RECOVERY PLAN FOR THE SPANISH GREENISH BLACK-TIP *Euchloe bazae*

Butterfly Conservation Europe

SPECIES RECOVERY PLAN
FOR THE SPANISH GREENISH BLACK-TIP
Euchloe bazae

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Contents

Introduction

This document presents a summary of all the information available for *Euchloe bazae* and the results of the field studies carried out during the field seasons of 2013 and 2014. It includes also unpublished data from the authors and collaborators.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 *Euchloe bazae* 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 had a meeting with officials from the regional government in Andalusia, in which we developed specific measures for the conservation of the species. 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 relevant habitat features.

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 in the literature and those that were detected during fieldwork. The final section explains in detail the specific actions that are proposed for an improvement of the conservation status of *Euchloe bazae*. At the end of the document there is a comprehensive list of references and an acknowledgements section.

Identification

Wing morphology

The male has a forewing of 17-22 mm long. The upperside of the forewings is sulphur yellow (pale sulphur yellow in *E. b. bazae* and vivid sulphur yellow in *E. b. iberae*), with a black and yellow area in the apex from the vein M3 to R2. The costal margin is yellow, with some black scales. It has a large black discal spot that does not reach the costal margin. In the subspecies *bazae* the scales on the costal margin of the forewing and the hairs between the head and the prothorax are pale or yellow (Fig. 1), while in subspecies *iberae* they are reddish (Fig. 2). The anal margin of the forewing is almost linear.

The hindwing is yellow on its upperside and has some black basal scales. The underside of the forewing is also sulphur yellow, with the apex greyish. It has a discoidal black spot, with light grey scales in the middle. The hindwing is greyish green and it has some white spots spaced along the costal margin and in the discal and postdiscal areas (Fig. 1). *E. b. bazae* shows a slight sexual dimorphism, with females showing a lighter coloration and darker in underside of the hind wings, which is not the case for specimens of *E. b. iberae*.

Figure 1. Euchloe bazae bazae *is the subspecies that occurs near Baza in Granada, southeast Spain (photo C van Swaay).*

Figure 2. Euchloe bazae iberae *is the subspecies from the region of Monegros, in North-East Spain (photo ML Munguira).*

Genitalia

The male genitalia show a short *uncus*, curved downwards with a blunt end. The valves have a truncated distal end, with a prominent dorsal tooth. The penis is distinctly curved. Both the female genitalia and the haplotype are unknown.

Taxonomy

Common name: Spanish Greenish Black-tip (in English) or Puntaparda Verdosa, Fabiana (in Spanish)

Latin name: *Euchloe bazae* Fabiano, 1993

Phyllum: Arthropoda

Class: Insecta

Order: Lepidoptera

Family: Pieridae

Assigned by some authors to the African *Euchloe charlonia* (Donzel, 1842) (e.g. Fabiano, 1993), also known as *Elphinstonia charlonia*, but morphological and molecular studies performed by Back et al. (2005, 2006), confirmed the previous hypothesis about *E. bazae* being a different species, as stated by Olivares & Jiménez (1996). The phylogenetic hypothesis proposed by Back et al. (2006) indicates that *E. bazae* is closer to *E. lucilla* Butler, 1886, *E. transcaspica* (Staudinger, 1891) and *E. penia* (Freyer, 1851) than to *E. charlonia*.

Two subspecies of *E. bazae* have been described:

- *E. bazae bazae* Fabiano, 1993, occurring near Baza, in southern Spain.
- *E. bazae iberae* Back, Olivares & Leestmans, 2005, occurring in the Monegros area, in North-East Spain.

Immature stages

THE EGG is barrel shaped (Fig. 3), with ca. 16 prominent longitudinal ribs and less pronounced transversal striations (Murria & Redondo, 1995). Transversal and longitudinal striations form rectangular cells that cover all the lateral area of the egg. The micropylar rosette and annular area are placed in the narrow pointed tip of the egg while the base is flat and slightly narrower than the equator of the egg. It is white when laid and turns later to a reddish colouration.

Figure 3. Euchloe bazae *eggs laid in captivity on the underside of the leaves of* Eruca vesicaria *in the Hoya de Baza, Granada (photo J Olivares). Note that it is unusual for so many eggs to be laid on plants in the wild.*

The full grown LARVA (Fig. 4) is green and has plenty of white and some black hairs. It has a faint dark dorsal band, with a thin white stripe visible in the first three segments of the body. In each segment it has dark brown spots with light dots, present in four or five rows (Olivares & Jiménez, 1996). Spiracles are white and are connected by a white discontinuous line. The species has five larval instars and the last instars have lengths of 6 mm (third), 11 mm (fourth), and 25 mm (fifth).

Figure 4. Euchloe bazae *catepillar from the Hoya de Baza, feeding on leaves of the larval food plant,* Eruca vesicaria *(photo J Olivares).*

Figure 5. The chrysalis of Euchloe bazae*, close to the emergence of the adult, with the forewing colour seen through the wing case of the pupa (photo J Olivares).*

THE PUPA has a length of 19-22 mm. It is elongated and cingulated, with a long cephalic projection (Fig. 5). The overwintering pupa has a light brown-yellow colour, with a dark dorsal line and two lateral black lines. It has other black lines of variable intensity on the cephalic and abdominal extremes. Along the dorsal area there are 8-10 black dots per segment. The non-overwintering pupa is of apple green colour, with a dark green dorsal stripe and a white point at the end of a shorter cephalic projection.

Distribution

Euchloe bazae is an Iberian endemic butterfly. It is restricted to small areas in the Hoya de Baza, a wide area surrounded by mountains in the Andalusian province of Granada, and in the region of Monegros, an area close to the Ebro River, in the provinces of Huesca and Zaragoza (Aragón), and Lérida (Catalonia) (Fig. 6). Both areas are separated by a linear distance of 450 km.

There is also an area that can potentially host the species due to its favourable climatic characteristics: the UTM square 30SWG57 (Romo et al., 2006). This is close to the populations from the Hoya de Baza. The area was not confirmed to host the species during field studies, but further search of the species would be necessary in order to validate the prediction.

The species has been recorded in eleven 10 x 10 km UTM coordinates (Fig. 6). The previously known squares were seven (García-Barros et al., 2013), and during the present project four more squares have been added which represent 36% of the total: 30SWG25, 30TYL49, 31TBF49 and 31TBF46. The locations and coordinates are listed below by provinces:

- Granada: Baza (30SWG24), Barranco del Espartal (30SWG25), Benamaruel (30SWG26), Cúllar (30SWG35) and Galera (30SWG37).
- Huesca: Peñalba (30TYL49), Candasnos (31TBF49 and 31TBF59).
- Lérida: La Granja d'Escarp (31TBF78) where the species is thought to be extinct. This idea is also supported by several visits along the three years of this project.
- Zaragoza: Caspe (31TBF46 and 31TBF56).

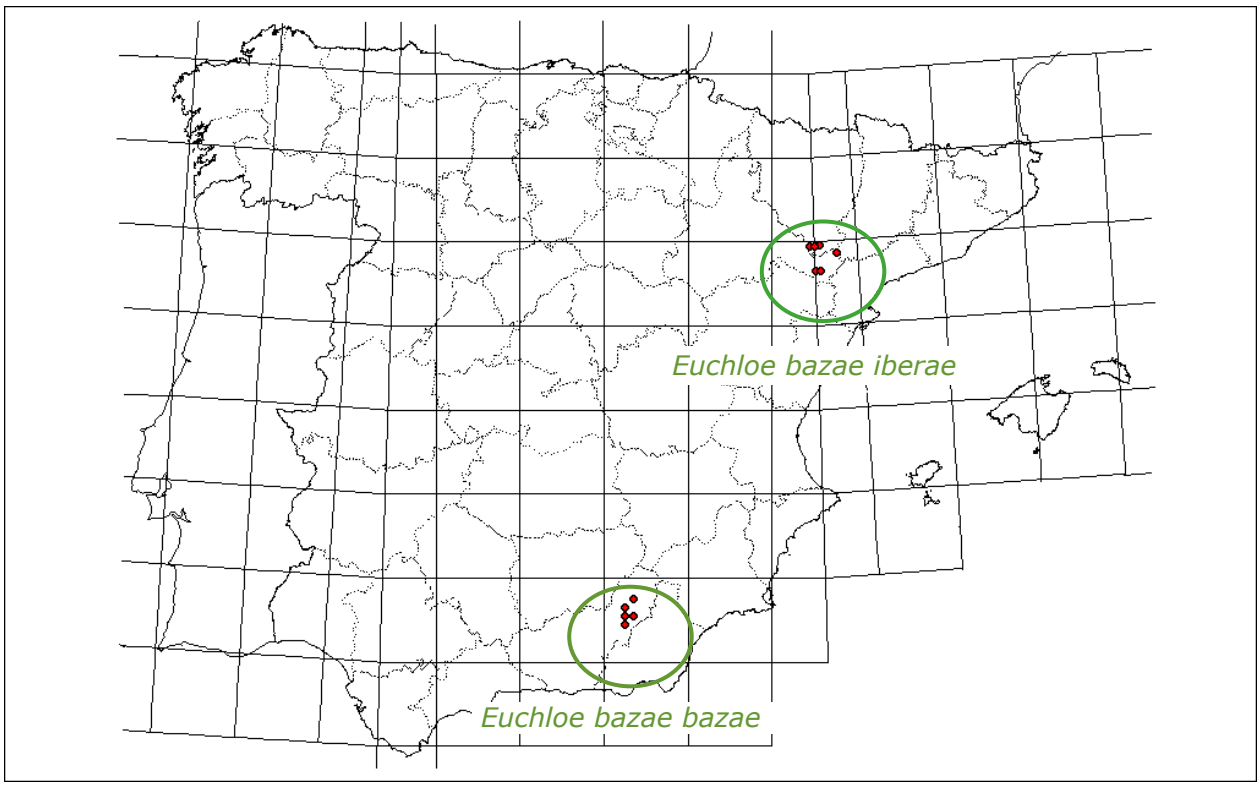

Figure 6. Distribution map of Euchloe bazae*. Each dot represents the presence of the species in a 10 x10 km UTM square.*

Habitat

Habitat description

The habitat of *Euchloe bazae* consists on sub-steppe grasslands or shrublands with a continental climate. Plant communities belong to the *Rhamno lycioidi - Querceto cocciferae* series (coscojares, or kermes oak shrublands). Predominant shrubs and grasses in these communities are:

- In the Hoya de Baza (subspecies *bazae*, Fig. 7) esparto (*Stipa tenacissima*), *Lygeum spartum, Retama sphaerocarpa, Ononis tridentata* and *Rosmarinus officinalis.*
- In the Monegros area (subspecies *iberae*, Fig. 8) *Quercus coccifera, Rosmarinus officinalis, Genista scorpius, Boleum asperum, Pistacia lentiscus*, and the grass *Lygeum spartum*. Some areas in the area close to the town of Caspe also have pines (*Pinus halepensis*) and junipers (*Juniperus phoenicea*).

Populations of the Baza area were found at an average altitude of 872 m (range 804-958 m) and those from Monegros at an average altitude of 226 m (range 109-331 m). Therefore, the altitudes at which the two subspecies are found do not overlap. The substrate consists of marl and marl-limestone with gypsum in the Baza area and marl-limestone or marl-sandstone in the area of Monegros. In the areas where the species lives, there is frequently a high percentage of bare ground and thus the substrate is always clearly seen (Figs. 7 and 8).

Figure 7. Habitat of Euchloe bazae *in Hoya de Baza (Granada, Andalusia) with esparto grasslands and* Retama shrubs *(photo J Olivares).*

Figure 8. Habitat of Euchloe bazae *in Caspe (Zaragoza, Aragon). Flowering yellow shrubs in the foreground are the larval foodplant of the species,* Boleum asperum *(photo ML Munguira).*

Habitat model

From the 22 UTM squares (1x1 km) of occurrences of *Euchloe bazae* obtained in the surveys of 2012-2014, a present potential distribution model was built with Maxent program (Phillips et al., 2006). The program works with the occurrence of the species and the output shows the suitability of habitat for the species as a function of the chosen variables. A set of 30 different variables, which can influence directly or indirectly in the butterfly distribution, were selected to build the potential distribution model (environment, topography, geological and human activity).

Since the sample size is small, we used the Jackknife (leave-one-out) procedure recommended by Pearson et al. (2007). Therefore, we built as many models as number of occurrences, and each time we deleted a presence point to build the model. Then, we assessed the predictive ability and the significance of the model with the P value software provided by Pearson et al. (2007), measuring the efficiency of the models to predict the excluded occurrence. As threshold value to transform this output in binary, we selected the 10 percentile training presence logistic threshold which does not consider 10% of the most extreme presence values.

The most favourable areas for the species are close to its known distribution (Fig. 9). New favourable areas from the environmental point of view are highlighted in the province of Granada in Andalusia (in the surroundings of La Sagra), but especially in Huesca, Zaragoza and Lérida (Aragon and Catalonia, Fig. 9). The potential map shows favourable areas in the surroundings of Granja d'Escarp (Lérida), where the species was present but has not been recorded in the last years. In this location the environmental conditions seem to be favourable for the presence of the species. The total number of favourable 1x1 km UTM squares predicted by the model was 2,338.

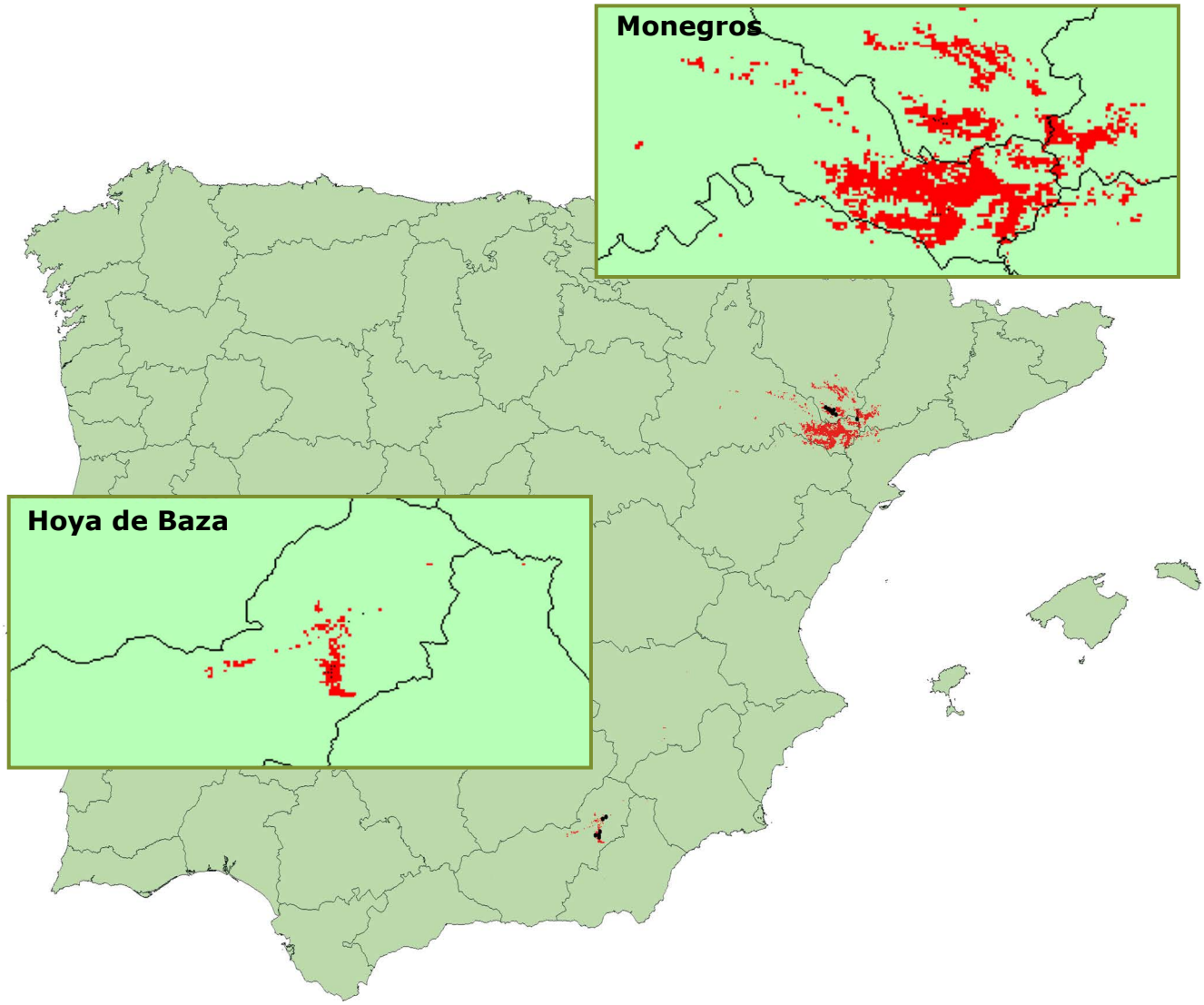

Figure 9. Model of the present potential favourable area for Euchloe bazae *in the Iberian Peninsula performed with Maxent program and detail of the favourable areas. Black dots indicate the occurrence of the species. Red colour shows the potential favourable area at 10 percentile training presence logistic threshold (0.434).*

Twenty-four variables contributed to the model performance. Among them, the most significant variables for the models were precipitation of the coldest quarter of the year (23.1% of contribution), land cover (14.9%), soil composition (14.5%), the topographical diversity (12.1%) and the mean temperature of the coldest quarter of the year (9.4%). The favourable conditions for *E. bazae* according to the model, seem to be areas with sedimentary deposits, grasslands or open scrub, with values of annual precipitation and temperature of coldest quarter around 70 mm and 7ºC, respectively. According to this model, it is expected that the predicted rise in temperatures of between 2.4 and 3.4°C from present to 2100 (IPCC, 2007) will not limit or restrict the potential future distribution of this species. AUC values (Area Under a Receiver Operating Characteristic –ROC– Curve) were higher than 0.8 (test AUC= 0.99), supporting the fact that the model obtained is better than a random one, and has a high discrimination power. The success rate for predicting the excluded squares with P-value program was 63.6% ($p<0.0001$).

Biology

PHENOLOGY AND BEHAVIOUR: *Euchloe bazae* is a univoltine species, with a partial second generation in the southern populations. Adults start flying at the end of February and can be seen until May, but fly mainly in March and April. Late sightings correspond to the partial second generation whose abundance relies heavily on weather conditions. Males show patrolling behaviour, with a zigzagging flight close to the ground. The females are less active and are only seen when they are searching for oviposition places. Prominent places or landmarks are often visited by males in search for females. Usually hilltops are used for this purpose. This behaviour differs from the typical hilltopping behaviour of other butterfly species because the males do not settle on the top of hills waiting for females.

The larval FOOD PLANT for subspecies *bazae* is *Eruca vesicaria* - the wild relative of the popular rocket salad (Fig. 10). In the Monegros area however the food plant of subspecies *iberae* is *Boleum asperum* (Fig. 11). *Eruca vesicaria* and *Reseda phyteuma* have also been mentioned in the latter area, but these plants are only used occasionally. Food plant densities, studied in 100 m² squares, are 140 for *E. vesicaria* (occasional observations) and 42 for *B. asperum* (12 quadrats sampled). *B. asperum* abundance is very probably not a limiting factor, as the plants are usually abundant in the species habitat, but scrub invasion can easily overgrow it and therefore cause its disappearance in abandoned areas. *E. vesicaria* is very common in traditional cultivations, but quite rare in the fields where the species normally flies. These cultivations remain uncultivated for more than two years and this can be important for the species, as they can become a good source of *E. vesicaria* seeds. Some years, *E. vesicaria* is very hard to find in the biotope, probably as a result of the lack of early autumn rain. In such years *E. bazae* is difficult to see in the Hoya de Baza, despite late winter or early spring rain. A repeated overwintering of pupae could be the cause of this observation.

Rosmarinus officinalis is the most frequent nectar source for the adults in March and April, but in May the most visited plant is *Eruca vesicaria* (J Olivares observation in Hoya de Baza, Fig. 14).

Figure 10. Eruca vesicaria*, the larval foodplant of* Euchloe bazae *in the Hoya de Baza, Granada Province (photo J Olivares).*

EGGS are laid one by one on the leaves of the food plant. Typically one egg is laid per plant, but occasionally more eggs can be laid on the same plant. The females from the Hoya de Baza populations prefer to lay eggs on isolated *E. vesicaria* plants that are close to "esparto" (*Stipa tenacissima*) shrubs, as seen in Fig. 10.

Figure 11. Boleum asperum*, the larval foodplant of* Euchloe bazae *in the Monegros region (photo ML Munguira).*

THE LARVA feeds on the leaves (Fig. 4), the flowers and on the developing fruits of the food plant. First instar caterpillars always feed on the axil of the leaves (Fig. 10). This fact would explain why *E. bazae* is only found in areas with little rain and frequent wind, as rain drops should be evaporate very fast, in order to avoid drowning of the very small caterpillars. The caterpillars develop very quickly and when they are fully grown descend to the base of the plant to pupate, although in captivity the chrysalis is always found on dry branches of the plant.

Figure 12. First instar larva of Euchloe bazae *feeding on the axil of the leaf of* Eruca vesicaria *in the Hoya de Baza (photo J Olivares).*

THE PUPA is the overwintering stage, but a low proportion of the specimens (25% under laboratory conditions) develop directly in the spring and produce a partial second generation of adults in May. The overwintering pupae, spend in this phase most of their life, taking about ten months to reach the adult stage.

NATURAL ENEMIES: these are poorly known but the wasp *Cotesia ancilla* (Hymenoptera, Braconidae) has been recorded as a parasitoid of the larvae (Garcia-Barros et al. 2013).

Population

Adult *Euchloe bazae* numbers were estimated from transect counts of 1 km length and 5 m width, during the years 2013 and 2014 in five localities of the Hoya de Baza (Granada) and five of the Monegros area (Aragon). The average numbers were significantly lower for the Hoya de Baza (1.9 adults per km, 16 counts) than for the Monegros area (8.3 adults per km, 11 counts) (Fig. 13). Both averages are also low when compared to other species studied during this project with the same method: e.g. *Polyommatus golgus* 20.5 adults/km, *P. violetae* 21.5 ad./km and *Agriades zullichi* 33 ad./km. These values show that adult densities are very low for this species, particularly in the Hoya de Baza, where numbers have already been reported to decline (Olivares & Jiménez, 2008). Four visits by two different recorders (R Vila and ML Munguira) to Granja d'Escarp in Catalonia, during the months of March and April of the years 2013 and 2014, produced no adult sightings, supporting the idea that this population has become extinct since its discovery in 1994 by Pérez de Gregorio. This is the easternmost population of the species (see Fig. 6).

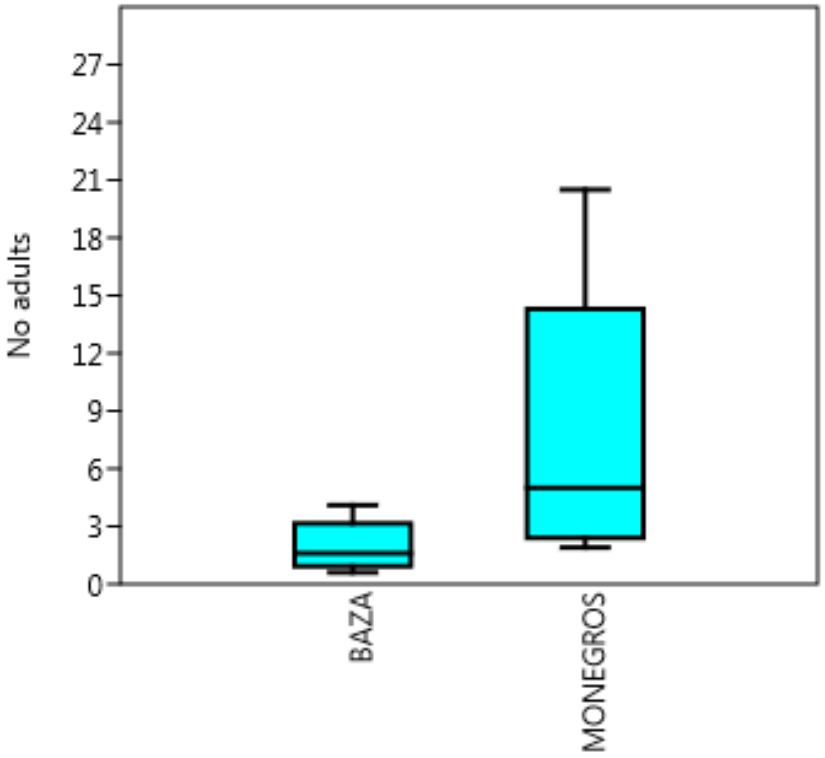

Figure 13. Boxplots of the adult counts of Euchloe bazae *in two different areas: Hoya de Baza in Andalusia (16 counts) and the region of Monegros in Aragon (11 counts). Counts for the years 2013 and 2014 were grouped in the graph for both regions. Values represent the number of adults on transects of 1km length.*

Conservation

Legal protection

Euchloe bazae is not protected legally at a regional, national or European level, despite its high conservation value. Moreover, none of its populations is within the boundaries of a protected area. It is one of the five species that is not found in Spain in the areas of the National Network of Protected Areas (Romo et al., 2006). The other species not in the network are *Gegenes pumilio, Pyrgus cinarae, Satyrium pruni*, and *Boloria napaea.*

Conservation status

Euchloe bazae has been listed in the following Red Data Books and Endangered Species Lists.

- Red Book of the Invertebrates of Andalusia (Barea-Azcón et al., 2008): VU B2ab (iii, v) C2a(ii)
- Spanish Invertebrates Red Data Book of the (Verdú & Galante, 2006): NT
- European Red List of Butterflies (van Swaay et al., 2010): VU
- IUCN Red List: VU B2ab(v) (The IUCN Red List of Threatened Species. Version 2014.3).

Figure 14. Euchloe bazae *feeding on its preferred nectar plant* Rosmarinus officinalis*, Hoya de Baza, Granada (photo J Olivares).*

Threats

Because *Euchloe bazae*, especially the populations in Hoya de Baza, has a very restricted distribution range and very low population densities, any threats can have impact with a relatively much more damaging effect.

The threats that have been compiled in the literature are the following (Fig. 15):

- Afforestation with *Pinus halepensis*
- Illegal waste disposal on the habitat of the species
- Wildfires
- Low population numbers
- Changes in land use causing agricultural intensification
- Urban development
- Overgrazing by sheep and goat

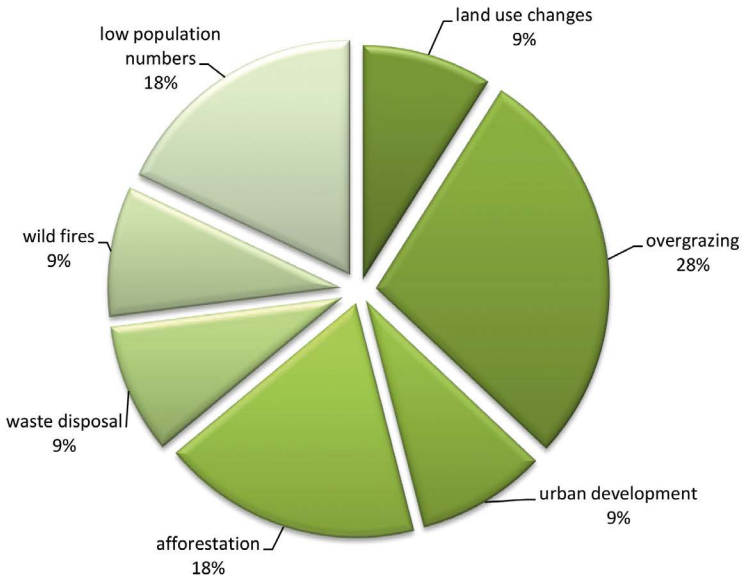

Figure 15. Percentage of the number of times that threats were mentioned in literature for Euchloe bazae.

During the years 2013 and 2014, threats were recorded in six locations in Hoya de Baza and ten in Monegros area (Table 1 and Fig. 16). The analysis included Granja d'Escarp in Catalonia, where the species is considered to be extinct.

In **Hoya de Baza** area most of the locations showed no evident threats. In one area pine plantations with *Pinus halepensis* is a threat for the habitat of the species. Another area was considered to be threatened by grazing.

The **Monegros** populations were threatened mainly by abandonment (five of the visited sites), with grazing, conversion of part of the habitat to arable land and pine plantations observed in two locations for each threat.

There is considerable difference between the threats reported during fieldwork and those mentioned in the literature (Figs. 15 and 16). Urban development, fires and waste depossition were not detected in our study while abandonment was not even mentioned in the literature, most probably because this threat was not considered as such in the near past. Another threat is the land use change related to illegal waste disposal, which changes the quality of the habitat and its characteristics. This is happening because semiarid areas, where the species lives, are often considered useless places.

Table 1. The threats per area recorded during the fieldwork years 2013 and 2014 for all studied locations of Euchloe bazae*. UTM coordinates and altitude are given for each location.*

LOCATION	UTM COORDINATE	ALTITUDE (m)	THREATS
HOYA DE BAZA			
Barranco del Espartal	30SWG25	858	None
Rambla de los Alamillos	30SWG35	909	Grazing
Barranco Mazarra	30SWG35	875	None
Barranco Cuevas Aquilón	30SWG35	863	Pine plantations
Las Hermanillas	30SWG35	851	None
Galera	30SWG37	942	None
MONEGROS			
Granja d'Escarp	31TBF78	109	Abandonment
Caspe I	31TBF56	224	Grazing
Caspe II	31TBF56	174	Grazing, conversion to arable
Caspe, Río Guadalope	31TBF46	160	Abandonment
Peñalba I	30TYL49	290	Pine plantations, abandonment
Peñalba II	31TBF49	250	Abandonment
Candasnos I	31TBF59	280	Abandonment
Candasnos II	31TBF59	200	None
Barranco de Valcuerna I	31TBF59	220	None
Barranco de Valcuerna II	31TBF59	250	Conversion to arable

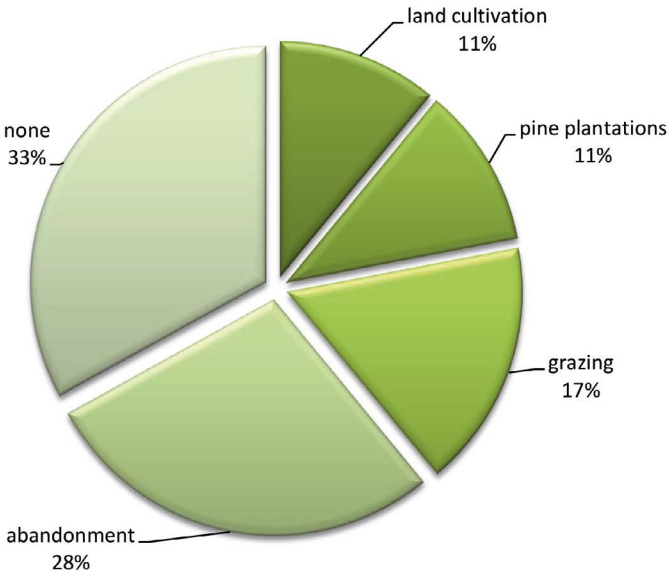

Figure 16. Percentage of the number of times that threats were registered for the habitats of Euchloe bazae *during fieldwork in the years 2013 and 2014.*

Abandonment of the fields in Monegros allows shrubs to grow, which shadows the larval foodplant and eventually cause its disappearance or at least its severe density reduction (Fig. 17). This is the main threat observed during fieldwork (28% of the records) and it may jeopardise the future of some of the Monegros populations of *Euchloe bazae*.

Figure 17. Habitat of Euchloe bazae *in Candasnos (Huesca Province, Aragon), where the growth of bushes following the abandonment of the land is already shadowing the larval foodplant of the species (*Boleum asperum*, with pale yellow flowers) (photo R Verovnik).*

Grazing is probably not a serious threat because most of the grazing taking place in the species habitat is extensive, done by sheep and goats foraging over wide areas. However, it was mentioned in 28% of the cases in the literature, being the most cited cause of concern. This apparent paradox relies on the fact that grazing animals can cause serious damage on the habitat of the species when food becomes scarce, which is quite frequent in the dry sub-steppe areas where the butterfly lives.

Pine plantations and land cultivation were both detected in 11% of the studied sites. Cultivation implies the conversion of noncultivated fields to arable land and the plantation of olive or almond trees that can benefit from irrigation schemes. Although the land where *E. bazae* lives has a very low productivity, further expansion of the newly cultivated arable fields can pose a real threat by reducing the size of the potential breeding area. In some parts of the Hoya de Baza irrigation projects are being developed and it is important that these schemes are not extended towards the habitat of *E. bazae.*

Pine plantations have also been detected in one locality from each of the two areas in which the butterfly is present. The growth of a pine forest would result in the total disappearance of the habitat of the species because both larval foodplants need open areas to survive.

Recent extensive changes in land use were detected during the end of 2014 and the beginning of 2015. Some habitat was destroyed 1 km north of Las Hermanillas population, one of the best sites of the Hoya de Baza. Impacts have taken place over a very large area (ca. 0.5 km²) and have seriously damaged suitable *E.bazae* habitat (Fig. 18).

Figure 18. Excavation and trucking on a large area north of Las Hermanillas population of Euchloe bazae *in the Hoya de Baza area (photo J Olivares).*

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 to overcome the main threats that the species is facing. The actions have been discussed with the personnel from the Junta de Andalucía, which is responsible for the conservation of the species at the regional level.

It is essential to monitor the populations of the species, as mentioned for some of the following specific actions, 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 or reduce their impact to a minimum. Some precautionary measures are also mentioned in the following sections.

Legal protection

As mentioned earlier, despite its high conservation value, *Euchloe bazae* is not protected legally. Barea-Azcón et al. (2008) and van Swaay et al. (2010) classified the status of this species as Vulnerable. It is of high priority to legally protect the species in Andalusia and Aragon, and we suggest that the species is included in the regional lists of protected species of these two regions.

Action:

Include *Euchloe bazae* in the Andalusian Catalogue of Threatened Species (*Catálogo Andaluz de Especies Amenazadas*) and the Catalogue of Threatened Species of Aragon (*Catálogo de Especies Amenazadas de Aragón*).

Protected areas

None of the areas where *Euchloe bazae* occurs is protected (Romo et al., 2007). The creation of protected areas for the species specifically is therefore needed **urgently**. The regime of the protected area(s) should consider the ecological requirements of the species and the management activities needed to maintain the habitats, and therefore the species populations, in a favourable status. The protected area status would greatly help the implementation of relevant conservation actions.

The protection of two areas in the regions where the species is present is strongly recommended, and we propose the creation of a protected area in Barranco del Espartal (Baza area, Andalusia) and Barranco de Valcuerna in Aragon (Fig. 19). The protection of these two areas could follow the type of Ecological Reserve (*Reserva Ecológica*) and would need an agreement with the owners of the land. This would only be possible with the involvement of the authorities from the regional governments of Andalusia and Aragon. The steppe-like areas where the species lives are also good for steppe birds and joint action with bird conservation organizations is needed to produce effective results.

Action:

Protect areas in Barranco del Espartal (Hoya de Baza, Andalusia) and Barranco de Valcuerna (Monegros, Aragon).

Figure 19. Barranco de Valcuerna (Huesca Province, Aragon), where the creation of a protected area to preserve the habitat of Euchloe bazae *is proposed (photo R Verovnik).*

Conservation measures

The suggested actions aimed to attain a favourable conservation status for *Euchloe bazae* are summarized below:

High priority:

- Ensure extensive grazing of the abandoned land and control for overgrazing on the areas where the species lives.
- Prevent pine plantations and the conversion to arable land (cereal, olive or almond plantations) in the species habitats.

Medium priority:

- Start a captive breeding programme for species reinforcement and test the possibility of introducing the species in new suitable areas.
- Continue with adult censuses of the species to follow up the effectiveness of conservation measures and the status of the populations.
- Raise public awareness by producing information leaflets and panels in the main areas where the species lives

ABANDONMENT AND GRAZING

Abandonment has been reported to be the major threat for the species, but it is a problem only in the populations of the Monegros area. Extensive grazing seems to be necessary for the maintenance of a good quality habitat. Clearing the scrub in overgrown areas will be necessary for some populations such as Granja d'Escarp, where the population might have already become extinct. Grazing, preferably with sheep (Fig. 20), would be necessary to keep or improve the quality of the habitat in the abandoned areas.

If Barranco de Valcuerna is declared a protected area, an extensive grazing regime should be implemented to preserve and maintain the adequate habitat for the species. For the populations threatened by abandonment, this action is of **high** priority.

On the other hand, in Hoya de Baza, overgrazing has been mentioned as a cause of concern for one site. Government officials from the Junta de Andalucía must keep control over the grazing regimes on key areas to prevent possible overgrazing. Special care should be taken in the Rambla de los Alamillos, where this threat has been reported. For this population in Hoya de Baza the priority of this action is **high**.

Figure 20. Habitat of Euchloe bazae *in Caspe (Zaragoza Province, Aragon), extensively grazed by sheep (photo ML Munguira).*

CAPTIVE BREEDING

Captive breeding would be a way to mitigate the threatening effect of the current low population numbers, particularly in the Hoya de Baza region. Field collected females can be used to obtain eggs given suitable indoor breeding conditions. These eggs could be used for a small scale breeding programme to provide adults that can be used to reinforce the populations with low numbers (e.g. Rambla de los Alamillos or Barranco de Cuevas de Aquilón, with 1 adult per km of transect). There are also opportunities to introduce the species to new sites close to the Hoya de Baza, which have been discussed with officials from the Junta de Andalucía and the property of Cortijo Conejo Becerra, owned by the Junta. The larval food plant *Eruca vesicaria* is abundant in this area. Preliminary research should be undertaken to select suitable sites and decide if this approach is appropriate (see below). Research could be conducted by experts on *E. bazae* but the local environmental agencies should also be involved and give the necessary permission for the development of this activity.

The priority of this action is **medium** and it would take time to be fully implemented after research is completed and permissions are obtained.

PINE PLANTATIONS

Pine plantations were mentioned as a threat in the Barranco de Cuevas Aquilón (Baza) and Peñalba (Monegros). Avoiding pine plantations on esparto grasslands within the distribution range of the species is necessary in order to conserve the habitat of *Euchloe bazae*. The coniferous forests resulting after planting change the natural characteristics of the habitat and the exclusive species that depend on the esparto grasslands disappear.

Relevant authorities from the Gobierno de Aragón and the Junta de Andalucía should avoid planning new pine plantations in the areas where the species occurs. The precise distribution information gathered by the present project will be available to help the officials in preventing plantations on sensitive areas (Fig. 21).

Due to the serious effect of new plantations on the butterfly's populations, the priority of this action is **high** and it should continue to be monitored closely in the future.

*Figure 21. Scattered pines (*Pinus halepensis*) are not a threat for the habitat of* Euchloe bazae*, but more dense plantations cause erosion and destroy the semiarid vegetation with* Boleum asperum *in which the butterfly survives. Barranco de Valcuerna (Huesca Province, Aragon) (photo ML Munguira).*

CONVERSION TO ARABLE LAND

In most of the species range, the habitat of *Euchloe bazae* is interspersed with arable land (Figs. 8 and 22). In the majority of the cases, crops are restricted to the bottom of the valleys and the high plateaus, leaving the steep slopes available as habitat for the species. In two localities of the Monegros area, in the Barranco de Valcuerna and Caspe, the extension of arable land has been reported as a threat. If the arable land is kept in its current state and irrigation schemes are not developed, the situation can remain favourable for the species survival. However, new plantations or irrigation programmes could considerably reduce the habitat for the species and should be avoided. This case is similar to what has been said about pine plantations. Thus, cultivating new areas and increasing the arable land at the expense of *E. bazae* habitat needs to be prevented.

The priority of this measure is also **high**, due the irreversible impact of new crops, and should be considered in the long term by land planning officials.

Figure 22. Arable land in the high plateaus and the valleys in the proximity of the habitat of Euchloe bazae *in Barranco de Valcuerna (Huesca Province, Aragon) (photo ML Munguira).*

Research

Adult censuses

Our knowledge on population numbers is still very limited. For Hoya de Baza populations declines have been reported, while in Monegros area, a population has presumably become extinct. Therefore population studies should be carried out to improve our knowledge of the population dynamics of the species. Adult censuses in the Monegros and Baza regions should be continued in order to detect the fluctuations or further declines in populations. This task is considered of **high** priority and can be carried out by volunteers and/or experts.

Distribution

The small scale distribution of the species is far from being totally understood. Information on new sites can be gathered by the entomological society of Aragon (Sociedad Entomológica Aragonesa) and from a current project that is mapping all Andalusian butterflies and is coordinated by experts from the Junta de Andalucía and amateur entomologists. Meeting with local people, who are concerned with the survival of the species, is necessary in order to encourage them to improve the knowledge about its distribution and density.

The priority of this action is **high**.

Captive breeding

The possibilities of captive breeding for the introduction of the species in nearby sites and/or population reinforcement should be assessed thoroughly before being implemented. An obvious target is the Hoya de Baza area in order to counteract the decline of the species. It should involve:

- Breeding of larvae until the adult stage emergence.
- Location of suitable sites in the Cortijo Conejo Becerra, a property of the Junta de Andalucía.
- Adult releases in the new suitable sites.
- Reinforcement of the populations in Barranco del Espartal and Cúllar.

The priority of this action is **medium**.

Public awareness

General information and ideas about the protection of the species for visitors to the areas where the species lives could encourage the involvement of the public and eventually their support for the conservation actions.

- Information leaflets will be produced during 2015 with information about the importance of the species and its conservation. Actions already taking place for the recovery of the species will be specified. They will use non-technical language, showing pictures of the species and its habitat. Leaflets will be available at tourist information centres of the towns that are close to the habitat of the species: Baza, Galera, and Caspe. They will be published in both English and Spanish. This action is of **high** priority and will be implemented as part of this project.
- Publish information in 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** and the time of application will continue in the following years, in order to share the news on the developments and the lessons learned.
- Produce and place information panels in the proposed conservation areas of Barranco del Espartal (Baza area) and Barranco de Valcuerna in Aragon, with information about the importance of the species and its conservation. Panels will contain general information on the importance of the butterfly fauna in each area, the main threats the species face and what the visitors to the area can do. This action is considered of **high** priority and will be implemented during 2015.
- Power Point presentations should be produced for training courses that usually take place for environmental officers, wardens, and local naturalists. They would include information on the species already gathered during this project and will be available to environmental officers. Priority of this action is **low**.
- Media releases (newspapers) with contents related to the recovery of *Euchloe bazae* have already taken place during the project and will need to be continued in the future. Priority is **intermediate** and long term.

Acknowledgements and literature

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Científicos. Los participantes en las jornadas de estudio sobre lepidópteros en peligro, celebradas en la sede del Parque Nacional de Sierra Nevada.
:: J. E. GÓMEZ

Estudian mariposas amenazadas

En Granada vuelan las cuatro especies españolas en peligro sobre las que trabaja la organización internacional Butterfly Conservation Europe

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