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**8<sup>th</sup> Symposium on the Conservation of Saproxylic Beetles**  
Basel (Switzerland), 13–15 June 2014

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The participants of the field trip to the Lägern, June 15, 2014. (Photo: Adrienne Frei).

#### FOREWORD

In 2014, the traditional symposium on the conservation of saproxylic beetles was held in Basel (Switzerland) from 13 to 15 June. It was the eighth meeting and attended by 64 researchers from Europe and even from Asia. The participants came from 13 different countries in Europe and one from Japan. The meeting was quite familiar; it was an opportunity to meet many good colleagues after two years. The last symposium took place in Granada (Spain) in 2012.

37 interesting presentations were given, 10 posters and 27 talks in the historical auditorium of the Natural History Museum in the heart of the town. The rich program was divided into eight sessions treating biology, species from the Habitat Directive, community ecology, monitoring, molecular approaches and chemical ecology as well as conservation. Stimulating discussions and the exchange between researchers vitalised the meeting.

The conference excursion took place in the Lägern, a north-eastern ridge of the Jura chain between Baden and Regensdorf in the cantons Zurich and Aargau. We got a collecting permit and enjoyed the warm and sunny weather. At different places local specialists informed us about the forest management of the Lägern, the nature conservation work of the canton Zurich and a saproxylic beetle project. We visited also a stand out of management for over 50 years and heard about the research for the project «Dynamics of Dead Wood and Saproxylic Beetles in Forest Reserves».

Instead of publishing own proceedings, the organizers present here the abstracts of all contributions during the symposium and some original papers treating saproxylic beetles.

Basel, April 2015; for the organizing committee: Eva Sprecher, Sylvie Barbalat, Adrienne Frei.

## Abstracts of the 8<sup>th</sup> Symposium on the Conservation of Saproxyllic Beetles Basel (Switzerland), 13–15 June 2014

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### PRESENTATIONS

#### **Specialized mycangial structure and host behavior for vertical transmission of symbiotic yeasts in stag beetles**

Masahiko Tanahashi & Takema Fukatsu — National Institute of Advanced Industrial Science and Technology (AIST) Central 6, Tsukuba, Ibaraki 305-8566, Japan

Most wood-feeding insects are associated with symbiotic microorganisms for digestion or detoxification of wood chemicals that the insects are merely able to utilize. While many insects harbor microbial symbionts within their gut, body cavity, tissues or cells, some insects are associated with symbionts outside their body. Female stag beetles (Coleoptera: Lucanidae) possess a sac-like epidermal structure, called mycangium, wherein symbiotic yeasts are harbored. First, we demonstrate that the mycangial yeasts are almost specific to each lucanid species. In general, such specificity is thought to be achieved by strictly vertical symbiont transmission through host generations. When female stag beetles lay eggs, mycangial secretions containing the symbiotic yeasts are deposited together with the eggs. Although larvae have no mycangium, they harbor the yeasts within their gut, therein presumably helping digestion of woody materials. Upon pupation, the gut contents are mostly purged, and the mycangium is newly formed as part of the adult epidermis. Therefore, the primordial mycangium has no chance to contact directly with the gut contents, which presents an enigma as to how the yeasts are transmitted from the larval gut to the adult mycangium. We discovered that eclosing females exhibit special behaviour to acquire the symbiotic yeasts from the pupal chamber into the mycangium. By applying dye chemicals, silica microbeads, or cultured yeasts to artificially-made pupal chambers, we confirmed that these materials are certainly transported into the mycangium. Peculiar fine structures of the mycangium are likely involved in facilitation of the symbiont transportation by this behaviour. Finally, relevance of our findings to conservation biology of stag beetles will be discussed.

#### **So what attracts *Rutpela maculata* (Cerambycidae) to early decay stage beech (*Fagus sylvatica*)?**

Sarah Hart — Anglia Ruskin University, East Road, Cambridge, CB1 1PT. UK

To date the majority of studies use fungi as a co-variable alongside dead wood position, size, age and stand type, for example. With only adult beetles collected they are unable to conclusively state whether fungi play a pivotal role in oviposition choice of pioneer xylophagous beetles of early dead wood. This study investigated whether fresh dead wood or combined wood with white rot endophytic fungi influenced oviposition choice. Following field exposure (May to October 2010) of sixty fresh beech logs (1 m x 15-21 cm) with 20 dowels apiece of *Stereum hirsutum* or *S. hirsutum* and *Eutypa spinosa* (10 each) or autoclaved dowels for control (hammered in a measured repeated diamond pattern along log length) they were removed for dissection. Data was collected on larval distance from fungal plug, larval species and log and ambient abiotic conditions. Two cerambycid species *Rutpela maculata* (46) and *Phymatodes testaceus* (71) showed oviposition preferences. *R. maculata* (RM) showed a preference for *S. hirsutum* logs ( $P < 0.0001$ ), ovipositing 0 – 10 mm from *S. hirsutum* (SH) plugs ( $P < 0.05$ ) in end sections ( $P < 0.0001$ ) with sun significant in dual fungal treatment ( $P < 0.05$ ). *Phymatodes testaceus* (PT) preferred *S. hirsutum* (SH) treatment logs ( $P < 0.001$ ) and plugs, ovipositing 10 – 20 mm from plug ( $P < 0.05$ ) in sun site end sections ( $P < 0.0001$ ). Log wood density and moisture content did not affect oviposition choice but whole log and section moisture content in sun sites was higher compared to shade site logs (end  $P < 0.001$ ; mid  $P < 0.001$ ).

### **Sexually-dimorphic post-eclosion behaviour in the European stag beetle *Lucanus cervus* (L.) (Coleoptera: Lucanidae)**

Maria Fremlin & Masahiko Tanahashi — 25 Ireton Road, Colchester, Essex, CO3 3AT, United Kingdom & National Institute of Advanced Industrial Science and Technology (AIST) Central 6, Tsukuba, Ibaraki 305-8566, Japan

The recent discovery of a unique post-eclosion, mycangium-related behaviour in several Japanese stag beetles seems to have solved the enigma of the transportation of their symbionts from larva to adult. Here, to confirm this behaviour in the European stag beetle *Lucanus cervus* (L.), and to compare the post-eclosion behaviour between females and males, we observed five females and three males during the period of pupation and adult eclosion under a controlled environment. The mycangium-related behaviour was repeatedly observed in all five females, which is almost the same as has been reported in the Japanese species; they everted the mycangium and swept the cocoon walls. In *L. cervus*, the mycangium everted two and a half hours after eclosion and the onset of the sweeping behaviour occurred two hours after that; it continued intermittently for about four hours. Although males exhibited no sweeping behaviour, they eclosed with everted genitalia and retracted them within four hours. In both cases, the teneral imago exuded a huge amount of transparent liquid droplets from the dorsal inter-segmental gap of the abdominal tip during the post-eclosion behaviour; we observed this loss of fluid in two females and one male. The origin of the liquid and the adaptive significance of these droplets are also discussed.

### **Large scale distribution study of *Osmoderma barnabita* with the help of amateur entomologists**

Matti Landvik — University of Turku, Section of Biodiversity and Environmental Research, Department of Biology, FIN-20014 Turku, Finland

The hermit beetles, genus *Osmoderma* is a species complex which is threatened in large parts of Europe. In Finland, only one population of the genus *Osmoderma* has been known to exist for two centuries in the Turku region. The Finnish species of *Osmoderma* belongs to the eastern clade of hermit beetles, and migration has likely occurred from Karelia, across the southern coast line of Finland all the way to the south west archipelago. Therefore the IUCN has assumed that *O. barnabita* also inhabits the south coast of Finland because of small fragmented oak forests in the area. I studied the hypothesis of the IUCN with the help of amateur entomologists. Volunteers were recruited through the internet site created especially for this distribution study, and locations with old broad leaf trees, or hollow tree habitats in optimal geographical regions were chosen for the actual study. During summers 2012 and 2013 over 40 sites of old-growth broadleaf tree stands were monitored with a total number of 96 pheromone traps by 20 amateur entomologists. The sites were located on the southern coast of Finland in the yards of country houses, road sides, urban parks, and in nature reserves. Despite abundant amount of the potentially good habitats, all the observations were negative, and for the moment the *Osmoderma* population in Turku remains the only known population in Finland.

### **Why are large trees important to saproxylic biodiversity? Environment-induced plasticity in habitat requirements of a veteran tree specialist**

Michal Platek, Pavel Sebek, David Hauck and Lukas Čížek — Biology Centre ASCR, Institute of Entomology, Branisovska 31/1160, 370 05, České Budějovice, Czech Republic

Large, veteran trees are key structures sustaining biodiversity in wooded landscapes. Most organisms associated with them are also able to inhabit trees of smaller diameters. Understanding the mechanisms behind the importance of veteran trees and the conditions allowing exploitation of smaller trees by veteran tree specialists might boost conservation of this diverse and highly endangered guild. To investigate this key issue, we studied local patterns of tree use by a veteran tree specialist, the great capricorn beetle (*Cerambyx cerdo*) at floodplain, dry-sandy and dry-rocky sites where the beetle exploits oaks of large (~1.5 m), medium (~0.75 m) and small (~0.25 m) diameter. The site characteristics affected the probability of beetle occurrence in a tree of a given diameter, whereas the number of beetles that developed in a tree was similar for all the sites. An average inhabited tree hosted ~160 beetles in the floodplain, but only ~5 beetles at the dry-rocky site. Beetles inhabiting large trees thus need to disperse less frequently than beetles dwelling in smaller trees. The diameter of locally exploited trees is likely to affect the population biology of the beetle, which may explain the great importance of large trees for saproxylic biodiversity. On the other hand, neither tree volume nor its age, but the state and quality of its wood are key factors to explain *C. cerdo* presence. This, together

with the above documented ability of the veteran tree specialist to survive without large trees, may open unexpected doors to conservation of biodiversity associated with veteran trees.

#### **Population analysis of *Morimus asper* in beech forests of central Italy: preliminary results**

Sarah Rossi de Gasperis & Giuseppe M. Carpaneto — Department of Sciences, Roma Tre University, Viale Marconi, 446, 00146 Rome, Italy

*Morimus asper* is a polyphagous longhorn beetle inhabiting both deciduous and coniferous forests of southern Europe. It is a flightless saproxylophagous species, associated with dead trees lying on the ground and old standing live trees with some decaying parts. For this reason its biological cycle may be affected by forest management. The status of its populations was recently brought to the attention of conservation biologists since it was taxonomically merged into the same species with *M. funereus*, a taxon protected by the Habitats Directive. Few ecological studies were made on the *M. asper* / *M. funereus* complex and more information is needed to monitor and conserve this species. The present study was performed in three relict beech forests in central Italy. A total of 166 trees, suitable for hosting the target species, were selected through a total area of 120 ha. Each study site was investigated from 29<sup>th</sup> April to 30<sup>th</sup> July 2013, every five days, from 10:00 am to 4:00 pm to cover all the daily activity of the species. Adult beetles were captured, marked and released. Meteorological and biometric variables were measured. The species showed two seasonal peaks of abundance (9<sup>th</sup>-19<sup>th</sup> May and 8<sup>th</sup>-18<sup>th</sup> June) without differences on sex phenology. All females and the majority of recaptured males remained in the same tree for the whole study period. Dispersal was only observed in five out of 107 recaptured males (20, 49, 50, 110 and 451 m respectively). In each population the sex ratio was near to 2:1 (♂/♀). Population size was estimated with either open or closed population models showing similar results. Captures were positively correlated to temperature. The estimates of apparent survival probability ( $\phi$ ) and capture probability ( $p$ ) obtained from population models were higher in males. Biometric variables confirmed the typical sexual dimorphism with longer antennae in males and longer elytra in females.

#### **Parts of the life history of *Osmoderma eremita*'s metapopulations in two study areas in the West of France (Coleoptera, Cetoniidae)**

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The Hermit beetle, *Osmoderma eremita* (Coleoptera, Cetoniidae), is a beetle living in cavities of old deciduous trees. Its populations are met in forest habitats and man-made habitats such as hedgerow networks and orchards. Our two studied areas are in these two types of habitat of substitution. We have observed a synchronous variation of the metapopulation size between the two sites despite of a distance of 120 km (from south to north). The periods of small size of the metapopulation represent probably a risk for the viability of the populations. The rate of dispersal is the same as that observed in Sweden (14–15 %). The distance is also quite similar with a longest distance of 310 m in a single flight and a maximum of 700 m in consecutive flights. Habitat fragmentation has run for at least 60 years in the hedgerow network in the Orne department and started more than 100 years ago in orchards of chestnut trees in the Sarthe department. The occupation rate is low and decreases strongly. During our 10 years survey, we also observed a temporary occupation of some cavities by *Osmoderma*. The medium size of these populations was low. The low density and the strong decrease of the occupation rate seem to have an effect on the risk of extinction. Without conservation efforts, these populations have a low probability of surviving. The hedgerow network in the Orne department has been protected in the land consolidation program. The orchard of chestnut trees in the Sarthe department is protected and maintained by an implemented plan of restoration by the department of the Sarthe. The preservation of the last metapopulations is urgent but difficult to implement because of the important duration of habitat restoration.

#### **Diversity of saproxylic beetles in oak forests of Poland: canopy vs understory**

Jacek Hilszczański, Radosław Plewa and Tomasz Jaworski — Department of Forest Protection, Forest Research Institute, ul. Braci Leśnej 3, Sękocin Stary 05-090 Raszyn, Poland

Oak forests are considered among the richest in respect of saproxylic fauna. We studied diversity and vertical distribution of saproxylic beetles in over 100-year-old managed oak stands in Poland. Studies

were conducted in 2009-2010 in five localities: Hajnówka, Krotoszyn, Łochów, Pińczów and Puławy. Beetles were collected using traps consisting of three units, i.e. yellow pan trap (Moericke's trap), barrier trap, and a plastic roof resembling a Malaise trap. Sixty traps were used in the study; 30 traps were installed in the lower and 30 in the upper layer of stands, at an average height of 20.5 m and 4.5 m, respectively. To investigate the colonization pattern of beetles inhabiting oak branches, freshly cut oak logs were also installed in both upper and lower forest strata. For each study site volume of dead wood and living trees were measured. Decay stage as well as distribution and coverage of study area by dead wood were estimated, to evaluate habitat quality for the development of saproxylic beetles. A total of 15 537 adult beetles were collected and 11 561 specimens (74.41 %) were classified as saproxylic. Saproxylic Coleoptera were represented by 366 species and 48 families. There were no specific communities of beetles for each forest stratum, however, this was confirmed for a number of individual species. Preferences of some species toward particular forest layer were also confirmed based on the experiment with oak logs. The highest values of parameters related to habitat quality for saproxylic beetles were found in Hajnówka. Nevertheless, the highest species richness was recorded in Puławy, and was followed by Krotoszyn, Hajnówka, Łochów and Pińczów.

### **Do early colonizing beetles on dead aspen affect fungi present 10 years later?**

Rannveig M. Jacobsen — The Norwegian University of Life Sciences, 1430 Ås, Norway

This study is based upon data from 60 sites where an aspen snag and log were created in 2001, insects were sampled during 2002–2005 and fungal fruiting bodies were registered in 2013. We investigated whether certain species of fungi were more or less likely to be present as fruiting bodies in 2013 on sites where certain species of insects had been abundant or simply present during 2002–2005. Preliminary results show that the fungi *Trametes ochracea*, *Datronia mollis* and *Bisporella citrina* were more frequently present in 2013 at sites where species of the predominantly fungivorous Ciidae had been sampled during 2002–2005. Fungivorous insects might act as vectors for spore dispersal, and they might shift the competitive balance between wood-decaying fungi through preferential grazing. Weevils and long-horn beetles seemed to have positive effects on some species of fungi and negative effects on other species. Some fungi also responded to abundance or presence of single species of insects.

### **Large oak trees within or outside of forests as key habitat elements for saproxylic beetle conservation**

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Forest managers have become increasingly aware of the role both of deadwood and of large trees, especially of microhabitat-bearing trees («habitat/wildlife trees»), in maintaining the declining saproxylic biodiversity. We here studied the effect of large oaks (DBH>70 cm), within and outside of lowland forests, on local saproxylic beetle assemblages, sampled using unbaited window flight traps hanged up high in trees. We first analysed in 2012 the influence of large tree densities on saproxylic habitat conditions (deadwood and tree microhabitat density and diversity, canopy closure) and beetle assemblages in 11 (mostly high) oak forests in northern France. Our results are meant to discuss conservation forestry methods based on extended rotations. We secondly focused in 2013 on beetle diversity associated with large oak trees within or outside (solitary, lined or clustered) of forests in a paired design. The importance of forest and non-forest habitat trees in saproxylic habitat networks for biodiversity conservation policies is discussed.

### **Favourable condition monitoring of UK sites for saproxylic beetles**

Keith Alexander — 59 Sweetbrier Lane, Heavitree, Exeter EX1 3AQ, England

The four constituent countries of the UK have been developing their own individual methodologies for assessing the favourable condition status of sites which are legally protected – at least in part – for their saproxylic beetle assemblages. In England a formal methodology has been developed which defines how the site survey event is organised, and the resulting species list – the saproxylic assemblage – is then assessed using a Microsoft Excel application designed for the purpose. This calculates a Saproxylic Quality Index (SQI) for each data set; the Index is based on the conservation status of

each species found. Individual species are not targeted other than through a broad search of the full range of habitats present. An assemblage approach is also taken in Northern Ireland but in a much more informal way, and involving lists of named target species and thresholds for species-richness which should be met through sampling in order to achieve favourable condition status. In Scotland, a shorter list of named target species needs to be sought and the condition assessment is based primarily on expert opinion following site survey. In Wales, the emphasis is placed on assessing the quality and quantity of the key habitat features rather than sampling the fauna directly. A case study is presented which illustrates the value of the SQI approach using three parkland sites and a traditional orchard in the English Midlands.

#### **The Life Project «MIPP»: monitoring of saproxylic beetles of community interest and citizens involvement**

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The Life Project «MIPP – Monitoring Insects with Public Participation» (LIFE11 NAT/IT/000252) deals with scientific tasks, the development of standard monitoring programs for Habitats Directive saproxylic species, and «citizen science», the involvement of citizens as surveyors for the implementation of the national database of distribution of these species. The project started in 2012, lasts until 2017 and the actions are distributed within 7 Associated Beneficiaries. The main goals of the project will be detailed. The monitoring programs are tested in five forest areas in Central and Northern Italy starting in 2014. Classical and innovative methods will be compared. For the first time the citizens will be involved in the survey of *Osmoderma eremita*, *Lucanus cervus*, *Cerambyx cerdo*, *Rosalia alpina*, *Morimus asper-funereus*, the potentials of this approach will be discussed.

#### **Is global research on saproxylic beetles neglecting one of the most important biogeographical rules?**

Jakub Horák — Czech University of Life Sciences Prague, Faculty of Forestry and Wood Sciences, Department of Forest Protection and Entomology, Kamycka 1176, CZ-165 21 Prague, Czech Republic

Latitude is one of the most evaluated phenomena in global biodiversity studies. It is indicated that the number of species is rising from Pole toward Equator. The main aim was to find how the number of scientific papers dealing with saproxylic beetles is distributed along latitudinal gradient. I found that, even when using other variables that potentially influence the studied gradient as co-predictors, the distribution of papers on saproxylic beetles is contrarily raising from Equator to Pole. As latitude was correlated with Gross Domestic Product per capita – one of the main conclusions appears to be relatively simple: Money inversed one of the biogeographical rules.

#### **Saproxylic beetles in harvested forests of Eastern Bohemia**

Teresa Loskotova — Česká Zemědělská Univerzita v Praze, Fakulta lesnická a dřevařská, Kamýcká 1176, CZ-165 21 Praha, Czech Republic

Harvested forests appear to be neglected in studies of saproxylic organisms. The main goal of our study was to find if there is a difference between native oak stands and non-native Norway spruce stands in species richness and abundance of saproxylic beetles. Saproxylic beetles were studied in east Bohemia (Czech Republic). The studied area had nearly 6,500 ha. We studied saproxylic beetles in a paired design – we had fifteen pairs of oak and spruce stands of the same age. We used flight-interception traps fixed to iron sticks, each trap was situated in the center of the particular studied stand. We trapped 201 species of saproxylic beetles with 1852 individuals. Norway spruce stands were species richer ( $31 \pm 2.20$ ) than oak stands ( $28 \pm 1.80$ ) and the same result was reached for abundance of

saproxylic beetles – Norway spruce ( $66 \pm 6.58$ ) and native oaks ( $57 \pm 5.66$ ). Our results were at least a bit surprising, since most of recent ecological studies report that non-native stands are biodiversity coldspots. Oaks are known to be biodiversity hotspots for a majority of saproxylic organisms. However, our results indicated a different pattern. Norway spruce stands can support biodiversity of saproxylic beetles in harvested forests.

### **Microclimatic divergence in a Mediterranean canyon affects richness, composition, and body size in saproxylic beetle assemblages**

Jörn Buse, Samuel Fassbender, Martin H. Entling & Tomas Pavlicek — University Koblenz-Landau, Institute for Environmental Sciences, Ecosystem Analysis, Fortstr. 7, 76829 Landau, Germany & University of Haifa, Institute of Evolution, Mt. Carmel, Haifa 31905, Israel

Large valleys with opposing slopes may act as a model system with which the effects of strong climatic gradients can be evaluated. The advantage of such comparisons is that the impact of a change of climate can be studied on the same species pool without the need to consider regional differences. The aim of this study was to compare the assemblage of saproxylic beetles on such opposing slopes at a Mediterranean site. We searched for patterns of species richness, assemblage structure, and body size resulting from interslope differences in microclimatic conditions. Field work took place in Lower Nahal Oren, Mt. Carmel, Israel (also known as «Evolution Canyon») with a 200-800 % higher solar radiation on the south-facing (SFS) compared to the north-facing slope (NFS). We sampled beetles with thirty flight-interception traps throughout the vegetation period in 2009. Fifteen traps per slope were placed at three elevation levels ranging from 50 to 100 m a.s.l. (five traps at each slope elevation). Richness but not diversity of saproxylic beetles was on average 34 % higher on the SFS compared with the NFS, with no detected influence of elevation levels. The number of individuals was not influenced by slope aspect or by elevation level. Both assemblage structure and average body size were determined by slope aspect, with more small-bodied beetles found on the SFS. The «Evolution Canyon» has a rich fauna of saproxylic beetles that includes a number of Near East endemic species. Both the increase in species richness and the higher prevalence of small species on the SFS well reflect ecological rules acting on larger spatial grain. Both patterns may be related to the relationship of saproxylic beetles with woody plants under drought stress (plant stress hypothesis). Physiologically stressed trees are probably more attractive for small but abundant wood-inhabiting beetles such as Anobiidae and Scolytidae.

### **Saproxylic beetle communities along a gradient of management intensities in Swiss beech forests**

Thibault Lachat & Beat Wermelinger — WSL, Zürcherstrasse 111, 8903 Birmensdorf, Switzerland

One of the main functions of forest reserves is the conservation of saproxylic species. In order to further evaluate their needs, we sampled saproxylic beetles with flight interception traps in Swiss beech forests along a gradient of management intensities – from managed forests to old forest reserves. For this, 15 forest sites with 5 sampling plots each were studied during 2 years. More than 60 000 individuals representing about 500 saproxylic beetle species were collected, representing about 80 % of the estimated species richness. We could demonstrate a positive effect of the abandonment of forest management on saproxylic beetles both at the species or community level and at the functional diversity level. More specialized species, more Urwaldrelict species and more threatened species could be observed in forest reserves compared to managed forests. The quantity of deadwood was not the only environmental factor influencing the saproxylic beetle diversity. The time since the last management and the deadwood diversity – including tree species, decay stages, position and diameter classes – were also positively correlated with the saproxylic beetles diversity. We also showed, that managed beech forests in Switzerland are no biodiversity desert. It even seemed that newly established forest reserves are less favorable for saproxylic beetles than forests managed in a close-to-nature way. Measures to accelerate the quality improvement of young forest reserves might benefit saproxylic species.

### **The trophic rank hypothesis investigated for saproxylic beetles in hollow oaks**

Hanne Eik Pilskog, Anne Sverdrup-Thygeson, Tone Birkemoe and Erik Framstad — Department of Ecology and Natural Resource Management, Norwegian University of Life Sciences, P.O. Box 5003, NO-1432 Aas, Norway

Hollow oaks have gained attention as being an important hot-spot for a range of rare and red listed species of insects, fungi and lichens, and around 1500 species are associated with oak in Norway. In our study we wanted to investigate how functional groups of saproxylic beetles are affected when living in hollow oaks standing alone versus in a group of five in cultural landscapes and forests. According to the trophic rank hypothesis, species-area relationship should be stronger at higher trophic levels and we hypothesized that there would be less species on higher trophic levels as well as less oak specialists in solitary oaks than in the groups. Beetle data from 34 hollow oaks in Norway were used for the analyses, and all species were put into functional groups regarding oak association and feeding guild. Preliminary results from GLMMs indicate that isolation had a significant effect on the number of xylomycetophagous species present in the trees, but landscape and tree characteristics were more important for most trophic levels.

### **Vertical stratification of saproxylic beetle assemblages in a lowland floodplain forest and a mountain forest**

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Determinants and patterns of vertical stratification of arthropods are insufficiently known in temperate woodlands, where most studies rarely consider finer scales than just canopy and understorey. We thus investigated vertical stratification of saproxylic beetles in temperate lowland and montane forests at five heights above ground. The beetles were collected using 150 flight interception traps arranged into vertical transects (0.6, 1.5, 7, 14 and 21 m above ground) in the broadleaf floodplain forest along the lower Dyje (Thaya) river (155 m a.s.l.) and in the beech dominated highland forests of the Beskid Mountains (W Carpathians; 715 – 1035 m a.s.l.). The main goal of our study was to compare patterns of vertical stratification between montane and lowland forests and to assess how various forest strata contribute to the diversity of local assemblages. The diversity was higher in the lowlands than in the mountains at all sampled heights. It peaked at 1.5 m above ground level at both elevations. In the lowlands, diversity was lowest at the 0.6 m height, and nearly identical at the three sampled heights of the canopy. In the montane forest, the diversity was lowest in the canopy (14 m and 21 m). In both habitats, the three canopy heights hosted more similar assemblages, whereas the assemblages in the understorey (0.6 m and 1.5 m) differed substantially from the canopy as well as from each other. Furthermore, the same strata (0.6 m and 1.5 m) showed the highest amount of stratum specialists in both habitats. We may conclude that in the two, ecologically different, forest types: (i) The patterns of vertical stratification were similar, and (ii) there was much higher turnover of species near the ground than in the canopy. Also, comparisons of diversity between canopy and understorey might give contrasting results depending on the exact heights sampled.

### **Effect of logging intensity on a community of bark beetles and their predators in montane beech-fir forests**

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Assemblages of bark and ambrosia beetles and their predators from the beetle families Cleridae and Salpingidae were studied in montane beech-fir forests of north-eastern Moravia, Czech Republic. 72 non-baited flight interception traps were placed at 1.5 m above ground in forests divided up into three categories of logging intensity. In the first category were nature reserves with non-intervention management, the second category comprised nature reserves with limited logging and the third category commercial forests. 3843 specimens belonging to 26 scolytid species were collected. Only few individuals of fir monophages (*Cryphalus piceae* and *Pityokteines curvidens*) were found at the study sites, although these had been reported as common a few decades ago. This is probably related to the decline of silver fir in most of the studied stands. Abundance of bark beetles peaked in nature reserves with limited logging, while significantly lowest numbers of bark beetles (Kruskal-Wallis,  $p < 0.05$ ) were found in non-intervention forests. Numbers of species were similar in all compared forest cat-

egories. 124 specimens belonging to five species of bark beetle predators (Cleridae, Salpingidae) were collected. Their abundance correlated significantly with the abundance of bark beetles ( $rS = 0.38$ ;  $p < 0.05$ ).

### **Response of saproxylic beetle fauna to wood-pasture restoration in Epping Forest, UK between 2003 and 2010**

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Epping Forest is the largest open space in the London area at over 2,500 hectares and has been owned and managed by the Conservators of Epping Forest since 1878. Of this open space 1,605 hectares is a Natura 2000 site. The majority of this, 1,400 hectares is lowland wood-pasture, making it one of the largest areas of this Priority Habitat in the UK. With an estimated 55,000 veteran pollarded trees, comprising mainly hornbeam *Carpinus betulus*, oak *Quercus robur* and beech *Fagus sylvatica*, Epping Forest has one of the largest populations of veteran trees in Europe.

The study reported here aimed to assess the changes in the saproxylic invertebrate fauna of the veteran oaks following wood-pasture restoration work. The restoration work involved clearing infill secondary woodland (especially Birch *Betula* and Holly *Ilex*) from around the veteran pollards. Removal of this infill opened up the aspect around the Oak pollards so that they were in conditions with increased light levels. The study concentrated, in particular, on beetles (Coleoptera) and samples were collected using vane traps suspended in front of tree cavities. The initial samples were taken in 2003 prior to any management works. The survey was then repeated in 2010, with the same traps set in front of the same cavities, several years after the clearance of infilling shade trees had taken place. Two sites in the Forest were sampled each with 20 vane traps on 20 Oak pollards, making a total of 40 traps. Of these traps 10 at each site were left in the shade as controls around which no clearance work took place between 2003 and 2010 – the control trees/areas. The other 10 traps at each site were on trees which were opened up to more light after 2003 – and in changed conditions by 2010 – the treated trees/areas.

During the trapping season between April and September beetle abundance and species richness both peaked around mid-June for all traps. The traps in trees in the opened areas showed increased abundance and species richness in 2010 after the trees had been opened to increased light. The traps in control trees did not show the same level of change between years. The number of species with a conservation designation (mostly saproxylics) also increased in the traps on trees in the two opened areas.

### **Opportunities for the conservation of deadwood inhabiting beetles in seminatural forests**

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It is important to understand how ecosystem components respond to changes in forest management. Saproxylic organisms have adapted to different deadwood qualities and amounts, determined by natural succession and disturbances in different forest types. We therefore analysed the presence of saproxylic beetles against deadwood quantities and qualities inventoried on a set of 128 stands varying from clear-cuts to old-growth forests on a gradient from nutrient-poor dry sites to nutrient-rich wet sites in Estonian hemiboreal forest. We captured 105 pre-defined habitat specialist species, of which 41 % were of conservation concern in the region. Species richness between site-types was very similar, while fertile mixed forests had the highest number of species not found in other types. As expected, old forests had more species and individuals than managed, mature forests. Clear-cuts hosted at least 3 times more individuals than closed canopy forests, and had also more species, retention-cut being the richest. Shannon's diversity index did not differ between site types or management stages. The substrate models for 34 species abundant enough for habitat modelling indicated no non-linear relationships and most substrate associations were with some broad dead-wood category. Other important stand parameters were forest naturalness, site-type, and sun exposure. We conclude that in such seminatural habitat other factors besides substrate, like habitat connectivity, patch size or landscape history can be influential. Hence, abundance of dead wood can only provide one step in adjusting forest management for protection of saproxylic organisms.

### **Pollarding: an important, but overlooked tool in the conservation of saproxylic beetles**

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Veteran trees and trees with hollows are key features sustaining biodiversity in wooded landscapes. However, they have become rare and localised, and most of the associated biota is declining and/or endangered. The challenge of its conservation, therefore, is to safeguard the presence of the hollow and veteran trees in sufficient numbers. Populations of numerous species associated with tree hollows and dead wood are often found in habitats that were formed by formerly common traditional silvicultural practices such as coppicing, pollarding or wood pasture. Pollarding is an age-old silvicultural practice that leads to rapid formation of tree hollows and bare wood, the microhabitats usually associated with old trees. Further, pollard trees also tend to live longer than unpollarded ones. Pollarding thus increases density as well as continuity of microhabitats associated with veteran trees. It is therefore a very important tool in the conservation and restoration of saproxylic habitats. It is, however, also the overlooked one. Despite its potential, pollarding is rarely practiced as conservation management. Since it was common in most of Europe, numerous old trees bear signs of former pollarding. Such trees are also key habitats for populations of many threatened veteran tree specialists such as *Rosalia alpina* or *Osmoderma eremita*. The old pollards, however, disappear without replacement due to removal in commercial forests, due to abandonment of the practice, and prevailing hands-off approach in wooded reserves. Restoration of pollarding is necessary to increase spatial and temporal landscape connectivity and prevent loss of saproxylic biodiversity across the continent.

### **Species richness of saproxylic beetles in recently dead aspen; the importance of the surroundings**

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Loss of natural forests and decline in forest biodiversity has led to several policy initiatives in recent years. Despite this, the importance of smaller set-asides versus forest reserves for conservation measures is poorly understood. In the present study we evaluated the importance of three different area-based conservation measures commonly used in north-European forest; retention patches, woodland key habitats and forest reserves. Eight replicated sites for each of the three conservation set-asides were investigated for saproxylic beetles in three boreal forest landscapes in south-Norway. Two identical units of aspen dead wood were added to each site and beetles were trapped by open and closed window traps during tree summers. By comparison of the two trap types on identical substrate, open window traps were found to oversample individuals of non-aspen saproxylics. Thus, further analysis was only performed on aspen-associated beetles. Summing up the species numbers from both trap types at each site, the subgroup aspen-associated specialists were able to locate recently dead aspen equally in all three set-asides. The aspen-associated generalists, on the other hand, reached the highest species richness in the woodland key habitats. Adding variables on forest volume (based on satellite data) and dead wood (based on field survey), areas with more than 75 m<sup>3</sup> deciduous wood per ha within 3 km from each sampling point were found to be the best single predictor of total aspen-associated beetle richness. Together with the design variable landscape, more than 50 % of the variation in the model was accounted for. Thus, although aspen specialists seem able to find their resource wherever it is situated in the landscape, high densities of deciduous trees appears important for the overall diversity of aspen-associated beetles.

### **Saproxylic beetles and hole nesting birds in three relict beech forests of central Italy: assessing the importance of dead wood in biodiversity conservation**

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Saproxylic beetles are one of the major components of forest communities and are assumed to be one of the most important food resources for vertebrates. Nevertheless, the correlation between saproxylic insects and hole nesting birds in forest ecosystems has never been studied in terms of species diversity and abundance. We studied saproxylic beetles and hole nesting birds in three relict beech forests of central Italy, and analyzed the preferences of these two groups of animals for different dead wood descriptors. Hole-nesting birds could be considered as obligate saproxylic organisms because the avail-

ability of dead wood is essential for their life cycle. Data on bird diversity were gathered by Standard Point Count Methods while saproxylic beetles were surveyed by four trap types set in the same sampling sites. We performed analyses of richness and similarity in the beetle communities of the study areas, and of the species composition in relation to trap position and colour. In order to correlate richness and abundance of beetles and birds in a symmetric way, we used co-inertia analysis (CoIA). To correlate the dead wood attributes (dead wood typology and decay class) with birds and beetles assemblages in a predictive way, we used redundancy analysis (RDA). Our results showed a significant relationship between saproxylic beetles and hole-nesting birds communities. Three dead wood variables (volume of standing dead trees, stumps and large branches on the ground) appeared to be good predictors of saproxylic beetle richness while the volume of standing dead trees and of dead trees on the ground appeared to be a good predictor of hole-nesting birds. An important outcome of this study is that deadwood diversity variables combined with wood decay classes provided more predictive models than volume alone and enables specific recommendations useful for forest management to be formulated.

### **Successful reintroduction of an endangered veteran tree specialist: Conservation and genetics of the Great Capricorn beetle (*Cerambyx cerdo*)**

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Habitat fragmentation is one of the main threats to biodiversity. Reintroductions or translocations may mitigate its effects by allowing species with limited dispersal ability to exploit otherwise inaccessible habitat patches. Despite the fact that reintroductions are among the most effective conservation measures, they are rarely used for invertebrates. In this study we investigate the potential of reintroductions as a conservation measure for beetles, and present the results of a reintroduction attempt for an endangered veteran tree specialist. A population of the Great Capricorn beetle was most probably established by translocation of 10 adult beetles in Hluboka nad Vltavou (Czech Republic) in 1987. Using population genetic analyses of 79 individuals based on nine microsatellite loci and 82 individuals based on the mitochondrial COI gene we assessed the origin of the reintroduced population, and compared its genetic variation, population structure and demography to the alleged source population (southern Moravia) and to the closest autochthonous population (Třebon). Although the reintroduced and the closest autochthonous populations are geographically close (24 km), their mutual genetic distance was much higher than that between each of them and the geographically distant (>150 km) potential source population in southern Moravia. The genetic diversity of the reintroduced population was the lowest from the three studied populations and represented a subset of the alleged source population suggesting its establishment due to a translocation from southern Moravia. Today, the reintroduced population is one of the largest populations of *Cerambyx cerdo* in the western part of the Czech Republic (Bohemia), where the beetle range collapsed in the past century. It represents an example of successful reintroduction of a threatened saproxylic beetle. Our results suggest that reintroductions could serve as a highly effective measure in biodiversity conservation and in some cases it may be the only chance to prevent extirpation of many endangered populations.

### **Conservation genetics of the Noble Chafer (*Gnorimus nobilis*): habitat fragmentation, population connectivity, and European phylogeography.**

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The Noble Chafer (*Gnorimus nobilis*, Coleoptera: Scarabaeidae) is a widespread Eurasian heartwood-rot specialist, feeding as a larva within the trunk and branches of veteran oak, willow and beech. However, in the UK it is largely restricted to traditionally-managed orchards; post-war changes in orchard management practices have resulted in a loss of 87 % of the UK's traditional orchards. This reduction, with consequent fragmentation, of habitat represents a serious threat to *G. nobilis* in the UK, with conservation practises hindered by the complete absence of data on population demography. Though the species is widespread, veteran forests are in decline, and it is at risk of extinction in parts of its range.

This research aims to employ a suite of genetic markers to investigate patterns of neutral and adaptive genetic structuring in Noble Chafer and to disentangle the roles of historical and recurrent processes on various spatial scales. Phylogeographic and population genetic analysis will provide insight into range wide genetic diversity, patterns of post-glacial recolonisation, and species life his-

tory/landscape factors determining contemporary population connectivity and demography. A key source of information will be genotyping frass pellets. High molecular weight DNA has been successfully extracted from frass pellets using standard extraction protocols permitting successful downstream analysis of mtDNA and nuclear loci. Frass thus represents an excellent resource for genetic studies of other cryptic/endangered rot-hole taxa. Currently, the mitochondrial COI gene indicates one dominant haplotype found in Europe, with populations in Poland, Italy and Russia being 1-5 % divergent from dominant haplotype. Ecological information will be interpreted within the wider project which incorporates information on society's role in orchard declines from a social science perspective to optimise conservation.

#### **Colonization gates: molecular ecology of the tree-fungus-beetle triangle**

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Species and habitat knowledge combined with DNA barcoding opened new possibilities for saproxylic molecular ecology using high-throughput sequencing. Trees, fungi and insects are involved in tight interaction networks, and resolving how such systems work is a major challenge. Before the patterns are explained and the processes modelled, species of fungi and insects at the cryptic life stages (spores, mycelia, larvae) need to be detected, identified and quantified. We approach an ecological triangle comprised of spruce, wood-decaying fungi and saproxylic beetles in Finland.

### POSTERS

#### **Distributional changes in selected saproxylic beetles in the Czech Republic**

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Distribution of saproxylic beetles listed in the Annexes of the Habitats Directive (*Cerambyx cerdo*, *Cucujus cinnaberinus*, *Limoniscus violaceus*, *Lucanus cervus*, *Osmoderma eremita*, *Rhysodes sulcatus* and *Rosalia alpina*) is in the Czech Republic an object of surveillance in the scope of Directive's obligations. Year 2013 was the 2nd reporting term and the status of these species, also based on distributional changes, was assessed. The status of these species in most cases remained unchanged and unfavourable. Despite that, several distributional changes in the reported six year period have been recorded, as new appearance in the biogeographical region (*Rosalia alpina*, *Limoniscus violaceus*) and new localities (*Cucujus cinnaberinus*, *Lucanus cervus*) confirming the habitat assessment presumptions. The recorded cases will be summed, illustrated and commented.

#### **Oak living saproxylic beetles from trap studies in 10 countries in Europe and neighbouring countries**

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Old oak and their fauna are very rare and threatened all over Europe and neighbouring countries. Some preliminary results can now be presented from an international project aiming to describe and compare the biodiversity on old oaks (*Quercus* spp) . In total 23 sites with old hollow oaks from 10 countries have been studied with similar methods. In all sites some kind of window traps were operated, with windows varying in size, but mostly near to 60 cm height and 30 cm width. They were used for one field season (during one year in the period 1994-2011) on 10 trees at each site. So far 541 taxa

from 13 families have been identified and used in the analysis. The families with the highest diversity were Anobiidae and Elateridae. The results show a large variation in species diversity and composition. The sites from north, west and central Europe have the most similar fauna while the countries around the Mediterranean show a larger variation among themselves. The most species rich fauna was found at some of the Turkish and one of the French sites. The richest Turkish site has over three times as many species as the sites with the lowest number of species from the studied families.

#### **What can the chemical composition of tree hollows tell us about their associated biodiversity?**

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Saproxylic beetles exploit many different kinds of microhabitats related to dead wood. In Mediterranean *Quercus* forests, tree hollows are one of the most important microhabitats for saproxylic fauna in terms of species diversity. Inside tree hollows we find a highly complex community in which different functional groups (xylophagous, saproxylophagous, xylomycetophagous, predators and guests) interact among themselves and with the organic resources offered by the cavity. It is well known that many saproxylic beetles are able to modify the substrate physically and chemically. Moreover, these chemical changes in the substrate could also benefit other saproxylic species.

In this study we analysed the changes of the chemical composition of tree hollow substrates throughout a year, and we related these changes of the saproxylic beetles inhabiting the hollows. We measured the content of N, total carbon (Ct), assimilable organic carbon (Ca) and P as well as the Ct/N, Ca/N and Ct/P ratios in 34 tree hollows of two *Quercus* species in the Mediterranean region of the western Iberian Peninsula. After one year, the organic matter in the hollows was richer in nitrogen, phosphorous and also in organic elements easy to decompose such as assimilable organic C. Moreover interesting positive correlations were found between the content of some of these elements in the tree hollow with the beetle species richness and abundance. These results suggested that the chemical composition of a tree hollow could be more a consequence of their biodiversity than a cause.

#### **The training of Osmodog in the LIFE Project MIPP**

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The main goals of the Life Project «MIPP – Monitoring Insects with Public Participation» (LIFE+, LIFE11 NAT/IT/000252) are: to develop efficient and low impact monitoring methods for flagship species of saproxylic beetles, to educate on Natura 2000 and to involve citizens directly in the collection of presence-data of insect species listed in the Habitats Directive (citizen science). In this context, some Actions of the project are focused on the acquisition and training of a dog (the so-called Osmodog) for detecting specimens of *Osmoderma eremita* (Scopoli, 1763) in the field. Osmodog will allow us to conduct surveys and to monitor this rare beetle species in different areas with a low impact technique, avoiding the use of traps and other potentially more invasive monitoring techniques during the project, e.g. black cross window traps, interception air traps, pitfall traps in the hollows of trees or wood mould sampling. In addition, the dog is the main advertising vehicle of the project: through the website [www.lifemipp.eu](http://www.lifemipp.eu), Facebook, newspapers, magazines, comic strips, participation in television programs, education activities at school, the Osmodog will serve to attract the non-specialist audience to the project. Anyone, in fact, can participate by sending reports and new records of the nine species of insects (beetles, butterflies and grasshoppers) involved in the project and included in the Annexes of the Habitats Directive. Here we present the preliminary results of our work with the dog.

### **Landscape genetics of the red click beetle *Elater ferrugineus***

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Understanding factors that limit gene flow through the landscape is crucial for effective conservation of organisms living in highly fragmented habitats. In this study, we analysed patterns of gene flow and population substructuring in *Elater ferrugineus*, an endangered click beetle living in old-growth, hollow trees in a network of rural avenues surrounded by inhospitable arable land. Using Amplified Fragment Polymorphism (AFLP) data, we aimed to evaluate if the landscape features important for the beetle's development, i.e. avenues of old-growth deciduous trees, are also important for its dispersal. By dividing the sampling area into 200 x 200 m cells, with each cell categorised into one of four classes according to its permeability for dispersing beetles, and by correlating matrices of genetic and landscape distances, we evaluated whether some landscape types showed higher correlation coefficients than resistance distances measured over null landscape models, i.e. homogenous landscapes. Substantial inbreeding in *E. ferrugineus* was detected, and there was a significant negative correlation between genetic relatedness and spatial distance. Of 81 landscape grid models tested, four models (those in which the highest conductance was assigned to tree avenues) gave a better fit with the observed pattern of gene flow compared to the 3 null models. Our data thus support the hypothesis that tree avenues can function as efficient dispersal corridors for *E. ferrugineus*. This study highlights the importance of saving such avenues to increase the connectivity among suitable habitat patches, thereby reducing the risk of local extinctions of *E. ferrugineus* as well as other saproxylic organisms.

### **Assemblage composition and vertical stratification of bark beetles (Coleoptera: Curculionidae: Scolytinae) in temperate lowland and montane forests**

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Vertical requirements of many insect species of temperate forests are still poorly known. If taken into account, research is mostly limited to a comparison of canopy and understory assemblages. We studied vertical stratification of bark beetles in temperate lowland oak-ash dominated and montane beech-fir forests using 150 flight interception traps arranged into vertical transects (0.6, 1.5, 7, 14 and 21 m above ground). 1428 specimens belonging to 30 species were collected in the lowland and 6698 specimens of 27 species in the montane forests. Thirteen species were identified as indicator species for one or more trap heights. The preferred flight height was affected by the exploited tree part: three species developing mostly in branches and twigs were associated with the traps exposed at 21 m and at 14 m, four species developing mostly in trunks and branches were associated with traps at 7 m height, and six species developing mostly in recently fallen trees or fresh snags were associated with traps at 1.5 m height. No species was associated with 0.6 m height. Species richness and abundance of ambrosia-fungi feeders peaked at 1.5 m in the mountains, while they were almost evenly distributed from 1.5 to 21 m in the lowlands. Species richness of phloem feeders peaked at 7 m height. In both forest types: (1) the overall species richness peaked at 7 m and (2) was lowest at 0.6 m; (3) the main change in assemblage composition occurred between 1.5 and 7 m; and (4) the canopy assemblages at 7, 14 and 21 m were rather similar and closer to each other than to the assemblages collected at 1.5 and 0.6 m. We found that the main patterns of species richness and vertical stratification of scolytid assemblages were similar between the lowland and montane forests. Our results also suggest that bark beetle stratification is most pronounced near the ground in temperate forests.

### **Association patterns in saproxylic insect networks among Mediterranean woodland sites**

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The diversity of saproxylic insect assemblages is the result of a wide conjunction of ecological features. In the Mediterranean woodlands of Cabañeros National Park (Spain), saproxylic diversity is

highly linked to the presence of tree hollows in mature trees. Moreover, the interaction between saproxylic insects and hollows shows specialised interacting patterns that model the structure and stability of these saproxylic assemblages. The objective of this work is to evaluate how interacting patterns of saproxylic insect networks vary according to woodland sites. We selected three representative Mediterranean woodlands in the Park: one sclerophyllous oak woodland of *Quercus rotundifolia*; one mixed deciduous oak woodland of *Quercus pyrenaica* and *Quercus faginea*; and one ash riparian woodland of *Fraxinus angustifolia*. We considered 30, 30 and 27 tree hollows, respectively, which were covered with emergence traps. Our study lasted one year, during which traps were emptied monthly and pots were replaced. We selected Coleoptera and Syrphidae (Diptera) as study groups. They were sorted according to trophic guilds: xylophagous, saproxylophagous, saprophagous, xylomycetophagous and predators. We used Aninhado and Modular programmes to evaluate the network architecture, and bipartite for R programme to study interacting attributes in the hollow-saproxylic insect interaction in each woodland site. Saproxylic insect-hollow networks presented a significant nested pattern, which means that most of the interactions are established with the most generalist nodes/species at both trophic levels (in this case, the lower trophic level is composed of hollows and the higher trophic level is composed of insects). Not all studied forests showed the same level of connectance (proportion of possible links between trees and species), the deciduous oak woodland being the forest with the most densely interconnected network.

### **Designing the study of the effect of volatile organic compounds (VOCs) emitted by *Quercus pyrenaica* on saproxylic beetle assemblages**

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Saproxylic fauna is one of the fundamental components of temperate deciduous European forests. Currently, many species of this saproxylic fauna are seriously threatened due to a wide range of factors (e.g. forestry, which is causing landscape fragmentation). Specifically, saproxylic beetles tend to shape very complex assemblages which are influenced by a lot of different factors which, in turn, determine both landscape- and local-scale forest structure. Therefore, it is necessary to perform a deep study of all the factors which are conditioning the formation of assemblages in this group of organisms and, one of those factors are the volatile organic compounds (VOCs) released by potential host trees. Previous studies have shown that insects can detect these chemical signals and develop a behavioral response. Thus, the formation of saproxylic beetle assemblages could be conditioned by the type and amount of VOCs released by the host tree. Based on the above, we analyzed whether there are significant differences in the set of volatile organic compounds released by specimens of *Q. pyrenaica* with different ages and decay stages and we tried to figure out how the release of these compounds affects the composition and species richness of saproxylic beetles associated with this tree species.

### **Do species interactions prevent *Limoniscus violaceus* from living in suitable basal hollow trees?**

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The violet click beetle (*Limoniscus violaceus*) is an endangered beetle that is protected in Europe. Its conservation required better knowledge on its biology. Recently, a study revealed that the probability of occurrence of *L. violaceus* in hollows increases with increasing tree circumference at 30 cm above ground and with increasing hollow decay stage (Gouix *et al.*, submitted). However, the model showed that it was easier to identify unoccupied hollows than to identify the occupied ones. As tree hollows harbour a range of associated and facultative species living within a relatively small habitat, we may suspect some species interactions (competition and/or predation) that prevent *Limoniscus violaceus* from occupying suitable basal hollow trees. We studied beetle and spider assemblages emerging from 73 basal hollow trees located within a single forest site of 3500 ha (in France). All trees were considered to be suitable for *Limoniscus violaceus* (i.e. trees with a circumference at 30 cm above ground greater than 235 cm and cavity at an advanced stage of decay). We used the probabilistic approach to test for statistically significant pair-wise patterns of species co-occurrence. In total, 4805 species pairs were analyzed and 9.6 % had non-random patterns. We detected very few negative co-occurrence patterns (19) compared with positive ones (444). Regarding *Limoniscus violaceus*, we

found 25 positive associations of the beetle with other species, and no negative association. The absence of *L. violaceus* in the suitable trees thus cannot be explained by competition or predation. Alternative hypotheses (other abiotic factors or the beetle's population fluctuations) remain to be investigated.

**Genetic differentiation patterns between two closely related species: the case of *Lucanus cervus* and *L. tetraodon* (Coleoptera, Lucanidae) in Italy**

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Twenty-two saproxylic beetles are listed in Annex II of the European Habitats Directive, nine of which are present in Italy. These beetles are considered «flagship species» for the conservation of ancient forests and are extremely familiar and easily determined species. One of the best known is the European Stag beetle, *Lucanus cervus*, with a western European distribution. In Italy, France, North Africa, Albany and Greece (Central Mediterranean distribution) it is present with a closely related species, *Lucanus tetraodon*. In Italy, it is mainly distributed in central and southern Italy but recently has also been recorded from a relict locality in Lombardy (Ticino valley). In some central and central-northern areas, where the two species are sympatric, individuals with mixed morphological traits are frequently found. We used both mitochondrial (COI) and nuclear markers (wingless) on 55 individuals from the Italian peninsula, inclusive of syntopic areas, to assess genetic identity of the two species and of the morphologically intermediate individuals. The COI results show a marked genetic differentiation between *L. cervus* and *L. tetraodon* species through the presence of two well-supported clades. The individuals with mixed characters fall either in *L. cervus* or in *L. tetraodon*. Interestingly, some samples from overlapping areas, morphologically attributed to *L. tetraodon* are actually genetically *L. cervus* and vice versa. The nuclear marker sequences show the presence of double peaks in conserved position. The double-peak pattern does not follow the COI-species distinction evidencing an introgression, probably old, between the two species and the presence of gene flow in sympatric populations. The areas of sympatry may represent a secondary contact between incipient species that diverged in allopatry and did not complete the process of speciation. One of the main conclusions is, therefore, the necessity of an extended morphological revision to re-define the diagnostic characters for the two species.

**A three years study of saproxylic biodiversity in an alluvial forest: deadwood, beetles and fungi of the Table-Ronde Island (Rhône, France) (Coleoptera)**

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Deadwood stocks and the diversity of saproxylic beetles and fungi were studied in seven stands of the alluvial forest of the Rhône river. The volumes of deadwood ranged from 22 to 184 m<sup>3</sup>/ha. The most represented trees by volume were Poplars. Deadwood resulted from large natural collapse of mature stands driven by storms or tree-by-tree in younger stands. 133 saproxylic beetle species and 107 saproxylic fungi were found in the study sites and 200 and 130 species, respectively, when considering the overall forest. Twenty beetle species were rare at the national level or red listed at the European level. Comparisons between saproxylic beetle communities suggested a decreasing similarity with the increasing distance between sites. For fungi, two species new for science were described in the material collected and 17 species were considered as rare at the national level. We found only a weak correlation between diversity of saproxylic species and the volume of deadwood. This is likely due to a sampling effect but also to the importance of deadwood quality rather than quantity.