



# 11<sup>th</sup> European Heathland Workshop

13<sup>th</sup> to 18<sup>th</sup> September 2009

Combined Universities of Cornwall (CUC), Glasney Park, Tremough Campus,  
Falmouth, Cornwall, UK

Programme, abstracts and delegate list

Natural England

2009

[i]



# Programme

## Sunday 13th September

Delegates arrive at CUC, Tremough Campus in the afternoon and evening.

- From 15:00            Registration  
18:30 – 19:30        Dinner  
19:30 – 20:00        Delegate welcome session and Introduction to The Lizard.

## Monday 14th September

- 07:15 – 08:00        Breakfast and pick up packed lunch (Daphne Du Maurier Area)  
08:15                    Coach leaves for the Lizard  
09:00 – 14:00        **Site visit to The Lizard**  
14:45 – 15:30        Tea and biscuits and freshen up  
15:30 – 16:00        **Reflections on The Lizard:** condition and management

### Session 1 – Management options

- 16:00 – 16:40        Werner Härdtle, Kirsten Falk, Uta Friedrich, Maren Meyer-Grünefeldt, Konrad Merkle, Goddert von Oheimb – *Molinia caerulea responses to N and P fertilisation in dry heathland ecosystems*  
16:40 – 17:20        Joost Vogels, Arnold van den Burg & Henk Siepel – *Mineral rich sites in Dutch heathland remnants: effects on heathland fauna*  
17:20 – 18:00        Suzanne Perry – *Update on the Foerstry Commission (England) Restoration of Open Habitats from Woods and Forest*  
18:00 – 19:00        Dinner (Daphne Du Maurier Area)  
19:00 – 19:30        Introduction to Bodmin Moor

### Posters:

Ana Muñoz, Rebeca Álvarez, Xosé-Manoel Pesqueira, Juan García-Duro, Margarita Basanta, Otilia Reyes & Mercedes Casal – *Communities of Erica ciliaris and Erica tetralix of the NW of Spain: status and conservation*

Alejandra Moran-Ordóñez, Susana Suárez-Seoane, Leonor Calvo & Estanislao de Luis-Calabuig – *Changes in heathland landscape services in the Cantabrian mountain range between 1957-2007*

Heather Tidball – *Reducing Arson on the Dorset Heaths*

Samira Mobaied & Bernard Riera – *Heathland vegetation dynamics in "Mare aux joncs" Fontainebleau (France) between 2000 and 2009. Mechanism of change and Simulation of the future evolution*

Joy Ede & Margaret Nieke - *Heathlands and the Historic Environment*

Inger Kappel Schmidt, Torben Riis-Nielsen, Jane Kongstad -  
*Regeneration of Calluna vulgaris after heather beetle attack –  
responses to experimental climate change*

## Tuesday 15th September

- 07:15 – 08:00 Breakfast and pick up packed lunch (Daphne Du Maurier Area)  
08:15 Coach leaves for Bodmin Moor  
09:15 – 14:00 **Site visit to Bodmin Moor**  
15:00 – 15:30 Tea and biscuits and freshen up  
15:30 – 16:00 **Reflections on Bodmin Moor:** condition and management

### Session 2 – Grazing

- 16:00 – 16:40 Geert de Blust – *30 years of grazing in the Kalmthoutse Heide (B);  
lessons for the future*  
16:40 – 17:20 Rita Merete Buttenschøn & Jon Buttenschøn – *Cattle grazing as  
management of coastal dune heathland on Læsø*  
17:20 – 18:00 Herbert Diemont, Patrick Hommel, Koen Kramer, Raymond Schrijver  
& Rein de Waal – *Is grazing of heathlands a necessity or a choice?*  
18:00 – 19:00 Dinner (Daphne Du Maurier Area)  
19:00 – 19:30 Introduction to Goss Moor and the China Clay Country

## Wednesday 16th September

- 07:15 – 08:00 Breakfast and pick up packed lunch (Daphne Du Maurier Area)  
08:15 Coach leaves for Goss moor  
09:15 – 14:00 **Site visit to Goss Moor and the China Clay Country**  
15:00 – 15:30 Tea and biscuits and freshen up  
15:30 – 16:00 **Reflections on Goss Moor and the China Clay Country:** condition  
and management

### Session 3 – Phytophthora & West Penwith Historic Environment

- 16:00 – 16:40 Ben Jones, Ann Payne – *Phytophthora*  
16:40 – 17:20 Graeme Kirkham – *Archaeology of Cornwall*  
17:20 – 18:00 Joy Ede – Habitat restoration and re-creation on landscapes with  
important features  
18:00 – 19:00 Dinner (Daphne Du Maurier Area)

19:00 – 19:30 Introduction to West Penwith  
**Posters** Defra/FERA posters on Phytophthora

### Thursday 17th September

07:15 – 08:00 Breakfast and pick up packed lunch (Daphne Du Maurier Area)  
08:00 Coach leaves for West Penwith  
09:00 – 14:00 **Site visit to West Penwith**  
14:00 – 14:45 Drive to St Ives along the coast road  
14:45 – 15:45 Free hour in St Ives. Meet back at the Tate  
15:45 – 16:30 **Reflections on West Penwith:** condition and management  
16:30 – 16:55 **Canapés and wine with a private viewing around the Tate Gallery**  
18:30 Depart for Tremough  
19:30 – 20:00 Freshen up before dinner  
20:00 – 22:00 Formal dinner with Cornish produce

### Friday 18th September

Tremough House Lecture Theatre C

07:15 – 08:00 Breakfast (Daphne Du Maurier Area)

#### Session 5 – Nitrogen deposition

09:00 – 09:40 Sally Power, Emma Green, Georgina Southon & Richard Ellis – *Global change and heathland ecosystems: How does nitrogen deposition affect recovery following a severe fire?*

09:40 – 10:20 Leonor Calvo, Tárrega, R., Valbuena, L., Marcos, E., Suárez, S., Taboada, A., Morán, A., Cuesta, D., Salgado, J.M., Luis-Calabuig, E. – *Heathlands in the Cantabrian mountain range as a monitoring system for global change studies*

10:20– 11:00 Eva Remke, Emiel Brouwer, Annemieke Kooijman, Irmgard Blindow, Jan G.M. Roelofs – *Low atmospheric nitrogen loads lead to grass encroachment in coastal dunes, but only on acid soils*

11:00 – 11:30 **Break**

#### Session 6 – Global Change

11:30 – 12:10 Jane Kongstad Nielsen & Inger Kappel Schmidt – *Flowering responses of D. flexuosa to climate change manipulations*

12:10 -12:50 Isabel Alonso & Vicky Morgan– *Achieving Favourable Conservation Status for European heathlands - are heaths protected by the Habitats Directive?*

13:00 – 14:00 Lunch (Refectory)

14:00 – 15:00 **Conclusions, discussions about 2011 EHW, finish conference**

**Posters**

Maren Meyer-Gruenerfeldt, Uta Friedrich, Kai Jensen, Kristin Ludewig, Sebastian Schmidt, Goddert von Oheimb & Werner Härdtle – *Combined effects of decreasing summer precipitation and nitrogen deposition on lowland heaths*

Elena Marcos, Susana Suárez, Leonor Calvo – *Soil nitrogen mineralization under field conditions in heathlands of Cantabrian Mountains*

Luz Valbuena, Leonor Calvo, Reyes Tárrega, Estanislao de Luis-Calabuig – *Is the soil seed bank the main source of Calluna seeds in the regeneration of Cantabrian heathlands after burning and burning plus nitrogen fertilization?*

A. Taboada, Calvo, L., Tárrega, R., Salgado, J.M. – *Spatial distribution of carabid beetles (Coleoptera, Carabidae) in a shrub-mosaic landscape: singularity of Calluna-heathlands*

Arnold van den Burg, Joost Vogels, Eva Remke & Henk Siepel - *Micronutrient limitation in heathland fauna as a result of nitrogen deposition*

**Title:** *Molinia caerulea* responses to N and P fertilisation in dry heathland ecosystems

**Author(s):** Werner Härdtle, Kirsten Falk, Uta Friedrich, Maren Meyer-Grünefeldt, Konrad Merkle, Goddert von Oheimb

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### Talk

In dry heathlands prolonged atmospheric N loads are considered one important driver for the replacement of dwarf shrubs by *Molinia caerulea*. The present study aims to contribute to a better understanding of mechanisms underlying the ongoing encroachment of *Molinia caerulea* in dry heaths based on a full-factorial fertilisation experiment with N and P in the Lüneburger Heide nature reserve. Fertilisation experiments were carried out in 2006 and 2008 at two different sites, each of which comprised a series of 10 randomly chosen replicate blocks. Aboveground biomass production of *Molinia caerulea* was limited by P in the first study year, but by N in the second year. In both years the biomass and the number of flowering tillers increased significantly as a result of fertilisation, whereas vegetative biomass increased significantly only in 2006. Fertilisation treatments were reflected by the nutritional status of *Molinia caerulea*, but the impact of P fertilisation was more pronounced in both years. We hypothesise that the kind of nutrient limitation (P vs. N limitation) was mainly mediated by the water availability during the vegetation period. P limitation was caused by a drought event in July 2006, whilst N limitation prevailed in the humid summer with sufficient water supply in 2008. Our study gives evidence that *Molinia caerulea* encroachment in dry heaths is not only a result of an increased aboveground productivity, but is also due to increased investments in reproductive tissue that allow for increased seed production and thus accelerated encroachment of seedlings in places where the dwarf shrub canopy has been opened due to disturbance factors.



**Title:** Mineral rich sites in Dutch heathland remnants: effects on heathland fauna

**Author(s):** Joost Vogels, Arnold van den Burg & Henk Siepel

**Address:** Bargerveen Foundation - Department of animal ecology and – ecophysiology, Radboud University Nijmegen P/O Box 9010 6500 GL Nijmegen

**Email:**

**Talk**

Nowadays, only five percent of the historical heathland area remains in the Netherlands as protected nature reserves. Anthropogenic influences such as atmospheric nitrogen deposition, acidification and desiccation degraded these remnants, resulting in further loss of heathland biodiversity. In order to counteract these negative impacts, conservation measures are being undertaken. Until recently, these were aimed primarily on the restoration of heathland vegetation, and, as a result, characteristic plant species of heathlands have responded positively to this management. In contrast, many characteristic fauna species of heathlands continued to decline. Large insects such as grasshoppers and many butterfly species are now extinct or highly endangered. The main scope of a new research program is to identify bottlenecks for heathland fauna resulting from both the negative anthropogenic influences as well as current management practices.

An important aspect of many fauna species is that they are mobile, and often use more than one habitat type for different activities and/or specific stages in their life-cycle. In order to account for this, a landscape approach is used. First, a theoretical framework of the historical heathland landscape was constructed. Species traits of characteristic heathland fauna were used to assess which landscape elements were most suitable or unsuitable for these species. This allowed the identification of bottlenecks that currently exist in Dutch heathland remnants. One important bottleneck appeared to be the lack of mineral-richer sites in the current heathland reserves. In order to test the possible relationship between the mineral-richness of the soil and fauna biodiversity, a field survey was made in two large heathland areas in the Netherlands. Fauna communities were sampled at sites with grazing and/or sod-cutting as management type, and contrasted with an array of other management types that result in mineral enrichment or in which no enrichment took place. Analysis



of trapped carabid beetles revealed a significant twofold increase in density in mineral enriched sites, compared to sites where no enrichment took place. Species richness did not differ between sites, indicating that mineral enrichment did not result in a loss of biodiversity. In order to further investigate the causal relationships between mineral rich and mineral poor soils and species performance, field and laboratory experiments with an endangered, heathland characteristic orthopteran, the field cricket (*Gryllus campestris*), were carried out. First results show a significant threefold increase in fecundity of adult female field crickets when fed with vegetation from enriched soils compared to vegetation from non-enriched soils. Implications for future management will be discussed.

**Title: Communities of *Erica ciliaris* and *Erica tetralix* of the NW of Spain: status and conservation**

**Author(s):** Ana Muñoz, Rebeca Álvarez, Xosé-Manoel Pesqueira, Juan García-Duro, Margarita Basanta, Otilia Reyes & Mercedes Casal

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**Poster**

*Erica ciliaris* and *Erica tetralix* communities are some of the scarcest heathlands of the Iberian Peninsula and they are also considered to be the smallest in extension. The surface area of the European heathlands has considerably decreased for many years because the traditional uses have been abandoned, although other causes have also influenced this decrease, such as the proliferation of forest plantations, wild fires, or the drying out of these ecosystems.

Thirty *Erica ciliaris* and *Erica tetralix* communities were selected and, from their study, the following results were obtained. These communities present a heterogeneous species composition and are the natural habitat of two endemisms of the NW Iberian Peninsula. In addition, their composition is influenced by environmental factors. Specifically, the degree of waterlogging and the type of management used in the communities affects the presence and abundance of the specialist and tree species, respectively. In the last 26 years, grazing has disappeared from these heathlands and more aggressive uses have increased. These have caused important changes in their structure and diversity. Moreover, the communities studied have suffered a decrease of 60% in their surface area, increasing their insularity. From the study of the vegetal dynamics of these communities after cultural burning and cutting, information was obtained that permits the determination of the adequacy of these two uses as tools for the conservation and management of *Erica ciliaris* and *Erica tetralix* communities.

**Title:** Changes in heathland landscape services in the Cantabrian mountain range between 1957-2007

**Author(s):** Alejandra Morán-Ordóñez, Susana Suárez-Seoane, Leonor Calvo & Estanislao de Luis-Calabuig

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### Poster

Through the last few decades, a huge transformation of traditional land uses has taken place in the Cantabrian Mountains. The decrease in the number of sheep flocks (as a result of the crisis in the transhumant system), the abandonment of agriculture in marginal areas and the rural exodus (specially marked since 1960) involved the loss of traditional management based on grazing, cutting and burning which has modelled the Cantabrian landscape for centuries. Those practices have favoured the maintenance of a traditional landscape in the high altitudes of this mountain range, consisting of an open mosaic of pastures and heath which we have called "heathland landscape". From the second half of the twentieth century, the loss of those traditional activities has favoured a heath and shrub encroachment process in these high areas, transforming the initial open mosaic of pastures and heath towards a continuous matrix of heath in which the forest is starting to recover. The changes in that heathland mosaic have induced changes in the ecosystem services that this kind of landscape provided for the areas where they could be found.

In this study we describe the main ecosystem services provided by the heathland landscape in the Cantabrian mountains. Moreover, and using aerial photographs, we analyze the landscape changes from 1957 to 2007. The aim of this study is to connect the changes in heathland landscapes in the Cantabrian mountains with those in the services provided by this kind of ecosystem.

This study was financed by the research projects JCYL LE021A08 and MCYT CGL2006-10998-C02-01/BOS.

**Title:** Reducing Arson on the Dorset Heaths

**Author(s):** Heather Tidball

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### Poster

Since 2001 a partnership of landowners and managers and emergency services in Dorset have worked together to reduce arson on the Dorset Heaths. This poster will outline methods use to monitor and address the problem and progress to date.

A multi disciplinary, partnership approach has been used addressing the problem in a number of ways. These include additional site wardening to discourage unwanted behaviour; education and awareness raising; improved fire fighting equipment, access, training and procedures; improved communication between land owners and emergency services; a common, web enabled, incident database used to justify and target resources and track progress.

We are now seeing a downward trend in the incidence of arson with an average decrease of about 60% in numbers of fires annually when comparing the period 1996 – 2001 to 2002 -2008. Improvements in fire fighting response mean that fires are less damaging as they are controlled and extinguished more quickly.

**Title:** Heathland vegetation dynamics in “Mare aux joncs” Fontainebleau (France) between 2000 and 2009. Mechanism of change and Simulation of the future evolution

**Author(s):** Samira MOBAIED (1) , Bernard RIERA (2)

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### Poster

In the EU Habitats Directive heathlands have been recognized as a natural habitat type of community interest, to conserve these habitats when they are threatened particularly in relation to global change (change of water regime, loss of grazing,...) the organizations of management have to intervene. To improve the management of these environments we studied the evolution of a heathland « La Mare aux Joncs » located in the Forest of Fontainebleau. The observations were made on an area of four hectares between 2000 and 2008. With the help of GIS, the development of the site was modeled using the model CA\_Markov. Between the two periods of observation and to avoid the afforestation of heathland the «Office National de la Forêt » apply a regularly cut of juveniles woody species in principal *Betula pendula* Roth. and *Pinus sylvestris* L. that spontaneously settled on the heathland. The results of this study shows that another type of dynamics occurs in plant communities is the expansion of *Molinia caerulea* L. at the expense of heather, this expansion is linked to the spatial distribution of shoots of *B. pendula* in the heathland. The high density of shoots of *B. pendula* and the management method applied seem to favour the installation of *M. caerulea* by increasing the available nutrition in the sol. The predictive model used indicates a gradual change of the heathland for the benefit of *M. caerulea* to the detriment of *Calluna Vulgaris* L. and *Erica tetralix* L. and also an expansion of forested areas by *P. sylvestris*.

**Title:** Regeneration of *Calluna vulgaris* after heather beetle attack –responses to experimental climate change

**Author(s):** Inger Kappel Schmidt, Torben Riis-Nielsen, Jane Kongstad

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### Poster

Climate change affects the performance of species in different ways and potentially it change community composition. *Calluna vulgaris* is expected to be more sensitive to climatic stress as a specialist with a narrow niche compared to e.g. the other dominant heathland species, the grass *Deschampsia flexuosa*, which is a generalist and expected to have a higher potential for adaptation to the new conditions. However, numerous experiments have shown that *C. vulgaris* is very resistant to environmental changes as a mature plant, whereas it may be highly sensitive to climatic stressors during its regeneration phase.

In a large scale experiment with night-time warming and extended summer drought at a Danish heathland co-dominated by *C. vulgaris* and *D. flexuosa*, we studied the effect of regeneration of *C. vulgaris* after a heather beetle attack killing all the heather plants.

A naturally occurring outbreak of heather beetles (*Lochmaea suturalis* Thompson) started in 1999 and 2000 defoliating and killing the heather plants (>95%). We observed a treatment effect of heather beetle grazing, although all plants finally died. The vegetation was mowed and the biomass removed to restore the heather in September 2000. *D. flexuosa* increased and totally dominated the vegetation in the first years. Slowly, heather re-established in the plots from seeds. Very few seedlings appeared in the drought plots whereas warming promoted growth. This shows a synergy between climate change and re-establishment of heathlands under pressure for grass invasion due to increased nutrient availability.

**Title:** 30 years of grazing in the Kalmthoutse Heide (B); lessons for the future.

**Author(s):** Geert De Blust

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### Talk

The heathland reserve 'De Kalmthoutse Heide', (approx. 1000ha) has been grazed for nature management purposes since the mid nineteen seventies. Mostly by sheep (350-650 animals), in recent years also by cattle (2x20 Galloway). During those 30 years, the grazing regime evolved. It started with shepherding, then quickly changed to confined grazing by temporary fencing of smaller areas during the growing season, while in the last decade free-ranging in very large permanent units was the option. Last year a general evaluation of the results of this management took place. Although clear examples of success can be identified, it can not be concluded that the desired and expected results are achieved everywhere. Whether this is due to a form of sub-optimal grazing or not, is far from clear. Indeed, the former changes in grazing management and major disturbances, such as wild fires, interfere and make it difficult to distinguish between the impact of the different factors. To achieve set objectives however, it seems to be more effective to establish a grazing regime that allows for a quick adaptation to newly arising conditions in the heathland. Especially in extensive areas where the natural dynamics can play a key role in ecosystem functioning, but the objectives are precisely defined (for instance related to the Natura2000 favourable conservation status), controlled grazing could be the strategy to attain the adaptive management that is necessary in this respect. In this contribution we will give some facts and figures to illustrate the above.



**Title:** Cattle grazing as management of coastal dune heathland on Læsø

**Author(s):** Rita Merete Buttenschøn & Jon Buttenschøn

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### Talk

While many coastal dune heathlands are stable over long time, some are subject to slow woodland encroachment and degeneration of the dwarf shrub stands leading to dominance by *Empetrum nigrum* – sobeit on Læsø. Accordingly it was decided to test cattle grazing. The pasture contains a mosaic of mire, wet and dry heathland and salt meadow and is pastured annually with a herd of 12-15 Galloway cows – a stocking rate of 40 tonnes\*days/ha. Judged by the dung-pat distribution the grazing pressure varies ten-fold with the vegetation mosaic with very low pressure on the mire and coastal dune-land.

We compare the vegetation before initiation of grazing (1991) with the vegetation after 17 years of grazing (2008). Multivariate analyses (DCA & CCA) were made on the species cover indices from 32 analysis-plots and environmental variables age of grazing, cover of litter, inclination, deposition of dung, height above sea-level, distance to subsoil water, pH and nitrogen. In the CCA the samples were shown to move along the horizontal axis– away from the litter-pH-N-vector cluster towards the grazing vector. Similarly, with the species, we see a reasonably consistent pattern where low stature, management dependent species and most mosses are associated with grazing, whereas the lichens and dwarf shrubs differ much with species. After an initial lag period of two to three years, there is an increase in species density. Paired t-tests on frequency data show significant change in qualitative composition of the vegetation, while the same tests on cover-index data do not indicate significant change in the quantitative composition. The initially dominant species remain important for the vegetation structure long time after introduction of grazing.

We attribute much of the change in vegetation to more diverse gap filling in a stable mesh of dominant species. As concerns the heathland character species we see that *Calluna vulgaris* and *Erica tetralix* expand in frequency as well as cover, as does the lichen element. We conclude that cattle grazing under low grazing pressure may initiate heathland regeneration where under i.a. *Calluna vulgaris* and *Erica tetralix*

expand. In order to achieve a differentiated grazing pressure the grazing management should be performed in large pastures with a vegetation mosaic. This will reduce the dune area subject to heavy wear and prevent massive sand drifting.

**Title:** Is grazing of heathlands a necessity or a choice?

**Author(s):** Herbert Diemont, Patrick Hommel, Koen Kramer, Raymond Schrijver & Rein de Waal

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### **Talk**

Both necessities and choices depend on your objectives. For instance, from a point of view of preserving biodiversity of species one may question whether man made ecosystems should be protected, but if the objective is to protect certain man made habitat the protection of man made heath may be useful. From an economic perspective heath is considered as marginal land at present, whereas in the past heath farming systems have been among the most intensive farming systems in the past and can become a profitable extensive farmed system in future. In such a future heath system probably cattle grazing will be preferred requiring less labour as compared to sheep grazing. In this account we identify some of the necessities and options for heath land management in cases where objectives are identified based on historic, economic and ecological information. Most of the information is compiled during the EU HEATH interreg project. It is concluded that grazing is not a necessity from an ecological point of view, but from a sustainable management point of view can become an attractive and profitable option for land management under certain WTO conditions.

**Title:** Global change and heathland ecosystems: How does nitrogen deposition affect recovery following a severe fire?

**Author(s):** Sally Power, Emma Green, Georgina Southon & Richard Ellis

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### Talk

Climate change predictions of warmer, drier summers are likely to increase the frequency and severity of wildfires in many parts of the world. However, the effects of fire on ecosystem processes are likely to depend on pre-burn vegetation characteristics, soil chemistry and microbiology, all of which are known to be affected by changes in nitrogen (N) deposition. Long term N addition experiments at a lowland heathland in the UK (Thursley Common National Nature Reserve) have established the mechanisms by which nutrient loading drives above- and belowground ecosystem change, and resulted in many treatment-related differences in plant and soil characteristics. The occurrence of a severe summer fire at the site in 2006, therefore, provided the opportunity to evaluate the impact of a major perturbation on nutrient and microbial dynamics in soils of contrasting chemistry and microbiology. The aims of the study were to determine the impacts of fire on: (1) soil nutrient and microbial community dynamics, and (2) the relationship between belowground chemistry, microbial community characteristics and post-fire regeneration of aboveground vegetation. Results indicate that the fire significantly reduced the size of soil nutrient stores, although pre-existing differences in N and P availability between control and N-treated plots remained. Temporal variation in nutrient availability and leaching was high, reflecting patterns in microbial activity and climate. Microbial community composition was dynamic, with clear differences apparent between unburnt and burnt areas, and between control and N-treated plots. Post-fire vegetation recovery showed clear effects of N treatment, reflecting patterns in both nutrient availability and microbial community composition. Evidence from the study to date indicates that, although severe summer fires have the potential to remove a proportion of accumulated soil nutrient stores, the speed and extent of ecosystem recovery after these events is affected by N deposition.

**Title: Heathlands in the Cantabrian mountain range as a monitoring system for global change studies**

**Author(s):** Calvo, L., Tárrega, R., Valbuena, L., Marcos, E., Suárez, S., Taboada, A., Morán, A., Cuesta, D., Salgado, J.M., Luis-Calabuig, E.

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**Talk**

*Calluna vulgaris* heathlands of the Cantabrian mountain range are expected to be highly sensitive to environmental changes, as they are situated at the southern limit of the ecosystem's distribution range. For this reason, these heathlands can represent the perfect scenario to investigate the effects of global change, together with the effects of common perturbations in this area, such as recurrent burning and the recent increase of atmospheric nitrogen depositions. Predicting the response of these heathlands to such environmental changes will require increasing the current knowledge of their specific vegetation structure, edaphic fauna and soil nutrient cycle.

Thus, the Heathlands' Research Team from the University of León (NW Spain) has developed several studies in this mountain range, the first of which aims to identify the specific structure of the *Calluna*-heathland vegetation as compared with other types of heathlands and shrublands and in the same area, as well as the effects of vegetation structure on the edaphic fauna and soil characteristics. Secondly, we have also focused on the effects of global change and common perturbations on the biodiversity, dynamics and functioning of the *Calluna*-heathlands located in areas of high conservation interest.

To achieve these objectives, firstly we selected the four main types of heathlands and shrublands of the Cantabrian mountain range, dominated by: (1) *Calluna vulgaris*, (2) *Erica australis*, (3) *Genista hispanica* and (4) *Genista florida*, where we determined the vegetation structure, edaphic fauna composition and soil characteristics.

Secondly, we selected three *Calluna vulgaris*-heathlands, where we established four permanent 20x20 m plots: (1) control plot, (2) fertilised plot (monthly fertilised with ordinary granules of ammonium nitrate, from June to October), (3) burned plot

(experimentally burned in June 2005), and (4) burned plus fertilised plot. For a three-year period (2005-2007), we assessed the effects of these perturbations at the *Calluna* population level, as well as the changes in the vegetation community, soil characteristics and in three insect groups (ground beetles, leaf beetles and true bugs). In this presentation we will summarise the main results obtained in the development of this project.

This study was financed by the research projects JCYL LE021A08 and MCYT CGL2006-10998-C02-01/BOS.

**Title: Low atmospheric nitrogen loads lead to grass encroachment in coastal dunes, but only on acid soils**

**Author(s):** Eva Remke, Emiel Brouwer, Annemieke Kooijman, Irmgard Blindow, Jan G.M. Roelofs

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**Talk**

The impact of atmospheric N-deposition on succession from open sand to dry, lichen-rich, short grassland and tall grass vegetation dominated by *Carex arenaria* was surveyed in 19 coastal dune sites along the Baltic Sea. Coastal dunes with acid or slightly calcareous sand reacted differently to atmospheric wet deposition of 5-8 kg N ha<sup>-1</sup> yr<sup>-1</sup>. Accelerated acidification, as well as increased growth of *Carex* and accumulation of organic matter, was observed only at acid sites with pH<sub>NaCl</sub> of the parent material below 6.0. At sites with slightly calcareous parent material, increased N-deposition had no effect. A trigger for grass encroachment seems to be high acidification in early successional stages to below pH<sub>NaCl</sub> 4.0. Metals like Al or Fe become freely available and may hamper intolerant species. At acid sites, N-mineralisation increases with elevated N-deposition, which may further stimulate *Carex arenaria*. Due to high growth plasticity, efficient resource allocation and tolerance of high metal concentrations, *C. arenaria* is a superior competitor under these conditions and can start to dominate the dune system. *Carex* forms a persistent, dense and species poor vegetation cover, which is not likely to be colonized by ericoid species. Even at the moderate N-loads in this study, species number of foliose lichens, forbs, and grasses was reduced in short grass vegetation at acid sites.



**Title:** Flowering responses of *D. flexuosa* to climate change manipulations

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### Talk

Human activities have increased atmospheric CO<sub>2</sub> concentrations causing global warming and changes in precipitation patterns as summer drought. These factors alone or in concert are likely to affect plant growth and phenology as bud burst, first flowering day and length of the flowering period.

Here we studied the flowering of the heathland grass *Deschampsia flexuosa*. The study was done within the *in situ* manipulation experiment CLIMAITE. CLIMAITE is a Danish multidisciplinary national research initiative, studying the biological effect of the changing climate. Within the CLIMAITE project a common large scale experiment was established with realistic manipulations according to a Danish climatic scenario anno 2075; Elevated atmospheric CO<sub>2</sub> concentration to 510 ppm, passive night time warming by approximately 2 °C air temperature and an extended summer drought period.

For two growing seasons we counted the number of flowering shoots. In 2008, we recorded number of flowers and phenological stages every week from the beginning of May to the end of June. In 2009, we only observed once by the end of June.

In May 2008, we observed a significant increase in the rate of shoots, which had initiated flowering in the warmed plots. A week later, the CO<sub>2</sub> plots showed increased flowering, probably due to a higher total amount of flowers in CO<sub>2</sub> treated plots. The spring 2008 was unusual dry and we observed a large number of flowering shoots, which aborted or died after initial development of the inflorescence. Interestingly, the mortality was lower in the CO<sub>2</sub> treated plots. This may be an effect of higher water use efficiency under elevated CO<sub>2</sub>.

The year 2009 was not as dry as the year before and we did not observed any significant treatments effects. However, we saw a lower amount of flowering shoots compared to the previous year. This study indicates the complexity of climate change effects on plant growth and phenology. Elevated CO<sub>2</sub> favoured the grass in years with dry spring whereas the combination of elevated temperature and drought in dry areas as heathlands had highly negative effect on development of flowers.

It also shows that climate change predominantly will affect ecosystem processes under extreme weather conditions with precipitation pattern as a very important factor.

**Title: Achieving Favourable Conservation Status for European heathlands - are heaths protected by the Habitats Directive?**

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**Talk**

The EC Habitats Directive was adopted by the European Union Member States in 1992 and later transposed into their national statutes. Its main aim is to promote the maintenance of biodiversity by requiring Member States to take protective measures to maintain or restore natural habitats and wild species of European importance at a Favourable Conservation Status (FCS). The Directive requires undertaking surveillance of those habitats and species and producing a report every six years on its implementation.

The last report was produced in 2007. This talk will summarise what were the requirements from the Member States and what information they submitted on the heathlands of the Atlantic region (habitat codes 4010, 4020, 4030, 4040, 4060, 4080 and 4090). We will highlight the areas where insufficient information was reported and the main causes for the habitats not meeting the FCS. This type of information has been produced as a summary for all habitats and species together (e.g. Spyropoulou, 2008) but as far as we are aware has not been presented for heathlands before.

Focusing in particular on the UK, we will describe how we are acting on the outcomes of the 2007 report for heathlands. This, together with identifying where current gaps on knowledge exist, will allow us to demonstrate some progress for the next reporting round in 2013.

Reference: Spyropoulou, R.S. 2008. The 2007 assessment of conservation status of species and habitats of European interest: Can restoration help? 6th European Conference on Ecological Restoration Ghent, Belgium, 8-12/09/2008

**Title: Combined effects of decreasing summer precipitation and nitrogen deposition on lowland heaths**

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**Poster**

Precipitation and nitrogen availability are key factors affecting plant growth. Climate change scenarios indicate an increasing risk for summer droughts in northern Germany due to less summer precipitation (10 to 30 % less in summer while the annual amount of rain remains constant). Nitrogen deposition is already a threat to species of habitats with low nitrogen availability. The project KLIMZUG-NORD aims to develop adaptation strategies to climate change in the metropolitan region of Hamburg. In the framework of this project a field experiment will be conducted in lowland heaths, but additional experiments will be carried out in ecosystems such as bogs and floodplain grasslands.

We carry out a two-factorial field experiment at two sites. We reduce summer precipitation by 25 % with rainout shelters and imitate nitrogen deposition by fertilization (equal to  $35 \text{ kg N ha}^{-1} \text{ a}^{-1}$ ). Further, we combine both treatments and install control plots. The experiment runs with 7 replicates per site. The two experimental sites are situated along a climatic gradient (one site under sub-oceanic and one under sub-continental climatic conditions) to determine if plants living under more continental conditions today are already pre-adapted to decreasing summer precipitation.

We hypothesize that nitrogen fertilization causes a shift from below- to aboveground biomass in plants which thus are more exposed to drought stress. As a consequence, we expect changes in plant growth, productivity and species composition. We assume that these effects will be more pronounced under sub-oceanic conditions. The experiment will result in recommendations for future nature management strategies for heathland ecosystems.

**Title: Soil nitrogen mineralization under field conditions in heathlands of Cantabrian Mountains**

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**Poster**

Heathlands dominated by *Calluna vulgaris* have a limited distribution in the northern mountain area of the Iberian Peninsula, mainly in the Cantabrian mountain range. Soils that support these heathlands are traditionally described as acid, nutrient poor, with net N mineralization and nitrification rates close to zero. These conditions are essentials to maintain this type of vegetation. Heathlands in the Cantabrian mountain range are classified as different community types associated mainly with soil characteristics (nitrogen and phosphorous content) and with the presence of herbivores, which allows an increase in species richness. We think that these types of heathlands are related to different N mineralization and nitrification rates because most plant-available N in soils is derived from the microbiological mineralization of N in soil organic matter and detritus. So, the purpose of this study was to estimate net mineralization of N and nitrification under field conditions in different types of *Calluna* heathlands.

We selected three different types of *Calluna* heathland: (1) two with high nitrogen content and high biodiversity; (2) two with low nitrogen content and biodiversity and (3) two with intermediate characteristics. To determine net soil mineralization and nitrification, we used the methodology proposed by Raison et al. (1987) based on sequential core incubation. In each area we established, at six different points, three PVC tubes (length 12 cm, diameter 5 cm) leaving 4 cm to facilitate extraction. The incubation was carried out over one year and was divided in three incubation periods: June-September, September-November and November-June. Soil humidity and temperature were measured in every incubation period. Finally, we studied the vegetation in all points where tubes were established.

There is a positive relationship between the highest values of N mineralization and the greatest richness of species. The areas with high biodiversity are associated with high values of  $\text{NH}_4$ , but not with  $\text{NO}_3$ .

This study was financed by the research projects ULE2004-04

**Title:** : Is the soil seed bank the main source of *Calluna* seeds in the regeneration of Cantabrian heathlands after burning and burning plus nitrogen fertilization?

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### Poster

*Calluna vulgaris* heathlands in the Cantabrian mountain (NW Spain) have been affected by different types of human land use and one of the most important was pasture. In the last few years the abandonment of grasslands has led to considerable changes in the management activities in these communities. Burning has been replaced by cutting and these new methods cause modifications in the characteristics of the plant community. *Calluna vulgaris* in these areas is very old and has lost the capacity to resprout, so the only regeneration mechanism is by seed germination. The main aim of the paper is to assess the species composition of the soil seed bank in *Calluna* heathlands after burning and burning plus nitrogen fertilization. We have tried to identify the potential of this soil bank to facilitate regeneration after perturbations.

We selected three *Calluna vulgaris* heathlands, where we established four permanent 20x20 m plots: (1) control plot, (2) fertilised plot (monthly fertilised with ordinary granules of ammonium nitrate, from June to October), (3) burned plot (experimentally burned in June 2005), and (4) burned plus fertilised plot.

We studied the species composition of the soil seed bank using the indirect method. Soil was sampled in each plot before experimental treatment and immediately after burning and burning plus fertilization with ammonium nitrate. At the same time we studied the number of seedlings of *Calluna vulgaris* and *Erica tetralix* in the field. The results showed a clear decrease after burning in the number of *Calluna vulgaris* and *Erica tetralix* seeds in the soil bank; however, there was a significantly higher number of *Calluna* and *Erica* seeds in the field after experimental treatments that could allow good regeneration.

This study was financed by the research projects JCYL LE021A08 and MCYT CGL2006-10998-C02-01/BOS.

**Title: Spatial distribution of carabid beetles (Coleoptera, Carabidae) in a shrub-mosaic landscape: singularity of *Calluna*-heathlands**

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**Poster**

Previous exploratory research pointed out that the carabid beetle (Coleoptera, Carabidae) assemblage inhabiting *Calluna vulgaris*-heathlands of the historically managed Cantabrian mountain range (NW Spain) is characterised by high species richness and the presence of several endemic species. However, no data have been gathered on the carabid assemblages dwelling in other typical shrub species-dominated ecosystems, adjacent to *Calluna*-heathlands. Thus, we aimed at investigating the spatial distribution patterns of these beetles in the continuous shrub-mosaic landscape of this mountain range, in order to determine the actual singularity of the carabid assemblage occupying the *Calluna*-heathlands.

We selected the main 4 types of shrub-dominated ecosystems in this region and 5 replicates (i.e. patches) per shrubland type: (1) *Calluna vulgaris*-dominated shrublands; (2) *Erica australis*-; (3) *Genista hispanica*-; and (4) *Genista florida*-. Beetles were collected by pitfall traps (15 per replicate, 300 in total) in June-October 2008. Generalised linear models (GLMs) were used to test for differences between shrub types at the carabid assemblage level (total species richness and abundance) and for individual representative species (i.e. collected with more than 25 specimens and from at least 5 of the replicates). Species composition similarity was determined by the complementarity index of Colwell and Coddington.

We captured a total of 69 carabid species and 2159 individuals. No differences were detected in terms of total species richness between shrub types, but significantly higher number of individuals was sampled from *Erica australis* shrublands. The most abundant species were *Calathus asturiensis* and *Cryobius cantabricus*, both endemic to this region. Thirteen of the 17 species tested responded significantly to the shrub type. *Calathus uniseriatus*, *Nebria asturiensis* and *Pterostichus cantaber* were mostly collected from *Calluna vulgaris* shrublands. However, other largely captured carabid



species from *Calluna*-heathlands were also greatly sampled in *Erica australis* shrublands (e.g. *Calathus asturiensis* and *Bradycellus ruficollis*). In general, complementarity values (i.e. dissimilarity) were high indicating low proportion of species shared between shrub types (especially in case of *Genista hispanica* shrublands), and great carabid species richness at the landscape scale.

This study was financed by the research projects JCYL LE021A08 and MCYT CGL2006-10998-C02-01/BOS.

**Title: Micronutrient limitation in heathland fauna as a result of nitrogen deposition**

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### Poster

Nitrogen deposition alters the vegetation composition of heathlands and thereby directs changes in faunal communities. Typically, plant and animal species are lost due to nitrogen deposition and a few species become dominant, e.g. grasses.

Management has been highly successful to restore heather-dominance at grass encroached sites, but the typical heather fauna does not recuperate in parallel with heather plants. Based on forest research, we hypothesised that nitrogen deposition results in a decline of plant quality for herbivorous insects, and that plant chemical composition can be as much a bottleneck for heather fauna as the total absence of food plants.

We studied the mineral and amino acid composition of Heather *Calluna vulgaris* in a range of different nitrogen deposition levels. The effect of chemical composition on fauna survival was studied in feeding experiments with Small emperor moth *Saturnia pavonia* caterpillars. Increasing nitrogen levels in heather plants coincide with lowered mineral concentrations of e.g. iron and nickel. Also, increased plant nitrogen did not correlate with plant amino acid concentrations. Apparently, excessive nitrogen is stored in a non-amino acid form, the identity of which remains to be revealed.

Mortality and developmental time of Small emperor moth caterpillars are both sharply increased on low quality high N-deposition heather plants. We have collected substantial evidence that nitrogen deposition alters the forage quality of heather plants and that this is a significant factor in the survival of heathland fauna. Details of plant chemistry and the nature of possible restoration measures still need to be further researched.

**Title:** Heathland management in military domains in Flanders (B)

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### Poster

Flanders (Belgium) is one of the most densely populated areas in Europe where heathland areas have become very scarce. Large interconnected areas of heathland are, however, still found in some military domains where landscape changes that generally took place elsewhere in the region during the 19<sup>th</sup> and 20<sup>th</sup> century, did not occur. However, lack of management and influences of atmospheric deposition caused deterioration of these remaining heathland vegetations and, by consequence, of the characteristic species associated with these vegetations.

Nowadays cooperation between the Agency for Nature and Forest of the Flemish government and the Ministry of Defence makes it possible to restore large areas of heathland and populations of associated endangered species on these military domains. This is, however, not an easy task and the remaining challenge is to select and implement the most suitable and effective conservation measures. Moreover conservation measures must integrate ecological and military goals.

In this contribution we will give some examples that indicate how a better understanding of species requirements and local ecosystem functioning (e.g. hydrology) is necessary to select the most suitable restoration measures. Selection of restoration measures is mainly based on a standard procedure that includes description of the actual state of the vegetation by fixed biotic and abiotic parameters, and comparing it to a 'reference state'. This comparison is essential for detecting possible bottlenecks and for assessing the potential for heathland restoration. However, implementation of the selected measures needs approval by the military and as such needs to be flexible and adaptive given the restrictions determined by the military use of the terrains.

**Title:** Re-creation of lowland heath on former arable farmland at Prees Heath Common Reserve in order to conserve a population of Silver Studded Blue butterfly

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### Poster

Commencing in 2006, Butterfly Conservation started work to create a new large area (>25 hectares) of lowland heath and acid grassland on existing arable land at Prees Heath Common, Whitchurch, Shropshire, UK. The existing small and fragmented areas of heathland on Prees Heath Common support the only remaining colony of the Silver-Studded Blue butterfly (*Plebejus argus*) in the English Midlands. A much greater area of heathland covered the site one hundred years ago and thus the heathland heritage provides a historical precedent for heathland creation. Silver-Studded Blue butterfly was once (60-80 years ago) much more common in Lancashire, Cheshire and Shropshire but loss of habitat was a significant factor in the decline of the species. Successional change in heathland, lack of grazing or other suitable management and habitat fragmentation have been responsible for local extinctions.

Historically Prees Heath Common Reserve had been heathland (known as Prees Heath or Whitchurch Heath) for several centuries at least and is a remnant of the previously extensive lowland heaths of north Shropshire. The site is registered as a common under the Commons Registrations Act, 1965 and historically has been used as common land with rights such as grazing of cattle, sheep, horses and goats, the collection of firewood and digging of sand and gravel.

A preliminary study of soil profiles at various sites within Prees Heath Common Reserve demonstrated that there was potential for restoration provided that the existing fertile topsoil developed by the former arable cropping regime could be replaced by underlying sand and gravel subsoils.

Phase I of the programme of heathland re-creation commenced in October 2006 when a soil survey was undertaken to inform the decision making about the re-creation of

heathland habitat. Hangars Field was selected as the area where the first phase of the project would be undertaken, involving deep ploughing to invert the existing soil profile to a depth of 900mm, followed by sulphur acidification treatment and spreading heather brash bearing ripe seed capsules of *Calluna vulgaris*. In order to reduce the pH of the upper sand horizon over a period of at least 24 months, and with the intention that pH would be reduced in the long-term, sulphur pellets were applied at a rate of 1.25 tonnes per hectare in August 2007. In November exactly 159 bales each weighing an average of 0.63 tonne were spread over an area of 6.47ha. This equates to 15.48 tonnes per ha and 24.6 bales per ha. Approximately 37,000 seeds of *Calluna* were spread per m<sup>2</sup>. Phase II commenced in autumn 2008 when part of the second area selected as a heathland re-creation site (East of Runway Field) was given a sulphur treatment and spread with heather brash using similar methods to Phase 1. The entire area of East of Runway Field had been deep ploughed previously in the first phase of the programme.

Regular monitoring demonstrated that soil pH had declined progressively from the initial pre-ploughing value (7.0) to a typical pH range for heathland (3.6-3.9) by 25th June 2008, a period of 20 months. Soil phosphorus concentration was reasonably low for heathland whilst soil Mg, Ca, K, NH<sub>4</sub>-N and NO<sub>3</sub>-N were all very low.

A census of *Calluna vulgaris* seedling population density made in October 2008 showed that the total mean density per m<sup>2</sup> was 24.95, although this masked a wide variation from 0 – 73.5 per m<sup>2</sup> for winter winter/spring 2008 germinators and 0 – 26 per m<sup>2</sup> for autumn 2008 germinators. In July 2009 maximum density of *Calluna* individuals exceeded 100m<sup>2</sup> in some sample plots.

The outcome was better than expected for colonisation of bare mineral substrate and compared favourably with other lowland heathland restoration sites in England known to the authors. The results suggest that there is an above average expectation that heathland (or a heathland /acid grassland mosaic) will develop successfully on Hangars Field over the next few years. There was other evidence that *Deschampsia flexuosa* (wavy hair grass) had established successfully on most parts of Hangars Field although the mean population density was less than for *C. vulgaris*. It is not yet clear what timescale will be required for Silver-Studded Blue butterfly to start colonising the new areas of heathland. Ongoing monitoring will reveal this in due course.

The wider significance of our approach to the re-creation of lowland heathland on former arable agricultural land for conservation of butterflies and other species will be

discussed in our presentation.

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