Nausícaa, Murcia.
- García-Barros, E., Munguira, M.L., Stefanescu, C. & Vives, A. 2013. *Lepidoptera: Rhopalocera*. In: *Fauna Ibérica*, vol. 37. M.A. RAMOS et al. (eds.). Museo Nacional de Ciencias Naturales, CSIC, Madrid.
- Gil-T., F. 2008. *Agrodiaetus violetae* Gómez Bustillo, Expósito y Martínez 1979. In: *Libro Rojo de los Invertebrados de Andalucía*. J.M. Barea-Azcón et al. (eds.). Consejería de Medio Ambiente, Junta de Andalucía, Sevilla. Pp. 1120-1123
- Gil-T., F. 2008. Description of the pre-imaginal stages of *Agrodiaetus violetae* (Gómez-Bustillo, Expósito & Martínez, 1979) and notes about compared ecology and morphology (Lepidoptera: Lycaenidae). *Atalanta*, 39, 343-346.
- Gil-T., F. & Gil-Uceda, T. 2005. *Agrodiaetus violetae* (Gómez-Bustillo, Expósito y Martínez, 1979): Morfología comparada y descripción de *Agrodiaetus fabressei subbaeticus* ssp. nov. del sureste de la península Ibérica (Lepidoptera, Lycaenidae). *Boletín Sociedad Entomológica Aragonesa*, 36, 357-364.
- Gómez-Bustillo, M.R., Expósito, A. & Martínez, P. 1979. Una nueva especie para la ciencia: *Agrodiaetus violetae* (Lepidoptera, Lycaenidae). *SHILAP Revista de Lepidopterología*, 7, 47-54.
- Ibáñez, S. & Gil-T., F. 2012. Contribution to the knowledge of *Agrodiaetus violetae* Gómez-Bustillo, Expósito & Martínez, 1979, *sensu lato*, an endemic Iberian species; new localities and first records for Sierra Nevada and Almería province (S. Spain). (Lepidoptera, Lycaenidae). *Atalanta*, 43, 91-94.

- Lafranchis, T., Gil-T., F. & Lafranchis, A. 2007. New data on the ecology of 8 taxa of *Agrodiaetus* HÜBNER, 1822 from Greece and Spain: hostplants, associated ants and parasitoids (Lepidoptera: Lycaenidae. Hymenoptera. Diptera). *Atalanta*, 38, 189-197.
- Martín, J. Gurrea, P., Munguira, M.L., Mozos, M. de los & Sanz, M.J. 1990. Entomofauna de la provincia de Albacete: áreas de distribución de las mariposas amenazadas de extinción en las Sierras de Alcaraz y Calar del Mundo. *Al-Basit*, 16, 5-40.
- Moreno-Benítez, J.M., Castilla-Calvo, M.I. & Ripoll-Rodríguez, J.J. 2012. *Agrodiaetus violetae* Gómez-Bustillo, Expósito & Martínez, 1979: nuevas localidades para las provincias de Málaga, Granada y Jaén (Andalucía, España) (Lepidoptera, Lycaenidae). *Archivos Entomológicos*, 7, 115-118.
- Munguira, M.L., Martín, J., Pérez-Valiente, M. 1995. Karyology and distribution as tools in the taxonomy of Iberian *Agrodiaetus* butterflies. *Nota lepidopterológica*, 17, 125-140.
- Muñoz Sariot, M.G. 2011. *Biología y ecología de los licénidos españoles*. GRX Servicios Gráficos, Granada.
- Tarrier, M. 1993. La Sierra de la Sagra: un écosystème-modèle du refuge méditerranéen (Lepidoptera Rhopalocera et Zygaenidae). *Alexanor*, 18, 13-42.
- van Swaay, C., Cuttelod, A. Collins, S., Maes, D., Munguira, M.L., Šašić, M., Settele, J., Verovnik, R., Verstrael, T., Warren, M., Wiemers, M., Wynhoff, I. 2010. *European Red List of Butterflies*. Publications Office of the European Union, Luxembourg.
- van Swaay, C., Maes, D., Collins, S., Munguira, M.L., Šašić, M., Settele, J., Verovnik, R., Warren, M., Wiemers, M., Wynhoff, I. & Cuttelod, A. 2011. Applying IUCN criteria to invertebrates: How red is the Red List of European Butterflies? *Biological Conservation*, 144, 470-478.
- Viedma, M.G. & Gómez-Bustillo M.R. 1985. *Revisión del libro rojo de los lepidópteros ibéricos*. Ministerio de Agricultura, Pesca y Alimentación. Instituto nacional para la conservación de la naturaleza, Madrid. Pp. 30-31.
- Vila, R., Lukhtanov, V., Talavera, G., Gil-T., F. & Pierce, N.E. 2010. How common are dot-like distributions? Taxonomical oversplitting in western European *Agrodiaetus* (Lepidoptera: Lycaenidae) revealed by chromosomal and molecular markers. *Biological Journal of the Linnean Society*, 101, 130-154.



PARQUE NACIONAL

Sierra Nevada constitutes an excellent natural laboratory for studies on the climate change effects on biodiversity, but also the impact of the management activities in a climate change scenario.

Sierra Nevada National and Natural Park works in a monitoring program aimed to track the global change effects on the ecological and socio-economical systems of this emblematic mountain range. This monitoring program is part of the Sierra Nevada Global Change Observatory. One of the main biological indicators in this program are the butterfly communities, giving special attention to endemic and endangered species as Zullich's Blue. The more important threatening factor for this species is the climate change. Tracking its effects is of major concern in order to improve the habitat management.

Recently, the Andalusia Government approved the High Summits Species Recovery and Conservation Plan (Acuerdo de 13 de marzo de 2012, del Consejo de Gobierno). This plan has a legal consideration and targets the species included in the Andalusian Endangered Species Act. Andalusian Anomalous Blue is one of these species together with other insects like the butterflies Zullich's Blue and the Sierra Nevada Blue, the bush cricket *Baetica ustulata* and the ant *Rossomyrmex minuchae*, as well as many mountain specific plant species. The plan aims to establish an appropriate framework for the development of an effective conservation strategy, taking into account key concepts as Global Change, adaptive management, traditional mountain land uses and public awareness.

Lay-out: René Manger and Gloria Angelova
Back cover photo: José Miguel Barea-Azcón
Front cover photo: José Miguel Barea-Azcón