

New data concerning the butterfly fauna (Lepidoptera, Papilionoidea) of Veglia – Devero Natural Park and its surroundings (northwestern Italian Alps)

Andrea Battisti*, Raluca Vodă*, Matteo Gabaglio, Cristiana Cerrato, Radames Bionda, Paolo Palmi & Simona Bonelli

*contributed equally

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Abstract

Species inventories represent a key instrument by which the biodiversity of an area can be better understood and are essential in developing optimal management plans for conservation. We present an annotated checklist of the butterfly fauna (Lepidoptera, Papilionoidea) of the Special Area of Conservation Alpi Veglia – Devero – Monte Giove, in the northwestern Italian Alps. The checklist represents the result of research carried out by the authors from 2003 to 2018. We identified 107 species (36.9% of the entire Italian butterfly fauna), eight of which are reported for the first time in the study area. Four species (*Erebia christi*, *Maculinea arion*, *Parnassius apollo*, *P. mnemosyne*) represent taxa of conservation concern that are included in the European Habitats Directive 92/43/EEC. We recorded a notable percentage (12.2%) of Alpine endemic species and a high number of species of the genus *Erebia* (17 species, 15.9%), including two highly localized Alpine endemics: *E. christi* and *E. flavofasciata*. We report new localities for these two species, discuss in more detail 19 species of particular interest, and for all species we provide information about their distribution and conservation status in the study area.

Profile

Protected area

Special Area of Conservation Alpi Veglia – Devero – Monte Giove

Mountain range

Alps

Country

Italy

Introduction

Alpine regions encompass a variety of environments that are responsible for a rich biodiversity. But in recent decades, climate change and human land use have started to alter some of these environments, and species adapted to particular conditions have been declining considerably (Nagy et al. 2003). Studying these regions and their fauna is thus of outmost importance in order to better understand and protect them. There are still many knowledge gaps concerning the diversity of alpine species, in particular regarding arthropods, which play a key role in ecosystem functioning, due especially to their remarkable biomass and species richness (Wallace & Webster 1996). Many arthropod species are also considered good bioindicators, since they respond promptly to disturbances in their environment (Gerlach et al. 2013). Such characteristics have made them model organisms in studies that evaluate the impact of habitat loss and fragmentation as well as the effects of climate change, two well-known factors related to biodiversity impoverishment, particularly in alpine environments (Beniston 2003; Ceballos et al. 2015). Monitoring biodiversity in protected areas has been used both as a valuable tool to ascertain the effectiveness of protection measures and to provide fundamental data for their successful management. Butterflies are one of the main groups that are currently the focus of country-based monitoring schemes and reintroduction campaigns (van Swaay et al. 2010; Dincă et al. 2018).

The alpine sector in northern Piedmont, Italy comprises some of the most important Prime Butterfly Areas in Europe, characterized by a high rate of endemism and the presence of species of conservation concern, such as *Erebia christi* (Rätzer, 1890) and *E. flavofasciata* (Heyne, 1895) (Balletto et al. 2010). Both these species and several others occur in Alpe Veglia and Alpe Devero, one of the 32 Prime Butterfly Areas in Italy (Van Swaay & Warren 2006). Although the butterfly fauna occurring here has been studied and monitored in recent years (Balletto et al. 2005; Palmi 2010; Viterbi et al. 2013; Battisti & Gabaglio 2016, 2017), there are still large knowledge gaps regarding the distribution and conservation status of many of the species present within this protected sector.

For our study area, we chose the Special Area of Conservation (SAC) and Special Protection Area (SPA) IT1140016 Alpi Veglia – Devero – Monte Giove (from now on, we refer to these two areas combined as the VDMG); the VDMG also includes the Alpe Veglia – Devero Natural Park (VDNP) (see Figure 1).

The main goals of the present work are to improve knowledge regarding the butterflies in VDMG and thus to aid the management and conservation of species characteristic of alpine ecosystems, particularly those that belong to endangered taxa.

Material and Methods

The entire study area covers 15 119 hectares, with an altitudinal range of 915 to 3553 m (only 272 ha

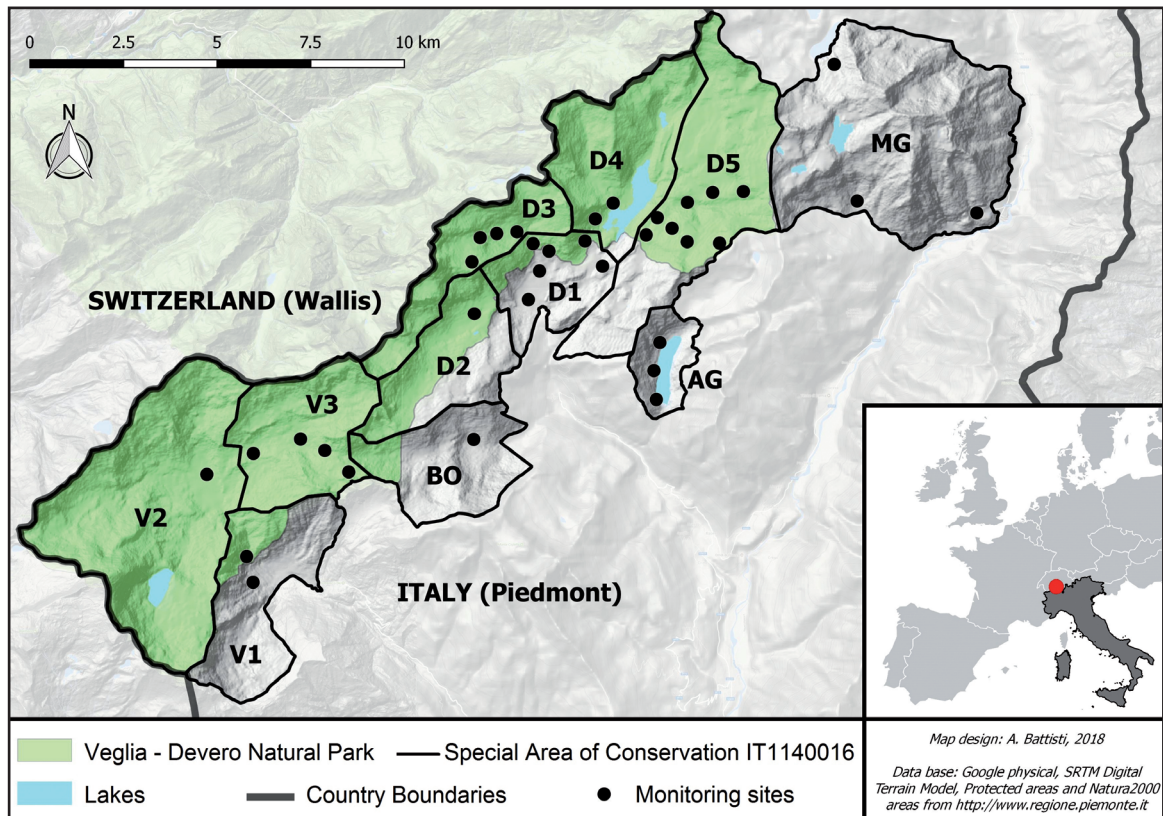


Figure 1 – The study area (Special Area of Conservation IT1140016) divided into eleven sectors, and the sampling localities shown as black dots. The codes of the sectors and localities are provided in Table 1.

are below 1400 m). This is one of the coldest regions in northwestern Italy and is generally very rainy, with more than 1300 mm/year precipitation (Cagnazzi et al. 2007). The area hosts a high diversity of environments, including five priority habitats listed in Annex I of the Habitats Directive, characterized by *Nardus* grass formations, *Pinus mugo* and *Arctostaphylos uva-ursi* scrublands, peat bogs, and Alpine pioneer formations of *Caricion bicoloris atrofuscae*; small patches at lower altitudes host alluvial forests of black and white alder and white willow.

The field research was conducted from 2003 to 2018. Species occurrence and community data for the butterfly fauna were gathered as part of three different projects:

1) *Animal biodiversity monitoring in the alpine environment*, a project that also included the study of other protected areas in the Alps, which used the same methodology for gathering data (Viterbi et al. 2013). Standardized monitoring was done for five years (2007–2008, 2012–2013 and 2018) in 18 sampling plots along fixed-route transects of 200 m, located at different altitudes (from 1350 to 2800 m), as described by Pollard and Yates (1993);

2) *Monitoring of E. christi*, initially as part of the European project LIFE02NAT/IT/8574, from 2003 to 2005 (Balletto et al. 2005), and within the project *E. christi monitoring*, from 2015 to 2018 (Battisti & Gabaglio 2016; 2017). For both projects we also col-

lected data on the entire community of butterflies from all sampling localities in the study area, applying the same methodology as referred to in point 1) (Figure 1, Table 1);

3) *Personal observations* made by Paolo Palmi, some of which were included in Palmi (2010), the first published contribution regarding the butterfly fauna of the VDNP.

Species identification was done mainly in the field; several specimens belonging to more difficult taxonomic groups (*Pyrgus*, *Plebejus*, *Melitaea* and *Erebia*) were collected and identified based on genitalia examination. For the taxonomy of species, we followed the nomenclature proposed by Balletto et al. (2014).

Results

We recorded 107 species of butterflies, representing 36.9% of the entire Italian butterfly fauna according to Balletto et al. (2014) (Table 2). Eight species are reported in this study area for the first time: *Apatura iris*, *Argynnis adippe*, *Cacyreus marshalli*, *Gonepteryx rhamni*, *Inachis io*, *Iphiclides podalirius*, *Maniola jurtina*, and *Nymphalis polychloros*. We did not record three taxa previously reported by Ramella (2003): *Leptidea sinapis*, *Coenonympha arcania* and *C. gardetta*. Ten species (*C. darwiniana*, *E. christi*, *E. flavofasciata*, *E. melampus*, *E. mnestra*, *E. tyndarus*, *Lycaena eurydame*, *Oeneis glacialis*, *Par-nassius phoebus*, *Pyrgus carlinae*) occur exclusively in the

Table 1 – Main localities investigated from 2003 to 2017. Codes refer to the eleven monitored sectors in the study area.

Codes	Macro-Area	Localities monitored
V1	Alpe Veglia	Conca di Nembro (1 350 m), Strada per Veglia (1 400–1 600 m)
V2	Alpe Veglia	Alpe Veglia (1 700 m)
V3	Alpe Veglia	Pian dul Scric (1 900 m), Pian Sass Mor (2 100 m), Passo di Valtendra (2 500 m), Cima di Valtendra (2 600 m)
D1	Alpe Devero	Piana di Devero (1 600–1 700 m), Crampiolo (1 700–1 800 m), versanti Pizzo Stange (1 900m), Alpe Campello, Sentiero della Rossa (1 700–1 900), Pareti Sentiero della Rossa (1 800–2 000 m)
D2	Alpe Devero	Val Buscagna (1 900–2 500 m)
D3	Alpe Devero	Piani della Rossa (2 150 m), morene della Rossa (2 350 m), Ghiacciaio della Rossa (2 500–2 800 m), Pizzo Bandiera (2 800 m)
D4	Alpe Devero	Lago di Devero (1 800–2 100 m), Conoide Val Deserta (1 800–2 200 m)
D5	Alpe Devero	Corte Corbernass 1 (1 900 m), Corte Corbernass 2 (2 200 m), Corte Corbernass 3 (2 400 m), Torbiera Corbernass – Valle (2 000 m), La Valle 1 (1 900 m), La Valle 2 (2 200 m), La Valle 3 (2 500 m), Punta della Valle (2 600 m)
BO	Valle Bondolero	Val Bondolero (1 500–2 100 m)
AG	Valle Agaro	Diga di Agaro (1 600 m), sentiero Lago di Agaro (1 600 m), Conca del Lago di Agaro (1 600–1 900 m)
MG	Monte Giove	Alpi di Vova (1 400–1 600 m), Lago Antillone (1 250 m), Valle del Vannino (2 000–2 200 m)

Alps, while three more (*E. montana*, *E. pluto*, *Melitaea varia*) have an Alpine-Appennine distribution, giving a total endemism rate of 12.2%. The genus *Erebia* was the most represented (17 species, 15.9%), with three species (*E. christi*, *E. flavofasciata* and *E. tyndarus*) having a highly localized distribution in the central Alps. Ten species are of conservation concern at European level, of which four are included in Annex II and / or Annex IV of the Habitat Directive 92/43/EEC (*E. christi*, *Maculinea arion*, *Parnassius apollo*, *P. mnemosyne*) (Table 2). Among all species occurring in the study area, only *E. christi* is ranked as Endangered, and only *E. flavofasciata* as Vulnerable in the Italian red list, while *C. marshalli* is Not Assessed; the rest of the species are considered as Least Concern (Bonelli et al. 2018). Among those of Least Concern we recorded *L. eurydame*, *L. subalpina*, *M. rebeli*, *Aricia allous*, *E. glaciegenita* and *C. darwiniana*, which are not listed in the European assessment since they are not considered good species (Karsholt & Nieukerken 2013).

Discussion

Although the arthropods occurring in VDMG have been studied and monitored in recent years, there are still large knowledge gaps regarding the distribution and conservation status of many of the species known to occur within this protected area. Research is presently limited to a few orders: Lepidoptera (Ramella 2003; Palmi 2010; Battisti & Gabaglio 2017; the current study), Orthoptera (Battisti et al. 2016), Coleoptera (Meregalli 1985; Giuliano 2009; Allegro et al. 2010), Odonata (Bionda et al. 2013) and Hymenoptera (Castracani 2014), but even for these groups, information needs to be updated and improved.

We have been investigating the butterfly fauna of this protected area for the last 15 years. Similar monitoring activities have been carried out in other protected areas in the Italian Alps, but a direct comparison between their faunas and that of VDMG cannot be made due to the different monitoring procedures, size of the area investigated, different altitudinal range, or because

the data have not yet been published. However, published data on butterflies are available for two areas with a similar alpine environment and mean sampling altitude: Mont Avic Natural Park in the western Alps (Pensati 2007–2008), and Stelvio National Park (NP), central-eastern Alps (Bonifacino et al. 2017). When comparing the rates of endemic and sub-endemic species among the three areas, VDMG has the highest number of Alpine-Appennine endemics, with 13 species (representing 12.2% of the total number of species), while Stelvio and Mont Avic have 12 (8.3%) and 8 (11.3%) endemic species, respectively. This is a high percentage for VDMG, considering that Stelvio covers an area nine times greater than VDMG. The composition of endemic species is similar among the three protected areas, with the exception of *E. christi* and *E. flavofasciata*, reported only for VDMG, *E. styx*, present only in Stelvio NP, and *P. carlinae*, which is absent from Mont Avic Natural Park. The two *Erebia* occurring in VDMG are the most emblematic species not only for our study area, but also at a global scale, given their endemic status and restricted distribution. Both species, but in particular *E. christi*, need special conditions in order to survive, conditions that are probably not met in any other areas in Italy, including apparently similar habitats such as Stelvio NP or Mont Avic Natural Park. These species may have remained isolated, after the last periods of glaciation, in peripheral non-glaciated areas (Schneeweiss & Schönschwetter 2011).

In VDMG we also recorded a fairly high number (four) of species of European conservation concern; thanks to these results, new conservation measures have been implemented for the Special Area of Conservation IT1140016 *Veglia Devero – Monte Giove*. Therefore, since 2017 it has been forbidden to collect butterflies inside this area (Art.43 e 44, D.G.R. n. 21/4635, 6 February 2017).

Below, we discuss in more detail 19 species of particular interest for the study area.

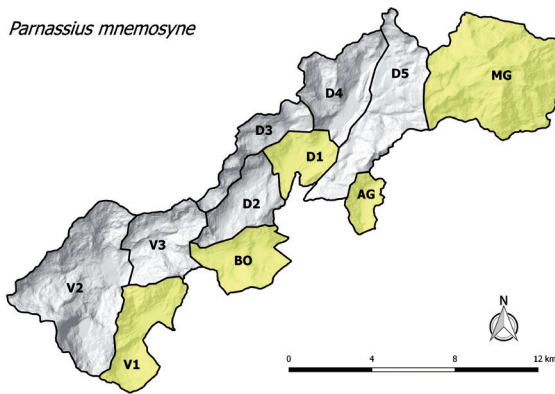


Figure 2 – Distribution of *Parnassius mnemosyne* in the study area and a specimen photographed in sector BO. © Battisti

New species for the study area

Argynnis adippe, *Apatura iris*, *Gonepteryx rhamni*, *Inachis io*, *Iphiclides podalirius*, *Maniola jurtina* and *Nymphalis polychloros*

As these can be common local species and relatively easy to identify in the field, it is surprising that they were not recorded before. However, these taxa are more common at lower altitudes, usually below 1 200 m; while the lowest altitude in our study area was 915 m, this relatively low altitude was found only in the Monte Giove sector where it covers an area of about 70 ha only. These factors would explain the sporadic occurrence of the species within VDMG, although because of climate warming the species may become more common in the future.

Cacyreus marshalli

Some invasive Lepidoptera can become pests in areas where they are introduced. Identifying and monitoring such species can be especially important for agriculture, horticulture and garden centres, as well as forest managers. One such pest on *Pelargonium* species is the South African butterfly *C. marshalli*. This

species was introduced in the 1990s in the Balearic Islands and spread rapidly throughout the Mediterranean (Tshikolovets 2011). In VDNP, we recorded this species for the first time in 2015 on flowers of *Pelargonium* spp. Three specimens were observed at 1 640 and 1 700 m in the vicinity of houses, where often there are flowerpots with *Pelargonium*. While *C. marshalli* is only found occasionally in our study area, monitoring it is important since it can represent a potential threat for native *Geranium* plants and for other Lycaenid butterflies that use *Geranium* as larval host plants (Quacchia et al. 2008).

Species previously reported and not confirmed

Leptidea sinapis

This species has been reported only by Ramella (2003), based on a single individual observed in Alpe Devero at 1 640 m, on the 12 July 2001, the identification of which was based solely on external morphology. Although the specimen may indeed have been *L. sinapis*, the area could also host populations of *L. juvernica* and/or even *L. reali*, which are indistinguishable from *L. sinapis* if identification is based on external appearance alone (Dincă et al. 2013).

Maculinea rebeli

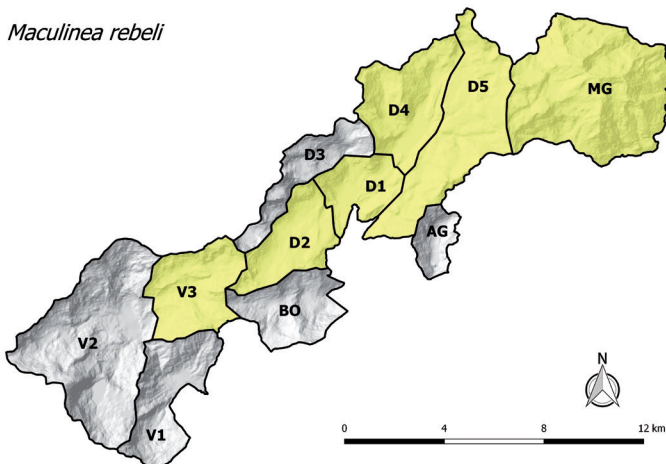


Figure 3 – Distribution of *Maculinea rebeli* in the study area and a specimen photographed in sector D2. © Palmi

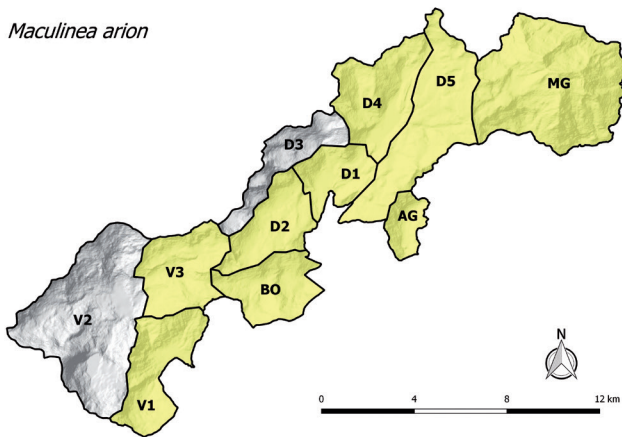
Maculinea arion

Figure 4 – Distribution of *Maculinea arion* in the study area and a specimen photographed in sector D4. © Battisti

Coenonympha arcania – *C. darwiniana* / *gardetta*

C. arcania was listed in Ramella (2003) for the study area based on five specimens observed before 1985. The specimens are stored in the Carlo Taccani collection at the Civic Museum of Natural History, Milan. The same author reported *C. gardetta* based on two individuals recorded in 2001 and 2002. We have never observed these two species in VDMG, but we have recorded *C. darwiniana*, which was a common occurrence. Recent studies on this group of species have suggested that *C. darwiniana* could be a hybrid of *C. gardetta* and *C. arcania*. However, the authors recommended species rank for all three taxa (Schmitt & Besold 2010).

Species of conservation concern

Parnassius apollo

P. apollo is listed in the Habitats Directive Annex IV, while in the red list of Italian butterflies it is treated as Near Threatened. It is also one of the two European butterfly species, the other being *Papilio hospiton*, listed in Appendix II of CITES, both of which occur in Italy. In the study area, *P. apollo* is widely distributed and does not seem to be at risk.

Parnassius mnemosyne

P. mnemosyne (Figure 2) is listed in the Habitats Directive Annex IV, while in the red list of Italian butterflies it is treated as Near Threatened. Inside the study area, *P. mnemosyne* is very localized, and since populations in the sectors investigated are all outside VDNP, this species should be closely monitored.

Maculinea rebeli

Although the *Maculinea* butterflies are among the most intensively studied insects in Europe, their taxonomy, and especially that of the *M. alcon* group, is still highly debated. Recent studies have reported constant genetic differences between the true *rebeli* (Hirscke 1904) from the type locality at high altitudes in Austria, and *M. alcon* (Berezcki et al. 2017). However, because of the low genetic divergence between them, it has been suggested that the taxon *rebeli* could be considered at most a subspecies of *M. alcon*. Moreover, only small genetic and morphological variations were found between the two ecotypes of *M. alcon*, the description of which was based on the larval host plants, *Gentiana penumonanthe* and *G. cruciata*. However, the genetic and morphological patterns found for the two ecotypes were consistent with their geographical distribution

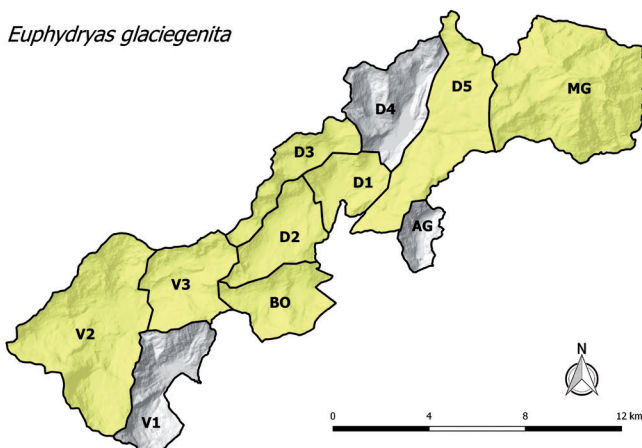
Euphydryas glaucigenita

Figure 5 – Distribution of *Euphydryas glaucigenita* in the study area and a specimen photographed in sector D5. © Bionda

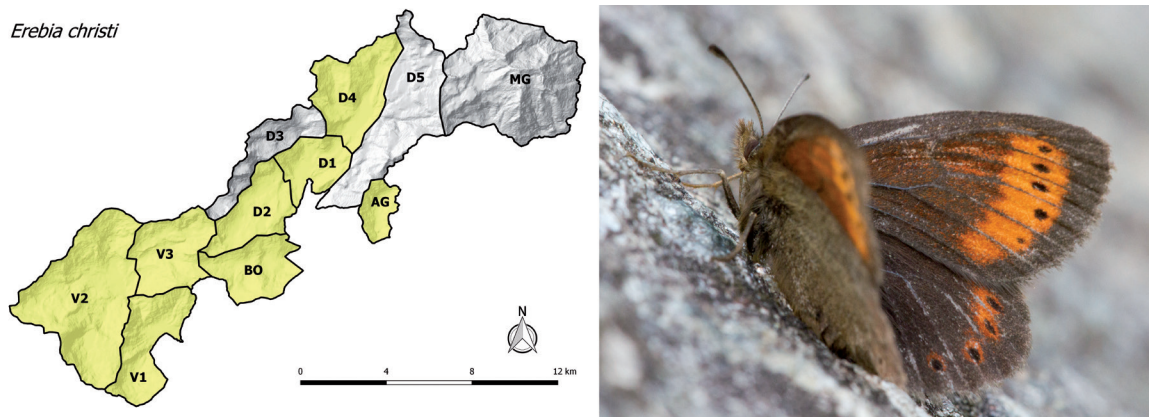


Figure 6 – Distribution of *Erebia christi* in the study area and a female specimen photographed in sector D4. © Battisti

and not with the host plants they use (Koubinova et al. 2017).

According to Palmi (2010), in VDNP, the *Maculinea* specimens belonging to the *alcon* group use *Gentiana nivalis* as their larval host plant. He also reported differences in male genitalia and described the subspecies *M. rebeli buscagnicus* (Figure 3). So far, no genetic studies have been conducted on this taxon, and since we followed the nomenclature of Balletto et al. (2014), we use the name *M. rebeli*. Further studies are needed to clarify the taxonomic status of the populations that occur in VDMG. This taxon is rare in the study area, but we found it each year at the monitored sites.

Maculinea arion

In Europe, *M. arion* has the highest number of dedicated conservation projects (Van Swaay et al. 2010) (Figure 4). The species is listed in the Habitats Directive Annex IV, and is classified as Endangered and as a SPEC1 species of European conservation concern (Van Swaay et al. 2011). In Italy, *M. arion* is widespread in the Alps and has no direct threats at higher altitudes. However, below 1000 m, it has become threatened because of habitat loss especially. In the study area, it is locally present in relatively good numbers, on grassy, south-east facing slopes.

Euphydryas glaciegenita

In Europe, *E. aurinia* is a complex of generally allopatric taxa, having distinct ecological requirements and slight differences in external morphology. The three entities occurring in Italy, *E. aurinia*, *E. glaciegenita* (Figure 5) and *E. provincialis*, are considered different Evolutionarily Significant Units (Casacci et al. 2014) and were evaluated separately in the Italian red list (Balletto et al. 2015). *Euphydryas aurinia* has been ranked as Vulnerable, mainly as a consequence of habitat destruction, while the conservation status of both the Mediterranean *E. provincialis* and the Alpine *E. glaciegenita* has been assessed as Least Concern (Bonelli et al. 2018). The latter taxon is widely distributed in the Alps, and in the study area it has no direct threats.

Erebia christi

E. christi (Figure 6) has one of the most restricted distributions among European butterflies, confined to an area of only 360 km², between Italy and Switzerland (Battisti & Gabaglio 2017). It is listed in the Habitats Directive Annexes II and IV, assessed as Vulnerable in Europe and Endangered in Italy. Recently it has been classified as SPEC1, an endemic species of European conservation concern (Van Swaay et al. 2011). The monitoring of *E. christi* in recent years has

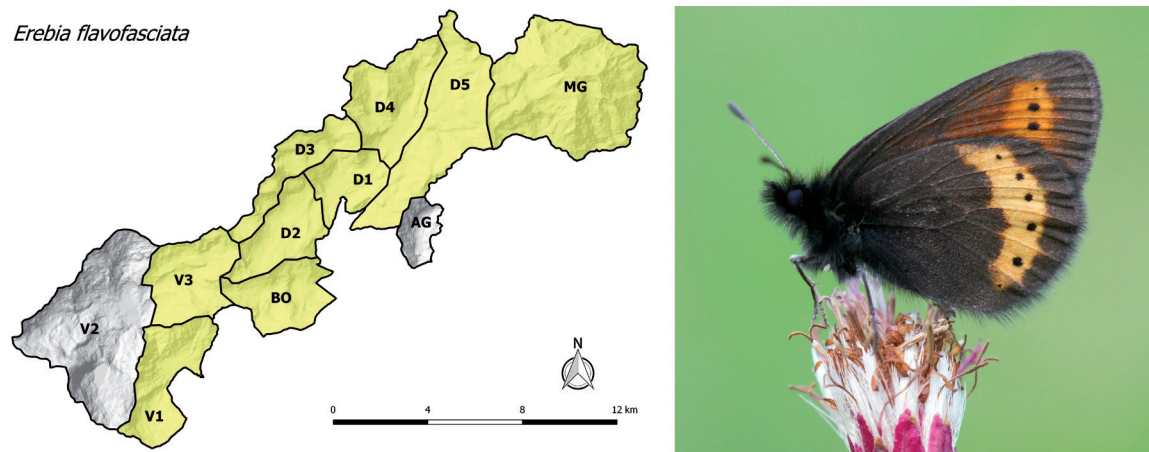


Figure 7 – Distribution of *Erebia flavofasciata* in the study area and a specimen photographed in sector D4. © Battisti

shown that the species is more abundant and has a wider distribution than previously thought (Leigheb et al. 1998; Battisti & Gabaglio 2017). In the study area, we report it for the first time in Bondolero Valley (sector BO), in the eastern part of the Alpe Veglia (sector V3), and in Buscagna Valley (sector D2) at 2350 m, the highest altitude ever recorded for this species. The biology and ecology of *E. christi* are still little known, and its conservation status should be carefully considered. Habitat alteration, following the widening of roads and paths, is probably one of the main threats for *E. christi* in the study area. Moreover, in Italy some populations occur in areas that are not protected, exposing them to higher risks and making their monitoring more difficult (van Swaay et al. 2012).

Erebia flavofasciata

E. flavofasciata (Figure 7) is an endemic of the central-western Alps, with a wider distribution than *E. christi*. It is less common in the central Alps and Austria, but more abundant on the western side of its range (Pfeifer & Burmann 1986; Pensotti 2004). It is classified as Near Threatened in Europe but as Vulnerable in Italy, where it is found only in a few localities.

We report it for the first time for VDMG in sectors BO, D2, D3, MG and V3. Inside the study area, it can be locally abundant: 64 individuals counted along a 200 m linear transect at 1900 m, on the 1 July 2016. We also confirm that *E. flavofasciata*, as well as *E. christi*, are more abundant every two years. No direct threats are known for *E. flavofasciata*, but due to its limited distribution it should be monitored, in particular the populations at lower altitudes (<1700 m).

Erebia mnestra

Palmi (2006) described the subspecies *E. mnestra de-verensis*, based on specimens collected in sectors V1 and D2 of our study area. This taxon is smaller than the nominotypic species, and both sexes lack the characteristic black spots on the dorsal part of the forewings. The subspecies can be found from the Simplon Pass (in the west) to Formazza Valley (in the east). *E. mnestra* is considered as Least Concern both in Italy and in Europe, and in the study area it does not face direct threats.

Conclusions

This article provides an updated checklist of the butterfly fauna occurring in the Special Area of Conservation *Veglia – Devero – Monte Giove*, which includes one of the 32 Prime Butterfly Areas in Italy. We recorded eight species for the first time in the region studied and several new localities for the rest of the taxa. Our observations indicate that *E. christi* and *E. flavofasciata*, two highly localized Alpine endemics, are more abundant and have a wider distribution than previously thought.

In order to preserve the entire butterfly diversity in the area studied, the existing suitable habitats for these

organisms should be protected, traditional management maintained, the construction of new infrastructure prohibited, and the illegal collecting of specimens prevented. Special attention should be given to ecological areas, but also to the herbaceous, south-east facing slopes between 1700 and 2400 m next to rocky walls, and to the immediate vicinity of peat bogs, some of the richest habitats for butterflies in VDMG.

This work underlines the importance of checklists for monitoring the biodiversity of an area and can also serve as a framework for future studies that investigate the effects of climate and environmental change on species distribution.

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Authors

Andrea Battisti*

is a conservation biologist who is particularly interested in species that are of conservation concern in alpine ecosystems. He works as a field researcher, studying butterflies, birds and biodiversity in general, especially those of protected areas in northwestern Italy. Ente aree protette dell'Ossola (Veglia – Devero Natural Park), Viale Pieri 13, 28868 Varzo (VB), Italy

Raluca Vodă*

is a postdoctoral researcher at Turin University. She is interested in the diversity and life history of butterflies. Her research focuses on various aspects of the

western Palearctic butterfly fauna, ranging from biogeography, systematics, ecology and conservation. Department of Life Sciences and Systems Biology, University of Turin, Via Accademia Albertina 13, 10123, Turin, Italy

Matteo Gabaglio

is a scientific illustrator and environmental biologist. He collaborates with various editors, focusing on environmental sustainability and the communication of science. As a biologist, his major interests are alpine biodiversity and butterfly conservation, with particular interest in endemic alpine species. Ente aree protette dell'Ossola (Veglia – Devero Natural Park), Viale Pieri 13, 28868 Varzo (VB), Italy

Cristiana Cerrato

is a conservation biologist who is interested in insect conservation and mountain ecosystems. She is currently working at Gran Paradiso National Park and collaborating with the Department of Zoology at Turin University, investigating the ecology of threatened butterflies. Department of Life Sciences and Systems Biology, University of Turin, Via Accademia Albertina 13, 10123, Turin, Italy

Radames Bionda

is a technician in the *Aree protette dell'Ossola* natural parks, where he is responsible for managing natural resources. He studies alpine wildlife, from butterflies to large carnivores. Ente aree protette dell'Ossola (Veglia – Devero Natural Park), Viale Pieri 13, 28868 Varzo (VB), Italy.

Paolo Palmi

is an entomologist who specializes in western Palearctic butterflies. He has worked as a field researcher for the Swiss Federal Office for the Environment and for several Italian natural reserves. He is currently an adviser for the Natural History Museum of Lugano, Switzerland. Via Europa 4, 20854 Veduggio al Lambro (MB), Italy.

Simona Bonelli

is an Associate Professor of Zoology at Turin University. She is a biologist and has a PhD in Agricultural Entomology. For the last 15 years, she has investigated the ecology and conservation of Lepidoptera, with an emphasis on threatened species. Department of Life Sciences and Systems Biology, University of Turin, Via Accademia Albertina 13, 10123, Turin, Italy

*contributed equally

Table 2 – Checklist of the species recorded from 2003 to 2018 and their distribution in the study area. Nomenclature is based on Balletto et al. (2014). Locality codes correspond to the ones used in Table 1. An estimation of species' abundance is reported: Abundant: more than 100 individuals / year recorded in the entire area; Present: more than 10 individuals / year; Rare: fewer than 10 individuals / year; Occasional: fewer than five individuals recorded. Endemic species are indicated as Alpine (A) or Alpine-Apennine (AA) endemics (Balletto et al. 2014). IUCN Red List categories are reported for Europe and Italy: Endangered (EN), Vulnerable (VU), Near Threatened (NT) and Not Evaluated (ne) (van Swaay et al. 2010; Bonelli et al. 2018). Sporadic observations of several species are also reported.

Taxon	Abundance	Distribution	Altitudinal Range [m]	Endemism	Italian Red List	IUCN Red List	Sporadic observations
Hesperiidae							
<i>Pyrgus alveus</i> (Hübner, 1803)	Present	V1; D1, D3, D4, D5; AG; MG	1 600–2000				
<i>Pyrgus andromedae</i> (Wallangren, 1853)	Present	V3; BO; D4, D5; MG	1 650–2000				
<i>Pyrgus calacalae</i> (Rambur, [1839])	Present	D2, D5; MG	1 600–2200				
<i>Pyrgus carlinae</i> (Rambur, [1839])	Present	D1, D5; MG	1 600–2200	A			
<i>Pyrgus malvoides</i> (Elwes & Edwards, 1897)	Present	Whole area	1 600–2100				
<i>Pyrgus serratulae</i> (Rambur, [1839])	Rare	D5; MG	1 600–2400				
<i>Spialia sertorius</i> (Hoffmansegg, 1804)	Present	V1; D1, D2, D4; AG; MG	1 600–1900				
<i>Erynnis tages</i> (Linné, 1758)	Abundant	Whole area	1 500–2000				
<i>Carterocephalus palaemon</i> (Pallas, 1771)	Rare	V1; D1, D4; AG	1 600–2000				
<i>Thymelicus sylvestris</i> (Poda, 1761)	Rare	V1; D1	< 1900				
<i>Thymelicus lineola</i> (Ochsenheimer, [1808])	Present	V1, V2; D1, D2; MG	< 1900				
<i>Hesperia comma</i> (Linné, 1758)	Present	Whole area	1 500–2400				
<i>Ochlodes sylvanus</i> (Esper, [1777])	Present	V1; D1, D4; AG; MG	1 500–1800				
Papilionidae							
<i>Papilio machaon</i> Linné, 1758	Present	Whole area	1 350–2600				
<i>Iphiclydes podalirius</i> (Linné, 1758)	Occasional	AG; D4	1 600–2000				One adult at Agaro (1 600 m), 08/07/2017 and another at Lago di Devero (2 000 m), 14/07/2018
<i>Parnassius apollo</i> (Linné, 1758)	Present	Whole area	1 350–2 100 (2800)			NT	One specimen observed on Ghiacciaio della Rossa (2800m), 25/07/2012
<i>Parnassius mnemosyne</i> (Linné, 1758)	Present	V1; BO; D1; AG; MG	1 350–2000			NT	
<i>Parnassius phoebus</i> (de Prunner, 1798)	Present	Whole area	1 650–2400 (2880)	A		NT	One specimen at Punta della Rossa (2880 m), 19/07/2017
Pieridae							
<i>Aporia crataegi</i> (Linné, 1758)	Present	Whole area	1 600–2000				
<i>Pieris brassicae</i> (Linné, 1758)	Present	V1; D1, D2	1 400–2400				One specimen at Passo di Valtendra (2400 m), 25/07/2018
<i>Pieris bryoniae</i> (Hübner, [1806])	Abundant	Whole area	1 350–2750				
<i>Pieris callidice</i> (Hübner [1800])	Present	V2, V3; BO; D2, D3, D5; MG	1 900–2900 (1700)				One fresh adult at Alpe Campello (1700 m), 13/06/2012
<i>Pieris napi</i> (Linné, 1758)	Occasional	V1; MG	1350				One specimen at Nembro (1350 m), 2008
<i>Pieris rapae</i> (Linné, 1758)	Present	Whole area	1 500–1950 (2800)				One specimen on Ghiacciaio della Rossa (2800 m), 11/07/2012
<i>Euchloe simplonia</i> (Freyer, 1829)	Rare	V1	1 600–1700				
<i>Anthocharis cardamines</i> (Linné, 1758)	Present	V1, V2; D1, D4; AG, MG	1 500–1800 (2050)				One specimen at Codelago (2050 m), 03/07/2017
<i>Colias alfacariensis</i> (Ribbe, 1905)	Rare	V1; MG	< 1600				
<i>Colias crocea</i> (Geoffroy, 1785)	Present	V1, V2; D3, D4, D5; AG; MG	< 2100				
<i>Colias palaeno</i> (Linné, 1761)	Present	V3; D1, D2, D3, D4, D5, MG	1 600–2000				
<i>Colias phicomone</i> (Esper, [1780])	Present	Whole area	1 600–2600 (2800)			NT	One specimen at Punta della Rossa (2880 m), 19/07/2017
<i>Gonepteryx rhamni</i> (Linné, 1758)	Occasional	V1; AG; MG	< 1600				
Lycaenidae							
<i>Lycaena eurydame</i> (Hoffmansegg, 1806)	Present	V1, V3; BO; D1, D2, D4, D5; AG; MG	1 500–2150	A		ne	
<i>Lycaena subalpina</i> (Speyer, 1851)	Present	V1; D1; D2, D3, D4; AG; MG	1 500–2100			ne	
<i>Lycaena virgaureae</i> (Linné, 1758)	Present	V1, V3; D1, D2, D4; AG; MG	1 500–1900				
<i>Callophrys rubi</i> (Linné, 1758)	Present	Whole area	1 500–2000				
<i>Cacyreus marshalli</i> (Buthler, [1898])	Occasional	D1, D4	1 600; 1700		ne	ne	One adult in Devero (1 640 m) and two in Crampiole (1 700 m), July 2015
<i>Cupido minimus</i> (Fuessly, 1775)	Present	Whole area	1 500–2400 (2600)				One specimen at Punta delle Valle (2600 m), 24/07/2012
<i>Celastrina argiolus</i> (Linné, 1758)	Occasional	D3; AG; MG	1 600–1800 (2100)				Two specimens at Piani della Rossa (2100 m), 14/07/2013 and 10/07/2018
<i>Glaucopsyche alexis</i> (Poda, 1761)	Occasional	D1; AG	1 600–1700				
<i>Maculinea arion</i> (Linné, 1758)	Present	V1, V3; BO; D1, D2, D4, D5; AG; MG	1 600–2050			EN	
<i>Maculinea rebeli</i> (Hirschke, 1905)	Rare	D1, D2, D4, D5; MG	1 850–2100			ne	
<i>Plebejus argus</i> (Linné, 1758)	Rare	V1, V2; D1	1 600–1800				
<i>Lycaeides idas</i> (Linné, 1761)	Abundant	Whole area	1 600–2200 (2600)				One adult at Punta delle Valle (2600 m), 02/09/2013
<i>Aricia allous</i> (Geyer, [1837])	Present	Whole area	1 500–2100			ne	
<i>Eumedonia eumedon</i> (Esper, [1780])	Present	D1, D2, D4; AG; MG	1 600–2200				
<i>Albulina optilete</i> (Knoch, 1781)	Rare	V3; D2, D4, D5	1 800–2100				
<i>Albulina orbiculata</i> (De Prunner, 1798)	Present	V1, V3; BO; D2, D3, D5; AG; MG	1 600–2300				

Taxon	Abundance	Distribution	Altitudinal Range [m]	Endemism	Italian Red List	IUCN Red List	Sporadic observations
<i>Cyaniris semiargus</i> (Rottemburg, 1775)	Present	V1, V2, V3; D1, D2, D4; AG; MG	1 650–2 200				
<i>Polyommatus bellargus</i> (Rottemburg, 1775)	Rare	V1; D1	1 350–1 700				
<i>Polyommatus coridon</i> (Poda, 1761)	Present	Whole area	1 350–2 100				
<i>Polyommatus damon</i> ([Denis & Schiffermüller], 1775)	Present	V1; AG; MG	1 350–1 900			NT	
<i>Polyommatus eros</i> (Ochsenheimer, 1808)	Present	V1, V2; D5; MG	1 500–2 600			NT	
<i>Polyommatus icarus</i> (Rottemburg, 1775)	Rare	V1; MG	1 500–1 800				
Nymphalidae							
<i>Apatura iris</i> (Linné, 1758)	Occasional	V1; AG	1 350–1 600				One adult at Agaro lake (1 600 m), 12/08/2018
<i>Nymphalis antiopa</i> (Linné, 1758)	Occasional	V2, V3; D1, D5; AG; MG	1 600–2 200 (2 400)				One adult close to Punta della Valle (2 400 m), 27/08/2018
<i>Nymphalis polychloros</i> (Linné, 1758)	Occasional	MG	1 350–1 900				
<i>Inachis io</i> (Linné, 1758)	Occasional	MG	< 2 000				
<i>Vanessa atalanta</i> (Linné, 1758)	Present	Whole area	< 2 800				
<i>Vanessa cardui</i> (Linné, 1758)	Present	Whole area	< 2 800				
<i>Polygonia c-album</i> (Linné, 1758)	Occasional	MG	< 1 800				
<i>Aglais urticae</i> (Linné, 1758)	Abundant	Whole area	< 2 800				
<i>Argynnis adippe</i> ([Denis & Schiffermüller], 1775)	Rare	V1; D1	1 350–1 700				
<i>Argynnis aglaja</i> (Linné, 1758)	Present	Whole area	1 500–2 150				
<i>Argynnis niobe</i> (Linné, 1758)	Present	V1; D1, D2, D3, D4, D5; AG; MG	1 350–2 200 (2 750)				One adult on Ghiacciaio della Rossa (2 800 m), 22/08/2012
<i>Argynnis paphia</i> (Linné, 1758)	Occasional	AG; MG	1 600–2 100				
<i>Issoria lathonia</i> (Linné, 1758)	Rare	Whole area	1 350–2 200 (2 600)				One adult at Puna della Valle (2 600 m), 27/08/2018
<i>Boloria euphrosyne</i> (Linné, 1758)	Abundant	Whole area	1 600–2 000				
<i>Boloria napaea</i> (Hoffmansegg, 1804)	Present	V1, V2, V3; D1, D3, D4, D5; MG	1 700–2 600				
<i>Boloria pales</i> ([Denis & Schiffermüller], 1775)	Abundant	Whole area	1 700–2 800				
<i>Boloria selene</i> ([Denis & Schiffermüller], 1775)	Present	V2; D1, D4; AG; MG	1 600–1 800				
<i>Boloria thore</i> (Hübner, [1804])	Rare	D1, D3; AG	1 600–1 900				
<i>Boloria titania</i> (Esper, [1789])	Present	V1, V3; D1; D3, D5; AG; MG	1 600–2 000			NT	
<i>Melitaea nevadensis</i> Oberthür, 1904	Present	V1, V3; D1; AG; MG	1 350–1 900				
<i>Melitaea diamina</i> (Lang, 1789)	Abundant	V1; BO; D1, D2, D4; AG; MG	1 500–2 000				
<i>Melitaea phoebe</i> ([Denis & Schiffermüller], 1775)	Occasional	AG	1 640				
<i>Melitaea varia</i> (Meyer-Dur, [1851])	Present	V1, V3; D1, D2, D4, D5;	1 700–2 400	AA			
<i>Euphydryas Cynthia</i> ([Denis & Schiffermüller], 1775)	Rare	D2, D3, D4, D5	2 050–2 400				
<i>Euphydryas glaciogenita</i> (Verity, 1928)	Present	V2, V3; BO; D1, D2, D3, D5; MG	1 600–2 400			ne	
<i>Limnitis populi</i> (Linné, 1758)	Occasional	D3	1 820				One specimen on Sentiero della Rossa (1 820 m), 17/07/2005
<i>Libythea celtis</i> (Laicharting, [1782])	Occasional	V1; D1; AG	1 600–1 800				
<i>Satyrus ferula</i> (Fabricius, 1793)	Rare	V1; MG	1 600–1 700				
<i>Erebia aethiops</i> (Esper, [1776])	Present	V1; MG	1 350–1 500				
<i>Erebia albergana</i> (de Prunner, 1798)	Abundant	Whole area	1 350–2 000				
<i>Erebia christi</i> (Rätzer, 1890)	Present	V1, V2, V3; BO; D1, D2, D4; AG	1 600–2 400	A	EN	VU	
<i>Erebia ephron</i> (Knoch, 1783)	Abundant	Whole area	1 600–2 400				
<i>Erebia euryale</i> (Esper, [1805])	Abundant	Whole area	1 350–2 400				
<i>Erebia flavofasciata</i> Heyne, 1895	Present	V1, V3; BO; D1, D2, D3, D4, D5; MG	1 650–2 400	A	VU	NT	
<i>Erebia gorge</i> (Hübner, [1804])	Present	V1, V3; D3, D5; MG	1 700–2 900				
<i>Erebia medusa</i> ([Denis & Schiffermüller], 1775)	Abundant	Whole area	1 350–2 050				
<i>Erebia melampus</i> (Fuessly, 1775)	Abundant	Whole area	1 500–2 400	A			
<i>Erebia mnestra</i> (Hübner, [1804])	Present	Whole area	1 700–2 400 (1 500)	A			
<i>Erebia montana</i> (de Prunner, 1798)	Present	Whole area	1 500–2 400 (2 600)	AA			
<i>Erebia pandrose</i> (Borkhausen, 1788)	Present	V3; D3, D4, D5; MG	2 000–2 800				
<i>Erebia pharte</i> (Hübner, [1804])	Present	Whole area	1 500–2 400				
<i>Erebia pluto</i> (de Prunner, 1798)	Rare	D3, D5; MG	2 600–2 900	AA			
<i>Erebia pronoe</i> (Esper, [1780])	Present	V1, V3; D1, D2; MG	1 500–2 200				
<i>Erebia triaria</i> (de Prunner, 1798)	Rare	V1	1 500–1 700				
<i>Erebia tyndarus</i> (Esper, [1781])	Abundant	Whole area	1 600–2 800	A			
<i>Oeneis glacialis</i> (Moll, 1783)	Present	V1, V2, V3; D1, D2, D3, D4; AG	1 600–2 600	A			
<i>Melanargia galathea</i> (Linné, 1758)	Rare	V1; AG; MG	< 1 600				
<i>Maniola jurtina</i> (Linné, 1758)	Rare	MG	1 000				
<i>Aphantopus hyperantus</i> (Linné, 1758)	Occasional	D2	1 900				One adult in Buscagna Valley 29/06/2005; species never before observed over 1 500 m in Italy (Palmi 2010)
<i>Coenonympha darwiniana</i> (Staudinger, 1871)	Abundant	Whole area	1 350–2 400	A		ne	
<i>Coenonympha pamphilus</i> (Linné, 1758)	Occasional	V1	< 1 600				
<i>Pararge aegeria</i> (Linné, 1758)	Rare	V1; AG; MG	1 600–1 700				
<i>Lasiommata maera</i> (Linné, 1758)	Present	V1; D1, D2, D4; AG; MG	< 1 900				
<i>Lasiommata petropolitana</i> (Fabricius, 1787)	Present	V1, V2; BO; D1, D2, D3, D4; AG; MG	1 500–2 100				