

# **16<sup>th</sup> EUROPEAN CARABIDOLOGISTS MEETING**

**Hotel Krystal, Prague, Czech Republic, September 22-27, 2013**

## **Carabids and man: Can we live with(out) each other?**

**Book of Abstracts with Conference Programme**

Edited by

**P. Saska, M. Knapp, A. Honěk, Z. Martinková**

Organised by

**Crop Research Institute**

**Faculty of Environmental Sciences, Czech University of Life Sciences**

**Administration of the České Středohoří Protected Landscape Area**



XVIth European Carabidologists Meeting

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Faculty of Environmental Sciences, Czech University of Life Sciences, Prague

Administration of the České Středohoří Protected Landscape Area, Litoměřice

Under auspices of:

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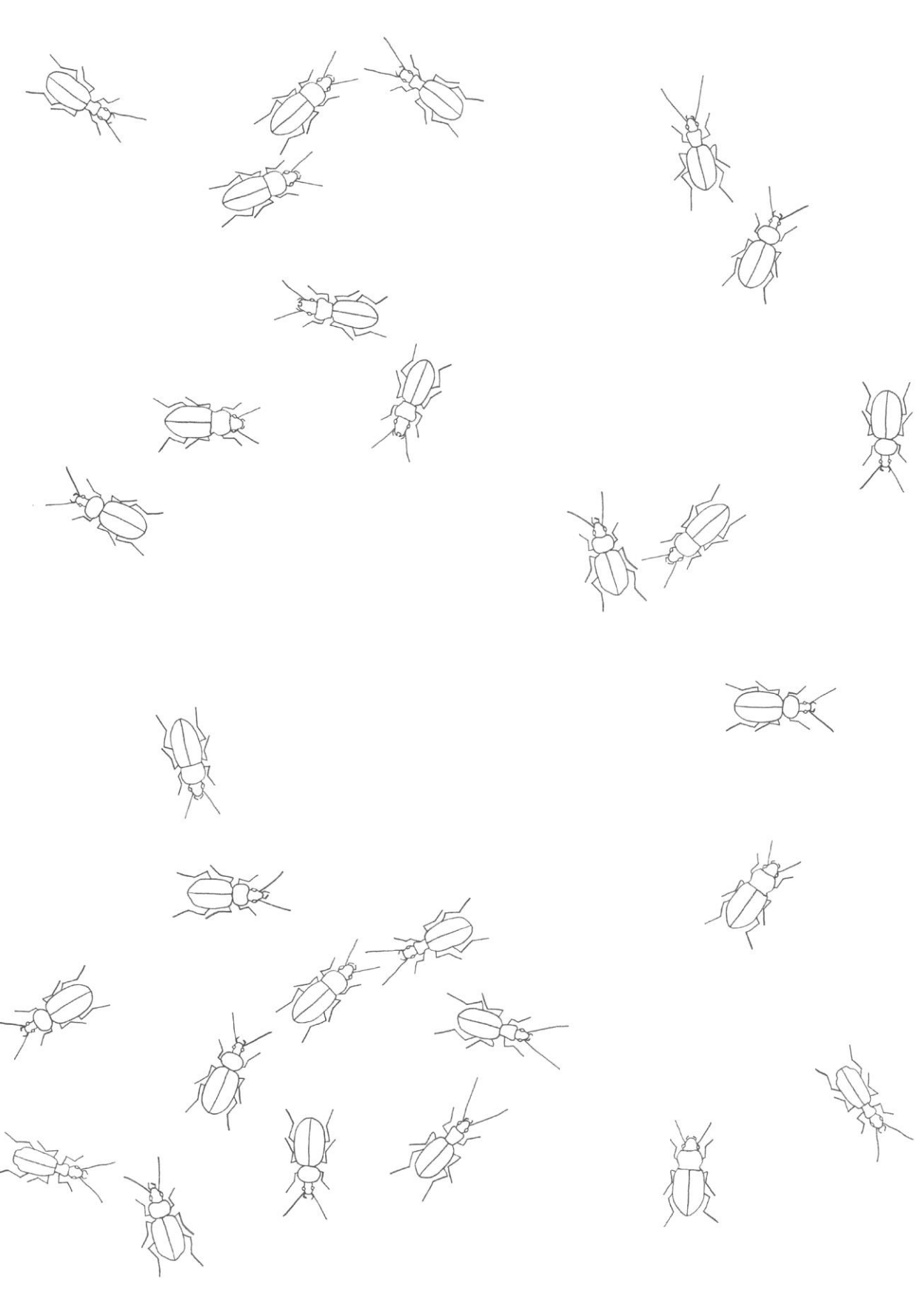
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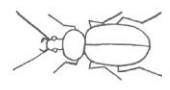
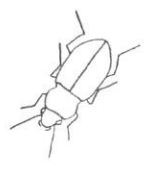
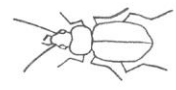
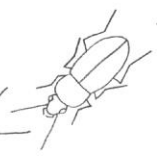
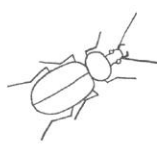
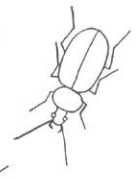
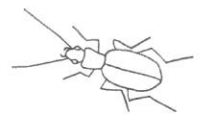
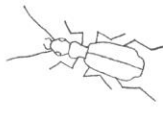
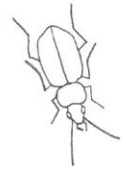
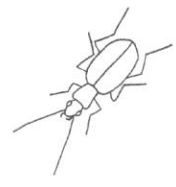
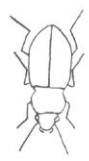
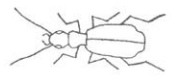
FRONT COVER: *Brachinus crepitans* (Linnaeus, 1758). Photo by Michal Knapp

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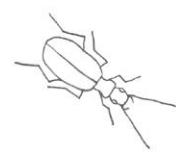
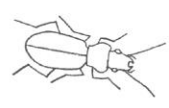
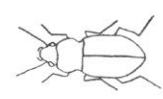
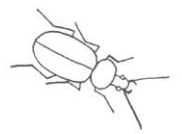
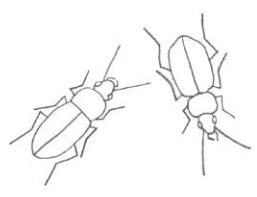
**List of Participants ..... 11**

**Abstracts ..... 16**





# PROGRAMME





## Sunday, 22<sup>nd</sup> September

17:00 - 21:00 Registration desk open in the hotel Krystal

## Monday, 23<sup>rd</sup> September

8:00 - 10:00 Registration desk open in the hotel Krystal

10:00 - 10:30 Opening ceremony

10:30 - 11:15 **Invited lecture:** Jonathan Lundgren - Complex interactions among seeds and the carabids that eat them (page **40**)

11:15 - 11:30 Coffee break

11:30 - 12:50 **Session 1** - POPULATION GENETICS AND BIOGEOGRAPHY (chaired by Claudia Drees)

11:30 - 11:50 Spatial genetic structure of a dominant carabid beetle, *Poecilus cupreus*, in an agricultural landscape - Gauffre B., Badenhausser I., Litrico I., Ribout C., Marrec R. (page **31**)

11:50 - 12:10 Excessive gene flow despite differences in male genitalia: A contribution to the lock and key hypothesis in Carabidae - Boutaud E., Drees C., Eisenacher D., Matern A., Assmann T. (page **21**)

12:10 - 12:30 Did sea level changes shape phylogeography of *Calomera littoralis* in Mediterranean? - Jaskuła R., Rewicz T., Grabowski M. (page **34**)

12:30 - 12:50 Multiple glacial refugia for two European *Carabus* species of cool montane habitats - Drees C., Homburg K., Brandt P., Husemann M., Assmann T. (page **27**)

12:50 - 14:00 Lunch

14:00 - 15:40 **Session 2** - DIETARY STUDIES ON CARABIDS (chaired by Jonathan Lundgren)

14:00 - 14:20 What do carabids have for dinner? – revealing the menu list using molecular analyses - Šerić Jelaska L., Vaughan I., Brown D., Symondson W.O.C. (page **52**)

14:20 - 14:40 Difference in trophic position and resource use between con-specific carabids: Isotopic study of seven common ground beetles on lake islands - Zalewski M., Dudek D., Godeau J.F., Kujawa K., Sienkiewicz P., Tiunov A., Ulrich W. (page **54**)

14:40 - 15:00 Influence of diet composition on the dynamics of stable isotopes in different tissues of ground beetles - Makarov K.V., Matalin A.V., Goncharov A.A., Tiunov A.V. (page **44**)

- 15:00 - 15:20 Seed predator carabids of the Italian fauna and evaluation for conservation of their life traits - Brandmayr P., Giglio A., Talarico F. (page **22**)
- 15:20 - 15:40 Predation of seeds and seedlings in *Atriplex sagittata*, a species with a distinctive seed polymorphism - Koprđová S., Martinková Z., Saska P., Honěk A. (page **33**)
- 15:40 - 15:45 Information about the excursion to the Divoká Šárka NPR and welcome drink
- 16:45 Excursion to the Divoká Šárka Natural Protected Reserve (optional)
- 19:00 - 21:00 Welcome drink at the Crop Research Institute

## Tuesday, 24<sup>th</sup> September

- 9:00 - 9:45 **Invited lecture:** John Holland - The spatial dynamics of carabid beetles from field to landscape and the implications for biocontrol of crop pests (page **32**)
- 9:45 - 10:00 Coffee break
- 10:00 - 11:40 **Session 3: AGROECOLOGY OF CARABID BEETLES** (chaired by John Holland)
- 10:00 - 10:20 Effect of land-use and tillage on the dynamics of a dominant carabid beetle *Poecilus cupreus* (L.) in Western France agricultural landscapes - Marrec R., Badenhauer I., Börger L., Gauffre B. (page **43**)
- 10:20 - 10:40 The spatial and temporal distribution of carabid beetles and weed seed predation in winter wheat: a comparison between conventional and conservation agricultural systems - Petit S., Trichard A., Ducourtieux C., Ricci B. (page **47**)
- 10:40 - 11:00 The effects of changing landscape and arable field management on the diversity of carabid beetles and their links with invertebrate crop pests - Brooks D.R., Bohan D.A., Chapman J.W., Firbank L.G., Kunin W.E. (page **24**)
- 11:00 - 11:20 Do differences in grazing pressure affect upland ground beetle (Coleoptera: Carabidae) assemblages? - Pozsgai G., Littlewood N.A., Pakeman R.J. (page **49**)
- 11:20 - 11:40 Effects of large grazers on ground-beetle communities in productive, man-made ecosystems - van Klink R., Vermeulen R., Smit C. (page **37**)
- 11:40 - 12:45 **Poster Session**
- 12:45 - 14:00 Lunch
- 14:00 - 16:00 **Session 4: CARABID ASSEMBLAGES IN FORESTS** (chaired by Emmanuelle Dauffy-Richard)



- 14:00 - 14:20 Do recover diversity and composition of indigenous ground-dwelling assemblages after fifty years of afforestation with native oak? - Tóthmérész B., Bogyó D., Mizser S., Nagy D., Magura T. (page **60**)
- 14:20 - 14:40 Carabid assemblages in pine stands disturbed by a hurricane in 2002: ten-years responses to hurricane impact (Piska Forest, Poland) - Skłodowski J. (page **57**)
- 14:40 - 15:00 Species composition and structure of carabid assemblages along the clear-cut originated succession gradient in pine forests - Aleksandrowicz O., Marczak D. (page **17**)
- 15:00 - 15:20 Changing climate associated with homogenization of forest assemblages of boreal ground beetles (Coleoptera: Carabidae) - Spence J.R., Bourassa S. (page **59**)
- 15:20 - 15:40 Restoration as a forest-management tool in Northern Europe: effects on carabid beetles - Koivula M., Toivanen T., Heikkilä T. (page **39**)
- 15:40 - 16:00 Ancient forest species: does the concept apply on carabids? An example in pine and oak forests in French lowlands - Dauffy-Richard E., Fleury J., Martin H., Bergès L., Dupouey, J.L. (page **25**)
- 16:00 - 16:30 presentation of the České středohoří Landscape Protected Area
- 16:30 - 16:35 Information about the excursion on Wednesday

## Wednesday, 25<sup>th</sup> September

Full day (ca. 8:30 - 18:00) excursion to the České Středohoří Landscape Protected Area and the town of Žatec, the capital of hop

## Thursday, 26<sup>th</sup> September

- 9:00 - 10:40 **Session 5: WHAT DRIVES THE VARIABILITY IN CARABID LIFE HISTORY TRAITS?** (chaired by Roberto Pizzolotto)
- 9:00 - 9:20 Functional diversity and life-history traits of carabid beetles in agricultural systems - Stockan J.A., Pakeman R.J., Baird J., Young M.R., Iason G.R. (page **59**)
- 9:20 - 9:40 Influence of the production system on life history traits of carabid beetles - Marie A., Plantegenest M. (page **42**)
- 9:40 - 10:00 The effect of abandonment of mountain meadows on assemblage structure and life traits of ground beetles (Coleoptera, Carabidae) - Skalski T., Armatys P., Kędzior R. (page **55**)



- 10:00 - 10:20 Responses of ground beetle assemblages to forest management in Japan – a study on beetle ecological traits - Shibuya S., Kikvidze Z., Toki W., Kanazawa Y., Suizu T., Yajima T., Fujimori T., Mansournia M., Abdelrahman S., Kubota K., Fukuda K. (page **53**)
- 10:20 - 10:40 Carabid species traits along an altitudinal gradient in the Dolomites (Italy) - Pizzolotto R., Albertini A., Gobbi M., Brandmayr P. (page **49**)
- 10:40 - 10:55 Coffee break
- 10:55 - 11:40 **Invited lecture:** Andrea Di Giulio - Morpho-functional and behavioral studies on the flanged bombardier beetles (Carabidae: Paussinae) (page **25**)
- 11:40 - 12:45 **Poster Session**
- 12:45 - 14:00 Lunch
- 14:00 - 16:00 **Session 6: FASCINATING CARABIDS** (chaired by Andrea Di Giulio)
- 14:00 - 14:20 The influence of *Humulus lupulus* on some physiological indicators of carabid beetle *Platynus assimilis* - Kivimägi I., Ploomi A., Jõgar K., Sibul I. (page **37**)
- 14:20 - 14:40 Integrative taxonomy in the subgenus *Mesocarabus* (Carabidae, Carabus) - Serrano J., Gómez-Zurita J., Andújar C. (page **53**)
- 14:40 - 15:00 The genus *Notiophilus* Dumeril, 1806 (Coleoptera: Carabidae) in fauna of Central Asia - Barševskis A. (page **18**)
- 15:00 - 15:20 Elytral surface structure in *Poecilus lepidus*: What about inheritance? - Mossakowski D., Paarmann W. (page **45**)
- 15:20 - 15:40 Effects of pitfall trap lid transparency and habitat structure on the catches of carabid beetles (Coleoptera: Carabidae) in tame pasture - Bell A.J., Phillips I.D., Floate K.D., Hoemsen B.M., Phillips C.E. (page **19**)
- 15:40 - 16:00 The explosive defensive system of paussine and brachinine bombardier beetles (Coleoptera Carabidae): comparative morphology and ultrastructure - Di Giulio A., Muzzi M., Romani R. (page **46**)
- 16:00 - 16:05 Information about the evening reception
- 19:00 - 22:00 Reception at the Valencia boat, with pleasure cruising on the Vltava river

## Friday, 27<sup>th</sup> September

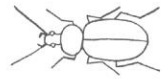
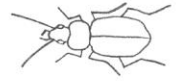
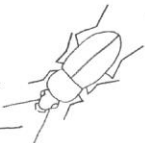
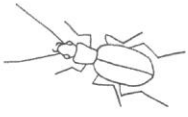
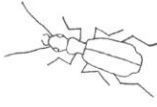
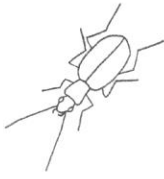
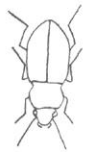
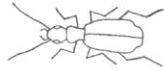
- 9:00 - 10:20 **Session 7: SPATIOTEMPORAL PATTERNS IN CARABID ASSEMBLAGES** (chaired by Lucija Šerić Jelaska)
- 9:00 - 9:20 High concordance in the dispersal abilities of distant *Carabus hungaricus* populations in Central Europe - Elek Z., Bérces S., Drag L., Pokluda P., Čížek L. (page **29**)



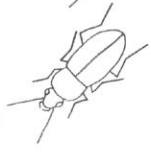
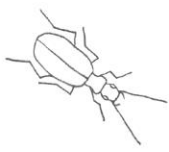
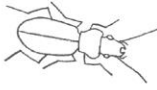
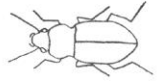
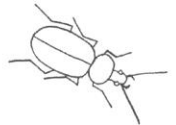
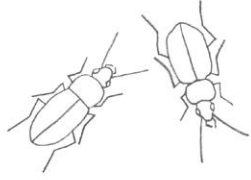
- 9:20 - 9:40 Carabid beetle assemblages above and below the treeline in the Dolomites (Italy) after thirty years (1980 - 2009) - Pizzolotto R., Gobbi M., Brandmayr P. (page **48**)
- 9:40 - 10:00 Impact of climate change on suitable habitats for ground beetles in beech forests on karst - Jelaska S.D., Vujčić-Karlo S., Šerić Jelaska L. (page **35**)
- 10:00 - 10:20 Edge effects on carabid beetles (Coleoptera; Carabidae) across forest-meadow ecotones of Dinaric beech-fir forests - Brigić A., Starčević M., Vujčić-Karlo S., Hrašovec B. (page **23**)
- 10:20 - 10:35 Coffee break
- 10:35 - 12:15 **Session 8: ANTROPOGENIC EFFECTS ON CARABID FAUNA** (chaired by Axel Schwerk)
- 10:35 - 10:55 The habitat-specific effects of highway proximity on ground beetles: implications for biodiversity conservation - Knapp M., Saska P., Knappová J., Vonička P., Moravec P., Kůrka A., Anděl P. (page **38**)
- 10:55 - 11:15 The impact of the construction and renovation of the Skepe bypass on the carabid beetles fauna - Dymitryszyn I. (page **28**)
- 11:15 - 11:35 Quantifying predation pressure by using artificial caterpillars along an urbanisation gradient in Denmark - Ferrante M., Lo Cacciato A., Lövei G.L. (page **30**)
- 11:35 - 11:55 Carabid Assemblages of Semi-Natural Grassland Habitats in Helsinki - Venn S.J. (page **61**)
- 11:55 - 12:15 Changes in carabid beetle fauna (Coleoptera: Carabidae) along a successional gradient on post-industrial areas in Central Poland - Schwerk A. (page **51**)
- 12:15 - 13:00 Closing ceremony
- 13:00 - 14:00 Lunch

## Saturday, 28<sup>th</sup> September – Sunday, 29<sup>th</sup> September

Post-meeting tour to Český Kras and Kokořínsko Protected Landscape Areas (optional)



# LIST OF PARTICIPANTS





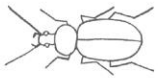
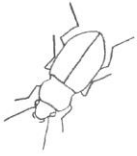
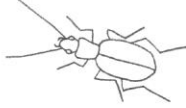
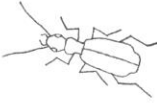
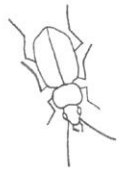
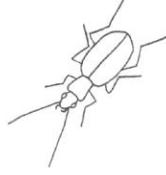
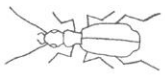
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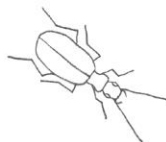
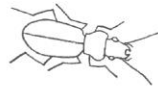
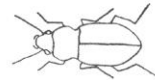
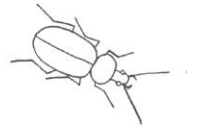
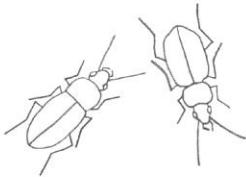


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**ABSTRACTS**





## Species composition and structure of carabid assemblages along the clear-cut originated succession gradient in pine forests

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Carabids assemblages were studied for 3 years to explore changes in their structure and species composition during a forestry cycle in the Nerwik (NE Poland). Native pine forest was clear-cut and replanted. Recently planted (2, 3, and 5 years old), young (16 years old), middle-aged (30 and 45 years old) and old pine forests (60, 80, 100 and 135 years old) were studied using pitfall traps. Our results showed that the species richness of carabids was significantly higher in the plantations than in the native pine forest.  $\beta$ -diversity of the 5 year old plantations was the highest. The abundance of the open habitat species remarkably increased on recently established plantations. Carabid assemblages typical for forests were observed in 16-years old forests and older ones.

## Small-scale spatiotemporal variability in body size and body condition of *Anchomenus dorsalis* in agricultural landscape

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Adult body size is one of the most ecologically relevant quantitative traits that determine many other traits of particular organism, including ecological, physiological and ethological ones. There are two different measures of body size: structural body size (e.g. elytron length) and body mass. In carabids, structural body size is determined during preimaginal development, whereas body mass is substantially affected by environmental conditions experienced by adults. Body condition, representing energetic reserves of an animal, is computed as body mass corrected for structural body size. This study investigates variability in structural body size and body condition of carabid *Anchomenus dorsalis* in time and space on small scale. The beetles were collected in four fields near Prague-Suchdol in autumn 2009 and 2010, and in spring 2010, 2011. Structural body size was significantly affected by sex (females are larger in comparison to males) as well as by field identity, overwintering (post-overwintering individuals collected in spring were larger in comparison to pre-overwintering individuals collected in autumn) and overwintering $\times$ year interaction. Our results suggest that particular fields and sampling years differed in environmental conditions experienced by *A. dorsalis* during larval growth, which results in differences in adult structural body size. Mean structural body size in *A. dorsalis* was also affected by overwintering, which was probably caused by size-specific winter mortality. Moreover, the effect of overwintering varied among years,



probably according to the specific weather conditions during particular winter. Body condition of *A. dorsalis* was affected mainly by overwintering and partially by field and year.

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## The effects of fire on carabid beetle diversity on a western Norwegian heathland

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Heathlands are a cultural landscape spanning 3600 kilometers of the western coast of Europe, and Norway is home to roughly one third of this longitudinal range. Due to the discontinuation of traditional management methods, heathlands have become a threatened nature type. As prescribed burning is such an effective and widespread method in heathland management, it is important to understand its effects on every part of the heathland landscape. So far, the bulk of research has been on the response of heathland flora to burning, however, the response of insects to fire is relatively unknown. This study focusses on carabids in different stages of *Calluna* heathland on Lygra, Western Norway. We are interested in the species composition and diversity of carabids in relation to the time since the last burning event, and aim to identify species that are characteristic of heathland in Norway. In total, 1968 individuals of 32 species were trapped between May and September of 2012. Preliminary results suggest that burning promotes the presence of more rarely occurring species, as well as improves diversity, and that carabids return quickly to burnt areas after fire. Commonly found species were *Carabus nemoralis*, *C. problematicus*, *C. violaceus*, *Poecilus cupreus*, *Pterostichus melanarius*, *P. niger* and *Nebria salina*. While most of these species have a high dispersal ability, species with low dispersal abilities, such as *Amara lunicollis*, *Notiophilus aquaticus* and *Pterostichus diligens*, were also recorded in newly burnt areas. *Loricera pilicornis* and *Cicindela campestris* were among the species found only in recently burnt heath.

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## The genus *Notiophilus* Dumeril, 1806 (Coleoptera: Carabidae) in fauna of Central Asia

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The genus *Notiophilus* Dumeril, 1806 (Coleoptera: Carabidae) is distributed in Holarctic region and northern part of Nearctic region. The world fauna includes 60 known species, and most diversity is found in Central Asia – 44 species, from these 22 are endemic. There are 21 taxa (17 species, 4 subspecies) from Asia described as new for science in last 30 years, for three taxons the status is changed. Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan) is one of these regions where the proportion of endemic species of genus *Notiophilus* is high, and the research of fauna of this genus is not completed. The goal of our research was to determine the composition of species for the genus *Notiophilus* as well as to specify the ranges of these species in region of Central Asia. The research is based on analysis of materials from more than 60 museums and private collections around the world. There are more than 5000 specimens from this genus processed. The results of research show that there are 12 species from the genus *Notiophilus* found in region of Central Asia, from these 8 species belongs to chorotype of Centralasiatic, one species belongs to Turanian chorotype, but three species which are found mostly in North-East of Kazakhstan are with Eurosiberian or even wider distribution. Nine species (75%) are endemic to Central Asia with narrow Dzhungaro-Tianshanian or Kopet–Daghian distribution. The distribution of *N. persicus* Breit is adjusted, and this species is indicated in Turkmenistan. The type of obscure species *N. ovalis* Breit is investigated, and doubts are dispelled about status of this taxon. The DNA analysis shows that *N. semenovi* Tschitsch. is separate species. There are proposed to change the taxonomic status of *N. sublaevis hiemalis* Sem. & Arn. after the study of holotype. The unique key for determination of the genus *Notiophilus* species found in Central Asia is developed for the first time. Illustrative materials and other information about species of this genus could be found in: [www.carabidae.org](http://www.carabidae.org).

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## Effects of pitfall trap lid transparency and habitat structure on the catches of carabid beetles (Coleoptera: Carabidae) in tame pasture.

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Pitfall traps are one of the most common methods for sampling surface-active invertebrates because they are inexpensive, easy to install, and capable of catching large numbers that provide good datasets for statistical analysis. Captures of insects in pitfall traps are affected by features of trap design that may confound the interpretation of data. One such feature is the lid



suspended over the opening of the trap to keep out debris and rainwater. In this study, we tested whether use of these lids affected captures of carabid beetles by altering the light conditions at the opening to the trap. In one experiment, we examined the effects of lid transparency (opaque, semi-transparent, transparent) on catch rates. In a second experiment, we manipulated the heights (high, medium, low) of vegetation adjacent to the traps to test for lid transparency and vegetation height interactions. In Experiment 1, significantly more carabids were captured with use of transparent lids. In Experiment 1 and 2, fewest *Agonum cupreum* Dejean, 1831 were captured in traps using opaque lids. No other effects were detected. Given these results, we advocate the use of transparent lids which provide the benefits of traditional opaque lids while minimizing the effects of lid use on light conditions at the opening to the trap.

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## Individual- and season-specific movement patterns affect the population density estimations for ground beetles

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Animal especially insect movement is not a linear process and there are several assumption in ecology to study its effects on the population density estimations. This study focuses on the estimation of population density from trapping data, given the extensive use of trapping grids and their appeal as a sampling tool and also present the most fundamental elements of movement characteristics for density estimations. The capture-recapture data of the highly endangered ground beetle *Carabus hungaricus* was used for those estimations, which was collected on the Szentendre Island, Hungary between 2010 and 2012. The population density was estimated by spatially explicit capture-recapture models. These methods fits separate probability models for the distribution of animals (as a spatial point process) and for the observation process. The detectors (i.e. traps) are considered as grid with 3.2 m average spacing for 270 sampling points. Around the grid a so-called mask area were fitted in order to exclude the migration effects from the models. The model estimates the density (D) and the detection ( $g_0$ ,  $\sigma$ , and  $z$ ). The probability of the detection ( $z$ ) by distance was estimated by the half-normal function. Two models were fitted into capture data, first the null model where the parameters are constant ( $D \sim 1$ ,  $g_0 \sim 1$ ,  $\sigma \sim 1$ , half-normal) and the learned response ( $D \sim 1$ ,  $g_0 \sim b$ ,  $\sigma \sim 1$ , half-normal) where the detection probability affects the subsequent detection. We found that the density and the home range were season- and individual-specific; resulting in average  $12 \pm 1.3$  individual per hectare. The average home-range for an individual was  $4.1 \pm 3m$ -radius circle. We found that the trapping grid is an effective tool for mark-recapture studies, however the spacing of the traps may influence the home range estimations.

## Distribution pattern and habitat types of Natura 2000 (Habitats Directive Annex II.) Carabidae and Rhysodidae in Hungary

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Hungary has a high responsibility for conserving the habitat types and species unique to the Pannonian Biogeographic Region of the Natura 2000 network. Pannonian Biogeographic Region is surrounded with the Alpine and the Continental Biogeographic Regions. Besides continental and a few alpine elements, Mediterranean and steppe species are also present in the region. In Hungary, four *Carabus*, two *Duvalius* and one *Rhysodes* species listed in the Natura 2000 Habitats Directive Annex II. are present. These species inhabit various habitats such as steppe (*C. hungaricus*), forest (*C. hampei*, *C. variolosus*, *C. zawadzki*, *Rhysodes sulcatus*) and caves (*D. gebhardti*, *D. hungaricus*). Our goal was to gather all the available information about these species. A GIS database was built from the occurrence data, which prompted us to develop distribution maps. A comprehensive list of the habitat types of the species were listed and identified as Natura 2000 (Habitats Directive Annex I.) habitat types. The short description of the species occurrences including new locations and data about the estimated population size is also implemented. Factors considered as threats for species and their biotopes are identified to harmonize the conservation efforts over the countries. We suggest the Natura 2000 network in Hungary cover all the key areas for an effective conservation effort for Carabidae and Rhysodidae species listed in the Habitats Directive Annex II.

## Excessive gene flow despite differences in male genitalia: A contribution to the lock and key hypothesis in Carabidae

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One of the most general evolutionary trends in animals with internal fertilization is the rapid divergent evolution of male genitalia. The lock and key hypothesis, which postulates that the difference in male genitalia prevent species from hybridizing, appears to be an effective mechanism in the genus *Carabus*. Allopatric taxa of *Carabus violaceus*, Linnaeus 1758, show



clear differences in male genitalia. This is especially true for *Carabus violaceus violaceus* and *C. v. purpurascens* which have a secondary contact zone in northern central Europe in the eastern lowlands of Lower Saxony. Morphological trait such as aedeagus and elytral sculpture, allozymes and mtDNA marker (CO1) were employed to estimate the occurrence of gene flow and all of them show congruent patterns: Both taxa exhibit excessive gene flow despite significant differences in aedeagus features and all markers are independent from each other at least in the hybrid zone. The taxa have a geographically large hybrid zone supporting the assumption of introgressive hybridization. As Hardy-Weinberg-equilibrium is predominantly fulfilled there is no evidence for a selection pressure against hybrids. As a consequence, species delineation based on genital morphology is questioned, at least for the *Carabus* genus. Moreover, phylogenetic analysis revealed high pairwise sequence divergence between haplotypes clustering on three well supported clades. Sequence divergence suggests the separation of *C. violaceus* haplotype during the transition between the Pliocene and the Pleistocene epochs.

## Seed predator carabids of the Italian fauna and evaluation for conservation of their life traits

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Several species of carabid beetles are important postdispersal predators of the seed of herbaceous plants. The preference of carabids for particular seeds differ, but the factors that determine their choice are little studied. The seed predator carabids of the Italian fauna belong to the tribes Zabrinini, with two genera, and to all Harpalinae (sub)tribes, from Anisodactylini to Ditomina. Data of dissections, observed in nature, rearing and “cafeteria” experiments, are collected here for the first time, including experimental evidence performed in other European countries. A small database concerning more than 10 genera has been constructed. A first overall look at the best known genera enables us to separate merely phytophagous (spermophagous) taxons from phytozoophagous “omnivores”. Strictly adapted seed devourers are found in the Ditomina and in the taxa around *Ophonus* and *Cryptophonus*. Most Ditomines feed on Umbrelliferae seed and sometimes accumulate seeds in a pedotrophic nest. The mixed diet is most found in Anisodactylini, in *Parophonus* and *Trichotichmus*, *Acinopus*, all taxa around *Harpalus*, *Pseudophonus*, and Stenolophini. In some cases an omnivorous diet is accompanied by a marked specialization on the seeds of some plants. *Bradycellus ganglbaueri* is perhaps the best known case for Italy, the predatory adults strongly prefer the *Satureja* seeds and on this way also the habitat choice is determined. Concerning evaluation for conservation, we suggest to distinguish between strict phytophagous species, that live most in natural or seminatural habitats, pastures, steppes, and omnivorous species, that behave more opportunistic and are frequent also in cropland and man made habitats.

## Soil features and spatial distribution pattern of larval burrows of *Calomera littoralis nemoralis* (Olivier, 1790) (Coleoptera: Carabidae: Cicindelinae) in a coastal habitat

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*Calomera littoralis nemoralis* is a tiger beetle living on sandy river banks and sea shores. In Italy as well as in other geographical areas the species is endangered. Females lay eggs in the sand and the larvae dig a burrow which emerges on the surface of the sand by a steep vertical pit. The larvae feed on insects and they draw back into their dens when the temperature drops. With this study we aim to investigate the distribution pattern of tiger beetles burrows along beaches (or river banks) in southern Calabria using the “quadrat count method”. The spatial analysis of the sampled data was performed using QGIS. The data obtained from GIS analysis were compared with structural and physical properties of the soil, in order to correlate them with the spatial distribution of *C. littoralis* burrows. The spatial distribution of the burrows in the sampling area is characterized by a 265 points clustered into classes (N =24). The QGIS analysis shows a significant difference in the distribution of the burrows within the cells with a clear relationship between their presence and microclimate and granulometry of the soil. Females of *C. littoralis* prefer humid sandy shores with fine grain size mainly to preserve their offspring from dehydration but also to ensure greater food availability.

## Edge effects on carabid beetles (Coleoptera: Carabidae) across forest-meadow ecotones of Dinaric beech-fir forests

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Carabid beetles were studied across forest-meadow ecotones of Dinaric beech-fir forests, in the Gorski Kotar region of western Croatia in April-September 2009. Beetles were collected by pitfall traps along gradients that extended 60 m from the forest edge into the forest interior and 60 m into the meadow. A total of 20,526 individuals belonging to 66 carabid beetle species were recorded. No edge effect was found at the carabid beetle assemblage level, i.e. species richness and diversity were not statically significantly higher in the ecotones as compared to the forest interior and meadow. However, an edge effect was detected at the species level and at the level of species ecological traits. Therefore, both positive and negative responses of carabid species towards the ecotones were observed. Furthermore, embedded forest edges acted as barriers for most open habitat species, while for some forest species they acted as



filters. Carabid assemblages in the ecotones were more similar to assemblages in the forest interior than to assemblages in the meadows. Soil temperature, soil humidity and canopy openness did not differ significantly between ecotones and forest interior, providing stable microclimate conditions for the carabid assemblages of the forest interior. Therefore, forest specialists occurred all the way to the forest edge. It appears that vegetation structure and edge ages play a key role in determining the spatial pattern of carabid beetles across forest-meadow ecotones.

## **The effects of changing landscape and arable field management on the diversity of carabid beetles and their links with invertebrate crop pests**

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Carabid beetles have important functional roles within agro-ecosystems, including regulating pests that reduce crop yields. Such ecosystem services may become increasingly valuable for maintaining food security under demands for increased agricultural productivity, especially as supplies of cheap chemical pesticides are likely to diminish. Therefore, carabids could contribute to a portion of farmland biodiversity that is indispensable in re-shaping agricultural systems to meet mankind's future needs. Much is already known about how the disturbance associated with farming leads to both negative and synergistic interactions with carabids. However, increasing food production within intensified, but sustainable, farming systems is likely to be expedited by increased knowledge of how carabids and man interact to affect crop yields. In particular, we need to understand better how the widescale management of landscapes influences any aspects of carabid biodiversity that have strong and demonstrable links to the provision of ecosystem services. We will present analyses investigating the relationship between landscape variation and carabid communities at a national scale in Great Britain. In particular, we will show that the functional diversity of carabids is correlated with landscape composition and management. The wider consequences of this relationship are assessed, particularly how changes in landscape parameters and arable management affect links between carabid functional groups and their invertebrate prey. Such influences on the correlation between carabids and major pest taxa, such as aphids, slugs, seed weevils and pollen beetles are presented, within the context of relationships with other important invertebrate components of their food webs, such as Collembola.

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## Ancient forest species: does the concept apply on carabids? An example in pine and oak forests in French lowlands

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In the past two centuries, the surface area covered by forests nearly doubled in France due to forest colonisation of abandoned agricultural lands. Numerous studies on flora showed that these recent forests do not have the same conservation value as ancient ones, since they are poorly recolonized by ancient woodland forest species. Because of their restricted ecological affinities and their rather limited dispersal power, forest specialist species of ground beetles might also need historical continuity of forests to persist in such ecosystems. To investigate this question, we compared carabid assemblages in ancient and recent forests, both represented by pine or oak stands, in Orléans State forest and surroundings. Ancient forests were mapped in GIS based on the first military map of France (1840). Carabids were trapped on a 52-plot sampling design, stratified on forest past land-use and tree-species composition, using 3 pitfall traps per plot, during 4 one-month periods (mi-April to mid-July and early September to early October 2011). The following hypotheses will be tested on the available data set: (i) some species are more abundant in ancient than in recent forests, (ii) forest specialist species richness is higher in ancient forests than in recent ones, (iii) the effect of past land-use change is stronger in oak forests than in pine forests. Depending on the highlighted patterns, we might be able (i) to confirm and extend the list of candidate species of ancient forests for carabids and (ii) to conclude on the possible application of this list in coniferous stands.

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## Morpho-functional and behavioral studies on the flanged bombardier beetles (Carabidae: Paussinae)

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Paussinae, known as flanged bombardier beetles, are a monophyletic subfamily that includes about 750 described species mainly distributed in tropical regions. They share a unique type of larva with a peculiar terminal disk at the end of an up-curved abdomen, and an explosive defensive strategy that parallels that of brachinines. Most paussines have broken the



communication code of the ants they live with, and they are tolerated as social parasites in the nest where they feed on ant brood and lay their eggs. Larvae of the beetle also develop in the host ant nest. Adaptations to a life with ants have resulted in the evolution of amazingly modified structural and physiological features, in both larval and adult stages, as well as extraordinarily refined strategies of communication that redirect the ant's behavior. New findings show an unexpectedly complex array of myrmecophilous strategies that can be tackled only by an integrated, multidisciplinary approach. My research combines studies of behavior, chemistry, acoustics, and functional morphology to gain insight into the mysteries of how these beetles are able to solicit beneficial behaviors from their hosts.

### **Sophisticated acoustical mimicry between a myrmecophilous carabid beetle (Paussini: *Paussus favieri*) and its host ant (Myrmicinae: *Pheidole pallidula*)**

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Animals use a variety of sounds for communicating. Acoustic communication is well known among vertebrates, whereas it seems restricted to few invertebrate groups that use acoustic signals mainly as a species-specific recognition system to assist mating. However, it has been recently discovered that caterpillars of a butterfly (*Maculinea*) that lives in ant nests are able to mimic the acoustic signals of their queen host ants. *Maculinea* caterpillars are not an isolated case. We found an even more surprising case of acoustic mimicry in insects. Here we show the ability of an ant nest beetle, *Paussus favieri* (Coleoptera: Carabidae: Paussini), in mimicking host ant, *Pheidole pallidula*, stridulations. The presence of stridulatory organs in Paussini has long been known, but the significance of their stridulation has remained a matter of speculation. The sound analyses revealed that *Paussus* has a repertoire of three melodies, in contrast with the monotonic stridulation pattern of *Maculinea*. *Paussus* melodies correspond to sounds produced by different ant castes (queen, workers and soldiers). This ant parasite uses a single, anatomically simple structure to "speak" different "languages" by modulating the emissions of three types of pulses. In particular, by mimicking the queen's stridulations the beetle can elevate its social status to solicit more effective cares, and to acquire free access to the nest. *Paussus* is the only known case of an invertebrate with a complex repertoire of acoustic signals among which it can choose according to its needs.

## Chemical strategy used by ant nest beetle *Paussus favieri* (Carabidae: Paussini)

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Among ants, recognition cues are mainly chemical. A cocktail of hydrocarbons provides a chemical signature, allowing workers to discriminate between kin and intruders. Many insects are strongly attracted by the valuable resources present in ant colonies, and myrmecophiles have several adaptive strategies to avoid or deter ant attacks. Myrmecophilous insects can break the recognition code of their host by being chemically insignificant or by using chemical mimicry or camouflage. The carabid subfamily Paussinae is among the largest myrmecophilous group, but the mechanism by which they have cracked the code of their hosts is still unknown. We investigated the chemical strategy adopted by *Paussus favieri* to live in host ant colonies of *Pheidole pallidula*. Our analyses show that the cuticular hydrocarbon profile of the beetle is a subset of the more complex profile of the ants, sharing more than 20 hydrocarbons. The relative proportions of the compounds in common are very different, and for this reason the PCA analysis shows that the chemical identities of beetles and ants are clearly distinct. However, *P. pallidula* are not aggressive towards *P. favieri* as suggested by the behavioral experiments; indeed, the beetles are continuously touched and actively licked, especially on the glandular antennae. In this ant-parasite system, we suggest that “chemical insignificance” and “camouflage” are unimportant, but the incomplete/imperfect chemical mimicry used by *P. favieri* is key to integrating into the ant colony, likely reinforced by the spreading of attractive antennal secretions.

## Multiple glacial refugia for two European *Carabus* species of cool montane habitats

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Many species survived the Last Glacial Maximum in classical refugia, such as the southern European peninsulas, which then acted as source populations for post-glacial colonization processes. Only recently, some studies have provided evidence for additional northern glacial refugia. In order to test whether ground beetle species also utilized refugia, classical or other, we combined species distribution modeling methods (SDMs) with mtDNA phylogeographic



analyses. We investigated two cold-adapted, stenotopic, flightless ground beetle species, *Carabus irregularis* and *Carabus sylvestris*, which are both disjunctively distributed across mountainous areas in central and eastern Europe. The past and present distributions of both species were modeled using MAXENT. We analyzed two mitochondrial genes in 91 *C. irregularis* and in 140 *C. sylvestris* individuals to reconstruct the phylogeographic relationships between populations across the distribution range. For *C. sylvestris*, allozyme polymorphism data were also analyzed. The SDMs suggest both classical and non-classical refugia for both species, including north of the Alps and in the Carpathians. The genetic data show similar results, with high genetic diversity in most of the proposed refuge areas. In both species, the Carpathian populations are not only genetically distinct from the central European ones, but are also grouped in separate sub-species based on morphological differences. The congruent results of both approaches confirm the assumption of multiple glacial refugia for the studied species and the usefulness of combining methods from different disciplines for understanding the biogeographic history of species.

### **What drives genetic diversity in *Abax parallelepipedus*? A case study across Germany**

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While the effect of land use management on species diversity is well studied, the effect on other levels of biodiversity, such as genetic diversity, remains poorly understood. We have collected 143 populations of the stenotopic, flightless ground beetle, *Abax parallelepipedus*, from the forest plots of the Biodiversity Exploratories, which represent the major forest management strategies and tree types found in central Europe. We developed a suite of 14 polymorphic microsatellite markers for this species and sequenced 24 individuals from each of these populations. The three Exploratories show differing levels of genetic differentiation and allelic richness, allowing us to explore how the local habitat parameters influence contemporary patterns, including forest age. We analyze how the current biotic and abiotic factors are related to genetic diversity. This allows us to understand the drivers maintaining genetic diversity at a stenotopic, forest beetle and how genetic diversity relates to other layers of biodiversity.

### **The impact of the construction and renovation of the Skępe bypass on the carabid beetles fauna**

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The aim of the research was to define the impact of the construction and renovation of the Skępe town bypass on the environment and the cenosis of the carabid beetles. A four-year research was based on catching sample beetles with the use of 36 traps. The traps were functioning in 2008 and later from 2010 to 2012, after renovation works of the road and were placed in 100-year-old pine tree stand, in the environment of wet peatbog around the local watercourse, as well as field bounds formed on the agricultural bonitation 4<sup>th</sup> class soil and also on the roadside verges. The collected material was defined in terms of the species and the species dominance and then the correspondence analysis was carried out. According to the data of the year 2008, the positions on the sides of the road located in the forest areas are separated from the positions on the sides of the road located by the fields. This means that the conditions of the sides of the road, 20 years after the construction, are formed not only by the regular maintenance, but are also under the influence of the surrounding environment edge effect. While comparing the data from the year 2008 and the years 2010-2012, there is a visible withdrawal of the positions of the sides of the road from the year 2008 from the same positions studied in the consecutive years. It shows that the renovation of the road has resulted in a change of the environmental conditions.

### **High concordance in the dispersal abilities of distant *Carabus hungaricus* populations in Central Europe**

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# Deceased

Animal dispersal is an important functional trait affecting most aspects of insect biology, including population ecology and conservation status. Several analytical tools available for studying insect dispersal might provide direct answers for an effective conservation management or restoration programmes. Using mark-release-recapture technique, we studied three populations of a highly endangered ground beetle species *Carabus hungaricus* inhabiting three different habitat types in Central Europe (one location in Hungary and two in the Czech Republic) to explore whether the local or regional attributes might affect the estimates of the beetle dispersal abilities. We fitted the inverse power function model (IPF) on our data to explore the significance of the dispersal power over long distances (up to 500m). We found no difference in the probability of movements between the sexes, regardless the locality. Also, we detected no consistent trends in the dispersal probabilities between the different sites, due to the varying sampling effort. The relative dispersal propensities, which describe the relationship between the dispersal power and the distance, did not show any differences among the localities, suggesting the identical dispersal power between the studied populations of *C.*



*hungaricus*. We concluded that there is a strong internal concordance in the dispersal functions (i.e. selection of similar habitats with similar dispersal power) of the populations of *C. hungaricus*. This may suggest harmonisation of the conservation efforts over the countries.

## Documenting predator marks on dummy caterpillars

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Predation by invertebrates is difficult to study: the predation events often go unnoticed, remains are missing, and/or predators are cryptic, or night-active. One usual, indirect method is the census of the predators – but this does not provide a simple, direct link between predators and their activity. The sentinel prey method has been used to measure rates of predation, by putting out prey in known numbers and detecting their disappearance. This does not identify the predator. Dummy caterpillars provide a simple and cheap method to obtain comparable measurements of predation between habitats. We made artificial caterpillars, 3.5 mm wide, 1.5 cm long, from green plasticine (SMEEDI PLUS, medium green, cat.no.776608); glued to a piece of bamboo, we placed them on the soil surface for 24h. Predators do not avoid such sentinel prey, and high predation rates can be recorded. The interpretation can be problematic, so we set out to create a catalogue of attack marks, which can help other researchers to identify predators in their experiments. In a calibration study in maize in Denmark, 2012, we found an overall predation rate of 17.6% /d, 48.4% at grassy edges, and no significant difference between single (19.5%) and grouped (15.6%) caterpillars. We identified predation by mammals, birds, beetles (Coleoptera, mostly carabids) and wasps (Vespidae), ants (Formicidae), centipedes (Chilopoda), and spiders (Araneae).

## Quantifying predation pressure by using artificial caterpillars along an urbanisation gradient in Denmark

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Urbanisation involves strong modification of habitats influencing the benefits resulting from their biodiversity, called ecological services (ES). One of the important ESs emerges from the effect of predators on their prey. Predation by arthropods is often cryptic, thus analysing predation is not simple and usually expensive. To measure rates of predation, we used artificial caterpillars made of green plasticine which preserve the mark when “attacked”, allowing the identification of the predator. We conducted this study from May to October 2010

around the city of Sorø (Zealand, Denmark), choosing an urbanisation gradient (rural-suburban-urban) as selected by the Globenet protocol. We put the same number of artificial caterpillars in each of the three habitats, at weekly intervals during spring and autumn, and obtained an estimate of the predation level along the urbanisation gradient. Half (50%) of the 1398 caterpillars used was “attacked” and 28.8% of the bites was attributable to chewing insects. We attribute the majority of this to carabids, the most common group of ground-active arthropods. We found significant relationships between predation by different predators and the different stages of the rural-urban gradient (chewing insects 52.1%, 10.1%, 16.4%; ants 4.68%, 11.3%, 16.4%; and mammals 4.89%, 22.2%, 8.08%, respectively).

## Impact of forest management on ground beetles

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Forest beetles belong to the most endangered groups of insect in Europe and their diversity is strongly influenced by forest management. In our study, impact of various forms of forest management and environmental factors on ground beetles (Carabidae) was studied. Using pit-fall traps in three study areas in the Czech Republic: Chejlava (western Bohemia), Žofín (southern Bohemia) and Salajka (northern Bohemia), ground beetle communities of following stages and forms of forest habitats were compared: i) natural forests (unmanaged), ii) extensively managed forests, iii) intensively managed forests, iv) young forests, v) mosaic of various stages of forest, vi) clearcuts. As environmental factors we tested influence of light, total cover and number of plant species in various layers of vegetation, amount of dead wood and leaf litter. During our research 11 178 individuals belonging to 61 ground beetle species were captured. On the basis of the multivariate analysis we can conclude that structure of ground beetle communities is strongly affected by the form of forest management. The strongest effect was found on clearcuts, where eurytopic and heliophilous species dominated. More intensively managed forests hosted most species recorded, but in extensively managed and natural forest rare and relict species reached the highest abundances. From environmental variables tested, light conditions explained most of the species data variability (54%). Also cover of canopy layer had strong effect (35%). There was no significant effect of amount of leaf litter though, only dead wood up to 10 cm diameter and laying dead trunks were significantly important for affecting ground beetle abundances.

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## Spatial genetic structure of a dominant carabid beetle, *Poecilus cupreus*, in an agricultural landscape

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Gene flow in natural population may be strongly influenced by landscape features. The integration of landscape characteristics in population genetic studies may thus improve our understanding of population functioning. In agroecosystems factors constraining species distribution are unstable over space and time because habitats are dynamic and suffer heavy anthropogenic pressures. In this study, we investigated the population genetic structure and pattern of gene flow of *Poecilus cupreus* (L.) (Coleoptera: Carabidae) in an agricultural landscape of central western France. *P. cupreus* is one of the most abundant carabid species in the study site and throughout most European agroecosystems. We hypothesise that high dispersal rates imposed by the high spatiotemporal heterogeneity of habitat quality which characterizes agroecosystems explain why this species is favoured with intensive agriculture. A total of 576 individuals from 250 field plots were sampled over a 450-km<sup>2</sup> area in central Western France and genotyped at 11 microsatellites loci. We used individual-based Bayesian methods to define the number of populations units and their spatial borders without prior delimitation of such units and spatial autocorrelation analyses to detect genetic structuring with distance and infer the scale of dispersal.

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## **The spatial dynamics of carabid beetles from field to landscape and the implications for biocontrol of crop pests**

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Dietary studies and experimental manipulations of carabid densities indicate that they contribute to pest control, sometimes substantially, yet techniques to manipulate carabids for this purpose remain rare. Carabid typically exhibit highly heterogenous spatial distributions over a range of spatial scales from small (several metres) to landscape scales. Given the range of species and accompanying variation in biology, size and propensity for dispersal it is also not surprising to find that the spatial dynamics of a community within fields is complex. However if we are to better exploit carabids for biocontrol then we need an understanding of what drives these dynamics. Many factors are now known to be important in determining their spatial pattern including the mobility of the species, their inherent behavioural instincts, environmental requirements and the distribution of their predators and prey. From a series of detailed studies over two decades and long-term monitoring over five decades we have identified some of the most crucial factors influencing carabid distributions and abundance. The location and success of overwinter survival dictates distributions early season followed by redistribution either within fields or between fields in search for appropriate environmental



conditions, prey and oviposition sites. Consequently, crop rotations, the type and intensity of tillage and insecticide and molluscicide inputs are all important determinants of survival during dormant and active periods. Soil moisture is an important predictor of where emergence may occur but whether this influences more the selection of oviposition or subsequent survival was not identified. It is now possible to make some recommendations for improving the biocontrol potential of carabids.

### **Predation of seeds and seedlings in *Atriplex sagittata*, a species with a distinctive seed polymorphism**

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Shining Orache, *Atriplex sagittata* Borkh, is well known for production of polymorphic seed. Three seed morphs differ in size, shape and presence of bracteoles. Consumption of two morphs of seeds, a small (1.5-2.0 x 0.8 mm, black, tough) and a large (3.0-5.0 x 1.0 mm, brown, soft), and seedlings germinated from these seeds under laboratory conditions was studied in species of seed predators, a carabid *Pseudoophonus rufipes* DeGeer (Coleoptera: Carabidae: Harpalini) and a terrestrial isopod *Armadillidium vulgare* Latreille (Crustacea: Isopoda: Oniscidea: Armadillidiidae). *P. rufipes* was more efficient seed consumer than *A. vulgare* and preferred small for large seeds and within each size category seeds covered with bracteoles for liberated seeds. In contrast, *A. vulgare* was a better seedling predator than *P. rufipes* but seedling consumption was lower than seed consumption, particularly in *P. rufipes*. Both species of seed consumers live in the same habitats as Shining Orache and may thus come in contact with its seeds and seedlings. However, seeds of Shining Orache are produced from mid-September onwards and thus probably not escape from predation in the same year when ripened. Major predation may occur in the next spring when, however, both morphs of seeds germinate and thus partly escape carabid predation.

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### **Student theses as major source of knowledge on Carabids (Coleoptera: Carabidae)**

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In the past years several bachelor and diploma thesis focusing on epigeic beetles were completed under the supervision of doc. RNDr. Jaroslav Boháč, Dr.Sc. (University of South Bohemia in České Budějovice, Faculty of Agriculture). Despite the fact, that these theses



contain interesting data, they remained unpublished neither in Czech nor in English language. Here I summarize data out of 23 previously unpublished bachelor and diploma theses defended at the University of South Bohemia in České Budějovice during the years 2008 to 2013. The main topic of these works is the investigation of epigeic beetle community in agricultural landscape. Three theses were composed as reviews, whereas the remaining 20 works were experimental. Out of the experimental theses I analysed data concerning carabid beetles. Carabid beetles were divided according their sensitivity to habitat and the studied plots were characterised by the index of beetle communities, all data were summarized into graphs and tables.

## **Did sea level changes shape phylogeography of *Calomera littoralis* in Mediterranean?**

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The tiger beetle *Calomera littoralis* is one of the most common species among Cicindelidae occurring in southern Europe. It occurs on sea beaches, saltmarshes, as well as on river and lake banks. The aim of this study was to reveal the genetic structure of *C. littoralis* in the Mediterranean Region. The material was collected on 39 sapling sites during a few „TB-Quest Expeditions” in Ukraine, Moldova, Romania, Bulgaria, Albania, Macedonia FYR, Turkey, Greece and Montenegro. Beetles were caught using entomological hand net and preserved in 96% ethanol. The HCO and LCO universal primers were used to amplify part of COI gene (680 bp). As a result we obtained 142 sequences among which 74 haplotypes were defined. The phylogenetic analyses with using Maximum Likelihood and Neighbor-Joining methods resulted in dendrograms of same topology showing two well supported clades. The first clade grouped specimens collected in the Mediterranean and Black Seas regions while the second included only individuals from the Black Sea coast. The genetic distance (KP2) within clades was below 1% while among them it was 4%. Our results show that during the Pleistocene the population of *Calomera littoralis nemoralis* in the Mediterranean separated in the two above mentioned units. That was possibly caused by the lowered sea level and disappearance of accessible habitats joining the Mediterranean and the Black Sea coasts. Then, possibly during some of the past interglacials, the population from the Mediterranean colonized some regions of south-western Black Sea coast.

## **Habitat preferences of some tiger beetle species occurring in the north-western Black Sea region**

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Similarly to the Mediterranean, the Black Sea Region is known as one of the most richest part of Europe with regards to Cicindelidae species richness. Unfortunately, for most of these species only some basic ecological data are known. The material used in this study was collected during three expeditions (TB-Quest III, TB-Quest V, TB-Quest VIII) in the localities with the following species: *Calomera littoralis nemoralis*, *Cephalota chiloleuca chiloleuca*, *C. circumdata circumdata*, *C. besseri*, *Cicindela monticola rumelica*, *C. maritima kirgizica*, *Cylindera germanica germanica* and *C. trisignata hellenica*. The samples were collected in 53 study sites in four countries: Ukraine, Moldova, Romania, and Bulgaria. To reveal habitat preferences of tiger beetles the following environmental parameters were chosen: macrohabitat type (marine sandy beach, bank of lake, bank of river, saltmarshes), pH, salinity, soil humidity, as well as soil granulometry. Among the studied species, *Calomera littoralis nemoralis* was found to be the most eurytopic species, occurring in all considered habitat types, while all the other species occurred only in 1-2 types of macrohabitat. The RDA analysis of Cicindelidae microhabitat preferences (soil parameters) showed that most species preferred soils with predominance of dust, loam, or sand particles.

### **Impact of climate change on suitable habitats for ground beetles in beech forests on karst**

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Distribution of ground beetles is still insufficiently surveyed in Croatia. Beech forests cover almost 17% of the land, and are among better surveyed areas with respect to available data on ground beetles. Here, we have used data from 44 localities from beech forests. We have selected 39 species with at least 5 records. To estimate possible climate change impact on distribution of carabids in beech forests, we have developed habitat suitability models using Maxent software, and season data on mean temperature and precipitation as environmental variables. For future climate data (2041 – 2070) we have used predictions that anticipate temperature increase from 1.5°C to 2.25°C among seasons, and precipitation decrease of 45 mm per season, except winter with small increase. Most important variables for Dinaric species were autumn precipitation and spring mean temperature, where former contributed to models above 71%. For Pannonian and widespread species there were more variables included in the models with more than 10% of importance, with spring temperature being among most frequent ones for widespread species. For Pannonian species spring and autumn precipitation were most frequent. Decrease in area of suitable habitats ranged from 30 to 100%. Latter meaning that for five species there are not going to be suitable habitats in beech forests in 50 years from now. Number of carabids per spatial unit can decrease from maximum of 29 at



present climate to 21 species in the future. Obtained results urge for future research on habitat requirement of carabids and their present spatial distribution.

## **Is it possible to determine the optimal landscape connectivity in relation to biodiversity of ground beetles (Carabidae)?**

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The fragmentation of environment is one of the crucial problems in today biodiversity conservation. Rapidly increasing isolation of natural habitats leads to their island character, deteriorating survival of particular species. The maximum biodiversity appears to be promoted by the heterogeneous landscape consisting of fragments with various connectivity. The aim of our study is to predict: i) the optimal landscape connectivity for the model group of carabid beetles and ii) metapopulation survival of particular species. The study was performed in the Bohemian Karst Protected Landscape Area. We selected 24 forest fragments and in five of them we installed pitfall traps. Minimum number of traps used per fragment (related to area) was five; in total we used 75 traps. Samples were collected at four-week intervals since the March 2008 till the March 2009. Connectivity of 24 forest fragments was calculated using IFM (Incidence Function Model). Simultaneously, we included data on habitat association of carabids (F – forest species, N – non-forest species). Species diversity (Shannon index) was related to connectivity using GLM (Generalized linear model). The total number of collected individuals reached 25 500, representing 40 species of Carabidae. Forest carabids were positively associated with increasing connectivity of forest fragments, whereas the non-forest species showed opposite but not significant trend. Testing on the species level revealed significant positive response of *Carabus glabratus* (F), *Molops piceus* (F) and *Pterostichus niger* (F), whereas abundances of *Amara ovata* (N), *Carabus cancellatus* (N), *Calosoma inquisitor* (F), *Pseudoophonus rufipes* (N) and other species decreased with higher connectivity of forest.

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## The influence of *Humulus lupulus* on some physiological indicators of carabid beetle *Platynus assimilis*

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Natural diversity is decreasing due to intensive farming pollutes our environment. The residues of synthetic pesticides can accumulate in the nature and also in agricultural products, which may be dangerous to the health of animals and humans. One of alternatives in plant protection is among botanical control agents that would have a different mode of action. There are several studies on the influence of plant extracts on pests but their influence on beneficial insects is still poorly studied. Model species (*Platynus assimilis* Payk.) was selected from carnivorous carabid beetles, which are one of the most useful insects in agricultural landscapes and they react sensitively to anthropogenic or the other changes in habitat quality. The aim of present research was to investigate the effect of hop extract (*Humulus lupulus* L.) on the physiological condition of the *P. assimilis*. Adult ground beetles were fed with cat food pieces treated in hop extract solution for 14 days. Ground beetle body weight was measured in the start and in the end of study to measure feeding activity during the study period. After feeding period were measured supercooling points (SCP). The results of this study show an effect of hop extract on some physiological indicators of the *P. assimilis*. Hop extract caused a weight loss and also the freezing-tolerance was decreased. It could be harmful to overwintering insects in cold winters with tiny snow cover. However, the hop extract was not caused mortality of the insects.

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## Effects of large grazers on ground-beetle communities in productive, man-made ecosystems

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In the Netherlands, nature is being created on land originally reclaimed from the sea for agricultural purposes. In order to prevent dominance of tall plant species and a decrease in plant species richness, large grazers (usually cows and/or horses) are used as management tool. We present the effects of grazing on ground-beetle communities in two of these ecosystems: a man-made salt marsh at the Wadden Sea coast, and a former agricultural area, located in a polder in the former Zuiderzee. On the salt marsh we found a fauna consisting of halophilic and agrobiontic species. The main factor explaining community composition was inundation frequency, whereas grazing played a minor role. There was, however a stronger decrease in



total abundance and species richness with increasing inundation frequency, leading to higher species richness in the ungrazed marsh at the low marsh, whereas there was no difference at the high marsh. In the formerly agricultural area we tested whether the edge of grazed / fenced areas would be richest in species, and whether there would be a positive edge effect radiating outwards. The fauna here consisted solely of agrobiontic species, but all species reached highest abundances in the fenced off areas. Total abundance and species richness were higher in the fenced areas than in the grazed areas, but species sorting was limited. Rather, the community in the grazed area was a subset of the richer community in the fenced areas. Only total abundance was highest at the edges.

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## **The habitat-specific effects of highway proximity on ground beetles: implications for biodiversity conservation**

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The total length of highways worldwide has increased continuously over recent decades. Highways and their roadside verges may substantially affect species dispersal, and the ecological effects of highways often extend to neighbouring areas. This study investigated the effects of highways on assemblages of ground beetles in neighbouring forest and open habitats. In total, 24 sites within five highway segments situated in the Czech Republic were sampled using transects of pitfall traps placed at increasing distances (0, 50 and 100 m) from the edge of highway verges. The total catch size and species richness of ground beetles varied more strongly with distance from the highway edge in forest habitats than in open habitats. Species composition was significantly affected by distance from the highway edge in open habitats as well as in forest habitats. The species richness of forest specialist beetles was negatively affected by highway proximity in forested sites, whereas habitat generalists and open habitat specialists benefited from proximity to a highway in both habitat types. The results indicate that highway verges may potentially enhance local assemblages of ground beetles because they provide suitable sites (in intensively managed open landscapes) or dispersal corridors (in forested landscapes) for habitat generalists and open habitat specialist species. However, negative effects on forest specialists must also be considered, especially in landscapes with little forest. The landscape context should be given substantial consideration in future decisions about highway location because possible threats to forest specialists and benefits for other species must be recognised and balanced.

## Restoration as a forest-management tool in Northern Europe: effects on carabid beetles

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The disturbance regime of boreal forests has been altered by human influence. Therefore, restoration has become an increasingly common tool to diminish the negative effects of forestry on biodiversity. Restoration refers to operations that intend to introduce processes and structural elements of natural conditions into managed forests. We studied the effects of prescribed fire, partial harvesting, downed wood and within-stand moisture gradient on carabid beetles in Southern Finland seven years after treatments. The moisture gradient was the strongest determinant of carabid assemblages, and moist patches probably served as refugia for spruce-mire specialists such as *Platynus mannerheimii*. The number of open-habitat associated species peaked at burned and harvested sites. Most of the forest carabids apparently tolerate natural disturbances and the studied restoration treatments. However, the suitability of the habitat patches, created by the treatments, is likely to be short-lasting for fire and open-habitat specialists.

## Assemblages of carabid beetles (Coleoptera: Carabidae) on winter triticale fields with no-till and conventional soil tillage system.

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Predatory ground beetles, which are natural enemies of many dangerous crop pests, play an important role in agricultural biocenoses. Their numerous occurrences on fields turn into a significant element of the natural resistance of the environment, which helps to prevent gradation of crop pests. Uncovering the stability of carabid communities in agricultural ecosystems is one of the principal aims in integrated plant protection programs, which at the present stage of development of farming and nature conservation are becoming an essential requirement. The purpose of this study was to determine the species composition of ground beetles colonizing fields of winter triticale cultivated under two different systems of soil tillage – conventional and no-till. Another objective was to try and identify the factors which may have had some influence on changes in the structure of the analyzed communities of carabid beetles. The experiment was conducted in northeastern Poland, in Tomaszkowo near Olsztyn. Modified Barber traps were used to capture insects. The traps were emptied every two weeks. Ground beetles were caught from early April to late October 2011. The traps were removed during harvest and while the soil was tilled for sowing (1 month). The species composition of captured carabids was typical of cereal fields. The most numerous species living on the winter



triticale fields were *Poecilus cupreus*, *Harpalus rufipes*, *Pterostichus melanarius* and *Carabus granulatus*.

## Ground beetle (Coleoptera: Carabidae) diversity and community composition in differently managed forests

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In this study, we compared carabid diversity, community composition and mean individual body length in various forests on Papuk Mountain located in eastern Croatia. Carabid beetles were captured using pitfall traps on 10 sites in 2008 and 6 sites in 2010. Sites were located in unmanaged stands, regularly managed and even aged managed stands. A total of 8,258 individuals, representing 51 species in range from 8 to 32 species per site, were collected. The results show greatest species diversity in unmanaged stands (the highest Shannon and Simpson diversity indices), as well as higher number of dominant species. Also, higher frequency of large bodied species was detected in unmanaged stands, while overall species richness was higher in managed stands. Large forest specialists were more numerous in unmanaged stands, and some, like *Carabus coriaceus*, were present only in unmanaged beech stands.

## Complex interactions among seeds and the carabids that eat them

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Seeds are a plentiful and nutritious form of food for many insects within a soil-dwelling community. The first step in understanding the granivore community associated with a seed species is diagnosing the degree to which arthropods within a habitat actually consume the seeds under natural conditions. We have coupled a protein-marking technique with ELISA-based gut content analysis to reveal the degree to which carabids and other arthropods consume protein-marked dandelion seeds under field conditions. Although frequently the most abundant animals trapped in pitfall samples, actual density samples and gut content analyses give a more realistic snapshot of where carabids fit within the communities associated with seeds or prey. In part, seed preferences determine the interactions among members of an insect community and a given seed. These preferences are shaped by numerous characteristics of both the seeds and the insects living within a habitat. But sometimes there are differences in dietary specialization even within a species. Recent work by our group reveals that bacterial symbionts may determine which biotypes within a sympatric carabid population are more granivorous than others. Specifically, we have identified that the presence of the gut bacterium,



*Enterococcus faecalis*, renders individuals of *Harpalus pensylvanicus* to become more granivorous than those individuals that lack the symbiont. New investigations in understanding the complex trophic interactions between carabids and seeds will likely make the use of granivory a more reliable source of pest management for weed species, as well as understanding the density and dispersion of many plant species within a habitat.

## The clear cutting and its effects on the communities of beetles of mountain spruce forests

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Clear cutting represents the method of logging of wood in which most of the wood is removing and taking away during forest clearing. Removing the wood causes decline of microclimate conditions, significantly damages of the herbaceous cover and also destructs the surface of soil in which the beetles lived and hide. The aim of the research was to find out the influence of logging on the communities of carabid beetles of forest ecosystems. The research was conducted in Veľká Fatra mts. from April to October in 2011 and 2012. Pitfall traps were installed in the forest and in the glade which was founded in 2010. Overall was recorded 21 species of beetles (Coleoptera, *Carabidae*). In 2011, in the forest was recorded 1850 individuals belonging to the 13 species. The highest abundance in the forest represents *Trechus pulpani* (Reska, 1965) almost half of all individuals. Another dominant species were *Pterostichus (Haptoderus) unctulatus* (Duftschmid, 1812), *Trichotichnus laevicollis* (Duftschmid, 1812) and *Carabus (Megodontus) violaceus* (Linnaeus, 1758). On the glade, the number of species paradoxically slightly increase but their abundance was significantly lower. We recorded only 119 individuals belonging to the 16 species. From the forest species retain a dominant position only species of *Carabus (Megodontus) violaceus* (Linnaeus, 1758) and *Pterostichus (Haptoderus) unctulatus* (Duftschmid, 1812), but their abundance has decreased by more than 70%. The deforestation were relatively tolerant species *Carabus (Chrysocarabus) auronitens* (Fabricius, 1792), *Notiophilus biguttatus* (Fabricius, 1779). The most numerous forest species *Trechus pulpani* (Reska, 1965) on the locale absented.

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## Effects of urbanization on the egg production of *Carabus convexus*

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The human population is rising exponentially and increased human activities are resulting in a vast amount of biodiversity loss, modifications and alteration of natural habitats.

We studied the egg production of the forest specialist ground beetle species, *Carabus convexus* Fabricius, 1775, in suburban and rural forested areas using pitfall traps in and around the city of Debrecen (North-East Hungary). Beetles were collected using pitfall traps filled with 4% formaldehyde as a killing-preserving liquid; there were twenty traps in each area. All trapped *Carabus convexus* individuals were dissected and the matured eggs in the ovary were counted. Our hypothesis was that the egg production is higher in the rural area than in the suburban area. We found that in the suburban areas with higher ground and air temperature (cf. heat island effect) matured eggs in the ovary were appeared two weeks earlier than in the rural sites. Matured eggs were evolved at the end of April in the suburban area. The mean number of matured eggs in the ovary was significantly higher in the suburban area ( $3.03 \pm 0.465$ ) compared to the rural one ( $0.87 \pm 0.273$ ). *Carabus convexus* was more abundant in the rural area than in the suburban one (45 versus 79 trapped female individuals during the vegetation period). We falsified the research hypothesis: the studied forest specialist ground beetle species were abundant and produced more matured eggs in the suburban area. Surprisingly we found no one individuals of *Carabus convexus* in the urban area.

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## Influence of the production system on life history traits of carabid beetles

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Conventional agricultural practices, especially the use of pesticides often have a negative impact on organisms inhabiting the agricultural landscape, including auxiliary communities, resulting in biodiversity loss or in disruption of development in some species. Most of the time, studies focus on the impact of agricultural practices on the presence of species and not on their characteristics. When traits are considered, interspecific variability only is addressed though intraspecific variability is generally ignored. However, comparing selected traits, at these two scales of organization, may shed light on the relative importance of environmental perturbations and of interactions between different species in structuring species assemblage. Indeed, a strong influence of environmental conditions should coordinate the responses of the community in terms of species' traits, as the responses of species in terms of individuals' traits. A preponderance of interactions, however, could lead to contrasting responses to avoid competitive exclusion. In our study, a range of traits (wing morphology, size, sex) were measured individually in carabid beetles sampled in wheat field in organic and conventional agriculture. Distribution and variability of the traits were compared in the two situations of production, at both intra- and inter-specific scales.

## Functional structure of carabid beetle communities in an agricultural landscape in Western France

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In agroecosystems species distribution are driven by their ability to survive in disturbed environments. Determining interactions between land use and functional traits in arthropods which are associated with agroecosystems, not only helps to predict implications for ecosystem functioning, but may also help to establish the principal factors driving population changes. Carabid beetles show considerable interspecific diversity/variability and also play key functional roles in agricultural ecosystems. They are therefore an ideal group to investigate functional traits. Our study investigates the influence of land use (crop identity and Agri-Environmental-Schemes) on carabid communities in a 450 km<sup>2</sup> intensive agricultural landscape in western France using a functional approach. First, we measured a large panel of morphological traits related to body size, dispersal (wing development, legs), resource acquisition (mandibles) on the 13 most abundant carabid species over the study site. A total of 312 individuals were measured. Secondly, we used data from surveys which were carried out over 7 years using pitfall trap sampling method in almost 500 fields among the dominant crops in the study site (alfalfa, grassland, sunflower, oilseed rape and winter cereals). The number of individuals of all carabid species per pitfall trap was used to describe beetle activity-density and to calculate the community-weighted trait values for each sampled field. The study confirms the existence of functional axes of specialization in carabid beetle species based on their functional traits and the existence of a functional structure in carabid beetle communities in response to land use.

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## Effect of land-use and tillage on the dynamics of a dominant carabid beetle *Poecilus cupreus* (L.) in Western France agricultural landscapes

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In agroecosystems factors constraining species distribution and abundance are unstable over space and time because habitats are dynamic and suffer heavy anthropogenic pressures. Among them, crop rotation is one of the main driving factors of insect population dynamics through tillage and habitat duration which is reduced in the case of annual crops. The aim of the study was to test the effect of tillage and crop rotations on *Poecilus cupreus* population dynamics in an intensive agroecosystem in Western France, the LTER "Zone-Atelier Plaine et Val de



Sèvre". *P. cupreus* is one of the most abundant carabid species in the study site and throughout most European agroecosystems. It is found in almost all land use types. As many carabid beetles, it is a beneficial insect contributing to restricting pest activity. Surveys were carried out over 7 years using pitfall trap sampling method in 683 fields among the dominant crops in the study site (alfalfa, grassland, sunflower, oilseed rape and winter cereals). *P. cupreus* activity-density was higher in oilseed rape fields than in any other crop type during the whole sampling period. In the other crops, *P. cupreus* activity-density increased when the crop was preceded by oilseed rape the year before while the opposite was observed when preceded by spring crops such as sunflower and maize. Oilseed rape benefited to *P. cupreus* activity-density in neighboring crops. Tillage occurring in autumn had a positive effect on *P. cupreus* activity-density while it was the opposite when tillage occurred in spring.

### **Influence of diet composition on the dynamics of stable isotopes in different tissues of ground beetles**

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In laboratory experiment the dynamics of stable isotopes ratios ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) in the tissues of *Pterostichus oblongopunctatus* and *Platynus assimilis* were studied. Four different diets were used: bloodworms, seeds of *Poa pratensis*, mixed diet, without food. Every ten days five males and females of each species were dissected and the samples of muscles (prothorax), chitin (elytra), fat-body, excrements, and gonads were taken. The differences of isotopic composition of gonads and muscles were observed in both species. These differences were significant on animal and mixed diet, but were not clear on seed diet and by fasting. The range of  $\delta^{15}\text{N}$  value measured up to 7‰ in muscles, and to 4‰ in gonads. In muscles the content of both heavy isotopes increased distinctly, however its values were on 2-5‰ lower as compared to diet. In gonads of both sexes on animal and mixed diets the value of  $\delta^{15}\text{N}$  was above than in food on 1-2‰. The mean values of  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  in chitin were relatively stable in both species during whole experiment and not significantly differed from control. Thus we conclude that: (i) in ecological studies  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values must be estimated in the separate tissues that prevent the distortion of results; (ii) the differences in content of stable isotopes in chitin would be used as a criterion in the studies of migrations of carabids; (iii) the individual variations of  $\delta^{15}\text{N}$  value in different tissues are high and can exceed the limit of formal "trophic level" (see Post, 2002; Ikeda et al., 2010).

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## Edge effect on ground-dwelling beetles (carabids and staphylinids)

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Diversity relationships of carabids and staphylinids were studied along forest – forest edge - grassland transects using pitfall traps. Transects were selected in the Hajdúság Landscape Protection Area (North-East Hungary). Our hypothesis was that the diversity of carabids and staphylinids will be higher in the forest edge than in the forest interior and in the grassland. In accordance with our research hypothesis we found that carabid species richness was higher in the forest edge than in the grassland and the forest interior. However, the number of carabid individuals was significantly higher in the grassland than in the edge and the forest. The number individuals of staphylinids and the species richness were significantly lower in the grassland than in the edge and the forest. The results of the non-metric multidimensional scaling also showed that the forest and the edge were separated from the open grassland. Our findings suggest that the forest edge play a vital role in the maintenance of carabid and staphylinid assemblages.

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## Elytral surface structure in *Poecilus lepidus*: What about inheritance?

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The cuticle of *Poecilus lepidus* displays a complex variety of colour morphs that are genetically determined (Paarmann et al. 2010, Mossakowski et al. 2010). Besides colour, there is a remarkable difference in cuticle surface structure between males and females. At least in Middle European populations all males show a bright surface of elytra, all females a matt one due to nearly plain surface in males but nubby one in females. At first glance, this phenomenon may be easily interpreted as due to secondary sexual character inheritance. *P. lepidus* specimens of other regions like the Italian Apennine Mountain and from Bulgaria differ: Females display the same bright elytral surfaces as males. Crossbreeding experiments with German and Bulgarian specimens resulted in a dominance of matt over bright in the classical Mendelian F2-relation 3:1 – but only in females. All the males showed a bright elytral surface. These findings question the interpretation given above. At first view such a distribution of characters may be the result of mechanisms like sex-limited inheritance, X-chromosome



linkage, non-disjunction, or matroclinal inheritance. But all these concepts cannot unambiguously explain the patterns found in our crossbreeding experiments and in nature because all the males only display the bright morph. We discuss two concepts that may give a sound interpretation: (i) haplo-insufficient dominance of one allele to its counterpart, and (ii) silencing of a gene by genomic imprinting. The first works provided that the gene is on the X chromosome or inherited sex-limited. This form of incomplete dominance is assessed in the literature to be unusual. In *Drosophila*, only a few genes display this mode of inheritance. Although genomic imprinting was described mainly in plants and mammals, it was first found in an insect (*Sciara*). In *Drosophila* only few cases are known with an effect on the adult phenotype. At the other hand, it is known that one of the two human X-chromosomes is silenced widely at an early level of female development by genomic imprinting and the initial start of sex determination in animals can be due to silencing special genes by imprinting.

## **The explosive defensive system of paussine and brachinine bombardier beetles (Coleoptera: Carabidae): comparative morphology and ultrastructure**

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The ground beetle subfamilies Paussinae and Brachininae, have always been of interest to scientists because of their ability to explosively eject a hot (up to 100°C) and irritating quinonoid secretion from pygidial glands, in response to attack by predators. The peculiarity of this defensive system led many scientists to consider "bombardier beetle" as a monophyletic lineage, emphasizing the general similarities in morphology, function and chemical reactions, despite the different ways of ejecting the spray (directing the abdomen in brachinines; using the elytral flange of Coanda in paussines). However, studies concerning fine morphology and ultrastructure of the components of the pygidial defensive systems (reaction chambers, valves, ducts, reservoirs, and glands that secrete H<sub>2</sub>O<sub>2</sub>, hydroquinones, catalases and peroxidases) are still lacking (paussines) or incomplete (brachinines). In order to render these issues available to a comparative advanced discussion, we performed a morphological and ultrastructural study of representative species belonging to the genera: *Metrius* (Metriini), *Pachyteles* and *Goniotropis* (Ozaenini), and *Paussus* (Paussini) for Paussinae; and *Brachinus* and *Pheropsophus* (Brachinini) for Brachininae. Samples were examined through optical microscopy (dissections, classical histology), scanning (SEM) and transmission (TEM) electron microscopy, and focused ion beam (FIB) microscopy. The relative parts of the defensive systems for each paussine and brachinine species were described, illustrated and comparatively analyzed. We found significant differences between the two systems at both cellular and microstructural levels. Our preliminary results raise some challenges to the acknowledged hypothesis of evolution of this peculiar defensive system that parallel other evidences on the relationship between paussines and brachinines.

## Carabids and staphylinids along a rural-urban gradient in Hungary

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Nowadays, the urban establishments are conquering more and more territory in the world. The increasing urban areas are affected on the whole of ecology systems. The effects of urbanization on the carabids and staphylinids were studied along a lowland rural-urban gradient in Debrecen, Hungary in 2009. The beetles were collected by pitfall traps (3 areas x 2 replicates x 10 traps = 60 traps). The overall number of carabid and staphylinid individuals was the highest in the rural area. There were no difference in the total number of species of carabids in the rural and urban area; the total number of species was the lowest in the suburban area. The total number of staphylinid species was the highest in the rural area. The number of forest specialist carabid species was the highest in the rural area. The number of forest and substrate dependent staphylinid species (saprophilous, phytodetrificial, mycetophilous, myrmecophilous) was also higher in the rural area compared to the urban one. Multivariate techniques showed that assemblages of suburban and urban areas were more similar to each other than to the assemblages of the rural area both for the carabids and staphylinids.

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## The spatial and temporal distribution of carabid beetles and weed seed predation in winter wheat: a comparison between conventional and conservation agricultural systems

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Carabids can be key players in weed seed predation within arable crops under temperate climate. Field management options, because they affect carabid communities, may represent potential levers to increase weed seed predation levels within fields. Among these options, Conservation Agriculture is often presented as a promising management option for carabids but its effect on weed seed predation levels is less clear. In this study, carabids and weed seed predation were monitored using a grid sampling from April till September 2011 in two adjacent winter-wheat fields in North-eastern France, one conducted as no-till with cover crop for 5 years (conservation agriculture) and the other as conventional tillage. A grid sampling of 66 plots (one plot = 2 pitfall traps and 2 predation cards under enclosure cages) was used to assess



the activity density of carabid trophic guilds and seed predation rate over the two fields. Our results indicate that the relative importance of the carabid trophic guilds and seed predation were comparable in the two systems during the wheat growing season but that granivorous species became scarce and predation rates dropped significantly in the no-till system after harvest. An analysis of the correlations between the spatial distribution of predation and the different carabid trophic guilds using the MAPCOMP software gave us some insight as to the processes underlying seed predation in the two systems.

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## **Carabid beetle assemblages above and below the treeline in the Dolomites (Italy) after thirty years (1980 - 2009)**

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We tested the hypothesis that species richness and abundance are affected by climate change because the vulnerability of a species to global warming is contingent on viable population keeping (species persistence), and on distribution range shifting. The climate change responses of animal populations living above/below the treeline in the Alps have not been estimated yet, moreover, south-eastern Dolomites are the only area of Italian Alps where quantitative carabid samplings have been gathered in the past century with standard pitfall traps. We compared the data sampled in 1980 in twelve stands below and above the treeline (1650-2250m) with those sampled in the same sites thirty years later, by means of several diversity indexes and with a new index, the Index of Community Change (ICC). We have found that species richness and abundance changed after thirty years as a consequence of local extinctions, uphill increment of abundance and uphill shift of distribution range. Species richness and abundance changed more critically in the environments above the treeline, where two microtherm species of the pioneer grass mat cushions, *Nebria germari* and *Trechus dolomitanus*, disappeared or showed strong abundance reduction. In forest ecosystems the soil invertebrate biomass strongly increased as an indirect consequence of the precipitations reduction, which affected the deep soil texture and watering dynamic, driving a transformation from *Sphagnum* rich (peaty) to humus rich soil. In three decades Carabid populations changed consistently with the hypothesis that climate change is one of the main factors triggering natural environment modifications.

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## Carabid species traits along an altitudinal gradient in the Dolomites (Italy)

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Carabid beetles have been sampled along an altitudinal-ecological gradient (1000-2250m asl) in the Dolomites (Italy). Nineteen sites have been studied in spruce forests, alpine grasslands and pastures, and talus slopes with the aim of evaluating the similarity/dissimilarity of traits vs. taxa distribution along the gradient. Species traits, as taxa, showed to be not uniformly distributed along the gradient, as a consequence the sample sites clustering based on taxa was not similar to the one based on traits. On the basis of such analysis it was possible to shift from the taxa level to a biological more comprehensive level, where the grouping of the species traits (i.e., adaptive morpho-functional features) is the main variable to be measured. Such approach may open new perspectives for comparing the distribution of very different taxa.

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## Do differences in grazing pressure affect upland ground beetle (Coleoptera: Carabidae) assemblages?

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Livestock grazing is the main form of land use in Scotland, occurring on over two-thirds of the total land area. However grazing intensities and grazer types vary, thus effecting biodiversity. The Glen Finglas experiment was established in 2002 to assess the impact of various grazing regimes on the biodiversity of upland habitats. Three grazing treatments and an ungrazed control were set up in a random-block design of six replicates resulting in 24 enclosures. Five pitfall traps were set in each enclosure in 2009 and 2011 to collect Carabids. Non-metric multidimensional scaling (NMDS) and analysis of similarities (ANOSIM) were used to compare ground beetle assemblages of the treatments. Despite the unclear separation between treatments on the NMDS plots the results of the ANOSIM supported a treatment effect ( $p = 0.01$ ). Pairwise ANOSIM revealed significant differences between the ungrazed control and any other treatments but not between the grazed treatments. Significant differences between all treatments were detected for mean abundance, species richness and Shannon-Wiener diversity (Kruskall-Wallis test,  $p = 0.027, 0.015, 0.019$ , respectively) with the control plots showing significantly lower species richness and Shannon-Wiener diversity than grazed ones. Mean abundances were also marginally significantly greater in grazed plots. The greater diversity



indices observed in grazed treatments than those in the ungrazed control were possibly caused by generalist species in disturbed habitats outcompeting specialized upland species. Therefore, maximising diversity may not be an appropriate conservation aim when managing upland habitats.

## Diel activity of carabid beetles and other arthropods

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Carabid beetles are active during various periods of the day, and their activity is species-specific. Despite the fact that carabids are a popular subject of study, their diel activity has not been intensively and available data are often controversial. In this paper we studied the diel activity of ground beetles and other arthropods active on the soil surface on four sites that differed with plant density, testing the hypothesis that the structure of vegetation can modulate the circadian rhythms of arthropods. Diurnal activity was monitored using time-sorting pitfall traps, which can split the daily capture into two-hour intervals. Field experiments were carried out during a total of six periods from June to September 2012, when traps were always run for four days. The data were then processed using the methods of circular statistics. The most abundant species in this study was *Pseudoophonus rufipes*, which was significantly more active at night, but the peak hours of its activity differed according to the site (type of vegetation). We found prominent diel activity patterns in several other carabid species and also in adults and larvae of *Leptinotarsa decemlineata*, larvae of Cantharidae, ant *Lasius niger*, millipede *Cylindroiulus caeruleocinctus*, isopod *Armadillidium vulgare* and lycosid spiders. The diel activity data for some of these taxa are the first available in the literature.

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## Publication activity of the Carabidology section of the Czech Entomological Society

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In this contribution we summarize the publication activity of active members of the Carabidology section of the Czech Entomological Society. The Section unites both scientists and amateur collectors that are interested in carabid beetles (Coleoptera: Carabidae). Since

establishment in 1986 the members of the Section published ca. 325 publications which at least partly deal with beetles of this family. Regarding the topic of the publications, 111 deal with carabid taxonomy, i.e. describe new species, provide taxonomical revisions or chapters from Palaearctic catalogue of beetles. Another 29 describe carabid larvae. Thirty-nine papers focused on carabid biology and ecology providing experimental or observational information. Faunistic information, i.e. individual species records, species surveys from a given area or country check-lists, is available in 134 publications. Nine papers are related with nature protection and three papers are popular. Reprints or pdf files of the publications are available by authors. Members of the Sections also wrote numerous unpublished reports from field surveys i.e. in protected areas or during the EIA evaluation process. Besides the works of carabidologists that are members of the Section, other publications on carabid beetles originating from the Czech Republic are also available in the literature.

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## **Changes in carabid beetle fauna (Coleoptera: Carabidae) along a successional gradient on post-industrial areas in Central Poland**

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An inventory of carabid fauna was carried out on two post-industrial areas in central Poland over the eight year period 2004-2011. The study areas were a heap consisting of ashes generated by a power station and a colliery spoil heap. In each area study sites of different age were investigated over the period of eight years using pitfall traps. A pine forest growing on natural soil located close to the ash heap was included as reference study site. Successional changes were described by studying the changes in the most frequently collected species, calculating Mean Individual Biomass of Carabidae (MIB) as synthetic indicator and using correspondence Analysis (CA). During the eight years of study 5032 individuals from 84 species were collected. Changes in the most frequently collected species were more pronounced on the mining heap, with the study sites covering a time slot of 26 years, compared to the ash heap, with a covered time slot of only 11 years. Despite differences in successional development between the study sites, changes in MIB values were generally observed after about 10 to 15 years. Succession seems to be somewhat more delayed on the ash heap. CA confirmed succession as an important factor for formation of carabid coenoses on the study sites. However, the study sites of advanced stage of succession were separated from the pine forest site on natural soil. The results of study are of value within the scope of restoration and management of post-industrial areas.



## What do carabids have for dinner? Revealing the menu list using molecular analyses

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Soil food webs are very complex because of high abundance and diversity of invertebrate species, different developmental stages and presence of microscopic and cryptic species. All these can make trophic interactions between soil invertebrates hard to identify. Carabid beetles are important predators in soil ecosystems regulating prey abundance. Data on their prey preferences has mainly been obtained by field observations, or under laboratory conditions and in agricultural fields. In this study we used MGCA (molecular gut content analyses) targeting earthworms, slugs, woodlice, springtails and lepidoptera species as potential prey. We screened carabid species in the forest ecosystem to reveal their diet within the community and to test whether they show prey choice between the seasons in five forest sites. In addition we applied GLMs to analyse the impact of: site; season; presence of other prey groups in the gut; beetles sex and size, on prey consumption. Monte Carlo simulations showed that, in general, earthworms and slugs were being predated in proportion to their densities in the field with little evidence of prey choice except for woodlice that were not among their preferred food. Seasonal differences have been revealed with more slugs consumed in autumn and more woodlice in spring. Also, we analysed relationships between predator size and prey groups, and confirmed that smaller carabids ate springtails more than larger ones. Large carabids had been predated on earthworms more than medium and small ones. MGCA proved to be useful tool to screen the whole community for broad range of prey.

## Morphometric differences between *Carabus ullrichi* populations inhabiting temporary flooded and non-flooded forests

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Species that inhabit a range of environments often display divergent morphologies between the populations that correlate with differences in ecological parameters. Flood is a strong temporary disturbance of terrestrial environment which could occur on regular frequency or occasionally, that has been shown to influence species composition and function of an ecosystem. On flooded areas, species with better dispersal abilities can migrate when environment become unfavorable. Since the forest ecosystem are inhabited mainly by non flying carabids, the aim of this study was focused on non flying *Carabus ullrichi* species, abundant in regularly flooded forests in Varoški lug area and non- flooded forests in Mt.

Medvednica and the influence of flood events on some morphology features for males and females. We have compared morphometric data between populations collected from two types of habitats (regularly flooded lowland forests in Varoški Lug and mountain forests in Medvednica Mt.). For both sexes, the body size showed significant differences between lowland and mountain forests, with smaller body sizes measured for individuals from flooded areas. In general, the most prominent pattern for both sexes is the lower ratio of body length vs. femur length of individuals from flooded forests. Due to flood events and migration activities, body size but not length of the legs, reduced as energy trade-off, trying to keep the dispersal ability at the highest level. These results provide empirical evidence for an adaptive benefit of the observed shape change (i.e., body size reduction but less legs length reduction).

### **Integrative taxonomy in the subgenus *Mesocarabus* (Carabidae: *Carabus*)**

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The subgenus *Mesocarabus* (Western Europe, Rif Mountains) is currently considered to include five species, but its taxonomy is controversial due to extensive polymorphism and lack of species diagnostic characters. In part, in the Iberian Peninsula, the problem seems to be related to gene flow across intermediate populations of unknown status as we have demonstrated through the analysis of several genetic markers. An integrative taxonomic approach based on external and genital morphology, molecular data and niche conservatism confirms the five currently accepted species as the main lineages of *Mesocarabus*, whereby two geographically and morphologically intermediate populations should be considered as distinct evolutionary entities, proposed here as separate species of hybrid origin.

### **Responses of ground beetle assemblages to forest management in Japan – a study on beetle ecological traits**

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We studied the responses of ground beetles to different management types in Satoyama secondary forests. Satoyama is a traditional agro-forestry system developed in Japan and represents a rural landscape with human settlement. We conducted our study in central Japan



(35°54'N, 139°55'E, altitude 20 m), where we experimentally applied two types of management: tree thinning or forest clear cutting. We also monitored adjacent areas and used them as control sites. We set up plots and sampled ground beetles prior to experimental manipulations in 2011, and then repeated sampling in 2012 (after manipulations). Overall we sampled 196 pitfall traps four times per year (in June, July, September and October). To see the effects of forest management type on beetle assemblages, we examined the following beetle ecological traits: wing form (short or long wings), breeding period (spring or autumn), habitat preference, diets, body size and sex ratio. Total numbers of caught beetle individuals were 8286 (48 species) in 2011 and 5841 (50 species) in 2012. Beetle abundance increased in response to clear cutting, but decreased in response to tree thinning. The responses were species-specific and it was possible to group species by management type. Most prominently, macropterous species increased in response to clear cutting, probably because these species might use their wings to respond quickly to habitat changes after the management. Overall, the compositions of beetle assemblages were significantly different before and after experimental manipulations, and wing type was the most affected ecological trait observed in response of these manipulations.

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## **Difference in trophic position and resource use between con-specific carabids: Isotopic study of seven common ground beetles on lake islands**

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Ground beetles are commonly considered as generalist predators however scale and the meaning of trophic generalism is not well established in this model taxon. Here we study trophic position of seven common European carabids: *Agonum fuliginosum*, *A. obscurum*, *Pterostichus niger*, *P. melanarius*, *P. strennus*, *P. oblongopunctatus*, and *Carabus granulatus*. Stable isotopes ratios ( $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ ) were measured for 561 individuals caught on 20 island and mainland sites of the Masuria Lakeland in Northern Poland. Our results show that populations of each of seven species were characterized by different trophic position at

different sites. Most of species utilized different sources of carbon at different sites. Notably these differences were observed between con-specific beetles from different sites but not from different type of two studied habitats. Our results point to local trophic opportunism of studied species.

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## **The effect of abandonment of mountain meadows on assemblage structure and life traits of ground beetles (Coleoptera: Carabidae)**

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Mountain meadows are amongst the most diverse ecosystems in temperate regions. Traditional management practice, grazing and mowing, prevents the secondary succession since the fourteen century in the Western Carpathians. In twenty century, however radical changes in the economy limited significantly the traditional husbandry and many abandoned glades changed its structure and composition during secondary succession. In this study, we determined the effect of traditional management practice (low density sheep grazing and mowing once a year) on the abundance and assemblage structure and life traits of ground beetles associated with managed and abandoned grasslands. Over 33 000 of carabid specimens belonging to over 100 species were collected on 66 localities. Ground beetles diversity and composition were similar among managed and unmanaged systems, while long-term abandonment significantly reduced the species richness and species diversity. Non metric multidimensional scaling indicated significant separation of managed and abandonment assemblages. Nestedness analysis revealed significantly structured gradient of local assemblages where the less diverse abandoned assemblages were subsets of species richer traditionally managed ones. Generalized linear model applied for the abundance parameters of life history traits indicated that large, wingless, forest specialists preferred mostly managed meadows, meanwhile small, winged omnivores were more abundant on abandoned sites. Our results showed that in mountain meadows which are N-limited ecosystems, the traditional management practices are the most sufficient tools for the conservation management.

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## **The effect of river channelization on structure of ground beetle assemblages on exposed riverine sediments: implications for river management and conservation**

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The influence of channel narrowing and straightening of ground beetle assemblages inhabiting exposed riverine sediment was investigated in the Raba River, Polish Carpathians. Ground beetles were surveyed by motor driven suction apparatus in 12 channelized and unmanaged river cross-sections at 12 sample points. The simple classification in non-metric multidimensional scaling into channelized and unmanaged ground beetles assemblages indicated no significant differences in similarity pattern between groups, however when the width of active river channel was taken into consideration, two groups of assemblages were clearly derived. Ground beetles structure parameters such as mean abundance and richness decreased significantly in narrowed cross-sections. All investigated assemblages were significantly nested and the subsequent order dependent on increasing active river channel ( $R = -0.76$ ,  $p < 0.001$ ) and number of low flow threads ( $R = -0.64$ ,  $p < 0.001$ ). The negative impact of river channel narrowing was also visible at population level. The presence of some population on exposed riverine sediments in single thread channels is a result of recent migrations from the unconstrained river parts. The co-occurrence pattern of species on narrowed channels is significantly random, meanwhile significantly aggregated on unmanaged sites. Narrow, channelized river sections are characterized by a rapid increase in flow velocity with increasing discharge which may be limited factor for terrestrial biological elements. In wider, unmanaged river sections, the increase in flow velocity with growing discharge is slower and the availability of exposed refugia associated with multi-thread morphology enables the ground beetles to escape to the upper parts during floods.

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## **Influence of hydromorphological degradation of gravel-bed rivers on ground beetle assemblages**

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The impact of river incision in response to channelization on the ground beetles assemblage structure is shown by the study of three montane rivers, southern Poland. Seventy five sites in four different channel morphology types were sampled: (i) incised, (ii) with gravel bed material, (iii) channelized, (iv) unmanaged, on three elevations from low flow water level. Principal component analysis of the spatial patterns of environmental variables clearly differentiated two main factors: bankfull discharge related to the first (eigenvalue = 0.99) and incision (eigenvalue = 0.99) related to the second axis. The redundancy analysis of 92 species indicated that the first PCA factor related to bankfull discharge is highly correlated with the first redundancy axis ( $R = 0.75$ ) describing 47.5% of species-environment relations, meanwhile the second PCA factor expressing channel incision is related the second RDA axis ( $R = -0.55$ ) describing 27.8% of the variation. In such highly variable conditions nestedness analysis indicated non-random distribution of species among localities ( $T_{\text{obs.}} = 18.9$ ,  $T_{\text{rand}} = 44.7$ ;  $p \ll 0.0001$ ). The gradual decrease of total species richness and of two upper classes of elevation in post-ordered assemblages is correlated with the second PCA axis reflecting the incision. Only on the most frequently flooded assemblages located close to the water level the nested order depended on bankfull discharge. These data indicate a need for increasing morphological complexity and improving hydromorphological quality of the river to recover the riverine ecosystems.

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## **Carabid assemblages in pine stands disturbed by a hurricane in 2002: ten-years responses to hurricane impact (Piska Forest, Poland)**

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The study was carried out in 2003-2012 in pine stands that had been disturbed by a hurricane (D) and in undisturbed control stands (C). Carabids were identified to species, and their length was measured and converted to biomass. During the study, 72 346 individuals belonging to 109 carabid species were collected. Reactions to the hurricane by the carabids, which were delayed by 3-4 years, were observed. The standardized number of carabid species was greater in the D stands, increasing significantly between 2004 and 2007. At the same time the percentage of forest species in the D stands decreased significantly. During the entire study period the percentage of xerophiles was higher in the D communities than in the C communities. RDA in 2005 correlated the occurrence of carabids in the D stands with lack



of shade (low LAI values), low rates of soil respiration and decomposition of organic matter, decreased acidification, and increased nitrogen and carbon content in the soil. The decrease in the rate of soil processes was associated with the hot summers of 2003-2006, which dried up the soil. The decreased nitrogen in the soil in 2011, accompanied by a tendency of the soil pH in the D stands to approach that of the C stands, as well as an increase in the decomposition rate, suggests that regeneration of the disturbed ecosystem had begun. In 2011 coverage of the surface in the D stands by natural regeneration ranged from 0.5% to 52.6%. It would seem that the preservation of the soil structure together with the forest bed should facilitate the regeneration of carabid communities, but in this case the regeneration did not begin until 2009, 7 years after the hurricane, which was indicated by a reduction in the number of species and an increase in the proportion of forest fauna. These are typical signs of the restoration of forest communities of carabids in pine plantations. Redundancy analysis of the data from 2005 correlated the occurrence of most of the large *Carabus* species with C stands, while occurrence of the mesophilic *C. violaceus* – and the xerophilic *C. arvensis* – was correlated, albeit weakly, with D stands. RDA from 2011 indicated a strengthening of the preference of the mesophile *C. violaceus* for C stands and of the xerophile *C. arvensis* for D stands. The study found delayed regression of carabid fauna, which led to a delay in regenerative processes in carabid communities.

## ***Elaphrus angusticollis* R.F. Sahlberg (Coleoptera: Carabidae) in Baltics**

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This work reflects specification of distribution of species *Elaphrus angusticollis* in the Baltics and Europe. Though ground beetles are widely researched all over the world, however information on several *Elaphrus* Fabricius species is scarce. *Elaphrus angusticollis* is representative of sub-genus *Elaphroterus* Semenov and genus *Elaphrus* Fabricius (Coleoptera: Carabidae), it has two sub-species *Elaphrus angusticollis angusticollis* (Asia: Russia: East Siberia, Russia: Far East, Nearctic Region ) and *Elaphrus angusticollis longicollis* (Europe: Finland, Russia: South European Territory, Asia: West Siberia). *Elaphrus angusticollis* distribution has been approved also in the territory of Belarus, it enabled commencement of searches of this species also in Latvia. Notwithstanding the fact that in 1983 H. Goulet did wide researches of the genus *Elaphrus*, including *Elaphrus angusticollis*, distribution of this species is not quite clear in Europe, therefore the aim of this work is analysis of literature and collection data, in the result of which summarization of information and specification of species distribution and diagnosis features will be done, which would foster specification of borders of total area of this species. In the result of researches it was concluded that, despite long-term researches, information on distribution of species *Elaphrus angusticollis* is scarce and commenced researches, supplementing of collection materials, inspection of existant findings and searching for new places should be continued in the territory of Latvia, Baltics and Europe. In the result of research distribution of *Elaphrus angusticollis angusticollis* and *Elaphrus angusticollis longicollis* was specified. For the timebeing in Latvia this species has

been found in utmost South-eastern part, in the valley of River Daugava. In other territory of Latvia in corresponding habitats *Elaphrus aureus* can be traced.

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## **Changing climate associated with homogenization of forest assemblages of boreal ground beetles (Coleoptera: Carabidae)**

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We studied carabid assemblages during 1981-82 and 2009-10 using pitfall traps on the same grids in five habitats in central Alberta, Canada. Traps were run overnight each week without killing agents during the frost-free season in all years. Overall average catch rate was 39.2% lower in the later period than during 1981-82 (1.62 vs 0.65 beetles/trap/day). Carabid activity was much reduced in Lakeside Forest (LS) and Meadow (ME) habitats, but higher in Spruce Forest (SF). Shannon-Weiner diversity ( $H'$ ) (2.73 vs. 2.45) fell between the two study periods, as did overall species numbers (56 vs 34). The 1981-82 catch included 32 species not subsequently collected; 21 were rare ( $\leq 5$  specimens), but many had been common during the earlier period, including *Pelophila rudis*, *Elaphrus clairvillei* and *Platynus mannerheimii*. Ten species captured during 2009-10 had not been detected during the earlier sampling period, including *Synuchus impunctatus*, *Metabletus americanus* and the invasive exotic species, *Pterostichus melanarius*. A Multiple Regression Tree analysis explained 84.4% of variation in the assemblages and identified differences between ME and the four forest habitats, the two sampling periods, and LS vs. SF, Upland Aspen (UA) and Moist Aspen (MA) forests as explaining, respectively, most variation in the assemblages. A Redundancy Analysis suggests that forest carabid assemblages have become more homogeneous in the later years. Weather records from nearby indicate that climate has become warmer and drier during the study period and our data support the hypothesis that climate effects are associated with changes in this local carabid fauna.

## **Functional diversity and life-history traits of carabid beetles in agricultural systems**

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Functional analysis of carabid beetles is still in its infancy despite the variety of well documented life-history, trophic strategies, and range of behavioural and morphological traits that exists within the group. This approach has the potential to provide better understanding of



how organisms respond to environmental variability and to identify what drives species assemblages. Two separate studies were carried out, one in a crofting area on the west coast of Scotland and one in riparian field margins on the east coast. Our results revealed trait shifts between different habitats. Body length, wing type, leg form and trophic strategy were the most useful indicators of changing environmental conditions. Functional diversity was found to be reduced at sites with lower disturbance and taller plants. Strong correlations were demonstrated between functional diversity of carabids and functional diversity of plants. Soil, management and vegetation were determinants of trait assemblage structure, although plant response traits were possibly the most successful in explaining the distribution of carabid functional traits. These studies provide evidence that the mean and variance of traits in one trophic group structure the assemblage of another, and highlight the importance of habitat diversity (beta diversity) in maintenance of a wide range of traits.

### **Do recover diversity and composition of indigenous ground-dwelling assemblages after fifty years of afforestation with native oak?**

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Carabid assemblages of a lowland oak forest secondary succession series were studied in forest patches nearby the city of Debrecen (North-East Hungary) by space-for-time substitution methods. There were 5 years, 15 years, and 45 years old stages; the control stand was more than 100 years old. There were 2 spatial replicates (stand) for each stage, and there were 12 traps in each stand; altogether, there were 96 pitfall traps (4 stages x 2 replicates x 12 traps). We found that both the total number of species and the number of individuals was the highest in the young (5 years old) plantation. From the 15 years old stages onwards there were no difference in the number of species and the number of individuals. The young plantation was characterized by large open sand surfaces; this resulted in an increased number of open habitat species. These species disappeared from the 15 years old stages onwards. The forest specialist and forest generalist species were missing from the 5 years old stages. The number of forest specialist and forest generalist species was stable from the 15 years old stages onwards. Multivariate analysis also shows that the composition of the carabid assemblages of the stages of 15 and 45 years old and stages is not different from the control stands.

This research was realized in the frames of TÁMOP 4.2.1./B-09/1/KONV-2010-0007, TÁMOP-4.2.2\_B-10\_1-2010-0024, TAMOP-4.2.2.C-11/1/KONV-2012-0010 and TÁMOP 4.2.4. A/2-11-1-2012-0001 „National Excellence Program – Elaborating and operating an inland student and researcher personal support system” The project was subsidized by the European Union and co-financed by the European Social Fund.

## A review of genus *Omophron* Latreille, 1802 (Coleoptera: Carabidae) - Indian fauna and distribution

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Round Sand Beetles (Coleoptera: Carabidae: *Omophron*) is usually considered to be the only genus of its tribe. The insects are broadly oval, multistriate, often complexly marked carabids which inhabit sandy shores of rivers and lakes. In world fauna 67 species of the genus *Omophron* Latr. ground beetles are known. The research is based on data gathered during three expeditions organised by Institute of Systematic Biology (Daugavpils University, Latvia), as well as the processed collection data. During research there are 1247 specimens processed from 7 collections of Natural Science museums and Universities - The Natural History Museum, London, United Kingdom; Institute of Systematic Biology, Daugavpils University, Latvia; Erdgenössische Technische Hochschule-Zentrum, Zurich, Switzerland; Muséum National d'Histoire Naturelle, Paris, France; Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia; Moscow State University, Moscow, Russia, Museum für Naturkunde der Humboldt-Universität, Berlin, Germany. In the India the genus *Omophron* Latr. (Coleoptera: Carabidae) is represented by 12 species - *O. affinis* Bänn., *O. axillaris* Chaud., *O. bicolor* Andr., *O. bretteinghamae* Pasc., *O. gemmeum* Andr., *O. guttatus* Chaud., *O. lunatum* Bänn., *O. maculosus* Chaud., *O. oberthueri* Gest., *O. pictus* Wied., *O. porosus* Chaud., *O. testudo* Andr.). During the research distribution range information has been adjusted for 5 more species. There is a lack of information about distribution of the species in regions, where the gathering of the material is very difficult, therefore it may happen that the real number of the species of the genus *Omophron* in region can be higher. The result of research is development of the list of India fauna of the genus *Omophron* Latr., it contains information about distribution of each species. The distribution range information of several species was updated as well.

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## Carabid assemblages of semi-natural grassland habitats in Helsinki

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Carabid beetles have typically been divided into species of forests, woodlands and open habitats. Whilst the beneficial and harmful effects of species inhabiting agricultural and horticultural habitats have been well studied, the habitat affinities of species of semi-natural grasslands are less well known. Recent studies of the vegetation of temperate dry grasslands have shown that their species richness exceeds that of tropical rain forests at fine spatial scales.



Carabid beetles also constitute a major component of the biodiversity of grassland habitats. Data on the carabid assemblages of managed dry meadows, rocky dry meadows, urban matrix grasslands and park lawns are used to determine the assemblages that are characteristic of each and the habitat affinities of grassland carabids in the Helsinki region.

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## **The European Dry Grassland Group (EDGG) - Join the network of scientists and conservationists**

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The European Dry Grassland Group (EDGG) was founded in autumn 2008 as a network of dry grassland researchers and conservationists in Europe. The basic aims of the EDGG are to compile and distribute information on research and conservation in dry grasslands beyond national borders and to stimulate active cooperation between dry grassland scientists (exchanging data and establishing common data standards, joint projects and databases). The EDGG covers all aspects related to dry grasslands, in particular: plants - animals - fungi - microbes - soils - taxonomy - phylogeography - ecophysiology - population biology - species interactions - vegetation ecology - syntaxonomy - landscape ecology - biodiversity - land use history - agriculture - nature conservation - restoration - policy.

## **Recovery of two populations of *Carabus nitens* by sod-cutting in an old heathland and by top-soil removal in an agricultural area**

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In the Netherlands, *Carabus nitens* (Coleoptera: Carabidae) is a characteristic species for large open heathlands. As result from reclamations, fragmentation and the excessive use of fertilizers *C. nitens* became almost extinct in the last half of the previous century. At the end of that century several measures were taken to restore the large heathlands in the province of Drenthe. For instance in one of the last remaining large heathlands, the Dwingelderveld, the poor soil conditions were brought back by sod-cutting and removal of those sods. In another area, the Mantingerveld, the small heathland remnants, scattered throughout the area, were reunited by removing the nutrient-rich furrow of the arable fields in between, restoring the poor sandy character of the soil. In the Dwingelderveld the species was not caught anymore in the period 1970-1990, but it probably survived somewhere in low numbers at the 1670 ha of heathland. 5-8 years after sod-cuttings were executed it was caught in high numbers (up to 250 individuals in one trap) at those areas. At the Mantingerveld it probably did not survive. Last catches at Hullenzand, a remnant of heathland in the Mantingerveld area, were recorded from 1969. Top-soil removals were done in 1994 but up till 2007-2008 no catches of *C. nitens* were made, despite the heathy character of this area. After 2008 an increasing number of catches were recorded with numbers of more than 300 in 2011 at the top-soil removal area. In 2003 75 exemplars were released at the Hullenzand at the border of the top-soil removal area. It is concluded that *C. nitens* profits from both measures, sod-cutting and top-soil removal. Sod-cuttings should be executed every 20-25 years to maintain a high level of individuals. *C. nitens* might be a good indicator for nature managers to determine the moment of taking measures.

## Geographical variation in thermal constants for development of carabid beetles

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Thermal constants are important descriptors of thermal requirements of species and their adaptations to local conditions. Geographical variation in the thermal constants of egg development was studied in 11 populations of 10 species of carabid beetles originating from the Czech Republic and Russian Federation. The data were obtained based on development times at 4-6 temperatures ranging from 9 to 29 °C, depending on species. Thermal constants – lower development threshold (LDT) and sum of effective temperatures (SET) – were calculated using three different linear equations (Lopatina et al. 2012, Honěk 1996, Ikemoto & Takai 2000) in the range of ecologically relevant temperatures. The obtained data were also compared with the literature data. In most cases the three methods provided similar estimates, but the method of Ikemoto & Takai (2000) seemed to be the most precise. In case of *Amara eurynota*, we found that the population from Russian Federation had higher SET with identical LDT, and thus developed longer, compared to the Czech population. In other cases there was no variation in thermal constants among populations or ecological significance of the observed



variation in thermal constants cannot be distinguished from the natural autocorrelation of LDT and SET estimates.

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## Testing the spatial influence of mixed broadleaved trees in pine forests on ground beetle (Carabidae) activity intensity

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The poor, dry soils in the German lowlands are mostly dominated by large homogeneous Scots pine (*Pinus sylvestris* L.) forests. They are typically single-layered, even-aged stands poor in flora and fauna diversity. It is thought that small aggregates or single mixtures of broadleaved tree species in pine stands form zones of spatial influence bringing positive changes in soil and micro-climate conditions as well as favourable conditions for some ground beetle species that are closely associated with broadleaved tree environments. The goal of the study, and the methodical challenge, is to test the correspondence of fixed tree species positions with ground beetle spatial activity intensity. Statistically, this problem was treated as a correlation between a point process (i.e. the oak positions) and a random field (i.e. the beetle activity intensity), enabling a partial pair correlation test. Therefore, in a mark-recapture study, 123 pitfall traps were placed on a grid of 15 x 15 metres in a pine forest area of about 3 ha with an admixture of single oak and birch trees. The main results showed species- and gender-specific preferred locations within the pine stand. In particular, for *Carabus coriaceus* L. females, a positive spatial association with broadleaved trees was statically verifiable, whereas no preference was found for adult male individuals. For individuals of *Carabus violaceus* L., the general preference illustrated by activity intensity revealed a higher frequency in stand patches characterized by pure pine.

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