

**FOUNDATIONS OF BIODIVERSITY: SAVING THE
WORLD'S NON-VERTEBRATES**
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RESEARCH POSTERS PRESENTED

Diversity of geometrid moths in Northern China - altitude and habitat

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In the mountain ranges north of Beijing, species composition and diversity of geometrid moths was investigated using light traps at four different elevations between 400 and 1600m in agricultural and semi-natural habitats. A total of 14,692 geometrid moths representing 110 species were recorded. Alpha diversity peaked at lowest elevations in all habitats, with highest values (Fisher's Alpha: 18.4) recorded on agricultural fields. At agricultural habitats located at higher elevations (800–1600m), Fisher's Alpha reached less than half the values observed at 400m, ranging between 8.5 and 7.3. The drop was less extreme for semi-natural habitats, with mean values of 13.9 at 400m and ranging from 10.1 to 6.3 at higher elevations.

Ordination diagrams revealed that species assemblages were grouped primarily according to elevation, with habitat-specific sub-clusters occurring within the respective elevation clusters.

Observed high values in agricultural fields are believed to relate to the relatively low levels of intensification in agricultural practices throughout the study region, whereas elevation has commonly been identified as a key factor explaining species turnover in insect assemblages.

Studies on animals in 'Sabah Al-Ahmad' natural reserved area in the State of Kuwait

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To evaluate the factors controlling biodiversity in 'Sabah Al-Ahmad' natural reserved area in the State of Kuwait, a comprehensive study was carried out on mammals, insects, arachnida, birds and soil, through the day and night for 12 months (May 2008–May 2009). The results indicate that overall biodiversity (both animals and plants) in the reserved area has been greatly influenced by the scarcity of the rainfall during the last years. The decrease in the plant density has caused the migration of animals that use the plants for protection.

The studying of biodiversity in relation to the soil, taking into consideration climatic factors, indicates that a number of animals (Scorpion, *Uromastix* (Dhub), Fennec fox, insects (butterfly, black and domino beetles, beetle pretends) and birds (hoopoe, desert lark, and slender-billed gulls) are found and monitored in "Sabah Al-Ahmad" natural replaced area. The large numbers of insects and birds observed in the study area may due to the presence of an artificial lake and increased vegetation around the lake. By contrast, some animals, such as snakes and rodents, were not found, which may be due to a lack of food and plant cover resulting from the scarcity of rainfall. However, the common occurrence of the *Uromastix* (Dhub) may be attributed to its hibernation habit and the presence of insects as a feeding source. Important results concerning factors controlling biodiversity are described and recommendations for preserving animals are given.

Identifying the Evolutionarily Distinct and Globally Endangered species of Gymnosperms: the EDGE-Gymnosperm Project

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Evolutionarily distinct species have very few or no close relatives on the Tree of Life, and therefore tend to be extremely distinct from other species. A high proportion of globally endangered species are also evolutionarily distinct. The EDGE of Existence programme (Evolutionarily Distinct and Globally Endangered), initiated by the Zoological Society of London and launched in 2007, offers a new approach to prioritising species conservation action, and is the sole global conservation initiative to focus specifically on threatened species that represent a disproportionate amount of unique evolutionary history. EDGE scores can be calculated for any clade of more than 100 species, providing that a dated species-level phylogeny exists for the group, and that each species has been assessed using the IUCN Categories and Criteria. Gymnosperms fulfil both these requirements, and are therefore a prime candidate plant group to be incorporated into the EDGE of Existence programme. We reconstructed a phylogenetic tree of Gymnosperms based on the plastid gene *rbcL* and obtained molecular time estimates using nine calibration points from the fossil record. Because gymnosperms are potentially not monophyletic, we compiled EDGE scores for each of the five groups within Gymnosperms (Pinaceae, Cupressophytes, Gnetophytes, Cycads and Ginkgo). We present here the top EDGE species for each group and discuss the implications of this metric for the conservation of these evolutionarily isolated and threatened species. Future projects within the EDGE programme will also be discussed.

Biodiversity training – introducing invertebrates to volunteer recorders

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The Biodiversity Training Project is a 5-year Heritage Lottery Funded Project designed to increase the number of people actively involved in biological recording in Shropshire and the wider West Midlands region. This is being achieved through the provision of free training courses in species identification by national and regional experts in field and lab-based skills. Many of our courses have sought to introduce invertebrate identification and recording to volunteers. Volunteers are already committed to the study of natural history, be they Wildlife Trust members, volunteers for Natural England or a local authority conservation body, or just individuals keen to learn. We are also helping people with skills in one area, such as botany, to diversify into recording invertebrates and are supporting regional and local recording groups, such as a beetle recording group and a hoverfly recording group. The poster will illustrate these activities.

BGCI – assessing the conservation status of plants in the wild

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Information about the status of plants in the wild is essential for planning conservation action and for meeting the targets of the Global Strategy for Plant Conservation (GSPC).

Target 2 of the GSPC calls for 'a preliminary assessment of the conservation status of all known plant species'. BGCI is using the IUCN Red List Categories and Criteria to document rare and threatened plant species worldwide.

BGCI has published a consolidated list of European threatened species. Compiled on a database, our list consists of national Red List data from 30 European countries and includes over 16,000 country records covering around 9,600 species. An analysis has allowed us to identify which European threatened species are included in living collections in European botanic gardens or seed banks and, more importantly, which are not.

The Global Trees Campaign, a joint initiative between BGCI, Fauna & Flora International (FFI) and the UNEP World Conservation Monitoring Centre (UNEP-WCMC) in association with other partners around the world, aims to save the world's most threatened tree species and their habitats through provision of information, conservation action and support for sustainable use.

The campaign focuses on trees as flagship species for conservation of ecosystems and landscapes, and enables local people to carry out rescue and sustainable use operations. The Red List of the Magnoliaceae, The Red List of Oaks, The Red List of Trees of Central Asia and the Red List of Maples have all been published alongside *ex situ* surveys to find out which threatened species are included in botanic garden collections.

Global Strategy for Plant Conservation

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The Global Strategy for Plant Conservation (GSPC) was adopted by the Convention on Biological Diversity in 2002. The GSPC has 16 outcome-orientated targets under five objectives: understanding and documenting plant diversity; conserving plant diversity; using plant diversity sustainably; promoting education and awareness about plant diversity; and building capacity for the conservation of plant diversity. The GSPC has galvanised botanical and conservation communities at global, regional and national levels, drawing together plant conservation projects and pushing forward plant conservation. The Global Partnership of Plant Conservation was established to support delivery of GSPC — it includes Botanic Gardens Conservation International [BGCI] and Plantlife International.

Landscape scale bumblebee conservation

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Substantial reductions in the distributional ranges of several species of bumblebee have been recorded in the UK. Loss of suitable habitat due to agricultural intensification is considered to be the main cause of declines. Of 26 British species, three are now considered to be extinct in the UK with a further six; *Bombus distinguendus*, *Bombus humilis*, *Bombus muscorum*, *Bombus ruderarius*, *Bombus ruderatus* and *Bombus sylvarum*, listed on the UK Biodiversity Action Plan (UKBAP) as priorities for conservation. The East Thames Corridor has one of the most diverse bumblebee assemblages anywhere in the UK. This region supports one of the most important remaining meta-populations of *B. humilis* and *B. sylvarum*. However, many of the sites supporting these populations are post-industrial brownfield sites and are threatened with imminent development.

Detailed knowledge of UKBAP bumblebee distribution and ecology is required to ensure that effective conservation management prescriptions are implemented. Foraging distance is particularly important where habitats are fragmented and under threat, such as in the South Essex region of the East Thames Corridor. The current and historical distributions of these species were mapped in South Essex. Microsatellite DNA analysis was used to estimate foraging distances in *B. humilis* and *B. sylvarum*. Minimum mean foraging distances were calculated as $475 \pm 97\text{m}$ for *B. humilis* and $231 \pm 58\text{m}$ for *B. sylvarum*. Mean distances were significantly greater for *B. humilis* than *B. sylvarum*. Sister bees were identified between sites, highlighting the need for a landscape-scale mosaic of suitable nesting and foraging habitat throughout colony development. Key areas have been identified for targeted habitat management or habitat creation to increase connectivity between existing key sites.

Coral mangrove communities: restricted but surviving

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Hermatypic corals are key ecosystem architects of coral reefs, supporting high biodiversity and in turn many millions of people worldwide. Optimal environments for coral growth are typically: high light, stable high temperatures, low nutrients and low anthropogenic pressures. However sub-optimal reef environments (often termed “marginal”) are increasingly becoming recognised as harbouring significant coral communities. These findings are key since such environments are likely to become more common under future climatic conditions and thus impact future reef form and function. One such environment is mangal, which is most often characterised by low light availability, high sedimentation, high organic loading and low appropriate benthic space that limits coral settlement and establishment of ‘true’ reefs. Mangrove habitats in South East Sulawesi were shown to harbour coral communities whose diversity and function seemed restricted due to extreme environmental pressures. This primary investigation highlights *Porites lutea* as a dominant species which form “reef balls” of 360° pigmentation within areas of sufficient tidal induced currents. Reef balls were shown to have significantly similar photosynthetic efficiencies across all planes, thus suggesting a constant rate of turnover. Subsequent growth of these “reef balls” seems to reach a maximum when hydrological energy is no longer sufficient to maintain constant rotation. It is at this point that these “reef balls” cease being “free-living” organisms and are accreted to the benthos and thus increase the structural complexity of their habitat. Understanding how these organisms cope with increasing environmental stresses can give an indication of their ability to cope with projected changes in ocean conditions.

Subterranean biodiversity: temporal and spatial distribution of hyporheic fauna throughout a chalk catchment in southern England

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The hyporheic zone, or transitional interface between groundwater and surface water, is an integral part of the lotic ecosystem. This interface provides a unique, thermally stable and highly oxygenated ecotone which is occupied by a highly specialised invertebrate community (hyporheos) which includes both stygobite (obligate groundwater) and stygophile (occasional hyporheic) fauna. Early studies, which were often based upon morphological identification, suggested a lack of diversity among the hyporheos; however, more recent investigations indicate that this community exhibits a great deal of diversity, comprising a number of cryptic and endemic species. This study assesses the distribution and composition of the hyporheic community in relation to environmental parameters, such as water chemistry and flow. Seventy-six species, including two stygobite fauna and one previously undescribed amphipod, were recorded from five sites along the ephemeral and perennial sections of the Little Stour, a chalk river in lowland southern England over one year. The data indicate a greater difference in community composition by depth at individual sites rather than between sites, despite significant differences in water quality and flow permanence along the watercourse. These results suggest that benthic (surface dwelling) and hyporheic communities respond differently to changes in environmental variables, indicating that the traditional monitoring of the benthos may be an insufficient measure of the lotic system. A greater understanding of the distribution and response of the hyporheos to environmental disturbance is essential for the conservation of this unique community.

Conservation of the threatened British white-clawed crayfish (*Austropotamobius pallipes*)

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Britain's only native crayfish, the white-clawed crayfish (*Austropotamobius pallipes*) is threatened by habitat degradation, non-native crayfish, and crayfish plague. Populations have been devastated in recent decades, and now inhabit only a fraction of their former range in scattered populations. Yorkshire has both native and non-native crayfish, and represents one of the final strongholds for white-clawed crayfish. Currently conservation efforts focus on relocating threatened populations into isolated 'Ark' sites, where it is hoped that populations can be maintained despite their almost certain extinction in the wild in coming decades. Through behavioural studies, field-based manipulation experiments, and observations of wild populations, we present water chemistry associations and requirements of the species, along with recommendations on best practices for relocation programmes. We demonstrate that the species is not as sensitive to water quality as previously reported. In an experimental relocation we found no evidence of growth or survival costs following introduction to a novel environment. We identified morphological differences between lotic and lentic populations throughout the country; carapace width is negatively correlated with flow rate, possibly an adaptation to reduced oxygen in benthic lentic environments. Following relocation, however, crayfish were able to plastically adapt to novel environmental conditions with allometric growth; carapace width growth rate was increased. These studies demonstrate that relocation conservation for threatened populations of white-clawed crayfish will not have a detrimental impact on short-term growth and survival in translocated animals. We believe that 'Ark' site conservation is a suitable method for the preservation of white-clawed crayfish in Britain.

Brownfield - UK's rainforest for invertebrates

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Brownfield habitats have been coined the 'new ancient woodlands' for invertebrates, in terms of their potential to support significant numbers of rare, scarce and UKBAP invertebrate species. 12–15% of the UK's rare and scarce invertebrates are found on brownfield sites, and the UK's first brownfield SSSI was designated for its invertebrate interest in 2005. Brownfield habitats can/are:

- *Complex & structurally diverse habitats
- *Nutrient poor, stressed, disturbed
- *Florally diverse with a rich nectar source
- *Support a variety of successional stages
- *Provide ample bare ground= hot microclimate
- *Important for species on the edge of their geographical range

Brownfield sites can also mimic/and or contain remnants of natural habitat features found in grassland, heathland and coastal habitats, in otherwise more 'barren urban landscapes'. With natural habitats declining and becoming increasingly fragmented, brownfield sites can play an important role in preserving biodiversity, maintaining/enhancing connectivity and protecting some of the UK's endangered invertebrates.

Increasing development pressure has led to the loss of many high-quality brownfield sites. In 2007 brownfield habitats were added to the UKBAP as a priority habitat under the 'Open Mosaic and Previously Developed Land' plan. With this in mind, the challenge we face is to combine the conservation of valuable brownfield habitats with the requirements for development. Buglife - The Invertebrate Conservation Trust - is commencing a 'National Brownfield Stepping Stones Project'. The aim of the project is to increase awareness, produce best-practice guidelines for planners and developers, identify high-quality brownfield sites and carry out detailed invertebrate survey work. This poster will provide an overview of the importance of brownfield sites for invertebrates, the

challenges both developers and conservationist face, mitigation measures and management techniques, and describes case study examples from the Thames Gateway.

Integrating phylogenetic and trait diversity into operational applications of biodiversity management

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Unfortunately there are just too many plant species and too few resources to conserve them all. To overcome this problem there needs to be a method to prioritise or assign value to species or areas. Based on a representative sample of 1500 monocotyledon species, I will ask: Why are certain species at higher conservation risk than others? Are there traits that make some species more prone to extinction? What is the phylogenetic context of extinction risk? How should priority or "value" be attributed to species or areas? Thus conducting the largest and most widespread analysis of plant phylogenetic diversity patterns to date.

Conserving soil biodiversity through smallholder agroforestry in western Honduras

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Soil organisms are often a neglected component of global biodiversity, despite the fact that soil is one of the most biodiverse habitats on earth. Soil macrofauna are a diverse group of organisms that includes earthworms, many species of ants, termites, beetles, millipedes, centipedes, spiders and numerous other invertebrates. Macrofauna are widely recognised for their influence on the physical, chemical and biological properties and processes of soil, which are critical to agricultural productivity. Conversion of land to agriculture has long been thought to reduce soil macrofauna abundance, diversity and biomass. The smallholder agroforestry system from western Honduras, used as the case study in this research, incorporates many features that should promote abundant, diverse soil macrofauna populations, including continuous litter cover, diverse vegetation within fields, and a mosaic landscape of forest, crop fields and pasture. Sampling of soil macrofauna within four different land-use types (secondary forest, recently planted agroforestry fields, mature agroforestry fields and pasture) showed that the soil macrofauna community was relatively diverse and abundant in comparison with other surveys from sub-tropical, agricultural areas. Based on the broad taxonomic groupings, there did not appear to be a substantial loss of functional groups of macrofauna, or shift in dominance patterns between different land uses. The results from fine-scale surveys comparing the spatial pattern of trees and earthworm surface activity suggest that the presence of trees within fields maintains below-ground biodiversity within the agricultural system. Promotion of diverse agricultural systems and landscapes could be a useful tool in the conservation of soil biodiversity.

Cone snails: a significant biomedical resource at risk

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Cone snails are carnivorous molluscs of the genus *Conus* in which there are some 500 species, the largest genus of any marine invertebrates and a major contributor to biodiversity. They occur in warm shallow tropical waters and capture their prey through the delivery of a cocktail of toxins. These 'conotoxins' numbering over 50,000 across the genus show enormous promise in the development of important drugs. Although research is still in its infancy with less than 1% of conotoxins characterised, a remedy for the relief of intractable pain, Prialt®, is already in use with

substantial resources being applied to develop drugs to combat other conditions, such as epilepsy and diabetes.

Cone snails have exceptionally beautiful shells and it is these that lead to their wholesale gathering as marine curios in a trade that is almost wholly unregulated. If the rate of collection exceeds their reproductive capability, it will inevitably result in extirpation and for those species with restricted range, the likelihood of global extinction. Such a tragedy for biodiversity would also rob humankind of the potential cure for some of our most pernicious diseases.

By undertaking field studies into the commerce surrounding the trade in cone shells supported by physical censuses of *Conus* and assessments of habitat loss, the Environment Department of the University of York will be able to determine their status in the wild and quantify the threat cone snails face with the aim of securing their future through conservation measures and, where appropriate, legal enforcement.

Many unnoticed extinctions: do molluscs really account for half the toll?

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According to the 2009 IUCN Red List molluscs are the group most affected by extinction, despite the fact that the group has not been evaluated thoroughly since 2000 and that the quality of information available for invertebrates is far lower than for vertebrates. A total of 310 mollusc species is listed as extinct in the Red List. A re-evaluation of listed extinct mollusc species, bibliographic research and consultation with experts, has indicated almost double the number of known mollusc extinctions. We suggest that assessment of the conservation status of invertebrate species is not only neglected in the IUCN Red List but is also managed differently than for vertebrate species. Yet, the difficulties encountered in recording mollusc extinctions are less critical than those faced in recording extinctions in other invertebrate taxa, such as insects. The approach we used for molluscs could be applied to other invertebrate taxa and would surely dramatically increase the number of documented extinctions.

Wet fens as reservoirs of cryptic biodiversity

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Protecting the diversity of small-sized species (such as invertebrates) is important, because they are a part of all ecosystems and contribute substantially to ecosystem processes. Small-sized organisms receive little attention in conservation surveys, particularly those organisms which are so small that they are invisible to the naked eye. These and dormant species constitute the cryptic biodiversity (e.g. Protozoa and meiofauna) within habitats. Here, we show initial results of a 2-year project which investigates the cryptic biodiversity of wet fens (in Dorset, UK). So far we have found that wet fens are a rich reservoir for small species and that they show unique assemblages. Our investigations of wet fen ponds in winter (Nov 2009–Jan 2010) show abundances of up to 950 ind./100ml of organisms sized between 40 and 500µm and a high species richness. We aim to improve the understanding of protozoan and meiofaunal diversity and their ecological importance for both science and conservation.

How many herbarium specimens are needed to identify threatened species?

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The Global Strategy for Plant Conservation (GSPC) called for a preliminary conservation assessment for all known plant species by 2010 (Target 2). To date, however, less than 4% of the world's vascular plants species have been assessed using IUCN Criteria (www.redlist.org). Full conservation assessments require expert knowledge of the group concerned, but the majority of plant species, especially those from the tropics, are poorly known, and for many the only source of data are specimens housed within natural history collections. Digitisation projects are under way in many of the world's herbaria; the next step is to make available, bring together and utilise this data to make better informed conservation decisions. One crucial question is: how many specimens are needed to be confident of a preliminary conservation rating? Using nearly 10,000 herbarium records from 378 endemic species of Leguminosae from Madagascar, we calculated the conservation status of each species based on range estimates, following IUCN criteria. By capturing up to ten specimens per species we achieve the correct rating (Threatened or Not) for 99% of species. With ten specimens all Threatened species are correctly identified as Threatened, while fewer than 2% of Not-threatened species are misclassified as Threatened. In addition, in more than nine out of ten cases, the correct Threatened category (Critically Endangered, Endangered or Vulnerable) is achieved, despite the fact that only 35% of the total number of specimens available appear on the database. This approach can therefore help progress towards the GSPC target of a preliminary conservation assessment for each plant species.

The Encyclopedia of Life - open access to information about all the world's species

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Most organisms are poorly understood, and what little information we have is usually scattered across libraries, museums, databases, and other storehouses of expert knowledge. The Encyclopedia of Life (EOL.org) is an unprecedented partnership between scientists and the public with the goal to describe and illustrate all species known to science. To build a comprehensive, freely accessible online system of biodiversity information, we aggregate materials from expert and amateur data partners, and we digitize the biological literature of the past. Text and data from multiple sources are integrated and complemented by photographs, video, maps, etc. Expert curators ensure quality of the core collection by authenticating materials submitted by diverse projects and contributors. Since its inception in 2007, EOL has quickly expanded its collection of taxon pages featuring materials suitable for casual and expert users. Not surprisingly, many non-vertebrate groups are poorly represented because data partners with relevant information are scarce. We address this challenge by using topical or taxon-focused themes that galvanize communities to achieve specific content development goals. In addition, we work with international institutions to establish regional encyclopedias, serving materials in different languages and sharing local content with the world through EOL.org. We always seek new collaborators, and we are continually adapting policies and practices to meet user needs. We are confident that our approach will scale to meet increasing demands for biodiversity information. We hope that increased access to knowledge about all taxa will transform science and the public understanding of life on Earth.

The Saint Louis Zoo's WildCare Institute's Center for American Burying Beetle Conservation: a new approach to conserving an endangered invertebrate

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In 2004 the Saint Louis Zoo launched the WildCare Institute to increase its conservation impact "outside of its fences". WildCare Institute's directive was to create conservation centers that would focus on more specific areas where the zoo's impact could be readily monitored and include zoo-based and field components. Each center was to be more holistic by addressing a variety of areas, including: wildlife management and protection; breeding for reintroduction; nutritional, reproductive, health and behavioral studies; field research; community development; and education. Twelve centers were created including the Center for American Burying Beetle (ABB) Conservation.

The American Burying Beetle (*Nicrophorus americanus*) was once abundant throughout most of the eastern and central United States and south-eastern Canada. It has disappeared throughout its ranges and was placed on the US Endangered species list in 1989. In 2002 the Saint Louis Zoo's Invertebrate Department began work with US Fish and Wildlife Service to survey Missouri for remaining populations of ABB. With the establishment of the Center for ABB Conservation over 4900 ABB have been reared (1444 reintroduced) with data collected on weight and pronotal width at eclosure, lifespan, number of offspring per pair, etc from each beetle. The ABB Center has increased its research to include funding genetic analyses of all extant populations, bio-acoustic studies on the impact of elytral clipping on communication, composition analysis of calling pheromones of male ABB's, and testing micro-transmitters for tracking ABB's. The ABB Center continues to expand and develop a broad-based approach to invertebrate conservation.

Welwitsch's historical bryophyte collections: a basis for current conservation assessment

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Records stored in herbaria provide a large amount of ready-to-use information and are becoming increasingly recognized as sources of data with conservation value. Data in historical museum collections can increase knowledge of the distribution of species for which few data exists, such as rare and endangered ones. Mapping the distribution of species using these historical data can be a tool to find answers to various conservation questions, in the present case, changes to species distributions, including extinctions.

Using bryophyte specimens collected by Friedrich Welwitsch in Portugal between 1839 and 1846, distribution maps for selected species were produced. These taxa were chosen based on their rarity and level of extinction risk according to species currently being assessed for the Portuguese Bryophyte Red List. Distribution maps were made from both these historical collections and from recent ones in order to see if the area of occurrence has shifted.

Although there are inherent biases in these collections, their usefulness for obtaining certain information should not be overlooked. A unique attribute of these historical collections is their ability to provide baseline data from ca. 200 years ago, essential for assessing current conservation status. The disappearance and change in quality of habitats for rare species is an important factor that can be retrieved from comparisons of historical and current data. Expansions of certain taxa are likely due to climate change and species that experienced range contractions, mainly species of mountainous areas, can be used in future studies as ecological markers.

Pauropoda: our forgotten Myriapods

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In 1867 Sir John Lubbock discovered the first two species of the class Pauropoda around the London area. Here *Stylopauropus pedunculatus* and *Pauropus huxleyi* were described and the class Pauropoda was born. Pauropoda boasts the accolade of being one of the two classes primarily erected in Britain, making its origins firmly grounded within the UK. Despite this and the interest it received upon its discovery, this charismatic and mysterious class of Myriapod has been tragically understudied worldwide, especially in Britain, its initial birthplace. This study aims to build a basis for the continuous study of Pauropoda within the UK by producing a key of British species, extending habitat information and adding the description of new species. We also aim to raise the profile of these minute yet fascinating soil-dwelling creatures and give them the exposure they deserve. The results of a new and still ongoing survey of the Pauropoda of England will be presented in this meeting. Of the 23 UK species hitherto described, three species from three genera (*Decapauropus*, *Pauropus*, *Trachypauropus*) and two different families (Pauropodidae, Eurypauropodidae) have been discovered in the Reading area. New localities and habitat data are added for *Trachypauropus britannicus* and *Pauropus furcifer* (found in Berkshire) and *Decapauropus distinctus* (found in Northamptonshire). In addition to the taxonomical studies, future outcomes aim to resolve questions about ecology, conservation, physiology and genetics of the Pauropoda.

Scavenging of dead invertebrates along an urbanization gradient in Singapore

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Although there are no data for the tropics, the total biomass of dead invertebrates produced per year probably greatly exceeds that of vertebrate carrion. Little is known about the animals that scavenge invertebrates in the tropics and the impact of human activities on such communities. We studied the scavenging process for five dead invertebrate types in six habitats along an urbanization gradient in equatorial Singapore: primary forest, old secondary forest, young secondary forest, recreational park, mown grassland and impervious surfaces. Ants were the dominant scavengers, except at night in grassland when an earwig (Labiduridae) dominated. Overall, the forest sites had more scavenger species, faster first detection and shorter bait survival times than the non-forest habitats. Ant species richness decreased and bait survival time increased monotonically along the urbanization gradient, suggesting that these two parameters could be used as indicators of habitat quality. Yellow crazy ants (*Anoplolepis gracilipes*), which are believed to be invasive in Singapore, were unexpectedly found in the older forests. Analyses have shown that the ant species was adept at exploitative and interfering competition, thus posing a threat to native ants. The level of competition, however, varied with density of *A. gracilipes* and the habitat type.

**FOUNDATIONS OF BIODIVERSITY: SAVING THE
WORLD'S NON-VERTEBRATES**
25 AND 26 FEBRUARY 2010 — ZSL SYMPOSIUM
RESEARCH POSTERS PRESENTED

Diversity of geometrid moths in Northern China - altitude and habitat

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In the mountain ranges north of Beijing, species composition and diversity of geometrid moths was investigated using light traps at four different elevations between 400 and 1600m in agricultural and semi-natural habitats. A total of 14,692 geometrid moths representing 110 species were recorded. Alpha diversity peaked at lowest elevations in all habitats, with highest values (Fisher's Alpha: 18.4) recorded on agricultural fields. At agricultural habitats located at higher elevations (800–1600m), Fisher's Alpha reached less than half the values observed at 400m, ranging between 8.5 and 7.3. The drop was less extreme for semi-natural habitats, with mean values of 13.9 at 400m and ranging from 10.1 to 6.3 at higher elevations.

Ordination diagrams revealed that species assemblages were grouped primarily according to elevation, with habitat-specific sub-clusters occurring within the respective elevation clusters.

Observed high values in agricultural fields are believed to relate to the relatively low levels of intensification in agricultural practices throughout the study region, whereas elevation has commonly been identified as a key factor explaining species turnover in insect assemblages.

Studies on animals in 'Sabah Al-Ahmad' natural reserved area in the State of Kuwait

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To evaluate the factors controlling biodiversity in 'Sabah Al-Ahmad' natural reserved area in the State of Kuwait, a comprehensive study was carried out on mammals, insects, arachnida, birds and soil, through the day and night for 12 months (May 2008–May 2009). The results indicate that overall biodiversity (both animals and plants) in the reserved area has been greatly influenced by the scarcity of the rainfall during the last years. The decrease in the plant density has caused the migration of animals that use the plants for protection.

The studying of biodiversity in relation to the soil, taking into consideration climatic factors, indicates that a number of animals (Scorpion, *Uromastyx* (Dhub), Fennec fox, insects (butterfly, black and domino beetles, beetle pretends) and birds (hoopoe, desert lark, and slender-billed gulls) are found and monitored in "Sabah Al-Ahmad" natural replaced area. The large numbers of insects and birds observed in the study area may due to the presence of an artificial lake and increased vegetation around the lake. By contrast, some animals, such as snakes and rodents, were not found, which may be due to a lack of food and plant cover resulting from the scarcity of rainfall. However, the common occurrence of the *Uromastyx* (Dhub) may be attributed to its hibernation habit and the presence of insects as a feeding source. Important results concerning factors controlling biodiversity are described and recommendations for preserving animals are given.

Identifying the Evolutionarily Distinct and Globally Endangered species of Gymnosperms: the EDGE-Gymnosperm Project

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Evolutionarily distinct species have very few or no close relatives on the Tree of Life, and therefore tend to be extremely distinct from other species. A high proportion of globally endangered species are also evolutionarily distinct. The EDGE of Existence programme (Evolutionarily Distinct and Globally Endangered), initiated by the Zoological Society of London and launched in 2007, offers a new approach to prioritising species conservation action, and is the sole global conservation initiative to focus specifically on threatened species that represent a disproportionate amount of unique evolutionary history. EDGE scores can be calculated for any clade of more than 100 species, providing that a dated species-level phylogeny exists for the group, and that each species has been assessed using the IUCN Categories and Criteria. Gymnosperms fulfil both these requirements, and are therefore a prime candidate plant group to be incorporated into the EDGE of Existence programme. We reconstructed a phylogenetic tree of Gymnosperms based on the plastid gene *rbcL* and obtained molecular time estimates using nine calibration points from the fossil record. Because gymnosperms are potentially not monophyletic, we compiled EDGE scores for each of the five groups within Gymnosperms (Pinaceae, Cupressophytes, Gnetophytes, Cycads and Ginkgo). We present here the top EDGE species for each group and discuss the implications of this metric for the conservation of these evolutionarily isolated and threatened species. Future projects within the EDGE programme will also be discussed.

Biodiversity training – introducing invertebrates to volunteer recorders

Pete Boardman, Field Studies Council. E-mail: pete@field-studies-council.org

The Biodiversity Training Project is a 5-year Heritage Lottery Funded Project designed to increase the number of people actively involved in biological recording in Shropshire and the wider West Midlands region. This is being achieved through the provision of free training courses in species identification by national and regional experts in field and lab-based skills. Many of our courses have sought to introduce invertebrate identification and recording to volunteers. Volunteers are already committed to the study of natural history, be they Wildlife Trust members, volunteers for Natural England or a local authority conservation body, or just individuals keen to learn. We are also helping people with skills in one area, such as botany, to diversify into recording invertebrates and are supporting regional and local recording groups, such as a beetle recording group and a hoverfly recording group. The poster will illustrate these activities.

BGCI – assessing the conservation status of plants in the wild

Botanic Gardens Conservation International (BGCI) [Belinda Hawkins].

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Information about the status of plants in the wild is essential for planning conservation action and for meeting the targets of the Global Strategy for Plant Conservation (GSPC).

Target 2 of the GSPC calls for 'a preliminary assessment of the conservation status of all known plant species'. BGCI is using the IUCN Red List Categories and Criteria to document rare and threatened plant species worldwide.

BGCI has published a consolidated list of European threatened species. Compiled on a database, our list consists of national Red List data from 30 European countries and includes over 16,000 country records covering around 9,600 species. An analysis has allowed us to identify which European threatened species are included in living collections in European botanic gardens or seed banks and, more importantly, which are not.

The Global Trees Campaign, a joint initiative between BGCI, Fauna & Flora International (FFI) and the UNEP World Conservation Monitoring Centre (UNEP-WCMC) in association with other partners around the world, aims to save the world's most threatened tree species and their habitats through provision of information, conservation action and support for sustainable use.

The campaign focuses on trees as flagship species for conservation of ecosystems and landscapes, and enables local people to carry out rescue and sustainable use operations. The Red List of the Magnoliaceae, The Red List of Oaks, The Red List of Trees of Central Asia and the Red List of Maples have all been published alongside *ex situ* surveys to find out which threatened species are included in botanic garden collections.

Global Strategy for Plant Conservation

Botanic Gardens Conservation International (BGCI).

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The Global Strategy for Plant Conservation (GSPC) was adopted by the Convention on Biological Diversity in 2002. The GSPC has 16 outcome-orientated targets under five objectives: understanding and documenting plant diversity; conserving plant diversity; using plant diversity sustainably; promoting education and awareness about plant diversity; and building capacity for the conservation of plant diversity. The GSPC has galvanised botanical and conservation communities at global, regional and national levels, drawing together plant conservation projects and pushing forward plant conservation. The Global Partnership of Plant Conservation was established to support delivery of GSPC — it includes Botanic Gardens Conservation International [BGCI] and Plantlife International.

Landscape scale bumblebee conservation

Stuart Connop¹, Sarah Henshall² and James Dale²

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Substantial reductions in the distributional ranges of several species of bumblebee have been recorded in the UK. Loss of suitable habitat due to agricultural intensification is considered to be the main cause of declines. Of 26 British species, three are now considered to be extinct in the UK with a further six; *Bombus distinguendus*, *Bombus humilis*, *Bombus muscorum*, *Bombus ruderarius*, *Bombus ruderatus* and *Bombus sylvarum*, listed on the UK Biodiversity Action Plan (UKBAP) as priorities for conservation. The East Thames Corridor has one of the most diverse bumblebee assemblages anywhere in the UK. This region supports one of the most important remaining meta-populations of *B. humilis* and *B. sylvarum*. However, many of the sites supporting these populations are post-industrial brownfield sites and are threatened with imminent development.

Detailed knowledge of UKBAP bumblebee distribution and ecology is required to ensure that effective conservation management prescriptions are implemented. Foraging distance is particularly important where habitats are fragmented and under threat, such as in the South Essex region of the East Thames Corridor. The current and historical distributions of these species were mapped in South Essex. Microsatellite DNA analysis was used to estimate foraging distances in *B. humilis* and *B. sylvarum*. Minimum mean foraging distances were calculated as $475 \pm 97\text{m}$ for *B. humilis* and $231 \pm 58\text{m}$ for *B. sylvarum*. Mean distances were significantly greater for *B. humilis* than *B. sylvarum*. Sister bees were identified between sites, highlighting the need for a landscape-scale mosaic of suitable nesting and foraging habitat throughout colony development. Key areas have been identified for targeted habitat management or habitat creation to increase connectivity between existing key sites.

Coral mangrove communities: restricted but surviving

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Hermatypic corals are key ecosystem architects of coral reefs, supporting high biodiversity and in turn many millions of people worldwide. Optimal environments for coral growth are typically: high light, stable high temperatures, low nutrients and low anthropogenic pressures. However sub-optimal reef environments (often termed "marginal") are increasingly becoming recognised as harbouring significant coral communities. These findings are key since such environments are likely to become more common under future climatic conditions and thus impact future reef form and function. One such environment is mangal, which is most often characterised by low light availability, high sedimentation, high organic loading and low appropriate benthic space that limits coral settlement and establishment of 'true' reefs. Mangrove habitats in South East Sulawesi were shown to harbour coral communities whose diversity and function seemed restricted due to extreme environmental pressures. This primary investigation highlights *Porites lutea* as a dominant species which form "reef balls" of 360° pigmentation within areas of sufficient tidal induced currents. Reef balls were shown to have significantly similar photosynthetic efficiencies across all planes, thus suggesting a constant rate of turnover. Subsequent growth of these "reef balls" seems to reach a maximum when hydrological energy is no longer sufficient to maintain constant rotation. It is at this point that these "reef balls" cease being "free-living" organisms and are accreted to the benthos and thus increase the structural complexity of their habitat. Understanding how these organisms cope with increasing environmental stresses can give an indication of their ability to cope with projected changes in ocean conditions.

Subterranean biodiversity: temporal and spatial distribution of hyporheic fauna throughout a chalk catchment in southern England

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The hyporheic zone, or transitional interface between groundwater and surface water, is an integral part of the lotic ecosystem. This interface provides a unique, thermally stable and highly oxygenated ecotone which is occupied by a highly specialised invertebrate community (hyporheos) which includes both stygobite (obligate groundwater) and stygophile (occasional hyporheic) fauna. Early studies, which were often based upon morphological identification, suggested a lack of diversity among the hyporheos; however, more recent investigations indicate that this community exhibits a great deal of diversity, comprising a number of cryptic and endemic species. This study assesses the distribution and composition of the hyporheic community in relation to environmental parameters, such as water chemistry and flow. Seventy-six species, including two stygobite fauna and one previously undescribed amphipod, were recorded from five sites along the ephemeral and perennial sections of the Little Stour, a chalk river in lowland southern England over one year. The data indicate a greater difference in community composition by depth at individual sites rather than between sites, despite significant differences in water quality and flow permanence along the watercourse. These results suggest that benthic (surface dwelling) and hyporheic communities respond differently to changes in environmental variables, indicating that the traditional monitoring of the benthos may be an insufficient measure of the lotic system. A greater understanding of the distribution and response of the hyporheos to environmental disturbance is essential for the conservation of this unique community.

Conservation of the threatened British white-clawed crayfish (*Austropotamobius pallipes*)

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Britain's only native crayfish, the white-clawed crayfish (*Austropotamobius pallipes*) is threatened by habitat degradation, non-native crayfish, and crayfish plague. Populations have been devastated in recent decades, and now inhabit only a fraction of their former range in scattered populations. Yorkshire has both native and non-native crayfish, and represents one of the final strongholds for white-clawed crayfish. Currently conservation efforts focus on relocating threatened populations into isolated 'Ark' sites, where it is hoped that populations can be maintained despite their almost certain extinction in the wild in coming decades. Through behavioural studies, field-based manipulation experiments, and observations of wild populations, we present water chemistry associations and requirements of the species, along with recommendations on best practices for relocation programmes. We demonstrate that the species is not as sensitive to water quality as previously reported. In an experimental relocation we found no evidence of growth or survival costs following introduction to a novel environment. We identified morphological differences between lotic and lentic populations throughout the country; carapace width is negatively correlated with flow rate, possibly an adaptation to reduced oxygen in benthic lentic environments. Following relocation, however, crayfish were able to plastically adapt to novel environmental conditions with allometric growth; carapace width growth rate was increased. These studies demonstrate that relocation conservation for threatened populations of white-clawed crayfish will not have a detrimental impact on short-term growth and survival in translocated animals. We believe that 'Ark' site conservation is a suitable method for the preservation of white-clawed crayfish in Britain.

Brownfield - UK's rainforest for invertebrates

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Brownfield habitats have been coined the 'new ancient woodlands' for invertebrates, in terms of their potential to support significant numbers of rare, scarce and UKBAP invertebrate species. 12–15% of the UK's rare and scarce invertebrates are found on brownfield sites, and the UK's first brownfield SSSI was designated for its invertebrate interest in 2005. Brownfield habitats can/are:

- *Complex & structurally diverse habitats
- *Nutrient poor, stressed, disturbed
- *Florally diverse with a rich nectar source
- *Support a variety of successional stages
- *Provide ample bare ground= hot microclimate
- *Important for species on the edge of their geographical range

Brownfield sites can also mimic/and or contain remnants of natural habitat features found in grassland, heathland and coastal habitats, in otherwise more 'barren urban landscapes'. With natural habitats declining and becoming increasingly fragmented, brownfield sites can play an important role in preserving biodiversity, maintaining/enhancing connectivity and protecting some of the UK's endangered invertebrates.

Increasing development pressure has led to the loss of many high-quality brownfield sites. In 2007 brownfield habitats were added to the UKBAP as a priority habitat under the 'Open Mosaic and Previously Developed Land' plan. With this in mind, the challenge we face is to combine the conservation of valuable brownfield habitats with the requirements for development. Buglife - The Invertebrate Conservation Trust - is commencing a 'National Brownfield Stepping Stones Project'. The aim of the project is to increase awareness, produce best-practice guidelines for planners and developers, identify high-quality brownfield sites and carry out detailed invertebrate survey work. This poster will provide an overview of the importance of brownfield sites for invertebrates, the

challenges both developers and conservationist face, mitigation measures and management techniques, and describes case study examples from the Thames Gateway.

Integrating phylogenetic and trait diversity into operational applications of biodiversity management

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Unfortunately there are just too many plant species and too few resources to conserve them all. To overcome this problem there needs to be a method to prioritise or assign value to species or areas. Based on a representative sample of 1500 monocotyledon species, I will ask: Why are certain species at higher conservation risk than others? Are there traits that make some species more prone to extinction? What is the phylogenetic context of extinction risk? How should priority or "value" be attributed to species or areas? Thus conducting the largest and most widespread analysis of plant phylogenetic diversity patterns to date.

Conserving soil biodiversity through smallholder agroforestry in western Honduras

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Soil organisms are often a neglected component of global biodiversity, despite the fact that soil is one of the most biodiverse habitats on earth. Soil macrofauna are a diverse group of organisms that includes earthworms, many species of ants, termites, beetles, millipedes, centipedes, spiders and numerous other invertebrates. Macrofauna are widely recognised for their influence on the physical, chemical and biological properties and processes of soil, which are critical to agricultural productivity. Conversion of land to agriculture has long been thought to reduce soil macrofauna abundance, diversity and biomass. The smallholder agroforestry system from western Honduras, used as the case study in this research, incorporates many features that should promote abundant, diverse soil macrofauna populations, including continuous litter cover, diverse vegetation within fields, and a mosaic landscape of forest, crop fields and pasture. Sampling of soil macrofauna within four different land-use types (secondary forest, recently planted agroforestry fields, mature agroforestry fields and pasture) showed that the soil macrofauna community was relatively diverse and abundant in comparison with other surveys from sub-tropical, agricultural areas. Based on the broad taxonomic groupings, there did not appear to be a substantial loss of functional groups of macrofauna, or shift in dominance patterns between different land uses. The results from fine-scale surveys comparing the spatial pattern of trees and earthworm surface activity suggest that the presence of trees within fields maintains below-ground biodiversity within the agricultural system. Promotion of diverse agricultural systems and landscapes could be a useful tool in the conservation of soil biodiversity.

Cone snails: a significant biomedical resource at risk

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Cone snails are carnivorous molluscs of the genus *Conus* in which there are some 500 species, the largest genus of any marine invertebrates and a major contributor to biodiversity. They occur in warm shallow tropical waters and capture their prey through the delivery of a cocktail of toxins. These 'conotoxins' numbering over 50,000 across the genus show enormous promise in the development of important drugs. Although research is still in its infancy with less than 1% of conotoxins characterised, a remedy for the relief of intractable pain, Prialt®, is already in use with

substantial resources being applied to develop drugs to combat other conditions, such as epilepsy and diabetes.

Cone snails have exceptionally beautiful shells and it is these that lead to their wholesale gathering as marine curios in a trade that is almost wholly unregulated. If the rate of collection exceeds their reproductive capability, it will inevitably result in extirpation and for those species with restricted range, the likelihood of global extinction. Such a tragedy for biodiversity would also rob humankind of the potential cure for some of our most pernicious diseases.

By undertaking field studies into the commerce surrounding the trade in cone shells supported by physical censuses of *Conus* and assessments of habitat loss, the Environment Department of the University of York will be able to determine their status in the wild and quantify the threat cone snails face with the aim of securing their future through conservation measures and, where appropriate, legal enforcement.

Many unnoticed extinctions: do molluscs really account for half the toll?

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According to the 2009 IUCN Red List molluscs are the group most affected by extinction, despite the fact that the group has not been evaluated thoroughly since 2000 and that the quality of information available for invertebrates is far lower than for vertebrates. A total of 310 mollusc species is listed as extinct in the Red List. A re-evaluation of listed extinct mollusc species, bibliographic research and consultation with experts, has indicated almost double the number of known mollusc extinctions. We suggest that assessment of the conservation status of invertebrate species is not only neglected in the IUCN Red List but is also managed differently than for vertebrate species. Yet, the difficulties encountered in recording mollusc extinctions are less critical than those faced in recording extinctions in other invertebrate taxa, such as insects. The approach we used for molluscs could be applied to other invertebrate taxa and would surely dramatically increase the number of documented extinctions.

Wet fens as reservoirs of cryptic biodiversity

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Protecting the diversity of small-sized species (such as invertebrates) is important, because they are a part of all ecosystems and contribute substantially to ecosystem processes. Small-sized organisms receive little attention in conservation surveys, particularly those organisms which are so small that they are invisible to the naked eye. These and dormant species constitute the cryptic biodiversity (e.g. Protozoa and meiofauna) within habitats. Here, we show initial results of a 2-year project which investigates the cryptic biodiversity of wet fens (in Dorset, UK). So far we have found that wet fens are a rich reservoir for small species and that they show unique assemblages. Our investigations of wet fen ponds in winter (Nov 2009–Jan 2010) show abundances of up to 950 ind./100ml of organisms sized between 40 and 500µm and a high species richness. We aim to improve the understanding of protozoan and meiofaunal diversity and their ecological importance for both science and conservation.

How many herbarium specimens are needed to identify threatened species?

Malin Rivers^{1,2}, Neil Brummitt¹, Thomas Meagher² and Eimear Nic Lughadha¹

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The Global Strategy for Plant Conservation (GSPC) called for a preliminary conservation assessment for all known plant species by 2010 (Target 2). To date, however, less than 4% of the world's vascular plants species have been assessed using IUCN Criteria (www.redlist.org). Full conservation assessments require expert knowledge of the group concerned, but the majority of plant species, especially those from the tropics, are poorly known, and for many the only source of data are specimens housed within natural history collections. Digitisation projects are under way in many of the world's herbaria; the next step is to make available, bring together and utilise this data to make better informed conservation decisions. One crucial question is: how many specimens are needed to be confident of a preliminary conservation rating? Using nearly 10,000 herbarium records from 378 endemic species of Leguminosae from Madagascar, we calculated the conservation status of each species based on range estimates, following IUCN criteria. By capturing up to ten specimens per species we achieve the correct rating (Threatened or Not) for 99% of species. With ten specimens all Threatened species are correctly identified as Threatened, while fewer than 2% of Not-threatened species are misclassified as Threatened. In addition, in more than nine out of ten cases, the correct Threatened category (Critically Endangered, Endangered or Vulnerable) is achieved, despite the fact that only 35% of the total number of specimens available appear on the database. This approach can therefore help progress towards the GSPC target of a preliminary conservation assessment for each plant species.

The Encyclopedia of Life - open access to information about all the world's species

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Most organisms are poorly understood, and what little information we have is usually scattered across libraries, museums, databases, and other storehouses of expert knowledge. The Encyclopedia of Life (EOL.org) is an unprecedented partnership between scientists and the public with the goal to describe and illustrate all species known to science. To build a comprehensive, freely accessible online system of biodiversity information, we aggregate materials from expert and amateur data partners, and we digitize the biological literature of the past. Text and data from multiple sources are integrated and complemented by photographs, video, maps, etc. Expert curators ensure quality of the core collection by authenticating materials submitted by diverse projects and contributors. Since its inception in 2007, EOL has quickly expanded its collection of taxon pages featuring materials suitable for casual and expert users. Not surprisingly, many non-vertebrate groups are poorly represented because data partners with relevant information are scarce. We address this challenge by using topical or taxon-focused themes that galvanize communities to achieve specific content development goals. In addition, we work with international institutions to establish regional encyclopedias, serving materials in different languages and sharing local content with the world through EOL.org. We always seek new collaborators, and we are continually adapting policies and practices to meet user needs. We are confident that our approach will scale to meet increasing demands for biodiversity information. We hope that increased access to knowledge about all taxa will transform science and the public understanding of life on Earth.

The Saint Louis Zoo's WildCare Institute's Center for American Burying Beetle Conservation: a new approach to conserving an endangered invertebrate

Edward Spevak and Robert Merz, Saint Louis Zoo, USA. E-mail: spevak@stlzoo.org

In 2004 the Saint Louis Zoo launched the WildCare Institute to increase its conservation impact "outside of its fences". WildCare Institute's directive was to create conservation centers that would focus on more specific areas where the zoo's impact could be readily monitored and include zoo-based and field components. Each center was to be more holistic by addressing a variety of areas, including: wildlife management and protection; breeding for reintroduction; nutritional, reproductive, health and behavioral studies; field research; community development; and education. Twelve centers were created including the Center for American Burying Beetle (ABB) Conservation.

The American Burying Beetle (*Nicrophorus americanus*) was once abundant throughout most of the eastern and central United States and south-eastern Canada. It has disappeared throughout its ranges and was placed on the US Endangered species list in 1989. In 2002 the Saint Louis Zoo's Invertebrate Department began work with US Fish and Wildlife Service to survey Missouri for remaining populations of ABB. With the establishment of the Center for ABB Conservation over 4900 ABB have been reared (1444 reintroduced) with data collected on weight and pronotal width at eclosure, lifespan, number of offspring per pair, etc from each beetle. The ABB Center has increased its research to include funding genetic analyses of all extant populations, bio-acoustic studies on the impact of elytral clipping on communication, composition analysis of calling pheromones of male ABB's, and testing micro-transmitters for tracking ABB's. The ABB Center continues to expand and develop a broad-based approach to invertebrate conservation.

Welwitsch's historical bryophyte collections: a basis for current conservation assessment

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Records stored in herbaria provide a large amount of ready-to-use information and are becoming increasingly recognized as sources of data with conservation value. Data in historical museum collections can increase knowledge of the distribution of species for which few data exists, such as rare and endangered ones. Mapping the distribution of species using these historical data can be a tool to find answers to various conservation questions, in the present case, changes to species distributions, including extinctions.

Using bryophyte specimens collected by Friedrich Welwitsch in Portugal between 1839 and 1846, distribution maps for selected species were produced. These taxa were chosen based on their rarity and level of extinction risk according to species currently being assessed for the Portuguese Bryophyte Red List. Distribution maps were made from both these historical collections and from recent ones in order to see if the area of occurrence has shifted.

Although there are inherent biases in these collections, their usefulness for obtaining certain information should not be overlooked. A unique attribute of these historical collections is their ability to provide baseline data from ca. 200 years ago, essential for assessing current conservation status. The disappearance and change in quality of habitats for rare species is an important factor that can be retrieved from comparisons of historical and current data. Expansions of certain taxa are likely due to climate change and species that experienced range contractions, mainly species of mountainous areas, can be used in future studies as ecological markers.

Pauropoda: our forgotten Myriapods

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In 1867 Sir John Lubbock discovered the first two species of the class Pauropoda around the London area. Here *Stylopauropus pedunculatus* and *Pauropus huxleyi* were described and the class Pauropoda was born. Pauropoda boasts the accolade of being one of the two classes primarily erected in Britain, making its origins firmly grounded within the UK. Despite this and the interest it received upon its discovery, this charismatic and mysterious class of Myriapod has been tragically understudied worldwide, especially in Britain, its initial birthplace. This study aims to build a basis for the continuous study of Pauropoda within the UK by producing a key of British species, extending habitat information and adding the description of new species. We also aim to raise the profile of these minute yet fascinating soil-dwelling creatures and give them the exposure they deserve. The results of a new and still ongoing survey of the Pauropoda of England will be presented in this meeting. Of the 23 UK species hitherto described, three species from three genera (*Decapauropus*, *Pauropus*, *Trachypauropus*) and two different families (Pauropodidae, Eurypauropodidae) have been discovered in the Reading area. New localities and habitat data are added for *Trachypauropus britannicus* and *Pauropus furcifer* (found in Berkshire) and *Decapauropus distinctus* (found in Northamptonshire). In addition to the taxonomical studies, future outcomes aim to resolve questions about ecology, conservation, physiology and genetics of the Pauropoda.

Scavenging of dead invertebrates along an urbanization gradient in Singapore

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Although there are no data for the tropics, the total biomass of dead invertebrates produced per year probably greatly exceeds that of vertebrate carrion. Little is known about the animals that scavenge invertebrates in the tropics and the impact of human activities on such communities. We studied the scavenging process for five dead invertebrate types in six habitats along an urbanization gradient in equatorial Singapore: primary forest, old secondary forest, young secondary forest, recreational park, mown grassland and impervious surfaces. Ants were the dominant scavengers, except at night in grassland when an earwig (Labiduridae) dominated. Overall, the forest sites had more scavenger species, faster first detection and shorter bait survival times than the non-forest habitats. Ant species richness decreased and bait survival time increased monotonically along the urbanization gradient, suggesting that these two parameters could be used as indicators of habitat quality. Yellow crazy ants (*Anoplolepis gracilipes*), which are believed to be invasive in Singapore, were unexpectedly found in the older forests. Analyses have shown that the ant species was adept at exploitative and interfering competition, thus posing a threat to native ants. The level of competition, however, varied with density of *A. gracilipes* and the habitat type.