International Symposium

Future 4 Butterflies In Europe

Dutch Butterfly Conservation
(De Vlinderstichting)

31st of March to April 2nd 2016
Hof van Wageningen
Hotel and Congress Centre
Wageningen, Netherlands

Butterfly CONSERVATION EUROPE

Dutch ButterflyConservation

Contents

Welcome

Our mission: Providing a future for butterflies and moths in Europe!

Butterflies and moths are declining seriously in most countries across Europe, and action is needed urgently at all levels, from local to European, in order to secure their survival. As charismatic species, indicators of biodiversity and providers of ecosystem functions and services, the conservation of butterflies and moths cover a broad spectrum of the conservation agenda.

Future 4 Butterflies in Europe is the fourth symposium on this theme. The first one was held in 1989, marking the start of a period of fruitful research, new insights on butterfly ecology and distribution, and the rise of a broad awareness of butterflies as indicators and tools in nature conservation.

The second congress, in 2008, witnessed the emergence of butterfly conservation in a European perspective, with butterflies as one of the leading groups of species targeted in conservation as well as in EU policy - and with increasing attention for the role of moths.

The third congress, in 2012, brought together a full-grown community of scientists, conservation practitioners and volunteers working on a broad range of Lepidoptera. The meeting highlighted growing insights on the impacts of climate change, land use and nitrogen deposition, as well as the novel issue of influences of artificial light on moths. With an ever-growing community of scientists and practitioners in the field of Lepidoptera conservation, we feel that 2016 offers a perfect occasion to meet again, to refresh our perspectives with current knowledge and set new priorities in providing a future for butterflies and moths in Europe!

With over 150 participants from 27 nations, we hope you will enjoy the meeting and will take the opportunity to meet each other outside the sessions. We are convinced that, ultimately, the resulting ideas and cooperation will benefit the conservation of butterflies and moths in Europe – and beyond!

We wish you a very pleasant and stimulating conference!

The Organising Scientific Committee,
Michiel WallisDeVries
Irma Wynhoff
Chris Van Swaay

Conference venue

The conference is being held in:

Hof van Wageningen Hotel and Congress Centre
Lawickse Allee 9
6701 AN WAGENINGEN
Tel. +31 317 490 133

Organisation:

De Vlinderstichting/Dutch Butterfly Conservation
Mennonietenweg 10
6702 AD WAGENINGEN
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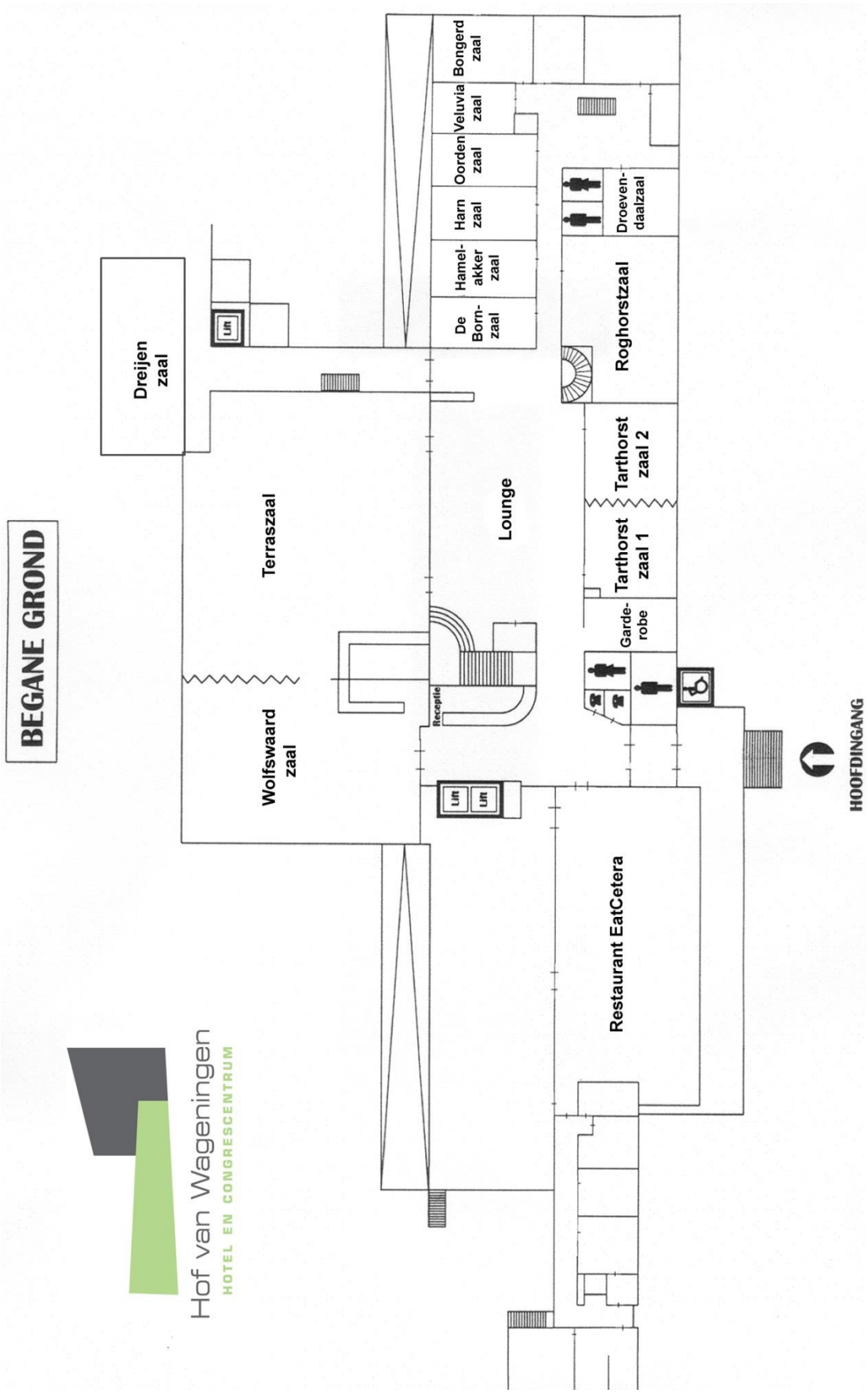
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Wolfswaard zaal
Lounge
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Oorden zaal
Veluvia zaal
Bongerd zaal
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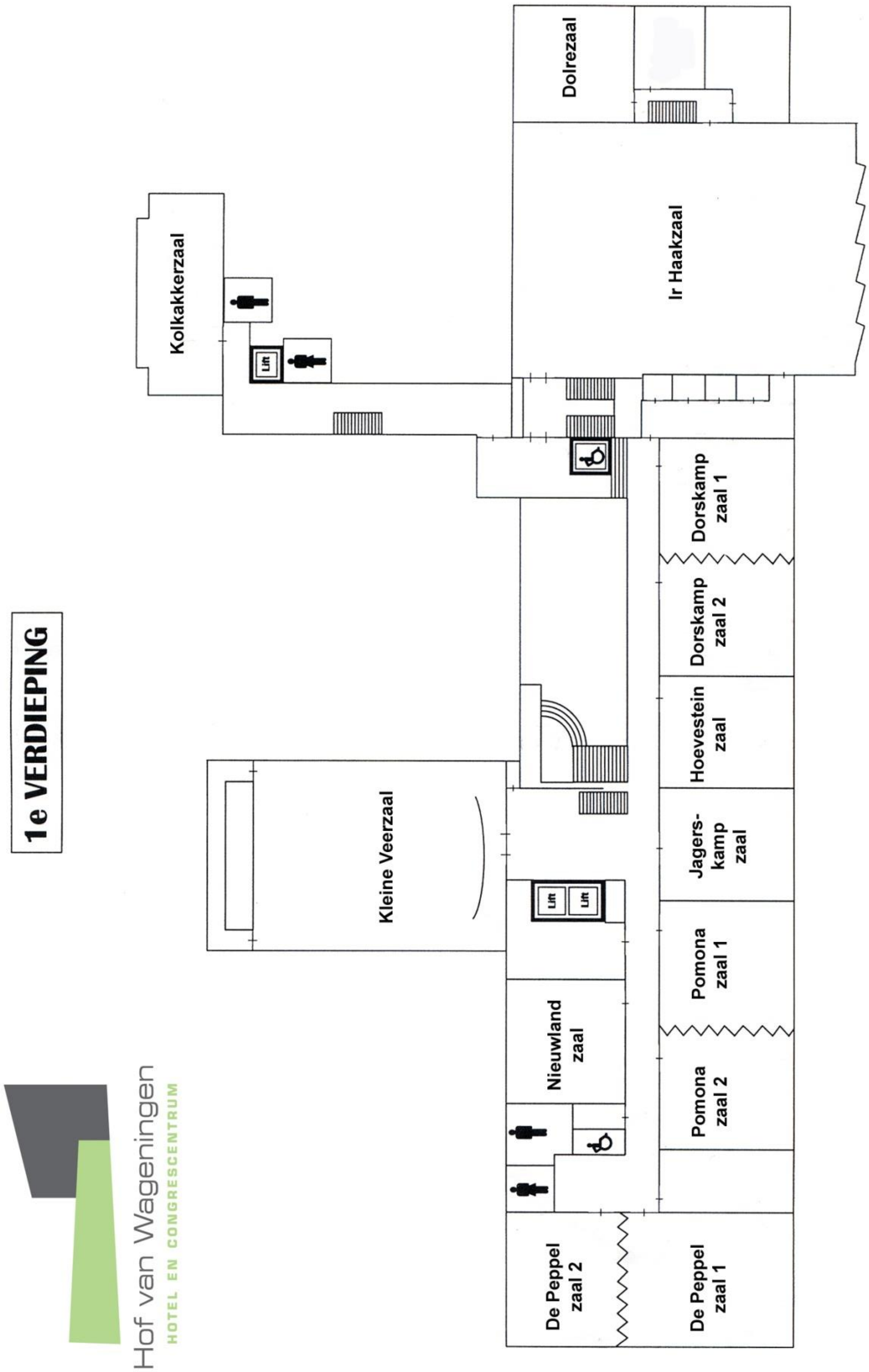
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Programme

Wednesday 30th March
18.00-21.00 Registration

Thursday 31rst March
07.30-08.30 Registration

8.45			*Welcome*
9.00		*Michiel WallisDeVries*	***Current issues in the conservation of butterflies and moths***
	1	**Biodiversity and Land Use**	
09.30	1-1	*David Kleijn*	*Pollinator conservation: a delicate balance between utilitarian arguments and inherent motivation*
10.00	1-2	Erik Öckinger	Can powerline rights-of-way contribute to conservation of grassland butterflies?
10.15	1-3	Tiit Teder	Where to see grassland butterflies if grasslands are gone?
10.30	1-4	Josef Settele	Intergovernmental assessments and the role of Butterflies and Moths - Insights from IPCC and IPBES
10.45		Coffee	
	2	**Climate change I**	
11.15	2-1	*Tom Oliver*	*Using long-term monitoring data to understand the impacts of climate change*
11.45	2-2	Anne Eskildsen	Disentangling the relative importance of land use and climate change in driving five decades of richness loss in European butterflies
12.00	2-3	David Gutierrez	Spatio-temporal heterogeneity in the sensitivity of butterfly phenology to climate
12.15	2-4	Aurélien Kaiser	Butterflies with contrasting thermal sensibilities are differently affected by urbanization
12.30		Lunch	

3 Monitoring I

13.45	**3-1**	*Chris van Swaay*	*From counts to indicators - progress in butterfly monitoring*
14.15	**3-2**	Arco van Strien	Butterflies in the Living Planet Index in the Netherlands: has the decline halted?
14.30	**3-3**	Emily Dennis	Dynamic models for butterfly monitoring data
14.45	**3-4**	Tom Brereton	The State of the UK's Butterflies 2016
15.00	**3-5**	Rudi Verovnik	Monitoring of Habitats directive butterfly species in Slovenia - ten years after
15.15	**3-6**	Lars Pettersson	Starting up targeted monitoring of Swedish butterflies and moths of the EU Habitats Directive
15.30		Tea	

4 Genes and populations

16.00	**4-1**	*Roger Vila*	*A genetic dimension to European butterfly diversity and conservation*
16.30	**4-2**	Vlad Eugen Dinca	Remarkable examples of cryptic species in European butterflies
16.45	**4-3**	Dirk Maes	Dispersal, gene flow and sibship analysis of *Phengaris (Maculinea) alcon* in NW Europe: implications for conservation
17.00	**4-4**	Martin Konvička	Analysing life history traits for conservation: the patterns found depend on questions asked
17.15	**4-5**	Quentin Dubois	Influence of meteorological conditions on demography and dispersal of a glacial relict butterfly, *Boloria aquilonaris*, in Belgium
17.30	**4-6**	Lucia Salis	Seasonal timing in a warming world: how can winter moths regulate the phenology of their entire life-cycle?
17.45		Poster session	
19.30		Dinner Buffet	
21.00			

Friday 1 April

5. Landscape ecology & Life History I

8.45	**5-1**	*Hans Van Dyck*	*Butterflies and landscapes: from structural to functional habitat and connectivity - a behavioural approach*
9.15	**5-2**	Thomas Merckx	Spatial scale-dependent impacts of urbanization on butterfly and macro-moth communities
9.30	**5-3**	Zoe Randle	Population trends of common and widespread butterflies in different habitats using Wider Countryside Butterfly Survey (WCBS) data
9.45	**5-4**	Christine Haaland	Patch occupancy, abundances and habitat requirements of the scarce copper in an urban-rural landscape: implications for management and planning
10.00	**5-5**	Camille Turlure	Suitability and transferability of the resource-based habitat concept in bog butterflies
10.15	**5-6**	Mari-Liis Viljur	Dispersal of butterflies in forested landscapes: does forest form a dispersal barrier?
10.30		Coffee	

6. Genetically modified crops & Lepidoptera I

6-1	Gabor Lovei	Can the growing of transgenic maize threaten protected Lepidoptera in Europe?
6-2	Bernadette Oehen	Potential exposure of butterflies in protected habitats by cultivation of Bt-maize: a case study in Switzerland
6-3	Salvatore Arpaia	Life cycle of butterflies in Italian protected areas: how to build a science based exposure analysis
6-4	Antonio Masetti	Macro-moths as possible assessment endpoints for estimating risks of Bt-maize cultivation to biodiversity: A field study in Italian protected areas
6-5	Andreas Lang	Monitoring of butterflies to detect early changes in population trends.
	Coffee	

7 Landscape ecology & Life History II

11.00	**7-1**	Martinus E. Huigens	Moth species trends explained by life history traits
11.15	**7-2**	Callum Macgregor	Artificial light affects abundance and species richness of moths, with implications for nocturnal pollen transport
11.30	**7-3**	Tijl Essens	Ecological determinants of butterfly vulnerability across the European continent
11.45	**7-4**	Zdenek Fric	Cold-adapted or herbivore-dependent? Quaternary climate and aberrant Eurasian butterfly fauna
12.00	**7-5**	Joop Mourik	More Fallow deer - less butterflies in the Amsterdam Water Supply Dunes
12.15	**7-6**	C.J.M. Musters	Are butterflies and dragonflies good indicators for the decline of respectively terrestrial and aquatic insects?
12.30		Lunch	

8 Genetically modified crops II / Citizen Science I

8-1	Emily Walker	A modelling framework for assessing lethal and sublethal effects of Genetically Modified (GM) maize pollen on non-target Lepidoptera
8-2	Lorenz Fahse	Assessing Bt maize induced mortality risk for non-target butterflies: A new simulation model approach
8-3	Mathias Otto	Assessing the risk from Bt maize on endangered butterfly species: an analysis of available data and models
8-4	Pieter Vantieghem	Resemblance of Essex skipper (*Thymelicus lineola*) and Small skipper (*T. sylvestris*) is causing a large overestimation of the distribution of Small skipper in Flanders.
8-5	Sylvain Cuvelier	Web-based migration survey of the Scarce tortoiseshell, *Nymphalis xanthomelas* (Esper 1781), in northwestern Europe
8-6	Jurgen Couckuyt	Area survey of the *Papilionoidea* diversity in Durme- and Schelde territory, Flanders (Belgium) 2013-2017.
	Lunch	

(Friday April 1)

9		LIFE and the conservation of *Maculinea* I		10. Monitoring II		
13.45	**9-1**	*Irma Wynhoff*	*Fen meadows on the move for the conservation of Maculinea (Phengaris) teleius butterflies*			
14.15	**9-2**	Frank van Langevelde	Ecological relationships relevant for the conservation of *Maculinea (Phengaris) teleius* butterflies	**10-1**	Juha Pöyry	Twenty years of moth monitoring in Finland
14.30	**9-3**	Mirja Kits	Hydrological restoration of a butterfly habitat	**10-2**	Ian Middlebrook	Monitoring on Butterfly Conservation's nature reserves
14.45	**9-4**	Piotr Nowicki	Source-sink dynamics in populations of *Maculinea* butterflies	**10-3**	Stefan Brunzel	First five years of a butterfly monitoring scheme in the National Park Kellerwald-Edersee (Hesse, Germany)
15.00	**9-5**	Caroline Bulman	*Maculinea arion* in the UK: a partnership between science and conservation	**10-4**	Byron Morgan	Modelling migrant butterfly species data
15.15	**9-6**	Jeremy Thomas	Conservation of *Maculinea arion* in challenging landscapes and under future UK climates	**10-5**	Martin Wiemers	LepiDiv: a new online resource for distribution maps of European butterflies
15.30		Tea			Tea	

(Friday April 1)

11. LIFE and the conservation of *Maculinea* II

16.00	**11-1**	David Nash	Maculinea rebeli: The rise and fall (and rise?) of a European endemic
16.15	**11-2**	Paula Seixas	Spatial distribution and movements of *Phengaris alcon (*Lepidoptera*: Lycaenidae)* populations in Portugal
16.30	**11-3**	Milos Popovic	Population ecology of *Phengaris teleius* in northern Serbia
16.45	**11-4**	Márta Osváth-Ferencz	From butterflies to ants: a population study of *Maculinea arion (*Lepidoptera*: Lycaenidae)* in Romania
17.00	**11-5**	Henk de Vries	100 years of *Lycaena dispar batava* in the Netherlands
17.15	**11-6**	Thomas Fartmann	Vegetation heterogeneity caused by an ecosystem engineer drives oviposition site selection of a threatened grassland butterfly
17.30			
17.45		Poster session	
19.15		Conference Buffet	

12. Climate Change II / Citizen Science II

12-1	Robert Wilson	Spatial variation in microclimate and phenology influence population and distribution-level responses of species to climate change
12-2	Toke Høye	High-arctic butterflies become smaller with rising temperatures
12-3	Cristiana Cerrato	Butterfly communities along altitudinal gradients: 10 years data from the Italian Alps
12-4	Mikko Kuussaari	Weather explains high annual variation in butterfly dispersal
12-5	Dave Maertens	European level identification survey of *Leptidea sinapis, L. reali* and *L. juvernica*
12-6	Laurian Parmentier	Mark Recapture research of the Grizzled skipper, *Pyrgus malvae* (Linnaeus 1758) in a Flemish population
12-7	Andras Ambrus	Mark-recapture study on the highly endangered noctuid moth *Arytrura musculus*

Saturday 2nd April

13 Conservation in Practice I

9.00	**13-1**	Sue Collins	Can policy improve the future for butterflies?
9.15	**13-2**	Simona Bonelli	The effect of management and environmental matrix on butterfly diversity in Natura 2000 farmlands
9.30	**13-3**	Sam Ellis	30 years of conservation effort on Britain's most threatened butterfly: the High Brown Fritillary *Argynnis adippe (*Lepidoptera*: Nymphalidae)*
9.45	**13-4**	Philippe Goffart	Successful creation and management of forest glades and clearings for butterflies in Southern Belgium
10.00	**13-5**	Matthias Dolek	How to create and maintain light forests for rare butterflies
10.15	**13-6**	Miguel L. Munguira	Recovery plans for the four Spanish endangered endemic butterfly species
10.30		Coffee	

14 Conservation in Practice II

11.00	**14-1**	Albert Vliegenthart	Butterflies, Bees and Business - perspectives for urban nature
11.15	**14-2**	Jan Miller	Staying Positive with Public Education Projects the problems and successes in 15 years of making and writing about community butterfly gardens in the UK
11.30	**14-3**	Théophile Olivier	Butterfly assemblages in residential gardens are driven by species' habitat preference and mobility
11.45	**14-4**	Anthonie Stip	What's up, Wall? Conservation lessons for a grassland butterfly species
12.00	**14-5**	*Martin Warren*	*From Silent Spring to Silent Summer: what have we learnt about conserving butterflies?*
12.30		Conclusion	
13.00		Lunch	

Afternoon excursion to LIFE project

Blues in the Marshes

Oral presentations – Abstracts

Current issues in the conservation of butterflies and moths

MICHIEL WALLISDEVRIES[1]

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Although recent population trends indicate that the rates of decline in butterflies and other flower-visiting insects have slowed down in north-western Europe, the road to recovery is still a long and difficult one for many species. This presentation briefly reviews the main themes of environmental change addressed during this conference. I will particularly focus on the impacts of nitrogen deposition, as a developing field of study. Furthermore, I emphasize the value of combining information from monitoring, mechanistic research and field experiments in developing both a better understanding and appropriate conservation measures.

Changes in species assemblages are showing a clear signal of increasing nitrogen loads with increasing numbers of mobile and multivoltine species with high reproductive capacity, rapid larval development and hibernation as pupae or adults. Vulnerable species from low-productive environments show a stronger decline in regions with high nitrogen deposition. The development of the community nitrogen index allows the evaluation of trends in species assemblages under nitrogen deposition at different spatial scales, from local to national and beyond.

We are still at an early stage to elucidate the underlying mechanisms driving these changes in communities and species abundances. Yet, such knowledge is crucial to design successful measures for mitigation and restoration. It becomes increasingly clear that complex interactions are involved. This is illustrated with a conceptual model how selectivity for warm microclimates under excessive nitrogen deposition may lead to an ecological trap due to inadequate hostplant quality.

1-1

Pollinator conservation: a delicate balance between utilitarian arguments and inherent motivation

DAVID KLEIJN[1]

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In recent decades utilitarian arguments have become increasingly important as a justification for biodiversity conservation. In other words, biodiversity should be conserved because it delivers services to people such as pollination, pest control and water purification. Using pollination as a an example I examine the implications and usefulness of this approach. Drawing mostly on studies from bee pollinators I show, first, that a very small proportion of all species contribute to the pollination of insect-pollinated crops. Second, threatened or even merely uncommon species contribute little or nothing to this service. Third, bee species decline is mostly driven by the decline of their host plants, and species specializing on crop plants generally do quite well. Fourth, conservation measures aiming to enhance the services provided by wild pollinators rather than the pollinators themselves primarily benefit common species. Conservation should therefore not be based on utilitarian arguments alone because this would not help the species most in need of conservation. For threatened species in particular, conservation should be based on arguments such as the fascination for nature or that appeal to the local identity of people. Interestingly, while governmental institutions have been moving towards increasingly services-based arguments for conservation the general public is becoming increasingly engaged in conservation because of inherent motivations. To halt the ongoing pollinator decline, conservationists need to successfully utilize both movements.

1-2

Can powerline rights-of-way contribute to conservation of grassland butterflies?

ERIK ÖCKINGER[1], ÅKE BERG[2]

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[2] Swedish University of Agricultural Sciences, Sweden

With decreasing areas of natural and semi-natural habitats, the importance of anthropogenic habitats for biodiversity is increasing. Infrastructure rights-of-way, such as road verges and electrical transmission line corridors cover large areas of land. In Sweden their total area exceeds that of semi-natural grasslands, and hence they have a great potential for conservation of especially species associated with grasslands. As linear habitats they also have the potential to act as dispersal corridors and increase landscape connectivity. We compared species richness and community composition of butterflies in power-line corridors in comparison with semi-natural grasslands, and tested how this was influenced by landscape configuration and local management. Power-line corridors had higher species richness than semi-natural pastures, but contained a partially different set of species. This can be explained both by differences in the availability of larval host plant species and differences in management which creates taller vegetation and a larger availability of nectar-rich flowers in the power-line corridors. Butterfly communities in power-line corridors were not affected by the amount of grasslands in the landscape, but instead the community composition in semi-natural grasslands and road verges are influenced by the vicinity of a power-line corridor. Studies of dispersal behavior indicate that the power-line corridors act mainly as habitat for grassland butterflies, and do not direct dispersal movements. We conclude that power-line corridors and other rights-of way habitats to some extent can be managed to act as a substitute for rapidly declining semi-natural habitats in anthropogenic landscapes.

1-3
Where to see grassland butterflies if grasslands are gone?

TIIT TEDER[1], MARI-LIIS VILJUR[1]

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Contemporary human-modified forest landscapes in boreal and temperate environments contain various novel types of open habitats which are potentially suitable for species traditionally considered to inhabit semi-natural grasslands. However, in the case of butterflies, there is no systematic analysis identifying the share of the regional species pool that can take advantage of this alternative. To assess the importance of man-made forest openings for open-habitat butterflies in Northern Europe, we compared their species richness and composition in forest cutovers with their regional species pool. We also investigated to which extent cutovers in different forest types differ in the butterfly assemblage. The species richness of butterflies in cutovers appeared to be remarkably high: we recorded the vast majority of the total regional species pool in just 37 cutover sites surveyed. The list of recorded species contained a very high share of regionally occurring grassland species, as well as nearly complete sets of open-habitat generalists and forest species. Different forest types harboured characteristic butterfly assemblages, their contribution to the cutovers' butterfly fauna being thus complementary. This as well as various other lines of evidence indicate that most butterfly species can form resident populations in harvested forest landscapes. Our findings demonstrate that novel types of man-made forest openings can to a remarkable degree mitigate the detrimental effects of the loss of seminatural grasslands, providing alternative habitats for high numbers of species characteristic to grasslands. Human-altered ecosystems may thus prove to be a viable alternative where restoring or maintaining natural and semi-natural habitats is impossible.

1-4

Intergovernmental assessments and the role of Butterflies and Moths - Insights from IPCC and IPBES

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The IPCC (Intergovernmental Panel on Climate Change) and the IPBES (Intergovernmental science-policy Platform on Biodiversity and Ecosystem Services) are both processes in which assessments play a crucial role. In its last Assessment Report (AR5), as in the ones before, IPCC assessed "The Physical Science Basis" (Working Group I), "Impacts, Adaptation and Vulnerability" (WG II), and "Mitigation of Climate Change" (WG III). The IPBES (Diaz et al., 2015) has started with thematic assessments - one on scenarios and one on pollination, which will be finished at the end of February 2016. Several regional assessments have started as well, e.g. for a) Europe and Central Asia, b) Asia - Pacific, c) Americas, and d) Africa.

In the presentation experiences from some of these assessments will be presented, based on the IPCC involvement (Settele et al., 2014) and on the involvement in the ongoing pollination work as well as the regional assessment for Asia and the Pacific and examples will be shown where information on Butterflies and Moths was used.

A special focus of the presentation will be on the pollination report which will have been published short before the Wageningen meeting. Questions on which some answers are planned to be provided are: a) Does IPBES use butterfly data (either from BMS or from another source), b) If yes, how is this used? Does it seem satisfactory? c) If no, how could it be improved and what can we the butterfly conservation community about it?

References:

Diaz, S., et al. (2015). The IPBES Conceptual Framework — connecting nature and people. Current Opinion in Environmental Sustainability 2015, 14:1–16.

Settele J et al. (2014). Terrestrial and Inland Water Systems. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. IPCC [Field CB et al. (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 271-359.

2-1

Using long-term monitoring data to understand the impacts of climate change

TOM OLIVER[1]

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Climate change impacts upon biodiversity in complex ways. Many aspects of the climate are changing in tandem, and the effects of climate variables can vary between locations. Long-term monitoring data are an essential resource to tease apart this complex nature of climate impacts, helping us to deepen our understanding of fundamental ecological processes and to design effective conservation strategies. I will summarise recent research on the impacts of climate change, including phenological shifts, extreme event impacts, local adaptation and climate-land use interactions. I will address several questions: What implications do these processes have for the way we manage our landscapes? What are the likely impacts of future climate changes on butterflies? What can other species monitoring schemes learn from the long legacy of butterfly monitoring and data analysis? Where next for butterfly monitoring with regards to understanding climate change impacts?

2-2

Disentangling the relative importance of land use and climate change in driving five decades of richness loss in European butterflies

ANNE ESKILDSEN[1], SIGNE NORMAND[1], LUISA CARVALHEIRO[2], DANIEL KISSLING[3], JENS-CHRISTIAN SVENNING[1], FLORIAN ALTERMATT[4], EMILIO BALLETTO[5], JACOBUS C. BIESMEIJER[6], JAROSLAW BUSZKO[7], MARC DUFRÊNE[8], VIOLAINE FICHEFET[9], RICHARD FOX[10], RICHARD FUCHS[11], ENRIQUE GARCÍA BARROS[12], ALEXANDER HARPKE[13], RISTO K. HEIKKINEN[14], HELMUT HÖTTINGER[15], LAURI KAILA[16], MIKKO KUUSSAARI[17], DIRK MAES[18], MIGUEL MUNGUIRA[12], JOSEF PENNERSDORFER[15], JUHA PÖYRY[17], ROLF REINHARDT[19], KIMMO SAARINEN[20], OLIVER SCHWEIGER[13], JOSEF SETTELE[13], NICOLAS TITEUX[21], MICHIEL WALLISDEVRIES[22], MARTIN WIEMERS[13], TOKE T. HØYE[1]

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Both historic and recent variation in global change drivers should be considered as potentially important determinants of recent biodiversity change. Moreover, it is increasingly recognized that interactions exist between such drivers, and that conservation strategies and projections of future biodiversity change that only address single drivers are inadequate. Still, no studies have yet succeeded in apportioning the relative importance of multiple global change drivers across space and time. We used a unique, newly collated dataset of butterfly records from 13 European countries to uncover species richness changes among grassland and forest butterflies during the past 5 decades (1960-2009). Further, by combining climate change data and a reconstruction of European land cover 1900-2009 we were able to address the relative importance of historic (i.e. 1900-1960) and recent (i.e. 1960-2009) changes in climate and butterfly habitat in driving these trends. We found a severe long-term impoverishment of both grassland and forest butterfly diversity at multiple spatial scales; however more country-level extinctions were found among grassland species. The decline in grassland butterfly richness was highly influenced by historic changes in grassland habitat, suggesting the presence of landscape-level extinction debts among grassland butterfly assemblages with a lag-time of up to five decades. In contrast, forest butterflies were more strongly affected by recent changes in forest habitat, indicating that any accumulated extinction debt related to past management practices may already have been paid. Further, recent climate change was found to be an increasingly strong driver of richness decline in both species groups.

2-3

Spatio-temporal heterogeneity in the sensitivity of butterfly phenology to climate

DAVID GUTIERREZ[1], SUSANA NIETO-SÁNCHEZ[2], ROBERT J. WILSON[3]

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[3] University of Exeter, United Kingdom

Phenology shifts are the most documented responses to climate change, with examples of advanced timing of life cycles of butterflies over the last decades. To predict the future impact of climate change on phenology, it is necessary to quantify its sensitivity to temperature and other environmental cues. However, few studies have considered simultaneously the spatial and temporal variation in phenology in response to climate, particularly along elevational gradients with strongly changing climate regimes over short distances. If the relationship between phenology and temperature is different across species' elevational ranges, individuals moved to localities with a different climate could experience a mismatch with local resources and other interacting species, with potential consequences for population viability. Here, we studied the spatio-temporal sensitivity of phenology (mean date) to temperature for 24 univoltine species along a c. 1800 m elevational gradient over a 9-year period in central Spain. For c. half of the species, temperature had similar effects on mean date over space and time, suggesting a plastic response of phenology. For 5 species, the best models for mean date were those with different spatial (between sites) and temporal (between year) responses to temperature, implying evidence of local adaptation. For the remaining species, there was uncertainty in the best models explaining phenology. Our results suggest that species could respond differently to climate change, with phenotypic plasticity providing most species with potential to keep up with future temperature increases, but also some species with limited ability to cope with warming due to possible local adaptation.

2-4

Butterflies with contrasting thermal sensibilities are differently affected by urbanization

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Urbanization is one of the most important examples of human-induced environmental change. A well-studied ecological consequence of urbanization is the 'Urban Heat Island', referring to the increased temperature and reduced humidity experienced by cities compared to their surroundings. As poïkilothermous organisms, butterflies are heavily dependent on ambient temperature for most aspects of their life. They are therefore likely to be strongly affected by climate-related effects of urbanization. Using a split-brood design, we assessed the impact of urbanization at two spatial scales on larval survival and adult body size of two closely related satyrine butterflies (*Pararge aegeria* and *Lasiommata megera*).

We show that the 'Urban Heat Island' was more pronounced at the local (0.2x0.2 km) than at the landscape scale (3x3 km). For the expanding species *P. aegeria* which occurs in different ecotypes, we did not find any influence of urbanization, neither on larval survival, nor on adult body mass. In the thermophilous, regionally endangered species *L. megera*, survival rate increased with an increasing degree of urbanization at the local scale; larval survival was twice as high in urban compared to rural sites. Additionally, male adult body size tended to increase with increasing urbanization at the local scale. We argue that daytime (rather than night-time) conditions may explain these patterns.

Our results shed light on the potential effects of urbanization on species with different thermal preferences. We believe these findings are also relevant in the context of urban biodiversity conservation, as they may inform adequate mitigation measures.

3-1

From counts to indicators - progress in butterfly monitoring

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Butterfly monitoring has come a long way since Ernie Pollard counted his first transects in the 1970s. In Europe it expanded to 22 countries in 2014, and new schemes are starting up every year. Also in the US butterfly monitoring is active in at least nine states. In Europe we want to facilitate new indicators as well as more research by collating data into an e-BMS. On a global scale the publication of the Global Guidelines for Butterfly Monitoring mark the expansion outside the temperate zone. Furthermore butterflies are the first non-vertebrate group for which trends are used for the 2016 version of the Global Living Planet Index.

3-2

Butterflies in the Living Planet Index in the Netherlands: has the decline halted?

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We calculated a Living Planet Index for the Netherlands, based on species from 7 animal species groups (including butterflies and dragonflies) occurring in terrestrial and freshwater habitats. According to the LPI, the state of biodiversity has slightly increased since 1990. However, large differences exist between habitat types. We found a considerable increase in freshwater animal populations, probably because of improvement of chemical water quality and rehabilitation of marshland habitats. We also found a slight increase in woodland populations. In contrast, animals in farmland and open natural habitats (coastal dunes, heathland and semi-natural grassland) declined, which we attribute to intensive agricultural practices and nitrogen deposition, respectively.
Several species groups have increased since 1990, among which dragonflies. But for butterflies, we found declining trends in all habitats. Yet, even for this group the decline seems to slow down in recent years.
The LPI shows that, even in a densely populated western European country, ongoing loss of animal biodiversity is not inevitable and may even be reverted back into increase if adequate measures are taken.

3-3
Dynamic models for butterfly monitoring data

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Several species groups have increased since 1990, among which dragonflies. But for butterflies, we found declining trends in all habitats. Yet, even for this group the decline seems to slow down in recent years.

3-4
The State of the UK's Butterflies 2016

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The LPI shows that, even in a densely populated western European country, ongoing loss of animal biodiversity is not inevitable and may even be reverted back into increase if adequate measures are taken.

3-5
Moitoring of Habitats directive butterfly species in Slovenia - ten years after

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Following the Habitats directive (Council Directive 92/43/EEC) the EU member states are required to monitor the status of threatened species listed in the Annex II and IV of the Directive. In Slovenia we have designed three level of monitoring with different monitoring frequency depending on known habitat requirements and known trends of surveyed species:
-monitoring of population size (selected populations);
-monitoring of selected core areas (patch occupancy, abundance);
-monitoring of isolated populations (presence of the species).
In general, we detected negative trends for majority of species where sufficient data are available at different, but not all levels of monitoring. The Southern Festoon (*Zerynthia polyxena*) has been the only noteworthy exception with stable distribution and patch occupancy. The most dramatic loss was detected for Large Blue (*Phengaris arion*) with 79% decline in patch occupancy and 43% range contraction. The Scarce Large Blue (*P. teleius*) and Dusky Large Blue (*P. nausithous*) have had mixed fortunes with population and patch occupancy declines at majority of sites coupled with range contractions with loss of several isolated sites in different regions in Slovenia. The False Ringlet (*C. oedippus*) has been almost wiped out from central Slovenia, being present just at one small blanket bog, but it is still stable in patch occupancy in south western Slovenia with even increasing population size at the monitoring site in Kras region. Majority of habitat loss that caused such severe declines could be attributed to recent changes in farming practices with small scale farming being abandoned, resulting in overgrowing of grasslands, or converted to large scale intensive farming as favored by EU agriculture policy. Despite availability of butterfly conservation targeted agro-environmental schemes these are not sufficiently attractive for farmers and habitat loss continues even in Natura 2000 sites.

3-6

Starting up targeted monitoring of swedish butterflies and moths of the eu habitats directive

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Following the EU Habitats Directive, member states have an obligation to preserve the species and habitats listed in the Habitats Directive Annexes and to assess the conservation status of all species and habitats of community interest covered in the Annex IV every sixth year. Sweden has now launched a nationwide targeted monitoring scheme for habitats directive species, covering 10 butterfly species, one butterfly subspecies, and one moth species. These twelve species represent a wide range of life history strategies, differing degrees of habitat specialisation, widespread vs. scarce and local populations, and target populations that may be remote and difficult to reach. Here we describe results and experiences from the pilot experiments in 2011-13 and the gradual launch since 2014. During 2015, approximately 140 sites were surveyed, covering 9 of the 12 species. The implementation of yearly sampling protocol constitutes a major step forward as all Swedish Habitats Directive reporting until now has been solely based on expert judgment every 6th year.

4-1

A genetic dimension to European butterfly diversity and conservation

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Our work as biologists, as well as our passion as lepidopterists, means describing biodiversity at all levels, understanding how it is generated and maintained, and, of course, finding ways to protect it. Technical advances, especially recent molecular techniques, are unfolding a previously invisible layer of complexity: genetically differentiated lineages, evolutionary significant units, and even cryptic species.
This new viewpoint brings a wealth of knowledge, but also poses new challenges and questions. How to methodologically approach the enormous descriptive task at fine phylogeographic scale? How much should we invest in the quest for cryptic diversity? Does recognising cryptic diversity represent a rather meaningless burden for monitoring and conservation, or does it have fundamental implications for biogeography, ecology and the preservation of existing biodiversity? How to integrate phylogeographic knowledge with conservation prioritization? Even if butterflies are an exceptionally well-studied group of invertebrates, a good number of cryptic species are still being discovered or confirmed. But most importantly, novel data give us some clues to answer the previous questions.

4-2
Remarkable examples of cryptic species in European butterflies

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The need for an accurate knowledge of global biodiversity is higher than ever not only because of answers needed to major scientific issues, but also because the looming extinction crisis calls for new rigors and approaches in conservation programs. Ongoing research on European butterflies allowed the detection of unexpected genetic patterns, suggesting unknown levels of biological complexity that require further studies.
We present two striking examples of cryptic diversity in European butterflies (*Leptidea* and *Spialia genera*). *Leptidea* is also a genus with pronounced karyotype instability and *Leptidea sinapis* is currently the metazoan with the highest intraspecific chromosome number variability unrelated to polyploidy (2n = 56 to 2n = 110). We tested the role of chromosomal rearrangements in speciation and the concept of clinal species by mating extreme chromosomal races based on laboratory lines.
Within the genus *Spialia*, recent research based on multiple sources of data suggests the presence of a new cryptic species that has likely speciated through a shift in larval host-plant. This species is apparently endemic to Iberia and its detailed distribution, as well as conservation status, requires immediate investigations.
Leptidea and *Spialia* represent exciting systems that improve our understanding of fundamental evolutionary processes. They also exemplify the challenges that lie ahead when documenting biodiversity, as well as implications for nature conservation.

4-3

Dispersal, gene flow and sibship analysis of *Phengaris (Maculinea) alcon* in NW Europe: implications for conservation

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Effective dispersal determines the long-term stability of metapopulations and plays a crucial role in the conservation and evolution of species. For butterflies, dispersal data are mainly based on mark-recapture observations which are usually poor predictors of long-distance dispersal. Detailed knowledge on effective gene flow through dispersal is often missing. During recent decades, the Alcon Blue (*Phengaris (Maculinea) alcon*) declined strongly throughout Europe and, therefore, attracted much attention among conservation biologists. Here, we analysed the genetic population structure and oviposition patterns of *M. alcon* in Belgium and the Netherlands using 12 microsatellite markers. We collected 211 wing clip-samples of adult butterflies from 8 populations in Belgium and 191 caterpillars from flower buds of the host plant *Gentiana pneumonanthe* in 2 locations in the Netherlands. At the regional scale, there was a clear spatial structure with an overall genetic differentiation among populations (Fst) of 0.26. At the local scale, spatial genetic structure was low or absent indicating frequent within-habitat dispersal over distances up to of 3 km. Populations in large habitat patches revealed higher levels of genetic diversity compared to small habitat patches. This emphasizes the importance of conserving large suitable habitat patches for maintaining viable populations. Egg-laying females did not move further than 100 meter between host plants and on average crossed less than 10 meter among host plants for oviposition. Parentage and sibship-relationships among caterpillars revealed full-sib families up to 18 individuals and indicate a high level of spatial clustering of eggs from individual females.

4-4
Analysing life history traits for conservation: the patterns found depend on questions asked

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Community analyses focusing on life history traits of constituent species represent a promising avenue of ecological research, which may hopefully reveal major patterns independently on taxonomic and geographical boundaries. Newly existing user-friendly software and increasingly detailed life history knowledge of entire faunas turned this approach into booming industry.
We employed traits approach for a wide scope of questions. Studying butterflies in Czech nature reserves, we found that reserve geometry affects the representation of traits associated with density-mobility gradient, while surrounding landscape heterogeneity facilitates colonisation processes. Study of forest encroachment in South Balkan revealed an association between vegetation succession, butterfly voltinism and host plant growth forms. Traits responses to succession were also apparent in a study of butterflies inhabiting military training ranges. Apparently, traits combinations significantly responding to an ecological process reflect the specific question asked.
This is even more apparent in traits-focused studies of Central European moths. For many moths, information on individual mobility, population density or fertility is not available. Consequently, the main gradients formed by the life history traits in analyses reflect crude habitat association (from grasslands to woodlands) and this gradient stands prominently in moths' data analyses.
Patterns revealed by analysing life history traits thus depend both on specific questions asked and on the duality of traits data. Focus on traits provides more mechanistic view on structuring lepidopteran communities, but we are still long way from trans-taxonomic and trans-regional integration.

4-5

Influence of meteorological conditions on demography and dispersal of a glacial relict butterfly, Boloria aquilonaris, in Belgium.

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The metapopulation concept is central to conservation ecology, especially in a context of increasing habitat fragmentation and climate change. To get a comprehensive picture of the functioning of a metapopulation, it is important to consider all the factors affecting it, such as variations in habitat quality, landscape connectivity, or weather conditions, for example. Numerous studies exemplified how changes in habitat quality and landscape connectivity impact metapopulation dynamics. However, the impact of weather conditions is less documented. Butterflies being ectotherms, changes in weather conditions, from one year to another, may affect the activity pattern and the survival of individuals throughout their life cycle, hence impacting metapopulation dynamics.
In this study, we focused on the impact of weather conditions (i.e. temperature and rain) on both demography (population size fluctuations) and dispersal in the cranberry fritillary, *Boloria aquilonaris*. We collected demographic and dispersal data (through intensive capture-mark-recapture and genetic sampling) in a Belgian metapopulation during six years. The weather data were compiled from local meteorological stations. We assessed the influence of weather on population demography according to three periods of the species life stage (1: egg and diapausing larvae, 2: active larvae and pupae, and 3: imagos). As *B. aquilonaris* is a relict species, we predict cooler temperature conditions during pre-imago stages to favour the demography of the species. Also, as adults require energy to disperse from one population to another, we predict higher temperature conditions and the absence of rain during the flight period to favour dispersal.

4-6

Seasonal timing in a warming world: how can winter moths regulate the phenology of their entire life-cycle?

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In seasonal environments there is only a limited period during which conditions for feeding, reproducing and growing are favourable. Thus, to maximize their fitness, organisms need to synchronize their phenology to the annual variation in environmental conditions. During the past decades, climate change has led to an earlier phenology in many species. To predict what the consequences of these increasing temperatures will be on the entire phenological cycle of species, a key question is whether the phenological advancement in one life-cycle stage is carried over to subsequent stages or whether it can be buffered via underlying mechanisms regulating phenology. In our long-term study (1994-2015) on the winter moth, we collect detailed data on timing of egg-hatching in spring and adult eclosion in winter. Timing of egg-hatching is strongly temperature-dependent and largely varies between years. However, we find little inter-annual variation in timing of adult eclosion. To understand how timing of adult eclosion remains uncoupled from the timing of egg-hatching, we manipulated phenology of egg-hatching in a laboratory experiment and recorded the phenology of the entire life-cycle until the timing of egg-hatching of the next generation. We show that winter moths can use photoperiodic information acquired during the larval development to set the timing of their annual program by adjusting the duration of subsequent life-cycle stages.

5-1

Butterflies and landscapes: from structural to functional habitat and connectivity - a behavioural approach

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Species responses to environmental change are influenced by processes operating at multiple scales. Butterflies have played – and still play – a significant role in the study of the regional persistence of spatially structured populations (e.g. effects of habitat fragmentation, meta-population dynamics, climate change related range shifts). In this talk, I will particularly address the behavioural mechanisms of resource use, dispersal and habitat selection from an integrated life style point of view. Life styles may vary significantly among butterfly species, but also at the intraspecific level one may observe spatial variation in habitat use and mobility. I will focus on internal and external information used by a butterfly in order to express particular levels of dispersal propensity and capacity. Landscapes with different quantities, qualities and configurations of key resources may result into different constraints for movements and habitat use. It may ultimately lead to different evolutionary responses. Examples will be presented focusing on our recent experimental work with Meadow browns (*Maniola jurtina*) from intensively and extensively manged landscapes (nectar poor and nectar rich environments, respectively). Flight is energetically costly and flight and metabolic responses to nectar-poor treatments are shown to differ relative to the landscape type of origin. I will also address the timely issue of landscape-related differences in sensory ecology and associated behaviours focusing on our recent experimental work with Speckled woods (*Pararge aegeria*) originating from woodland, agricultural or urban landscapes. This allows us to explore the relative importance of visual and olfactory cues in the different populations for detecting habitat from a distance.

5-2

Spatial scale-dependent impacts of urbanization on butterfly and macro-moth communities

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Urbanization is a case of human-induced rapid environmental change, to which short-lived poïkilothermous organisms, such as Lepidoptera, are likely to show a variety of ecological and evolutionary responses. Not only is urbanization accompanied by changing configurations of habitat resources, but chemical and light pollution within urban environments may interfere too with the ecological functioning of individuals and populations. In turn, this may affect ecosystem functioning.
Using micro-climatic data from 81 Belgian sites across urbanization gradients at two spatial scales, we show that the "Urban Heat Island" effect is generally more pronounced at the local (0.2x0.2 km) than at the landscape scale (3x3 km).
Surveys within the same sites scoring the presence and relative abundance of butterfly and macro-moth species indicate a filter effect of urbanization on communities, with the resulting biological homogenization being spatial scale-dependent: butterfly communities turn out to be more affected by local-scale urbanization whereas macro-moth communities mainly respond to landscape-scale urbanization. This scale-dependence may indicate that macro-moths move on average at a coarser spatial scale than butterflies.
Having observed this landscape-scale effect of urbanization on macro-moth species, we set out to explore whether the species-poor urban communities consist of individuals and species with different biological traits. We did an inter- and intra-specific comparison of body mass between urban and non-urban conditions. The results will be interpreted in a framework of urbanization-induced shifts of communities through trophic interactions as moths are important prey items for predators such as spiders and bats.

5-3

Population trends of common and widespread butterflies in different habitats using Wider Countryside Butterfly Survey (WCBS) data

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The Wider Countryside Butterfly Survey (WCBS) forms part of an integrated approach to monitoring butterflies though the UK Butterfly Monitoring Scheme, complementing conventional butterfly transect recording at semi-natural sites (Roy et al., 2014). It represents the first UK-wide survey of butterfly abundance using a random sampling framework and aims to generate unbiased data on the population status of common and widespread butterfly species across the whole countryside (Brereton et al., 2011). Many of these species are in long-term decline (Brereton et al., 2015). The WCBS uses a reduced effort method (Roy et al., 2007), whilst the network of monads representatively samples the main land cover types of the UK (Butterfly Conservation unpublished data). Here, for the first time, we use this unbiased sample to present habitat and regional trends in common and widespread butterflies and in relation to environmental variables, in order to help understand the drivers of change and inform policy responses.

5-4

Patch occupancy, abundances and habitat requirements of the scarce copper in an urban-rural landscape - implications for management and planning

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The scarce copper is a butterfly species which is still relatively common in Sweden, but has experienced severe decline in certain regions as well as in other parts of Europe. In this study, patch occupancy and abundances were investigated in 44 patches ranging from urban and peri-urban to rural locations. Habitats investigated were urban parks, urban grasslands managed by the municipality for biodiversity, abandoned arable sites, road verges, meadows and pastures. Scarce coppers were recorded at four occasions on each patch during the field season. In total 624 sightings of scarce coppers were recorded. Highest abundances were observed in unmanaged patches and meadows, while pastures had low abundances; in the urban parks no coppers were found. Of the 44 patches 13 were not occupied, while 13 other patches were occupied at all four occasions. In patches which were cut, copper numbers dropped in almost all cases to zero after cutting. Factors influencing abundances were habitat type, patch area, flower abundance, vegetation height, grade of tree succession and abundance of larval food plant. The study shows that current high abundances of the scarce copper in the long term will not be ensured in this landscape when building takes place at the urban fringe where the largest numbers of coppers were found and no other measures are taken. Other habitat types are either small in size or support only small numbers of coppers due to lower habitat quality or have a non-optimal management. This includes also sites situated in nature reserves.

5-5
Suitability and transferability of the resource-based habitat concept in bog butterflies

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A functional definition of the habitat-concept based on ecological resources incorporates three interconnected parameters: the composition, the configuration and the availability of resources. The intersection of those parameters represents the functional habitat of a given population or species. Resource composition refers to the co-occurrence of the resources required by each individual to complete its life cycle (nectar and host feeding resources, appropriate structure and microclimate, ...). Resource configuration refers both to the way individual resources are spatially distributed within the habitat (from fine to coarse grain) and the way all the resources are organised in the habitat space (from superposed, overlapping to fully separated). Resource availability refers to the accessibility and procurability of resources, including quality and amount in both space and time. Variations in these parameters are likely to influence the demographic response of the population. To test the suitability and the across landscape transferability of this definition, we first conducted a very detailed study on five butterfly species (*Lycaena helle*, *L. hippothoe*, *Boloria eunomia*, *B. selene* and *B. aquilonaris*) within a large nature reserve presenting a mosaic of peat bog vegetation. Second, we conducted a larger scale study, focusing on metapopulations of *B. eunomia* and *B. aquilonaris* in Belgium. We monitored local abundance and population size for each species using mark–release–recapture studies and tested whether variations in local abundance and population size can be explained by 1) the vegetation type, 2) the vegetation composition or 3) the availability and configuration of the species-specific ecological resources.

5-6

Dispersal of butterflies in forested landscapes - does forest form a dispersal barrier?

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Boreal and temperate managed forests contain various novel types of open habitats which are potentially suitable for species traditionally considered to inhabit semi-natural grasslands, including butterflies. On the other hand, it has previously been shown that open habitat butterflies perceive forest as a dispersal barrier. If these individual-level behavioural patterns affect the colonisation of open habitats in forested landscape, has remained uninvestigated so far. To fill this gap, we studied if, and to what extent, forest impedes the colonisation of cutover sites by butterflies with different life-histories. For this purpose, we took the advantage of conventional, clear-cutting-based forest management practices which create variously isolated open spaces in forested landscapes in Northern Europe. In particular, we compared the species composition and richness of butterflies in cutovers completely surrounded by forest (isolated cutovers) with those connected to the network of other forest openings (control cutovers). We conducted the study (Estonia, Northern Europe) during four consecutive summers and covered the flight time of most regional butterfly species. We found no effect of isolation on colonisation for open-habitat butterflies, neither was colonisation affected by any species traits. Our results provide a population level perspective to butterfly dispersal in contemporary forested landscapes in Northern Europe.

6-1

Can the growing of transgenic maize threaten protected Lepidoptera in Europe?

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The large-scale growing of transgenic GM maize in North America seems to have created serious problems for the migratory lepidopteran, the monarch butterfly (*Danais plexippus*), a unique species and conservation icon. In Europe, transgenic GM maize is one of the few crops authorised for commercial cultivation, although the acreage devoted to GM maize is not extensive. We used our earlier modelling results concerning the threat to the peacock butterfly (*Inachis io*) which indicated that in several areas of Europe, this species could be under threat by GM maize growing. We checked the larval phenology to identify other protected European butterflies that can be under threat due to phenological overlap. Additionally, we analysed the spatial distribution of maize growing and the distribution of protected areas in Europe, based on the Natura 2000 protected area network. The landscape analysis indicates that insect-resistant GM maize does pose a threat to several protected European lepidopteran species via maize pollen deposition on their food plants. The possible future spread of herbicide-tolerant maize poses an equal or even larger threat, which can be mitigated by careful landscape management. Special attention needs to be devoted to Eastern and South-eastern Europe, as they contain a large share of the European biodiversity of agricultural landscapes.

6-2

Potential exposure of butterflies in protected habitats by cultivation of Bt-maize: a case study in Switzerland

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Transgenic Bt-maize can produce insecticidal Cry proteins toxic to butterflies and moths (Lepidoptera). In protected habitats near maize fields, Bt-maize pollen containing the toxin can be drifted by wind onto host plants of Lepidoptera, and inadvertently harm lepidopteran larvae feeding on these host plants. For a heterogeneous, agricultural landscape in Switzerland, we investigated the butterfly community of protected habitats and their potential exposure to possible cultivation of Bt-maize, recorded the densities of maize pollen deposited on a butterfly host plant, simulated the effect of different pollen dispersal ranges and Bt-maize adoption rates on the exposure of protected habitats, and explored the consequences of different buffer zones around protected habitats. On average, the 49 recorded butterfly species showed a temporal overlap of larvae of 50.10%±30.09% with the maize pollen shedding period. Mean maize pollen density on nettles (*Urtica dioica*) was 6.49±13.58 pollen/cm2 (range: 0–100). Most of the pollen was deposited close to maize fields less than 30m distance, but pollen also drifted onto host plants as far as 500m away. In simulations, protected habitats were highly exposed to Bt-maize pollen deposition even at low adoption rates of Bt-maize, given that maize pollen is distributed to larger distances. The conflict between species conservation and Bt-maize cultivation could be minimised by establishing buffer zones around protected habitats, where non-Bt-maize is grown. The results and the known sensitivities of lepidopteran larvae to Bt suggest at least 50m–100m broad buffer zones, and case-specific risk assessments for distances above 100m.

6-3

Life cycle of butterflies in Italian protected areas: how to build a science based exposure analysis

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Several genetically modified (GM) crop varietis express insect resistance against Lepidopteran pests by the introduction of *Bacillus thuringiensis* synthetic genes. While these GM crops provided effective resistance and led in some cases to a reduction in insecticide use, concerns were raised regarding possible adverse effects to non-target organisms. In Europe direct feeding on maize leaves by Lepidoptera larvae, other than 2 target pests, is limited to handful sporadic pest species. However, the exposure of larvae to plant products expressing Cry proteins is also possible in adjacent environments, due to pollen transportation by wind on wild host plants for larvae. Pollen collection with different methods and may lead to very diverse estimates of possible exposure. The completion of an exposure analysis should also carefully consider the receiving environment, since the presence of Lepidoptera sensitive stages and the life cycle of crops locally may be very variable. For this scope, a database was created to store the information collected in two years of sampling on Lepidoptera in five Sites of Community Interest (SCI) in Italy. The database provides support to the estimation of biodiversity and the assessment of exposure of Lepidoptera to environmental stressors. Since cropped areas constitute relevant surfaces within SCIs, specific risk assessment should be conducted using relevant focal species. When considering the overlap between pollen shed and presence of non-target species, very different exposure scenarios in the selected regions are predicted. We conclude that potential risks can only be correctly estimated when these biological information are available.

6-4

Macro-moths as possible assessment endpoints for estimating risks of Bt-maize cultivation to biodiversity: A field study in Italian protected areas

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Lepidoptera are the phytophagous groups most at risk of impact by genetically modified crops since most of insect-resistant plants have been developed to express toxins specific for lepidopteran pests. In the case of Bt maize cultivation, pollen grains could dust larval host plants growing inside or nearby crop, thus leading to caterpillar exposure to (pro-) activated toxins. This route of exposure has been studied mainly for day-active butterflies, whereas moths, in spite of their great diversity and abundance, were rarely considered. In this study, macro-moth faunas were sampled by means of light traps in three protected areas of Northern, Central and Southern Italy, where maize is among the main crops. The light traps were activated from the beginning of June to the end of July, a period that encompasses the anthesis of most maize cultivars grown in Italy. Overall, 11446 individuals belonging to 203 species and nine families were collected. Given that larvae of most of the sampled species match to the criteria of potential exposure to Bt maize pollen, macro-moths might be considered in the preliminary problem formulation of an environmental risk assessment for GM plants, especially in the vicinity of protected areas.

6-5

Monitoring of butterflies to detect early changes in population trends.

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In Europe, genetically modified (GM) maize is one of the few transgenic crops authorised for commercial cultivation, and large-scale growing of transgenic maize would be a potential threat to butterflies occurring within agro-ecosystems. Environmental monitoring of GM crops is compulsory in Europe, and Lepidoptera have been proposed as indicators due to the specific risk involved by gm maize. Setting up effective survey strategies for monitoring butterflies in agro-ecosystems involves decisions on sampling effort, on required statistical power, and on cost-effective approaches. Here, we report on a 3-yr field survey (transect walks) of day-active Lepidoptera in farmlands of Sweden, Spain and Romania. In comparing the three countries, we analysed the recorded data with respect to common and protected species occurring in arable land and their temporal as well as spatial dynamics. We assessed the necessary time for the involved field work, and drew conclusions on the required number of transects to detect a given effect on lepidopteran populations and the resulting effort for monitoring schemes. The results and recommendations presented here will support predictions of power and cost-efficiency of future butterfly monitoring schemes in farmland to identify adverse effects of GM crops (and other stressors) on diurnal Lepidoptera.

7-1
Moth species trends explained by life history traits

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In Europe, alarming declines of many butterfly and moth species have been reported over the past decades. A recent preliminary Red List analysis of trends in abundance and distribution of 741 resident species of macro-moths in the Netherlands has indicated that 7% of the species has disappeared and 60% is more or less endangered. Eight % of the species are even critically endangered. In this study, we tried to explain trends of these moth species using an electronic database of their life history traits. Moreover, we compared species trends in areas that differ in levels of light pollution and/or nitrogen deposition. The results should help to improve our understanding of the potential causes of species declines, and ultimately to come up with adequate conservation measures

7-2

Artificial light affects abundance and species richness of moths, with implications for nocturnal pollen transport

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Nocturnal moths (Lepidoptera) are known to be affected by artificial light in multiple ways. These effects may permeate to other taxa that interact with moths. Moths are underappreciated providers of pollination services to many plants, but the scale of their contribution is not fully understood.
We present the results of the first study to use night-time transect walks in addition to light-traps to sample moths at matched pairs of artificially lit sites and unlit controls. We assessed the impact of artificial light on the abundance and diversity of moths and on pollen-transport by moths in lowland agro-ecosystems in the U.K. We found that 22.7% of moths (83 species of 203) in our study were pollen carriers for at least 28 plant species. We show that abundance and species richness of moths are significantly lower at artificially lit sites than unlit controls, leading to reduced pollen transport. This appears to be due to disruption of moth behaviour in the vicinity of an artificial light source. This result demonstrates for the first time that artificial light may have indirect negative effects upon other taxa mediated by effects upon moths.

7-3
Ecological determinants of butterfly vulnerability across the European continent

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Butterflies face combined threats from climate change, land use and nitrogen deposition. Species' intrinsic adaptive capacities to withstand these environmental alterations, in relation to current species distributions, regulate the persistence of populations. Butterflies restricted to narrow environmental ranges, as well as species with behavioral and/or physiological constraints (e.g. voltinism and diet breath), are more vulnerable to rapid environmental modifications compared to species with broad spectra of ecological traits. Current criteria for the IUCN Red List include distribution area, area of occupancy and population size. However, complementary assessments of species-specific ecological determinants may increase our capacity to predict species vulnerability and to develop more effective conservation strategies. At present, such information is lacking at a European scale. Here, we compiled ecological trait composition (wing and egg size, voltinism, mobility, overwintering stage, development time, aestivation, larval host specificity and species specific climate variables) for 397 butterfly species found across the European continent. We used PCA and cluster analysis to characterize species groups in terms of ecological amplitude and vulnerability. We analyzed how these species characteristics are reflected in Red List status, distribution and range size.

7-4

Cold-adapted or herbivore-dependent? Quaternary climate and aberrant Eurasian butterfly fauna.

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Current butterfly ranges result from combinations of climate, habitat availability and habitat configuration (so called landscape geometry), as well as from distribution limits in the past. Predicting range changes, e.g. during climate change, is hindered by imprecise to non- existent information on distribution changes during different past epochs. Many phylogeographic analyses lack dating of dispersal events and thus such patterns as retraction of distribution ranges to 'glacial refugia' are assigned to the last glacial period. As we as humans prefer warm to cold, we assume that insects are better adapted to interglacial than glacial periods, forgetting that the Quaternary glacial periods were a magnitude longer than interglacial periods, providing the butterflies forming current Palaearctic faunas longer time to adapt. We argue that the temporal predominance of cooler periods, during upper Pliocene, favouring grassland vegetation, created the aberrant butterfly fauna of temperate and boreal Eurasia. In contrast to other continents, the fauna contains large numbers of species linked to open habitats and rather few woodland species. In addition, disproportionate number of grassland species display rather large distributions. Woody vegetation encroachment, characteristic for interglacial periods, would had normally be controlled by large herbivores, allowing grassland species to persist until next cooling periods, but largely extirpated during the Holocene. Besides explaining the aberrant Palaearctic butterfly fauna structure, our scenario explains why so many butterflies in Europe are management-dependent, and advocates for large herbivores restoration efforts.

7-5
More Fallow deer, less butterflies in the Amsterdam Water Supply Dunes

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Large numbers of Fallow deer (*Dama dama*) populate the Amsterdam Water Supply Dunes (AWD), The Netherlands. The population increases rapidly since there is no regulation scheme and the area (3400 ha) is well-fenced to prevent escape. Woodland, scrub and grassland are intensively grazed throughout the year. As a result the vegetation structure is simplified towards short trimmed grassland and open woodland. A survey of the flora shows a decrease in the distribution of herbs in recent years. Especially a sharp decline was observed in the plant numbers of tall flowering species, including many important nectar and pollen producers. Butterfly monitoring indicates a significant dose-effect relationship between the number of Fallow deer and differences in trends of butterfly numbers in the AWD compared to adjacent dune areas with a lower density of deer. Most sensitive are butterfly species foraging on the severely grazed group of tall herbs in woodland and scrub (European Habitat types Dune woodlands (H2180) and Buckthorn scrub (H2160). Typical and endangered dune butterfly species, generally living in the open habitat of Grey dunes (H2130) and foraging on low herbs, were less sensitive for the time being. Nevertheless we conclude that ongoing intensity of Fallow deer herbivory will induce loss of diversity of butterflies and all other insects feeding on flowers and therefore of dune habitat quality.

7-6

Are butterflies and dragonflies good indicators for the decline of respectively terrestrial and aquatic insects?

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Contrary to the trends in vertebrates, the trends of insects are not well known.
This makes the management of insect populations dependent on indicator groups. Butterflies and dragonflies are among of the most intensively studied groups. Both groups are frequently claimed to be good indicators of the trends in other insects. But how well are these claims supported by empirical data? In an earlier paper we studied whether butterflies might be a good indicator group for insects in general (Musters et al., 2013). Here, we compared the number of declining species in butterflies and dragonflies with the number of declining species in respectively terrestrial and aquatic insects. This made clear that the number of declining species of butterflies and dragonflies deviate from those in other groups. Secondly, we made extended sets of decision trees, Random Forests, for predicting the decline of a species based on its traits. The butterflies and dragonflies were our training datasets. We used these Random Forests of butterflies and dragonflies to predict the decline of respectively terrestrial and aquatic insects and calculated the percentage of correct classification to evaluate the indicative power of butterflies and dragonflies traits in relation to decline. Our results showed that neither butterflies nor dragonflies are good indicators for declining insects. Other insect groups, especially bees and mayflies, performed better.

Musters C.J.M., Kalkman V. & Strien A. van (2013). Predicting rarity and decline in animals, plants, and mushrooms based on species attributes and indicator groups, Ecology and Evolution 3(10): 3401-3414.

8-1

A modelling framework for assessing lethal and sublethal effects of Genetically Modified (GM) maize pollen on non target Lepidoptera

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The cultivation of Genetically Modified (GM) Bt maize within agricultural landscapes may impact on those populations of non-target organisms which are sensitive to the Bt toxin and may be exposed to maize pollen. As pollen dispersal of pollen grains occurs over mid and long-distances and depends upon several climatic and agronomic factors, modelling approaches are useful to carry out a quantitative risk assessment and help design possible mitigation scenarios.
In the case of non-target Lepidoptera, a modelling package has been developed to (i) design a spatially-explicit exposure model for both the pollen dispersal and the spatial dynamics of Lepidoptera and (ii) account for the temporal dimension of the exposure model (phenology of non-target Lepidoptera and different flowering periods of maize).
Techniques from spatial statistics and stochastic geometry were used to simulate landscapes where the spatial aggregation of GM fields and the position of field margins, where Lepidoptera lay their eggs on host plants, may vary. Pollen dispersal is estimated by convolving the emission of maize plants and a dispersal kernel while the locations of exposed individuals are drawn by point processes. Pollen adherence and loss on host plants are considered as well as the individual toxicological response to pollen, making it possible to predict the risk of mortality for each exposed larva.
This modelling framework is operational through an R package named 'SEHmodel'. Simulations are run for several combinations of parameters to propose management measures reducing risk of GM pollen on Lepidoptera.

8-2

Assessing Bt maize induced mortality risk for non-target butterflies - a new simulation model approach

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The cultivation of transgenic Bt maize may induce a non-negligible mortality risk for non-target butterflies leading to a scientific and political debate about the legal admission of Bt maize in Germany and other countries. Substantial data and tools are highly desirable in order to assess quantitatively the risks for non-target Lepidoptera. To this end, we developed an individual-based simulation model (LepiX) that takes into account important processes, like differences in pollen shed, pollen deposition on plant leafs, the larval phenology of the butterfly species and its sensitivity to Bt toxin. The larval development of the phenology is considered to depend mainly on weather conditions, and the effect model is similar to the current approach of EU model for the regulatory assessment of Bt maize. The model simulates the dose consumed by individual larvae and allows to estimate the mortality risk on a population level.
In this talk we present a case study where we used pollen deposition data with specific spatial resolution provided from long-term monitoring and applied the model for a butterfly species with a phenology comparable to Inachis io in order to estimate risk mortality in dependence of the distance from the Bt maize field. Our exemplary results show a relative high sensitivity of mortality risk against, e.g. the temporal course of pollen shed, especially in the second generation of larvae, or against the assumed dose-response curve. The findings will be discussed compared to other models available.

8-3

Assessing the risk from Bt maize on endangered butterfly species - an analysis of available data and models

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In the EU an environmental risk assessment (ERA) of genetically modified crops is mandatory. Insect resistance is a major trait in GM crops such as Bt maize, which produces its own insecticides, so called Bt toxins. Because the European Corn Borer, a moth species, is one of the pests most frequently targeted by Bt maize effects on non-target Lepidoptera are a critical issue for the ERA.
The potential hazard of Bt maize to butterflies has long been recognized but the actual risks, including for species of conservation concern, is an issue which is controversially debated between different stakeholders. As the available information on the hazard and the likelihood of exposure is limited the EU regulatory authorities started modeling the risk from Bt maize cultivation on Lepidoptera in 2009 and use the modelling results as tool informing both, the risk assessment and the risk management. However, different models exist to estimate non-target effects of Bt maize on Lepidoptera. The respective approaches differ, as do the data used for these models.
In my presentation I will analyze the potentials and limitations of different model approaches. To do so it is important to look at the model specifications and at the quality of the data available for modelling. I will also relate the analysis to the different management options which can be applied to minimize harm from Bt maize on butterfly species.
PS: please forsee this presentation for the session 'Genetically modified crops and Lepidoptera'

8-4

Resemblance of Essex skipper (*Thymelicus lineola*) and Small skipper (*T. sylvestris*) is causing a large overestimation of the distribution of Small skipper in Flanders.

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Essex and Small skipper are widespread and closely-resembling hesperids. Apart from genitalia examination, (fresh) females can be separated only by the color of the antennal clubs' undersides; the shape of the androconial patch constitutes an extra trait for males. Because of the limited morphological differentiation within this species pair, it is suspected that citizen scientists frequently settle on wrong identifications. In practice, one assumes this is only a minor problem since both species naturally co-occur in similar grassland biotopes anyway. However, if one of both species, in casu Small skipper, is more susceptible to habitat deterioration, we hypothesized its decline may go largely unnoticed as a result. Here, we tested for such a bias through surveying skippers, simultaneously by three experts, in 45 sites selected from the pool of all very recent observations of Small skipper in Flanders and Brussels (euro.observado.org). We selected 15 sites for each of three types: (i) with and (ii) without photographic evidence (and at least 15km away from type (i)), and (iii) no records, but semi-natural grassland within a 1-5km distance from type (i).
We show that while numbers of Essex and Large skipper do not differ significantly among the types, Small skipper occurs almost exclusively and at much higher densities in sites where it was recorded with photographic evidence, compared to the other types. We discuss the implications for the species' current distribution and Red List status in Flanders (N-Belgium) and other nitrogen-stressed regions of Western Europe.

8-5

Web-based migration survey of the Scarce tortoiseshell, *Nymphalis xanthomelas* (Esper 1781), in northwestern Europe

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From 2009 to 2013 the Scarce Tortoiseshell, *Nymphalis xanthomelas* (Esper 1781) gradually expanded its range in Scandinavia and settled over large parts of southern and central Finland and southern Sweden. In July 2014, an unprecedented migration to northwestern Europe was observed. Large numbers of *N. xanthomelas* were seen in wider parts of Scandinavia (including Denmark and Norway), the Netherlands, Flanders (Belgium) and southeastern England (Manil & Cuvelier, 2014; Manil & Cuvelier, 2015). The question arose whether this phenomenon would result in a long term settlement of *N. xanthomelas* in northwestern Europe or if it will remain an exceptional annual migration. To study the phenomenon the different national, open access, web-based platforms for the registration of nature observations were consulted at the end of the season and during two subsequent years (2014-2015). These different national platforms are compared and pro and cons of the modules for studying such a migration phenomenon are presented. A suggestion is made for the development of an integrated European web-based platform for the registration of butterfly observations. Results of the survey are summarized, giving a preliminary answer to the question whether we witnessed an exceptional migration or a potential long term settlement of *N. xanthomelas* in northwestern Europe.

8-6

Area survey of the Papilionoidea diversity in Durme- and Schelde territory, Flanders (Belgium) 2013-2017.

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As from 2013, volunteers of Vzw Durme started a detailed study in the area of "Durme- and Schelde" for all butterflies (Papilionoidea), focusing especially on the common species.
For this 5-years study, a national, web-based module (www.waarnemingen.be) for nature observations is used. All butterfly observations from Nr volunteers are registered. A mapping software is incorporated, documenting at 1x1km level the distribution of all the taxa and to study at a smaller scale, the detailed distribution of isolated populations.
The study area is +/- 1000 km2. Main land use, typical of the Flemish scenery, consists of agriculture, residential and industrial buildings. Remaining natural areas are sparse and found along the three rivers: Schelde, Durme and Moervaart. Here one would expect most of the butterfly diversity.
In such a highly fragmented area, it is interesting to study the population size and evolution of common species like the Ringlet, *Aphantopus hyperantus* (Linnaeus, 1758) or get detailed information on the distribution of the Small heath, *Coenonympha pamphilus* (Linnaeus, 1758) and to study if the small populations are still connected.
Can such a survey provide information why the Essex skipper,*Thymelicus lineola* (Ochsenheimer, 1808) is gradually disappearing from the area or why the Silverwashed fritillary, *Argynnis paphia* (Linnaeus, 1758) is extending its range?
Preliminary results are presented, focusing on the status and evolution of 'common' species, the discovery of 4 new species for the study area and the effect of using a web-based system on the investigation intensity of butterflies in Flanders (Belgium).

9-1

Fen meadows on the move for the conservation of *Maculinea (Phengaris) teleius* butterflies

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In the Netherlands, a single population of the obligate myrmecophilic butterfly *Phengaris (Maculinea) teleius* occurs on only 3 ha of habitat for more than 25 years now, whereas at least 40 ha of habitat are thought to be required for a sustainable metapopulation. Therefore, 170 ha of farmland will be converted within a LIFE+ project. When creating suitable habitat, the habitat requirements of the butterfly with its particular life cycle as a parasite of the ant species *Myrmica scabrinodis* have to be taken into account. The occurrence of *M. scabrinodis* is highly dependent on vegetation structure. In order to accelerate the colonisation by this ant species in the restoration areas after large scale soil excavation, sods collected from fen meadows are translocated to the restored sites. To test the colonization of ant nests in these restoration areas, we divided 63 plots, each sized 1 m2, randomly over 7 patches at 5 locations. The effect of the transplantation of these sods on ant and butterfly colonization was investigated and factors describing the development of the vegetation structure and soil properties were tested. Already in the first summer after the translocation, significantly more ants were found at the transplanted sods in comparison to the surrounding area. In these areas herb cover had a significant positive effect on ant presence. In the second year, *Myrmica* ants were found around the sods as well. So far, the applied restoration activities bring us closer to the goal of habitat restoration for *P. teleius*.

9-2

Ecological relationships relevant for the conservation of *Phengaris (Maculinea) teleius* butterflies

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The Scarce Large Blue Butterfly *Phengaris (Maculinea) teleius* has a specific life cycle which includes the use of the single host plant *Sanguisorba officinalis* and a specific *Myrmica* ant species. The caterpillars live for 10 to 23 month in the nests of *Myrmica scabrinodis*, where they feed on the ant grubs as true predators. The only Dutch population suffers from the lack of suitable habitat needed to increase the population size to a sustainable level. Therefore, in the LIFE project 'Blues in the Marshes' 170 ha of former agricultural land is being transformed to moderately nutrient rich moist fen meadows. After top soil removal, appropriate vegetation with *Sanguisorba* has to be established that will be colonized by *Myrmica* ant species and finally *Phengaris butterflies*. To allow colonization of the ants, also the food for the ants should be present, especially springtails can serve as food for *Myrmica* ants. In this presentation, we explore the multi-trophic interactions between soil properties, collembolan abundance, ant nest presence, vegetation development and occurrence of the butterfly *P. teleius*. Therefore, we collected data on butterflies, vegetation characteristics, host plants, ant communities, *Collembola* communities and environmental factors in the meadow where *P. teleius* occurs for more than 25 years and the new restoration areas. We used path analysis to test direct and indirect interactions in this multi-trophic food web. The results lead us to the relevant factors for future conservation work on the extension of habitat for the butterfly species.

9-3
Hydrological restoration of a butterfly habitat

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Water board Aa and Maas is responsible for the restoration of the hydrological system needed for different (butterfly) habitats. This lecture is about the proposed hydrological system applied in newly created nature areas as well as the optimized existing habitats. The pallet of actions applied range from removing phosphate rich top soil excavation to reconstructing the water management system.
The main objective of the LIFE+ project + Blues in the marshes is to enlarge the area (170ha) and improve the quality (50ha) of the habitats *Molinia* meadows on calcareous, peaty or clayey-silt-laden soils (*Molinion caeruleae*) (H6410) and lowland hay meadow with *Alopecurus pratensis* and *Sanguisorba officinalis* (H6510) for the butterfly species of Scarce Large Blue (H1059).
Furthermore, this project will enhance the quality of the project area that is situated in the Natura 2000 area "Vlijmens Ven, Moerputten and Bossche Broek" (NL132). This area consists of damp meadows, fens and wet forests, but also semi-natural grasslands as well as intensive agricultural land.
The project will not only improve the status of the existing habitats in the nature reserves Moerputten and Bossche Broek, but will also create and develop new nature areas for target habitats and species. This applies to currently intensively used arable land in the project area of Vlijmens Ven, De Maij and Honderdmorgen. The nature development is urgently needed to increase the chances of long-term persistence of the target habitats and species.
One of the aims of the projects is the restoration of the habitat of a highly threatened butterfly species in Europe, the Scarce Large Blue (*Phengaris (Maculinea) teleius*) (H1059), listed in Annexes II and IV of the Habitats Directive. This project will significantly improve the resilience of populations and thus increase the chances on long-term survival of this butterfly species in the Atlantic Region and the European Union as a whole, as well as their habitat.

9-4
Source-sink dynamics in populations of *Maculinea* butterflies

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The land fragments where high abundance of adult butterflies is observed are not necessarily tantamount with areas from which these individuals originate. An eminent example of the above principle are source-sink systems, in the case of which excess individuals eclosing in source areas leave them during adult lifetime and gather in sink areas. We detected the existence of source-sink dynamics in the populations of *Maculinea (= Phengaris) nausithous* and *M. teleius*, sympatrically occurring in central Transylvania. Both species were investigated with intensive mark-recapture sampling over the entire flight period. In the first half of the season, the butterflies of both species were predominantly found in the central fragment of the habitat patch with relatively high abundance of the essential resources, i.e. foodplants and host ants. In contrast, in the second half of the season the adult numbers were substantially higher in peripheral fragments of the patch. Through the analysis of movements we revealed that a great majority of the individuals captured in the patch peripheries came from the central fragment, and the timing of the rise in such movements corresponded well with the period when the adult numbers in the patch centre reached carrying capacity, as defined by the resource availability. Our findings have serious implications for species conservation in fragmented landscapes, because they indicate that setting conservation priorities over different land fragments cannot be based exclusively on local abundances of the focal species, but it should also take into account dispersion processes.

9-5

Maculinea arion in the UK - a partnership between science and conservation

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Maculinea arion (Large Blue) formerly occurred in several landscapes across southern England but became extinct in Britain in 1979, despite efforts to save it following a long-term decline. As a result of intensive scientific research and a large-scale conservation programme, the butterfly has been successfully re-established in South West England (Thomas et al. 2009).
The ecology of the Large Blue butterfly is complex; young larvae feed on *Thymus* flower-heads but are parasitic on red ants, especially *Myrmica sabuleti*, for most of the year. In the UK these requirements are only fulfilled in short-turf grassland where the host ant is abundant. Agricultural neglect is a major threat and sites need a continuity of grazing and scrub control to maintain suitability. A key landscape for the butterfly is the Polden Hills in Somerset, with a network of suitable habitat patches, which has enabled the butterfly to colonise 22 sites from four re/introductions between 1992 and 2004. This landscape now supports nearly 80% of the British *M. arion* populations and therefore consolidating this network, and expanding it beyond the core sites has been a key action.
This presentation will focus on the conservation work undertaken since 2011 to restore suitable habitat on currently unoccupied sites within the Polden's; on either occupied sites with the potential to extend further and other sites which were known for *M. arion* in the 1800s. A targeted programme of practical conservation management has been carried out on 14 sites and we will demonstrate how this has been achieved, assess success and summarise lessons for future application in other landscapes.

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9-6

Conservation of *Maculinea arion* in challenging landscapes and under future UK climates

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Despite successful restorations of *Ma. arion* to former landscapes in southern Britain, all early attempts to re-establish populations in its previous stronghold of the Cotswolds failed. Recent research reveals why. The donor phenotype from Sweden was maladapted to the cooler local climate of the Cotswolds, where it emerged too late to oviposit on *Thymus* flower-buds. Today, the outlook is much improved: (i) 23 generations of selection in Somerset has advanced adult phenology to coincide exactly with local *Thymus*, producing phenotypes that closely match the extinct UK populations (and *Thymus* phenology) when introduced to the Cotswolds. (iii) In contrast, on some UK railway cuttings the microclimate is so warm that its ant host *Myrmica sabuleti* inhabits shadier turf, too tall for *Thymus* but ideal for *Origanum*, the alternative foodplant used in southern Europe. *Origanum* flowers 2 weeks after *Thymus*, and on these hot sites there has been selection for a 2-week-later-emerging phenotype of *M. arion* (whereas other recorded insects emerge 10-12 days earlier there). This potentially doubles the breeding area in the Cotswolds, for *Origanum* frequently coincides with *My. sabuleti* under our new management prescriptions. (iii) Today's donor populations are significantly more mobile than the original Swedish type, enhancing dispersal across landscapes. Recent trial introductions of mixed *Thymus*- and *Origanum*-exploiting phenotypes to four Cotswold sites are so encouraging that a major new initiative has begun to re-establish the butterfly across three former Cotswold landscapes. The new phenotypes, given heterogeneous habitat, should also withstand future climate warming and extremes of weather elsewhere.

10-1

Twenty years of moth monitoring in Finland

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A moth monitoring scheme (Nocturna) using traps equipped with Hg bulbs was established in Finland in 1993. Here we present results of the first 20-year period 1993-2012. Analyses are based on a set of 65 trap sites with a minimum of eight observation years covering the annual flight season of moths. At the community level annually observed species richness and evenness (Fisher's alpha) have significantly increased during the study period, the increase being largest in the south of Finland but the change levels off towards the north. Total abundance of all moth species was analyzed by using TRIM software. The results revealed very high periodic variation with two strong peaks during 1994-95 and 2004-05, but no clear trends. The annual number of observed multivoltine species, i.e. species producing more than one generation a season, has significantly increased, although the year-to-year variation is high. The increase of ultivoltinism is highest in the south of the country. Changes in species composition of communities were studied using NMDS ordination. Directional changes in ordination space were observed across sites, and the results indicate that species composition previously restricted to southwestern parts of the country is becoming more widespread.
Trends of individual species were also studied using TRIM software. Several southern species show strongly positive and several northern species strongly negative population trends. Many of the observed changes coincide with a notable recent summertime warming in Northern Europe, and are in line with predictions of changes in climate.

10-2

Monitoring on Butterfly Conservation's nature reserves

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Butterfly Conservation (UK) owns or manages 35 nature reserves across England, Wales and Scotland covering a wide variation in size and habitat. Many volunteers are involved in the management of these reserves, and also play an important role in conducting monitoring to evaluate the effectiveness of that management. Regular butterfly monitoring is conducted at 33 of these reserves, mostly through full transects within the UKBMS. Our monitoring data goes back 30 years for one of our sites, and all except six of the UK's resident butterfly species have been recorded on our reserves. Combined analysis of priority species over the last ten years shows there is no significant difference between their performance on our reserves and elsewhere across the UK. However, this headline masks a mixture of local extinctions and conservation successes. More detailed analysis reveals the difficulties in managing for key species where some of our reserves are only of a small size or geographically isolated from the nearest core populations.

10-3

First five years of a butterfly monitoring scheme in the National Parc kellerwald-Edersee (Hesse, Germany)

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A butterfly monitoring scheme in the National Parc Kellerwald-Edersee (State of Hesse, Germany) started in 2011. The monitoring addresses to main subjects 1) evaluation of conservation management of man made habitat types of the EU-habitat-directive, and 2) assessment of climate change impact on butterfly communities in the Parc. 14 transects were established and individuals were counted four times a year. Eight transects were located in man made habitats (heathland, mountain meadows, Nardus- and other meager grasslands), three along paths in old growth beech forests and three in successional stages of former spruce forest devastated by the Orcan 'Kyrill' in 2007. Regarding former surveys carried out in 80-ties and 90-ties of the last century some species could no be detected during the last five years, e.g. *Lycaena hippothoe, Boloria euphrosyne, Plebejus argus*. On the other hand a couple of species were recorded for the first time in the study area, e.g. *Apatura ilia, Leptidea sinapis/reali, Maculinea nausithous, Polyommatus agestis*. After years comparatively unfavourable for butterflies (e.g. 2012) butterfly communities recover best in man made habitats managed by sheep grazing. A positive correlation between transects with low ambient temperatures and comparatively dark mean colours of the corresponding species composition seem to exist even on the local scale of the study area so that a strong impact of climate change on the composition of butterfly communities in the National Parc can be expected for the future.

10-4

Modelling migrant butterfly species data

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Recent papers have presented new models to account for British butterfly count data. Some of these models can estimate survival probabilities and the productivities of different broods. However the models are designed for resident species only.
In this talk we present modifications that may be applied to describe migrant species data, with particular reference to UKBMS data on Painted Lady, *Vanessa cardui*. The work described is joint with colleagues at Butterfly Conservation and the Centre for Ecology and Hydrology, Wallingford.

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10-5

LepiDiv - a new online resource for distribution maps of European butterflies

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LepiDiv can be regarded as a successor of MEB (Mapping European Butterflies) which produced distribution Atlases of Butterflies in Europe in printed form (Kudrna et al. 2011). The underlying database was already used for further research, e.g. on the effects of climate change (Settele et al. 2008) and the calculation of climatic niche characteristics of European butterflies (CLIMBER; Schweiger et al. 2014).
LepiDiv intends to further develop and extend this database as an invaluable community resource for ecological research on butterflies of Europe and adjacent areas. As a first step, online distribution maps are provided for Europe and Asian Turkey (http://www.ufz.de/european-butterflies/index.php?de=22477). By inclusion or linkage to further National or regional mapping schemes and interaction with recorders it is intended to update these maps and improve their resolution in space and time, which will help to enhance the quality of dependent data such as the climatic niche characteristics.
LepiDiv also aims to collect and integrate further data on ecological characteristics of European butterflies.
We hope for your support to further improve this online resource and greatly appreciate your feedback.

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Schweiger O, Harpke A, Wiemers M & Settele J, 2014. CLIMBER: Climatic niche characteristics of the butterflies in Europe. - ZooKeys 367: 65-84.

11-1

Maculinea rebeli: The rise and fall (and rise?) of a European endemic

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Since its description in 1904 there has been much confusion over the status, distribution and ecology of the '*rebeli'* form of *Maculinea*. Initially described as a variety of *Maculinea alcon*, in later years it became regarded as a distinct, and European endemic, species of *Maculinea*. This species was distinguished from *M. alcon* by its reliance on *Gentiana cruciata* as a foodplant, rather than *Gentiana pneumonanthe*, and by its association with a different set of *Myrmica* host ants. However, genetic analysis has consistently failed to show any large-scale divergence of the *Maculinea* butterflies using these two host plants, so that the '*rebeli'* name, and its status as a European endemic species has been suppressed. The original description of the '*rebeli'* form suggests unique wing patterning, and is from an area above the altitude where *G. cruciata* is found. Recent 'rediscoveries' of populations of *Maculinea* in such areas suggest that species of *Gentianella* are used as the host plant of this high altitude form, together with a unique *Myrmica* host ant, raising the possibility that *Maculinea alcon var. rebeli* may be a European endemic after all. Here I try to clarify some of the confusion that has arisen within this group of butterflies by taking an historical overview of the group, and by examining what is known of their host plant and host ant use, and their genetic and morphological differences.

11-2

Spatial distribution and movements of *Phengaris alcon (*Lepidoptera: Lycaenidae*)* populations in Portugal

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Phengaris alcon is a butterfly specie considered rare in Portugal whose known populations are mostly concentrated in the northeast region of the country. These populations represent the western edge of the distribution range in Europe.
Data regarding population dynamics were obtained during the butterfly flight period of 2013 and 2014, of a fragmented population of *P. alcon* at the Natural Park of Alvão, with a covering area of 54 km2
A total of 3411 individuals were recaptured through 5 sites. Estimated population size ranged between 2397.84 and 3323.34 individuals. The average adult lifespan was of 4.05 days with a maximum observed of 13 days. Seasonal sex ratio dynamics showed a clear protandry pattern, and the sex-ratio of captured individuals was balanced, with a slightly trend to be more male-biased (40:60).
On overall individuals preferred to remain in the same patch site, but males tended to fly greater distances and move more frequently between patches, than females. Only 11 emigration movements were observed. We found a relatively low dispersal capacity of ca. 1km, with a dispersal mean distance of 74.26m. The dispersal distance was modelled by an inverse power function and 0.5% was the estimation value for a movement to exceed 500 m.
Our study points out to the importance of patch quality preservation in fragmented landscape for *P.alcon* specie, with small dispersal ability. Nevertheless, our results suggest that the studied populations are relatively well conserved.

11-3
Population ecology of *Phengaris teleius* in northern Serbia

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Owning to its threat status and interesting life cycle *Phengaris teleius* is recognised as priority species for conservation. It was discovered in Serbia only in 2012, and in 2014 its populations were studied using mark-recapture design. Four persons were involved in the study over the large area in northern Serbia. The aim was to compare population demography parameters and exchange of individuals between local populations. Butterflies were on the wings from July 17 and study lasted from July 19 to August 28. It should be noted that weather conditions were bad and changed every few days during the entire period. In total, 3972 butterflies were individually marked with permanent pen, estimating population size of 9583 individuals (160-5522). Sex ratio (females/males) varied between 0.43 and 1.14, but was mostly male biased. Survival varied between 0.7 and 0.8 resulting in residence period of about 3 days. Butterflies did not expose any large distance movements, with only a few individuals leaving their home patch.
Compared to other parts of Europe, *P. teleius* starts to fly later in northern Serbia. Populations from each studied locality differed in population parameters. This is especially true for the smallest population studied followed by the most isolated locality. Study indicates that management practice of Serbian populations should differ from the rest of Europe. New habitat patches could be created to promote migration between local populations and unoccupied meadows could easily be restored by controlling the time of mowing.

11-4

From butterflies to ants: a population study of *Maculinea arion* (Lepidoptera: Lycaenidae) in Romania

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The obligate social parasite butterfly *Maculinea arion* went extinct in many regions of Europe, but it is still relatively common in Romania, where its populations have never been studied so far. Our aim was to study the ecological requirements of *M. arion* to obtain important information for proper habitat management. In a two years study, we investigated a single adult population of *M. arion*, the distribution of host plants and the ant community in its habitat in Transylvania, Romania. The flight period was between late June and late July in both years. The total estimated population size in 2014 was 281 individuals (95% CI: 251-335), while in 2015 it was only 148 (95% CI: 133-188). The low precision of the 2014 estimate can partly be explained by the sparse sampling in that year. The number of females was ~1.5 times higher in 2014 and ~1.7 times higher in 2015. The daily survival probability was constant in both years. In case of males, we found a high recapture probability (2014: 0.82, 2015: 0.71) which can be explained by the high detectability of mate-locating males. Altogether 15 ant species were identified in 2014, the most abundant was *Myrmica scabrinodis*, a known host species of *M. arion*. The spatial distribution of *M. scabrinodis* was the most even out of all *Myrmica* species on the study site, showing that *Maculinea* caterpillars have the highest chances to be adopted by its foragers.

11-5

100 years of *Lycaena dispar batava* in the Netherlands

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In the 19th century the Dutch weren´t aware of the presence of one of our most beautiful insect species, *Lycaena dispar*. In 1915, the discovery of *L. dispar batava* in the province of Friesland led to expeditions from Dutch and foreign entomologists. After the extinction of a similar subspecies in the U.K., the Dutch population is the only one remaining. Last year, 2015, marked the 100th anniversary of this milestone in Dutch entomological history. Soon after the discovery fear grew that we wouldn't be able to protect this species adequately. Collection of this valuable butterfly was intense and reclamation of its habitat for agriculture was being planned. Therefore, conservationists sought ways to preserve the species, firstly by introduction into new areas, secondly by buying nature reserves. The first strategy proved not successful, none of the introduced populations survived. But the designation of nature reserves has been successful up to this day. Nevertheless, several areas lost their Large Copper population and at present only two still harbour this endemic subspecies . The current approach to conserve this butterfly still has much in common with the original efforts. Thus, measures are still aiming to restrict the influence of agriculture and enhancing establishment and growth of its food plant, *Rumex hydrolapathum*. A more recent approach is the introduction of selective summer mowing. Volunteers mark foodplants with Large Copper eggs after which mowers avoid these. For the coming years our main target will be to enable the recolonisation of a third area, De Wieden.

11-6

Vegetation heterogeneity caused by an ecosystem engineer drives oviposition site selection of a threatened grassland butterfly

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Soil disturbing ecosystem engineers play an important role for plant species diversity within grasslands as they increase vegetation heterogeneity by creating gaps due to burrowing or mound buildings activities. However, knowledge on the ecological importance of these microsites for animals is still rare. In this study we analyze the role of ant nest mounds of Lasius flavus for oviposition site selection of the silver-spotted skipper, *Hesperia comma*. Thereby, ant mounds were searched for eggs of *H. comma*. At occupied sites and control samples within the matrix vegetation environmental parameters were ascertained. Furthermore, we analyzed the habitat requirements of *L. flavus* within different sites. *L. flavus* occurred most frequently on unmanaged sites with a greater soil depth. The likelihood of finding eggs of *H. comma* was increased on ant hills compared to the matrix vegetation. In contrast to the surrounding vegetation, nest mounds of *L. flavus* had a lower cover of vegetation and litter and more bare ground. Furthermore, these sites harbored a significantly higher cover of host plants compared to control samples. These microhabitats offered the essential key factors for larval development of *H. comma*: (i) a suitable microclimate due to an open vegetation and (ii) a high amount of host plants. The study highlights the importance of *L. flavus* as an ecosystem engineer within central European grasslands as this species increases vegetation heterogeneity. For the conservation of *H. comma*, we recommend the introduction of traditional rough grazing to create small-scale patches of bare ground and an open vegetation structure.

12-1

Spatial variation in microclimate and phenology influence population and distribution-level responses of species to climate change

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Recent changes to species distributions reflect geographic variation in rates of climate change, but ultimately depend on local population dynamic responses to climate variation at much finer resolutions than are captured by regional trends in warming. Understanding the ecological consequences of this fine-scale climatic variation presents opportunities for adapting conservation to climate change. Here, we show the respective influences of topographic heterogeneity and spatial variation in phenology on the responses of species distributions to climate change. Patterns of regional extinction in England by Lepidoptera, Coleoptera and plants reflect both regional rates of warming, and the extent to which local heterogeneity in topography provides microclimatic variation through its effects on levels of solar radiation. For many species, landscapes with the greatest topographic heterogeneity act as a buffer against the effects of warming. Such landscapes could play a role in conservation as contemporary refugia for species threatened by climate change. We also show for the butterfly *Hesperia comma* that spatial and temporal variation in phenology, driven by local and regional variation in climatic conditions, can modulate climatic effects on population dynamics, ultimately influencing the locations of high- and low-latitude range margins for this species in Britain and Spain. Understanding how regional variation in topography and phenology influence the conditions experienced by individuals in a changing climate can help to elucidate likely ecological consequences of climate change, and hence to inform measures to target landscapes or species for adapting conservation to climate change.

12-2

High-arctic butterflies become smaller with rising temperatures

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The response of body size to increasing temperature constitutes a universal response to climate change that could strongly affect terrestrial ectotherms, but the magnitude and direction of such responses remain unknown in most species. The metabolic cost of increased temperature could reduce body size but long growing seasons could also increase body size as was recently shown in an Arctic spider species. Here, we present the longest known time series on body size variation in two High-Arctic butterfly species: *Boloria chariclea* and *Colias hecla*. We measured wing length of nearly 4500 individuals collected annually between 1996 and 2013 from Zackenberg, Greenland and found that wing length significantly decreased at a similar rate in both species in response to warmer summers. Body size is strongly related to dispersal capacity and fecundity and our results suggest that these Arctic species could face severe challenges in response to ongoing rapid climate change.

12-3

Butterfly communities along altitudinal gradients: 10 years data from the Italian Alps

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Mountain ecosystems are particularly sensitive to changes in climate and land cover, but at the same time can offer important refuges for species from the more altered lowlands. To explore the role of mountain ecosystems in butterfly conservation and to assess the vulnerability of the alpine species, we analysed the short term oscillation (2006-2015) of community composition, species richness and functional diversity along an altitudinal gradient in the Italian NW Alps.
We sampled butterfly communities once a month (13 sampling stations, 5 seasonal replicates per year, from May to September) for 10 years, by semi-quantitative sampling techniques.
The monitored gradient ranges from the montane to the alpine belt (1200-2400 m a.s.l.) within the Gran Paradiso National Park. This allowed to avoid the effect of anthropic changes in land use and offered us the possibility to analyse the role of weather variability, climatic trends and the natural evolution of vegetation.
To identify the most vulnerable ecological guilds, we characterised each species in terms of habitat requirement, elevational range and temperature preferences, obtained by combining detailed information on butterfly distributions collected all over the Italian Alps (CKmap Project - Checklist and distribution of the Italian fauna) and the corresponding climatic and habitat conditions.
Our dataset represents the first example of a prolonged and standardised monitoring at fixed plots over the area, and offers the possibility to compare the amount of change at different altitudes, as a tool to identify the most vulnerable habitats and species in mountain ecosystems.

12-4

Weather explains high annual variation in butterfly dispersal

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Annual variation in weather may be an important determinant of between-year variation in the amount of butterfly dispersal, because it fundamentally affects butterfly activity. However, studies documenting annual variation in dispersal activity within a metapopulation are scarce, and surprisingly little is known of how weather affects such variation. We studied how flight season's weather conditions (temperature, sunshine, cloudiness and windiness) explain the annual variation of dispersal in a Clouded Apollo (*Parnassius mnemosyne*) metapopulation. This metapopulation was monitored using mark-recapture method annually for 11 years. Dispersal was quantified for each year separately using three complementary measures: emigration rate (fraction of individuals moving between habitat patches), average residence time in the natal patch and average distance moved by recaptured individuals. Male and female data were combined, as variation of annual dispersal was very similar between the two sexes. There was much variation both in dispersal and average weather conditions among the 11 study years. Weather variables significantly affected the three measures of dispersal and alone explained >65% of the variation in all measures. Explanatory power of the regression models exceeded 80% when metapopulation size and number of patches occupied by the butterfly were included as adjusting variables. In general, emigration rate and movement distances increased with increasing temperature and decreasing cloudiness. In contrast, these variables had the opposite effect on residence time in the natal patch. Number of exceptionally warm days, with an increasing effect on dispersal, was an additional variable improving explanatory power of models.

12-5

European level identification survey of *Leptidea sinapis*, *L. reali* and *L. juvernica*

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In a cryptic species complex, it is difficult to have accurate knowledge about the distribution of the similar taxa. This yields uncertainties for monitoring activities and conservation policies.
Such a cryptic complex was recently described (Dinca et al. 2011, 2013) in the genus Leptidea. Identification criteria, based on French material, for the triplet *Leptidea sinapis* (Linnaeus, 1758), *L. reali* Reissinger, 1989 and *L. juvernica* Williams, 1946 were published (Mazel 2012).
To thoroughly test these criteria at an European level, a web-based identification study with volunteers was set up by the VVE Workgroup Butterflies. The study is based on wing vouchers from 86 DNA barcoded specimens kindly provided by V. Dinca and R. Vila. Upper- and underside of the wings were photographed in a standardized way.
In order to process all the results for each criterion and the identifications based on external characters, a web-based database application (based on Oracle Apex) was used by all volunteers. A demonstration of this system will be given during the presentation.
This blinded (no details available on collecting date and locality) module was set up for scoring all criteria and providing the first identification for each specimen. Thereafter, locality data were released and each volunteer could record the final identification. When all volunteers finalized the identification of a specimen, the DNA-based identification was revealed.
The scoring results for each parameter and for the identifications will be documented.The utility of the module for the Leptidea complex and for potential other cryptic butterfly complexes is discussed.

12-6

Mark Recapture research of the Grizzled skipper, *Pyrgus malvae* (Linnaeus 1758) in a Flemish population

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Pyrgus malvae (Linnaeus 1758) is distributed throughout Europe but has declined in large areas, especially in the non-chalk habitats. An example of its decline is found in Flanders (Belgium) with only four populations remaining. The smallest of these remnant populations is found in 'Het Drongengoed' (East-Flanders). Unfortunately, only little information about the population size, dynamics between suitable habitats and population structure was available. In order to fill this gap, a mark-recapture study was set up by volunteers of the VVE WG Butterflies. During the flight period of *P. malvae* when temperature was above 15°C, monitoring was carried out from April till June 2015 in a selection of four potential habitat zones. On each captured butterfly, a unique colour mark was placed on the wings according to the habitat zone and period. Other recorded parameters were: sex, condition of the butterfly and vegetation type. 9,88 % exchange between different zones was observed. In order to process the monitoring information gathered in the field, a specific web based database-driven application (based Oracle-Apex) was used by all volunteers. A demonstration of this system will be given during the presentation. This system proved to be particularly useful to: 1. Inform participating volunteers and enhance/ease communication about the study and planned site-visits. 2. Enforce consistent input of data. 3. Draw detailed results of this MRR study. Finally the results will be presented focusing on the population dynamics of *P. malvae* and on the importance of monitoring projects with volunteers to influence policymakers and nature managers.

12-7

Mark-recapture study on the highly endangered noctuid moth *Arytrura musculus*

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The study was inspired by a high-profile legal case on the removal of grey willow (*Salix cinerea*) shrubs from 5 hectares of wetland in the Kék-Kálló valley, North-Eastern Hungary. This action allegedly caused a serious damage to the local population of *Arytrura musculus*, a night-flying noctuid moth strictly protected under Natura 2000 and Habitats Directive Annex II and IV, by destroying the overwintering larvae. Our aim was to estimate the population density of the species in the affected area using a Capture-Mark-Recapture (CMR) method during its peak flight period. To attract the moths, we used various types of lamps, including a standard 125W MV bulb, in front of white sheets, and live capture light traps with 8W fluorescent tubes operated simultaneously. Each specimen was marked with a unique serial number on the hindwing, using fineliner marker pens. A total of 94 captures occurred (78 first captures and 16 recaptures) of which 80 were used for statistical analysis. The longest recorded movement was 2.5 km. Daily population sizes ranged from 11 to 117, and the estimated total population for the entire survey period was 226 individuals. Based on the recorded movements, the location of collecting lights, and the vegetation coverage patterns identified from aerial photos, the effective survey area was calculated as 38 hectares. It gives a minimal density of 6 adults (imagos) per hectare, which, although a cautious underestimate, is much less than the previously claimed value of 1200 individuals (larvae) per hectare, deduced from a single light trapping occasion.

13-1

Can policy improve the future for butterflies?

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Butterfly abundance is declining in many countries across Europe. The mid term review of the EU Biodiversity Strategy shows that greater efforts are required to halt losses and support restoration. Grasslands are the most threatened habitat. Agriculture policies, practices and the way in which EU CAP funds are deployed all need to be improved. Reducing abandonment and preventing further losses of semi natural grassland habitats is essential, together with restoration at a landscape scale.

13-2

The effect of management and environmental matrix on butterfly diversity in Natura 2000 farmlands

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Since 2010, we have been monitoring the butterfly communities occurring in two of the most profitable agro-systems of North Italy, i.e. the rice-fields and the vineyards, both cultivated under different managing regimes (conventional or organic).
Our data showed that different agro-systems host specific butterfly communities, but the type of management crucially affects species richness and, in agreement with several studies, butterfly richness was positively influenced by organic management.
In Italy, however, about 30% of the agricultural landscape (100.000ha, 200.000 farms) occurs within one or more NATURA-2000 sites. As a consequence, where agro-systems are embedded in the NATURA-2000 network in a heterogeneous environmental matrix, the available species pool is larger than in intensive agricultural landscapes.
In the framework of a national project aiming at assessing the sustainable use of pesticides in the NATURA-2000 areas, we found that butterfly diversity is strongly influenced by the complexity of the surrounding landscape. In vineyards, the fraction of the local butterfly diversity is conspicuous even in the conventionally managed agro-systems, where the negative effects of pesticides are mitigated by the surrounding abandoned or semi-natural open areas. By means of a multiple-taxa approach, we were able to extend this result to various levels of the food chain, including butterfly predators (e.g., bats).
Properly managed agricultural lands occurring within a complex landscape can accommodate a very high fraction of biodiversity and provide semi-natural habitats which may ensure the long-term conservation of an important segment of biodiversity, often representing the only available habitat for some specialists.

13-3

30 years of conservation effort on Britain's most threatened butterfly: the High Brown Fritillary *Argynnis adippe* (Lepidoptera: Nymphalidae)

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The High Brown Fritillary *Argynnis adippe* is Britain's most threatened butterfly, having declined in distribution by 96% from pre-1995 levels and mirrored by a 86% downward population trend between 1994 and 2014. Only 36 colonies now remain with 39 extinctions since 1994 (52% loss); the butterfly has disappeared from most of England and Wales. Efforts to reverse the decline of the High Brown Fritillary started in the mid-1980s, but resourcing was limited and it was not until 2005 that a properly funded landscape-scale approach to conserving this species was implemented. For each of the four remaining occupied landscapes, we describe the conservation methods employed in Bracken and woodland habitats, the land management results and the response of the butterfly. Our data demonstrates successful conservation in some landscapes, but it is too early to be sure in others. We also highlight benefits to other species of management targeted at the High Brown Fritillary and identify the need for further urgent autecological research.

13-4

Successful creation and management of forest glades and clearings for butterflies in Southern Belgium

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A 'Butterfly' Life+ project started in 2009 in five regions of southern Belgium and has been completed at the end of 2014. One of the three target species, the Marsh Fritillary (*Euphydryas aurinia*), was subject of restoration actions in the large humid forests of Fagne and Famenne regions, where glades and clearings have been created or enlarged to extend grassy vegetation with *Succisa pratensis*. Seed sowing has been used to accelerate colonization by this last hostplant, which is known to have slow dispersal capacities. Beyond restoration and management techniques, this communication will present the results obtained after six years of butterfly monitoring in a sample of new glades, which have been compared to older habitats taken as a reference. It appears that butterfly abundances on new glades meet the ones on reference transects after three years, on average, while butterfly richness on former sites overtakes the one on latter sites after four years. Butterfly populations which had colonized new glades included several threatened species, like *Boloria euphrosyne, Mellicta athalia, Argynnis aglaja* and *Carterocephalus palaemon,* in addition to *Euphydryas aurinia.*

13-5
How to create and maintain light forests for rare butterflies

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In 2000 a species action plan for *Euphydryas maturna* in Bavaria was initiated, followed by more action plans for butterflies of light forests (*Coenonympha hero, Lopinga achine* and the moth *Eriogaster catax*) and application of the knowledge in practical management. Larval ecology and habitat needs of the considered species were studied in the beginning to understand what kind of forest habitat they need. Main features of the habitat are light-penetration of the forest, temperature, humidity, food-plants, and nutrient availability. Based on this knowledge, several possibilities of habitat maintenance and improvement were developed and introduced in different parts of Bavaria during the last 15 years. Successes and difficulties of the developed management options are presented, including coppicing, wind-fall management, and utilisation of forest track management.

13-6

Recovery plans for the four Spanish endangered endemic butterfly species

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Species Recovery Plans were produced by Butterfly Conservation Europe for the endangered and endemic butterflies in Spain with the financial support of MAVA Fondation Pour la Nature. The species involved were *Polyommatus golgus, P. violetae, Agriades zullichi* and *Euchloe bazae*. During two fieldwork seasons, data on the distribution, ecology and threats for each species were gathered. Distribution data improved for *E. bazae* (known records increased 36%) and *P. violetae*. Habitat models were worked out for all the species except P. violetae, resulting in wider areas than current distributions, but geographically close to them.
Although part of the populations did not show evident threats, we detected three main threats for the habitats of the species: abandonment for *E. bazae* and *P. violetae*, trampling for *A. zullichi* and overgrazing for *P. golgus*. Based on this information we suggested recovery measures for the four species that included legislation, specific actions, research and public awareness. Specific actions are mainly oriented towards the habitat and included:
- Precautionary measures: limit new urban developments, pine plantations and crops.
- Enhance extensive grazing and prevent overgrazing.
- In mountain areas, reduce the effect of trampling by visitors.
- Captive breeding.
- Woodland and scrub clearing of abandoned areas and pine plantations.
Climate change will have an important negative effect, displacing upwards the habitat of *A. zullichi* and *P. golgus*. Population reinforcement of sensitive populations is suggested to mitigate the effects of climate change, although the global aspects of this threatening factor need to be taken into account.

14-1

Butterflies, Bees and Business - perspectives for urban nature

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Biodiversity is increasingly considered as an integrated part of one's everyday environment. Though declining of biodiversity raises awareness. Bees and butterflies are primary indicators for our environment and also very popular by the public, particularly the butterflies are favourite. The principle of the successful project "Idyl" gathers butterflies, bees and people on new soils. People are contributing and initiating more and more "green initiatives" and commercial enterprises are willing to support biodiversity as a part of their sustainability programme. Fortunately biodiversity takes more position in the policy of companies today. The Dutch Butterfly Conservation is filling in the gaps for them to gain more awareness, species and environment.

Investments in biodiversity provisions and setting up biodiversity management plans results is a part of our strategy to protect butterflies, bees and more species (biodiversity) in the urban background. Using higher ambitions, packed in coalitions with entrepreneurs, NGO's and governments (known as Green Deals) and green boards, biodiversity has become top-priority in cities. The concept of "Temporary Nature" exemption should give an impulse to increase biodiversity and remove legal obstructions for the land owner. This concept is successful for species that have the opportunity to colonise and establish; management costs are low; and it raises the recreational value for employee visitors. Interest in this approach continues to grow and more permits are granted in the Netherlands. Nature and companies thus both benefit from this new initiative. Additional arguments from studies on Butterflies and Bees on various top-roof constructions has resulted in a top-roof where butterflies as Cabbage White, Cabbage Moth can and Common Blue can reproduce. Again a renewable sustainable supply for energy reduction and water storage. But most of all… an extended habitat for butterflies and bees.

14-2

Staying Positive with Public Education Projects the problems and successes in 15 years of making and writing about community butterfly gardens in the UK

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There has been a lot of public interest, worldwide, in projects to encourage pollinators in the last five years due to publicity surrounding Colony Collapse Disorder in Honeybees. In the UK this has meant small financial grants becoming available for community planting projects like orchards, wildflower meadows, as well as town parks, schools and private gardens being given awards for being 'pollinator friendly'. As Lepidoptera conservationists we should be tapping into this. My talk will describe several butterfly gardens I have designed and helped volunteers and schools to plant in the last 15 years, and highlight some of the problems and current solutions encountered. I will also discuss how effective these pollinator plantings are in towns and gardens; are they really making a difference to conservation? Or are they really only valuable as public education?

14-3

Butterfly assemblages in residential gardens are driven by species' habitat preference and mobility

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Understanding the factors contributing to maintaining biodiversity is crucial to mitigate the impact of anthropogenic disturbances. Representing large proportions of green area in highly modified landscapes, residential gardens are often seen as local habitats that can contribute to larger networks of suitable environments at the landscape scale. We investigated the impact of the land- scape context on butterfly communities observed in residential gardens, taking into account garden characteristics, land-use types and presence of linear features in the surrounding landscape. We examined how species traits affected butterflies' response to landscape context and habitat quality. We performed a cross-scale study, based on citizen science data documenting butterfly species composition and abundance in 920 gardens across France. We examined the effect of garden quality, the area of different land-use types and the length of linear elements measured at three scales within the surrounding landscape. Species were grouped according to their habitat preference and mobility. Urbanization negatively affected total spe- cies richness and the abundance of butterfly in each group. This was related to declining habitat quality and reduced area of suitable habitat in the surrounding landscape. The magnitude of this effect, however, was negatively correlated with mobility, a trait related to habitat preference. The spatial scale at which landscape context best explained variation in butterfly abundance changed with species' habitat preference. This study highlights the importance of preserving high quality habitats in altered landscapes and considering species' mobility and habitat preference when assessing the impact of landscapes on butterfly communities.

14-4

What's up, Wall? Conservation lessons for a grassland butterfly species

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In the last few decades the Wall brown *Lasiommata megera* faced tremendous declines over north western Europe. In the Netherlands, populations crashed with 98% since 1992. Until recently, factors driving this decline are not very well known, although several studies suggest that changes in climatic and microclimatic conditions might have negative impacts on the species (WallisDeVries et al. 2015; Van Dyck et al. 2015). We show that, based on the ecology of the Wall brown, conservation action can already be applied. Several management cases from the Netherlands are discussed, focusing on small scale habitat heterogeneity and the creation of reproduction habitat. As we show, the process of 'learning by doing' can result in successful measures stimulating the Wall brown locally.

14-5

From Silent Spring to Silent Summer: what have we learnt about conserving butterflies?

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The paper will give an overview of some of the milestones in the conservation of butterflies since the publication of Silent Spring in 1962. This book was highly influential in raising awareness of the impact of pesticides but also sparked a period of great innovation in ecological research and the foundation of the first systematic butterfly recording and monitoring schemes in the UK. Our understanding of the extent of the problems facing butterflies has since been revolutionised, as has our understanding of species ecology and the drivers of change. The paper will include an overview of recent solutions and successes in conservation that will act as building blocks as we face future challenges.

Poster presentations – Abstracts

P-1-1
A Red List of Italian Butterflies

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Italy has outstanding responsibility in European butterfly conservation, since its fauna is the richest of the continent and includes 37% of the total number of Euro-Mediterranean butterfly species. Among the 289 Italian species, one was recently (passively) introduced from South Africa, 17 are endemic, while the geographical distributions of another 20, classified as sub-endemic, narrowly extends outside the Italian political boundaries. Nevertheless, the extinction risk of Italian butterfly species, based on recognized IUCN standards, has not been assessed so far. To fill this gap, the first Red List evaluation of all Italian 289 butterfly species was undertaken. Current IUCN criteria were applied to data from the CkMap and the "Barcoding Italian Butterflies" datasets, as well as from available regional databases (e.g. Lazio: Monitoring Centre for Biodiversity; Veneto: ARVE Project). Results demonstrate that one species (*Lycaena helle*) has become Regionally Extinct (RE) in recent times; 18 species (6.3% of the assessed ones) qualified as threatened (1 Critically Endangered (CR), 8 Endangered (EN) and 9 Vulnerable (VU)), while 16 species were classified as Near Threatened (NT). Only for 2 species available data were insufficient to assess extinction risks (DD) and 4 butterflies were considered ineligible for assessment (NA). The remaining 248 species (86% of the total) were classified as of Least Concern. Although the number of Italian threatened species is rather low, the Red List of Italian butterflies provides an important baseline to define conservation priorities and to set up long-term monitoring actions of the Italian butterfly conservation status.

P-1-2
Diversity For Biodiversity

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"Farfalle in Tour" is a completely new citizen science project that starts from citizen and not from scientists. In fact the project was born from a particularly group of citizen: doctors and users of mental health centers of Turin.
The project is a metaphor: like the butterflies that need flying from one green area to another and meet each others, taking care of them together is the necessary enrichment to come out from a relational isolation, which feeds the pleasure to do things together. So mental-care users and the staff of educators became available to the science and have developed the project that gets them involved in the activities. Mental health centers of Turin are surrounded by green spaces so far uncultivated or managed to urban garden. Through the 'Farfalle in Tour' project, green areas are transformed into oases attractive to butterflies with nectar sources (i.e native Thymus, Oreganum, Lavandula) and foodplants (i.e Plantago, Ferula, Crataegus).
Butterflies that reach the oases are annotated and photographed by patients. All the data are validated by scientists and published on the website. The project involves also primary schools, where patient and student observe the development of some visible species like Papilio machaon and Aglais urticae.
The final aim of the project is to create a network of green areas with the participation of public and private social institutions, actively involved in the care, that provide places to meet, create new relationships and transform the urban architecture in a permeable barrier for butterflies.

P-1-3

Coupling academia and society facilitates the discovery and protection of a multifaceted butterfly fauna on islands

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The current worldwide biodiversity crisis calls for identification, prioritization and protection of diversity hotspots. Insular populations are exposed to high risks of extinction because restricted habitats often amplify the impact of stochastic events or human-induced effects. The emergence of endemic taxa, the persistence of relicts and the extinction of populations can follow deterministic processes, largely affected by functional species traits. Although this is considered a postulate of island biogeography, empirical tests on a diverse animal group over an entire archipelago have not yet been done. Here we analysed the data of 15 years of research on the butterflies of the Tuscan Archipelago. The combined effort made by academic units, public institutions, amateur entomologists and citizens have allowed us to i) carry out an extensive DNA barcoding assessment of the entire butterfly fauna including a comparison with populations from Sardinia, Corsica, and Tuscany, ii) identify which species recorded in the past experienced extinction or a dramatic decline, and iii) identify which functional traits (morphological, phenological, trophic and climatic preferences) are correlated with genetic structure, haplotype uniqueness and negative population trends. A key signal detected was a preference for lower temperatures and/or lower temperature tolerance for the species displaying higher genetic structure and species that have disappeared during the last decade. In practice, the species differentiating islands are also under higher risk and their conservation should be prioritized. Our results traced the pathway for conservation actions and point out the importance of linking academic research, institutional commitment and citizen engagement.

P-1-4

Monitoring habitat restoration through macrolepidoptera sampling with transects and light traps in the Gönyű military shooting range in North West Hungary

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The faunistic research and lepidoptera monitoring of the 248 hectare project site, a military shooting range was commissioned by the Fertő-Hanság National Park as part of the Hungarian Little Plain LIFE+ project (LIFE08 NAT/H/000289).
The initial research had two main goals. First, we tried to assess if the populations of found protected and rare species typical of the project area are stable (regular occurrence). Second, we aimed at an as-complete-as-possible faunistic survey. To achieve these, a comprehensive survey was conducted from June 2012 to June 2013 (base survey), which was repeated in 2015 (final survey). During the in between period, we focused on sampling selected high value microhabitats and searching for expected but undetected species. Since the effects of the carried-out habitat rehabilitation actions (land surface reconstruction, removal of invasive trees and plants, burning of coppice material) and introduced management practices (limited grazing) will be palpable in few years only, we laid the basis of proper monitoring by selecting the target species and setting up butterfly transects and moth sampling locations (live catch light traps). The activity will be continued during the After-LIFE phase.

p-2-1

Absence of regular mowing resulted in an increase of otherwise drastically declining population of Coenonympha oedippus in central Slovenia (Natura 2000 site Ljubljansko barje)

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The False Ringlet is one of the most threatened European butterfly species, and protected by the Habitats Directive and Bern Convention. In Slovenia, the species has a disjunct distribution, with two main centres: central (wet habitats) and south-western (dry habitats) part of the country. In central Slovenia only one metapopulation (in Natura 2000 site Ljubljansko barje) and three small neighbouring populations have been known within the last 15 years. During this period, two of the smaller populations have become extinct and the third is close to extinction. In Natura 2000 site Ljubljansko barje, 11 habitat patches were still inhabited by the species in 2001, but only three were left in 2014 and 2015. Main reasons are regular mowing during or before flight season and the destruction of habitat by intensifying agriculture. Two of three remaining subpopulations are at imminent extinction as their size decreased 97% and 99%, respectively. The habitat area of third subpopulation decreased 30%, and its size declined by 52% between 2001 and 2014. In 2015, we registered its first increase, with the population size was twice the size it was in previous year due to the absence of regular mowing in 2014 on half of the patch. In uncut area, the direct mortality of pre-adult stages was prevented and vegetation structure was improved due to thicker litter layer and undestroyed cover of hostplants. Within the project 'LJUBA' (EEA Grants in 2015), we implemented first urgent conservation measures to preserve the species in Natura 2000 site Ljubljansko barje.

p-2-2

Effect of intensive mowing on *Phengaris* (Lepidoptera: *Lycaenidae*) butterflies populations

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The current trend of agriculture intensification has a negative effect on the viability of grassland butterflies populations. The meadows are usually mowed several times per year regardless of the flight season. This study is aimed at evaluating the effects of intentional inappropriate mowing during the flight season on *Phengaris nausithous* and *P. teleius* populations at Dolní Labe, Czech Republic. At this locality, these butterfly species have been monitored since 2008. For a period of three years (2013-2015), the meadow has been intentionally mowed in the middle of butterflies' flight season. Both populations' species have been monitored via the capture-recapture method. The population sizes were calculated using the best AIC values models in program MARK. Subsequently, the statistical comparison between obtained population sizes with and without intensive mowing in the middle of flight season was conducted. Based on our results, no statistically significant effect of mowing ($p>0.05$) was found. On one hand, the time series analysis of 2013-2015 does show a decreasing trend in the blue butterflies' populations at the locality with intentional mowing implementation. On the other hand, it partly correlates with the decrease of total metapopulation size. The only case of a population decline steeper than that of the metapopulation was observed in *P. nausithous* in 2014. This relative difference was, however, still not statistically significant. Based on the obtained results, it is not possible to confirm the initial assumption, that long-term inappropriate management could cause a reduction in blue butterflies' populations with the risk of extinction.

p-3-1
The Finnish moth monitoring scheme (Nocturna)

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A moth monitoring scheme (Nocturna) covering the entire country was established in Finland in 1993. The scheme uses light traps equipped with Hg bulbs, and the traps are emptied annually once a week between early spring (April) and late autumn (October). The Finnish regional environmental authorities (ELY centres) have been responsible of maintaining and emptying the traps, and voluntary amateur lepidopterists have identified all Macrolepidoteran species from the samples. In addition, Microlepidoptera have been identified from the Kainuu region of Finland. All records are saved to a database. A total of 208 trap sites were included in the monitoring network during 1993-2012, with the highest number of traps in 1996 (n = 152). During 2010s the number of trap sites has varied between 42 and 45. Moth material collected through the monitoring scheme has been used to explore long-term changes in moth communities at the level of both communities and species. The inspected community-level variables include total annual species richness and community evenness (Fisher's alpha) as well as total number of individuals per trap site. Changes in species composition of communities were studied using NMDS ordination. At the species-level we have calculated population trends for a representative set of individual species. Trends of individual species and total number of individuals were studied using the TRIM software. Some key findings of the monitoring scheme are presented.

p-3-2

Long-term monitoring of Phengaris (Lepidoptera: Lycaenidae) butterflies in the Přelouč surroundings (Czech Republic)

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Due to the project of making the Elbe river navigable to Pardubice, which will involve constructing an artificial waterway through the habitats of *Phengaris teleius and P. nausithous*, their populations near the town of Přelouč (Slavíkovy ostrovy locality) have been studied since 2002. From 2004, they have been monitored using a capture-recapture method. The detailed information about the sizes of the metapopulations of both species are available for the whole period with the exception of 2012, for which insufficient amount of data was collected. During the years, the number of the investigated sites have increased. Originally, only 8 patches on the right bank of the river were monitored. Currently, there are 13 patches being monitored on both banks. All the local populations inhabiting the investigated patches are well interconnected by dispersal, including flights across the Elbe river. In 2015, the estimated metapopulation size reached 5105 adults of *P. teleius* and 1045 adults of *P. nausithous*. At present, the metapopulations of both species are little fragmented, which allows the survival of both species at the locality despite relatively small sizes of the local populations. However, if new waterway is built crossing the system, then it will be necessary to introduce a suitable management for most of the affected patches in order to preserve the genetic links of their populations with neighbouring localities via appropriate corridors. Regretfully, the Czech Government did not approve the proposal of including the meadows around Přelouč into the National list of sites of the European Community Importance.

p-4-1

Distribution of *Lycaena helle* in the Luxembourgish Ardennes

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The main aim of the LIFE+ Nature Project Life Eislek is the restoration of the wetlands in the Luxembourgish Ardennes region. As a surrogate species of the concerned habitat, *Lycaena helle* has been selected as one of the three target species of the project. The biology and requirements of the violet copper have been sufficiently studied, but no specific monitoring has previously been carried out in Luxembourg. In species conservation, the facts have to be known sufficiently in order to use funds efficiently. The evaluation of the MNHN database , the results of the national biomonitoring and the Life Eislek monitoring allow to draw conclusions on the distribution in Luxembourg. Especially isolated populations have low chances of survival. The wetlands are threatened by urbanisation and the intensification of agriculture, on the other hand through natural succession. By buying the concerned parcels and managing them to the benefit of L. helle, Life Eislek tries to slow down the decline of the species.

p-4-2

Global phylogeography of two Holarctic butterfly species - *Boloria eunomia* and *Boloria selene* (Lepidoptera: *Nymphalidae*)

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Glacial relict *Boloria eunomia* and more common *Boloria selene* occur over large areas of the Northern Hemisphere. We studied the phylogeographic patterns of both species using one mitochondrial (COI) and two nuclear genes (Wingless, Arginine Kinase). Our obtained genetic data reveal that both species are monophyletic and probably originated in Central or East Asia. Although both species have a similar distribution pattern, they do not show the same phylogeographic history. We found strong phylogeographic structure in *B. eunomia* showing that this species (re)colonised northern Europe from the east and not from the south as is the case of many other species. Polish populations are probably derived from Balcans population and Poland might be the contact zone for different lineages of this species. Populations from Czech Republic, Germany and Austria are closely related and also derived from Balcans population. Populations from Spain, France and Belgium form a cluster distinct from other European populations. In contrast to this highly structured phylogeographic pattern of *B. eunomia*, the populations of *B. selene* are characterised by two widespread haplotypes, one for Euroasia and one for North America, occurring in high frequency. This pattern suggests a rapid expansion scenario. The single congruent pattern found for both species is a considerable strong genetic split between Nearctic and Palearctic populations. The divergence times between North American and Euroasian populations are around 1.7 Mya for *B. eunomia* and 2.5 Mya for *B. selene*. In both species most of the populations within Palearctic region differentiated around 0.5 Mya, long before the last ice age.

p-4-3

Phengaris alcon status in SE Slovenia based on egg count

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The Alcon Blue butterfly *Phengaris alcon* has declined in several European countries and is thus target species for conservation. The marshland form *alcon* is one of the fastest declining butterflies in Slovenia. An estimation of population size of *P. alcon f. alcon* in SE Slovenia was performed based on egg count. We have examined all known populations in the area and searched for new ones. The presence of eggs has been confirmed in all seven currently known populations of the larval host plant *Gentiana pneumonanthe* in the area. Only three locations harbour population sizes greater than 10 individuals. Due to short distances between populations it is probable the existence of one metapopulation with an estimated population size of about 200 individuals. We have recorded two new localities of P. alcon in the area and a local extinction where *P. alcon* was still present in 2008. In order to preserve the existence of *P. alcon* in SE Slovenia we propose further conservation measures.

p-4-4

Identifying the butterfly diversity in the east of Konya, Turkey and modeling the suitable habitats of butterflies

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Central Anatolian steppes in Turkey are very rich in diversity yet among the most neglected. East of Konya, a good representative of Central Anatolian steppes with its rich butterfly diversity, is threatened by agricultural intensification and urbanisation. In the past, butterfly enthusiasts and experts carried out many random visits for butterflies yet no systematic study was realized for identifying butterfly, and habitat diversity. To determine the butterfly diversity in the region, we first identified our study area and the habitat diversity within the region through Georaphical Information Systems. Later we organised extensive field studies between April and August 2013. We recorded 145 species (38 % of butterfly species in Turkey), 28 of which were recorded for the first time in the study area. We later modelled the suitable habitats of 12 butterfly species by Maximum Entropy Method using environmental factors (i.e. topograpy, hidrology, forestry). The results of the model was compatible with the collected records. Distance to the drainage systems appeared as the major environmental factor influencing the distribution of the species modelled. This study shows that even though butterflies are among the most well known invertebrates in Turkey, more systematic research is needed to understand the diversity and distribution.

p-4-5

Butterflies and moths of Bhutan: Current state of knowledge

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Bhutan forms a part of the eastern Himalaya Biodiversity Hotspot. Bhutan, along with northeastern India, is the meeting place of the central Asia, and Chinese Palearctic region and hence considered very rich in terms of lepidopteran diversity. The altitude ranges from 200 m a.s.l. in the southern foothills to more than 7,000 m a.s.l. The country has both Oriental and Palaearctic species inhabited. So far the country was very poorly studied in terms of Lepidoptera fauna. Early studies on Lepidoptera of Bhutan are conducted by Britist researchers during 19th and early 20th century. Some works are recorded at 'The Fauna of British India' series. Some recent studies could also found in the past two decades in the form of booklets and checklist published on lepidoptera fauna of the country. About 670 species of butterflies have been documented through a review of available literatures so far; which is too low as expected 800 to 900 species of butterflies to be present in the country. Presently, the author have about 700 species of moths recorded from the Central & southern parts of the country which collectively give us idea on the rich diversity of lepidoptera in the country. Some studies on butterfly and moth has been going on in different parts of Bhutan but still could not develop a complete database on Lepidoptera fauna. To sum it up, the data for Bhutan is very limited. The general problem is the low number of enthusiasts with limited knowledge due to limited access to identification literature and limited data sharing.

p-4-6

Butterflies of Croatia - establishing of the Lepidoptera recording scheme

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Preparing the accession into the EU, Croatia expanded ecological network beyond the core of the National and Nature Parks aligned with the EU Nature Protection Legislation; the Bird and Habitat Directives (HD). Based on 506 species and 74 habitats on Directives, more than 37% of total territory of the country is included in Natura 2000 Network. This network of areas extend across public and private lands with varying degrees of legal protection and requires new approaches for public and private collaboration to ensure biological values are maintained, especially as the conflicts between the conservation goals and the interest of different stakeholder groups at local scale is increasing.
Butterflies and moths with 10 HD Annex II species are present on 107 sites.
In 2014 we started a EU Natura 2000 Integration Project (NIP). Within the scope of the project activities, the Lepidoptera team started a field research in order to gather new distributional and monitoring data on species of the taxonomic group Lepidoptera (butterflies and moths) with special attention on the HD species. With the help of previously established national database of Lepidoptera distribution records in Croatia and accumulated knowledge 124 10x10 km square grid cells were selected within 50 50x50 km grid cells based on features specified in the Contract. The overview of the results and future plans will be discussed.

p-4-7

Contribution to the knowledge of the butterfly fauna (Lepidoptera: *Papilionoidea* and *Hesperioidea*) of Apulia, South-eastern Italy.

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An updated checklist of *Rhopalocera* occurring in the Apulian region, in south-eastern part of Italian peninsula, is presented along with patterns of distribution. The surveys were carried out from 2007 to 2015, and we encountered 106 butterfly species from 6 families, including several confirmations of historical published records. Among these, threatened species such as *Zerynthia cassandra, Melanargia arge, Euphydryas aurinia* should be mentioned. In this paper new localities and confirmations are registered for *Melanargia russiae, Boloria euphrosyne* and *Hamearis lucina*. If we include all the published records, mainly in 'grey' literature, the total number of butterfly species recorded in Apulia has risen to 119, which equates to 40 % of the total Italian butterfly fauna.
A revised checklist represents a starting point for further research, provides a foundation for future butterfly conservation actions and implies that more research is needed, in order to increase the general knowledge of those insects in South Italy.

p-4-8

Steppe species under the glacial cycles: Phylogeography of *Proterebia afra*

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Continental grassland, i.e. the steppe, is one of the most prominent biomes in Eurasia. Temperatures alternation during the Cenozoic period forced species to repeatedly change their distribution. Continental steppe biota was favoured by drier continental climate during glacial maxima, and so should experience range shrinkage under current warmer conditions. *Proterebia afra* (Fabricius, 1787) (Lepidoptera: *Nymphalidae: Satyrinae*) is a representative of such steppe species, inhabiting only separated regions in Europe (Askion Mts. in Greece, Dalmatia in Croatia and Crimean peninsula), but distributed rather continuously in Uralian and Kazakh steppes and Caspian Sea surroundings. We obtained samples of the species from several parts of the region and reconstructed the species historical expansion events and dating using 4 genes (COI, COII, ArgKin, WG). According to both the haplotype network and the Bayesian analysis, the Russian, Kazakh and Crimean samples form a single clade, with Greek samples closely relative to them. The Iranian and Armenian samples form another clade. Interestingly, haplotypes found in Turkey are relative to Croatian haplotypes, and the position of the clade in the tree is uncertain. Based on population analyses and tree topology, we suggest that the separated populations were formed by vicariance rather than by migration. The species needed to be distributed wider during the history, and probably repeatedly. We constructed also possible past distribution of the species via Maxent modelling. Understanding of the processes in the past may help to conserve the species in future in the endangered steppe biome.

p-4-9
Butterfly Species Richness and Diversity in the northeast region of Portugal

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Identifying and developing eco-indicators is recent among ecologists and biologists in conservation of biodiversity. Butterflies can be sensitive to ecosystems disturbance therefore suitable to be used as eco-indicators of habitat quality and environment changing and degradation. We determined the species richness and diversity of butterfly's species at five trails at the Northeast region of Portugal. The trails of the study area were located at different landscapes, varying from urban zones and extensive management such as agricultural zones, vineyards and meadows, to more natural areas such as grasslands, rivers and forest. Sampling records were made using 500m walking transect counts, during five days in July 2013. A total of 570 individuals belonging to 59 species, 47 families and 11 genera of Lepidoptera were recorded. Families such us *Coenonympha*, *Pieris* and *Pyronia* were dominant and represented 29% of the total recorded individuals. From the pooled data, four species are listed in the threatened category (*Euphydryas aurinia, Hesperia comma, Phengaris alcon* and *Hipparchia hermione*) which represent 7% of the total of the identified species. Butterfly diversity parameters (Menhinick index, Shannon-Wiener index, Simpson´s Dominance, Evenness index) showed variations for the five sampling trials. On overall the results showed high values of species richness and diversity of butterflies, low dominance of species and moderate evenness of distribution. Additionally diversity profiles were higher for Alvão, followed by Mineiro, Vale do Corgo, Marão and Douro Vinhateiro. PCA analysis showed that butterflies communities of Alvão, Mineiro and Douro Vinhateiro are more similar than Marão or Vale do Corgo.

p-4-10

Sharing biodiversity data: citizen scientists' concerns and motivations

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Citizen scientists play a pivotal role in providing necessary biodiversity data across large spatial scales. To ensure the continued involvement of a strong volunteer base, insight into the motivations of voluntary recorders is crucial. This paper presents the findings of a large-scale survey (N = 2193) among Dutch volunteers in biological monitoring of diverse taxa, and focusses on three questions: what are the characteristics of these citizen scientists regarding their activities and socio-demographic background, what are their motivations for monitoring biodiversity, and what are their views on data sharing and ownership?
Our findings show that a connection to, interest in and concern for nature are the most important motivations for biodiversity recorders. Volunteer recorders have high expectations regarding the impact of their data, both for their own learning as well as for science and management. Almost half the volunteers consider their data to be public goods, but this does not mean they support unconditional data sharing; more than half would like some sort of attribution if possible (for the volunteer or the data manager), and more than a third would prefer their data not to be used for (private) financial gains.
Our results highlight the importance of connectivity to nature and learning to motivate volunteers. We suggest that organisers could pay more attention to informing volunteers of (citizen science's impact on) relevant research and policy, and argue that clear and transparent data policy that respects volunteers' views on their data is vital for maintaining their engagement in the long run.

p-5-1

Host plant cover and patch isolation drive occupancy and abundance at a butterfly's northern range margin

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There are now numerous examples of species shifting there range poleward and towards higher altitude as a result of climate change. Distribution shifts occur through a process involving range contractions at the rear edge and expansion at the leading-edge margins via dispersal and colonization of newly suitable sites. Hence, understanding the processes that drive demography at high-latitude populations is essential to forecast the response of species to global changes. We investigated here the factors affecting the demography in a network of populations at the northern range margin of the Oberthür's grizzled skipper butterfly *Pyrgus armoricanus*. Butterfly abundance and various habitat variables were surveyed in 41 habitat patches. We used these data to assess the respective importance of microclimate, habitat quality and connectivity on occupancy and the average and variability in abundance among patches. We found that all patterns were mostly influenced by the cover in host plants and the spatial isolation of patches, while microclimate had low effect. However, knowing that the distribution of host plants extends further north, we hypothesized that the actual variables limiting the northern distribution of P. armoricanus might be its dispersal capacity that prevents it to reach more northern habitat patches. The persistence of this metapopulation in the face of global changes will thus be fundamentally linked to the maintenance of an efficient network of habitats.

p-5-2

The grayling (Hipparchia semele) in a fragmented heathland

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The grayling (*Hipparchia semele*) is a declining butterfly species in the Netherlands. The presence-absence of the grayling in habitat patches is considered a function of the quality, the area and the isolation of habitat patches. The detection of presence-absence is also influenced by date, time of day and weather at the moment of observation. From 1991 to 1993 the presence-absence of the grayling was determined in a landscape with approximately 80 heathland fragments in the Netherlands. The relative importance of patch area and several patch isolation variables in predicting the presence-absence of this butterly species is analysed with a logit-regression model. The influence of patch area and patch isolation on the occupancy probability of the grayling is also studied with a dynamic site-occupancy model while taking detection probability into account. It is considered whether habitat fragmentation on this scale poses a problem for this butterfly species. Finally the consequences for conservation of the grayling are discussed.

p-5-3

Butterfly assemblage structure and biodiversity conservation along Mediterranean coastal dune succession

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The butterfly assemblages of coastal ecosystems in the 'Dune Costiere' Regional Park in Apulia, South Italy, were studied for the first time to evaluate the ecological value of Mediterranean coastal dune succession.
Seven different habitat types (coastal dune, retrodunal garigue, grassy heat, woodland, traditional olive-grove, organic olive-grove and a reconstructed shrubland area) were investigated bi-weekly from April to September 2015, in order to assess the abundance, species richness and diversity of butterflies.
A total of 1934 individuals, belonging to 43 butterfly species and five families, were recorded during the sampling period. *Melanargia arge* and *Zerynthia cassandra* are the most important species occurring in the area. Both are Italian endemic species: *M. arge* is listed in Annexes II and IV of the 'Habitat Directive'; *Z. cassandra* which was recently splitted from *Z. polyxena* (Annex IV). Some other important species present are *Hipparchia statilinus* and *Thymelicus acteon*, both listed as near threatened (NT) in IUCN European Red List of Butterflies.
In Coastal Dunes habitat we found the highest Shannon index value (H=2.73) Traditional Olive Grove was the habitat with the lowest Shannons' index value (H=1.59) and then with less biodiversity of butterflies (only 6 different species). The assemblages were also compared with multivariate method. The results of several diversity indexes suggests that Retrodunal Garigue habitat, with *Stipa austroitalica* prairie, plays an important ecological role in dunal succession and can promote the persistence of species of conservation importance.

P-5-4

Local and landscape drivers of butterfly richness and abundance in a human-dominated area

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In Europe, butterflies (*Rhopalocera*) have declined over the last decades mainly due to the agricultural intensification and land-use changes. Therefore is crucial quantifying specific effects of anthropogenic disturbances on butterfly communities in order to counteract this negative trend. This research was performed in a human-dominated area (about 170 km2), North of Milan (Italy). Overall, in 2014 and 2015, from April to September, we surveyed 494 50-m sections, grouped in 44 line transects, whose length varied between 8 and 26 sections. During 64 field surveys, we detected 8343 individuals, pertaining to 50 species. As the effects of environmental variables on species richness and abundance are strictly linked to species-specific ecological traits, we performed the analyses at single species and functional groups level, in order to account for the degree of mobility and habitat preferences. By means of GAMMs, we analysed the effects of micro-habitat variables measured at section level, such as the abundance of nectar plants, mowing, shelter, hedgerows, field margin, grass height. We performed a second GAMM to assess the effect of land-use in buffers centered on line transects, from local to landscape scale. In the first model, as random effects, we used the year and the transect (to account for spatial autocorrelation), while only the year in the second one. Both micro-habitat and land-used variables affected differently species pertaining to different functional groups. Butterfly richness of low mobility species was positively affected by hedgerows and abundance of nectar plants, and by the presence of meadows within a wooded landscape.

p-5-5

Landscape of origin affects the impact of nectar limitation on life-history traits in a grassland butterfly

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Since wild flower diversity and abundance are strongly reduced in intensive agricultural landscapes, flower-visiting insects may experience limited nectar quantities and qualities. Adult insects that rely on energy-rich nectar income for flight, survival and reproduction are expected to be much more affected than insects that rely on their larval reserves. We dealt with this issue at the intraspecific level by comparing the responses of several life-history traits to different nectar regimes between butterflies originating from relative intensive and extensive agricultural landscapes (IL and EL). We studied the grassland butterfly *Maniola jurtina* in outdoor flight cages in which we simulated four treatments of low/high nectar quality and low/high quantity. IL individuals were heavier than EL individuals. IL butterflies survived better than EL butterflies and survival was highest in the high nectar quantity and quality treatment. EL females lost body mass in all treatments, but less so in the high nectar quantity and quality treatment. IL females were able to buffer, or even increase, their body mass in the high nectar quantity treatments, but differences with EL females disappeared under low nectar quantities (independent of nectar quality). In males, body mass losses were always larger in EL compared to IL individuals. 40% of the females showed complete reproductive failure in the low quantity/low quality treatment compared to c. 7% in the other treatments. In the low quantity/low quality treatment, realized fecundity decreased strongly in IL females, but not in EL females. Egg size was not affected in the high quality nectar treatments, but showed very different responses relative to landscape of origin in the treatments with low quality nectar. Our results showed strong effects of reduced nectar supply on fitness-related traits, but responses were different between landscapes with contrasted nectar regime. We discuss the consequences for population viability and dynamics in nectar-poor landscapes.

p-6-1

Flower visit patterns in the Clouded Apollo butterfly *Parnassius mnemosyne*

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In some butterflies, besides larval food intake, adult diet proved to affect lifespan and fecundity. Adults choose among nectar source species. Few detailed foraging patterns and analyses are published at individual levels in the context of temporal changes in flowering. Clouded Apollo butterflies spend much of their adult lifetime on feeding on floral nectar, but only little is known on their consumption patterns.
We aimed to understand differences between individuals in consumption. Data were collected in a small meadow in the Visegrádi-Mts, Hungary, May, 2011. We recorded nectar consumption of individually marked butterflies daily. We listed flowering species and estimated their abundance each 3 days.
Butterflies visited 28 of 63 insect-pollinated plant species. Flowering and consumption varied within the flight period. Most individuals visited one nectar source more than 50%, although many visited several species regularly. Feeding patterns were different among individuals. They swapped between plant species during their lifetime and the timing of swaps also showed individual differences.
Butterflies frequently used a handful of nectar sources neglecting many others. Few nectar sources are highly preferred, probably due to high profitability. Individual feeding patterns depended rather on temporal changes in food availability, i.e. the overlap between high abundance of profitable species with an individual's flight period, than a large difference in individual preferences. The Clouded Apollo is able to adapt to changes in flower composition, and differences in individual consumption might cause differences in fitness.

p-6-2

The different way of living of the two sister species *Melitaea diamina* and *Melitaea athalia* (Lepidoptera, *Nymphalidae*) - insights for conservation issues

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Nowadays, highly human-influenced landscapes are strongly affected by habitat fragmentation and isolation as well as biodiversity loss. Seminatural habitats of high structural variability and diversity have a special importance for nature and wildlife conservation. In addition to the preservation and restoration of such landscapes, knowledge about the behaviour and habitat use of single species within these landscapes is essential for conservation measures. Therefore, we conducted a mark-release-recapture (MRR) study in eastern Germany (Brandenburg). The study area is characterised by extremely dry habitats adjoining the wetlands of a lowland fen.From 07 June to 05 August 2015, we collected data on dispersal and movement patterns of the two *Nymphalidae Melitaea* diamina and *Melitaea athalia*. In total, we marked 120 individuals of *M. diamina* and 198 individuals of *M. athalia* with recapture ratios of 29.2 and 22.2 %, respectively. Within the research area the home ranges of the two species are clearly delimited. The extrapolated dispersal distances do not differ significantly between both species. However, *M. athalia* seems to use more landscape structures and perform higher within-habitat movements, whereas *M. diamina* appears to be more sedentary and strongly linked to its larval habitat. The highly concentrated occurrence of *M. diamina* in a relatively small area might restrict *M. athalia* in its spatial distribution. With these insights we discuss necessities and demands of an effective and sustainable wildlife conservation.

p-6-3

Habitat use of Clouded Apollo butterflies is primarily related to their nectar sources

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Knowledge on the habitat use of butterflies is essential for their effective conservation. We studied the microdistribution of the protected Clouded Apollo butterfly (*Parnassius mnemosyne*) in Hungary, within a single habitat patch that comprised of a meadow and the surrounding woodland. Our aim was to reveal the relationships between adult butterfly density, proportion of open habitat and density of the larval food plant (*Corydalis* spp.) and nectar plants. Butterfly density was positively correlated with density of the main nectar plant (*Dianthus giganteiformis pontederae*) and the proportion of open habitat, but it was not related to larval food plant density. Microdistribution of adult butterflies changed during the flight period. In Central Europe, the larval food plants of *P. mnemosyne* occur in woodland understorey, but the primary nectar plants grow in open habitats such as meadows and clearings. Adult females therefore, need to frequently move between oviposition sites (woodland) and feeding sites (open habitat). Thus the Clouded Apollo requires such habitats where host plant rich woodlands and nectar plant rich open habitats can be found in close proximity. Woodland clearings without nectar sources can be ecological traps for the butterfly, while afforestation of flower-rich meadows can lead to its local extinction.

P-6-4

Erebia christi the rarest and the least known European butterfly species

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Erebia christi is an endemic species of the European Alps, listed in the Habitats Directive (Annexes II and IV). It occurs in a very small area in the Laggintal valley in Switzerland and in 1972 was discovered also in Italy. Despite it being the rarest European butterfly, *E. christi* is one of the least known. It is found on steep, sunny slopes with patches of rocky meadows, cliffs and scattered larch or spruce; larvae feed on *Festuca* spp. The species is considered Vulnerable (VU) at European level and Endangered (EN) in the Italian Red List. The majority of Italian populations occurs in the protected areas "Veglia-Devero Natural Park". The natural area promoted a Life project in 2004-05 and in 2015 starts to monitor the species according to the article 17 of Habitats Directive (93/42/CEE). In this project, *E. christi* was investigated with: i) linear transects, displayed horizontally along grass slopes at the bottom of rock cliffs; ii) vertical transects, displayed both on grass slopes and rock cliffs. Vertical transects were performed with mountaineering equipment and allowed us to mark and release 54 individuals in 8 monitoring days. Our results showed a strong habitat selection of *E. christi* for rock cliffs above the treeline (> 1900 m a.s.l.). This new methodology allowed us to observe females during oviposition and first instar larvae for the first time in field. With our monitoring protocol, the distribution data of this rare and endemic butterfly was updated.

P-6-5
Habitat quality in the Euphydryas aurinia complex

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Across its European range, the *Euphydryas aurinia* complex (Annex II of the Habitats Directive) includes a series of taxa, each showing some morphological differences and distinct eco-ethological features. At least 3 of these occur in Italy and all of them occupy habitats protected at European level (Habitat 6410, *Molinia* meadows; Habitat 6210, semi-natural dry grasslands on calcareous substrates; Habitat 4060, Alpine and boreal heaths), threatened by land use changes, which modify both the structural and functional connectivity of habitat patches and the quality of the habitat itself. Understanding the needs of all life stages, in relation to resource distribution, is essential to develop the most appropriate conservation strategies.
In this framework, we analysed resource use by *E. (a.) glaciegenita* (in a mesophilous alpine grassland) and *E. (a.) provincialis* (in a Mediterranean dry grassland) at i) landscape, ii) patch and iii) host-plant level.
We collected data on adults flight by MRR in 15 patches for each population, focusing on specimen density and distribution as a function of landscape and patches' characteristics (topography and vegetation).
We sampled first instar larvae within fixed plots and compared occupied vs unoccupied host plants (161 vs 109 LHP in the mesophilous alpine grassland; 57 vs 61 in the Mediterranean grassland), focusing on micro-habitat (percentage of vegetation cover and height of herbaceous layer) and micro-climate features (bare ground percentage and exposure as proxies).
We discussed our results for each "entity" belonging to the *E. aurinia* complex and interpreted them in the light of current environmental changes.

p-7-1

Modelling phenology and abundance responses of a butterfly community along an elevational gradient

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Insects and particularly butterflies represent one of the most useful indicators of the effects of environmental change on biodiversity, and have provided considerable evidence of changes to species' phenology resulting from climate change. Yet there is still little understanding of how phenological change will influence population dynamics, and whether changes will be consistent across species or different parts of species' geographic ranges. Here we present a new approach to modelling the phenology and abundance of butterfly populations across an elevational gradient in a mountain region of central Spain. Butterfly abundance was sampled in 20 transect locations from 930 m to 2040 m elevation over the ten years from 2004 - 2013. Models for ten univoltine species fitting peak flight dates and abundances to elevation and site environmental features suggest relatively consistent responses across species to interannual climatic variability. For the majority of species, earlier flight periods were associated with greater abundance. However, apparent variation among species in responses to climatic variability at different times of year emphasises the differences in climatic sensitivity of different species in the butterfly communities sampled. Here, we highlight our key findings and an outline of future work.

P-7-2

Annual changes in weather alter the parameters of a butterfly movement model

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Annually varying weather conditions may cause differences in dispersal of butterflies between flight seasons. Multiple attempts to model butterfly dispersal in metapopulations realistically have been made, but they rarely consider the influence of weather on movements. In this study, we investigated the effects of weather and landscape structure on the movement parameters of a diffusion-based movement model parameterized with two-year mark-recapture data on a metapopulation of the threatened Clouded Apollo (*Parnassius mnemosyne*). The model was parameterized separately based on data gathered in a warm and sunny flight season 2013 and in a largely cold and rainy flight season 2014. The results from this forested landscape were compared with earlier results from a more open landscape and data collected in warm and sunny weather conditions in 1999. The unfavourable weather conditions in 2014 led to model parameters predicting drastically less butterfly movements between habitat patches (>95% decrease in long-distance between-patch movements) than the warm weather in 2013. Interestingly the model parameters, based on data collected from two structurally different landscapes in favourable weather conditions for butterfly activity, did not differ substantially from each other. These results suggest that this modelling approach produces similar movement parameter values despite varying landscape structure. Moreover our results highlight the importance of considering the effects of weather on butterfly activity and model parameters. Taking into account weather conditions, an issue largely neglected in previous modelling studies, may substantially increase realism in predictions of annual movement rates of butterflies between suitable habitats.

p-7-3

Within-species spatial niche variation alters predictions of species distribution under future climate change

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Species distribution modelling often ignores that the niche of a species may vary within the geographical space it occupies. Non-stationarity in the response of a species to environmental conditions may induce low predictive performance at a local scale and uncertain spatial inference across the studied area. Surprisingly, there is a lack of modelling approaches that deal with this issue and that are suited to predict species distributions under future changing conditions. Accordingly, it is largely unknown to which extent predictions of future species distributions may be altered when accounting for non-stationarity. Here, we used a large sample of butterfly species over Europe and we compared the future predictions of species distribution according to (1) a global modelling approach that assumes a uniform response of the species to climate conditions across Europe, and (2) a local modelling approach that deals explicitly with within-species spatial niche variation. The local approach is based on partitioning procedures to split the entire distribution of the species into ecologically relevant subsets. Local models are built at the level of each subset and assembled with each other to capture within-species spatial niche variations across Europe. We provide the first evidence that ignoring non-stationarity may significantly overemphasize species range contraction under future climate change, especially for widely distributed species. We argue that future research efforts should achieve a better balance between the development of local and global modelling approaches to better evaluate the level of uncertainty due to within-species spatial niche variation in global change impact assessments.

p-8-1

The importance of habitat specialism and availability on species' population dynamics

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Species' responses to recent environmental changes have been highly heterogeneous, showing variation in abundance trends, geographic range size changes, and directions of range shifts. Using British butterflies and moths as exemplar species, we explore the role of habitat in driving such population changes. First, we describe a new method to quantitatively define habitat specialism and habitat availability using species' distribution data and remotely-sense land cover data. We test the performance of our new method by showing that it can distinguish 'specialists' and 'generalists' defined from expert opinion, and we then demonstrate positive but non-linear relationships between habitat availability and habitat specialism for our study species. We go on to recommend ways in which our method can be used in novel research in future, for example, in relation to understanding factors affecting species' responses to environmental changes.

P-8-2

Population studies on the strictly protected *Polymixis rufocincta isolata* L. Ronkay & Uherkovich, 1983 with marking in Hungary

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Polymixis rufocincta isolata (Habitats Directive II. and IV. Annexes, Bern Convention, strictly protected in Hungary) is confirmed to live in a single population at the Szársomlyó (SW-Hungary). The habitat is under strict protection by national law and belongs to Natura 2000 site HUDD20006, but is still threatened by quarrying and invasive plants.
The Ministry of Agriculture initiated a detailed survey of the species within the framework of the National Biodiversity-monitoring Scheme, involving experts from various institutions. A network of small lighttraps was used to map the distribution of the moth over the site with marking and instant release once. It was complemented by capture-mark-release run in parallel at selected locations in 5 occasions with heavy light sources. The statistical model estimated the gross population about 860 individuals.

P-8-3

CMR studies on the rediscovered *Coenonympha oedippus* population in the Hanság area (NW-Hungary)

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Coenonympha oedippus is among the key species (listed in Habitats Directive II. and IV. Annexes and Bern Convention I. Appendix, strictly protected in Hungary) referring to the good ecological status of a peatland area covered by multilayer grassland vegetation including tussock formations. It was known only one natural population in Hungary in the vicinity of Ócsa, and one more succesfully reintroduced colony in the Kiskunság area up to 2009 when the second natural population was rediscovered in the Hanság area after 70 years' periode of vanishing data. Right after finding the population it has started a mapping survey and an intensive capture-mark-release study on sample sites following the protocol of the National Biodiversity-monitoring Scheme. This report deals with the CMR records of the past 7 years. Different sampling strategies were applied for a one hectare "intensive sampling spot" and a 11 hectare "transect sampling" area. Effects of the different sampling strategies, experiments of small scale management practices (shrub removal from certain spots) and movement patterns of the marked individuals were investigated.

p-9-1

Ecology of Southern Festoon (*Zerynthia polyxena*) in tri-trophic interactions system

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The Southern Festoon belongs to tribe *Zerynthiini*, one of the oldest groups of butterflies in the world. Members of this group are strictly specialised on plants of subfamily *Aristolochiaceae*. The species is in Central Europe bound to the *Aristolochia clematitis*. The species is listed on the Habitats Directive Annex II and Bern Convence Annex IV and is also protected by national legislatives. The aims of the study were a comparison of host plant requirements of *Z. polyxena* in different habitats and its host-parasitoid interactions. The data were collected in two seasons 2013 and 2014 in South-west Slovakia. Our results show that females preferred for oviposition higher plants with longer leaves in shady habitats. The number of eggs was dependent on size of the leaf and the size of the clutch depended on number of already occupied leafs. Similarly also caterpillars preferred higher plants with more leafs, where they can eat and rest in their shadow. Our results also pointed that parasitation was sex-dependent, and the parasitoids attacked solely the female caterpillars. The parasitation negatively influenced the weight of the pupae during their development. The prevalence of parasitation was higher with higher number of present caterpillars. More threatened were populations of *Z. polyxena* occurring along edges of forests, but open meadows and grasslands with many species of flowering plants had a higher diversity of parasitoids.

p-10-1

The Hymenoptera parasitoids (*Hymenoptera: Ichneumonoidea*) of *Satyrinae* (Lepidoptera: *Nymphalidae*) along a vertical gradient in the Ötztal Alps and Dolomites

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Superfamily *Ichneumonoidea* belongs to the most diverse groups of insects in the world, and in terms of their ecological role in ecosystems, the most important organisms in general. We do not know so far how diverse the group actually is, but estimated number is around 100,000. The knowledge about biology is similarly unknown. The group consists of two families - *Braconidae* and *Ichneumonidae*, and they are the subject of this study. The evolution of host-parasitic relationship between parasitoid wasps and butterflies dates back to the formation of these groups. The first goal of our study is to determine how altitude affects the degree of diversity of these parasitoids in European mountain ranges and the second goal is how parasitoids and their hosts deal with climate and habitat changes. From previous studies we know that the rate of infestation by parasitoids decreases with increasing climate variability and that the parasitoid wasps are more abundant and diverse group in mountainous areas in relation to other parasitoids. Additionally, our results suggest that along altitudinal gradient Ichneumonidae are more diverse group, but *Braconidae* appears to be the dominant group parasitoids in the caterpillars of *Satyrinae*. The results also show that the highest rate of *Satyrinae* parasitism is at the altitude about 1,100 meters in the Austrian Alps and the Dolomites.

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p-10-2

Assessing tri-trophic interactions at the community level using pierid butterflies in a semiarid environment

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Insect herbivores experience different communities of plants, enemies (i.e. parasitoids), and other herbivores associated with the same plants. Their host-plant selection and diet breadth may be shaped by these different selective pressures. We assessed the ecological drivers of host-plant use by butterflies of the Pieridae family in a semiarid region in southeast of Spain. Over three years we collected caterpillars of pierid species in the field, together with data on the plant species, the part of the plant and the time of the year. Caterpillars were reared in the lab to assess mortality by parasitoids. Our food web consisted of 10 potential host plant species, 7 pierid butterfly species and 4 parasitoid species. We found that caterpillars were associated with particular plant species and this affected the likelihood of being parasitised. Parasitoid host selection was determined by butterfly species and the host-plant on which the caterpillar was feeding. Rates of parasitism were also density dependent. We discuss our findings in line with the Tri-Trophic Interactions hypothesis (TTI) which predicts that the benefits of host-plant specialisation are modulated by host-plant quality, the presence of natural enemies and the presence of other competitor herbivores.

p-10-3

Heat and desiccation resistance in early developmental stages of three Copper butterflies

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The Earth's mean surface temperature and the frequency of extreme weather events such as heat waves have already increased as a result of climate change. Although there is broad support for the hypothesis that temperate-zone species may benefit from higher temperatures, there are substantial differences between species. Against this background we test in two experiments the stress tolerance of eggs and hatchlings in three closely related species of Copper butterflies, *Lycaena tityrus* (Poda, 1761) with a low risk of vulnerability to climate change, *Lycaena dispar* (Haworth, 1802) with an intermediate risk and *Lycaena helle* (Denis & Schiffermüller, 1775) with a high risk. Here we focus on early developmental stages because these may be most relevant in determining the vulnerability to environmental stress. We found for all species an increase in mortality rates in the simulated heat wave and an even stronger increase in the simulated drought treatment. Interestingly we found that mortality rates increased most strongly in *L. helle*. This might be one explanation for the strong population declines of *L. helle* in the last decades besides the loss of habitats. These results show the importance of considering life stages other than the adult stage and that closely related species may strongly differ in their vulnerability to climate change.

p-11-1

Time capsule genetics: Natural history collections in modern Lepidoptera conservation.

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A key goal in conservation is the maintenance of genetic diversity. Unfortunately conservation efforts usually begin only after a species has undergone population declines with an accompanying loss of genetic diversity. It is then very difficult to extrapolate historic levels of genetic diversity from that found in the extant population. An understanding of the past genetic diversity and population structure of a species would help to inform conservation efforts by identifying suitable source populations for reintroductions. Museum collections, some containing Lepidoptera specimens dating back over two hundred years, can play a key role in conservation by providing this historic population information.

The Marsh Fritillary (*Euphydryas aurinia*) is declining globally. Once widespread in Britain, it is now predominately confined to the South-west with an additional meta-population in Scotland and a small number of isolated colonies elsewhere. This significant reduction in range and population may have been occurring for over fifty years with unknown effects on the genetic diversity of the species. However, specimens held by museums can give us access to the genetic diversity of the past, providing a baseline against which to compare the modern populations.

The aims of this project are two-fold:

- To elucidate the historic levels of genetic diversity of the Marsh Fritillary in Britain, providing a baseline for future investigations of current populations.
- To raise awareness of an often over-looked resource; the entomological drawers of Natural History collections.

p-11-2

Differential gene expression analysis of winter moth (*Operophtera brumata*) phenology in response to photoperiod.

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In past decades, global warming has influenced the seasonal timing of many species at different rates. As a consequence, phenological mismatches in ecological interactions have occurred (e.g. predator-prey; herbivorous insect-host plant) with detrimental effects on fitness and species' persistence. To predict if species will be able to adapt to the warming temperatures and restore their phenological matches, it is crucial to understand the mechanisms underlying phenology and its regulation. In a lepidopteran species, the winter moth, the phenological synchrony between egg-hatching and the oak's budburst has major fitness consequences on larval survival and adult fecundity. As spring temperatures have advanced the timing of egg-hatching, the question is whether this advancement is carried over onto the following life stages. Most winter moth life stages are known to be strongly influenced by temperature but less is known about the role of photoperiod in regulating phenology. Previous studies in our lab show that winter moth pupae regulate the timing of adult eclosion depending on the photoperiodic cues experienced as larvae (Salis et al., submitted). To gain insight in the mechanisms underlying the regulation of pupal development in response to day length, we repeated the experiment and studied the differential gene expression in winter moth pupae originated from larvae under three photoperiod treatments using RNAseq. Here we present preliminary results of a transcriptome analysis which sheds light on the regulation of winter moth phenology in the face of climate change.

P-11-3

An insight into genetic population structure of butterfly False Ringlet, *Coenonympha oedippus* (*Nymphalidae*, *Satyrinae*) from Slovenia

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The False Ringlet is one of the most threatened European butterfly species. In Slovenia, where it reaches the southern range limit, the species has a disjunct distribution. It inhabits semi-open wet grasslands in central part of the country, and dry grasslands in different succession stages up to light woods in the SW Slovenia. These rather peculiar habitats question the differences among geographically and reproductively separate populations and the role of local adaptations to wet and dry habitats. We conducted study of two mitochondrial markers (12s rRNA, COI) from 34 Slovenian populations in a total length of 993 base pairs. All together 17 unique haplotypes were revealed, however showing no clear connection to the geographical origin of the samples. Moreover, the most spread haplotype occurs throughout the distribution range and also both habitat types of the species in Slovenia, thus indicating historic connections among the populations. Previous morphometric analyses showed that individuals from the wet grasslands in central Slovenia have larger wings than the individuals from the dry habitats in the SW part of the country. Since these differences may be of adaptive nature, we are planning to develop SNP markers with double digest Restriction Amplified DNA sequencing in order to answer this question.

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