Serena Corezzola, Sönke Hardersen & Lorenzo Maffezzoli

Discovery of isolated populations of *Phengaris alcon* and of *Melitaea diamina* in the central Po Plain, Italy
(Lepidoptera Rhopalocera)

Riassunto - *Scoperta di popolazioni isolate di* Phengaris alcon *e* Melitaea diamina *nella Pianura Padana centrale (Italia) (Lepidoptera Rhopalocera)*. All'interno del Parco del Mincio (Mantova, Lombardia) sono state scoperte popolazioni di *Melitaea diamina* (Lang, 1789) e *Phengaris alcon* ([Denis & Schiffermüller], 1775) (Lepidoptera Rhopalocera), rispettivamente nell'anno 2008 e 2010. Entrambe le specie non sono note per la Pianura Padana, e le popolazioni più vicine conosciute si trovano a 170 e 50 km, rispettivamente per *P. alcon* e *M. diamina*. Durante l'anno 2011 sono state svolte ulteriori indagini su queste nuove popolazioni. Entrambe le specie sono state riscontrate esclusivamente in prati umidi, di cui sono considerate specie tipiche. Le nuove popolazioni dovranno essere protette, garantendo il mantenimento in futuro dei prati umidi mediante sfalcio.

Abstract - Populations of *Melitaea diamina* (Lang, 1789) and *Phengaris alcon* ([Denis & Schiffermüller], 1775) (Lepidoptera Rhopalocera) were discovered in the Mincio Natural Park (Mantua province, Lombardy) in the years 2008 and 2010, respectively. Both species had not been known from the central Po Plain and the closest populations are approximately 170 km and 50 km away for *P. alcon* and *M. diamina*, respectively. More data on the new populations were collected during the year 2011. Both species were exclusively found in wet meadows, for which they are considered typical. The newly discovered populations need to be protected by ensuring that the meadows will continue to be mown in the future.

Key words: Lepidoptera, *Phengaris alcon, Melitaea diamina*, Italy, river Po Plain.

Introduction

The distribution of the Italian butterflies is generally well known (Balletto *et al.*, 2005a), but new and important discoveries, which extend the known geographic range of species, are regularly reported (*e.g.* Sala & Bettini, 2000; Rallo & Uliana, 2001; Pensotti, 2004; Negrisolo & Uliana, 2006; Bertaccini, 2008). This also applies to the Po Plain (*e.g.* Camerini & Groppali, 2003; D'Amico, 2005), which represents the most strongly industrialized and densely populated area of Northern Italy. In the years 2008 and 2010 single individuals of the species *Phengaris alcon* ([Denis & Schiffermüller], 1775) and *Melitaea diamina* (Lang, 1789), two species which are listed in the European Red List of Butterflies (Van Swaay *et al.*, 2010), were discovered in the Mincio Natural Park (Mantua province, Italy). *Phengaris alcon* (Alcon Blue, Fig. 1) was not known from the Po Plain (*e.g.* Wynhoff, 1998; Lafranchis, 2004, Tolman & Lewington, 2009, Balletto *et al.*, 2005a; Villa *et al.*, 2010) and is considered "near threatened" in the countries of the European Union (Van Swaay *et al.*, 2010). *Melitaea diamina* (False Heat Frittilary, Fig. 2) was not known from the central Po Plain (Lafranchis, 2004; Balletto *et al.*, 2005a; Tolman & Lewington, 2009) and is considered "near threatened" in the countries of the European Union (Van Swaay *et al.*, 2010).

The aim of this work is to document the newly discovered populations of *P. alcon* and *M. diamina*, to provide some indications on local populations and to discuss the discovery from a biogeographical and conservational point of view.

Material and Methods

Study area. The Mincio Natural Park, established by Regional Law 47/84, is situated in the Mantua province (Lombardy Region), and protects mainly areas along the river Mincio, for a total extension of 15.942 ha (Fig. 3). Here *P. alcon* was found in sites belonging to *Molinia* meadows on calcareous, peaty or clay-silt-laden soils (*Molinion caeruleae* (L) Moench.) (Habitat 6410, Habitats Directive). From a phytosociological point of view, habitat 6410 coincides with the *Selino-Molinietum caeruleae* Kuhn 1937 association.

Study species. Here, *P. alcon* is considered as a species, as it has been done by many authors (*e.g.* Balletto *et al.*, 2005; Küer & Fartmann, 2005; Villa *et al.*, 2010), even though recent studies suggest that *P. alcon*, and *P. rebeli* (Hirsche, 1904) are ecologic forms

Fig. 1. *Phengaris alcon* ([Denis & Schiffermüller], 1775). Photo by S. Hardersen.

Fig. 2. *Melitaea diamina* (Lang, 1789). Photo by L. Maffezzoli.

of the same species (Als *et al.*, 2004; Bereczki *et al.*, 2005; Pecsenye *et al.*, 2007; Descimon & Mallet, 2009) and that the case of *P. alcon* and *P. rebeli* is the closest to "ecological races" (Descimon & Mallet, 2009). Morphologically, *P. alcon* and *P. rebeli* are almost indistinguishable (Leigheb, 1990), and this also applies to larvae and pupae (Śliwińska *et al.*, 2006) and recent studies did not find relevant differences at the genetics level (Als *et al.*, 2004; Bereczki *et al.*, 2005; Pecsenye *et al.*, 2007; Descimon & Mallet, 2009). The population described in this paper has been attributed to *P. alcon* based on ecological and phenological characteristics (*e.g.* habitat, host plant and phenology), as these are the most important traits to distinguish the two species (Sielezniew & Stankiewicz, 2004).

The Alcon Blue is a hygrophilous species of lowlands and hills, which lives in wet meadows and marshes below 1000 m a.s.l. (Leigheb, 1990; Hellmann & Bertaccini, 2004; Küer & Fartmann, 2005; Varga-Sipos & Varga, 2005; Villa *et al.*, 2010). Its main host-plant is *Gentiana pneumonanthe* L. (Bereczki *et al.*, 2005; Küer & Fartmann, 2005; Śliwińska *et al.*, 2006; Pecsenye *et al.*, 2007; Villa *et al.*, 2010), but other species from the genus *Gentiana* have also been reported (Munguira & Martin, 1999; Sielezniew & Stankiewicz, 2004; Bereczki *et al.*, 2005; Villa *et al.*, 2010). The species of the genus *Phengaris* van Eecke, 1915 have a particular life cycle: in addition to being oligophagous, they are obligatory parasites of ants of the genus *Myrmica* Latreille, 1804. *Phengaris alcon* is associated with numerous species of the genus *Myrmica*, but *Myrmica ruginodis* Nylander, 1846, is considered the main host species (Balletto, 1993; Hellmann & Bertaccini, 2004). The Alcon Blue is univoltine and adults fly from the middle of July to the end of August (Leigheb, 1990; Hellmann & Bertaccini, 2004; Sielezniew & Stankiewicz, 2004; Stankiewicz *et al.*, 2005).

Melitaea diamina is an hygrophilous species and is present from hilly to alpine zones, below 2000 m a.s.l. (Balletto & Kudrna, 1985; Hellmann & Bertaccini, 2004; Villa *et al.*, 2010). In lowland sites the species can be bivoltine, and flies in June-July and in August-September (Lepidopterologen-Arbeitsgruppe, 1991; Villa *et al.*, 2010). The False Heath Fritillary is mainly associated with the host plant *Valeriana officinalis* L. (Balletto & Kudrna, 1985; Hellmann & Bertaccini, 2004).

Field work. To follow up the initial discoveries of *P. alcon* (22.VIII.2010) and *M. diamina* (24.V.2008), more data on the local populations were collected during the year 2011 by visiting a number of sites. The first individual of *P. alcon* was observed on 11.VII.2011. From 1.VIII.2011 onwards the site, which was found to host the largest population, was visited approximately every 10 days (time span 9-13 days). The last field survey was carried out on 12.IX.2011 (Fig. 4). During these "standardized surveys" two persons (SC & SH) walked in a sub-section of a larger wet meadow, which measured approxima-

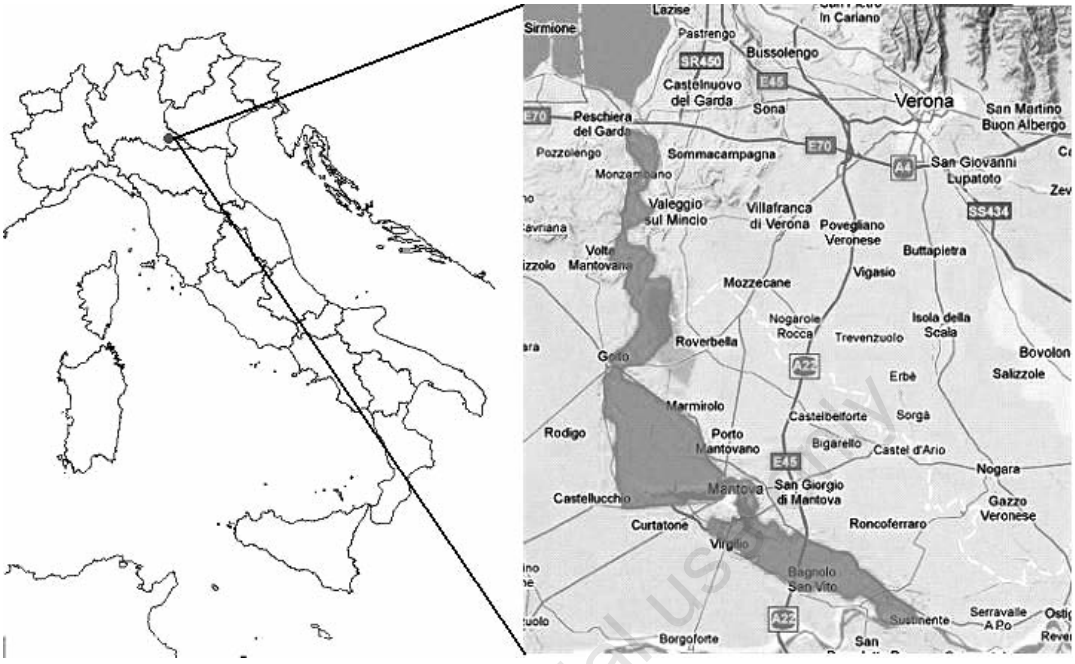

Fig. 3. Mincio Natural Park territory.

tely 3 ha, for 30 minutes, trying to cover the entire area. All adults of *P. alcon* observed were counted.

The populations of *M. diamina* were found to be much less localized and no standard survey was carried out.

Nomenclature follows Karsholt & van Nieukerken (2004).

Results

Phengaris alcon was observed in a total of 5 sites, which are all within a radius of 0.5 km, between 11.VII. and 02.IX (Tab. 1). All observations were made in wet meadows (Tab. 3), which are potentially suitable for reproduction. Here females were observed during oviposition and eggs were recorded on many buds and flowers of *Gentiana pneumonanthe*. For the sites where *P. alcon* was found only municipality is reported, and UTM coordinates are truncated not to reveal the exact location of the populations.

Melitaea diamina (Lang, 1789) was observed in a total of 6 sites, which are all within a radius of 3 km, between 15.V. and 01.VIII (Tab. 2). All observations regarded single individuals and were made in wet meadows (Tab. 3), which are potentially suitable for reproduction.

Discussion and Conclusions

Biogeography. The butterfly fauna of Italy is generally well known (Balletto *et al.*, 2005a). However, new discoveries are regularly reported, which extend the known biogeographic range of species (*e.g.* Sala & Bettini, 2000; Rallo & Uliana, 2001; Camerini & Groppali, 2003; Pensotti, 2004; D'Amico, 2005; Negrisolo & Uliana, 2006; Bertaccini, 2008). Therefore, on a finer scale the distribution of many Italian butterfly species has not been mapped in sufficient detail. This also applies to the Po Plain, as it is demonstrated by the two newly discovered species for the Mincio Natural Park. For *P. alcon* and *M. diamina* the closest known populations, to those reported here, are approximately 170 km and 50 km away, respectively. *Phengaris alcon* had never before been reported from the Po Plain and the population reported here extends the distributional area to the south (Fig. 5) and seems to

Tab. 1. Records of *Phengaris alcon* ([Denis & Schiffermüller], 1775) in the Mincio Natural Park.

Number of individuals	Sex	Site (Tab. 3)	Date	Vidit	Legit	Collection
uk	♂, ♀	G	22.VIII.2010	LM		
uk	♂, ♀	H	22.VIII.2010	LM		
1	♀	E	11.VII.2011		SC	CNBFVR
1	♂	E	01.VIII.2011		SH	CNBFVR
45	♂, ♀	E	01.VIII.2011	SC, SH		
1	uk	F	01.VIII.2011	SH		
4	♂, ♀	J	01.VIII.2011	SH		
> 100	♂, ♀	E	11.VIII.2011	SC, SH		
6	♂, ♀	E	24.VIII.2011	SC, SH		
4	♂, ♀	E	02.IX.2011	SC, SH		

Abbreviations. Observers: LM - Lorenzo Maffezzoli, SC - Serena Corezzola, SH - Sönke Hardersen. Other abbreviations: uk - unknown, CNBFVR - Centro Nazionale per la Biodiversità Forestale "Bosco Fontana" di Verona.

Tab. 2. Records of *Melitaea diamina* (Lang, 1789) in the Mincio Natural Park.

Number of individuals	Sex	Site (Tab. 3)	Date	Vidit	Legit	Collection
uk	uk	A	24.V.2008	LM		
1	♂	B	17.VII.2008		SH	SH
uk	uk	C	15.V.2011	LM		
1	uk	D	17.V.2011	SC		
1	♂	E	30.V.2011		SC	CNBFVR
1	♂	D	14.VII.2011		SC	CNBFVR
1	uk	D	14.VII.2011	SC		
1	♂	F	01.VIII.2011		SC	CNBFVR

Abbreviations. Observers: LM - Lorenzo Maffezzoli, SC - Serena Corezzola, SH - Sönke Hardersen. Other abbreviations: uk - unknown, CNBFVR - Centro Nazionale per la Biodiversità Forestale "Bosco Fontana" di Verona.

Tab. 3. Observation sites (see Tabs. 1 & 2).
For sites where *Phengaris alcon* was found only the municipality is reported, and UTM coordinates are truncated to not reveal the exact location of the population of *P. alcon*.

Acronym	Municipality	Locality	m a.s.l.	UTM 32 T	
A	Porto Mantovano	Belvedere	16	633473	5003788
B	Mantua	Rio Freddo	17	637803	5003127
C	Porto Mantovano	Belvedere	17	634453	5002748
D	Marmirolo	Bosco Fontana	24	637181	5006755
E	Porto Mantovano	-	16	633000	5003000
F	Porto Mantovano	-	17	633000	5003000
G	Porto Mantovano	-	17	633000	5003000
H	Porto Mantovano	-	16	634000	5003000
J	Porto Mantovano	-	16	634000	5003000

be very isolated. In Northern Italy, *M. diamina* is mainly known from the Alps, however populations from the Po Plain have been reported, from the river Ticino (Ozzero, Turbigo and Vigevano, Lombardy Region) and from two sites in the Region Friuli-Venezia Giulia (Azzano Decimo and Portogruaro) (Fig. 6) (Balletto *et al.*, 2005a). The population discovered in the Mincio Natural Park extends the known distributional area for *M. diamina* in Northern Italy.

Flight period. For *P. alcon* the flight period coincides well with the one reported in the literature, from the middle of July to the end of August (Leigheb, 1990; Hellmann & Bertaccini, 2004; Sielezniew & Stankiewicz, 2004; Stankiewicz *et al.*, 2005). The observation of 4 individuals on 02.IX.2011 extends this period to early September. The population described here was recorded 53 consecutive days, while Nowicki *et al.* (2005b) reported that the flight period lasted 18-36 days.

For bivoltine populations of *M. diamina* the flight periods are given as June and September (Lepidopterologen-Arbeitsgruppe, 1991) and June-July and August-September (Villa *et al.*, 2010) For the population described here the flight periods observed were late May and middle of July to early August. This early flight period of *M. diamina* reported here might be related to the low elevation of the sites (16-24 m a.s.l.) and/or to the high summer temperatures, that can influence butterfly flight period (Balletto *et al.*, 2009).

Habitat and conservation. In Italy butterflies confined to lowland grasslands have the highest extinction risk in the short term and hygrophilous species restricted to the Po Plain are among the most endangered in Italy (Balletto *et al.*, 2009). It is in keeping that *P. alcon* is considered among the most endangered hygrophilous butterfly species in Italy. The main risk factor for this species is habitat alteration (Wyhnoff, 1998; Balletto *et al.*, 2005b), which negatively affects the availability of the host plant *Gentiana pneumonanthe*, which in turn limits populations of *P. alcon* (Nowicki *et al.*, 2005a). The protection of wet meadows in the Po Plain is particularly difficult as this part of Italy is the most heavily industrialized and most densely populated area of the country. The few remaining semi-natural habitats are small, fragmented and isolated, as well as under continuous human pressures (Balletto *et al.*, 2005b). Therefore, it is of the highest importance to protect the remai-

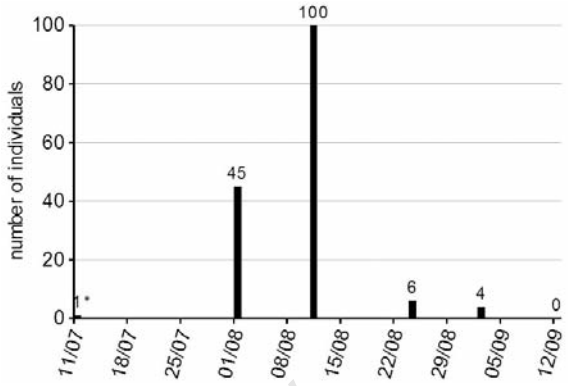

Fig. 4. The number of individuals of *P. alcon* observed during "standard counts" (see text) in an area covering approximately 3 ha. The individual reported for 11 July was counted on a much smaller sub-area (1250 m^2).

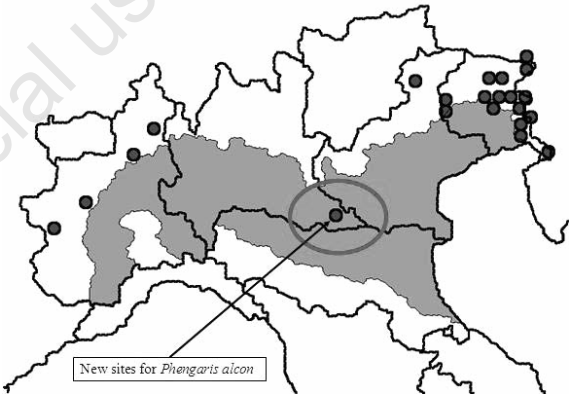

Fig. 5. *P. alcon* distribution (Balletto *et al.*, 2005a) update with the new sites found in central Po Plain (grey area).

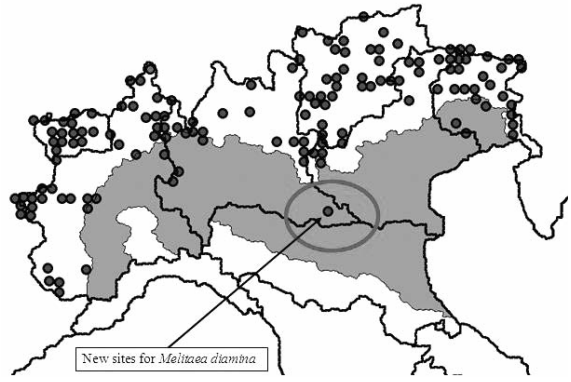

Fig. 6. *M. diamina* distribution (Balletto *et al.*, 2005a) update with the new sites found in central Po Plain (grey area).

ning wet meadows in the Mincio Natural Park and to manage these in accordance with the biology of *P. alcon* and *M. diamina* as the survival of these species depends on traditional agricultural activities which maintain their habitats (Wyhnoff, 1998). Currently these wet meadows are regularly mown. If this activity ceases the vegetation rapidly develop into different plant communities, which are less suitable for host ants and food plants for *P. alcon* (Clarke *et al.*, 2005; Rigoni *et al.*, 2010) and for the food plants for *M. diamina*. Additionally, it is important to investigate further the butterfly fauna of the Mincio Natural Park, as currently very limited knowledge about this taxon is available (Rigoni *et al.*, 2010). The data provided for the Alcon Blue suggest that the Mincio Natural Park hosts a rather large population. However, data from only part of the suitable habitat and from a single year are not sufficient to provide a detailed analysis of the population of this rare butterfly. Similarly, the False Heath Fritillary Further is now known to be relatively widely distributed within the Natural Park. However it is necessary to learn more about local populations, before this species can be protected efficiently. Further surveys of butterflies are also important as more species of conservation concern might be present in the Mincio Natural Park.

Acknowledgments

We thank the administration of the Mincio Natural Park for the permission to investigate butterflies and Elena Bontempo for correcting the English.

References

Als T.D., Vila R., Kandul N.P., Nash D.R., Yen S.-H., Hsu Y.-F., Mignault A.A., Boomsma J.J. & Pierce N.E., 2004 - The evolution of alternative parasitic life histories in Large Blue butterflies. Nature, 432: 386-390.

Balletto E., 1993 - Large Blues, *Maculinea* spp. Pp. 85-87. In: New T. R. (ed). Conservation biology of Lycaenidae (butterflies). International Union for Conservation of Nature and Natural Resources. Species Survival Commission.

Balletto E., Bonelli S. & Cassulo L., 2005a - Insecta Lepidoptera Papilionoidea, pp 257-261. In: S. Ruffo & F. Stoch (eds). Checklist e distribuzione della fauna italiana. Memorie del Museo Civico di Storia Naturale di Verona - 2. Serie, Sezione Scienza della Vita, 16.

Balletto E., Bonelli S. & Cassulo L., 2005b - Mapping the Italian Butterfly Biodiversity for Conservation, pp. 71-76. In: E. Kühn, R. Feldmann, J.A. Thomas & J. Settele (eds). Studies on the Ecology and Conservation of Butterflies in Europe. Vol. 1: General Concepts and Case Studies. Pensoft Publishers, Sofia.

Balletto E., Barbero F., Casacci L.P., Cerrato C., Patricelli D. & Bonelli S., 2009 - L'impatto dei cambiamenti climatici sulle farfalle italiane. Studi Trentini di Scienze Naturali, 86: 111-114.

Balletto E. & Kudrna O., 1985 - Some aspects of the conservation of butterflies in Italy, with recommendations for a future strategy. Bollettino della Società Entomologica Italiana, 117(1-3): 39-59.

Bereczki J., Pecsenye K., Peregovits L. & Varga Z., 2005 - Pattern of genetic differentiation in the *Maculinea alcon* species group (Lepidoptera, Lycaenidae) in Central Europe. Journal of Zoological Systematics and Evolutionary Research, 43(2): 157-165.

Bertaccini E., 2008. Note integrative sulla Macrolepidotterofauna Romagnola (Insecta Lepidoptera Rhopalocera, Heterocera). Quaderno di Studi e Notizie di Storia Naturale della Romagna, 26: 91-128.

Camerini G. & Groppali R., 2003 - Nuove segnalazioni di *Lycaena dispar* (Haworth) in pianura padana (Lepidoptera Rhopalocera). Pianura. Scienze e storia dell'ambiente Padano, 17: 142-145.

Clarke R.T., Mouquet N., Thomas J.A., Hochberg M.E., Elmes G.W., Tesar D., Singer A. & Hale J., 2005 - Modelling the local population dynamics of *Maculinea* and their spatial interactions with their larval foodplant and *Myrmica* ant species, pp. 115 - 119. In: J. Settele, E. Kühn & J.A. Thomas (eds). Studies on the Ecology and Conservation of Butterflies in Europe. Vol. 2: Species Ecology along a European Gradient: *Maculinea* Butterflies as a Model. Pensoft Publishers, Sofia.

D'Amico G., 2005 - Segnalazione di alcune specie di macrolepidotteri (Lepidoptera) nuovi per il Parco della Valle del Ticino. Pianura. Scienze e storia dell'ambiente Padano, 19: 149-154.

Descimon H. & Mallet J., 2009 - Bad species, pp. 219 - 249. In: J. Settele, T. Shreeve, M. Konvička & H.V. Dyck (eds). Ecology of Butterflies in Europe. Cambridge University Press, Cambridge.

Hellmann F. & Bertaccini E., 2004 - I Macrolepidotteri della Valle di Susa. Italia Nord-occidentale (Alpi Cozie-Graie).

Regione Piemonte, Museo Regionale di Scienze Naturali, Monografie XL, 389 pp., 16 Tavv.

Karsholt O. & van Nieukerken E.J., 2004 - Fauna Europaea: Papilionoidea. Available at http://www.faunaeur.org [accessed December 2011 as version 2.4 of 27 January 2011].

Küer A. & Fartmann T., 2005 - Prominent shoots are preferred: microhabitat preferences of *Maculinea alcon* ([Denis & Schiffermüller], 1775) in Northern Germany (Lycaenidae). Nota Lepidopterologica, 27 (4): 309-319.

Lafranchis T., 2004 - Butterflies of Europe. Diatheo, Paris, 351 pp.

Leigheb G., 1990 - Una colonia relitta di *Maculinea alcon* Denis Schiffermüller in Piemonte (Lepidoptera, Lycaenidae). Rivista Piemontese di Storia Naturale. Carmagnola, 11: 129-134.

Lepidopterologen Arbeitsgruppe, 1991 - Tagfalter und ihre Lebensräume:Arten, Gefahrung, Schutz. Schweitzerischer Bund für Naturschutz. 3. Auflage, Basel, 516 pp.

Munguira M.L. & Martin J., 1999 - Action plan for the *Maculinea* butterflies in Europe. Conseil de l'Europe, Strasbourg, 64 pp.

Negrisolo E. & Uliana M., 2006 - Nuovi dati sui Ropaloceri dei Colli Euganei. Lavori Società Veneziana di Scienze Naturali, 31:116-117.

Nowicki P., Pępkowska A., Kudłek J., Skórka P., Witek M. & Woyciechowski M., 2005a - Landscape scale research in butterfly population ecology - *Maculinea* case study, Pp. 140-143. In: J. Settele, E. Kühn & J.A. Thomas (eds). Studies on the Ecology and Conservation of Butterflies in Europe. Vol. 2: Species Ecology along a European Gradient: *Maculinea* Butterflies as a Model. Pensoft Publishers, Sofia.

Nowicki P., Settele J., Thomas J.A.& Woyciechowski M., 2005b - A review of population structure of *Maculinea* butterflies, pp. 144-149. In: J. Settele, E. Kühn & J.A. Thomas (eds). Studies on the Ecology and Conservation of Butterflies in Europe. Vol. 2: Species Ecology along a European Gradient: *Maculinea* Butterflies as a Model. Pensoft Publishers, Sofia.

Pecsenye K., Bereczi J., Tihanyi B., Tóth A., Peregovits L. & Varga Z., 2007 - Genetic differentiation among the *Maculinea* species (Lepidoptera: Lycaenidae) in eastern Central Europe. Biological Journal of the Linnean Society, 91: 11-21.

Pensotti C.S.M., 2004 - Nuovo contributo alla conoscenza delle Farfalle diurne (Insecta, Lepidoptera, Hesperioidea e Papilionoidea) della provincia di Sondrio (Lombardia, Italia Settentrionale). Il Naturalista Valtellinese - Atti del Museo Civico di Storia Naturale di Morbegno, 15: 29-59.

Rallo G. & Uliana M., 2001 - Note su alcuni Lepidoptera di Valle Averto in Laguna di Venezia e dell'entroterra veneziano. Ricerche scientifiche nella Riserva naturale del W.W.F. di Valle dell'Averto. Bollettino Museo Civico di Storia Naturale di Venezia, 52: 103-112.

Rigoni P., Martignoni C., Corazza M., Maffezzoli L., Messori L. & Fabbri R., 2010 - Piano di Gestione del SIC IT20B0017 "Ansa e Valli del Mincio" e della ZPS IT20B0009 "Valli del Mincio".

Sala G. & Bettini R., 2000 - Contributo alla conoscenza della lepidotterofauna (Lepidoptera, Hesperioidea e Papilionidea del Compensario Gardesano e di altri biotopi del bresciano con la prima segnalazione di *Brenthis ino* per la provincia di Brescia. Natura Bresciana, Annuario del Museo Civico di Storia Naturale di Brescia, 32:77-88.

Sielezniew M. & Stankiewicz A.M., 2004 - *Gentiana cruciata* as an additional host plant of *Maculinea alcon* on a site in eastern Poland (Lycaenidae). Nota Lepideptorologica, 27 (1): 91-93.

Śliwińska E.B., Nowicki P., Nash D.R., Witek M., Settele J. & Woyciechowski M., 2006 - Morphology of caterpillars and pupae of European Maculinea species (Lepidoptera: Lycaenidae) with an identification table. Entomologica Fennica, 17: 351 - 358.

Stankiewicz A.M., Sielezniew M. & Buszko J., 2005 - *Maculinea alcon* and *M. rebeli* in Poland: distribution, habitats, host ant specificity and parasitoids, pp. 90-93. In: J. Settele, E. Kühn & J.A. Thomas (eds). Studies on the Ecology and Conservation of Butterflies in Europe. Vol. 2: Species Ecology along a European Gradient: *Maculinea* Butterflies as a Model. Pensoft Publishers, Sofia.

Tolman T. & Lewington R., 2009 - Collins Butterfly Guide. The most complete guide to the Butterflies of Britain and Europe. Harpes Collins Publishers, London. 384 pp.

Van Swaay C., Cuttelod A., Collins S., Maes D., López Munguira M., Šašić M., Settele J., Verovnik R., Verstrael T., Warren M., Wiemers M. & Wynhoff I., 2010 - European Red List of Butterfies. Luxembourg: Publications Office of the European Union, 47 pp.

Varga-Sipos J. & Varga Z., 2005 - *Maculinea* habitats: diversity of vegetation, composition and cenological relegation, pp. 45-50. In*:* J. Settele, E. Kühn & J.A. Thomas (eds). Studies on the Ecology and Conservation of Butterflies in Europe. Vol. 2: Species Ecology along a European Gradient: *Maculinea* Butterflies as a Model. Pensoft Publishers, Sofia.

Villa R., Pellecchia M. & Pesce G.B., 2010 - Farfalle d'Italia. Istituto per i Beni Artistici, Culturali e Naturali della Regione Emilia Romagna. Editrice Compositore, 375 pp.

Wynhoff I., 1998 - The recent distribution of the European *Maculinea* species. - Journal of Insect Conservation, 2: 15-27.

Authors' addresses:

S. Corezzola, Corpo Forestale dello Stato, Centro Nazionale per lo Studio e la Conservazione della Biodiversità Forestale "Bosco Fontana" di Verona, Strada Mantova, 29, I-46045 MARMIROLO (MN). corezzola.serena@gmail.com

S. Hardersen, Corpo Forestale dello Stato, Centro Nazionale per lo Studio e la Conservazione della Biodiversità Forestale "Bosco Fontana" di Verona, Strada Mantova, 29, I-46045 MARMIROLO (MN). s.hardersen@gmail.com

L. Maffezzoli, Viale Piave, 7, 46100 Mantova. lmaffezzoli@libero.it