



SER
SOCIETY FOR
ECOLOGICAL
RESTORATION

Society for Ecological restoration Liverpool 2000



Reflections on the past directions for the future

Abstracts

PREFACE

This volume contains the 332 abstracts of all the contributions, whether oral or poster, to SER 2000. They give an excellent overview of what restoration ecology is about at the start of the new millenium. It is clear that there is a wealth of opportunities for restoration, to which a wealth of ideas are being applied. Restoration is no longer, in most cases, just putting back a plant cover of any sort, but putting back a carefully constructed mixture of species which restores original biodiversity and is self sustaining

This cannot be done without the support of good science, careful application of established and new techniques, and the wise involvement of people. There is, however, an understandable tendency amongst practitioners who want to get on with the job, who perhaps form the majority of the membership of SER, to get on with the job and record little about what was done. By this we can all gain personal experience, but learn little from each other's mistakes and successes. These abstracts, which record, if only briefly, what has worked and what has not, therefore have great value.

With the remarkable wealth of offers it has not been possible for everyone to make an oral presentation, and many have opted for a poster presentation anyway. So no distinction is made between the two sorts of offers because none is deserved. The posters merit as much attention as the oral papers, and will be given excellent exposure in Liverpool's great St Georges Hall, before the Conference Dinner.

The abstracts would not have been assembled without the hard work of the SER2000 office, Richard Scott, Vicky Keen and Alex Kraberg, to whom we should all be very grateful. We hope there are no errors but if there are, please forgive us - time was not on our side.

Tony Bradshaw Chair SER 2000 Programme Committee

Abstracts from SER 2000 : Reflections on the Past - Directions for the Future

THOMAS M. ALCOZE

Northern Arizona University

Ecological restoration and indigenous conservation knowledge: fire, life and human traditions in landscape management

This presentation will focus on historic and contemporary practices using prescribed burning as a landscape management tool. Fire as an attribute of human identity, will be traced to evolutionary indications of humans as fire specialists and the complex and sophisticated fire technologies used by original nations across the globe. The presenter will emphasize landscape scale management strategies and cultural practices that reflect the conservation knowledge of such diverse First Nations as the Chippewa, Iroquois and Paiute of North America. Benefits of fire management for ecosystem restoration and for humans will be explored. Specific focus will be on the consequences of human fire use for increased biodiversity and edge habitats. The Habitat Mosaic Model of Ecological Restoration will be offered as a restoration design that integrates the traditional knowledge of original nations with modern ecological restoration applications. The issues and benefits of fire ecology will be tied to examples of indigenous fire use in North America, Australia, Africa and Europe thus indicating the relevance of traditional knowledge to modern, global perspectives of environmental conservation and ecological restoration. (Topic 3.5)

RK ALONSO, R. LOCKWOOD

English Nature, Northminster House, Peterborough PE1 1UA

Tomorrow's Heathland Heritage: delivering the UK BAP targets for heathlands

Tomorrow's Heathland Heritage is an exciting, forward looking initiative, which aims to significantly increase the coverage of lowland heathland in the UK, contributing to the delivery of the Lowland Heathland Biodiversity Action Plan targets for restoration and re-creation. We use "restoration" to refer to habitat management and maintenance, and "re-creation" for those areas recovered from woodlands, conifer plantations, arable, grassland or mineral extraction sites which occupy historic heathland areas. The THH umbrella scheme is being funded by over £18m, with £14m from the Heritage Lottery Fund. There are currently five tranches of projects in various stages of assessment and approval for funding. The habitats cover dry, wet and coastal lowland heathland. A project has to demonstrate its contribution to meeting BAP targets, including associated species. Each project should provide an increase in access, education, awareness and enjoyment of heathland by the public, local community involvement a strategic geographical approach and a holistic approach including historical, archaeological and landscape interests. Field restoration and re-creation methods used in THH projects include tree clearance (both plantations and invasive scrub), bracken and gorse control, provision of cattle grids and stock fencing, (re)introduction of grazing, reprofiling of waste tips, collection and spreading of seeds of heathland species and linking of heathland fragments by corridors. (Topic 4.3)

HANI ALZALZALLEH, TONY KENDLE

Department of Horticulture and Landscape, University of Reading

Optimising plant stock production systems for plant establishment on arid soils

Trees on arid soils often rely upon extensive or deep rooting habits to survive. Containerised planting material often suffers from root-spiralling. In the long term, spiralled roots can lead to decline, instability or even premature death of the trees. There have been

attempts to produce containers that accommodate these large root systems, but they are impractical. An alternative strategy is to develop a container system that promotes rapid root regeneration. Examples are root trainers and spring-rings. *Eucalyptus viminalis* seedlings were grown in normal containers, Spring-rings and root trainers, of comparable volume but very different in shape. Above ground growth did not vary much between these, but spring-rings lose water faster than the other containers and need more care in the nursery. Specimens were field-trialled in Kuwait. After one year there were no significant differences in measurable growth parameters, but the root system from the spring-rings had a more desirable root architecture and appeared more likely to succeed in the long term. Nurseries may be slow to adopt these containers as they are expensive and more difficult to manage, and benefits are not seen for several years. (Topic 3.6)

PENNY ANDERSON, KATHARINE LONGDEN

Penny Anderson Associates, Buxton, Derbyshire

Restoring high altitude, eroding, blanket bog

In 1980, the Peak District's Moorland Management Project reported on the extent and likely causes of the very extensive area of bare peat and regolith present within the moorland environment of this English National Park. Formerly mostly blanket mire or dwarf shrub heath moorland, the main damaging factor was identified as fire, mostly in dry summers. After revegetation trials set up by the project in 1981 failed to restore eroding deep peat at one site at 530m, various surface stabilisers were evaluated. A geojute mesh was chosen in 1989 to hold the puffy, mobile peat in place, while grass seed, lime, fertiliser and heather (*Calluna vulgaris*) seed were added. The experiment examined the efficacy of applying 100% and 50% geojute cover, and 3 different fertiliser combinations. Monitoring of the vegetation cover and species composition has continued for 10 years, and the paper will present the results to date. Having been fenced from sheep grazing for 9 years, the fence has now disintegrated. The likely future of the plot and the general applicability of the technique to other areas will be discussed. (Topic 4.3)

SHIMON C ANISFELD, MARCIA J TOBIN, GABOURY BENOIT

Yale School of Forestry and Environmental Studies, New Haven, Connecticut 06511

Sedimentation rates in flow-restricted and restored salt marshes in Long Island Sound

Many salt marshes in densely populated areas have been subjected to a reduction in tidal flow. In order to assess the impact of tidal flow restriction on marsh sedimentation processes, sediment cores were collected from flow-restricted salt marshes along the Connecticut coast of Long Island Sound. Cores were also collected from unrestricted reference marshes and from a marsh that had been previously restricted but was restored to fuller tidal flushing in the 1970's. High bulk densities and low C and N concentrations were found at depth in the restricted marsh cores, which we attribute to a period of organic matter oxidation, sediment compaction, and marsh surface subsidence upon installation of flow restrictions (between 100 and 200 years before the present, depending on the marsh). Recent sedimentation rates at the restricted marshes (as determined by ¹³⁷Cs and ²¹⁰Pb dating) were positive and averaged 78% (¹³⁷Cs) and 50% (²¹⁰Pb) of reference marsh sedimentation rates. The accumulation of inorganic sediment was similar at the restricted and reference marshes, perhaps because of the seasonal operation of the tide gates, while organic sediment accretion (and pore space) was significantly lower in the restricted marshes, perhaps because of higher decomposition rates.

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Sedimentation rates at the restored marsh were significantly higher than at the reference marshes. This marsh has responded to the higher water levels resulting from restoration by a rapid increase in marsh surface elevation. (Topic 4.5)

SVEN ARNTZEN

Department of Humanities and Cultural Studies, Telemark College, Norway

Restoration, ethics and history

Some philosophical arguments in support of ecological restoration resemble arguments for wilderness preservation in that they favour a natural environment which has no evidence of human modification or influence. I discuss these arguments, which are based on a dualistic version of ecocentrism. I propose that ecological restoration be viewed in a different light, in the context of an ethic of integration of humans or culture, on the one hand, and nature, on the other. Considering restoration in the context of an area's cultural history as well as its natural history can help provide a clue to solving certain ethical problems, for example the problem of exotic species and animal welfare in restoration projects. (Topic 1.1)

N ASHWATH, K BRENNAN, M BRUNDRETT, S SCHMIDT

Environmental Research Institute of the Supervising Scientist (ERISS), Jabiru, Australia

Studies on restoration of disturbed uranium mines in Kakadu National Park, Australia

Kakadu National Park has been included in the World Heritage list because of its biological diversity and large concentration of Aboriginal rock art. Kakadu and its surrounding areas also contain significant reserves of uranium, gold and platinum group metals some of which have been mined in the past and the others are currently being mined, or are proposed to be mined. Because Ranger mine operates within Kakadu National Park boundaries, and its final land use has been determined as a Park land, the Government has imposed very stringent environmental regulations. The current requirements are that Ranger mine should establish native plant communities at a density and richness similar to those found in the adjacent undisturbed areas of Kakadu National Park, and it should also ensure that the established plant communities will not require higher maintenance regime than that being practised by the Park authority. Since very little was known on the biology of native plants and their establishment procedures, a research program was established by the ERISS over five and a half years, involving universities, CSIRO and other agencies. The aim of this program was to develop restoration procedures for disturbed mine sites in the Region. This program included a number of studies such as: an understanding of the distribution of native plants on various landforms, establishing relationship between soil type and plant species composition, study of native plant seed biology, determining dependence of native plants on symbiotic micro-organisms such as rhizobia and mycorrhizal fungi, developing agronomical procedures for establishing native plants on mine spoils, isolating and testing rhizobial cultures on mine spoils, assessing revegetation success by applying stable isotope techniques and examining colonisation of rehabilitated areas by indicator species such as ants. (Topic 3.3)

CONRAD ATKINSON

University of California, Davis

Mining culture

The mines I create are beautiful and contain images from the highest achievements of our culture. The English pride themselves on their

landscapes and their love of gardening, however when a member of The Mines Advisory group opened one of my exhibitions, he said that when he came back after defusing landmines in other countries he could no longer walk on an English lawn...this echoes Wordsworth's inability to look at the sea, as he had before his brother was drowned at sea. Two centuries ago Wordsworth articulated the metaphorical (or is it material?) relationship between the Cumbrian landscape and its people. As we approach the bicentennial of the publication of Lyrical Ballads with its discovery of landscapes both external and internal, the prime question might be in relationship to the managed landscape framed thus: we know the landscape is managed materially and physically, but more complex and less focused upon is how the landscape is managed internally, how is it manipulated aesthetically, emotionally, poetically, politically internally; we know the production and marketing reasons which construct political apples and economic steaks but who constructs its meanings and for what purpose? How is the management of the landscapes of our desires and emotions created and by what poetic, aesthetic, politics does it operate? Most clearly stated in the question that Wordsworth asked of the transient worker he met on the road outside Dove Cottage in the poem Resolution and Independence "How is it you live and what is it that you do?" Is the TV commercial for Sellafield, where this halcyon incidental development within an apparently arcadian idyll: the most perfect contemporary English landscape artwork? How has the Lake District and Wordsworth been laundered to disguise the residues of power and the low thresholds, and the americium, and the strontium 90 and the distorted insects and the plutonium and the tied cottages and the seasonal labor patterns of the tourist industry with its low wages and agribusiness and dioxin and 245t. Whose fantasy; whose life, whose landscapes, whose desires? (Topic 6.2)

GRIGORE BABOIANU

Danube Delta Biosphere Reserve Authority, Tulcea, Romania 4.

The first wetland restoration program in the Danube Delta Biosphere Reserve

The Danube Delta is one of the world's largest wetland and among Europe's last largely natural landscape. In the last century, there were mainly, three waves of works - for navigation, for reed growing, and for fish culture, which affected its stability, and integrity. When these works were stopped in early 1990 at the moment of political change in Romania, the dyked area of the delta comprised 97,408 ha, 39,974 ha of which were dedicated to agriculture use. This negative effects were amplified, also, by the hydrotechnical works which destroyed an important flooding area (400,000 ha) up stream. Having in view that the Danube Delta is a complex biome, mainly wetland, but including also forests, flood plains, sandy dunes etc., the ecological restoration in the Danube Delta are based on the following main principles:

1. Restoring the original structure of each zone.
2. Identifying the optimum diversity for each zone (hydrological, chemical, economical optimum).
3. Making analyses for each area in the Delta ensemble and present the individual-holistic balance within structures and functions.
4. Ensuring that adequate ecotone areas are achieved.
5. Because all restoration activities are influenced by water quality, continuous monitoring of entrance and exit water in both the Danube Delta and the Razim lagoon complex.

This new ecological program involves the restoration of

1. the hydrological system
2. the abandoned polders for agriculture
3. the abandoned fish ponds
4. the habitats and ecosystems

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5. declining populations
6. affected landscapes. (Topic 4.2)

S. P. BAIRAGI

Chairman, Dolphin Conservation Society, Blue Hill, Jyotinagar, Guwahati 781021,

Riverbed sand extraction and its effects on the ecology and the resident dolphin

Kulsi is a small southern tributary of river Brahmaputra is particularly known for a resident dolphin population (*Platanista gangetica*) found in a small area of the river. River dolphins are one of the most threatened aquatic mammals of the world found mainly in Indian Sub-continent. This population in Kulsi is unique as it is the only population reported so far in India, which is residing round the year in the same spot. The depletion of the population (from 25 in 1993 to 11 in 1997) is mainly due to the ecological degradation of the river. This part of the river has been leased out by the local Govt. for riverbed sand extraction. Some earlier workers with a belief that this would maintain the depth of the river, which was necessary for the dolphin population, supported this unscientific activity. But this misconception results drastic increase of turbidity of the water causing low productivity of food fishes. Moreover, the turbid water is depositing washed off fine sands during extraction in to the immediate downstream part of the river which is affecting dolphin migration. This silted area also contain connections to some neighboring productive wetlands, thus blocking the release of food fishes from these wetlands causing serious food crisis as observed in last 8 years. To save the dolphin population from extinction this process has to be stopped immediately. (Topic 4.7)

MALCOLM BARTON

Groundwork UK, 85-87 Cornwall Street, Birmingham, B3 3BY

The UK Trust for the Restoration of Derelict Land : A sustainable solution to brownfields dereliction

Changing Places is involved with a large amount of post industrial dereliction but it is only scratching at the surface of the problem facing society at the start of this new millennium. What is needed is a new initiative that can deal positively with growing urban blight. Old solutions, based largely on commercial considerations, will not work in a world of rapid global social and economic change. One possible solution was first mentioned by Professor John Handley in a report published in 1965. In this report, which reviewed the status of derelict land at that time, he proposed the creation of a new, nationally based trust whose purpose would be to promote the reclamation of derelict land, to act for the nation in the acquisition of land at the end of its economic life, and to hold such land as trustee; working with the community to restore it to health and manage it for public benefit. The UK Trust for the Restoration of Derelict Land is therefore intended to take over where Changing Places ends. Its development is being shaped by the experiences of delivering Changing Places but further extensive work in the form of a feasibility study is currently being carried out and this paper will explain the background to this work and describe the proposals for this radical new organisation. (Topic 5.1)

ANDREW J BEATTIE, TONY PIK, MARK DANGERFIELD,
Key Centre for Biodiversity and Bioresources, Macquarie University, NSW, Australia

Virtual ecological restoration

Monitoring progress in restoration projects often involves the observation, collection and management of large numbers of species and specimens, especially when comparisons between different

treatments are essential to determine the best methods for restoration. BioTrack is a new system for managing large numbers of species and specimens in restoration projects. Specimens are first bar-coded and thus directly entered into a relational database, together with associated text such as collection and identification details. Each specimen is then digitally imaged to create a virtual specimen collection. These simple steps, together with the appropriate software, mean easy management and analysis of large amounts of data, remote and computer-assisted identification, efficient tracking of progress and clear presentation of results. The virtual collection of images and associated text means increased efficiency in the addition of new data, species and specimens. Specimen storage issues may be avoided as data, text, images, analyses and results merely occupy a portion of a hard disc. A survey of a national park and a vegetation restoration project near Sydney illustrate the efficiency of the BioTrack system for a state agency, a local council, a local community and for scientific research. (Topic 3.5)

N A D BENDING, A J MOFFAT

Progressive Restoration, Ewyas Harold, Herefordshire
Forest Research, Environmental Research Branch, Alice Holt Lodge, Farnham, Surrey,

The key to successful integration of the use of organic waste materials in restoration - dividing responsibilities between user and producer

The quality of reclamation using soil-forming materials can be considerably enhanced by the addition of organic matter during restoration. This stimulates colonisation by soil micro-organisms and kick starts nutrient cycling. Experience suggests that the majority of problems that arise in using organic waste materials are attributable to a lack of waste processing and treatment, inappropriately high application rates, poor choice of equipment for spreading and incorporation, or inadequate provision for maintenance. Many ventures are flawed because the responsibilities between user and producer are poorly defined though blame is more often attributed to inclement weather than poor organisation! Recycling of wastes is one of the most important priorities set out in UK policy on sustainable waste management. Waste producers have long viewed reclamation as an alternative disposal route but use for most has remained ad hoc. Significant opportunities exist for waste producers to form partnerships with mineral operators and agencies involved in reclaiming derelict land but a revaluation of attitude is required. European Union proposals on sewage sludge management will remove legislative ambiguities concerning sludge use in reclamation and place additional obligations on waste producers. This will ensure a more consistent approach with quality assurance brought very much to the fore. (Topic 3.4)

CHRISTINE BENNETT

Environmental Advisory Service (formerly Joint Countryside Advisory Service), Merseyside

The Mersey Forest Biodiversity Action Plan

The Mersey Forest initiative and the biodiversity process in the UK will be examined to determine the impacts both may have on landscape restoration. The Mersey Forest area will be described highlighting the variability in landscape and biodiversity. Reference will be made to the early landscape appraisal which enabled identification of appropriate tree planting areas and tree planting proportions across the Mersey Forest area. Mersey Forest targets for woodland creation and management over the first five year period will be considered and reviewed against the initial targets of achieving an

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increase in woodland cover of 30% over thirty years. The recognition of the need for targets for other habitat creation and restoration has driven the process of biodiversity action planning within the Mersey Forest. Examples from UK biodiversity action plans relevant to the Mersey Forest will be considered. The difficulties of setting, agreeing and reviewing appropriate targets for appropriate areas within the Mersey Forest will be described. Targets will need to reflect landscape and biodiversity variability across the Mersey Forest area thus increasing the pressure to find appropriate land in the right places. Examples demonstrating this pressure will be described. The question of whether there is sufficient land area within the Mersey Forest to accommodate targets for restoration of habitats and, equally as important, creation of habitats will be discussed. (Topic 1.3)

CONNIE BERSOK

Department of Environmental Protection, Tallahassee, Florida

Mitigation banking in Florida - a retrospective view

The Florida state legislature authorized wetland mitigation banking in 1993 and the state adopted associated rules in 1994. Since that time, 23 permits have been issued to construct and operate mitigation banks. Two of these are to non-profit or public entities; the remainder are to for-profit corporations. The mitigation banks range in size from 45.10 to 6,250 acres. The extent and degree of ecological improvement (preservation, enhancement, restoration) is translated to a common measurement known as a mitigation credit through the use of a functional assessment methodology. If all of the mitigation banks are fully constructed and ecologically functional, they can provide a total of 13,829 mitigation credits to offset wetland impacts occurring elsewhere. Each of the mitigation banks have a mitigation service area in which credits can be used; the size of those service areas range from 7,790 to 2,860,478 acres. The use of mitigation banks will concentrate wetland mitigation activities in a central location to offset wetland impacts that are found throughout the service area. One of the mitigation banks will be presented as a case study of the reality of mitigation banking and the potential challenges and ecological benefits of this mitigation option. (Topic 2.1)

LYNN BESENYA

School of Applied Science, University of Wolverhampton

The importance of after-management in grassland habitat creation - the Wolverhampton experience

Hay meadows have been created on public amenity sites in Wolverhampton since 1983, mostly using a hay strewing technique in an attempt to replicate existing semi-natural species-rich grassland. Many of these sites have been subjected to long term annual monitoring of the vegetation. In this paper the development and change in vegetation at some of these sites will be examined in relation to the management regimes applied at the different sites, also to other characteristics such as soil fertility. The paper will offer an assessment of factors controlling the development and persistence of plant diversity and trueness to type in grassland restoration. (Topic 4.4)

ROLAND BOBBINK

Section Landscape Ecology, Dept of Geobiology, Utrecht University, Netherlands

Restoration of hot spots of plant diversity in deteriorated dwarf shrub communities

Around 1900 species rich heathlands were common in the Pleistocene areas of the Netherlands, but they have decreased dramatically since then. Major reasons are changes in land use, atmospheric inputs and changes in hydrology. The habitats of these communities are nutrient-

poor, weakly buffered, sandy soils. This makes them very sensitive to air pollutants and lowering of the water table (wet heaths). Ecological restoration of these degraded nature reserves has therefore high priority. In this paper an overview of experimental restoration measures and the main factors of success or failure are presented. Field trials with different restoration measures have been set up in former hot spots of diversity in both wet and dry heaths since 1989 to counteract the negative impacts of air pollutants and lowering of the water table. The first aim was to restore former soil conditions, as we feel that long-term rehabilitation of ecosystems should start with restoring abiotic site conditions. Removal of the vegetation and top soil (sod cutting), liming and hydrological measures, or a combination of measures, were used depending on the cause of the degradation. These proved to be successful in restoring appropriate soil conditions and a low productive dwarf-shrub community. A full recovery of plant diversity was, however, seriously limited when the characteristic species had already disappeared, especially in dry heaths. This is caused by a non-persistent seed bank of many endangered species and the restricted dispersal capacity of most plants in the fragmented Dutch landscape. (Topic 4.3)

WILL BOND

Alaska Contracting, Stokeford Farm, E Stoke, Wareham, Dorset

Habitat translocation; should we even be discussing it ? aren't there better alternatives?

The author, one of the best known contractors in the field, responsible for a hundred or so schemes over the last ten years, looks at case studies which confuse the moral debate over habitat translocations, including those that

1. suggest that refusing consent to translocate certain habitat types may actually seal their fate by neglect.
 2. support the view that many translocation projects fail to deliver what they promise
 3. refute the perceived wisdom that translocation fragments ecosystems
 4. support the view that success is difficult to define and clumsy to measure
 5. refute the assumption that translocation is chiefly concerned with the sorts of habitat that are too valuable to tinker with.
- In a broad overview of translocation, drawing heavily on the authors personal experience and commitment, he considers
1. whether translocation proposals allow unacceptable damage to invaluable ecological sites, or whether the costs of such proposals put a new, and much higher, base value to ecological sites which have not hitherto had a demonstrable economic value
 2. whether translocation is an easy option for developers, or a means for ecologists to turn a necessary evil to their advantage
 3. the relationships of science, art, and track record in translocation development
 4. the contentious interpretation of monitoring results
 5. developments in methodology and equipment; the speed of change and costs
 6. the present state of translocation; its technical capability, ecological standing and prospects. (Topic 3.2)

DAWN BRICKWOOD

The High Weald Unit, Corner Farm, Hastings Road, Flimwell, East Sussex

Weald Meadows Initiative

The Weald Meadows Initiative partnership has aimed, over the last four years, to tackle the loss of unimproved meadows in the High and Low Weald. During this period it has successfully established itself as

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a centre of expertise with landowners and countryside advisors, and has provided an effective and comprehensive advisory service. Recognising the importance of adequate financial support to continue the traditional management of meadows the Initiative has successfully lobbied for the countryside stewardship scheme to target meadow sites and established a mechanism of harvesting local wildflower seed as a means of generating an additional income from the resource. The profile of wildflower grassland in the Weald has been raised to the extent that by the year 2001 it is expected that most of the wildflower grassland sites will have been identified and landowners contacted with preliminary advice. It is expected that almost half of these sites will be under appropriate management with the costs of management part supported by either the countryside stewardship scheme and/or income from the sale of seed. Expansion of the resource has been achieved by proactively promoting and advising on the creation and enhancement of species rich grassland. The Initiative has assisted local contractors to diversify their operations into the environmental field thereby supporting rural employment. It has also equipped landowners with the necessary knowledge and skills to manage their land in an environmentally responsible way. (Topic 3.6)

STEFFEN BRØGGER-JENSEN

COWI Consulting Engineers & Planners AS, Dept. Natural Resources & Rural Infrastructure, Søborg, Denmark

Regional development as a means for conservation and regeneration of the temperate primaeval Bialowieza Forest, Poland

One of the few remaining temperate, primaeval mixed-deciduous forests in Europe, the unique Bialowieza Forest in Eastern Poland, which covers 10.000 ha, is surrounded by forests under varying management regimes, covering 40.000 ha. As a consequence of an on-going enlargement of the existing national park, which covers all of the primaeval forest, the current forestry will change emphasis. Future objectives of the forestry will be to enhance and support forest ecosystems and biodiversity, including the only large population of European bison, wolf, lynx, a unique community of woodpeckers etc. New management goals will aim at supporting natural processes in recreating near-natural forest stands, with a species composition reflecting natural growth conditions. Natural disturbance regimes, such as grazing by present herbivores, should also be supported. Forestry and forestry-related job opportunities in the local community surrounding the forest will be greatly reduced in terms of income-generating capacities, and the park enlargement process faces significant local resistance due to a fear of loss of jobs and income. A project supported by the Danish government aims at facilitating regional preparations for changing emphasis in the forestry sector by setting in with a host of regional development measures, thereby providing economic incentives for the park enlargement process. The project encompasses task sets within regional development support measures, public awareness-activities, tourism development and planning, education and nature interpretation, and input to a new forest management policy. (Topic 2.2)

JACKIE BROOKNER

131 Spring Street, New York, NY 10012, USA

Art and remediation

Because the sources of the problematic relationship of human beings to our environment lie beyond the rational, transforming that relationship requires more than the rational appeal of sustainability. It demands change in our individual and collective imaginations, emotions, desires and needs —particularly constellating around issues

of Life, Death, Self, Other. This raises questions about sustainability—particularly what ability, who, and where is being sustained. Is the concept of sustainability itself sustainable? Art, with its capacity for metaphor and sensuous appeal, is an obvious tool for this part of the work. By integrating art with environmental remediation systems we can restore the environment at the same time as we restore our relationship to it. My biosculptures provide a working model for integrating art and environmental restoration. These sculptures are biogeochemical filters that function ecologically as well as aesthetically. Designed in consultation with ecologists, they use natural systems principles to turn waste and pollutants into nutrients and resources, cleaning air and purifying water in the process. The prototype, Prima Lingua, can be modified to function in different contexts - at smaller scale to clean household greywater or wastewater, at larger scale as part of freshwater treatment systems for urban stormwater or agricultural runoff. I will discuss two demonstration projects being developed in cities (New York and St. Louis), and a rural project near Krakow, Poland. (Topic 6.2)

SHERI C BROWN

Jones & Stokes, Sacramento, CA95616, USA

Interpretive exhibits on restoration sites

Interpretive exhibits provide an opportunity to describe the processes and value of ecological restoration to the general public. Unlike typical signs around many restoration projects that warn visitors to “KEEP OUT”, creative interpretation can provoke curiosity and involvement. Appropriate interpretive exhibits can help ensure project success by fostering stewardship and involvement. There are many considerations when planning interpretive exhibits including 1) audience, 2) longevity of the message, 3) materials, and 4) cost. The audience may be resident or transient. The sign material may outlive the message conveyed or the site may be rapidly changing therefore the message may also need to change. In addition, there is a broad range of exhibit materials and associated costs. This presentation will highlight at least six projects that integrate environmental restoration with interpretation. Experience with more than 50 exhibits will be drawn on to discuss what elements work, and what materials and processes can be appropriate. (Topic 6.3)

SHERI C BROWN

Jones & Stokes, Sacramento, CA95616, USA

Connecting a new neighborhood to history and the environment

As a successful example of using ecological restoration to connect people to their environment, the Parkway Venture housing development in the City of Folsom, California, USA will be discussed. The Parkway Venture (610 acres) was initially proposed as a typical housing development; however during the design process, the ecological restoration of 70 acres of dredger tailings left from 1938 gold mining activities became a vehicle to connect the new residents to their local history and environment. The final plan: 1) restored natural creek channels and riparian habitat, 2) created wetlands, 3) created passive recreation and accessible open space, 4) provided environmental education opportunities, 5) preserved remnant mine tailings to maintain site history, 6) focused mixed-use development on the natural open space, and 7) provided 100-year flood protection. The talk will focus on the design process, community involvement, environmental education, and key considerations for incorporating ecological restoration into housing developments. (Topic 5.2)

HOLGER BRUX

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Farming and restoration ecology in wetlands: how to start a new deal

In Northwest Germany the Dümmer Lake Region is an important bird area. This flat landscape is also an area of intensive large scale meat production which causes a lot of environmental conflicts. Cultivation of former wetlands and moor has started long time ago and boosted since 1953, so plain rewetting and restoration to wilderness would not solve these problems. Ecological restoration for endangered bird habitats needs mowing and grazing. Supported by the German government and the County of Lower Saxony, a E+E-project started in 1996 in the Dümmer Lake Region. 'E+E-projects' are practice oriented projects for large scale tests and development of new methods in nature conservation and landscape management. The main goal is to find the tricky pathway between natural processes and sustainable land use. Because the activity of local farmers was important in the development of this important bird area, cooperation with them instead of confrontation is a major tool.

The contribution presents results of the first phase:

- How to get the project started
- Ecological situation of the investigation area
- Development of a sustainable partnership of local authorities, farmers, nature conservation board and scientists
- Development of sustainable nature conservation goals
- Breeding success of endangered bird species. (Topic 2.1)

ANDREW BRYANT, DON EASTMAN.

School of Environmental Studies, University of Victoria, VICTORIA, BC.

Forestry and historical population dynamics of Vancouver Island marmots (*MARMOTA VANCOUVERENSIS*)

We used data from systematic population surveys, ear-tagged or radio-tagged animals, GIS-based landscape measurements, and missing values analysis to clarify changes in the abundance and distribution of Vancouver Island marmots (*Marmota vancouverensis*). Data are insufficient to assess population dynamics or the timing of marmot disappearance from parts of northern Vancouver Island. On southern Vancouver Island, clearcut logging of old-growth forests was associated with profound changes in marmot abundance and patterns of habitat occupancy. Marmots began to colonize recently logged (0-15 year old) clearcuts during the early 1980s. By the 1990s half of the world's population of this species was living in clearcuts. However this expansion was temporary and limited in geographic scope. Overall marmot numbers declined from a peak of 300-350 animals during the mid-1980s to fewer than 70 animals in 1999. The principal effect of forestry was to concentrate the population, apparently making marmots more susceptible to mortality from unsuccessful hibernation, predators and disease. The prognosis for continued survival of this critically endangered species remains hopeful provided that current plans for captive-breeding and reintroduction are pursued aggressively. (Topic 4.7)

MJ BRYANT, EVJ COHN, IC TRUEMAN, MA FULLEN

Environmental Science Research, School of Applied Sciences, University of Wolverhampton

The influence of soil fertility and light intensity on field layer development in urban secondary woodlands.

In the past many woodland restoration schemes have focussed on tree planting and have been more a product of trial and error than of sound

scientific research. This research concentrates on ground flora enhancement, via species introductions, in existing plantations with the aim of restoration using W8 as a target community. Previous work on ground flora enhancement has focussed on manipulation of the light climate to promote growth of introduced species while inhibiting that of weeds. This usually involves making species introductions upon canopy closure. However, evidence gained by the Wolverhampton Habitat Creation Group suggests that woodland field layer vegetation is strongly influenced by the interaction between soil fertility and light intensity during the establishment phase. Work to date which has investigated this interaction with respect to ground flora has largely been autecological. The current research aims to investigate this interaction at the community level in urban secondary woodlands with introduced ground flora, where these two environmental factors have been manipulated in replicated plot experiments. Light climate and soil fertility are defined and quantified. Multivariate analyses are used to elucidate which environmental factors are having the greatest influence on the direction of development of the ground flora vegetation. (Topic 4.3)

E BUISSON, L CASTELLINI, J HARWAYNE, J MILLER, S PAUQUET, J PEARSON, A SWINEHART, P ZIMMERMAN, M JOSSELYN,

Romberg Tiburon Center, San Francisco State University

New science comparing restored tidal marshes of various ages

An investigation comparing three tidal wetland restoration sites with a natural marsh indicates that biological communities in restored wetlands have different rates of establishment over time. The study investigated changes in soil characteristics and biological community heterogeneity at four wetland sites: a 3 month-old Caltrans mitigation site in the Albany mudflat; a 7-year-old channel at the Corte Madera Ecological Reserve; a 13-year-old mitigation site (Lincoln Properties) in Richardson Bay; and the 3-4,000 year old Hoffman Marsh. Wetland functions and attributes evaluated included soil bulk density, organic content and particle size distribution; vegetative community heterogeneity and plant biomass; benthic community heterogeneity; and fish utilization of tidal channels. Samples were taken within the tidal channel, along the channel edge, and in the high marsh. Results indicated that wetland functions within restored marshes exhibited temporal and spatial variation with increasing age. Some functions (bulk density, vegetative biomass) rapidly approached that of natural marshes. Other functions (organic matter development, benthic community structure) increased steadily over the 13 years observed in this study, but were not similar to the natural marsh. Some functions (such as fish use) do not appear to be related to marsh age but to geomorphic features and proximity to other habitats. (Topic 4.5)

F M BURCH, J MITCHLEY, G P BUCKLEY, T A WATT

Biological Sciences, Wye College, University of London

A method for monitoring restoration habitats

Monitoring the progress of restoration projects is essential both to assess the effectiveness of establishment and management methodologies used and to identify factors which may alter the course of habitat development. In order to achieve these aims, straightforward and robust monitoring techniques are required. Performance monitoring has traditionally been centred around a quantitative assessment of the numbers and distribution of individual species and has largely concentrated on the detailed sampling of vegetation quadrats. However this approach is extremely time consuming and expensive and requires high levels of expertise. This paper presents a

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habitat monitoring methodology developed and tested on a range of restoration sites as part of the English Nature Habitat Restoration Project, which aims to provide a simple, rapid and effective method of monitoring restoration projects. The methodology centres on the selection of attributes (both positive and negative) which are measurable and which are considered important determinants of restoration success in individual habitats. Condition targets for these attributes are determined on a time scale of 1, 3, 5 and 10 years after the commencement of restoration and simple forms used to monitor restoration progress. This paper will explain the methodology and provide examples from a range of habitats. (Topic 3.5)

CARLA BURTON ,PHIL BURTON

Symbios Research & Restoration, Smithers, British Columbia, Canada

Fertilization can sometimes reduce the amount of seed needed to revegetate degraded soils

Fertilisation is often decried for use in the ecological restoration of plant communities, because exotic and weedy species typically respond to nutrient addition more than longer-lived and slower-growing native plants. Yet native plant materials are often expensive and difficult to come by, thereby providing an incentive to optimise their survival and growth on restoration sites. We have spent several years collecting, propagating and field testing species of *Achillea*, *Carex*, *Elymus*, *Festuca*, *Geum* and *Lupinus* indigenous to the northern interior of British Columbia, Canada. These species have been sown at densities ranging from 375 to 6000 pure live seeds per m², with and without 18-18-18 fertiliser, on a range of sites degraded by road construction and logging activities. Fertilisation can increase the cover produced by a given density of seeds by two to four times, or equivalently reduces the amount of seed required to generate the same amount of cover. Fertilisation is not advisable when invasive or cultivated plant species are present, or where the restoration of diverse plant community composition is more imperative than plant cover establishment. This technique, which permits one to substitute inexpensive fertiliser for some expensive native plant seed, is not as effective on sites with intact topsoil. (Topic 3.4)

KEVIN R BUTT, CHRISTOPHER N LOWE

Department of Environmental Management, University of Central Lancashire.

Are earthworms a valuable component of ecological restoration?

That earthworms perform beneficial activities within soils is now universally accepted. Through the creation of burrows they assist drainage and permit soil aeration, and the throughput of soil they ingest leads to an intimate mixing of organic and mineral fractions. As part of restoration schemes some groups now advocate the introduction of these animals to assist the recovery of soil function. What evidence is there to suggest that this is necessary or in fact does evidence exist to the contrary? This presentation reviews documented reports on earthworm introductions and aims to disclose instances which permit valid comments to be made on the benefits of such actions. Major findings relate to fundamental mistakes which have been made, for example, in the species of earthworm chosen, the timing of introduction or the failure to provide sufficient organic matter. Other findings relate to natural colonisation by earthworms of restored sites. From past experience it is now possible to suggest if and when earthworm introduction to a site may be of practical use. Earthworms should not be viewed as a panacea in restoration, but they may have a useful role in appropriate circumstances. (Topic 3.4)

PATRICK CAGNEY

US Army Corps of Engineers, Seattle

Ecosystem restoration in the Green/Duwamish River Basin

The Green/Duwamish River Basin is unique in that its upper portions are located in remote forests, while the river ultimately winds through the urbanized Seattle metropolitan area, one of the most rapidly developing areas in the United States. The 1250 sq. kilometer basin originates in the Cascade mountain range and empties into Elliott Bay on Puget Sound, Washington. The Green/Duwamish Basin supports a wide variety of fish and wildlife, but its several species of native salmonids are a totem of watershed health and the focus of attention. Several salmonid species are currently threatened with extinction. During the last 100 years, development has significantly altered the processes that provide habitat for the salmon. The Seattle District, Corps of Engineers and local municipalities have initiated a habitat restoration study for the entire river basin. The focus of the evaluation is restoring habitat functions and riverine processes, where possible. A basin-wide analysis was conducted to identify factors limiting ecosystem health. Over fifty restoration projects in both the upper and lower portions of the watershed have been identified. Potential projects were screened using a multi-criterion analysis with factors including scale, feasibility, and biological effectiveness. (Topic 4.2)

PETER CAMPBELL

Ranger Services, Liverpool City Council

Larkhill Gardens Lake improvement

Larkhill Gardens Lake improvement is a collaborative project between the City Council, the Environment Agency and the local community.

Larkhill Gardens Lake (4936m²) a circular shaped, steep, vertical hard-banked lake, situated in a small estates garden in a densely populated inner city area of Liverpool. The lake exhibited, like many lakes in the City, problems associated with:

1. structural decline;
2. lack of water;
3. poor water quality;
4. poor habitat quality;
5. loss of management of the user,
6. lack of proactive management by the City Council.

The lake's structure was changed to create a deep-water fishing area, shallow water area and wetland. Water supply was addressed through the installation of a borehole; an outflow was fitted with a top water level and a summer water level within the wetland, a previously adjacent area of land prone to flooding. The bank profiles were reduced and marginal planting undertaken by the use of locally sourced native species. Access and reduction of user conflict was facilitated by the incorporation of a boardwalk and fishing platform. The lake has not been restocked yet and invertebrate diversity has increased. (Topic 4.2)

MH CAREY, R BELL, RJ HOBBS

Environmental Science, Murdoch University, Western Australia;

Simulating plant function along naturally saline rivers to restore plant communities affected by secondary salinisation.

Extensive clearance of deep rooted vegetation in southern Australia has reduced transpiration, allowed water to accumulate beyond the root zone and subsequently raised water tables. Secondary salinisation occurs when soil salts dissolve in rising groundwater and concentrate

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in surface seepage particularly along drainage lines. Such hydrological change has meant that plant communities along drainage lines can no longer function in these dramatically altered landscapes. Many of Australia's south west rivers are associated with low gradients and ancient drainage lines in which salt has accumulated over thousands of years. These soils have allowed plant communities, such as yate (*Eucalyptus occidentalis*) woodlands, to function along naturally saline rivers. We examined the potential of using the responses of these woodlands to increasing salinisation to guide restoration efforts in areas subject to secondary salinisation. The survival requirements of plant species typical of yate woodlands along naturally saline rivers were examined to determine if recent changes in hydrology and salinity affect yate woodlands and how various parts of the woodland respond. From this we were able to assess the consequences of hydrological change for the plant communities occurring in naturally saline areas, and to determine what components of the community could potentially be used in broad-scale restoration efforts in landscapes subject to secondary salinisation. (Topic 4.2)

GEOFF CARTWRIGHT, RICHARD WATTS, IAN ROTHERAM Centre for Environmental Conservation, Sheffield Hallam University **Airport steelworks or historic landscapes - integrated development of Sheffield City Airport.**

A large area of secluded and enclosed land surrounding the former Tinsley Park steelworks in Sheffield was surveyed for its ecological interest in the mid 1980s and found to be extremely rich in its diversity of habitat - types. This being the result of industrial usage such as railway siding gravel beds, and relatively untouched more naturalistic communities of marshland, ponds, heathland, 'ancient' woodland and vast areas of grassland. Some of these had survived from the major medieval deer park which formerly covered the area. Protection of elements of this landscape, in opposition to potential obliteration through opencast mining in advance of development of a small, regional airport, was a battle that resulted in compromise - a reclamation together with a 'rescue' exercise of soils and vegetation to a nearby site. Issues of access, landscape approaches compatible with end use and the success and failure of various rescue/vegetation transfer techniques are discussed. (Topic 5.2)

GEOFF CARTWRIGHT, RICHARD WATTS Centre for Environmental Conservation, Sheffield Hallam University and Department of Planning, Transportation and Highways, Sheffield City Council **Environmental concerns in integrated redevelopment of derelict industrial areas: a case study of Sheffield's former industrial heartland.**

Sheffield's industrial heritage is based around steelmaking, cutlery and tool manufacture, and engineering works all of which utilised water power from the abundance of rivers and streams in the Don Valley catchment within the Sheffield area. Many of these workplaces were located on the wide floodplain of the River Don to the east of the city and into the neighbouring town of Rotherham. The decline of these heavy industries in the 1970s brought about major unemployment and a landscape of dereliction. The paper describes the attempts of the City Council to provide a scenario to attract new development and employment into this area alongside integrated leisure and environmental restoration initiatives. With regard to the later, Sheffield adopted a unique approach of restoring elements of a landscape that existed prior to nineteenth century industrialisation alongside modern development. An attempt to rediscover the magic of descriptive local place names such as 'Salmon Pastures'. Issues of integrated survey and

planning, cross specialisation, political desires, public consultation and community involvement are examined. (Topic 2.2)

GEOFF CARTWRIGHT, RICHARD WATTS Centre for Environmental Conservation, Sheffield Hallam University and Department of Planning, Transportation and Highways, Sheffield City Council **Sustainable sewage: restoration of floodplain landscapes on derelict sewage works**

Sewage works in the urban environment present many problems when they come to the other end of their working life. Many have spent decades receiving a mixture of domestic and industrial effluent. Regulation now requires a suitable landscape amelioration that has to take account of methane production and potential contamination from heavy metals - particularly if its end use involves access to the public. This paper describes two contrasting landscape restoration schemes in Sheffield that mimic typical floodplain landscapes of the region whilst being sufficiently robust to accept high levels of public access and with a main aim of promoting environmental education. The two case studies are at Blackburn Meadows on the Rotherham/Sheffield boundary, and at Coisley Hill in the Shire Brook Valley countryside management project area in the south east of the city. Issues of innovative design techniques are described together with an examination of partnership schemes, the importance of community involvement, funding and health and safety issues. (Topic 6.4)

RICHARD CASS Cass Associates, Liverpool **Nature in the cities - restoration in towns and cities** The process of urbanisation has meant the expansion of the human habitat at the expense of most forms of natural ecosystem. This process still occurs today over most of the developing world. Post-industrial societies are creating a very different kind of urban development. This frequently involves the presence of large amounts of redundant land, and a wish to see nature reintroduced as a component of the urban fabric. This paper describes three practical examples of this process, and the opportunities it creates for ecological restoration:-

The Liverpool Garden Festival Site
The restoration of a Milford Haven Oil Refinery
The Everton Park Nature Garden, Liverpool
All three cases involved the creation of a diverse range of new habitats from previously sterile or toxic conditions left over from intensive urban or industrial development. All three involved a deliberate and carefully considered integration of landscape design with habitat creation, taking a balanced, constructive view of the relationship and interaction between the human needs and biodiversity. All three involved extensive research and the development of practical techniques for habitat creation and management. The paper reviews the background to the three examples of, describes the restoration methods used, and discusses the practical results after between 10 and 15 years experience following a restoration. (Topic 5.2)

LAURA CASTELLINI Department of Biology San Francisco State University **Stream bioassessment in Presidio of San Francisco watersheds as a baseline for Riparian restoration plans** Stream bioassessment indicators were compared in a degraded stream and a reference stream to detect differences in benthic macroinvertebrate communities. The study site is a stream in the Tennessee Hollow watershed in the Presidio of San Francisco. Most of

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the stream is either buried or enclosed in a concrete channel. A restoration project is being planned that will “daylight” the creek and restore a natural stream channel and riparian habitat. Project monitoring will provide valuable information, especially if pre- and post-restoration data can be compared to document habitat improvements. In order to collect this baseline data, I conducted the California Department of Fish and Game’s Rapid Bioassessment Protocol on four reaches of the stream. I chose a reference stream in the adjacent Fort Scott watershed that met certain criteria set out by the Environmental Protection Agency (intact riparian zone, vegetative cover, no channelization) and repeated the procedure in four reaches of the Fort Scott stream. Macroinvertebrates were identified to the level of family. Metrics such as EPT Index, Percent Dominance, Percent shredders, Percent Collectors, and Percent Intolerant Organisms showed some striking differences between the degraded and reference site. The Tennessee Hollow stream has an impacted benthic invertebrate community that reflects the degraded habitat. (Topic 3.7)

HUGH CHALMERS

Carrifran Wildwood, Melrose, Scotland.

The Carrifran Wildwood Project

The Wildwood Group of Borders Forest Trust (BFT) has recently purchased a 600ha valley in the Southern Uplands, with the intention of restoring the rich diversity of native species present in the area before human activities became dominant. Many obstacles have been overcome over the last five years to get to this stage, in particular finding a suitable site which was available for sale, and in raising the purchase price of £345,000. The money was raised over the last two years, and came principally from individuals who wished to become ‘founders’ of the Carrifran Wildwood, and paid either £250 or £500 for the privilege. The entire watershed of an upland valley will be restored, with the first 8 years of the 3rd millennium concerned with tree planting. A Woodland Grant Scheme has been approved by the Forestry Commission, including an obligatory in-depth Environmental Statement drafted entirely by volunteers from the Wildwood Group. Through an exceptionally well preserved pollen record, we know a good deal about the ancient woodland of Carrifran. We will use this record as a guide. Already, volunteers have collected thousands of native seeds from surviving woodland remnants in the vicinity of Carrifran, and these have been grown on, ready for planting from 2000 onwards. Today, only tiny fragments remain of the broadleaved woodland which covered the hills and valleys of southern Scotland. These fragments cling on in the few places inaccessible to sheep and goats. Over the last 2000 years, an entire ecosystem has been lost. We have now arrived at a unique point in history, where we are able to start to reverse the degradation of one relatively small (but spectacular) valley in the Southern Uplands. Perhaps our example will persuade others to follow, especially if livestock headage payments from the EU are discontinued. (Topic 4.3)

JUDY CLARK

Department of Geography, University College London

Making sense of nature: negotiating wetland values in north Devon

This paper concerns an experimental methodology, developed by ESRU researchers, which aims to provide decision makers with usable information about popular values for wetlands. The methodology, which uses a deliberative procedure to identify wetland values as they are perceived by non-professionals and a collective ranking procedure to determine their relative importance, was tested in the context of a proposal to enhance the nitrate removal function of a small wetland

area at Tetcott Barton, close to the river Tamar in north Devon. I evaluate the methodology not only as a means of capturing various wetland values but also as a way of ‘eavesdropping’ on how non-professionals make sense of nature. In line with a growing body of work on popular understandings of nature, this study too indicates that it is simplistic to conceptualise the roles of lay publics in ecological decisions as polarised between the antithetical extremes of people as obstacles and participation as a panacea. Rather, it may be more productive to progress from understandings of how popular meanings are constructed to develop processes for making the best shared sense we can of ecological issues in order to reach mutually acceptable decisions. (Topic 6.1)

ANDRE CLEWELL, JOHN RIEGER, JOHN MONRO

98 Wiregrass Lane, Quincy, Florida

Managing ecological restoration projects

Ecological restoration projects represent long-term commitments of land and resources. Project work is generally costly in terms of direct expense and labor. Most projects are complex and inter-disciplinary. Guidance is essentially unavailable on how to plan and execute restoration projects. As a consequence, some projects have been hampered by too much enthusiasm and too little planning. Other projects have been hindered by too many bureaucratic restraints and too little focus on achieving project goals. We prepared an annotated checklist for restoration project managers, so that they can avoid the errors of omission and commission that threaten project quality. This checklist is entitled Guidelines for Ecological Restoration Projects. Fifty-one items in the checklist are grouped among six categories: Conceptual Planning (identifies the need for restoration and the overall strategy for its accomplishment), Preliminary Tasks (tasks on which planning depends), Installation Planning (plans that describe how restoration will be implemented), Installation Tasks (the fulfillment of installation plans), Post-Installation Tasks (mid-course corrections and adaptive management), and Evaluation (monitoring and publication). The guidelines are applicable to any ecosystems, terrestrial or aquatic, and in any management context. Design issues for specific ecosystems are not included. Examples of guidelines are sometimes simple and straight forward, e.g., make sure you describe and take good photos of the restoration site prior to doing any project work. Other guidelines deal with more complex issues such as liaison between the restorationist and the public or between the restorationist and the project manager for larger projects of which restoration is a component. The guidelines are under consideration for adoption as an official document of the Society for Ecological Restoration. (Topic 3.1)

M N CLOUT, J L CRAIG

School of Environmental and Marine Sciences, University of Auckland, Tamaki Campus, Auckland, New Zealand.

Ecological restoration for vertebrates in New Zealand

Following the human settlement of New Zealand and the introduction of alien mammals, native vertebrates (particularly birds) suffered disproportionate rates of extinction and endangerment. Lowland forest ecosystems were especially diminished by clearance and degraded by invasive species. The towns and cities of the lowlands are where most New Zealanders live, and for many of these people the presence of native birds improves their quality of life. In this paper we therefore focus primarily on prospects for the restoration of lowland ecosystems, including those in urban areas, to benefit native birds. We consider the “ecoservices” provided by natural ecosystems and the wildlife which they contain, explore what degree of restoration is feasible for

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vertebrates, and discuss some of the complexities of managing the threats to restoration posed by invasive species. Finally, we discuss the seasonal food resources of key native bird species, such as kereru (*Hemiphaga novaeseelandiae*) and tui (*Prothemadera novaeseelandiae*), and the pivotal role which these birds can play in restoring and sustaining vital ecological processes in forest ecosystems. (Topic 4.7)

PHILIP COLEBOURN

Ecological Planning and Research, Winchester

Creation of an intertidal creek and wetland on an area of reclaimed dredgings and creation of new intertidal mudflat through recharge

Ecological Planning & Research (EPR) are involved in developing proposals for a controversial infrastructure project on the Hampshire coast. The proposals will result in the loss of an intertidal area forming part of a site of international importance for wintering waterfowl. An area of approximately 240ha of coastal grassland, including areas which are seasonally inundated, will also be lost. As ecological consultants, EPR are responsible for ensuring that the design of the proposals minimises overall ecological impact. The proposals:

- 1 The construction of an intertidal creek from an area of reclaimed dredge spoil. The creek will be approximately 1 mile long and 200m wide at its widest point; it has been specifically designed to provide intertidal mudflat for feeding birds;
- 2 The creation of a series of transition habitats at the top of the creek, grading from salt marsh communities, brackish damp grasslands, saline pools and reedbeds. The objective of this area has been to retain habitat for local botanical interests and to provide habitat for wildfowl which feed on the terrestrial habitats when inundated during the winter.
- 3 The recharge of an area of contaminated mudflat to both extend the intertidal area by approximately 20has (down to MLW) available for feeding birds and to cap the existing contaminated sediments to improve their quality (approx 120has)

We present the story behind the design of the proposals and the underpinning philosophies that have led to the final scheme. (Topic 4.5)

PHILIP COLEBOURN, NICOLA FRENCH

Ecological Planning and Research, Winchester

The effectiveness of the Habitats Regulations 1994 in promoting an ecologically sound development scheme

Ecological Planning & Research (EPR) are involved in developing proposals for a large infrastructure project proposed on the Hampshire coast. The proposals will result in the loss of an area of intertidal mud which is designated part of the statutorily protected Solent & Southampton Water Special Protection Area (SPA), an international designation to protect habitats of importance for wintering waterfowl. In addition, an area of approximately 240ha of coastal grassland, including winter wetland areas, will be lost. Part of this area is designated a Site of Importance for Nature Conservation (SINC) a non-statutory nature conservation designation. The recognised importance of the habitats affected by the proposals has driven a careful design process whose overall objective has been to minimise the ecological impacts of the scheme such that eventual development will be acceptable under planning and nature conservation legislation. We consider to what extent the large and ambitious habitat creation scheme which forms part of the proposals has been both initiated and frustrated by the protective legislation and policy surrounding the site; and most importantly, how effective policy has been in encouraging a

workable development scheme which is meaningful in ecological terms. (Topic 2.1)

TIM COLLINS

Studio for Creative Inquiry, Carnegie Mellon University, Pittsburgh

Talking to the trees

For this paper I will focus on the role of art in urban eco-restoration. It is in the city that a restoration of green infrastructure and its multi-benefit potentiality has the most to offer. It is to improve nature's function, it subsumes nature. It is in the city, where the observation of nature (the biologist learning without acting) is institutionalized in natural history museums. It is in the city where the inspirational effects of nature (the artist affected by, but not responsible for nature) are presented in galleries, bookstores, museums and concert halls. It is in the city where the damage to nature is greatest and the healing effect of restoration ecology reaches its widest audience practices. On one end lie the arts and humanities; the other end is defined by the biologic, hydrologic, and soil sciences. Restoration ecology has the potential to replace the conservationist paradigm with sustainable changes in the way people (and institutions) relate to nature. I will explore this idea and the import of diverse (and conflicted) authority as we clarify the theories that drive restoration ecology. (Topic 6.2)

TIM COLLINS

Studio for Creative Inquiry, Carnegie Mellon University Pittsburgh

Urban restoration - infrastructure meets ecology

The Nine Mile Run Greenway Project in Pittsburgh Pennsylvania integrates restoration ecology with civic dialogue in the context of a post-industrial American city. The site is a 230-acre brownfield, at the mouth of an urban stream flowing from a city park. A social approach to sustainability (Orr) is the philosophy guiding the city and region. The project addresses the establishment of vegetation and stream restoration. The project achieves broad civic dialogue through publication, onsite tours and community programs. The process has three steps:

1. Ample Opportunity the Community Dialogue An analysis of the issues and opportunities revealed when a community takes a restoration based approach to urban brownfields
2. Ample Opportunity, the Ecology of a Brownfield An ecosystem/watershed analysis and planning program designed to present restoration options as a basis for community decision making.
3. Ample Opportunity the Brownfield Transformation, Final community consensus designs complimented by an institutional and economic plan.

Each step will be reviewed for intent and outcome. Institutional reorganization, Stream restoration design and vegetation test plots are under way. A text on restorative approaches to urban stormwater has been published with Rocky Mountain Institute. (Topic 5.2)

ADRIAN COLSTON,

The National Trust, Wicken Fen National Nature Reserve, Cambridge

Transformation of drained agricultural land to wetland

99.5% of the original basin of the E. Anglian Fens has now been drained and today only three 'wild' fens remain: Wicken, Chippenham and Woodwalton. All are small (less than 400ha) and all are isolated. Indeed in Cambridgeshire as a whole less than 2.9% of the county is SSSI - the national average is 6.8%. The county is therefore a 'black hole' for wild life. As a result the National Trust is exploring the desirability and feasibility of restoring 5000ha of what is currently high grade agricultural land back to wetland habitats over the next 100 years. This paper will set out the vision for the project, put it into the

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context of climate change, sea level rise, meta-population ecology, island biogeography, and discuss the uses of extensive grazing regimes as a final management tool. The situation will be contrasted with that in the Netherlands. The paper will also report on the feasibility work that has already been carried out, and the local reactions (public and private) to the proposals. (Topic 1.3)

FRANCISCO A COMÍN, JOSE A ROMERO

Department of Ecology, University of Barcelona, Barcelona, Spain.

Coal mine restoration through wetland creation

Wetland creation can be a useful tool to restore mining zones. This paper describes the changes occurred during the first year after the establishment of a wetland created to restore a 27 ha coal mine depression excavated in Andorra (NE Spain). It began to be filled with rainfall water draining from a 4.57 km² area in 1998. Carbonate rocks were added in a 4,000 m² area of the depression to buffer the pH of the water and soil. After 11 months, 5.6 ha were covered by water permanently (maximum depth 2 m). The water conductivity is very low (3 µS cm⁻¹). It remains oversaturated with oxygen all the time. The initial pH (3.5) has increased to 7.4 and alkalinity to a value of 1.2 meq l⁻¹. The nutrient content of the water remains low (1.6-3.5 µM of soluble reactive phosphate, 7-46 µM of dissolved inorganic nitrogen). Secchi disk is visible through the entire water column. Low concentrations of phytoplankton pigments were observed (1.3-5.2 mg total chlorophyll m⁻³). Phytoplankton was dominated by small (less than 25 µm maximum length) cells of flagellated cryptophytes and chlorophytes. A few small (less than 10 m²) spots of emergent vegetation (*Phragmites australis*, *Typha latifolia*) have colonised the shores (less than 1% of the total non-submerged area). The major pond has been colonised by *Chara* sp, which have covered 50% of the bottom area. These results indicate that a relatively quick chemical stabilisation and a slow biological colonisation are taking place in the wetland. (Topic 3.3)

ROB COOKE

English Nature, Peterborough

Restoring damaged sites - seeking a wider context.

Nature conservation in the UK is achieved through a combination of legislative measure and policy framework. In the majority of circumstances nature conservation is but one factor which has to be weighed where there are conflicting land use demands, and increasingly stiffer tests have to be satisfied before damage or destruction is allowed to occur. Nevertheless, in rare circumstances these tests are satisfied and protected sites are lost or damaged as a result of planning decisions as well as illegal activity. However, the greatest threat facing protected sites today is inappropriate management, such as over-grazing, or neglect. In these circumstances restoration of the site may help lessen the impact. It is the goal of conservation bodies to protect prime nature conservation sites so that they continue to support threatened and rare wildlife and natural features. To this end when sites are damaged every effort is taken to restore, or re-create, damaged or destroyed habitats, whether as a matter of policy or legislation. New legislation is currently proposed by the Government which, if enacted, will strengthen the powers of courts to order restoration where sites have been illegally destroyed, or deliberately mis-managed. Sites, though, cannot be considered in isolation, and national and regional strategic policies and frameworks such as the Biodiversity Action Plan and Natural Areas provide the context within in which to steer site-based restoration. (Topic 4.1)

RICHARD COPAS

The Environment Agency, Reading

The Environment Agency's experience in procuring British native plants

The Environment Agency is a public body with a range of responsibilities and regulatory functions covering freshwaters, contaminated land, flood defence and pollution control. It is a major procurer and user of native plants, mainly associated with landscaping and ecological restoration following river engineering and flood defence works. For well over a decade the Agency, and its predecessor, has been seeking to utilise plants of British native origin and local provenance for many of its capital projects. However, this has been very difficult to achieve in practice. Some of the difficulties encountered :

- 1 Suppliers, contractors and consultants did not believe we really meant it
- 2 We did not understand the structure of the landscape and horticultural industries sufficiently to be able to identify a workable procurement process which worked within public sector procurement rules
- 3 Our own project timescales did not plan for these requirements to be addressed in an achievable and realistic way
- 4 Appropriate plants were not available off the shelf, as the market was not substantial enough to encourage suppliers to collect the seed and grow the plants without a specific buyer and an up-front agreement to purchase.
- 5 For some plants it was not even clear if appropriate seed was available, and if so where it was and who would collect it?
- 6 There was also uncertainty amongst ecologists and biologists about the definition and value of restricting the origin of plants to those from only local or UK sources.

Our presentation will describe how these issues were addressed with reference to our experiences in procuring different types of plants and on projects including the Maidenhead Windsor and Eton Flood Alleviation Scheme. (Topic 3.6)

NOEL CORKERY

5 Rodborough Avenue, Crows Nest, NSW, Australia

Sydney 2000 Olympic Games Site restoration legacy

The greatest legacy of the Sydney 2000 Olympic Games will be the restoration of the highly degraded Homebush Bay (760 ha) site to create a major new sporting and open space asset at the geographic centre of Sydney. Over 200 years of land use had destroyed most of the original ecological values and created a highly degraded and extensively contaminated site. However, Sydney's successful bid for the 2000 Olympic Games has provided the catalyst for one of the largest site remediation projects in Australian history. The \$150 million 12-year remediation project includes approximately 160 ha of former landfill together with ecological restoration in areas of remnant woodland, grassland, mangroves and tidal wetlands. The large scale and complexity of the project has demanded the involvement of a highly diverse team with scientific, administrative, political, planning, design and management skills. The knowledge gained is applicable to other cities where major sporting and cultural events can provide the catalyst for rehabilitation of highly degraded sites through the application of ecologically sustainable management principles. This paper will describe the nature and scale of the rehabilitation component of the Homebush Bay site. The implications for ongoing management, maintenance and monitoring of the rehabilitated site, as a major public open space recreation facility within Australia's largest city, will also be addressed. (Topic 2.2)

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J CORTINA, S BAUTISTA, M T HUESCA, F T MAESTRE, N SEVA, A VALDECANTOS, V R VALLEJO.

Dept. Ecology. University of Alacante, Spain and CEAM Valencia, Spain

Microscale spatial heterogeneity and dryland restoration

Spatial heterogeneity in plant distribution is a common trait in water deficient ecosystems. Spatial patterns may result from local differences in infiltration and runoff, water storage capacity, temperature, nutrient availability, and from several biotic factors including seed dispersion and predation, availability of suitable mycorrhizal inoculum, etc. In turn, they are favoured by vegetation through changes in resource flow and local environmental conditions (i.e. ecosystem engineering). Numerous studies show that spatial heterogeneity affects ecosystem composition and function, and that it is a key factor in post disturbance regeneration. In dry and semi-arid Mediterranean ecosystems vegetation patterns can be very relevant for the re-introduction of plant species of interest. In this contribution we review the factors causing microscale spatial heterogeneity in these environments, and analyse the role of microscale spatial heterogeneity in ecosystem restoration. (Topic 4.8)

ALEC DAUNCEY,

Director of Tir Coed, Wales, UK

Opportunities in forestry

Many of the policies and practices which created the need for habitat restoration, arise from the geopolitical history of the early 20th Century. Forestry in Great Britain after the First World War was focussed on the creation of a strategic timber reserve in case of naval blockade. Despite the disappearance of this 'raison d'être', legislation, incentives and the basic character of existing forests have continued largely unchanged. While environmental outputs are stated objectives, 'closer to nature' management and large-scale ecological restoration are viewed with suspicion by stakeholders and managers. Forestry and land-use policy continues to be dominated by interventionist mindsets and vocabulary. Modern forest design continues this approach through intensive management and control of natural processes to ameliorate the worst effects of exotic timber production forests. Similarly, new woodland creation continues to be based upon intensive tree planting, rather than natural regeneration. The latter is often characterised pejoratively as abandonment, neglect or scrub invasion. Those advocating a more natural approach to restoring natural habitats must change perceptions, vocabulary and opinions, and develop policies and incentives which will encourage lower input natural processes to effect ecological restoration, while sustaining the social value of an economically active population in the countryside. (Topic 2.2)

LINDA DAVIES

Kent County Council

The role of local biodiversity action plans in ecological restoration

Biodiversity action planning provides a new agenda for nature conservation; it identifies a process by which nature conservation can be taken into account by all those with an influence (direct or indirect) upon the management or use of land. Ecological restoration is the ultimate objective of the BAP process. Ecological restoration seeks to re-establish dynamic, natural processes which, until relatively recently, maintained and ensured biological diversity. In all but a few cases, traditional nature reserves (besieged islands of habitat) are unable to accommodate the restoration of natural processes. It is the BAP

process, with its emphasis on seeking cross-sectoral solutions, that provides the opportunity to reconnect fragments of semi-natural habitat and restore processes that have been constrained (unwisely it is now increasingly apparent) by a desire to control and tame nature. GIS offers opportunities to inform targeting activities by looking at habitat capability and thereby a vision of the possible. BAPs will not, and should not, necessarily, provide the mechanism for recreating large areas of pristine wilderness; they can, however, forge partnerships that will promote a holistic approach to land management and land-use planning, which has ecological imperatives at its core. Furthermore, ecological restoration, especially in lowland Britain, is conditional upon the support and understanding of all spectrums of society - BAPs provide an opportunity to reconnect people with nature. (Topic 4.1)

CAROL DAWSON, THOMAS GRANT

Denver Botanic Gardens

Rare *Astragalus*

Astragalus osterhoutii Jones (Fabaceae) is a long-lived iteroparous perennial endemic to sagebrush steppe of the western United States. *Osterhoutia* milkvetch is restricted to a 25 square kilometer area near Kremmling, Colorado. Threatened by habitat fragmentation and the construction of the Wolford Mountain Dam, this species was federally listed as endangered. Increased grazing pressure is thought to have increased big sagebrush densities, hence decreasing available soil moisture. A habitat manipulation experiment was implemented to determine the effects of soil surface disturbance and the removal of sagebrush plants on the survival and growth of seeds and transplants. Sagebrush removal and soil surface disturbance were manipulated in a two factor, split plot experiment using a randomized complete block design. The habitat manipulation study has shown that augmenting existing populations of *Astragalus osterhoutii* through the use of seeds or greenhouse grown transplants will be a formidable challenge. Survivorship of seeds and transplants was surprisingly low. Experimental treatments did not significantly increase the seedling recruitment of this species, although fall plantings were more successful than summer plantings. Competition for limited soil moisture with sagebrush and crested wheatgrass may impose severe limitations on growth and development of the milkvetch. Further experimentation will address the impact of an exotic species on the growth of milkvetch seedlings. (Topic 4.7)

NARAYAN DESAI, HEMA SANE, PRAKASH GOLE

A-4, Shagun Apts. 346 Somwar Peth, Pune 411 011; Botany Dept., Abasaheb Garware College, Pune 411 004; Ecological Society, Pune 411 008, India

Sacred Groves: Potential Reference Sites for Restoration Projects

Sacred groves are the forest patches representing climax or near climax community of a particular area preserved on religious grounds. These forest patches preserved on the religious grounds are the true indicators of the type of vegetation that once existed in that particular geographical area. Intensive studies related to the sacred groves made us to think about its importance in natural resource conservation and management. The paper presents their importance as possible reference sites and their need for protection. (Topic 5.3)

MARK DIAMOND, GEORGE AGER, KEITH HENDRY

Environment Agency, Warrington, UK.

The restoration of the River Mersey, NW England

The River Mersey is widely regarded as one of the most polluted rivers in Europe. The pollution of the River has its roots in the days

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of the Industrial Revolution and the birth of the British chemical industry. In recent times the extent of pollution from discharges into the river and its estuary has been reduced as a result of over £ 1 billion of investment in sewage treatment, sewerage infrastructure, and by industry. The pollution load of rivers flowing into the Mersey has been reduced by more than 80 % over the last 25 years. Mercury discharges have been reduced by more than 90% over the last 15 years. The concentrations of heavy metals deposited in salt marshes in the Estuary have in some cases reduced to near pre-industrial levels. The Mersey Estuary has become an international important site for wildfowl and waders. Fish have returned in great numbers to the Mersey estuary and many parts of the river. In 1999 Atlantic Salmon have been recorded above the tidal limits of the River Mersey for the first time since the mid 1800's. In addition to pollution, the physical structure of the river has been altered along most of its length. The prime example is the Manchester Ship Canal a major navigation, built in the 1880's, between Manchester and Liverpool. Its route largely follows the original river bed and it has consequently transformed the hydraulic regime of the river. This deep sluggish waterbody with highly contaminated organic sediments has severe water quality and ecological problems over its 54 km length. These problems can currently only be mitigated locally using artificial mixing, oxygenation and habitat improvement. The role of artificial means to achieve improvements is discussed in the context of a desire for more sustainable solutions. (Topic 4.2)

GERALD A DION

Society for Ecological Restoration Board. Sacramento, CA, USA.

The Zoological Parks Initiative

An initiative to link those SER members involved in ecological restoration and zoological parks involved in restoring habitat for wildlife. Zoological parks have been at the forefront of conservation efforts for many years. These efforts have included breeding programs, reintroduction programs, and habitat conservation programs. However, there is a growing movement within the zoological park institutions to help go beyond preservation and actively restore habitat for rare and threatened species. There is great opportunity to focus the energy, resources, and knowledge of zoological parks with members of the Society for Ecological Restoration to develop critical habitat. The discussion will focus on

- 1) four examples of zoological parks engaging in ecological restoration,
 - 2) a draft agreement between the American Zoo and Aquarium Association and the Society for Ecological Restoration, and
 - 3) opportunities to be involved with the Zoological Park Initiative.
- (Topic 1.2)

HORACE DOBBS

International Dolphin Watch, North Ferriby, East Yorks

Dolphins and Dustbins

Four fifths of the planet is covered with water. But what about the remaining fifth upon which most of us live? Our modern consumer society has produced unprecedented quantities of waste that has to be put somewhere. In North Ferriby it used to be dumped alongside the River Humber. When the banks eroded, parts of this stockpile of household and industrial waste were exposed, washed into the river and thence into the sea. In 1981 the dumping was stopped. The site was closed and capped with a thin layer of soil. Since then, thanks to inspired efforts by the local community, this once hideous eyesore has been transmogrified. It has been spontaneously recolonised by many rare plants. These have been supplemented by the judicious planting of

wildflower seeds. Now it is a place where people can roam freely and restore their spirits amidst trees and abundant wildlife, just as they must have done in the early Bronze Age. For this is the site of an ancient settlement where the inhabitants built the largest plank boats in the northern hemisphere - over 15 metres in length. A beacon built on this site to welcome the new millennium heralds a fascinating future for this ecologically restored corner of Britain. Porpoises and seals can sometimes be seen in the estuary from Riverside Walkway as this stretch of the Ferriby foreshore is now called. The latest plan is to have a specimen of every native tree and shrub established on site by the end of the year 2000. (Topic 6.4)

KEITH DUBLANICA

Skokomish Indian Tribe, Shelton, WA, USA

Salt marsh and riparian restoration within a Pacific Northwest Indian Reservation

The Skokomish Indian Reservation is located on the Hood Canal in western Washington, in the Pacific Northwest of the United States. The Tribe's Reservation, established following the 1855 Treaty of Point No Point, is approximately 40 miles west of Seattle, at the foot of the glacially carved Olympic Mountains. The Skokomish Tribe have resided at an area near the mouth of the Skokomish River since time immemorial. Midden sites have been dated to 2,000 years before present. The area has undergone extensive changes due to upstream watershed processes, including water withdrawal diversions for hydropower production, forest practice activities including clear cut logging and improper road building, agricultural modifications, channeling and diking of the river system, among other pressures of development. The river had the largest and strongest salmon runs of the Hood Canal, and the Skokomish Tribe is enlisting various collaborative and cooperative efforts to enhance and improve both the natural resources as well as the cultural resources. The watershed has a variety of jurisdictions within it. The upper North Fork Skokomish River boasts National Park protection that is composed of alpine montane slopes above timberline to temperate rainforest, an old-growth coniferous forest with complex and diverse structural and biological integrity. This area leads into a reservoir for a hydropower diversion that unfortunately has not provided for fish passage in its 70+ years of existence. This investigation tracks the spatial and temporal changes in this area, utilizing an adjacent undisturbed salt marsh as control and reference area, for both an intact diked system as well as a breached dike system experiencing salt marsh recolonization, using aerial infrared photography, and collecting transect data related to salinity, vegetation, sedimentation and migratory waterfowl use. The Skokomish Tribe has made this area a priority in implementing efforts of restoration, with support from local, state and federal entities, for both cultural as well as ecological attributes of their homeland, by reintroducing *Scirpus pungens* (sweetgrass). Another part of the study addresses the cultural icon of salmon, and the opportunities for the Tribe to restore elements of damaged habitat for salmon. (Topic 6.4)

JENNY DUCKWORTH

Plantlife, London.

The Back from the Brink project of Plantlife

The Back from the Brink project is a species conservation programme for threatened plants in the UK, run by Plantlife - the Wild Plant Conservation Charity. The project concentrates on the protection and enhancement of habitats of native plants, aiming to restore self-sustaining populations in the wild. Recently this work has been developed within the framework of the UK Government's Biodiversity Initiative; as part of this initiative Plantlife has taken on the role of

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Lead Partner for 75 species, including fungi, bryophytes, lichens, stoneworts and vascular plants. For each species an 'action plan' has been developed to deliver a programme of survey, research, management advice, practical action and monitoring. Plantlife works with partners in government and the voluntary sector, and with our own volunteer resource, to implement these plans. This can involve creating or restoring habitat in disturbed or degraded habitats, including former quarries, which offer opportunities for species survival not available within the modern farmed landscape. Species conservation practitioners are frequently faced with the question of when it is desirable to translocate populations into such restored or newly created habitat. Plantlife are exploring the ethical and practical considerations which inform these decisions in the context of the Back from the Brink project. (Topic 4.7)

JESSICA DUFFY

British Trust for Conservation Volunteers, Pennine Project, Huddersfield

Support for local nature reserves in urban areas

BTCV has been involved in the designation and initial stages of management of four new LNRs in the North Kirklees as part of a group headed by Kirklees Countryside Unit (landowners), the Wildlife and Landscape Advisory Forum, (local naturalists who helped select sites for designation), and FWAG (drew up the outline management plans). The sites are key areas of public open space in an area otherwise full of industry, old and new housing and horticulture. It was therefore seen as key to involve local people in the designation and decision making about the sites. Local people initially felt their use of the site for informal recreation might be threatened, and were also concerned that increased management would alter the essential character of the sites. They were reassured on these points and are some of them are now starting to get involved with site monitoring and management, initially through a Fixed Point Photography project funded through an EN LNR grant. The Countryside Unit hopes in future to fund BTCV's involvement in community development and physical improvements on the sites through a Heritage Lottery Grant. BTCV's role has been to liaise with local people, set up meetings, plan and run activities and act as a point of contact outside the local authority. We hope to be able to establish a group around each site to undertake monitoring and management projects as well as offering some informal wardening. (Topic 6.4)

PRISCA DUIJN

Ministry of Transport, Public Works and Water Management. The Netherlands

Nature friendly banks along waterways in the Netherlands

Since 1995 the international protection strategy against river floods is based on creating water buffers and broader and deeper winter beds. Furthermore, the river must be given room to organise itself so it will be more natural and at the same time easier to manage and maintain. Water systems are now regarded multi-functional. In addition to functions as water supply, fishing and transport, recreation and ecological value are regarded. A result of this policy is to create nature friendly banks along waterways: apart from the defense-function (the land has to be defended against the water) nature has to be able to go its own way as much as possible. Various types of nature friendly banks will be discussed. (Topic 4.2)

NIGEL DUNNETT

Department of Landscape, University of Sheffield

User responses to created meadow vegetation in public parks

If ecologically-relevant urban vegetation is to be truly sustainable then it must also be publicly accepted. In this paper we present the results of a major survey into the public response to large-scale created species rich meadows in urban parks in Sheffield, UK. In 1998 and 1999, large areas of species poor amenity grassland in four public parks in the city were converted to flowering meadow grasslands. The four parks were located in different geographical areas of the city, with differing socio-economic profiles. In the summer of 1999 (to be repeated in 2000) an extensive social survey was carried out into the response of local residents to the inclusion of these meadows in their parks. Respondents were asked to indicate how much they liked or disliked the meadows, and why. Questions were also asked to evaluate user response to the naturalistic vegetation compared with traditional horticultural vegetation, and to find out whether respondents would favour more of this type of planting in their neighbourhoods. The results are discussed in terms of age, gender, socio-economic status and ethnicity. (Topic 6.1)

NIGEL DUNNETT, JAMES HITCHINMOUGH

Department of Landscape, University of Sheffield

Sustainable urban plantings: ecological vegetations for urban public space in the UK

The urban environment is fundamentally different to that of the rural: disturbed or artificial soils, enhanced temperatures, reduced water percolation, air and water pollution, and heavy inoculation pressure from cultivated plants, and high density of human population. Certainly, in many European countries, urban plant communities can no longer be equated with those in the wider countryside, being characterised instead by a cosmopolitan and location specific mix of native species and garden and park escapes. So can the standard principles of restoration ecology be applied to the urban environment? We think not, and have developed a set of techniques which borrow from restoration ecology to create ecologically-functioning and aesthetically attractive vegetation types with high habitat value, for urban greenspace. In so doing, we propose that we achieve some of the major goals of restoration ecology: maintenance and enhancement of natural processes, support for wider urban ecosystems, reference to site and location, reduction in resource and energy inputs into vegetation management, and community involvement in landscape, without recreating specific semi-natural plant communities. In this presentation we discuss the results of our work, with specific focus on urban grasslands and meadows. (Topic 5.3)

NIGEL DUNNETT, DUNCAN WESTBURY

Department of Landscape, University of Sheffield

A biological approach to increasing species diversity in restored meadow grasslands

The species-richness of herbaceous plant communities is generally related to soil fertility. Restoration of species-rich grassland on fertile sites, such as former crop-growing agricultural land, can be problematical, resulting in dominance by vigorous, competitive grasses and forbs. Various techniques for reducing fertility have been proposed; such as top soil stripping, subsoil turning, encouragement of leaching and continuous cropping. These can be costly and highly intrusive. In this presentation we discuss an alternative approach: utilising hemi parasitic grassland species to reduce the vigour of vegetation dominants, thereby promoting greater diversity. In particular we discuss the results of trials into the creation of forb rich swards by controlling grass abundance using the hemiparasite

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Rhinanthus minor. During autumn 1998 a standard mix of forbs and grasses was sown on trial plots, with three sowing densities of *R. minor*. In the summer of 1999, species abundance was assessed visually and through biomass sampling. Total vegetation productivity, and particularly that of the grasses, was significantly reduced in the presence of *R. minor*, resulting in an increased proportion of forbs in the sward. The abundance of the dominant forbs was strongly related to the presence of *R. minor*. We will show whether these effects were carried over into 2000. (Topic 4.4)

DON EASTMAN

School of Environmental Studies, University of Victoria, Canada

Educating and training non-traditional students through university programs

Sound preparation for working in the field of environmental restoration requires knowledge of social and economic dimensions as well as a broad understanding of natural systems: purely technical or theoretical approaches are increasingly unacceptable. Providing an educational program with this broadened content to non-traditional students challenges typical approaches of educational institutions. The Restoration of Natural Systems (RNS) Program at the University of Victoria illustrates how educational institutions can respond to these challenges. Twenty courses were developed for the program, with input from theoretical and practical specialists. These courses are offered in field and classroom environments. Content includes freshwater, marine and terrestrial ecosystems; human impacts on ecosystems; land management systems of indigenous peoples; ethical, legal and policy issues; and communication, public education and dispute resolution. Courses are delivered in several innovative formats and at different times of the year, to recognize the varied needs of part-time, non-traditional students who are unable to attend traditionally-formatted university courses. This paper will discuss institutional issues - such as providing practical, interdisciplinary content in unusual formats within a traditional university setting - and student issues, including the mix of backgrounds in the classroom, employment issues, and the need to provide generalized restoration skills. (Topic 6.3)

SALLY EDEN, SYLVIA TUNSTALL, SUE TAPSELL

Hull University and Middlesex University

Streams of consciousness? Public responses to river restorations in England

In this paper, we explore how local publics have responded to two river restoration schemes in northern and southern England. Both schemes were demonstration sites for the River Restoration Project to develop and test state-of-the-art river restoration techniques, including constructing new meanders in the river channels, creating wetland areas, reshaping river banks and landscaping. Using interviews and surveys from research funded by the ESRC, we show that public awareness and approval of the restorations on both rivers were generally high but greater benefits were perceived where restoration took place in a more urban environment. These views can be compared to those of the restoration managers, to emphasise how the 'value added' by restoration is perceived differently according to its social and geographical context and not merely its ecological or hydrological effectiveness. We therefore argue that restoration proponents must consider not only the specific physical environments in which they are applied but also their sociopolitical context. If restoration is to sustain public and political support, it must integrate local understandings which are both technical and cultural. (Topic 6.1)

R H M EERTMAN

National Institute for Coastal and Marine Management, Middelburg, The Netherlands

Restoring estuarine habitats in the port of Rotterdam

The Port of Rotterdam is an example of an estuarine environment that has never had the chance to develop into a balanced ecosystem. The Port of Rotterdam is situated on a branch of the rivers Rhine and Meuse and is connected to the North Sea by a man made channel, named the New Waterway. This estuarine channel has a shipping and industrial function. The potential for ecological development has until recently been neglected. The Port area has the potential of developing into a valuable estuarine ecosystem, without harming economical interests. Restoration efforts should always be in line with the physico-chemical processes that characterise the ecosystem. At present the area has several shortcomings in comparison to reference ecosystems, the most important of which is the almost fully absence of intertidal areas. Recently, a study was concluded looking into the potential of selected sites of developing into tidal flats and salt marshes. The Port area has the potential of facilitating brackish habitats, a type of habitat which is relatively rare in the Netherlands these days. (Topic 4.5)

SIMON ELSON

Environment Department, County Hall, Kingston upon Thames, Surrey

Is it the Pits?! - restoration-led mineral planning, a partnership approach

The issue of whether people and restoration is a problem or a panacea will be explored at two levels. Firstly, at the organizational level, examining the types of problems that can occur. The fallacy of stereotyped images, how to break down such stereotypes and overcome conflict to create proactive partnerships. Through a series of examples, the presentation will demonstrate how local authorities can work with the minerals industry and the local community to create effective restorations, based on consensus building and espousing the concept of restoration led mineral planning. Secondly, through the process of design itself, examining how problems between ecological restorations and people's needs can arise, and how they can be resolved. Again, through a series of examples, the presentation will explore the concept of multi use versus single zoned uses, does compromise actually compromise the success of restorations, and how careful targeting from the start of the process avoids conflict and promotes excellence. (Topic 6.4)

VERA LEX ENGEL, JOHN A PARROTTA

Universidade Estadual Paulista, Dept. of Natural Resources, Botucatu, SP, Brazil. International Institute of Tropical Forestry, USDA Forest Service, Río Piedras, PR, USA

An evaluation of direct seeding for reforestation of degraded lands in central Sao Paulo State, Brazil

The use of planted forests to accelerate forest restoration processes is a promising approach. To be effective and widely accepted by landholders and public land managers, techniques should be inexpensive to establish and manage, provide a direct economic return, and effective under a variety of site conditions. In 1997-98 a research project was established at three contrasting deforested and degraded sites in Sao Paulo State, Brazil to test this. This paper reports the 2-year results from one of these treatments, direct seeding with 5 early successional species in mixed-species plantations: *Chorisia speciosa* (Bombacaceae), *Croton floribundus* (Euphorbiaceae), *Enterolobium contortisiliquum* (Leguminosae), *Mimosa scabrella* (Leguminosae), and *Schizolobium parahyba* (Leguminosae). Of these, only *Enterolobium* and *Schizolobium* showed good survival and growth

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rates, averaging 4.1-4.6 cm stem diameter and 0.8-0.9 m height growth after 2 years. Despite the poor performance of the other species, the natural regeneration of native forest species originating from remnant forests in the vicinity was significantly greater within the direct-seeded plots than in the unplanted (but protected from fire and other disturbances) control plots. With careful selection of species and seed sources, direct-seeding is an effective, low-cost alternative to planting of nursery-grown seedlings to re-establish native tree cover on degraded tropical lands. These plantings even at an early age serve to catalyze native forest succession by providing roosting sites for seed-dispersing wildlife and improved conditions for germination and growth of forest species introduced by bird-, bat- and wind-dispersal. (Topic 4.3)

**OLIVER ENGELMAYER, IRENE BURKHARDT (FREISING),
FRIEDRICH DUHME**

University of Munich, Germany

Comparing methods for environmental impact assessment in practice in Germany

As EIA is compulsory in Germany at all stages of city development, there is a strong need for the standardization of evaluation schemes. This is basically happening on the level of the federal states (Länder), but large cities often have evaluation schemes of their own. Any standardized evaluation scheme implies a set of assumptions and values, which in most cases are neither transparent, nor are questioned or modified by the consultants and planners who deal with city and other developments. Current evaluation schemes in Germany differ widely, but are often based on similar assumptions. Examples will be presented to show how differences in evaluation procedures have explicit effects on the type and the extent of restoration measures. We present the example of the New Fair in Leipzig as a large-scale development that has now been completed for several years, and where it is possible to make some evaluation of whether restoration has actually been effective. The current large scale development of housing and offices on former railway grounds in Munich is another example on how different approaches in evaluation can lead to extremely different conclusions about the need for restoration measures. An alternative approach is the development of eco-accounting, as for the city of Leipzig, highlighting possible consequences of different evaluation schemes on the city and its landscape development. (Topic 4.1)

SUE EVERETT

Flora Locale, The Nature Conservation Bureau Ltd, Great Britain

The Flora locale initiative

Over the last 20 years, native plants have been introduced into the British countryside (and in towns) on a massive scale. These large-scale plantings have been undertaken for a variety of landscape enhancement, amenity and wildlife purposes. Examples include landscape plantings on highway verges, closed landfills and mineral workings, restoration of damaged wildlife habitats and the re-creation of new ones (e.g. on land formerly subject to intensive farming), woodland management and the establishment of new woods and hedges. Professionals and land managers working in horticulture, ecology and countryside management, landscape, forestry and agriculture have been responsible for supervising these plantings and ordering stock. However, until recently, little attention was given to the sources of planting stock. The net result is that the majority of trees and shrubs planted in the countryside during this time have originated from non-British native sources. Although increasing quantities of wildflower seed now used is of British native origin, the majority of

grass seed and some of the wildflower seed consists of agricultural cultivars. Flora Locale was established in 1997 to address the range of problems centred on the problem of plant sourcing and procurement. The work of Flora Locale aims to address the full range of professional and land management sectors involved and across public, private and voluntary sectors and to encourage best practice in the collection, growing, supply and use of native plants for ecological restoration. (Topic 3.6)

VICKI O FABIYI

Baltimore Ecosystem Study, University of Maryland, Baltimore County Baltimore, MD, USA

The Baltimore ecosystem study

The Baltimore Ecosystem Study (BES) is one of 21 Long-Term Ecological Research (LTER) projects funded by the National Science Foundation (NSF). The BES is a unique study of the urban and suburban Baltimore metropolitan area ecosystem, and the impact of humans on the system. One of the three central questions of the BES is: "How can urban residents develop and use an understanding of the metropolis as an ecological system to improve the quality of their environment and their daily lives." To assist in finding answers to this question, during the second year of the project the Demographic-Social and the Education Teams of the BES collaborated to develop a program called the Neighborhood Science Program (NSP). The Neighborhood Science Program partners BES scientists with youth at two community centers in Baltimore City. The Neighborhood Science Program engages youth in on-going investigations of their environment, which relate directly to their every day lives. The investigations combine basic education skills such as math, reading, science and history with field ecology topics such as vegetation, soils and biodiversity. The youth, guided by BES scientists, research the ecology of their surroundings, and through a participatory action research approach, use this information to decide the topics which most address their community needs. The youth also use the data collected during their research to explore ways to build local capacity and find long term sustainable solutions to community issues. (Topic 6.3)

MARZIO FATTORINI, HALLE STEFAN

Institute of Ecology, Friedrich-Schiller-University Jena, Germany

Common traits and differences in the regeneration of terrestrial and aquatic ecosystems: a contribution to the conceptual framework of restoration ecology

In 1996 the interdisciplinary graduate study program "Analysis of Function and Regeneration of Degraded Ecosystems" was initiated at the Friedrich-Schiller-University Jena. In this research project, funded by the German Science Foundation (DFG), graduate students, scientists and professors from the University Departments of Biology, Geography and Chemistry and two Max-Planck-Research Institutes are working together. The objective is to study how two different degraded ecosystems, a terrestrial and an aquatic, regenerate. One is a grassland that was heavily polluted for decades by dust from a fertilizer factory, which resulted in almost vegetation-free areas. The other is a small river polluted by waste water and input from agricultural land use, which in addition is affected by still existing barriers. In both cases the over-supply of nutrients stopped after 1990, and an unaffected process of regeneration is now going on. From the comparison of the two systems we want to conclude on the possibilities for, and the necessity of, active restoration management to either speed up the regeneration process, or to direct it into a desired pathway. Probably because of natural disturbances by flood waters, regeneration was found to be

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much faster in the aquatic as compared to the terrestrial system. (Topic 1.4)

VICTORIA FLETCHER

SCARAB Research Centre, University of Wales Newport, Caerleon Campus

The colonisation of derelict land by vegetation in the Forest of Dean, Gloucestershire, and implications for biodiversity management

The study area focuses on the small 85km² Forest of Dean Coal Measures, located within the Royal Forest boundary. The region has been extensively worked for its iron-ore, coal and stone resources since the Roman period. Spoil heaps, quarries and iron-workings are therefore a common feature of the landscape, some of which remain derelict. The vegetation growing on former such derelict land is influenced by many environmental factors, but site-specific knowledge is currently lacking as to which combinations of environmental factors are limiting growth. Lack of such knowledge often leads to the planting of conifer or other monocultures, where a more species diverse plant community may be more desirable. The aim of the study is to identify and investigate a range of environmental variables which may influence successful establishment of vegetation found on selected sites. This will be undertaken by firstly investigating any variation found in the distribution and floristic composition of vegetation between and within sites. Secondly, any pattern found will be associated with environmental variables such as substrate microclimate, toxicity, nutrient status and mechanical properties. Data will be analysed using appropriate univariate and multivariate statistical methods. The hypotheses generated from analysis of the field survey data will be tested via field and laboratory growth experiments a factorial analysis of how selected environmental factors affect the growth of a species rich seed mixture. The information gained will be geared towards aiding future management decisions in the Forest of Dean, and achieving species rich vegetation cover via restoration schemes. (Topic 3.3)

JANICE FOSTER

Unit 2, 15 Palmer Street, Jolimont, Victoria, Australia

Ecologically sustainable design: a revised practice of landscape architecture

Ecologically sustainable design is an emerging area of practice in landscape architecture, but one which is not yet well understood. This study aims to explore current practices and views about ecologically sustainable design with the intention of contributing to its future practice. It investigates how it is possible to achieve ecologically sustainable design, combining high design quality with ecological performance, through exploring four primary research questions: • What approach is typically used and what is essential to achieving ecologically sustainable design? • What knowledge of ecology and environmental systems is needed by designers of ecologically sustainable landscapes? • What obstacles are typically encountered in realising ecologically sustainable design, and how are they overcome? • How is it possible to achieve both high quality design and high quality ecological outcomes? Twelve pioneers of ecologically sustainable design from around the world were selected for this investigation and interviewed to gain their insight into these questions. Common themes in their comments were identified and discussed. The study reveals significant changes are necessary in both landscape architecture practice and education, and areas where further research is particularly required, for ecologically sustainable design to

succeed. (Topic 3.5)

JENNIFER FOSTER

York University, Toronto, Ontario, Canada

The ecological restoration of academic institutions in Canada, from elementary schoolyards to university campuses

Over the past ten years, Canadian students from elementary to post-secondary levels have assumed an increasingly active role in campus planning, where opportunities for personal and community development are rich. In Canada, campuses often occupy large tracts of urban and suburban land, offering valuable opportunities for improving habitat, species diversity and ecological connectivity in intensively settled locales. At the elementary (primary) school level, schoolyard naturalization is rapidly gaining popularity and acceptance as a critical means of addressing educational objectives whilst improving the biophysical functions of Canadian urban and suburban landscapes. Research has shown that school-yard environments play a critical role in defining important early relationships with/within nature. At the secondary school (high school) level, students are increasingly developing knowledge and skills related to natural and social sciences through 'naturalization' and remediation programs benefits of which include provision of critical links between theory and practice; stimulated awareness of species, habitat and ecological function; and nurturing a sense of empowerment among young adults. Meanwhile, at the post-secondary level (universities and community colleges) interdisciplinary academic objectives are increasingly linked to ecological restoration through curricular initiatives which combine theory with experiential learning. Through this presentation, I will: i) explore the benefits of integrating ecological restoration into academic programming; ii) examine circumstances surrounding 'greening' and 'naturalization' of schoolyards and campuses in urban Canada; iii) profile a selection of projects, including successful and unsuccessful experiences and approaches (what has worked and what hasn't?); and iv) explore opportunities and barriers for ecological restoration in academic fora. (Topic 6.3)

JOANNA L FRANCIS

Tigh na Creag, Morar, Invernesshire

Increasing the diversity of woodland ground flora communities in newwoods: the need, the techniques, the long-term results

Woodland creation has been widely practised during the 20th Century, both in Europe and America. This practice has rarely amounted to more than the planting of trees and shrubs, though local ecotypes are now more of a priority in many schemes. Research in woodlands of different ages (Peterken & Game 1974, Francis et al. 1996) has demonstrated that while groups of newly planted trees may grow and establish successfully, such are the barriers to colonisation in modern landscapes that the usual long-term result is the creation of impoverished, species-poor wooded areas. Developing ground flora communities in young woods can be manipulated in order to increase plant species diversity. Extensive research has shown that many woodland wildflowers can be successfully introduced into new woods using practical techniques. This paper reports on the progress and success of a 3ha (7.4acre) field trial in Milton Keynes, implemented in 1987 and monitored since 1990. Introduction methods are described and the created ground flora communities are compared with those in established woodland habitats. (Topic 4.3)

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NICOLA FRENCH, PHILIP COLEBOURN

Ecological Planning and Research, Winchester

Can the loss of habitat justify the opportunity for habitat creation and how does this opportunity relate to sustainable development?

Ecological Planning & Research (EPR) are involved in developing proposals for a large infrastructure project proposed on the Hampshire coast. The proposals include an ambitious habitat creation scheme which involves: the construction of an intertidal creek; the creation of a wetland habitat complex extending to approximately 20 hectares; and, the recharge of a large area of intertidal mudflat to create additional mud (to MLW) and to cap existing, but contaminated sediments. The under-lying motive for this scheme is one of commercial development. We consider whether the opportunity that the scheme generates for habitat creation and restoration justifies the habitat losses which occurs as a consequence of the development. Whilst developing the scheme, it has been notable that a justification is often sought by a requirement to minimise the risks associated with the proposals and we consider how the design process for the scheme has approached this. In particular, we consider the process through which the habitat creation proposals have been developed, examining the role of consultation, the importance and relevance of other schemes and the parallels that can be drawn. In addition, the importance of detailed monitoring both during and after construction is considered with respect to the opportunity that the scheme presents for substantially furthering a new and developing science, minimising risks for future schemes. (Topic 4.5)

MATHEW FRITH

London Wildlife Trust, Harling House, London

Promoting the conservation of black redstart in areas of regeneration in inner London

London supports between 10%-30% of the national population of the black redstart, and although it is protected under the Wildlife & Countryside Act, 1981, listed on the UK Red Data Book and a UK BAP species, it has been difficult to promote pro-active conservation measures. However, over the past 4 years work has been going on to not only raise its profile and research its specific requirements in the context of a dynamic regeneration environment, but also to encourage new approaches to habitat creation in new development programmes with specific reference to the black redstart. This paper will outline the preliminary works Greenwich, including The Millennium Dome. It will highlight the approaches made to alert a whole range of professions of the bird's presence as well as its requirements. Difficulties in the past have led to conchice through the planning process. However, the awareness that that the bird's needs are not diametrically opposed to development has led to the start of a new understanding. Since 1998 there have been a number of innovative designs which we hope will start to set the trend for new urban developments that meet the needs of both developers and the black redstart. The black redstart, beautiful and rare though it may be, is not the sole reason for this work. Inner urban biodiversity, particularly on post-industrial land, is under threat - with the Government's endorsement. Simply saving pockets, and planting trees in them is not, we feel, necessarily the way forward. The bird is a symbol with some protection. by which a variety of fauna and flora, characer!stic of a dynamic urban environment can also be conserved, to the benefit of people who live here. (Topic 4.7)

GEORGE D GANN, KEITH A BRADLEY, STEVE W WOODMANSEE

Institute for Regional Conservation, Miami, Florida, USA

Restoring Southern Florida's Native Plant Heritage : Restoration as an Element of Regional Conservation Programs

In order for ecological restoration to be successful, restoration projects must be designed and planned within a regional conservation context. This presentation describes a six year effort to inventory the southern Florida (USA) vascular flora, with the goal of improving the outcomes of protection and restoration efforts within the region. The Floristic Inventory has compiled over 100,000 plant occurrence records of 2,200 species within the region, from sources including staff field research, observations of area botanists, floras, literature, and herbarium label data of Southern Florida. These data have been analyzed to determine the extirpated and extinct species in the flora, species that are imperiled or rare in the region, and species that are naturalized exotics. Recommendations have been developed for land managers and restoration practitioners in the region that, if implemented, will: (1) reduce the number of extirpations and extinctions in the region; (2) restore populations of extirpated species and augment populations of critically imperiled species; (3) restore critical habitat for rare native species utilizing the proper floristic elements; and (4) help prioritize exotic plant species control in the region. Training workshops are planned that will assist land managers to integrate these recommendations into site-specific restoration and management projects. (Topic 1.3)

JENNIFER S E GARRISON

Dept of Zoology; University of Hawaii; Honolulu

The effects of alien tree plantations on restoration of native Hawaiian forest plants

In areas where natural forest regeneration is slow or unlikely, foresters often plant alien tree plantations to speed rehabilitation of the land. I investigated some of the long-term ecological effects of ca.60 year old plantations of four alien tree species (*Eucalyptus robusta*, *Grevillea robusta*, *Casuarina equisetifolia* and *Fraxinus uhdei*) on Oahu, HI, and the colonization of these plantations by native plant species. As part of this study, I measured soil nutrients, vegetation structure and native plant establishment in small patches of native lowland mesic forest and the four plantation types. I found that the five forest types had significantly different concentrations of soil nutrients, which in turn affected germination and survival of native plant species. The five forest types also differed significantly in vegetation structure, which also affected native seedling survival. Each plantation had a unique set of attributes, some of which seem to encourage native plant restoration while others discourage it. This suggests that there is no simple test to determine which plantations are preferable in areas where the ultimate goal is native species preservation. Instead, it seems that a variety of studies are needed to determine the suitability of a plantation for restoration work. (Topic 4.7)

PETER GATELEY

PSG Vegetation Surveys, 6 Prescott Road, Ormskirk, Lancashire

'GEMS' - A modern, technological approach to large scale ecological surveying.

The sites of the Changing Places programme are protected by covenants for 99 years. During this period the project purpose cannot be changed without the permission of Groundwork. Early in the programme it was decided that this represented an unprecedented

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opportunity to record, on a large scale, the commencing ecology of the sites and to hand this legacy on to future generations of ecologists with the hope that they will map and study the changing habitats. The daunting task of recording some 1000 hectares of land has led to the development of new methods of recording using GPS (global positioning by satellite) and GIS (geographical information systems). The result will be a digital record of sub metre accuracy. This paper will describe and demonstrate the techniques used and will touch on yet further exciting developments for extending the work into virtual reality landscapes for use in community consultation exercises. (Topic 5.1)

STEVE GATEWOOD, MONICA FOLK

Society for Ecological Restoration, Tucson, Arizona

The Disney Wilderness Preserve, Kissimmee, Florida, USA

Taking advantage of restoration opportunities: the Disney Wilderness Preserve Mitigation Project

The Disney Wilderness Preserve was created in 1993 as a joint effort between five government regulatory agencies, The Nature Conservancy (a private, non-profit conservation organisation) and the Walt Disney World Corporation. Initially conceived as an off-site mitigation project, compensating for impacts to wetlands, listed species and natural communities resulting from the final build of the Disney World resort, the project blossomed into an integrated restoration strategy and community involvement campaign. Multiple parties added adjacent lands to the mitigation area; innovative restoration and monitoring techniques were used; a watershed level plan was developed to describe regional restoration needs and opportunities; programmes and facilities were created for extensive volunteer participation. An outreach programme was also implemented, including training for decision-makers and public education opportunities. Focusing on the Disney Preserve as our example, we will discuss the opportunities and pitfalls of design, implementation and management of a project some consider to be "too good to be true". (Topic 4.1)

STEVE GATEWOOD, DAVID M. JOHNS

Society for Ecological Restoration, Tucson, Arizona

Portland State University and The Wildlands Project, Oregon

Large scale wildlands restoration in North America

The Wildlands Project works throughout North America to create an integrated network of wilderness reserves capable of sustaining large carnivores, wide-ranging animals, and large-scale disturbance regimes. These elements of "rewilding" are fundamental to the health of ecosystems because they perform essential regulatory functions and provide for evolutionary resilience. Even in western North America, existing public lands and protected areas are inadequate and too isolated to establish a reserve system that can meet these goals. Major restoration efforts are needed on spatial and temporal scales not heretofore attempted. Although restoration as currently practiced offers many useful tools, restoration efforts at this scale present new scientific as well as political problems—from the identification of what needs to be done to developing a comprehensive strategy for undertaking the work across traditional boundaries. Wildlands planning requires that the scientific and political aspects be dealt with simultaneously. Three regional networks in the process of design and are discussed from the standpoint of restoration challenges: the Yellowstone to Yukon Conservation Initiative, the Klamath-Siskiyou Conservation Strategy, and the Sky Islands Wilderness Network. (Topic 1.3)

LAURA GESELBRACHT

The Nature Conservancy, Florida, USA.

Community involvement in the restoration of Florida's Everglades

The Everglades is an ecosystem under siege from urban and agricultural development that has brought substantial changes to the system's hydrologic functioning. A massive restoration is currently underway, but until recently, insufficient attention was being given to how this multibillion dollar effort would be funded. Early in the planning process, the federal government gave an implicit commitment to fund half of the effort, but state, regional and local contributions to the restoration were left unresolved. In 1998, The Nature Conservancy initiated a public forum program in South Florida that helped to educate the public on water supply, water resources management and ecosystem restoration issues including restoration funding issues and collected participant opinions on these issues. The purpose of the program is to build public support for the restoration and restoration funding as well as to inform policy makers about public opinions on these topics. The results of the 1998 forums were released in August 1999 just as Florida's Governor and legislators were beginning to formulate their policies on the state's financial commitment to Everglades restoration. We believe the release of these Florida's Everglades restoration funding policies are shaping up. (Topic 6.4)

JOANNE GILBERT, DAVID GOWING

Institute of Water and Environment, Cranfield University, Silsoe, Bedford

The role of phosphorus in successful Habitat restoration

High available phosphorus in soil can provide conditions limiting to the success of habitat restoration. A detailed knowledge of the soil is required before target vegetation communities can be selected. In some circumstances it is necessary to lower available phosphorus to achieve levels within the range tolerated by the target community. Existing techniques of measuring plant available phosphorus are based on correlation with plant growth in an agricultural environment. A bioassay experiment has been undertaken comparing eight commonly used techniques with the biomass produced by a mixed sward comprising plants typical of mesotrophic grassland. The results of this can be used to advise on the choice of method for measuring phosphorus availability in areas destined for habitat restoration. Results will be presented regarding the level of available phosphorus tolerated by a range of semi-natural communities and compared with that found in typical ex-arable soil. A range of chemical ameliorates to reduce phosphorus availability in soils have been tested and the effect of these on vegetation diversity will be presented. (Topic 3.4)

PETER GILCHRIST, MIKE NICHOLLS

Ecology Research Group, Canterbury Christ Church University College, Canterbury, Kent.

Restoration of East Kent colliery waste: an examination of the relationship between higher plant diversity and nitrogen availability on a nutrient poor substratum

Nitrogen influences productivity and species diversity in developing plant communities. However, in natural systems increased nitrogen availability is also correlated with the associated ameliorating effects of increasing amounts of organic matter. We examined the effect of adding nitrogen and peat on the establishment of a plant community on East Kent colliery waste. Factorial experiments on colliery waste were

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sown with 90+ angiosperm species, and treatments included the presence or absence of legume species and addition of peat and quarterly applications of four levels of ammonium nitrate. Percentage cover and importantly, species diversity were influenced by the availability of nitrogen, the addition of peat and the presence of legumes. A nitrate application comparable with the annual nitrogen uptake level for temperate high-yield cereal crops (Killham 1994) yielded maximum percentage cover, species number and diversity (Simpson's Diversity index); these yields being less at higher and lower nitrogen levels. No significant synergism between nitrate and peat applications was found, nevertheless application of peat equivalent to an annual carbon deposition of 200g/m² increased percentage cover, species number and diversity in comparison with control plots. These results will be discussed in the context of ecological restoration strategies. (Topic 3.3)

STEVE GLASS, DAVE EGAN

UW-Madison Arboretum, Madison, WI, USA

Partnership in urban areas

Managers of urban conservation areas must develop partnerships with neighborhood groups to maintain the ecological integrity of their area and to garner support for their restoration efforts. We hypothesize that when managers obtain a civic endorsement of their management goals and objectives, they will create a "civic buffer" around their conservation area that is based on civic advocacy and personal responsibility. To strengthen this bond, managers must provide the neighborhood with the opportunity to participate in ecological restoration activities that are designed to help neighbors and managers see the conservation area as both a visual landscape and a dynamic ecosystem, rather than one or the other. In doing so, the participants will begin to see their own historic connections to land use and take responsibility for it. This concept builds on our earlier proposal (Glass and Egan 1995) and on the generated edge hypothesis of Schonewald-Cox and Bayless (1986). The "civic buffer" extends the administrative boundary when civic advocacy is high and negatively affects the conservation organization when it is low by foreclosing management options and diverting management resources. We will use case studies from Illinois, Wisconsin, and Arizona to show the various outcomes predicted by our hypothesis. (Topic 5.2)

JAY GOMBOSO

Department of Conservation and Land Management (CALM), Crawley, Australia

Towards a biodiversity conservation strategy for Western Australia

The fauna and flora of Australia is characterised by high natural diversity, endemism and susceptibility to extinction and decline. In Western Australia (WA) the incredible species richness of our flora has been recognised internationally. However, genetic, species and ecosystem diversity has declined and conserving biodiversity in WA is now a major challenge. Natural and, to a greater extent, human-induced disturbances continue to exert major stresses on our natural environments. There are a number of key challenges for biodiversity conservation in WA. These include: establishing iCARi terrestrial and marine conservation reserve systems; controlling threatening processes; promoting off-reserve conservation; implementing threatened species and communities recovery plans; and improving legislation. Taking into account these challenges and recognising achievements that have been made to date, the Department of Conservation and Land Management is developing WA's Biological Diversity Conservation Strategy. The Strategy will address

commitments to the international 1992 Convention on Biological Diversity and help bridge gaps in the management of biodiversity identified in the National Strategy for the Conservation of Australia's Biological Diversity. The Strategy will also complement the proposed WA Biodiversity Conservation Act that is intended to repeal and replace the Wildlife Conservation Act 1950 and deliver a modern approach to biodiversity conservation. (Topic 1.2)

JOHN GOOD

Institute of Terrestrial Ecology, Bangor, Gwynedd

Translocation trials at Selar Farm

Whole turf translocation (WTT) is a costly and time consuming, though often effective method of moving vegetation and re-establishing it elsewhere. Looking for simpler but still effective techniques for moving herb-rich mesic grassland communities we compared WTT with spreading turf over twice the surface area from which it had been removed, followed by rotovation to integrate it with the soil at the receiver site. Three years after translocation plant cover and species composition were similar in the WTT and "spread and rotovated" (S&R) plots, suggesting that S&R provides a satisfactory ecological alternative to WTT. In practical terms S&R is simpler to do, especially where turf is stony or lies over shallow rock, or is in short supply, and it involves no special equipment or labour skills. "Spread and rotovate" is also considerably cheaper; approximately one-third the cost in our trial. However, with S&R as with WTT, altered soil hydrology and nutrition can adversely affect success rate, and especially the reestablishment of species with very precise soil requirements, which tend to be the rarer ones. In our case cutting was found to be a poor substitute for grazing as a means of maintaining species diversity in the translocated turf, whether WTT or S&R. (Topic 3.2)

RICHARD GORDON, PHIL HART, GRAEME HALL, LARRY BURROWS, JOHN TAN

Landcare Research, Lincoln, New Zealand

Sink and all: Restoration as a route to greenhouse gas mitigation for organisations wanting to do better than buy permits or pay taxes

The Kyoto Protocol and international agreements for reducing greenhouse gas emissions are spawning carbon trading schemes and carbon taxation. Trading schemes based on harvested plantation forestry (often using non-indigenous species) miss an opportunity to achieve the parallel biodiversity gains and social benefits which are associated with indigenous restoration programmes. Greenhouse gas emissions have been calculated for a New Zealand service-sector company with 400 staff. Around 80% of the 300t carbon per annum carbon emissions from this company are associated with staff business travel. Using plant growth and community models, we estimated the area of indigenous species required to offset carbon emissions. The model also enabled us to evaluate different species mixes (e.g., early successional species versus later species), and different geographical locations. Companies adopting this approach to greenhouse gas mitigation have the potential to support the restoration of indigenous forest biodiversity, community groups, local employment, and education programmes, in ways that are not so readily achieved through standard carbon trading and taxation. (Topic 1.4)

F W GRAYSON

Bank House Farm, Silverdale, Carnforth, Lancashire

Restoring Conservation Grazing to Agriculturally-Abandoned Land

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This paper describes how wildlife-friendly grazing regimes were reinstated on a series of high-value nature conservation sites around Morecambe Bay in north-west England. 20th century farming intensification caused the extensive pastoral systems which originally maintained the area's open limestone landscapes to be abandoned, resulting in a gradual accretion of tree and shrub cover. The continuing passage of time saw open habitats disappearing at an ever increasing rate, arousing serious concern over the future well-being of many Sites of Special Scientific Interest that had originally been designated for their limestone grassland communities. The low productivity of these reserves made neighbouring farmers unwilling to provide animals from their commercial systems to graze them. The conversion to organic status, however, of a small, conveniently situated farm eventually resulted in the restoration of appropriate grazing through collaboration between the farm's tenant and the various conservation bodies charged with managing the sites. This also established a useful model, around which to structure some of the guiding principles for Regional Grazing Schemes, an initiative which aims to promote effective and sustainable conservation grazing partnerships throughout the UK, under auspices of the Grazing Animals Project. (Topic 2.3)

PHIL GRIFFITHS, RICHARD HULL

Environment Agency, Sussex Area. c/o Environment Agency, Worthing.

The restoration of Pevensey Levels, East Sussex

The Pevensey Levels are a large area of lowland wet grassland covering 3,500ha, designated both as a Site of Special Scientific Interest (SSSI) and a Ramsar site of international wetland importance on account of the diverse assemblages of flora and fauna supported in the ditches. The Levels support a large and population of the rare Fen Raft Spider, which is only found at one other site in the UK. The Levels were traditionally managed for seasonal grazing of livestock and the ditch system served both as wet fencing and as a source of drinking water for livestock, but have been progressively drained during the past century. Whilst the improved drainage facilitated more extensive grazing and even arable farming, the effects on the biodiversity of the site has been substantial. Typical wetland wading birds have declined in numbers to such an extent that the site failed to meet criteria for designation as a Special Protection Area under the Birds Directive (1979). In 1992, a Study Group investigated these declines with a view to remediating the situation. Water Level Management Plans (WLMPs) were written for the site by 1998, identifying areas where the raising of water levels was feasible, were ecologically beneficial and where higher water levels might be acceptable to landowners; and a Project Engineer employed. Wherever water levels are being raised a package of monitoring is put in place. This includes monitoring of water levels in ditches, water table in-field, and ditch and soil invertebrate sampling. Aside from water management on the Levels, a significant problem encountered in the main drainage channels is that of the invasive alien aquatic weed known as Floating Pennywort (*Hydrocotyle ranunculoides*). This grows at alarming rates during the summer, causing problems for flood defence by blocking drainage channels, out-competes native vegetation, prevents angling, threatens fish stocks and generally decreases the amenity value. The Agency has been controlling the plant using approved herbicides over the past two years with some success. (Topic 2.2)

EMMA GRIFFITHS

University of Manchester, Oxford Road, Manchester

Participative land restoration

Empirically the paper details a case study undertaken in Stoke-on-Trent which was informed by theories of social capital to examine the position the local community are playing as a partner in the land restoration programme. It highlights the actions of three groups who are central to the reclamation project (Groundwork Stoke-on-Trent, The City Council and the Friends of Berryhill Fields) and how the relationship between them has constantly adjusted and readjusted over time throughout the land reclamation process. In addition to this the paper will discuss the benefits the community have gained through working on this project. It concludes that these tangible and non tangible benefits in addition to this the paper will discuss the benefits the community have gained through working on this project. It concludes that these tangible and non tangible benefits in addition to greater social capital ensures that there is a mechanism in place to safeguard the long-term success of the reclamation initiative. (Topic 5.1)

COLIN GRIGG

ECC International Ltd, Cornwall

Heathland regeneration in the china clay industry

ECC International Ltd is the world's largest single producer of china clay [approx. 2.5 million tonnes per annum from its Cornish based operations]. 250 years of exploitation has had a dramatic impact upon the landscape of the mid-Cornwall moorland environment which was once dominated by heathland. Only fragments of this resource now remain. ECC has long established innovative techniques for restoring vegetation on despoiled land and has, since the early 1990's, extended this expertise into practices for re-creating heathland on the surfaces of waste tips. In association with English Nature, the Company has recently embarked on an ambitious 5 year project aiming to re-create 600 ha of heathland type habitats within the china clay area. The "flagship" for this initiative is the complete re-modelling and restoration to heathland [and other habitats] of a 100 ha sand tip situated between two china clay villages - this very extensive scheme has gained national recognition by a top award from The Royal Town Planning Institute. (Topic 3.3)

P GROOTJANS, J P BAKKER, A J M JANSEN, R H KEMMERS

Laboratory of Plant Ecology, University of Groningen, AA Haren, KIWA Research & Consultancy Division, BB Nieuwegein, the Netherlands and Alterra, Wageningen, the Netherlands

Restoration of fen meadows in the Netherlands; successful and unsuccessful projects

Until recently restoration measures in Dutch brook valleys aimed at restoring species-rich fen and hay meadows consisted of re-introducing traditional management techniques such as mowing without fertilisation and low-intensity grazing. At present additional measures, such as rewetting and sod cutting are carried out on a large scale to combat negative influences of drainage and atmospheric deposition. An analysis of successful and unsuccessful projects led to a conceptual model of factors influencing successful fen meadow restoration. Restoration of brook valley meadows was most successful when traditional management techniques were applied in recently abandoned fields which have not been drained or fertilised. Large scale top soil removal in former agricultural fields were often unsuccessful since seed banks had been depleted, while hydrological conditions and seed dispersal mechanisms were sub-optimal. Restoration of fen meadows on peaty soils was unsuccessful in cases where long term drainage had led to irreversible changes in chemical and physical properties of the soil. Successful sites were all characterised by a

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regular discharge of calcareous groundwater provided by local or regional hydrological systems, and where not very long ago populations of target species existed. On mineral soils, in particular, sod removal in existing nature reserves was a successful measure to increase the number of endangered fen meadow species. It is argued that the aim of restoring species-rich meadows should be dropped in former agricultural fields, where pedological processes have led to almost irreversible changes in the soil profile and where soil seed banks have been depleted. From a soil conservation point of view, such areas are better off when they would be exploited as eutrophic wetlands. (Topic 4.6)

MICHELE GUGGENBILLER, LEANNE M JABLONSKI

Marianist Environmental Education Center, The Ohio State University, Columbus, Ohio

Experiencing restoration in action: service learning for non-major ecology students

Service Learning was used as a tool for experiencing restoration ecology. College students participated in hands-on work on the 100-acre Marianist Environmental Education Center (MEEC) Nature Preserve during 10 weekly visits. In dialogue with land managers and ecologists, each team of two chose focus habitats and designed studies that both assisted in the restoration management, and addressed their research questions. Savanna restoration was examined through census of oak tree size and herbivory. One team eradicated invasive shrubs and examined their impact on under-story development by quadrat sampling. The MEEC prairie was compared with other prairies of the region by interviewing land managers and compiling literature information. A wetland team assessed the physical and chemical factors and bluegill population in a groundwater pond and followed salamander egg development in a constructed pond. Students kept written or photo journals of their observations, personal experiences and their perceptions of restorationists. Data collected will form part of a long-term data base for restoration ecology education. Engagement in hands-on work, dialogues with restoration ecologists and quantitative analyses assisted students in their understanding of restoration work and issues in their home region. This partnership benefited the educational and research missions of both MEEC and the University (Topic 6.3)

ROLAND GUSTAVSSON

Department of Landscape Planning Alnarp, University of Lund, Sweden

Teenage woodlands - a difficult age?

The teenagers, their first part in life, and their long term dynamics - reflections on the base of twenty-two North-European urban sites, that have been followed during the period from 1978 to 1999 exploring an ecological-structural approach and a dynamic landscape architecture. The urban ecological movement in the seventies and eighties affected design in several of the North-European countries. This was in many way the beginning to an enlarged ecological thinking. Some of the areas that came out of it are today 'classical', international well known areas, found in England, Holland, as well in the Scandinavian countries. A lot of interesting questions emerge if you want to join the areas through time, and do a more scientifically based evaluation of them, related to both more general and more specific questions as:- What has happened with these specific areas, the different habitat types and with the ideas through time, what has been a success, and what has been a disaster? Is it really possible to keep a high quality in the long term run, and through all phases? Don't you get a teen-ager problem similar to in a family-life? How can we improve our dynamic

thinking? Generally speaking, maintenance rather than a long term sustainable management dominate the scene. Landscape architecture and landscape design are static rather than dynamic as landscape views. The landscape is the opposite; it is changing dramatically. What do the alternatives look like? Urban green areas are very, very young as biological systems. And in landscape ecology terms; they are often isolated. - How can we support the systems, how can we speed up, how can we make it in a more sustainable way? (Topic 5.1)

JOHN HADIDIAN, JOHN W GRANDY, SYDNEY SMITH

The Humane Society of the United States, Washington, DC, USA

Restoring urban lands: implication for animal welfare

The repair and restoration of urban lands to create open space and natural zones in and around the human dominated environments of cities and towns is both a worthy and practical pursuit. The many benefits of urban open space are gradually becoming well known, and both the social and physical amenities of well-planned urban greenspace have become accepted as elements of good landscape design. Restoration and preservation imply that natural communities of both plants and animals will be found; they do not, however, imply that such communities will be regulated by the same processes that would occur on true wildlands. This paper examines the relationship between urban lands, open space, and conflicts with animals that are, for the most part, attributable to elements of the urban landscape design. Three common species, the White-tailed deer (*Odocoileus virginianus*), the Canada goose (*Branta canadensis*) and American beaver (*Castor canadensis*) are used to exemplify the range and magnitude of human-wildlife conflicts in the United States. Signal lessons can be learned from the sorts of issues posed by these very different species that can help us better plan and manage restoration and preservation schemes. (Topic 5.3)

DAGMAR HAGEN, JURUND AASETRE

Department of Botany, Norwegian University of Science and Technology, Trondheim, Norway

Restoration ecology - who benefits? A case study from the Svalbard archipelago and Dovre mountain, Norway

This project is a multidisciplinary approach to the use of restoration ecology in management of arctic and alpine vegetation. The objective is to identify benefits of vegetation cover in different actor groups and to evaluate how these can give a feedback to managers and users concerning the management of undisturbed, altered and restored vegetation. Restoration has to be placed in a social context. There are no objective answers to what to restore. For whom do we restore ecosystems and what benefits do we want to attain? What to restore will change from one place to another, and priorities will be differ between actors. The vegetation cover of the two study areas is sensitive and human activities leading to pressure and alteration of the vegetation are increasing. Ecological research and practical restoration projects have been performed in both areas. Use and management regimes differ markedly. The actor groups related to these activities have different expectations and preferences for the areas and the basic resource (the undisturbed, altered or restored vegetation cover). Focus group techniques supported by qualitative interviews have made it possible to make an analyse of the actors and their attitudes in the study areas. (Topic 6.1)

ROY HAINES-YOUNG

Nottingham University.

Data requirements in the wider countryside

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There is a growing wealth of data about the rural environment in the UK. This year, for example, will see the publication of the results of Countryside Survey 2000, which will provide a rich source of information on the state of broad habitats in the wider countryside. This paper will describe CS2000 and consider how it can be linked with other information sources to help us target and design habitat and landscape restoration schemes. The paper will consider issues of scale and data quality, and what tools are available to help us achieve the effective integration of these key data sources. The potential these new data sources offer for modelling at the landscape scale will be described. (Topic 3.7)

DAVID HALEY

Manchester Metropolitan University, St Augustines, Manchester, UK
Eco-Art/Eco-Culture Restoration in perspective

If we draw a diagram of our society's values, placing Eco-culture at the centre of a web, then draw arrows illustrating feedback loops between the centre and our other concerns, finally, connect each of the other elements to each other. Conceptually, we may be able to envisage a rich pattern of relationships, emerging as a new paradigm of 'sustainable diversity' (Loveday). Is it only out-moded values and belief systems that prevent this necessary social evolution? Eighteen months ago the Tate, Liverpool invited me to meet people from Landlife to discuss the coordination of an arts input to SER 2000. Working towards this conference, I have been privileged to meet and curate an outstanding group of artists. Each will tell their own story, but collectively, they represent something of a practising/critical 'movement' - Eco-Art, perhaps? This is particularly true if we consider the lineage of their form in relation to Joseph Beuys, Marcel Duchamp, Paul Klee and Leonardo da Vinci. This paper will focus on a synthesis of Eco-culture and the practice of Eco-Art, in relation to climate change and biodiversity, viewing restoration in perspective (Topic 6.2)

MARCUS HALL

University of Bologna, Italy

Restored places, restored pasts: managing parklands in the Adirondacks and the Abruzzo.

Park managers face the dilemma of protecting the land while accommodating visitors; conserving the scenery while providing for enjoyment of the people. Restoration is providing a way to do both. When Americans restore wildlands, and when Italians restore cultural lands, they may be restoring ideal pasts as much as ideal places. These national senses of time can be exposed by exploring how Americans manage cultural artefacts in their wilderness parks, and how Italians manage wild animals in their pastoral parks. It seems that Italians are renaturing historic landscapes, while Americans are restoring ahistoric, timeless landscapes. By looking at key management conflicts in the Adirondacks and the Abruzzo, I will suggest that assumptions about ideal times and better pasts may be as important to restoration projects as soil surveys and species lists. (Topic 1.3)

WILLIAM L HALVORSON

School of Renewable Natural Resources, USGS Sonoran Desert Field Station, University of Arizona, Tucson, Arizona, USA

Historical perspectives on the concept of ecosystem degradation

The concept of environmental degradation has evolved with the development of human society and settlement. In early human development, tribes when through a series of cycles of taming or developing mastery over the environment, to utilising the resources of

that environment until they could no longer support the population, which lead to moving on to do it again in a new area. There seems to have been little sense that human activity was causing any degradation, it was only that there was no longer enough food. The lack of a sense of degradation can even be seen as late as the 16th and 17th centuries in North America as Europeans "tamed" the land from the south, east, and north. For the Europeans, this taming of the "dangerous" and "inhospitable" lands even included the indigenous peoples. It is a rather modern social understanding that human activities can and do damage and degrade natural ecosystems. The concept began to dawn when society began to understand that some activities caused degraded human health. Only recently has society begun to understand the need for generally healthy natural ecosystems and this understanding has brought with it a whole host of legal, political, and restoration actions to make it happen. (Topic 1.2)

TIMOTHY L HAMAKER, MARK R TOMPKINS, DENNY MENGEL

CH2M Hill, Redding, California

Best Slough realignment and restoration, Beale Air Force Base, California

The realignment and restoration of Best Slough at Beale Air Force Base, Marysville, California is a unique example of a stream restoration project. Currently, Best Slough seasonally receives contaminated groundwater. The United States Air Force has implemented an interim remedial action (IRA) at this site to eliminate or significantly reduce the contamination. The project will include a containment system to prevent continuous migration of contaminated groundwater. A primary objective of the realignment was to create a stable stream channel that provided enhanced habitat for wildlife and fish. The design for this restoration and re-alignment considered surface and groundwater hydrology, hydraulics, and ecosystem function. The new channel was designed to optimise conditions for the establishment of aquatic and riparian habitats. Aquatic habitats in the new, realigned channel will be created through the establishment of emergent vegetation on the channel borders, creation of side-channel pools and deep pools and runs, and placement of aquatic habitat structures. The objectives for the adjacent riparian community were to improve existing, degraded habitat and to reconnect the upstream and downstream riparian corridors. The new stream reach was designed to establish open water, bulrush marsh, scrub riparian forest, mixed riparian forest, and valley oak riparian forest habitats. An interdisciplinary team provided solutions and enhancements during the planning of this restoration. The implementation of this project will result in an ecologically sound solution to a groundwater contamination problem and will result in the enhancement of the riparian and aquatic functions within an impacted reach of Best Slough. (Topic 4.2)

STEVEN N HANDEL

Center for Urban Restoration Ecology, Rutgers University, New Brunswick, New Jersey, USA

Biotic links between restored sites and the surrounding landscape

Long-term success and change in restored landscapes are tied to surrounding habitat quality. Experiments in restoring woodlands to a degraded landfill site in the New York metro area have shown that new plantings quickly attract the migration of seeds into the site, and rely on the availability of native pollinators, and mycorrhizal infection rates. Each of these biotic factors can have major influences on the trajectory of community development over the first several years after

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a restoration is installed. Restoration design must recognise and consider landscape setting and mutualisms as strong influences on the success and fate of the new community. (Topic 3.3)

JOHN HANDLEY, EMMA GRIFFITHS, CHRIS LING

University of Manchester, Oxford Road, Manchester

An eco-cultural audit of derelict land restoration

The Urban Task Force brings to our attention the demand for a new method of urban regeneration and the need to tackle social exclusion in isolated communities that live adjacent to abandoned mines and factories. This paper examines the ecological approach to the reclamation of derelict land, a technique which is both community led and ecologically informed. Using this approach the unique physical and chemical characteristics of derelict land are used to maximise the inherent biological potential and this is incorporated with the need to address social exclusions. We examine the effectiveness of this approach to land restoration and consider whether this results in a more sustainable landscape. Groundwork's Changing Places initiative has provided an opportunity to test the methodologies on a large scale. Ultimately through a project within the European Union's Life programme this methodology will be compared with examples of best practice in the EU leading to the development of an interactive web-based Toolkits packages. This resource will significantly enhance the capacity of community groups and other partners in the restoration process. (Topic 5.1)

MARGARET HANNIGAN-POPP

Groundwork, Merthyr, Rhondda and Cynon, S. Wales

The distillation of landscape and aspiration

Working on the ground with the communities of the Taff Bargoed Valley started in 1993 when the local community organisation and the local Council asked the Merthyr Groundwork Trust to assist the formulation of a Local Action Plan. The local Collieries had closed down over a four year period losing 2,500 jobs, the average local income was reduced to one third of the previous level and the whole lower Valley floor lay derelict. Over the past seven years the concept and the reality of a Community Park on these 50 hectares has been slowly but inexorably coming into being - fuelled by a combination of community political campaigning, partnership working, the setting up of a new Community Development Trust and the constant engagement of local people through the crests and troughs of expectation and apathy. The Merthyr Groundwork Trust has located itself at the centre of these events and, with the investment of the £3.5 million grant from the 'Changing Places' Programme, has sought to bring the power of this grant to enable its partnership commitment to empower the aspirations of the local community. The development proposals of the national and local Government agencies have thereby been refocused to facilitate the creation of a fully integrated, community led, ecologically informed project incorporating green tourism, conservation and recreation facilities. (Topic 5.1)

STEPHANIE J HARRIS, SIMON R MORTIMER, VALERIE K BROWN

CABI Bioscience: Environment, Silwood Park, Ascot, UK

Influence of propagule availability on chalk grassland regeneration after scrub clearance

Chalk grasslands are prized for their diverse plant and insect communities. The relaxation or cessation of grazing poses a threat to remaining areas of chalk grassland, as it allows the encroachment of scrub and a consequent reduction in botanical diversity. Scrub clearance is being carried out on many sites in order to prevent scrub

encroachment and to restore chalk grassland. One constraint on the restoration of chalk grasslands after scrub clearance is the availability of propagules from which new populations can be established. Seedling recruitment depends on two seed sources, the persistent seed bank and the seed rain. The aim of this study was to examine the potential for these two sources to allow establishment of chalk grassland on cleared areas. The study was carried out on a site where scrub clearance has been implemented for the past 8 years. The vegetation developing after clearance of dense scrub was found to differ considerably from that of chalk grassland. The soil seed bank is unlikely to provide a source of seed for the re-establishment of chalk grassland species following the clearance of dense scrub. Grassland species establishing in cleared areas were derived mainly from local dispersal in the seed rain. (Topic 4.8)

CAROLYN HARRISON

Geography Department, University College London

A social science perspective on why people matter.

A dominant perspective in the social sciences construes individuals as being isolated from and apart from society. Loosely characterised as a reductionist perspective, this approach often positions people as consumers who respond rationally to environmental decisions. This approach now co-exists with a new, contextualised approach to understanding how people and society interact which emphasises the more reflexive way in which people respond to environmental problems. In this presentation we review the assumptions underlying these two contrasting approaches particularly in terms of assumptions they make about how people respond to information and hierarchical decision-making processes about environmental issues such as pollution, flooding and habitat change. We aim to show how a contextualist approach to environmental problems is consistent with new participative ways of working with local residents and other stakeholders. Building on case studies undertaken with a number of public sector partners we show how this new approach allows a more inclusionary approach to both the environment and stakeholders to be adopted. When applied to decisions about habitat restoration and loss, deliberative approaches to decision-making encompass a wider range of ethical issues and local knowledges than is conventionally the case. (Topic 6.1)

HELEN MEYER HARRISON, NEWTON HARRISON

Del Mar, California, USA

Casting a green net: can it be we are seeing a dragon?

This work of art is the artists' first proposal for England. It is formed by word / image / narrative, embodies a conceptual design for making the Trans-Pennine area of North England increasingly self-sustaining, proposing a transformation that will permit biodiversity and cultural diversity to co-evolve across the Pennines to each other's advantage. The dragon image rhymes the Mersey and Humber estuaries in a manner that identifies, enlarges and attempts to connect the multitude of fragmented, biodiverse areas from Liverpool to Hull. Presenting their ideas on five maps, each about tree metres by four and a half metres, the artists have cast an imaginary GREEN NET, reworking ordnance maps so that the man-made parts - 55,000 miles of road - recede, and the natural features of the land - the rivers, mountains, ecological reserves and urban patterns - are accentuated. The area of the maps average about thirty five miles in width and one hundred and ten mile in length and encompasses approximately nine million people living in cities, towns, villages and farms. The maps present a new history for the Pennine Region in which urban agricultural, economic,

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social, geographical and ecological values are interwoven. The area, bounded east and west by the two coastlines, is thus defined ecologically. The north and south boundaries, the remnants of the Roman roads north above Manchester and through York and south through Chester, although more randomly chosen, mark certain historic, cultural boundaries. An astonishing image emerges when these boundary lines are drawn and the two Pennine parks outlined. The image reads as an awkward, strangely shaped dragon in flight, with a lake for its eye. Its head is at Hull, pointing to the east. Its tail is slightly curled at the estuary of the Mersey, while the Pennine Parks are seen as wings, the image adding a further metaphorical layer to the artists' conceptual design for the future of the region. (Topic 6.2)

TREVOR HARWOOD, RICHARD SCOTT

ITE, Merlewood, Grange over Sands, Cumbria

The bay taketh away- but then it giveth back again....natural restoration?

Morecambe Bay is the second largest estuary in Britain. The wide range of the tides and the gentle gradient make much of Morecambe Bay suitable for the formation of extensive areas of saltmarsh. The firm sandy nature of the sediment makes the saltmarshes suitable for the grazing of stock, particularly sheep. This gives the extensive close-cropped swards typical of the saltmarshes of western Britain. As noted by Gray, the seaward edge of the Morecambe Bay saltmarshes tends to terminate in an abrupt short sandy cliff, with the traditional "pioneer" vegetation characteristically absent. These features are related to the fast flowing tides and to the regular but rather random movements of the low tide channels of the main rivers. Some of the recent work on Morecambe Bay has focussed on the channel-related erosion along the eastern shore at Silverdale. In spite of such apparently "serious erosion" there has nevertheless been a net gain in saltmarsh area. The trend towards accretion is related at least in part to the ongoing history of land claim. Extensive areas of new saltmarsh are currently developing in the Grange-over-Sands area, on the north shore of the Bay. This gain in saltmarsh appears to be related to the relatively recent spread of *Spartina anglica* – but is it? This paper looks at how extensive areas of saltmarsh are developing and how they relate to past and present land claim, channel movements, and plant species. The paper will also look at the research potential presented by the development of new areas of ungrazed saltmarsh, an uncommon resource within Morecambe Bay and indeed along most of the coastline of Wales and north-west England. (Topic 4.5)

SEAN HATHAWAY

Planning Department, City of Swansea

Alternative methods for the control of Japanese Knotweed

As part of the role of the Knotweed Officer, control techniques have been trialed as an alternative to the standard spraying technique which is not appropriate for all sites.

Method 1 Direct injection of herbicide into the rhizome. Spraying knotweed growing within desirable vegetation is not practical due to the danger of damage caused by drift. Direct injection of 1 parts Roundup Biactive to 2 parts water below the bottom node using a cattle drench gun with knapsack sprayer was used for knotweed in a hedge. Every other stem was injected with all stems cut and piled within the site. This allows accurate targeting of the herbicide. Results will be known this growing season.

Method 2 Suppressing growth of knotweed. Some sites are not suitable for chemical use, eg local nature reserves. Year 1 In winter the knotweed stand was cleared of all dead stems which were piles on the

site. Locally harvested willow whips of varying sizes were planted at approx 50cm spacing. These were to rapidly grow and the leaf growth help shade out the knotweed growth. By the summer in year 1 the knotweed was at its normal height and was not impeded by the willow in any way. Year 2 Same site but this time a 'Plantex' weed suppressant sheeting was laid first and the willow planted through that. This should give the willow the chance to establish sufficient growth to help shade out the knotweed before it eventually breaks through the liner which it undoubtedly will do. Results will be known this growing season. (Topic 4.7)

FRANK HAYES

US National Parks Service Grand Canyon National Park, Grand Canyon, Arizona.

Visitor pressure in US National Parks and the need for restoration

These areas are often described as America's "Crown Jewels." But circumstances are not always perfect in the royal court. Although the words "National Park" have long evoked images of beautiful, pristine landscapes and healthy ecosystems, those images now also include overcrowding, congestion, and threats to park resources from both external and internal sources. Two hundred and seventy million visitors threaten to overwhelm the very resources the National Parks were set aside to protect. Grand Canyon National Park is no exception to this problem. National Park Service staff at Grand Canyon National Park recently completed a survey of trampling impacts on Pinyon Pine (*Pinus edulis*) and Utah Juniper (*Juniperus osteosperma*). These two species are very long-lived (300-800 years) and are the predominant overstory trees along much of the South Rim of the Canyon. Preliminary results show significantly higher mortality rates in areas of severe trampling for both Pinyon Pine and Utah Juniper. If nothing is done to reverse this trend, much of the canyon rim will be denuded of these species. Restoration of heavily visited sites at Grand Canyon, to a semblance of their natural condition, becomes more difficult if not impossible because of the slow growth and longevity of these species. Findings from this research will add to the literature already available regarding the relationship between recreation and vegetation. More importantly, the research points out the need for park managers to mitigate recreational impacts or face the likely outcome of a treeless canyon rim at one of the world's "Crown Jewels". (Topic 4.8)

M J HAYES

Institute of Grassland & Environmental Research, Aberystwyth, Wales, UK

Restoring floristic diversity to agriculturally improved grasslands

In the U.K concerns over losses in grassland biodiversity have resulted in a number of government funded agri-environment schemes designed to halt and reverse declines in the extent of species-rich grassland habitats. However research is required to identify both practical methods and 'best practice' and for the restoration of viable and locally relevant plant communities. The poster will present results from 8 years experimental research on methods of restoring species-rich semi-natural grassland communities from agriculturally-improved pastures in Mid-Wales. Both upland and lowland replicated field trials situated in mid-Wales will be described. Within both trials a range of extensive managements have been compared for their success at enhancing diversity through reducing residual soil fertility, ameliorating soil/sward conditions and applying different cutting/grazing regimes. Increases in diversity have been assessed through both natural species

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recolonisation and by active species introductions. Treatments have also been monitored for their effects on soil nutrient status and productivity. Results to date will be summarised and will emphasize the important roles of:- 1) regional variation in grassland restoration programmes 2) natural species colonisation against species introductions and 3) potential modifications of traditional management practices for restoring grassland diversity. (Topic 4.8)

M J HAYES

Institute of Grassland & Environmental Research, Aberystwyth, Wales, UK

Restoration and establishment of Welsh hedgerows

Hedgerows are important historical features of the Welsh rural landscape and they have a vital role in maintaining biodiversity in intensively farmed areas. However over recent decades hedgerows have undergone widespread loss and neglect and hedge renovation is currently a high priority. The poster will highlight the following aspects of our hedgerow restoration research:- 1) Origin of hedging material - Results from a 5 year provenance trial comparing 9 different native and continental provenances of Hawthorn (*Crataegus monogyna*) have identified many environmental and agricultural benefits of planting appropriately sourced material. Locally-collected strains were better adapted to climate and soils of planting-sites, they were more branched and thornier than alien strains and less prone to disease. There were differences in timing of leaf bud-burst and flowering dates with potential knock-on effects for native wildlife. Moreover use of locally produced material maintains regional hedge diversity and involves local sustainable land management. 2) Practical hedgerow establishment techniques - Research results have shown that fencing of young hedges at appropriate widths is essential in grazed areas and that mulching of newly planted hedges can treble initial growth rates. 3) Wildlife benefits of mixed-species hedges - Results from a trial quantifying the wildlife benefits of planting 'conservation hedges' has shown large increases in the numbers and variety of invertebrates found on such mixed plantings and thus greatly enhancing their wildlife value. (Topic 4.8)

GERRIT W HEIL

Faculty of Biology, Utrecht University, Utrecht, Netherlands

Habitat and species restoration in heathland: observations and computations

During the eighties, atmospheric nitrogen deposition caused an extensive increase of grasses in most of the Western European heathland habitat. The resulting decline in species forced managers to find solutions to restore the heathland habitat and the species diversity. Different management strategies were applied, i.e. sod cutting, burning and grazing, to reduce the cover of grasses and to improve the re-establishment of characteristic plant species. Traditionally grazing by sheep is a predominant management strategy. Since the mid-eighties, grazing with cattle has been introduced in heathland areas as cost-effective, long-term management. Recently, cattle grazing has been evaluated with respect to effectiveness in reducing the dominance of grasses, such as *Molinia caerulea* and *Deschampsia flexuosa*, and if characteristic species return. Field observations show that grazing by cattle has a significant positive effect on the species composition of heathland. This effect is significantly stronger than other management strategies applied. Sod cutting as initial restoration management enhances the effect of grazing. Computations with a simulation model based on system processes support these results: grazing has a positive effect on the ratio heather B grass and this effect is significantly bigger than other management strategies applied. (Topic 4.3)

D R HELLIWELL, R HOWELL, G P BUCKLEY, T R WORTHINGTON

Yokecliff House, West End, Worksworth, Derby

Changes in grassland and marshland vegetation, over a period of 19 years, following transference to a new site

Approximately 0.4ha of grassland and marshland vegetation was transferred to a new site, during the course of gravel extraction, in the autumn of 1980. The soil and vegetation was moved in three separate layers, following a sequence of operations which avoided any machinery driving over the soil, either before or after transference. No attempt was made to move the vegetation as intact turves; it was merely included with the upper layer of soil. This paper presents an analysis of data recorded at the 'donor' site in 1980 and at the 'receptor' site over the following 19 years. Hodgson (1989) recorded that "in general terms the transference was a success. There were few changes either in species composition or in numbers of species per m² after transference and there was no indication of any gradual replacement of species characteristic of species-rich vegetation by those of more species-poor communities." While the grassland has shown some changes during the 19 years following transference, the overall effect of these changes has been no greater than might be found in undisturbed grassland. The marshland has, however, changed by a greater amount, due to alterations in ground water levels, and is still in the process of reaching equilibrium. (Topic 3.2)

JUANA HERMOSO, LUISA CUNHA, ISABEL FERREIRA, FATIMA ALVES, FILOMENA MARTINS, CELESTE COELHO.

Department of Environment and Planning, University of Aveiro, Campus Universitário Santiago, Portugal

Restoration of the coast of Portugal: classification and management of the Foz do Cáster protected area

The Ria de Aveiro in Portugal, like most coastal zones, has always attracted human activities. So it has been subject to excessive human pressures that have caused the degradation and destruction of natural systems and landscapes. Nowadays, following European policies, there is concern to restore such habitats combining natural and human worlds. In accordance with this and inside the framework of the European LIFE 96 programme, the Integrated Management Program for the Ria de Aveiro has as its main objective a search for ways of managing coastal zones that would allow the integrated development of human communities and nature, not only in the Ria de Aveiro but also in other areas with similar characteristics. The presentation will show that good management and control of natural and anthropogenic processes can guarantee the biodiversity and the integration of people in the landscape of coastal wetlands, referring to one case of restoration inside the program ESGIRA-MARIA. The Classification and Management of the Foz do Cáster Protected Area in order to restore habitats for migratory species (include nesting sites), to protect the native fauna and flora of the Ria de Aveiro, to valorise the landscape by its diversity and harmony, at the same time as to promote the region development valorising the interaction between the natural and human components of the population, and creating one space for environmental education and scientific investigation. We will discuss the results of one-year work in this case in order to provide a better understanding of Portuguese experience on the ecological restoration of coastal zones. (Topic 6.1)

JUANA HERMOSO, LUISA CUNHA, ISABEL FERREIRA, FATIMA ALVES, FILOMENA MARTINS, CELESTE COELHO

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Department of Environment and Planning, University of Aveiro,
Campus Universitário Santiago, Portugal

Restoration of the coast of Portugal: rehabilitation of the Aveiro salt pans.

The Ria de Aveiro in Portugal, like most coastal zones, has always attracted human activities. So it has been subject to excessive human pressures that have caused the degradation and destruction of natural systems and landscapes. Nowadays, following European policies, there is concern to restore such habitats combining natural and human worlds. Inside the framework of the European LIFE 96 programme, the Integrated Management Program for the Ria de Aveiro has, as its main objective, a search for ways of managing coastal zones that would allow the integrated development of human communities and nature, not only in the Ria de Aveiro but also in other areas with similar characteristics. This presentation will show that good management and control of natural and anthropogenic processes can guarantee the biodiversity and the integration of people in the landscape of coastal wetlands, referring to the rehabilitation of the Aveiro salt pans, maintaining economic activities or introducing new ones and the natural and landscape values of the wetland. We will discuss the results of one year work in this case in order to provide a better understanding of Portuguese experience on the ecological restoration of coastal zones. (Topic 6.1)

**JUANA HERMOSO, LUISA CUNHA, ISABEL FERREIRA,
FATIMA ALVES, FILOMENA MARTINS AND CELESTE
COELHO.**

Department of Environment and Planning, University of Aveiro,
Campus Universitário Santiago, Portugal.

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GORDON HEWSTON

Sherwood Forest Trust, Greenwood House, Kirkby in Ashfield,
Nottingham

The restoration of Sherwood Forest

In the time of legendary Robin Hood, about 26,000 hectares were subject to the rule of Forest Law. About two thirds of this area was probably heathland, with oak woodland and temporary farmland making up the remaining area. Today, these habitats are seriously fragmented by the pressures of coal mining, agriculture, forestry and expanding villages. 90% of Sherwood's heathland has disappeared since 1922. The Sherwood Forest Trust was established in 1996, from a partnership of government agencies, local authorities, landowners and voluntary organisations. The Trust has increased the heathland area in Sherwood by over 30% in three years and successfully created new woods and wetlands. Careful targeting with the flexibility to act on

opportunities forms the basis of the Trust's approach, alongside a strong partnership with landowners from the agricultural, mineral, leisure, military and forestry land use sectors. A detailed analysis of the Trust's work shows that the leisure sector offers enormous potential for habitat restoration while working with the mineral, military and forestry sectors can also yield significant gains. The detailed evaluation of the Trust's work provides a clear understanding of future opportunities and a set of learning points for use elsewhere. (Topic 4.1)

M K HIETALAHTI, G P BUCKLEY

Wye College, University of London, Wye, Ashford, Kent.

Can ancient woodlands be transplanted?

As a technique for re-locating displaced habitats, translocating soil from woodlands is especially problematic, owing to the sensitivity of the vegetation, the loss of canopy cover and the length of time needed to re-establish shaded conditions. Apart from the difficulties commonly encountered at the outset in matching donor and receptor sites, particular concerns are: a) the extent of physical damage, both to the soil and vegetation, b) dilution of the seed bank, c) long-term changes in soil chemistry and d) competition from species of open-ground habitats during the establishment phase. Examples are given of operations in which the surface soil layers of former ancient woodlands were moved to receptor areas, using both conventional loose tipping and soil placement methods. The potential success of these operations is reviewed through two main investigations, one involving the long-term monitoring of vegetation following soil transfer and the other contrasting spring and autumn transfer with alternative placement techniques. Preliminary results indicate the need not only for careful soil handling to avoid vegetation damage and fundamental community change, but also the drawing up of 'best-practice' protocols to guide future transfers. (Topic 3.2)

ANDY HILL, JOHN BOX

ECC International Ltd, St Austell, Cornwall

Wardell Armstrong, Telford, Shropshire

The translocation of wet heath in the Wareham Basin of Dorset, UK

Habitat translocation is a method of last resort where it is not possible to conserve habitats of particular value for nature conservation in situ and other mitigation proposals are not adequate to compensate for the total loss of the habitat. ECC International has a number of active open-cast ball clay workings in the Wareham Basin of East Dorset which are adjacent to internationally important heathlands. The restoration of the ball clay workings to wet and dry heathland requires detailed engineering and ecological expertise. This paper reports the methods and the results of the translocation of some 1,000m² of wet heath in 1993 to an engineered receptor site as part of the permitted extension of ball clay workings. Annual hydrological and vegetation monitoring undertaken since 1994 demonstrates that this translocation has been a success. The environmental context of the donor and receptor sites, the translocation technique, and the habitat management of the translocated vegetation have been identified as critical success factors for habitat translocation. The implications of this for site restoration and nature conservation are discussed. (Topic 3.2)

DAVID HILL, DUNCAN WATSON, VALERIE HACK

Ecoscope Applied Ecologists, Crake Holme, Muker, Richmond, North Yorkshire

Habitat creation on landfill sites

The concept of sustainability is now central to the landfilling of wastes

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in the UK. This paper highlights the opportunities for habitat creation presented by the landfill restoration process and outlines the potential benefits of ecological restoration on landfill, both for the conservation of biodiversity and the landfill industry. A summary of the major constraints upon successful ecological restoration on landfill sites is given, the commonest causes of failure in existing projects are outlined, and a set of general best practice guidelines for habitat creation on landfill sites are presented. The paper concludes with two case studies illustrating how ecological restoration on landfill sites can contribute directly to objectives and targets for the conservation of habitats and species. The information presented in this paper is drawn largely from the forthcoming book 'Wildlife Management and Habitat Creation on Landfill Sites - Guidelines for Best Practice' (due for publication Spring 2000) (Topic 3.3)

G HIRONS, M AUSDEN, M SELF

RSPB, Bedfordshire

Principles and techniques of wetland creation and restoration at RSPB nature reserves

RSPB has restored 3500ha of existing lowland wet grassland and 250ha of reedbed, and re-created 450ha of lowland wet grassland on arable and, including work in progress, 360ha of reedbed on arable or grassland. RSPB's re-habilitation of these two habitats is aimed primarily at conserving priority bird species but also benefits other wetland biodiversity of high conservation value. This paper establishes the general principles and successful techniques of reedbed and wet grassland creation and wet grassland rehabilitation from experience gained from specific case studies. For reedbed these will include Ham Wall (reedbed creation following peat extraction) and Lakenheath (reedbed creation from arable). Topics considered will include compliance with planning requirements, land forming, management of water, reed propagation and establishment and the cost-effectiveness of different approaches to reedbed creation. Wet grassland creation and rehabilitation will be described with reference to case studies at Otmoor (wet grassland creation from arable on clay soils) and West Sedgemoor (restoration of improved grassland on peat). Topics covered will include hydrological design and management on different soil types, sward establishment and costs. (Topic 4.6)

RACHEL HIRST

Centre for Ecology and Hydrology, Monks Wood, Abbots Ripton, Huntingdon, Cambs

Understanding habitat disturbance thresholds - the case of military training areas

The Ministry of Defence is one of the largest UK landowners, and one of the most intensive uses of this land is for tracked vehicle manoeuvres. Vehicle disturbance of grasslands causes direct changes to soil structure and vegetation composition. Many of the UK training areas contain land of high conservation value, but besides issues of habitat degradation and loss, extensive areas of bare ground are also less useful for training purposes. The high expense of land recovery projects over large areas, and the disruption this may cause to realistic military training, makes active ecological restoration in training areas inappropriate. It therefore is necessary to understand the directions which military disturbance forces natural systems and ascertain natural re-establishment periods and thresholds which result in unstable or unproductive states, and utilise the systems natural ability for regeneration. This study investigated some aspects of habitat response to disturbance on the Salisbury Plain Training Area (SPTA) in southern England. Covering some 38,000 hectares, SPTA contains the largest known expanse of unimproved chalk grassland in NW Europe. A

chronosequence approach was used to estimate typical recovery periods of different chalk grassland communities found on SPTA. A second experiment investigated the comparative disturbance effects of different military vehicles on chalk grassland vegetation composition. The chronosequence showed that an *Arrhenatherum elatius* grassland community takes approximately 30 years to recovery from heavy military disturbance, whereas a typical chalk grassland community such as a *Bromus erectus* grassland takes over 50 years. The second experiment demonstrated that the composition of a plant community following military disturbance is primarily governed by the area of soil exposed. These studies have important implications for the management of disturbance in terms of exclusion periods for recovery and manipulating species compositions in order to meet statutory conservation objectives. (Topic 4.8)

JAMES HITCHMOUGH

Department of Landscape, University of Sheffield

Germination and establishment of meadow forbs in unproductive urban substrates

This paper presents the results of two studies; a pot experiment into the germination and growth of 12 native forbs of dry habitats in monoculture in crushed brick rubble, sand, brick rubble/sand, and subsoil, and secondly establishment of communities of these species on similar substrates in the field in Sheffield. One hundred seeds of each spp. were sown per pot (4 replicates per treatment) in January 1997, and germinants counted weekly. Substrate type had a significant effect on germination and establishment, with brick rubble the least successful substrate and sand the most. Many spp. germinated in early March, whilst *Scabiosa columbaria* showed peak germination in May-June. Seedlings were harvested at three intervals across the year and their dry weights determined to provide an indication of likely competitive capacity across substrate gradients. The field study was undertaken with English Partnerships on an urban clearance site (machine destroyed subsoil clay/building debris) that was in the process of being colonised by typical urban ruderals. These sites are often topsoiled by developers at substantial cost prior to landscaping. We wanted to see if it was possible to produce an attractive, meadow-like vegetation through oversowing these sites. Over-spraying with glyphosate, burning, and mowing, in combination with surface cultivation or no surface cultivation were investigated. Six forb species were sown in autumn and spring, with seedling establishment and survival assessed over a 2 year period. Burning + cultivation in spring, followed by glyphosate + cultivation in spring produced significantly more seedlings than other treatments. (Topic 4.4)

MADELINE HOLLOWAY

66 Norwood Terrace, Shipley, Bradford

Translocation of metallophyte grassland in Northumberland: successes and failures of management, temporary storage and inadvertent habitat creation

This paper describes the translocation and subsequent management and monitoring of an area of established metallophyte grassland adjacent to the River Tyne, Haltwhistle, Northumberland. Problems at each stage of the translocation process are discussed and the success or failure of turves translocated directly and indirectly (via a 10 month period in a temporary storage site), from donor to recipient site are compared. Initial results indicate that temporary storage of the grassland turves has a significant deleterious effect on the translocated local population of mountain pansy *Viola lutea*, an indicator species of the metallophyte grassland community. The implication is that temporary

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storage is not an effective translocation option for this type of unimproved grassland. The disappearance of other plants (such as *Galium verum* and *Conopodium majus*), from both the directly and indirectly translocated turves calls into question the success of translocation as a viable mitigation measure rather than simply a good technique for habitat creation. In terms of preserving local populations of *Viola lutea* the 4 year monitoring study indicates that natural regeneration from a persistent seed bank within the adjacent areas of seeded, but untopsoiled, areas was more successful than the more problematic maintenance of existing *Viola lutea* populations within the translocated turves. (Topic 3.2)

NIGEL HOLMES, PETER SPILLETT, KEVIN PATRICK

Alconbury Environmental Consultants, The Almonds, Warboys, Huntingdon, Cambs PE17 2RW, UK

Thames Water, Environment & Quality, Gainsborough House, Manor Farm Road, Reading, Berks, UK

Rehabilitating the Upper River Kennet

In the UK finding opportunities for restoration of rivers is easy; determining which has greatest priority when funds are limited is not so straightforward. The River Kennet, UK, is a chalk river and as such is in need of protection through the European Habitats Directive (Chalk Stream Habitat Action Plan). The river as a whole is considered to be one of the best examples of its type in England and has been designated a Site of Special Scientific Interest. Despite SSSI status, the Kennet is far from being in prime condition, being severely degraded physically, like many chalk rivers, due to impoundments for milling, land drainage and flood defence works; it is also influenced by groundwater abstractions. In 1999 Thames Water embarked upon a rehabilitation project on a 10km stretch of the river at Axford, Wiltshire. This was in partnership with local landowners, community interests and statutory agencies responsible for river management and conservation. This paper will report on the following:-

- 1 criteria used, and procedures, for selecting reaches to be rehabilitated (species, habitats, degree of degradation, community aspects);
- 2 learning from what has been done before to ensure best practice (utilizing RRC database, site visits to other projects addressing similar problems etc.)
- 3 undertaking an early demonstration project to illustrate to owners what can be done;
- 4 experimentation with new (or modifying existing) techniques to take the process forward;
- 5 pre- and post-monitoring (ensuring environmental interest not impacted by works and key objectives for target species and habitats realised). (Topic 4.2)

PATRICIA M. HOLMES

Cape Ecological Services, South Africa.

Restoration of alien-invaded ecosystems : what do the seed banks tell us?

The Cape Floral Kingdom harbours one of the world's highest densities of vascular plant species, of which a large proportion are endemic. This unique diversity is under threat from invasion by alien trees and shrubs, mostly from other Mediterranean-climate regions. Once present, these alien species spread rapidly to form dense stands that outcompete and eliminate most indigenous species. In fire-prone Fynbos vegetation, about half the species lack sprouting ability and rely on seed for regeneration. Although Fynbos seed longevity has not been studied extensively, it is anticipated that many, especially shorter-lived, species have persistent seed banks. Soil-stored seed banks were sampled under dense alien stands of recent (one fire-cycle) and older

(three fire-cycles) origin. Seed banks in recent alien stands were smaller, but similar in composition to those in uninvaded Fynbos, whereas those in older alien stands were much more depauperate, with a higher proportion of short-lived species. Field studies corroborate the seed bank results and indicate that there is good restoration potential at sites that have been invaded for one-two fire cycles. (Topic 3.4)

PETER HOOD, SIEGY KRAUSS, KINGSLEY DIXON.

Kings Park and Botanic Garden, West Perth

Can seed provenance be practically defined for rehabilitation?

Genetic provenance infers that local seed is best suited for restoration efforts. Bold Park is the largest bushland remnant in Perth, Western Australia and is in urgent need of restoration. Many native species set little seed in the Park, so seed are required from elsewhere. But from how far can seed be collected before the genetic integrity of local populations is compromised? We are using a DNA fingerprinting technique (AFLP) and multivariate ordination procedures to delineate genetic provenance in species targeted for rehabilitation. Species are being selected which represent key life forms so that general principles of provenance can be defined for most of the 289 native plant species in Bold Park. Populations were sampled from up to 50 km north and south of the park. Extensive population genetic differentiation was found for most of the species studied. For example provenance was largely restricted to Bold Park for the parasitic tree *Santalum acuminatum* (Santalaceae) and the shrubs, *Hibbertia hypericoides* (Dilleniaceae), *Stirlingia latifolia* (Proteaceae) and forb, *Conostylis candicans* (Hemodoraceae). However, the wind pollinated sedge, *Mesomelaena pseudostygia* (Cyperaceae) showed no genetic differentiation among populations. These early results highlight the apparently restricted nature of the Bold Park provenance for most species (Topic 3.6)

JOHN HOPKINS

English Nature, Northminster House, Peterborough.

Habitat management / restoration : who needs it?

In the British tradition of nature conservation the need for human interventions is central. Many of the systems with high levels of biodiversity are highly anthropogenic, as for example meadows and other grasslands, coppice woodlands, fens, heaths and a range of standing waters. Virtually all these require management to arrest succession. A change in thinking about the universality of a need for management is however taking place. On the coast, above the tree-line, in certain woodlands, on a range of upland rivers and on acid bogs, the role of management is unclear, as other factors such as extreme climate or active erosion, maintain the valued biodiversity features. Approaches to restoration in the UK have usually taken the existing habitats as a model. Highly interventionist approaches have been employed to create habitat simulacra. Restoration does not however depend upon man. Natural processes, not least natural species dispersal, are often likely to create a habitat more appropriate to the site. Adoption of natural processes in conservation could threaten the livelihoods of a range of interest groups including farmers, water engineers, and nature conservationists. Fortunately for these groups much wildlife would be lost if we relied entirely upon natural processes. There are however many more cases where natural processes should be relied upon than occur at present. (Topic 1.1)

PAUL HORVATIN

U.S. Environmental Protection Agency, Great Lakes National Program Office, Chicago

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Great lakes basin indicators: a foundation

The demand for high-quality, relevant data concerning the health of various components of the Great Lakes ecosystem has been escalating rapidly for the past decade or so. The United States and Canada have spent billions of dollars and uncounted hours attempting to reverse the effects of cultural eutrophication, toxic chemical pollution, over-fishing, habitat destruction, and introduced species. Environmental management agencies are being asked to demonstrate that past programs have been successful and that the success of future or continuing programs will be commensurate with the resources expended. At the same time, in both countries, the amount of taxpayers dollars being devoted the Great Lakes environmental and natural resource issues is decreasing. The demand for high quality data, while operating with limited resources, is forcing governmental agencies to be more selective and efficient in the collection and analysis of data. The 1999 State of the Great Lakes Report represents a transition to focusing data collection and analysis efforts on a suite of 80 indicators. Over the next ten years, using the indicators as the foundation, the United States and Canada will put in place new ecological protection and restoration measures across the Great Lakes basin. (Topic 4.2)

PAUL HOWSE

Chester Zoo, Chester, UK

Native species habitats at Chester Zoo

The zoos' mission statement is - to support and promote conservation by breeding rare and endangered species, by excellent animal welfare, high quality public service, recreation, education and science. This is becoming increasingly relevant to British species. The larger zoo estate, the land outside the zoo, is some 350 acres much of which is tenant farmed. A biodiversity audit by the Cheshire Wildlife Trust, (CWT), has been carried out. Overall currently habitat variety is unexceptional, the major part being improved pasture with small areas of woodland and arable farmland.

1 A canal forming the northern boundary is a valuable wildlife corridor.

2 All the hedges are of moderate to high ecological value, forming valuable network across the site.

3 One pond group was thought appropriate to designate as a site of biological importance.

For the future, following Agenda 21 and the biodiversity action plans with appropriate partners, such as CWT, habitat recovery and regeneration will be undertaken to significantly increase the biodiversity of the local flora and fauna with specific management plans for certain species. This will become a showcase for green and progressive land management involving amenities and local development. It will also be used as an educational asset with training and further educational opportunities for habitat assessment and restoration. (Topic 4.1)

ANDREW HULL

Pond Life Project, 15-21 Webster Street, Liverpool

The Pond Life Project and beyond: new opportunities for restoring pond landscapes

The loss of farmland ponds and pond landscapes in the United Kingdom has been well documented. In lowland Britain the greatest concentration of these ecologically valuable wetland sites remains in north west England where a four year demonstration project - the Pond Life Project - was part-funded by the Life Programme of the European Union from 1995-1999. This £1.1 million project addressed the issue of pond loss via a working partnership between the farming community, public authorities, voluntary sector organisations and local

volunteers. The main activity of the Project was to build and sustain a series of networks at different levels in order to identify and activate all potential sources of support for pond conservation. The networks themselves were designed to develop activity and focus pressure. Additionally, financial, legislative, educational and organisational instruments for resisting loss were considered and an ecologically sound programme of pond landscape restoration was developed. Results from the project will be discussed together with principal recommendations for future work where ponds and pond landscapes remain under threat. (Topic 4.2)

LYNNE HULL

Fort Collins, CO USA

Environmental art as restoration

Environmental artists have a role to play in restoration, putting their creativity to work as artist/activists to restore damaged sites and atone for lives lived beyond natural sustainability. Frequently these artists work with restoration scientists while raising community awareness, support and participation in restoration projects, helping to create change through shifting values and philosophies. With a brief slide survey of current art practices, I will introduce the conference scientists to artists whose new methodology, philosophy, and creative problem solving involve exciting collaboration and exchange. Artists are working on water cleanup, soil remediation, and native plant and wildlife habitat restoration through processes differing from those of scientists. I would continue with slides of my trans-species art projects which enhance wildlife habitat on damaged sites, sculptures functioning in the temporal gap between the beginning of restoration and the time nature is able to take over again.

(ref. www.wecca.com/ecoart/) A new concept for setting up collaborative opportunities on "ecoatone sites" would be introduced at the session. The creation of a website linking environmental groups, restoration scientists, artists and interested community volunteers could provide the opportunity for all of us to contact each other and accomplish the work so urgently needed for global restoration. (Topic 6.2)

R N HUMPHRIES

Holts House, 25 Wymeswold Road, Hoton, Loughborough, Leics

Implementation and assessment of good practice guidelines for grassland and heathland translocations

The success of these was mixed and the practice rapidly, and rightly, gained a poor reputation with the conservation bodies. In anticipation that future opencast schemes would have to offer translocations as mitigation in order gain planning consent the British Coal Corporation commissioned a review of experience and the formulation of good practice guidance. The Good Practice Guidance was completed in 1993 and has been used in several schemes using intact turf or turf fragments on coal, sand and hard rock sites in the UK. The purpose of this paper is to review this guidance, the results achieved, and identify where improvements could be made. (Topic 3.2)

JASON J. HUSVETH, J. ROBERT BUFFLER

Great River Greening, 35 West Water Street, Suite 201, Saint Paul, Minnesota, USA

Urban restoration planning at the landscape scale: Upper Mississippi and Minnesota River Valleys case study

In 1999, a partnership of twelve government agencies and private conservation groups began a collaborative inventory and planning

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effort as the initial phase of a long term restoration of the Upper Mississippi and Minnesota River Valleys in the Minneapolis/Saint Paul Metropolitan Area, Minnesota, USA. The primary goals of the collaborative effort are to: 1) develop and refine a land cover classification system that captures the existing continuum of land cover in the metropolitan region, from remaining natural communities and semi natural lands to culturally-based landscapes and modified landscape patterns, 2) compile available information on existing and presettlement landscape conditions, identify information gaps, and collected needed data to enable effective restoration planning, 3) evaluate restoration opportunities over the entire project area and prioritize future restoration projects, 4) to create a unified vision for existing natural resource preservation, conservation, and restoration planning efforts within the metropolitan river corridors, and 5) foster collaboration among government agencies, private land owners, and community volunteers to implement natural resource inventory tasks and natural community restoration projects. Our presentation will focus on methods we have developed restoration planning for an 810km² project area within the river corridors of a rapidly urbanizing metropolitan area. We will discuss the opportunities and challenges unique to large-scale restoration planning and prioritization within our project area. (Topic 3.7)

LEANNE M. JABLONSKI, MICHELE GUGGENBILLER, DONALD R. GEIGER

Marianist Environmental Education Center, Dayton, Ohio.

Oh happy fault ! - developing a resource for research and education from a constructed gravel-pit prairie

The Mount Saint John Prairie occupies 12 acres of the Marianist Environmental Education Center (MEEC) in Dayton, OH, USA. The gravel-pit remaining following highway construction in 1985 provided an opportunity to establish educational and research programs. Native tallgrass species were chosen for planting since 1802 surveys showed prairie and wetland remnants nearby. By 1999, 484 species and several micro-habitats had established. The prairie is part of regional land acquisition efforts and a greenspace corridor being conserved amid intense suburban development. The MEEC mission is to increase appreciation for the workings of the Earth, to develop skills and promote the preservation, restoration and enhancement of our landscapes and their life-sustaining systems. Hands-on education in restoration is provided to school and other groups of all ages. In 1999, 226 volunteers gave 1950 hours. The prairie provides one-time and extended opportunities for ecological research for both students and professionals. Long-term study plots have been established to assess floristic diversity and quality and impacts of soil edaphic factors and topography on species establishment. By providing examples of regional geology, history and ecology, the prairie helps increase awareness of the human role in the ecosystem. Through connected learning and reflection, both land and soul are restored. (Topic 6.3)

MARTIN JANES

River Restoration Centre, Silsoe Campus, Silsoe, Bedford

River restoration in the UK

The majority of river systems in the UK can be considered to be degraded because of environmentally unsympathetic engineering and pollution. There has been a pressure in the UK and in Europe to re-engineer river systems to produce a more natural channel and a more bio-diverse natural habitat thus producing an enhanced visual landscape. The urban river Skerne, Darlington, County Durham, has been progressively straightened and realigned during a period of industrial and urban housing development over a period of some 200

years. A 2km reach was chosen for rehabilitation. The works aimed to recreate a more natural stream which would become an attractive landscape for the local community and a local amenity area. The work involved restoring a meandering plan form, in-channel deflectors to create sinuosity, bank reprofiling, channel narrowing, spoil disposal, landscaping, surface water outfall rationalisation, backwater creation, soft revetment engineering, increasing floodplain storage, extensive marginal planting of native species and the creation of wetland scrapes. This work was funded by the EU LIFE programme, the Environment Agency of England and Wales, English Nature, the Countryside Agency, Northumbrian Water plc and Darlington Borough Council, with an emphasis on engaging the local public so that scheme 'ownership' could be assured. Many constraints had to be overcome but the final project has achieved its aims of restoring a 'rural' urban watercourse with implicit amenity and landscape appeal. Such works are costly to implement and the benefits are not easily quantified for cost/benefit analysis. However, in the long term such schemes can recreate what is essentially a more natural (rural?) river system which has a greater self-regulatory capacity with benefits for flood protection, wildlife, amenity and water quality. (Topic 4.2)

E V JENKINS, A E DOUGLAS, J B SEARLE

Dept. of Biology, University of York

Enhancement of farm woodlands: does introducing wildflowers restore the insect community?

Introducing wildflowers to recently-planted farm woodlands has been shown to enhance the understorey plant species diversity. To explore the community of phytophagous insects on introduced plants, three species of wild flower, knapweed (*Centaurea nigra*, a meadow and hedge border species), red campion (*Silene dioica*, a shade tolerant species), and primrose (*Primula vulgaris*, an ancient woodland species), were introduced into 4 x 4 m plots in eight farm woodlands planted under the Farm Woodland Premium Scheme. Plants were visually inspected regularly over 2 years for phytophagous insects (such as aphids, Heteroptera, leaf miners and Lepidopteran and Dipteran larvae). Within 6-12 months, an insect community similar to that on naturally occurring plants developed on *C. nigra*, but not on *S. dioica* or *P. vulgaris*. The relative importance of (a) lack of colonisation and (b) unsuitable conditions for persistence on *S. dioica* and *P. vulgaris* are being investigated. (Topic 4.3)

VIPAK JINTANA, SOMSAK PIRIYAYOTHA

Department of Forest Management, Faculty of Forestry, Kasetsart University, Bangkok, Thailand

Mangrove restoration in Thailand

More than a half of Thai mangroves disappeared in the second half of the past century. Recognising the ecological, environmental and socio-economic importance of mangrove ecosystem particularly to the local communities in Thailand, many efforts have been done by various sectors to restore the degraded mangroves. Three different ecological habitats namely degraded mangroves, abandoned mining areas, and abandoned shrimp farms have been reforested. Moreover, certain areas of the coastline are accreting due to the formation of new mudflats and they form a potential habitat for afforestation of mangroves. Silviculture techniques for re-afforestation and speeding up the process of natural succession of these areas were developed. This study reveals some outputs from relevant experimental sites. Establishment of plantation, species selection, monitoring survival and plant growth, in different soil and water conditions is presented. (Topic 4.5)

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MARKETA JIRACKOVA, JAKUB MRAZEK, PETR DOSTAL

Department of Botany, Faculty of Science, Charles University,
Benatska, Czech Republic

The role of plants with different life histories in primary succession

The species well adapted for spatial dispersal (e. g. for spreading by wind) may be easily spread to bare sites, however they may not successfully establish in the stressful environment (lack of nutrients, water deficit) of these habitats. What is the ultimate decisive factor in control of the primary succession dynamics then? The sedimentation pond of toxic ore-washery by-products in Chvaletice (Czech Republic) is an example of a primary succession on man-made habitat. After almost 20 years of the succession the woody anemochorous species (*Betula pendula*, *Populus tremula*) with the clonal grass *Calamagrostis epigejos* dominate. The species with dispersal modes other than anemochory are very poorly represented in the site. We try to provide an explanation for that by monitoring various dispersal events (endozoochorous, esp. ornithochorous ones) and by direct sowing experiments with use of anemochorous and non-anemochorous species. Preliminary results will be presented. (Topic 1.4)

M E A JOCHIMSEN

AG Pflanzensoziologie und -ökologie, Universität-GH Essen, FRG

Spontaneous colonization compared to induced vegetation development

Spoil originating from deep coal mining is known to be reluctant in greening itself because of the extreme site characteristics. Therefore this derelict land has to be reclaimed. But in ecology there is a debate whether vegetation development should be left to a spontaneous colonization or has to be induced by seeding. The investigation of 32 spoil heaps of different age resulted in 524 relevés which were analysed by a Twinspan classification. They form the basis for a substantial comparison per unit time with an artificially induced vegetation development. In order to improve reclamation, we did several studies on virgin mine spoil. It is not only the adaptation of species to harsh site conditions which should be considered, also the aspect of an accelerated development. Four seed mixtures prepared according to phytosociological alliances, and different amendments to the substrate were investigated. One of these pioneer communities now under study for 12 years has been able to cope with the situation best. This will be demonstrated by the parameters cover, species number and abundance, as well as by the alteration of dominant species demonstrating an early succession and the phytosociological character of settlers subsequently arriving by chance. (Topic 3.3)

PATRICIA JOHANSON

Buskirk, New York, USA

City as ecological art form: the Rocky Marciano trail

Brockton, Massachusetts, a city of 100,000 is characterized by a disrupted social fabric and fragmented natural systems. The goal of my recent Master Plan (1997-99) has been to restore and reconnect urban waterways and remnant forest, adding the concept of "survival landscapes" to our vocabulary of parks and gardens, by returning both autonomy and evolution to the urban landscape. My designs for major sites: parks, playgrounds, and historical places, link tourism, community benefit, and infrastructure with ecological restoration. These magnet sites are then connected to each other by means of "green streets", forest corridors, that are in turn linked to the city's network of small brooks and fragmented open spaces. Aesthetic structures; paths, bridges, and overlooks, provide access to restored natural landscapes, while preventing damage to sensitive habitats.

"Living bridges" expand urban wildlife habitat and openwork sculpture installed against eroded streambanks creates a supporting matrix for the buildup of soil and vegetation, providing shade for fish. Other individual projects incorporate infiltration basins, and structures that celebrate seasonal natural events by revealing the poetry of the rising and falling water, rather than property-damaging floods. Individual restoration projects, as well as larger scale strategies for reintegrating ecology and urban infrastructure will be discussed. (Topic 5.2)

DAVID M. JOHNS

Portland State University and The Wildlands Project, McMinnville, Oregon

The uses of biology in advocacy

Although conservation is a multi-disciplinary mission-oriented effort, the melding of science and protection has been problematic because of unrealistic expectations and confusion among both scientists and advocates. An analysis of efforts by the Wildlands Project to integrate biology into reserve design in several regions of North America has lead to a more precise identification of these problems and their dynamics. While conservation biology is a value driven science, it cannot generate values or provide scientific proof for values, as some advocates expect. Nor do advocates understand that skepticism is a part of all, even mission oriented science. Critics likewise fail to understand that there is no contradiction between objectivity and mission. Science will not resolve value differences. The importance of conservation biology to protection efforts lies not in its ability to persuade policy-makers, but to inform advocates of what needs to be done to protect biodiversity. The findings of biology are also important in judicial and administrative arenas where laws require empirically verifiable standards be met. Good science is important in countering the effects of bad or pseudo-science. And scientists can, if they are willing to speak to the public in popular media, have an influence on popular perception. The findings of biology and related disciplines are not especially useful in persuading policy-makers who do not have positive attitudes toward biodiversity or conservation. When scientists and advocates understand what can reasonably be expected of science marital discord is significantly reduced. (Topic 3.1)

DAVID M JOHNS

Portland State University and The Wildlands Project, McMinnville, Oregon

Our real challenge: managing ourselves instead of nature

We are story-telling animals and there are many stories that attempt to explain, criticize or justify the human destruction of the natural world. Most of these stories have two things in common: our self-importance and a superficial and simplified image of who we are. These stories obscure more than they enlighten thereby preventing us from addressing the causes of the current extinction crisis. Like other creatures, there are continuities and differences between us and other species. In the scheme of evolution we are just another animal, yet our impact on the world seems undeniably disproportionate. Four factors underlie this disproportionate impact. As a species: 1) We can change our behavior and social organization to accommodate larger numbers and other changed circumstances; 2) We can develop tools that enable us to capture greater amounts of energy to feed, clothe, house increased numbers and to feed the desires of some to accumulate goods and wealth; 3) The biopsychological attributes that make adaptation through social and technological change possible are double-edged; and 4) The feedback loops that might alert us to the

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consequences of our actions are too long in many cases for us to learn quickly enough; or where feed back is rapid those making decisions are insulated from the feed back. A fundamental approach for dealing with these factors is suggested. (Topic 1.2)

PAUL JOHNSON , TOM ARMOUR, MICK HALL

Environment Department, Rail Link Engineering, London.

Holistic ecological landscape restoration on the Channel Tunnel Rail Link

The Channel Tunnel Rail Link (CTRL) is the U.K.'s first high speed rail link and first major railway constructed for over 100 years. The new railway will extend for some 109km from the Channel Tunnel terminus at Folkestone in Kent to St. Pancras Station in London. Section 1 of the project, which will provide 74km of new track from the Tunnel to existing infrastructure leading into London's Waterloo Station, has been under construction through largely rural Kent since October 1998. The CTRL passes through a varied agricultural and wooded landscape partly designated as an Area of Outstanding Natural Beauty within a county often described as the Garden of England. There are also many sites of ecological and historic interest. The paper will describe how through a process of holistic and integrated design, the setting of ecological landscape objectives and extensive external consultation, the landscape and ecology of this part of Kent is being restored following construction work. Wide scale habitat restoration involving several hundred hectares of woodland, hedgerows, grassland and wetlands has commenced. The innovative techniques used in the field and special problems that have been overcome when dealing with restoration on a landscape rather than site scale will be discussed. These include ancient woodland soil translocation, river and wetland reconstruction, dealing with protected species, the acquisition of native planting and seeding material, the management of soil fertility to reduce maintenance and the need for long term monitoring and management (Topic 1.3)

ANDREW JONES

Grasslands Officer, The Wildlife Trusts

The role of ecological restoration in conserving genetic variation

Across the developed world, the effect of agricultural intensification has been to destroy wildlife habitat more rapidly than any natural catastrophe and those habitats that have survived are small in area and fragmented. Many plant species that were formerly widespread and existed in large interconnected populations are now restricted to 'island' reserves or to linear habitats such as road verges where they survive on a knife-edge. Most plant species have within 50 years lost considerable amounts of genetic variation representing the accumulated products of evolution over thousands of years under a host of ecological and climatic pressures. In most cases we don't know the extent of such losses or their importance for the continued evolution and survival of these species. These losses have, however, come at a time when such genetic variation is crucial for adaptive flexibility in the face of global climate change and the insidious effects of modern farming. Ecological restoration has a role in the conservation of genetic variation by rebuilding and expanding fragmented plant populations that are otherwise vulnerable to local extinction. The first priority in habitat restoration programmes should be the identification of local plant populations as seed and propagation sources in the rebuilding process. (Topic 3.6)

B.E.JONES

Environment Agency

Wetlands for Wales

The project was conceived in 1995, underpinned by the Water Management duty to further conservation, and driven by:

1. the success of the Anglesey Wetlands Strategy and the subsequent establishment by the Agency of further wetland strategies and partnerships on Llyn and Dyfi
2. recognition through the LEAP process of the scale of wetland losses, biodiversity issues, and the Agency's role in Water Level Management Planning
3. the failure of existing schemes (ESA, Tir Cymen, Habitats Scheme) to restore wetlands

Funding potentially ceased to be a problem with the availability of up to 75% grant aid from the Heritage Lottery Fund whose priorities for environmental projects were:

1. individual sites of outstanding importance to the national heritage, in or intended for, public ownership
 2. integrated area-based conservation projects focusing on an area, or region
- strategic, theme based conservation projects focused on one class of natural feature or habitat

The Wetlands for Wales partnership met these priorities through three objectives:

1. restoration of key wetland habitats, species and landscapes in North and Mid Wales
2. improved public access to wetland areas
3. promotion of wetland areas as an educational resource

The main parties to the project are the RSPB, Countryside Council for Wales, National Trust, North Wales Wildlife Trust and Gwynedd Council. Funding will go largely towards acquisition and/or restoration of 15 sites with funds also allocated for survey, modelling and scheme design for hydrological restoration of Cors Fochno, Wales largest raised mire. Biodiversity benefits will include restoration of reed bed, fens, lowland heath, grazing marsh, rivers and lowland purple moor grass and rush pasture. Key species that will benefit include otter, bittern, medicinal leech, southern damselfly, lapwing and water vole, over the five-year life of the project. (Topic 4.6)

PAUL JOSÉ

RSPB, The Lodge, Sandy, Bedfordshire

Habitat restoration for the Bittern, *BOTAURUS STELLARIS*, in the United Kingdom

The bittern, one of the UK's most endangered birds, is benefitting from a £1.7 million ECU grant from the EU's LIFE Nature Programme. The number of bitterns in the UK have fallen from approximately 80 booming males in 1954 to 11 in 1997. Habitat restoration work has aimed to reverse the decline of breeding bittern in UK reedbeds and ensure a long term improvement in breeding numbers. Extensive research has been undertaken to determine the reasons for this decline. Measures have been put in place on 13 sites by 7 partner organisations to meet the requirements of bittern and wider biodiversity. This programme of work is a significant contribution to the implementation of the European Action Plan for Bittern in the UK. To date this project is the main means of delivering actions for bittern in the UK. The challenge has been to restore degraded artificial reedbed systems which are no longer sustained by natural processes. The number of booming bitterns in the UK has increased from 11 in 1997 at the start of the project, to 19 in 1999. 11 of the booming males are now found on EU LIFE sites (60% of the UK total). The previous total was 4/5 birds (36% of the UK total) on

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EU LIFE sites. The challenge for the future will be to look at long term sustainable management and the rehabilitation of more naturally functioning eco-systems. (Topic 4.7)

PAUL JOSÉ, P BENSTEAD, G THOMAS

RSPB, The Lodge, Sandy, Bedfordshire

Sharing restoration experience

Throughout Europe, historical demands to protect people and property from flooding have resulted in a legacy of insensitive land management and flood defence activity. River engineering and subsequent isolation of floodplain wetlands have exacerbated problems of eutrophication, water shortages and flooding. The 1990s saw greater recognition that the apparently conflicting pressures of wetland management and flood alleviation could be met at one and the same time by working with rather than against nature. RSPB and partner organisations have been at the forefront of the production of informative, practical, yet easily accessible guidelines on habitat management which integrate the needs of people and wildlife. Case studies are presented from RSPB's New Rivers and Wildlife Handbook, the UK Reedbed Guide and UK Grassland Guide, as well as the European Wet Grassland Guide. These illustrate that conservation and restoration of rivers and wetlands can no longer be regarded as an 'add on' solely with benefits for wildlife but as an essential process with important social and economic benefits. The importance of case studies as part of the communication process is shown to be paramount (Topic 6.1)

PAUL W KATZER

NYC Parks & Recreation / Natural Resources Group, New York, USA

Integrating Geographic Information Systems with natural resources management and restoration in the New York / New Jersey harbor estuary

The Natural Resources Group, founded by Commissioner Henry J. Stern in 1984, implements restoration, research and management programs for the City's natural resources. NRG uses geographic information system (GIS) and global positioning system (GPS) technology to support Restoration and Monitoring, Natural Resources Protection, Acquisition, Resource Management and Policy & Planning projects. The Natural Resources Group is active in regional environmental policy, restoration and management initiatives. NRG currently chairs the NY/NJ Harbor Estuary Program's Habitat Workgroup and maintains the Habitat Workgroup's GIS. NRG, in cooperation with federal, state and local government agencies in New York and New Jersey, maintains an extensive inventory of GIS data, characterizing habitats, acquisition and restoration priorities, habitat threats and impairments, and regional terrain and infrastructure data. Data from numerous sources are used to visualize and rank the Habitat Workgroup's priority sites and management concerns. NRG is presently managing nearly \$60 million in restoration programs funded by natural resources damages claims, federal and state grants, and public works mitigation. NRG's restoration projects reduce non-point source pollution in the waterbodies of the New York/New Jersey Bight, combat the spread of invasive plants, restore and create new habitat for numerous plant and animal species, and re-introduce locally rare, threatened and endangered plant species. Restoration sites are mapped using secondary data sources and field data collected by NRG scientists. Baseline vegetation and land cover data are used to design restoration projects. Restoration mapping, e.g. Rare Plant Propagation Program planting sites, as-built plans, etc., are used to monitor the success of restoration projects. This paper will highlight how mapping tools, such as GIS and GPS are used to inventory, manage and restore

natural resources in New York City Parks and in the NY/NJ Harbor Estuary. (Topic 3.7)

S KELLIE, A V A KWOLEK, J OLLERTON

University College Northampton, Park Campus, Northampton

Restoration of species -poor grassland in an urban local nature reserve

Species-rich grasslands now occupy a tiny fragment of their former range in England and Wales and as such there is considerable interest in restoring biodiversity to existing species-poor grassland. The aim of this project is to evaluate a number of restoration techniques in order to assess which would be most suitable for restoring an area of grassland, currently low in conservation value, on the Bradlaugh Fields Local Nature Reserve in Northampton, England. The techniques being investigated are: chain harrowing, rotovating, surface stripping, all with and without re-seeding. The project commenced in 1998 and already differences between the trial plots are emerging. This poster describes the project and presents some of the data obtained to date. (Topic 5.3)

TONY KENDLE, JULIET ROSE

Department of Horticulture and Landscape, University of Reading

Ecological restoration of degraded land on St Helena Island

St Helena Island in the South Atlantic Ocean has one of the most important endemic floras in the world. The island vegetation was devastated by uncontrolled goat grazing and woodland clearance in the early 1500s. Today the degraded wastes cover one third of the island. The last goats were culled in the 1960s. Components of the endemic are recovering including some species that had declined to populations of just one or two plants and were believed extinct. Their genetic viability may be compromised. Soil and climatic changes have been severe, although the tolerances of the endemic flora are not clear. The wastelands are being colonised more rapidly by a range of introduced species. Many of these are internationally classed as 'weeds' because of their invasive behaviour. Loss of species and environmental change means that the original plant communities can never be restored. The island also does not have the resources to control all 'weeds'. There must be an evaluation of which colonists may be temporary, which may play an acceptable part in future plant communities and which threaten the integrity of the island ecosystem. The island provides a case study of how restorationists tackle the issue of environmental change. (Topic 4.8)

ANDREW KENNY, JOHN GOSS-CUSTARD, CATHERINE HUTCHINSON, IAN TOWNEND, CHRIS JACKSON, NIGEL PONTEE

ABP Research & Consultancy Ltd, Pathfinder House, Maritime Way, Southampton

Modelling the effects of habitat loss on populations of wintering shorebirds on the Humber Estuary (UK)

With the implementation of the European Habitats and Environmental Assessment Directives, and the adoption by the OSPAR commission of an ecosystem approach to management of the aquatic environment, there is a need to better understand the processes which regulate aquatic ecosystem structure, function, productivity and biological diversity. This has recently been highlighted by a number of developments in UK estuaries which are required to assess the potential impacts upon the site integrity of Special Protection Areas (SPA's) and marine Special Areas of Conservation (SAC's) under the Habitats Directive. However, the scientific methodology for assessing

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the impacts of habitat loss on SPA and SAC site integrity has not been fully defined. This has inevitably led to difficulties in satisfying the regulatory conditions during project development. Applied research directed at understanding the trophic interactions between the invertebrate fauna inhabiting intertidal feeding areas and overwintering bird populations has been undertaken by ABP Research and the Institute of Terrestrial Ecology (ITE). The research was conducted between 1998 and 2000, and commenced with a study to report on the feasibility of building a general model to predict over-winter shorebird mortality caused by a loss of feeding habitat. The overall conclusion reached was that a general model could be constructed with reasonable confidence, assuming that certain field measurements could be made to validate the model parameterisation. Accordingly an intensive field sampling campaign was undertaken over the 1999/2000 winter season to acquire the necessary macrobenthic and bird data to validate the model. This paper describes; i) how the model was developed and tested, ii) how it will allow environmental managers to properly and adequately determine the effects of habitat loss on SPA site integrity and, iii) how it provides a scientific method for determining the scale of habitat creation needed to mitigate or compensate for original loss of habitat. (Topic 4.5)

JANICE KERBY, SAM LATTAWAY

Forest Restoration Research Unit, Thailand and Nottinghamshire County Council, UK

BAP's, planners, miners and ecologists - a tale of heathland restoration in Nottinghamshire.

The development of Biodiversity Action Plans has added substantially to the formidable array of tools available for restoration ecologists in the U.K. Now, armed with these guidelines to give your plans credibility, and with the National Vegetation Classification as a clue to the essential building blocks of your intended habitat, you can make progress on large-scale land restoration with the blessing (usually) of your local planners and nature conservation agencies. Currently, there are unprecedented opportunities for ecologists to work together with professionals of other disciplines to share experiences and consequently to develop innovative techniques for resolving restoration conundrums. By applying ecological principles to highly damaged landscapes and combining this with knowledge from agriculturists, engineers and planners, substantive and exciting restoration can be achieved. We will illustrate how these tools and techniques were applied to heathland restoration in the Nottinghamshire coalfield. In this example, extensive areas of colliery spoil tip were reclaimed with the intention of restoring the Sherwood Forest landscape of heathland, acid grassland, sessile oak-birch woodland, and oligotrophic wetland. This example demonstrates how successful restoration needs to build on multidisciplinary interactions, sound ecological principles and leaps of faith. (Topic 3.1)

DOUG KERN

Urban Watershed Project, San Francisco, California, USA

Tennessee Hollow Riparian Corridor Restoration Project

The Tennessee Hollow watershed is a unique 250-acre natural setting in the Presidio of San Francisco, a former U.S. Army base and now an urban National Park. Nearly 150 years of Army activities have altered the landscape and forced creeks into culverts and concrete-lined ditches. Invasive vegetation, crisscrossing roads and deteriorated utilities negatively impact the site. Despite the degradation, significant opportunities exist for habitat restoration. The Urban Watershed Project (UWP), a non-profit environmental organization, is developing

restoration plans for Tennessee Hollow. The restoration program will create rare, continuous riparian habitat from headwater springs to tidal marsh. Valuable ecosystems such as serpentine grassland and coast live oak riparian forest will be established. The project will eventually support diverse native plant and animal communities in a densely populated urban environment. Challenges to the project's ultimate sustainability are numerous. A major freeway passing over the lower riparian corridor will soon be under reconstruction. Hazardous waste landfills are located directly in the projected stream corridor path. A multi-million dollar redevelopment complex is immediately adjacent to the site. This paper will describe restoration planning efforts and document the community/agency collaborations, water quality monitoring activities and environmental education programs now underway. (Topic 5.3)

MARGARET KILVINGTON, WILL ALLEN

Landcare Research New Zealand, Lincoln, New Zealand

From landscapes dreams to ground level action:

Moving towards regional-scale ecosystem restoration

New Zealand's conservation history has resulted in designation of 30% of its lands as conservation areas under crown ownership and management. Inadvertently this process has created a rift, in the minds of public and policy makers, between the public land we preserve, and the private land we use. However, many ecosystems occur only in the productive landscape. While there are cases of conservation and restoration on private land these have been at best islands of success, involving local efforts to protect iconic flora and fauna. There is a clear need for regional scale co-operative ventures to achieve meaningful restoration of fragmented natural systems in the productive environment. Planners aiming to enhance biodiversity on private land, are faced with a twofold challenge: to co-ordinate the regulatory opportunities available to achieve protection, and to harness voluntary support. Particular problems include a lack of leadership, hostility towards regulatory approaches, suspicion over potential encroachment on private property rights, and a lack of appreciation for the biodiversity values of patch ecosystems that superficially appear to hold less aesthetic and heritage values than pristine protected areas. We examine the challenges of securing voluntary support, based on studies of attitudes towards biodiversity protection and restoration in urban and rural environments, and examples of community environmental management. Particular attention is paid to how collaborative processes can harness different values involved in biodiversity protection, influence motivation, and improve information on restoration. The value of networking (including use of the Internet) is also explored. (Topic 1.3)

MIKE KING

British Trust for Conservation Volunteers

The ecological restoration of communities

If ecological restoration of semi-natural habitats is to be successful and sustainable there is a need to build a new relationship between people and land. A relationship that makes ecology and landscape relevant to the day to day lives of local communities. Too often community involvement and volunteering is seen as a means to achieving an ecological outcome. This paper proposes that we should take the opposite view, starting to position ecological restoration as a means to building sustainable communities. The current trends in community involvement are considered and suggestions made as to how these could be applied. A more holistic approach is proposed whereby the restoration of 'Environmental Capital' is greatly enhanced by the development of 'Human and Social Capital'. The new

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relationship between people and land that flows from this is one whereby active voluntary participation in ecological restoration brings considerable community benefit. This in itself helps develop a community with the capacity to sustain the environmental, social and economic benefits that result (Topic 6.4)

Y KITAYA, AJ KENDLE

College of Agriculture, Osaka Prefecture University, Sakai, Osaka, Japan: Department of Horticulture and Landscape, University of Reading

A method for restoring vegetation in abandoned wet lowlands

Large areas of wet lowlands such as abandoned clay pits and gravel pits have been left as wastelands with absence of appropriate vegetation. Establishment of some plants in wet lowlands can be challenging as there may be inadequate soil aeration. Although many true wetland species have special adaptations that allow them to grow in waterlogged conditions, some can only establish as young seedlings during favourable periods, which may be rare. This is particularly the case for species adapted to only periodic inundation. Degraded wetlands lacking functional vegetation cover can be more frequently inundated than healthy wetlands of this type. In this paper, we summarize the effects of soil aeration on plant growth and propose a method to revegetate abandoned wet lowlands by improving soil aeration. A method that was developed for utilising wet lowlands as arable fields without drainage has been adapted for restoration. In the newly developing method, soil mounds are ridged on the submerged ground with at least 20 cm exposed above the water surface. Easily available indigenous materials such as wheat straw bales or massive coarse peat are placed inside soil ridges to maintain sufficient aerial spaces in the soil before plant introduction. (Topic 4.6)

Y KITAYA, V JINTANA, S PIRIYAYOTHA, K YABUKI, T FURUTANI, S IZUTANI, A NISHIMIYA, M IWASAKI

College of Agriculture, Osaka Prefecture University, Sakai, Osaka, Japan

Growth characteristics of seven mangrove species planted in estuaries affected by different tidal levels

The research was initiated to determine the appropriate zonation of mangrove species in an estuary in Thailand in order to guide restoration efforts. The growth characteristic of seven typical mangrove species in Thailand have been studied in respect to topographic conditions and exposure to different tidal effects. The plant materials used were viviparous seeds of *Rhizophora mucronata* (Rm), *Rhizophora apiculata* (Ra), *Bruguiera cylindrica* (Bc) and *Ceriops tagal* (Ct), and seedlings of *Sonneratia alba* (Sa), *Avicennia officinalis* (Ao) and *Xylocarpus granatum* (Xg) from natural habitats. These were introduced in six bare areas including two that were abandoned after tin mining and four gap areas in natural habitats in June 1998. The experimental plots (10 x 10 m², each) were sloping and showed a maximum elevation difference of 1.8 m. The plots were naturally submerged with 2-3% saline water twice a day. Salinity, pH and concentrations of several ions in the soil water were almost the same in all of the plots. More plants of Bc, Ct and Xg had died at lower elevations a year after planting, while Rm and Sa mostly survived showing different growth rates in response to topography. Ra and Ao showed intermediate growth rates of the two groups mentioned above. In the early growth stage, mangrove plants showed increasing tolerance to high tidal levels in the order, Rm, Sa, Ra, Ao, Ct, Bc and Xg. (Topic 4.5)

ERIK KIVIAT, GRETCHEN STEVENS, SVEN HOEGER, ROBERT BRAUMAN, PETER M.GROFFMAN, PETER J.PETOKAS, KRISTA MUNGER, STACEY THEW, LAURA T.HEADY

Hudsonia Ltd., Bard College, Annandale NY, USA

Blandings turtle

A restoration project was completed May 1997 to replace habitats of the state-threatened Blanding's turtle (*Emydoidea blandingii*) lost to a school expansion. Vegetated wetland sods and underlying organic soil were moved 200-700 m to excavations, creating 1.4 ha of deep-flooding, shrubby, groundwater-fed wetlands surrounded by gravelly, sparsely vegetated, upland nesting habitat. In 3 seasons since construction, turtles nested on constructed habitats but hatchling production declined. Adults used the constructed wetlands during nesting season and summer but little in winter and early spring which are seasons of narrow habitat use. Sod vegetation survived well. Plant richness in wetland plots was highest the first year after construction, and has fallen since. Microbial activity was similar in constructed wetland sods and in reference wetlands, but was lower in inter-sod areas. Microbial activity in constructed wetlands increased year-to-year. In 4 years of study (1 before, 3 after construction), summers have been alternately very wet and dry. Turtles and vegetation responded to precipitation, partly obscuring post-construction trends. The longterm prognosis of this habitat restoration experiment is uncertain. Therefore we recommend that wetland and nesting area construction be used to increase habitat for Blanding's turtle rather than to mitigate the planned destruction of wetlands. (Topic 4.7)

IRENE KLAVER

Department of Philosophy, University of North Texas, USA

Restoration as de-domestication of land and politics

Restoration can lead to an increase in natural values in so far as it contributes to an integration of disturbed nature into its larger surroundings or if it allows for disrupted functions to take up a self-regulative course again. We can conceive of this as a process of "de-domestication" of the land. I will argue that an augmentation of natural values through restoration entails an augmentation or de-domestication of political values. An "enlarged" sense of democracy is called for in which natural entities will be represented in an enlarged parliament through different spokes-persons. I will explore this sense of "enlargement" through Hannah Arendt's version of Kant's notion of enlarged thought, which refers to the capacity to judge from the perspectives of others. Where for Kant and Arendt these others are always human others, I will enlarge this realm with non-human others also. To be able to represent natural entities entails an augmented relation with one's place, an increase in knowledge and experience of the place, and an astute capacity of translating natural issues in political language. I will conclude with some suggestions how his process of translation can be facilitated. (topic 1.1)

DOUG KNAPP

Department of Recreation & Park Administration, Indiana University, Indiana, USA.

Content analysis of interpretive restoration programs

Two important content areas associated with educating individuals on restoration are ecology / natural science topics and awareness of environmental problems / issues. This study attempted to evaluate which of these content areas may provide a more optimum learning experience. A quantitative analysis was conducted on two interpretive programs at a national park that has as its mission the preservation and restoration of lakeshore environments. Two variables that were chosen

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as indicators of program success - knowledge retention and attitude change - are outcomes that have been found prevalent in interpretation. These programs were administered at the Paul H. Douglas Environmental Science Center at Indiana Dunes National Lakeshore in the United States. The results of this study showed significant gains in science related knowledge following both the ecology and issue oriented treatments. The data indicate that the focus of the program (ecology or issues related to restoration) did not significantly alter the way participants responded to the knowledge section of the evaluation instrument. Results showed little impact on participants' affect toward park site or related subject matter following either presentation type. This presentation will review these findings as well as discuss other current research that is examining the impact of interpretive programs on individuals' knowledge and attitude toward restoration. (Topic 6.3)

AVA KWOLEK, JI JACKSON, VGF SMITH

University College Northampton, Park Campus, Boughton Green Road, Northampton

The Tailby Meadow - River Ise restoration scheme

Although many small river restoration schemes have been implemented, far fewer have been monitored and evaluated. In 1994 the River Ise, a lowland river in the East Midlands of England, was subject to an ecological enhancement scheme which involved re-instating a 250 metre section of the old meandering course of the river, whilst retaining the canalized section for a portion of the flow. Subsequent monitoring showed that flow in the re-instated section was insufficient and that considerable siltation had occurred, along with excessive macrophyte growth. This paper describes the enhancement scheme and examines whether the invertebrate data collected to date reflect the observable changes in the re-meandered section, particularly the low flow. (Topic 4.2)

KAE KYOUNG KWON, JONG-GEEL JE

Marine Biology Division, Korea Ocean Research & Development Institute

Preliminary studies on relationship between reed and bacterial communities in coastal wetland

With the increased recognition about the values of coastal wetlands, conservation and restoration of coastal environments have been issued in Korea in recent days. Understanding of the relationship between components of ecosystem was one of the most important requisite things for the regulation of restoration processes. In this respect, we investigated the distribution of heterotrophic bacteria, extracellular enzyme activities and degradation rate of cellulose at two sites of coastal wetland, one with reed communities and the other without. Number of heterotrophic bacteria and β -glucosidase activities were higher in reed area but there was no difference in aminopeptidase activities at both areas. Degradation rate of cellulose in exposed area was drastically decreased with depth, but minor changes were shown in reed area. Spectrum of substrate utilization by BIOLOG GN microplates was different in two areas. The numbers and activities of bacterial populations seemed to be stimulated by the reed communities. (Topic 4.5)

TOM LADELL

Direct seeding of trees and shrubs to create new woodlands

Woodland can be established by direct seeding of trees and shrubs. It is an alternative to planting nursery stock. The technique is quite different to the horticultural/forestry methods of conventional planting. It is an 'ecological' technique that requires an understanding of seed

dormancy, conditions for germination and seedling survival. The seed mixes must be designed to suit the site and aim for the succession to woodland to be as natural as possible. The techniques for direct seeding on nutrient rich sites were developed in Britain in the 1970s and 80s with a research programme and extensive field trials. This will be reviewed, together with earlier German work on subsoil sites. The methods of site preparation and sowing will be described and the progress of some of the sowings done up to 20 years ago will be assessed. This is a potentially valuable technique for ecological restoration. It produces a more naturalistic result than planting and is ideal for many local seed sources and involving the public in seed collection. The paper will review present knowledge and practical experience. (Topic 4.3)

S.S.S. LAU, S. N. LANE

Department of Geography, University of Cambridge, Downing Place, Cambridge and School of Geography, University of Leeds, Leeds

The role of limiting nutrients in restoration of eutrophic shallow lake

A positive relationship between phosphorus load and phytoplankton biomass has been well-established. However, P loading and phytoplankton biomass relationships tend to display considerable scatter and thus the applicability of such relationships to particular lakes for restoration is questionable. This paper aims to explore the relationship between limiting nutrients and phytoplankton dynamics in Barton Broad (Norfolk, UK). This paper uses multivariate analyses to evaluate the relative importance of various nutrient factors in explaining not just eutrophication rates, but also dynamics, in the context of seasonal periodicity. The results show that phytoplankton dynamics are related to not only phosphorus, but also nitrogen and silicon in both the growing and the non-growing seasons. The results may help explain failure of the past restorations of eutrophic shallow lakes. (Topic 4.2)

CLARE LAWSON, DAVID GOWING

Cranfield EcoHydrology Centre, Cranfield University, Institute of Water and Environment, Bedfordshire

Identification of water-regime requirements for the successful restoration of wet grassland habitats

The association between plant community composition and hydrological conditions, although expressed in largely qualitative terms, has long been recognised. Quantitative information regarding the water-regime requirements of plant communities will be a valuable tool in establishing the appropriate hydrological conditions for the restoration of species-rich wet grassland, a habitat which has declined dramatically throughout Britain this century. This paper describes research undertaken using an approach based on water-table regime and the concept of sum exceedence values to quantify the hydrological requirements of both individual plant species and wet grassland habitats. For a restoration site, this information can be used to identify either the most appropriate community to suit the present hydrological conditions or the alteration in water-regime necessary to promote a specific wet grassland habitat. Furthermore this information will provide a strategy for the targeted restoration of wet grassland habitats to those sites identified as exhibiting the most suitable water-regime. This paper will illustrate the type of information available and indicate how this can be used in specific situations. (Topic 4.6)

M G LE DUC, R H MARRS

Biological Sciences, University of Liverpool, Liverpool, UK

Restoration of land after infestation by *PTERIDIUM*

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AQUILINUM

This paper describes investigations carried out across a wide geographical range in Great Britain. Their purpose was to examine the possibility of restoring land, infested by bracken (*Pteridium aquilinum*), to conditions of value for grazing, conservation or amenity. The investigations comprised extensive ecological surveys and 19 field experiments. The current management approach to the problem is to apply a selective herbicide (asulam), often by helicopter. We surveyed a number of such sites together with some unsprayed controls (117 in total). The results were very variable, with many environmental factors having strong influences. Initially the bracken frond kill was very good, but re-invasion (via the rhizome system) was almost inevitable. The remaining vegetation was often species-poor, with much bare ground, resulting from the dense bracken canopy and large amounts of litter. Subsequent succession was very slow, with little chance for valuable vegetation to establish before the bracken re-invasion. Experimental investigations supported the survey's conclusions on bracken control. They demonstrated that under certain conditions cutting was a better control technique, but combinations of cutting and herbicide application were best of all. The experiments also investigated succession following control. They showed how certain treatments might be used to direct the succession and how multivariate modelling can be used to measure progress towards target communities. However, in these circumstances, true succession can be extremely slow. (Topic 4.3)

S LEMAUVEL, F ROZE

Laboratoire d'Ecologie Végétale, University of Rennes, France

Vegetation dynamic of protected dunes

North Brittany (35 F) dunes have been protected. This causes changes in sand level, vegetation cover, richness (species number) and plant species distribution. A complete vegetation cover is achieved in 3 to 6 years. Complete restoration in terms of diversity, however, requires a longer period. Annual plants of embryo dunes and ruderal plants are more numerous in the first years: they decline thereafter. Biodiversity increases again when *Ammophila arenaria* slowly disappears in the rear dunes. When the soil has a complete vegetation cover, restoration is not complete; it is in a transition stage. Full restoration requires a number of species which are not yet present. The habitats are identified in terms of Natura 2000 (Topic 4.5)

HENRY T LEWIS

Department of Anthropology, University of Alberta, Edmonton, Canada

Learning about or yearning for the past? Indigenous managers amid the wilderness

North American Indians are widely acknowledged as having used habitat fires, as did indigenous peoples virtually everywhere in the world. The earlier view was that such practices were "primitive" and destructive, denigrated in the American west as "Paiute forestry". A more recent, though no less misinformed view is that Indians merely imitated natural fire regimes because they were ecologically benign and "lived in harmony with nature". Both views are ethnocentric and are content to learn "why" Indians set fires (e.g. send smoke signals, drive game, etc.), as if knowing the reasons were sufficient for explaining what such fires involved for hunter-gatherers. This paper asks the obverse question: What reasons would hunter-gatherers have for not using habitat fires? It further asks: Why would hunter-gatherers merely imitate natural fire regimes given the considerable advantages of diverging from them? The ponderosa pine forests of Western North America were utilized by over 100 different "tribes", all of whom used

similar strategies, and all of which differed from natural fires. The implications of this are considered in terms of current management practices in ponderosa pine areas, and suggests how we can benefit in learning from indigenous fire technologies. (Topic 1.2)

ANDREW LIGHT

Departments of Philosophy & Environmental Studies, SUNY, Binghamton; International Center for Advanced Studies, New York University, USA

Restoring ecological citizenship

This paper picks up on my recent work which focuses on restoration as an environmental practice that morally motivates people to act as better environmental citizens, or, as a kind of school house for environmental responsibility. A direct participatory relationship between local human communities and the nature they inhabit is a necessary condition for encouraging people to protect natural systems and landscapes around them rather than trade off these environments for short-term monetary gains. Such participation is a necessary condition for sustaining nature and creating a culture of ecological citizenship. Why? One reason is that environmental protection often admits to free rider problems. Often, when environmental legislation is mandated from above, then local populations have no reason to take an interest in environmental protection. Little motivates citizens in such circumstances from abstaining from free rides, or even out and out violation of environmental regulations. For reasons such as these I am tempted to gauge the relative importance of different environmental practices in terms of their ability to engender a more participatory relationship between humans and the nature around them. Following from recent social science research on restoration projects, I will argue that restoration ecology represents such a practice. (Topic 1.1)

CHRIS LING, JOHN HANDLEY

University of Manchester, Oxford Road, Manchester

Substrate variability and plant biodiversity on derelict land

Conservation is a cost-effective way of recycling derelict land, and improving biodiversity is an important part of conservation. The physical and chemical conditions that exist on derelict sites may result in vegetation establishment of high biodiversity. Three sites that are part of Groundwork's 'Changing Places programme' were studied for substrate variability and vegetation diversity. Total species complement is more a function of site size than substrate variability. Species density is not enhanced by substrate variability, however the stressed environment common to derelict land often leads to a greater density of species. Spatial variation however is clearly enhanced by substrate variability and this is often lost in land restoration projects where homogenous top or sub-soil is imported and seeded. This traditional approach therefore reduces the biodiversity potential of a site. (Topic 5.1)

ANDY LIPKIS, KATE LIPKIS

The Tree People, 12601 Mulholland Drive, Beverley Hills, California

Urban forest catchment management: an integrated ecosystem approach

An integrated ecosystem-based approach to sustainably fund and manage the inter-related problems of stormwater quality, water supply, flood prevention, waste stream reduction and air quality improvement. The T.R.E.E.S. Project (Trans-agency Resources for Environmental and Economic Sustainability) is a five year research and demonstration project that has successfully shown how an integrated ecosystem approach can attract the partners and funds to address urban

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infrastructure problems. The Project brought together multiple agencies, created designs for retrofitting urban landscapes, built demonstration projects, conducted a cost-benefit analysis, created a GIS-based cost-benefit modeling tool, and has already resulted in significant local policy changes. A home and two schools were retrofitted to capture, filter, store and re-use rain from a 100 year storm event, completely re-use on site, all yard waste and biomass. Other industrial and commercial sites have been designed and are being prepared for renovation. The successful demonstrations and cost-benefit analysis have caused the LA Unified School District to vote to remove 30% (20 million square feet) of the asphalt from their schools. The LA Regional Water Quality Board has just required new development to retain the first 50% of rain on site. The County Flood Control Agency is conducting a feasibility study to use the T.R.E.E.S. designs to retrofit an entire 2,700 acre urbanized watershed (catchment) instead of building a traditional stormdrain. The \$42 million budget for the stormdrain is being made available for the retrofit. The demonstrations are attracting funding from multiple agencies. The presentation will detail the key steps and results, with special focus on the designs, and cost-benefit computer planning model. (Topic 5.1)

KATE LLOYD-BOSTOCK, TONY KENDLE

Department of Horticulture and Landscape, University of Reading, UK
Creation of habitat displays in the Eden Project, Cornwall, UK

Throughout this century botanic gardens have defined the primary role and purpose of the living collections as biodiversity conservation. However there is growing awareness of the constraints and weaknesses of ex-situ collections. The development of seed or DNA banks require living display collections to change their focus, and there is a shift towards their use as tools for conservation education. The Eden Project in Cornwall, funded by the Millennium Commission, aims to demonstrate how humans depend on plants, and to build connections between our exploitation of the living world and the need to conserve nature. The Wild Cornwall area is dominated by recreations of two declining biotope types that are found in the county - bryophyte-rich oak woodlands and lowland heathland. The design of these needs to carry conservation messages effectively and to create something of the atmosphere and richness of the sites. The technical and design challenges will be reviewed. Interpretation messages will include discussion of the role that people can and must play in positive management of these areas and an exploration of the many ways in which they benefit people. (Topic 6.3)

RICARDO LOPEZ

School of Natural Resources, Ohio State University, Columbus
Seed banks in restored wetland in Ohio

This study compares the seed banks in the restored Pipe Creek Wetland (PCW), Sandusky, Ohio, one and thirteen years after restoration. Restoration in 1984 involved the construction of a peripheral dike and three internal dikes dividing the wetland into four cells. Dredge material from the mouth of Pipe Creek in Sandusky Bay was deposited on the bottoms of three of the cells. The initial seed bank assessment was done in the summer of 1985. This is compared to a comparable assessment carried out in 1997. Since the restoration of PCW, total seed density has increased by over 600 percent and seed bank biological diversity increased from 21 to 49 species. Since restoration, the seed bank of PCW has undergone a 130 percent increase in its perennial to annual ratio and a 230 percent increase in the presence of facultative wetland and obligate wetland plant species.

Our results suggest that the hydrologic management regime at PCW, implemented since 1984, was sufficient to foster a diverse wetland potential plant community and have important implications for wetland restoration projects, particularly those that attempt to ensure the long term biological integrity of wetland ecosystems. (Topic 4.6)

GRANT LUSCOMBE, RICHARD SCOTT, ACAPPELLA VOICES

National Wildflower Centre, Courtheys Park, Knowsley, Liverpool
The Landlife story: a journey in creative conservation

Landlife is a 25 year old urban wildlife group, which has evolved to consider many of the dilemmas of conservation on a peopled planet. Landlife's philosophy has always been - Working with People for Nature, Working with Nature for People. The presentation demonstrates valuable lessons for the future of the conservation movement which addresses the benefits of promoting nature where people live, and combines issues of social justice and a holistic strategy of working. Landlife has developed the craft of establishing wildflower landscapes on a large scale involving and celebrated by local communities. It has developed the philosophy of creative conservation - creating new places for wildlife and enabling people to enjoy them, and highlighted its role as a positive action in response to global warming. Also by establishing a successful wildflower cropping industry, Landlife has created employment and demonstrated real sustainability. Recently Landlife has built the UK National Wildflower Centre, which will exhort the benefits of wildflower landscapes and creative conservation to a much wider audience, and open during the conference. This presentation will be an audio visual interpretation and celebration of the organisations lessons and achievements. (Topic 4.4)

ROBERT MACFARLANE, DUNCAN FULLER, MIKE JEFFRIES

University of Northumbria, UK

Ecological restoration and creation projects: whose ecology?

The rationale for landscape and ecological restoration projects often comes directly from social and cultural forces; in common with the conservation effort at large, these forces may be mediated by scientific judgements about typicality, rarity, history and appropriateness, but personal environmental values are often constructed with reference to the everyday and the familiar. Just as historical antecedents are often analysed at length in determining appropriate management strategies for designated sites such as SSSIs, such histories may be all-important at a personal and community level in determining the level of interest and involvement with conservation projects. Ethnic minority groups are often highly marginalised in the environmental and conservation movements and there is an extensive literature on the cultural exclusiveness, of many of the pillars of UK conservation, perhaps most notably the English countryside, and external efforts to involve ethnic minority groups with urban conservation projects have only met with very limited success. Environmental initiatives by ethnic minority groups in the UK, which have embraced community gardens, sacred lands and food gardens, are fundamentally about the creation of meaningful areas of nature, and cultural landscapes. These often communicate ideas about ecology, landscape and nature that need to be accommodated in the wider thinking about ecological restoration and urban conservation initiatives. This research is analysing a number of landscape genesis projects in Tyneside, from highly personal spaces through to wider public areas. The implications of the meanings and motivations, which are driving such projects, for present local authority activities are evaluated and a more widely referenced

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approach to landscape and ecological restoration projects is developed. (Topic 6.4)

DONALD MACINTYRE, RICHARD BROWN

Emorsgate Seeds, Manor Farm, Langridge, Bath

Commercial growing of wildplant crops

Emorsgate has been producing native seed for about 20 years, and currently has about 150 acres of land under production. Native wildflowers and grasses are grown in single-species crops that are harvested by mostly using conventional agricultural harvesting equipment. Amenity landscaping has been the main market until recently, but there is now increasing interest in using native seed for “agri-environment” schemes, such as the creation of wildflower grassland on former arable land. The market is, overall, continuing to grow strongly. Emorsgate uses fairly standard agricultural techniques to produce seed. However, the company, when it started up, was growing “novel” crops (which no one had grown on a large scale before) so we have had to develop both methods and technology for growing and harvesting. As a result of experience and experimentation, our expertise has accumulated over the years. We have also monitored sites where native seed has been used and know what can be expected, i.e. how individual species perform in different situations and how they interact in mixtures. Accurate records on the origin of all the plants grown are maintained and stock plants are replenished at sufficient interval to reduce the risk of self selection. (Topic 3.6)

FRASER MACKENZIE

Scottish National Heritage

The approach to urban greenspace in Scotland

Scotland is one of the most urbanised countries with over 80% of the population resident in our towns and cities. Scottish Natural Heritage, a government agency with responsibility for landscape, biodiversity, recreation and earth science issues, has over the past four years, been attempting to raise the issue of the quality and extent of our open spaces up the political and economic agenda. This has been achieved through the production of specific research and work on national and local policy with partners such as the Scottish Executive and the Confederation of Scottish Local Authorities. The talk will cover the issues arising from;

- 1 the state of Scottish Greenspace (SNH 1998): an overview examining the extent and quality of open space in 5 major centres;
- 2 the planning and management of Urban Open Space in Scotland; a study undertaken with Dundee City Council on the development and implementation of Dundee's public open space strategy;
- 3 Quality Greenspace for Residential Areas - a checklist for the development and management of sustainable greenspace in new and existing housing schemes developed jointly with Scottish Homes and the Scottish House Builders Association
- 4 the ongoing research which is informing a forthcoming Planning Advice Note on Open Space which will be issued before the end of 2000 by the Scottish Executive

The talk will examine the key issues associated with Standards in provision, ongoing management, involvement of communities and discuss the collaborative partnership approach adopted in Scotland. (Topic 5.3)

DAVID MAHLER

Environmental Survey Inc, Austin Texas, USA

Restoration principles applied to urban landscaping

The principles of habitat restoration are being successfully applied to landscape design and installation at residential and office sites in

central Texas, USA. The natural communities of oak savannas on the limestone hills west of Austin, Texas support many attractive grasses, flowers, shrubs and trees which are being used more frequently in landscape settings. However, these species are often just substituted for species formerly used in straight rows of low diversity plantings. Several landscape projects will be shown where communities of native species are planted based on models of natural sites. These designs are rooted on careful analysis of site conditions including moisture, sunlight, and soil type while paying close attention to microclimates. The plantings are based on establishing the communities of species that fit the site, and shaping this diverse assemblage with the aesthetic perspective of good landscape design. (Topic 5.3)

LORI MAKARICK

Grand Canyon National Park, Grand Canyon, Arizona, USA

Grand Canyon exotics

The Revegetation Crew at Grand Canyon National Park recently used a ranking system designed by Hiebert and Stubbendieck (1993) to rank and prioritize the 145 exotic plant species that occur in the Park. The analytical approach designed by Hiebert and Stubbendieck provided Park managers with a method to categorize the species based on their present level of impact and their innate ability to become invasive. Based on the ranking system used, there are about 26 species that are considered high priority for immediate control actions. Staff is currently working on preparing the necessary action plans and compliance documents, and acquiring funding to work on as many of these species as possible. This talk will focus on two of the top priority species, Himalaya blackberry (*Rubus discolor*) and tamarisk (*Tamarix ramosissima*), and the actions that the Park is taking to control their spread or eradicate populations. The Park has acquired 2-3 years of funding to initiate control efforts for these species, which will begin in 2000. This talk will discuss the current status of these projects, some of the challenges encountered along the way, and the future actions necessary to successfully control these invasive species. (Topic 4.7)

MJ MALINS, RK MARTINDALE

Lackham College, University of Bath, Wiltshire

An assessment of economic initiatives for the restoration of wildlife habitats on farmland

Changing agricultural practices have significantly reduced biodiversity on farmland habitats. Research has identified that whilst many farmers believe that they have a duty to protect the countryside, this may be compromised by what has historically been seen as a culture of ‘good farming practice’ where important criteria are high output and efficiency. The authors review the current uptake of environmental initiatives in England and provide further analysis on this data. Computer modelling with economic assessments defines financial thresholds, above which farmers may be encouraged to pursue a change in agricultural practice in favour of the creation of wildlife habitats. Recommendations are offered on agency driven ‘better financial awareness’ strategies plus options for future initiatives that would help to further restore a balance between farming and wild life. The authors’ proposals are designed to favour both intensive agricultural holdings where the need for habitat creation is paramount, as well as farms which have been historically managed in a manner which is more sensitive to environmental needs. Adoption of these proposals would contribute towards meeting government aims on Quality of Life Indicators. (Topic 4.8)

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IAN MARSHALL

Environmental Planning, Cheshire County Council, Hunter Street, Chester

Ecological networks - a strategic approach to creative conservation

Nature conservation strategy is undergoing a sea change, with a significant shift in emphasis away from the defensive, protection of sites, to the proactive, creation and restoration of habitats. The opportunities to reverse the decline in biological and landscape biodiversity suffered across Europe over the last 50 years have never been greater. The techniques for habitat creation and restoration are much improved, and there is considerable awareness and acceptance of the need for this new proactive approach amongst politicians, land managers and the public. For nature conservation gains to be maximised in this new era, however, much more consideration needs to be given to the wider landscape contexts in which habitat creation and restoration schemes are proposed. The identification of ecological networks using Geographic Information Systems and landscape ecology principles offers a mechanism for planning and designing whole landscapes. Within this spatial framework, the most appropriate habitats for a locality can be selected, positioned and arranged to facilitate the enhanced operation of ecological processes. Creative conservation effort will be better focused by adopting such a strategic approach. This philosophy underpins the "Life EConet Project" - a 4 year project funded by the Life-Environment Programme of the European Commission which aims to demonstrate sustainable development through the use of ecological networks in Cheshire, UK and two Italian regions, with expert guidance from the Netherlands. (Topic 1.3)

A D MARTIN

WA Fairhurst and Partners, Newcastle upon Tyne

A country park themed on biodiversity

For North Tyneside's City Challenge programme a former tip site was reclaimed to a country park themed on biodiversity within a strongly designed landscape framework. The nature of the project allowed complete design from land-form to manipulate microclimate and drainage, through subsoils and soils, to planting and management. A range of traditional and innovative techniques were used including creation of:

- 1 An artificial spring and calcareous flush,
- 2 landscape art using graded acidic and calcareous quarry waste and natural regeneration,
- 3 semi-natural grasslands using a variety of techniques,
- 4 pool clusters for great crested newts,
- 5 hedge banks using native edible species,
- 6 bridleways to provide multi-user green corridors.

After four years, much can be learnt from the successes and the failures. Muck shifting had to be done in the winter, pre-seeded matting included agricultural clovers, money for grassland maintenance ran out after two years, the flush works well in wet weather but dries out too quickly. However, partridge, roe deer, water vole, newts, sky lark and hare are now present in an urban area, the safe bridleway network resulted in an explosion of children using the area and creates green links to other wildlife sites, the quarry waste and grasslands are developing excellent habitats. (Topic 3.3)

ROGER K. MARTINDALE

University of Bath and Lackham College Dept. of Conservation & Environment

Restoration of riverline environments through

integrated catchment management.

This study focuses on the sustainable use of fresh water resources with reference to regional catchment management. It examines the problems and conflicts experienced by riparian authorities. There were four main areas of study: economic development, environmental externalities, water policy, and water conservation. The study highlights a number of fundamental problems. The main one is that water has a lack of value so that the social cost of water is seldom considered in decision making processes. Water conservation measures are promoted but with little success, due to suspicion, monetary gain and ancient rights. The study found that countries holding greatest reserves of water could indirectly control dialogue on agreements and therefore on restoration schemes. Lack of co-ordination between states to fully police the agreements and enforce policies makes the agreements examined practically worthless. Harmonisation of water policy and conservation measures need to be carried out with a holistic approach and not in isolation. Other related policies affecting water such as development and agriculture also need to be harmonised with fellow riparian states. Regionalisation of bodies to manage catchment areas irrespective of political boundaries is required. These changes would help the restoration of riverine habitats and the preservation and increase of the associated flora and fauna. (Topic 2.1)

MARC A MATSIL

Natural Resources Group, The Arsenal, Central Park, New York, USA
Managing urban ecosystems - forest, wetland & grassland restorations, a case study in the science of restoration, funding and monitoring natural systems in New York Harbor.

NYC Parks Natural Resources Group, founded in 1984 by Parks Commissioner Henry J. Stern, is presently juggling \$60 million in restoration programs supported by monies recovered from natural resources damages claims, state and federal grants and public works mitigations. Everyone is accountable and everyone pays! This presentation will address the buzzwords, and programmatic goals that drive the nation's largest urban conservation program. New York City occupies a unique position on the eastern seaboard. Located at the juncture of northern and southern hardiness zones, the City is home to more than 40 rare and endangered species contained in a 28,000 acre parks system. NYC Parks Natural Resources Group (NRG) has inventoried and mapped on its GIS, northern sugar maple and beech forest communities, mingling with southern hackberry and sweetbay magnolia, at the edges of their ranges. NYC was the first municipality in the country to inventory and its endangered species, in cooperation with the Natural Heritage Program, and propagate and re-introduce rare plants including serpentine bedrock influenced state rarities: *Asclepius viridiflora*, *A. Purpurascens*, and *Cyperus ovularis*. Hosting the largest breeding peregrine falcon population in the world, the City is managing ten sites. NRG's forest and wetland restoration projects are funded creatively through state, federal and private grants. NRG's Salt Marsh Restoration Team, now in its eight year, is supported by \$1.75 million negotiated from an Exxon oil spill settlement. More than 3km of shoreline has been restored with 400,000 *Spartina alterniflora* marsh plants propagated from seed, collected by 500 inner City volunteers. Comprehensive research protocols have been established to monitor restored vegetation, Total Petroleum Hydrocarbons (TPH), bacterial analysis, macro-invertebrate populations in m2 quadrats. The project has focused on elucidating a relationship between heterotrophic bacteria, capable of degrading petroleum hydrocarbons, and the significant reduction in oil product through bioremediation. NRG presently serves as Chair of the NY/NJ Harbor Estuary Program's

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Habitat Workgroup (HWG). The HWG has standardized wetland monitoring protocols for public works mitigations and damages claims, as well as prioritizing acquisition and restoration projects for NY/NJ harbor's critical watersheds. This paper will highlight some of New York City's current forest, wetland and grassland restoration and monitoring programs, and address the hemisphere of potential funding sources available; A proactive model for funding restoration and monitoring, based on sound ecological principals. (Topic 5.3)

G M MCGOWAN, N G BAYFIELD

Institute of Terrestrial Ecology, Hill of Brathens, Glassel, Banchory

Techniques for restoring vegetation on disturbed ground in montane areas

Techniques to establish acid grassland and heathland communities were tested in the uplands of Scotland. At an experimental site, significant vegetation cover was established by seeding, seeding and transplanting turves and seeding and 'live mulching' in comparison to control plots. The species richness of the vegetation established on the roadside plots after ten years depended on the treatment adopted. The techniques were also applied at a new ski resort. Ground disturbed during construction was well vegetated within five years, with some seeded and turved areas being indistinguishable from intact vegetation. However, the success of the reinstatement techniques decreased with increasing altitude. Successful vegetation reinstatement at higher altitudes depends on achieving a high percentage total plant cover in the first growing season. Novel techniques need to be developed for use in the fragile plant communities found at higher altitudes. (Topic 4.8)

DUNCAN MCLAREN

Friends of the Earth, UK

Reviving cities - a key route to global ecological restoration

Global biodiversity is in crisis. Many of the pressures upon it arise from the demands of urban populations for food and materials, and in particular from the growing per capita consumption and population dispersal out of cities associated with modern western life. This paper explores how treating the city as an ecosystem - the human habitat - can reduce those pressures. The paper will briefly examine the metabolism of modern cities and measures that could be used to make the city less parasitic upon its hinterland, whilst improving the quality of life of its inhabitants. Key measures suggested include: reducing traffic levels by a combination of improved public transport and raising urban population densities; stimulating markets for recycled materials to cut urban demands for timber, metals and construction materials; and tackling social exclusion to improve the city as a quality place to live. In conclusion the paper will present a vision of a flourishing sustainable city system in harmony with both local and global ecology. (Topic 5.2)

EUAN MCPHEE

College Road, Truro, Cornwall

Environmental education opportunities provided by derelict quarries : the Penhalurick Quarry experience.

Quarry Bank is a 3.5 hectare agricultural smallholding in Cornwall in receipt of a Countryside Stewardship Grant to provide educational access to a range of habitats typical of unimproved upland Cornish farmscape. The main feature is the disused Penhalurick Quarry, a granite quarry which has not been worked for 50 years, during which time bryophyte-rich rock faces, sphagnum bog and lowland heath have become established. The last 50 years have also seen a decline in these

habitats nationally and internationally, thus the quarry represents an opportunity for the creation of new habitats, eg cliffs and bogs, as well as conserving remnants of formerly widespread habitats, eg lowland heath. Conservation management is focused on providing access whilst minimising damage to the bog and pool within the flooded quarry, and scrub clearance around the quarry rim and adjacent spoil mounds to encourage lowland heath vegetation eg *Vaccinium myrtillus*, *Erica tetralix*, *Calluna vulgaris*. Educational visits highlight these issues, and the importance of not only saving such sites from traditional 'reclamation' but of positive management to safeguard and enhance their ecological value. (Topic 6.3)

ANTHONY MELONE

Tetra Tech/KCM, Seattle, USA

Seattle management

Seattle Washington experienced the economic wealth and environmental impacts generated as a busy port city similar to Liverpool while becoming a pioneer in the U.S. environmental movement. With deep respect for indigenous peoples and the role of salmon in the regional culture and ecosystem, Seattle is proactive in the restoration of many of its urban streams. Since the early 70's local government has aggressively implemented projects to improve water quality throughout the city. The recent federal endangered species listing of chinook salmon has driven state and local governments to new levels of habitat protection and restoration. Seattle responded by accelerating the implementation of watershed action plans and restoration projects on four major streams. Projects ranging from construction of stormwater detention facilities by the city public works department to removal of non-native and invasive vegetation by volunteers are now being supplemented by large-scale instream habitat restoration projects. In celebration of the new millennium, Seattle's mayor created the Urban Creeks Legacy Millenium Project to reconnect the community as stewards of the environment. Four watersheds are targeted for restoration of natural creek and riparian habitat, improvement and protection of water quality, flood control, sustainability of benefits and gains, and celebration of natural resources. (Topic 1.3)

J MEMMOTT, M L FORUP

School of Biological Sciences, Woodland Road, Bristol

The restoration of ecological processes

While ecological patterns are often considered as restoration goals, rather less emphasis has been placed on the restoration of ecological processes. This is unfortunate as the long-term viability and sustainability of a habitat depends upon the reinstatement of ecological processes such as pollination and seed dispersal. One method of understanding these processes is to use interaction webs. Probably the most familiar of these are food webs which quantify interactions between predators and prey. Similar approaches can be used to describe plant-pollinator interactions and seed dispersal. In this presentation we will show that a comparison of interaction webs from pristine and degraded habitats can provide a target for restoration. At present restoration ecology suffers from what has been called the "fuzzy target" problem. If you don't know how the community or ecosystem worked before being damaged, how do you know when it is restored? Comparing webs from pristine and restored habitats will allow for an assessment of the efficacy of the restoration programme. The use of interaction webs is novel and practical. Moreover it could be applied to any habitat or ecosystem. (Topic 1.4)

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COLIN D MEURK, GRAEME HALL, MARGARET KILVINGTON & RICHARD GORDON

Landcare Research, P.O. Box 69, Lincoln 8152, New Zealand

Restoration in New Zealand: Battling the Biogeography and Confronting the Comfort Zone

New Zealand's biogeographic history has resulted in high levels of biological endemism, now greatly threatened. This poses unique challenges for conservation and ecological restoration. Techniques that work well in northern continents, like excavating ponds and allowing natural colonisation by indigenous wetland plants, fail in New Zealand where disturbed sites are rapidly dominated by exotic species. Apart from ecological difficulties, there is cultural and legal inertia. The public are familiar and identify with imported biota, and, despite progressive environmental legislation, there are no tangible bottom lines for sustainability of indigenous ecosystems in terms of critical mass, connectivity, visibility and public acceptance of habitat. Ecological restoration in New Zealand begins with protecting and nursing remnant habitats. Then, species- and site-specific management and restoration are required. A Decision Support System (based on the stress-disturbance concept) can prescribe optimal combinations for given climate-substrate conditions, of planting, grazing, burning, mowing, and animal control, that reduces predation and weed competition while maintaining palatable or sensitive native plants. We illustrate, through modelling plant succession, dispersal and establishment across the cultural landscape, how spread of viable populations of indigenous plants and wildlife, and ecological integrity can be achieved. However, translation of the possible into reality ultimately depends on community support. (Topic 2.1)

ANDREW MILLIKEN

U.S. Fish and Wildlife Service, Coastal Ecosystems Program, Charlestown, Rhode Island, USA

Regional planning for habitat restoration and protection in the watershed of New York Harbor - significant habitats and habitat complexes of the New York Bight watershed.

The protection and restoration of significant habitats was identified as the top priority for the New York Harbor estuary and its watershed by the New York - New Jersey Harbor Estuary Program, a National Estuary Program partnership of federal, state, and local agencies and organizations. As an initial step in planning for habitat conservation in the harbor and watershed, the U.S. Fish and Wildlife Service conducted a study of the status and distribution of, and threats to, species and habitats in the watershed. The resulting Significant Habitats and Habitat Complexes of the New York Bight Watershed report focuses on the identification and description of essential habitats of key marine, coastal, and terrestrial species inhabiting the New York Bight watershed. Data acquisition and analysis for the report focused on these key species, referred to as species of special emphasis. All known and potential sources of biological data on the distribution and status of species of special emphasis and their habitats were contacted, queried, and background environmental data were collected. Based on an extensive analysis of these data, a regional ranking was developed for each species and specific habitat areas where each occur were identified, prioritized and delineated on maps for further analysis. The analysis of species and habitat data produced the identification of 35 large habitat complexes in the watershed study area. Final maps and map overlays were prepared for the 35 identified habitat complexes and site narratives were prepared describing the location and boundaries of each area, ecological communities and processes in the area, various habitat subunits incorporated within the boundary design,

general ownership or protected status of the area, ecological importance and significance/uniqueness of the area, an assessment of threats to the long-term integrity of each of the sites, both to species populations and the physical structure of the habitat, and recommended conservation considerations and protection/restoration strategies. The New York Bight watershed exhibits extraordinary physiographic diversity and geological complexity which, along with climatic and historical events, have contributed directly to the region's remarkable biological diversity and the current distribution patterns of its biota. The study area contains parts of five major physiographic provinces and includes both glaciated and unglaciated regions. The Bight and its adjacent shorelands and uplands within the watershed are rich in fish, wildlife and plant resources. These resources are considerably lessened from their former abundance and their habitats greatly reduced in extent. The protection of remaining areas is critical to the maintenance of the regional biodiversity. At the heart of this ecosystem is the New York City metropolitan area - the financial and commercial center of the country and one of the most populous and heavily industrialized coastal areas in the world. The ecosystem is subject to extreme social and economic use impairments and severe ecological impacts as a result human activities. Yet in spite of these severe environmental stresses and loss of habitats, the Bight and its adjacent shorelands and uplands within the watershed continue to be rich in living resources, many of which are of significant economic and social value to the region's greater than 20 million people. With the background information on regional biodiversity and significant habitats from the Significant Habitats report, the Harbor Estuary Program partnership is now working together to identify, plan, fund and implement over 100 habitat restoration and protection projects within the identified significant habitat complexes in the harbor. (Topic 1.3)

ALISON MILLWARD

Alison Millward Associates, Birmingham

What is it that attracts people to visit ecologically rich, restored landscapes in towns and cities?

What is it that attracts people to visit ecologically rich, restored landscapes in towns and cities? How can we: Identify local people's aspirations for these places, Incorporate these needs into the restoration scheme, and Monitor their impact on people's experience? A summary of the findings of a diverse range of research studies into people's perceptions and use of ecologically rich, urban open spaces will be presented, and how these may be translated into design criteria. People are looking to enjoy the contact with nature ecologically restored landscapes offer, peace and tranquillity, signs of the change in seasons, the opportunity to relax and unwind or take some exercise. In towns and cities these places need to be good for people as well as wildlife. But, like any other open space, people need decent paths, places to sit, a litter free environment, on-site interpretation, facilities for young and old and to feel reasonably safe during visits. The importance of involving local communities in determining what should be kept, created and better managed through a restoration, and the tried and tested methods for doing this, will also be described. Planning for Real, questionnaire surveys, on-site observations, guided walks, focus groups and other methods will be explored. (Topic 6.4)

R J. MITCHELL, R H MARRS, M H D· AULD

Institute for Terrestrial Ecology, Banchory Research Station, Hill of Brathens, Glassel, Banchory

Restoration of heathland on successional sites: the implications of raised soil nutrient levels

Studies on successional sites on Dorset Heaths in Southern England

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indicate that different soil nutrient levels increase depending on the successional species invading. Sites where fewer changes in soil nutrients have occurred may be easier to restore to heathland. To test this, a range of successional sites that have been managed to restore heathland were studied. In general heathland restoration was more successful on *Pinus* sites, where the least changes in soil nutrients had occurred, and least successful on *Betula* sites, where the greater changes in soil nutrients had occurred. This implies that if resources are limited it is more effective to target restoration on sites where the soil nutrient levels are as close as possible to heathland levels. Given that lowland heathlands are generally found on nutrient-poor acidic soils, it is important to remove as many nutrients from the system as possible when managing successional sites. Estimates on the nutrients removed when a range of successional species and their litter are cleared from one heathland site in Dorset are presented. The importance of litter stripping to promote heathland restoration are presented. (Topic 4.3)

JONATHAN MITCHLEY, PETER BUCKLEY

Wye College, University of London, Wye, Kent

Opportunistic restoration: 'salvage' operations or new opportunities for conservation?

We evaluate this question in the light of the developments surrounding the UK Channel Tunnel. Samphire Hoe, the land created de novo from tunnel spoil, is a 'new opportunity' in the sense of brand new maritime and chalk habitat. So is the woodland planting around the Terminal, but does it compensate for the loss of ancient woodland, and does Samphire Hoe replace losses and damage to the sub-littoral communities on which it was constructed? In addition to these new habitats, various management spin-offs have resulted from the Channel Tunnel Project itself - e.g. the work of the White Cliffs Countryside Project in restoring grazing management to neglected chalk grassland on the escarpment slopes surrounding the terminal site - in other words true ecological restoration. As well as the impact downstream, what are the upstream effects, in terms of loss of habitat or, alternatively, planning for ecological restoration resulting from the Rail Link? Are there any measurable benefits for future restoration work, or lessons learned, from research carried out to date? Is long-term monitoring the soft option if the answers lie too far down the line (and may turn out to be negative in the end)? (Topic 4.1)

A J MOFFAT

Forest Research, Environmental Research Branch, Alice Holt Lodge, Farnham, Surrey

The particular problems of establishing trees on new landfill sites

Trees have to face two sources of hostility on modern landfill sites. The first is due to poor restoration practice, and is due to commonplace problems such as inadequate landform, insufficient soil resources, compaction and infertility. The presence of landfill gas, leachate and elevated temperature can also pose problems where these occur within the tree root zone. A second source of hostility often comes from the landfill profession who have judged trees as a threat to pollution control systems integral to modern landfill sites. Both sets of obstacles can be overcome. Sufficient is known of the requirements of tree crops for restoration specifications to be drawn up to allow successful establishment, and prolonged growth of tree plantations on modern landfills. Research over the last decade has shown that many fears about the ability of trees to damage the integrity of landfill pollution control systems are also misplaced. The risks posed by trees can be mitigated by simple attention to soil provision, placement

technique and species choice. Concerns about trees preventing access to landfill gas and leachate control facilities can be allayed by sensible planning. (Topic 3.3)

A J MOFFAT, N A D BENDING, G WYATT

Forest Research, Environmental Research Branch, Alice Holt Lodge, Farnham, Surrey

How to treat soil materials with respect

Modern mineral working demands the identification, stripping and storage of soil materials prior to extraction, and its replacement afterwards. This is because it is universally accepted that soil provides the best platform on which to establish vegetation. Why then does mineral extraction often serve to treat soil as little more than a special kind of overburden? Conventional soil handling can seriously affect those physical properties which actually distinguish soil from geological materials. This invalidates the effort expended in soil identification and separate storage. More sensitive methods of handling, in which soil materials are not trafficked once laid, have been tested experimentally over the last decade. These include loose tipping, where materials are replaced using dump trucks and spread using excavators. Complete cultivation is recommended to decompact materials that have not been spread by loose tipping. Results from experiments across a wide spectrum of mineral substrates demonstrate a significant improvement in soil physical conditions, and vegetation performance over more conventional practice. Machinery evaluation has also demonstrated that these techniques are comparable in terms of cost. An ethos where soil damage is prevented, rather than attempts made at remedying it, is put forward as the only acceptable one in modern reclamation practice. (Topic 3.4)

C MOFFAT

Department of Biology, Imperial College, Silwood Park, Ascot, Berks

Insect community response to field-layer manipulation in broadleaved plantations

It has previously been demonstrated that field layer plant species typical of ancient woodland can be successfully introduced into broadleaved plantations. What is not known is whether this enhancement triggers or hastens the development of a more complete functional woodland ecosystem, an important goal of ecological habitat creation. This study uses insects as an indicator of ecosystem completeness to assess how communities have been affected by field layer introductions in the roadside plantations of Milton Keynes. Comparisons are being made between communities of 'enhanced' and 'non-enhanced' plantations as well as those of three ancient woodlands in Milton Keynes. Community sampling is by suction apparatus, fenced pitfall trapping and a novel tent-like trap which samples from a fixed area of vegetation. Calculations of diversity for each site and similarity between each pair of sites, are being used to reveal general patterns. Some of the introduced plant species are being targeted for closer examination. Introduced patches and naturally established patches are being searched for the presence of herbivorous insects, known from the 'Phytophagous Insect Data Bank'. Thus the extent of colonisation of particular species will be assessed. Preliminary results tentatively suggest that field layer introductions may not increase insect diversity and that specialist woodland insects are not common. (Topic 1.4)

SCOTT MOORE

Native Plant Salvage Program, Everett, Washington, USA

Operational Logistics For A Biomaterials Utilization

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and Recycling Program

Snohomish County's Native Plant Salvage program began in 1995 with grant funds from the Washington State Department of Ecology (Ecology). The original intent of the program was to plant and maintain riparian areas throughout the county using salvaged plant materials and volunteer labor. The program has grown to include legions of volunteers, thousands of plants, and many habitat restoration sites throughout the county and is now fully funded. The Program has expanded to include harvest of large trees to be used as large woody debris (LWD) components in dozens of riparian restoration projects and two experimental engineered logjams. In addition, the program is experimenting with soil salvage and transplanting moderate size (up to 45 feet tall) trees with their associated shrub communities onto riparian restoration sites to provide shade and competition for invasive plants. The program has also established several acres cutting plantations to provide bio-engineering materials such as live stakes, fascines, and wattles for various revegetation and bank stabilization projects. This paper discusses costs, maintenance needs, monitoring protocols and results, recommendations for creating similar programs, and a vision for the future of the county's investment. Case studies will be detailed to provide examples and to outline overall program functions. (Topic 3.5)

FREDERIC MORAND

Department of Agriculture Economics and Social Science, Humboldt University, Berlin

Restoration of "multi-qualified" sites: how best to decide?

Social acceptance, and therefore economic and ecological success of restoration, may be at risk when experts' and other stakeholders' views differ. Conflicts are more likely to occur in inhabited areas where people do not only recreate or carry out research, but also farm, mine, fish, etc, in order to make a living locally. Why do we decide to restore? Restoration can be viewed as an outcome of a qualification process: setting restoration goals follows a change in the qualities assigned to a site. Technology, aesthetics, identity, ecology, market, ethics, etc; distinct qualities may be invoked to advocate restoration, alternative restoration or non restoration. The communication postulates that successful restoration of "multi-qualified" sites significantly depends on how those qualities go along together. Borrowing from Economics of Conventions (France) and Historical Ecology (USA), the communication focuses on the qualification dynamics to which restoration belongs. Investigation of past, present and foreseeable conflicts and compromises between qualities takes advantage of various sources, from historical archives to stakeholders interviews and analytical models. Multi-criteria and participative methods are discussed as communication and decision tools that may help the selection and the achievement of compromises. (Topic 6.1)

PETER MORGAN

Groundwork UK, Cornwall Street, Birmingham

Changing Places - The delivery of large scale, ecologically informed, participative programme.

The Changing Places programme comprises of 21 individual sites covering a total area of over 1000 hectares of post industrial dereliction. The sites are being delivered by individual Groundwork Trusts and are distributed throughout England and Wales. The total programme value is a little over £50 million with £22.1 million of this amount being funded by the Millennium Commission. The programme is being delivered with two key criteria in mind. Firstly, the individual communities served are fully involved in both the design and delivery

processes and a constant dialogue is maintained through the use of consultation exercises. Secondly, the reclamation is ecologically informed enhancing natural regeneration wherever possible and capitalising on the low levels of fertility often to be found in the soils of damaged sites. The programme has presented unique opportunities due to its critical mass. It has meant that the entire body of work is a huge experiment in producing social change and it has promulgated the development of several interesting and innovative features. This paper will describe the history and delivery of the programme and will examine the issues arising and the lessons to be learned. (Topic 5.1)

SIMON R MORTIMER, VALERIE K BROWN

CABI Bioscience: Environment, Silwood Park, Ascot

Directing succession: acceleration of old-field succession using turf and soil translocation

Large areas of chalk grassland have been lost through conversion to arable cropping in recent decades. Restoration of chalk grassland on ex-arable land can be achieved by allowing natural colonisation. However, sources of potential colonists are often rare in the surrounding landscape. Alternatively, seed of chalk grassland species may be sown. This option is expensive and may lead to the introduction of genotypes of non-local provenance. The aim of this study was to investigate the potential for using small-scale turf transplantation or soil translocation as a means of enhancing the colonisation of chalk grassland restoration sites by appropriate plant species of local provenance. An experiment was established at a site in Buckinghamshire, UK, using small-scale turf and soil translocation. The translocation treatment successfully accelerated the development of chalk grassland vegetation on ex-arable land. The efficacy of the translocation treatment varied according to the nature of the background sward at the recipient site. Donor site species that failed to colonise the plots were either perennial graminoids of chalk grassland, or short-lived forbs with heavy seeds. Species introduced by the translocation treatment spread rapidly, indicating that such techniques have the potential to provide small 'focal points for colonisation' in ex-arable fields. (Topic 3.2)

BRIAN MOSS

School of Biological Sciences, University of Liverpool

Lake restoration and the ultimate ecology

The theory underlying restoration of shallow lakes from impacts like eutrophication has rested heavily on the development of alternative stable state models. Restoration attempts have had variable results dependent on the scale of the system that was available for restoration. This has prompted application of the theory to systems of human societal organisation, whose nature may make or mar restoration attempts. The ultimate conclusions of application of this theory are that successful and sustained restoration of habitats on any extensive scale requires the restoration first of different forms of human societal organisation. (Topic 1.2)

BRIAN MOSS, LAURENCE CARVALHO, JOANNE PLEWES

School of Biological Sciences, University of Liverpool

The case of the lake at Llandrindod Wells

Llandrindod Wells is a small town in mid-Wales, which expanded in late Victorian times with the establishment of a spa. As part of the amenity of the town, a stream was dammed to create a small lake. The lake had clear water until the middle of the twentieth century, when it became turbid, following the adding of phosphate to control aquatic plants and replacement of the brown trout-dominated fish community with common carp and other cyprinid fish. In the 1990s the local

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authority decided that it wished to restore clear water and to remove potentially toxic algal growths. Limnological research was carried out and a management and restoration plan made and carried out. The outcome will be related, together with the consequences of changing the target during the restoration process. Various lessons of general application will be drawn. (Topic 4.2)

LARISSA MOTT

Iowa State University, Ames, Iowa, USA

Integration of military land management and experimental plant community restoration at Camp Dodge, Iowa, United States.

Camp Dodge Army National Guard military reservation in central Iowa, United States, has been an exceptional source of opportunities for research and education in natural resources. By supporting research and monitoring programs on small mammals, avian nest parasitism, amphibians, and techniques for assembling native plant communities, Camp Dodge has established itself in Iowa as a leader in integrating the rigors of military training and natural resource protection and management. Recognizing that an important component of successful land management is understanding how ecosystem functions can be restored following natural and training-related disturbances, long-term studies have been established at Camp Dodge to determine, in particular, how woodland herbaceous layers can be restored and maintained within the context of military training activities. In June of 1998, permanent plots were seeded and planted with 35 native temperate woodland herbaceous species beneath a successional, mesic canopy. The study facilitates the evaluation of methods of introduction and species-specific responses to the percent of photosynthetically active radiation (PAR) reaching each plot and soil fertility. This paper will present the results of this study after two years of monitoring plant survival, growth, and flowering of eight woodland herbaceous species in experimental plots at Camp Dodge. (Topic 4.3)

OWEN MOUNTFORD

Centre for Ecology and Hydrology, Huntingdon

Geographical targeting of areas for the restoration and re-creation of coastal and floodplain grazing marsh in England

Grazing marsh has been recognised as a key habitat in the UK, and was amongst the first to have a costed action plan within the BAP structure. In the present research, the conservation value of extant grazing marsh in England and its geographical variation were assessed, and a strategy for targeting restoration of grazing marsh was developed. The approach employed national data-bases for vascular plants, birds and insects, as well as information on areas designated for biodiversity protection or through which restoration schemes were likely to be administered (e.g. English Nature Natural Areas). Six ecological attributes were derived from these databases, which enabled sites and areas to be ranked for restoration. Areas were also ranked on the basis of the total area of grazing marsh they presently contained. Qualitative and quantitative rankings were then compared. Finally, these rankings of Natural Areas were assessed on the basis of the liability of the land to flood, its altitude and the land-cover. The research identified two clear philosophies for a targeting of restoration, focussing either on areas of high quality marsh where success is likely, or on degraded marsh and ditched arable where relative gain in biodiversity may be greater. (Topic 4.6)

CAROLINA MURCIA, GUSTAVO KATTAN, ALBERTO GALINDO.

Fundación EcoAndina-Wildlife Conservation Society, Cali, Colombia.

Effect of two restoration strategies on coarse woody debris and associated fauna in the Colombian Andes.

Two general strategies are frequently used for the restoration of degraded lands in the Colombian Andes: monospecific plantations and natural regeneration. To assess the effectiveness of both restoration strategies on the recovery of ecological processes, I quantified the amount of coarse woody debris (> 10 cm diameter) and their associated bess-beetle fauna in 30 year old alder plantations and adjacent 30 year-old naturally regenerated forests, and in nearby mature forest remnants, located at 2400 m elevation in the Ucumari Regional Park. All three forest types contained the same number of logs per unit area, but the volume of wood available to beetles was twice as large in the remnants and the regeneration than in the plantations. Forest remnants contained a larger number of occupied logs and individual beetles than the two young forests. At this high elevation, only five species of bess-beetles occurred. Both forest remnants and natural regeneration contained 4 species in the area sampled, while plantations contained three. All three forest types contained as many species per unit area or wood volume. These results suggest that planting alder may be equivalent or less advantageous than natural regeneration in terms of resource availability and attractiveness to wood decomposing beetles. (Topic 4.8)

M NIJSSEN, M GEERTSMA, A HOFFMANN, J T KUPER, J G M ROELOFS, H ESSELINK

Bargerveen Foundation, Department of Environmental Studies
University of Nijmegen, Nijmegen, The Netherlands

Does sod-cutting aid restoration of characteristic species rich vegetation and fauna communities in dune heathlands?

Nature restoration management and research is mainly focused on rehabilitation of vegetation in relation to restoration of abiotic conditions and geomorphological processes. Only little is known about the influence of habitat deterioration and the effects of restoration measurements on fauna communities. From 1997 until 1999 a study was carried out in several grass-encroached and sod-cut dune heathlands on the Waddensea island of Ameland, The Netherlands. Besides soil chemistry and composition and structure of the vegetation, five fauna groups with different ecological characteristics were investigated; bumblebees (*Hymenoptera*), butterflies (*Lepidoptera*), grasshoppers (*Orthoptera*), carabid beetles (*Carabidae*) and spiders (*Arachnidae*). Although sod-cutting seemed to restore nutrient-poor soil conditions, the base saturation status of the soil was not improved, probably due to lowered groundwater tables. As a result the vegetation in sod-cut sites was poor in plant species, which was reflected in a poor species diversity of flower visiting bumblebees and butterflies. Grasshopper species typical for dense grass vegetations were lacking in sod-cut sites, while characteristic heather species were common in sod-cut sites. Some characteristic carabid and spider species were only present in sod-cut sites while other characteristic species seemed to lack after sod-cutting. In general, numbers and abundancies of characteristic species and total species diversity was not higher on sod-cut sites. It seems that sod-cutting measurements only can not restore characteristic vegetation and faunal communities of dune heathlands. (Topic 4.3)

PAUL NOLAN, JIM MACKAY

The Mersey Forest, Riseley Moss, Warrington

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The Community Woodland role in recycling brownfield land

The guiding principle of Community Forests is to develop multipurpose forests which will create better environments for people to use, cherish and enjoy, with one of the key objectives being to improve the landscape, including reclamation of derelict land, to create a visually pleasing and varied countryside. A substantial area of derelict land is thus targeted. This involves a number of issues. 1. A staged pathway approach - a site should pass sequentially through increasingly detailed investigation and design stages so that site owners do not need to commit significant resources to site investigations until the potential of the site is agreed. 2. The importance of detailed investigations - the design and remedial options of sites are dependent upon their social, physical and chemical characteristics. 3. Recognition of ecological interests - surveys are required so that woodland design can incorporate and encourage these - guided by a formal Biodiversity Action Plan. 4. Sustainable remediation of contaminated land - important but requires the accumulation of more information, otherwise sites may be ruled out un-necessarily. 5. Community involvement - the proximity of large areas of brownfield land to local communities means that site remediation has an impact on local people. The issue is not whether they should be involved but rather when and at what level. Giving local people a sense of pride and ownership is the best way to ensure that community woodlands are well managed, used and valued in the long term. (Topic 3.3)

G OFTEDAL, H ANTONSEN, S S DHILLION

Department of Biology and Nature Conservation, Agricultural University of Norway, Aas, Norway

Restoration techniques which impact plant species establishment and soil-microbe characteristics.

Changes in land use and management in Norway have led to meadows in various states of succession. A large proportion of these areas are dominated by locally dominant and invasive forbs like *Deschampsia cespitosa*, *D. flexuosa* and *Ranunculus acris*. Such plants not only disallow establishment of desirable meadow species but also reduce the number of palatable species and alter nutrient dynamics in meadows. Our work has centred around restoring old fields and meadows in western Norway by employing techniques which create gaps through the removal of dominant species, the addition of lime and propagules to 'jump-start' the system, and the set-up of plants communities of varying plant diversity. The former presumably reduces intense competition from the established dominant species (or functional plant group) allowing for new species to establish - i.e., species establishment can be facilitated by the creation of gaps.. In addition results show that we can alter mineralization and the make-up of fungal (including mycorrhizal) communities through liming. This paper will present approaches used under a given set of conditions and also explore those which could be used given a certain state of a site. We will address the following questions. What determined the restoration tools used and what have we learnt so far from employing these? What are the practical and management implications of the restoration techniques used? (Topic 4.8)

JOHN O'NEILL

Department of Philosophy, Lancaster University, U.K

Restitutive Ecology

A central thread in Robert Elliot's continued criticism of restoration ecology is the role of causal continuity in the history of a place in relation to the valuations of its worth. However, the role of history and

causal processes in environmental valuation looks more complex than Elliot allows. The concept of causal continuity is too thin to do the work that Elliot wants it to do. However if appropriately thickened to include a fuller narrative of places, then history plays a role not just in the value of natural landscapes, but also in cultural landscapes. Moreover, a fuller narrative approach to the value of places can be used to defend many of the activities that come under the title of restoration ecology by reconceptualising them as acts of restitution. This paper defends a version of restitutive ecology distinguishing it from more ahistorical approaches to environmental restoration and habitat creation. (Topic 1.1)

JUNKO OIKAWA, TONY KENDLE

Department of Horticulture and Landscape, University of Reading Process and Product Oriented Restoration Practice in the UK

Ecological restoration as a developing technology faces many challenges to its credibility and acceptance, such as the difficulty in demonstrating long term viability in what has been achieved, the high costs compared to nature protection and the compromise to traditional conservation criteria because of the high levels of human involvement and loss of naturalness. To some extent these problems can be offset by placing less focus on the restoration product and maximising the value of the restoration process for research, education and capacity building. A survey was conducted of UK restoration practitioners in collaboration with the SER UK Chapter to examine attitudes and the key areas for future efforts for ecological restoration in UK. The main benefits of the restoration projects were seen as improving ecological qualities on the sites by direct activities, while more holistic views such as education or research opportunities were less focused. For the majority of the organisations that responded restoration played a minor parts of their activities. Central government was criticised for its poor support of restoration activities whereas the NGO sector seemed to take a lead. (Topic 1.2)

BRAD OLSON

East Bay Regional Park District Restoration Partnerships, East Bay Regional Park District, Oakland, CA, USA

Endangered Species Habitat Protection and Restoration Projects on East San Francisco Bay Parklands

For 65 years the District has been working to acquire, develop and operate parks, open space and trails in Alameda and Contra Costa Counties. The District operates 59 parks and open space areas, and manages 91,000 acres (36,827 hectares) of land. During the last ten years, the District has acquired 25,000 acres (10,117 hectares) of new parklands and assisted others in acquisition of several thousand additional acres of open space. The majority of these acquisitions have focused on preservation of open space, wildlife migration corridors and habitats for State and Federally-listed species, and on development of appropriate public access. The District is leading or partnering in more than 15 enhancement and restoration projects along the San Francisco Bay shoreline. A large percentage of these projects have focused on restoration and management of tidal marshlands and other aquatic habitats that benefit several endangered species, including salt marsh harvest mouse, Delta smelt, California clapper rail, California least tern and soft bird's-beak. The District has also committed substantial resources to manage and protect these habitats from a variety of threats, including introduced predators and non-native vegetation, and soil and groundwater contamination. Further inland, the District has made several key acquisitions to protect important wildlife

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migration corridors. Other acquisitions protect from development important habitats for the endangered San Joaquin kit fox, Alameda whipsnake, California red-legged frog and California tiger salamander. District staff are participating in biodiversity and recovery planning efforts to protect and restore habitats for numerous other listed-species. (Topic 5.3)

OLE OSTERMANN

Route de Quissac, F30610, Logrian, France

European directives and initiatives

The main relevant directives and initiatives in Europe related to nature conservation are the so-called Habitats-Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild flora and fauna), and the Birds Directive (79/409/CEE, April 2, 1979) for which the sites designated are supervised, together with those of the Habitats Directive, by the European Commission. The obligations towards the Convention on Biological Diversity (CBD, Rio de Janeiro 1992) are expressed through the European Community Biodiversity Strategy. Other EU policy interferes with conservation policy, as the Common Agricultural Policy CAP, but also structural and cohesion funds, and the Agenda 2000. Other Conventions are Ramsar, Bern, Bonn, CITES, OSPARCOM, HELCOM and Barcelona. Further there are policy initiatives as the Pan-European Biological and Landscape Diversity Strategy, coordinated by the Council of Europe and UNEP. NGO initiatives cover almost all aspects of nature conservation, including distribution atlases for most taxa, and ecological networks and landscape aspects. (Topic 3.7)

GREGG PAGET

Department of Environmental and Geographical Sciences, Manchester Metropolitan University

Multiculturalism and Ecological Restoration

A 'people' dimension to ecological restoration is global multiculturalism that should be respected and nurtured. The main focus of ecological restoration must be the restoration of biodiversity with an emphasis on natural systems that belong to a particular locality. However restoration ecology in an increasingly urban and multicultural world demands some innovative solutions that look forward rather than just restoring a natural environment of the past though of undoubted importance. This paper proposes to show, in the UK, how ecological restoration can contribute to the positive promotion of multiculturalism and how multiculturalism can contribute to successful ecological restoration. For instance, ecological restoration in cities can introduce ethnic minorities to native species of the English countryside. It can make connections, for ethnic minorities, between native wildflowers, introduced species, and plants in 'home' countries. Multiculturalism, if handled sensitively, can build among ethnic minorities a constituency of 'environmental' support for ecological restoration. The UK case study, quoting practical projects, will show how to combine the natural and human worlds. 'People' and ecological restoration is neither a problem nor a panacea but an opportunity. (Topic 6.1)

DUNCAN PAINTER

Land Use Consultants, London

Urban regeneration in London

Land Use Consultants is an environmental consultancy specialising in planning, design, management and ecology. For over 30 years it has been exploring the concepts of sustainable development and evolving practical forms of resource management with strong emphasis, through design, on the conservation and enhancement of environmental quality.

The results of two urban regeneration projects in London will be presented:

1. Bedford lakes - the regeneration of 100 hectares of former gravel workings and landfill into a complex of parkland and aquatic habitats.
2. Harmondsworth - the restoration of 270 hectares of former gravel workings and landfill into wildflower rich grassland with associated wetland habitats. The lessons learned from the design and construction of Bedford Lakes were applied to the recently completed Harmondsworth scheme. We will present the restoration issues, lessons learned and the ecological enhancements associated with both schemes. (Topic 5.2)

RICHARD PARADIS

University of Vermont, Environmental Program, Burlington, Vermont USA

RESTORING AND MANAGING ALPINE ECOSYSTEMS IN THE NORTHEASTERN UNITED STATES

The summits of the highest mountains in the northeastern United States harbor isolated alpine ecosystems with structural and compositional characteristics similar to Arctic regions thousands of kilometers to the north. These mountaintop archipelagoes harbor rare and fragile natural communities and species of regional and global significance. These same summits are also popular destinations for hundreds of thousands of visitors annually and are optimal locations for ski resorts and telecommunications facilities. Historically, these activities have resulted in a myriad of disturbances including trampled vegetation, soil loss, species decline and extirpation, habitat fragmentation, ground and surface water contamination, aesthetic blight, and overcrowding. As a response to this degradation, site managers have developed and applied a variety of successful programs and techniques to both control these impacting activities and to restore degraded landscapes. This paper surveys the programs and techniques developed by site managers in collaboration with regional scientists, educators, conservationists, and policy experts to address and control the activities that result in degradation of the alpine ecosystems in the northeastern United States. Management strategies are surveyed by type (education, site enhancement or modification, regulatory) and intended target (individual visitors and groups, development projects, the physical environment) and assessed as to how effective they are in mitigating impacting activities and restoring damaged elements. Techniques developed and implemented in these situations are applicable to other alpine ecosystems and similar sensitive ecosystems that are besieged by site degradation activities. (Topic 4.8)

GRAHAM PARRY

Groundwork Ashfield and Mansfield, Nottinghamshire

Empowering communities - a method for promoting sustainable environments.

Delivering projects using a participative approach has meant engaging with many of the issues and problems that result from this form of project delivery. There are several well established systems for consulting the community - but what about the longer term development of 'a sense of community ownership', that is sustainable well beyond the first flush of enthusiasm? Changing Places has attempted to engage with this question and as a result has established two initiatives. The first is an award programme aimed at increasing the skills of individual members of the community group framework. The second is the creation of a network of community groups associated with the individual sites. This paper describes the thinking behind these initiatives and describes the way the work is being organised and delivered. (Topic 5.1)

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JOHN PARRY

St Anne's Crescent, Lewes, East Sussex

'Because I'm worth it' - taking out the spin and putting in the backbone.

Building on his work locally as a volunteer and as a researcher in education for the environment, John Parry will outline some of the theoretical basis to his work on the ground, including the establishment and setting up of the first Junior Management Board in the country for a Local Nature Reserve. Some of the theory will explore the notion of autonomy, the need for troubles in cognition and the value of culture in relation to ESD through the work of Piaget, Riesman, Coles, Dewey, Oakshott and Giddens. This will serve to underpin the use of information technology pioneered by John Parry in relation to a CD-ROM Global Environmental Change research project conducted in Leeds, London, Bradford and Lewes from 1994 - 1997 and more recently in the creation and use of an environmental database being pioneered in 6 schools within the East Brighton Education Action Zone. These developments will be linked back to the emerging National Curriculum, especially in relation to Citizenship and the opportunity, or otherwise, for truly grounding the notion that people not only matter but are absolutely essential. (Topic 6.1)

GORDON PATTERSON

Forestry Commission, Edinburgh.

Genetic conservation of British native trees and shrubs: policy and research needs

Over the last 20 years or more the planting of native species of trees and shrubs in Britain has steadily increased for woodland and hedgerow planting and landscaping schemes. Although a species may be native to Britain or part of it, the planting stock is often of European Continental origin – the seed having been collected hundreds of miles from the planting site. In the UK, there is an increasing wish to use local origin stock for native species planting, especially in native woods, on the grounds that it may have local adaptations to climate and soils, and in some cases there could be historically distinct populations which should be conserved. However, with the partial exception of the native pinewoods of northern Scotland we have little knowledge of the pattern and significance of the genetic variation of our trees and shrubs and it is necessary to develop a much better understanding of this in order to reliably guide the sourcing of seed and cuttings to achieve genetic conservation objectives. In response to these needs, the Forestry Commission has recently: Commissioned a review of genetic conservation concepts and policy and research needs in relation to native species of trees and shrubs. Strengthened and refocused our research and policy development in this area. Allied to this, the UK has recently joined EUFORGEN, the research network for forest genetic resources in Europe. Published a Practice Note which gives guidance on local sources of native trees and shrubs centred on a map of local seed zones. These zones have been based upon climatic variation on the assumption that this would be reflected in the patterns of genetic adaptation of populations of native species. In due course it will be reviewed once research reveals the actual genetic pattern. The Note provides a common language for the first time for all those interested in collecting seed, and growing and planting native trees and shrubs. A new voluntary system of labelling for native seed lots and planting stock has been established under which the FC issues Certificates of Local Provenance. (Topic 3.6)

STEVEN PATTERSON

EDAW, Inc., Sacramento, CA, USA

Upper Truckee River and Wetland Restoration at Lake Tahoe, California.

Extensive river and wetland restoration efforts are being undertaken in the Lake Tahoe Basin (California and Nevada, USA) in an attempt to halt and reverse a catastrophic decline in lake clarity. Lake Tahoe's famed clarity is a function of its extremely oligotrophic (nutrient-poor) state. Urbanization associated with Tahoe's popularity as resort destination has resulted in greatly increased sedimentation rates and nutrient levels. Lake clarity has been decreasing by approximately one foot per year for the last three decades. Ecological restoration efforts are a major component of overall efforts to halt and reverse that decline. The California Tahoe Conservancy is undertaking river and wetland restoration on the Upper Truckee River, the largest single contributor of flow to Lake Tahoe, supplying approximately 25 percent of runoff entering the lake. Wetlands filled by previous development will be excavated and restored and the river returned to its former floodplain. River restoration planning must balance geomorphic and hydrologic considerations, poorly understood, and perhaps limited opportunities for sediment and phosphorus reduction, urban development on three sides of the project area, public willingness to endure 17,000 truck trips to remove excavated fill, political and social obligations to provide public access, and the presence of an endangered plant, Tahoe Yellow Cress, endemic to Lake Tahoe's few sandy barrier beaches. This paper highlights on-going planning and technical studies being conducted to address these issues. (Topic 5.2)

STEPHAN PAULEIT, FRIEDRICH DUHME

Lehrstuhl für Landschaftsökologie, Am Hochanger, Freising

Data capture and analysis for the ecological restoration of urban systems

The governance of urban agglomeration strongly depends on different groups of professionals who look at the city from different perspectives and use different approaches: city planners and architects concerned with the built environment, civil engineers with infrastructure, landscape architects with open spaces, ecologists with natural relics. These work altogether for providing the basic urban functions and services such as housing, industry and commerce, services, communication, transport, and recreation which form a mosaic of spatial compartments. Urban functioning and development is predominantly driven by a capital-oriented stewardship whereas the natural resources are very much under priced and play a minor role in decision making and urban governance. Nevertheless, cities are now the global players in resource use with major impacts on climate and biodiversity. However, the urban resource use and consumption is not adequately monitored and thus the change in practice for the maintenance of the urban system and the need for its renewal and restoration are not as clearly documented as it needs to be. To overcome this deficit, we developed a systems oriented concept for monitoring. The concept was based on the delineation of land cover units as basic compartments of urban agglomerations. Characterising these units by predominating structural and functional features enabled us to identify the specific priorities for preservation and restoration of the natural capital within the city. Moreover, assessing the metabolism, i.e. the compartments will be a means for the comprehensive and comparative monitoring of the environmental performance of urban systems. (Topic 3.7)

KEVIN PEBERDY

The Wetland Centre, London

Wetland Creation - The Wetland Centre London

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The Wetland Centre is one of the largest and most complex wetland creation schemes in an urban environment in Europe. Over forty - two hectares of open water lakes and ponds, reedbeds and seasonally flooded wetlands have been created on the site of a derelict reservoir less than 8km from the centre of London. The site has over 250 metres of boardwalk, 3.4 km of pathway and seven hides and observatories, together with a main visitor centre and a further three themed education buildings. Based on conservation objectives in their widest sense the site is designed to maximise habitat and species diversity and to raise awareness of wetland conservation issues to a large number and broad spectrum of visitors. The project illustrates a number of new approaches to the philosophy of development in urban environments, including the use of enabling developments and recycling, a new approach to environmental education and financial sustainability. This paper describes the philosophy, design and development of the Centre which opened in May 2000. (Topic 4.2)

PENG SHAO LIN, ZHAO PING

Guangzhou Branch, Chinese Academy of Sciences, Guangzhou, PR China

Restoration of Degraded Ecosystems and Its Ecological Effect in Low Subtropical China

The process and effect of vegetation restoration of degraded ecosystem in low subtropical areas of China have been examined by long-term studies. In this zone, some ecological factors are favorable to restoration, such as light, temperature and rainfall, and some are unfavorable, such as fall draught, typhoon and rainstorm. But the key factors are soil material, water and fertility. The first step of restoring and reconstructing extremely degraded ecosystem is to control soil erosion, to raise soil fertility and to improve its physical and chemical structures. This needs comprehensive renovation combining engineering and biological measures. A degraded ecosystem, structurally and functionally, is in its early stage of succession. The successional principles of natural forest in low subtropical zone are important guidelines for restoration in this area. Zonal forest restoration should, whenever natural or man-made, follow these regularities. A successful restoration of degraded ecosystem depends on the restoration and development of species diversity, and soil fertility in this zone. The selection of species when establishing pioneering community would affect restoration direction and speed. Vegetation recovery on degraded lands significantly ameliorate surrounding environment, increase species diversity, improve soil structure, raise soil fertility, enhance productivity, and promote regional agricultural production. Keywords: restoration and reconstruction of vegetation, degraded ecosystem, low subtropical zone, soil fertility, climax community. (Topic 3.4)

FABIO PERCO

Sgonico; Gabrovizza n., Trieste, Italy

A strategy for nature conservation and sustainable development along the Northern Adriatic coast.

The lagoon of Grado, Marano (25.000 ha), in the Italian Region Friuli-Venezia-Giulia, is the northernmost wetland area of both the Adriatic and Mediterranean sea. Along with the lagoon of Venice and the delta of the River Po this is a key area for migrating waterbirds, but it is a highly developed and very crowded area as we 11, where problems of coexistence between development and nature conservation programs are very complex. With the potentially high wildlife value of this wetland in mind, a natural park covering the entire area of the lagoon was previously proposed under the General Urban Plan of the Region in 1976. This regional plan did not exclude the possibility of some

hunting in the natural park, but in 1992 a national law stated that any kind of hunting activity should be prohibited in this kind of protected area. This, along with some opposition by fishermen, was the main reason why until now only the creation of four, relatively small, nature reserves has been possible. The achievement of this goal has been permitted by a strategy based upon the establishment of two main wetland centres, open to the public and linked with the management and restoration of nearby bird sanctuaries, where members of the general public have the opportunity of watching significant numbers of birds. The result of the establishment of relatively small areas as interpretation facilities, regularly visited by school classes and other kinds of guided groups, has proved fundamental in gaining the favour of the majority of people and politicians. From this point of view the restoration of a wetland on formerly cultivated fields, followed by the creation of an observation hide, along with the introduction of Camargue horses, and Greylag goose, has proved to be the most successful operation. Highly visible fauna means a better appreciation by the public with positive feedback on the conservation of surrounding areas. The creation of nature reserves along with better legislation and substantially reduced hunting pressure increased the number of wintering waterfowl in the lagoon, allowing better hunting bags outside bird sanctuaries, and, in at least one case, blocking the proposed building of a huge new boating marina. The realization of better wetland management in specially protected areas is now coming to fruition in at least four places which were officially declared nature reserves in 1996: The Mouth of the River Stella; Valle Canal Novo (Udine), the Mouth of the River Isonzo and Valle Cavanata (Gorizia). A key factor in this process which could lead to a sustainable form of development seems to be the promotion and the creation of new jobs linked to nature conservation for local people. We hope this can bring about in a few years the goal of an integrated management of the whole lagoon. (Topic 3.1)

FABIO PERCO

Sgonico; Gabrovizza n., Trieste, Italy

Restoration of a wetland in Italy, a case study: Mouth of the River Isonzo Nature Reserve.

At the mouth of the River Isonzo in North Eastern Italy, a Nature Reserve was created in 1996. The main aims of this project are: - Conservation of reedbeds, sand dunes, mudflats and saltmarshes in their current state. - Restoration of an experimental area of 50 ha as a freshwater marsh, with temporary wetlands and hooded meadows. - Recreation and conservation of an example of Plains Woodland. - Management of the area with the aim of increasing diversity using herbivores, such as Camargue horses and Greylag geese, to control vegetation, reproducing the natural sequence of summer droughts and winter flooding. - Education of visitors in the recently built Wetland Centre. - Creation of the "Stazione Biologica della Cona" with the aim of promoting field research, coaving topics such as: wetland ecology, restoration and management of recreated habitats, biodiversity and biogeography, bird populations and migration, compatibility between conservation and human activities, management planning etc. - Increasing awareness about wildlife conservation. The biodiversity of the area, already great for a number of reasons including its position at the northernmost point of Mediterranean, increased enormously from the first flooding of the experimental pool (October 1989), the introduction of horses (1991) and, more recently, the extension of a hunting ban to cover the whole reserve (1994). The slight decrease of wintering waterfowl registered in the western side of the lagoon was counterbalanced by a parallel increase in the east, contributing to the maintenance of a fairly high waterbird population in the region, a fact

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which shows the importance of a network of well distributed and safe day-roosts for conservation and wise management of wildfowl populations. The area's value for birds, which only few years ago very small, is now great, with more than 15-20.000 ducks and 5.000 coots wintering and almost 300 bird species recorded with a number of first observations for Italy. The building of hides and an interpretation/research centre is helping in the control of disturbance from a rapidly increasing number of visitors (about 30.000 per annum in recent years) and allows for a wider knowledge of results of the project. (Topic 4.1)

JÖRG PERNER, STEFFEN MALT

Ecosystem Ecology Group, Institute of Ecology, University of Jena, Dornburger Str, Germany

Bioindication of changing agricultural land use: the conversion of arable land into grassland in the Unstrut floodplain region (Thuringia, Germany)

In a set of different agricultural land use types, the groundwater dynamics, nutrient balance, microclimate, vegetation (structure and composition), and spatial and temporal patterns of ground-dwelling arthropods (spiders, beetles) were comparatively recorded. Overall, the model groups examined are suitable for the evaluation of restoration effects in agricultural landscapes. However the assemblages show considerable differences in reaction time to changes in land use. Ground-dwelling spiders and beetles mainly respond to changes in the microclimate and the soil moisture. Therefore, efficient bioindication of restoration management is possible after 3-5 years already. Vegetation assemblages appeared as less powerful bioindicators of short-term restoration processes. Land use conversion of former arable lands into extensive managed grasslands cause considerable changes in the structure of ground-dwelling spider- and beetles-assemblages. Because of that, mesophilous habitat generalists of open landscapes are favoured in early stages of restoration however, without changes of the soil moisture regime no increase of the amount of *hygrophilous* species can be observed. The giving up of agricultural land use without changes of the soil moisture regime alone does not produce ecological effects in the sense of floodplain restoration management. (Topic 4.8)

M R PERROW, M NEWSON, S JOHNSON

ECON, University of East Anglia, University of Newcastle, Environment Agency, Anglian Region

'Developing a strategic approach to River restoration/rehabilitation: case study of the River Wensum SSSI (UK)'

River restoration/rehabilitation typically proceeds in an opportunistic sited-based manner in the UK and often results from the mitigation of the impact of schemes to maintain/improve flood defence standards. In order to provide a sound scientific and financial basis for restoration/rehabilitation of the fishery of the River Wensum, one of a series of designated rivers of conservation value in the UK, both monitoring data and more anecdotal information was analysed to determine the presence and cause of any decline. A reduction in the physical habitat quality of the river and floodplain was identified as the single most important factor. A strategic approach to habitat restoration over the majority of the catchment (60 km) was developed. This required compilation of all baseline information and establishing appropriate geomorphological models. Extension of areas of high conservation and fisheries value underpinned the approach. Twenty-five schemes (to 3 km in length) incorporating a wide range of techniques focused on natural recovery mechanisms were proposed.

Ten priority schemes were selected using a simple benefits (keystone species and habitats) to cost (financial and political constraints) ratio. The approach adopted may be used as a blueprint for restoration/rehabilitation of other river systems. (Topic 4.2)

LAURA G PERRY, SUSAN M GALATOWITSCH

Department of Horticultural Science, University of Minnesota, St Paul, Minnesota

The Influence of Annual Cover Crops on *Phalaris arundinacea* Invasion in Restored Prairie Pothole Wetlands

Rapid establishment of the invasive grass *Phalaris arundinacea* often precludes colonization of restored prairie pothole wetlands by sedge meadow vegetation (i.e. *Carex* spp.) in North America. Introducing a fast-growing cover crop during community establishment could alter the competitive balance between *Carex* spp. and *P. arundinacea* by depleting resources for which *P. arundinacea* is a poor competitor. We assessed the effectiveness of *Echinochloa crusgalli* and *Polygonum lapathifolium* for controlling *P. arundinacea* invasion while allowing for *Carex hystericina* establishment in a Minnesota experimental wetland. *P. arundinacea* and the cover crops were sown at three elevations (3, 10, 22 cm above water level), three total densities (1000, 2500, 5000 seeds m⁻²), and five ratios (0, 12.5, 50, 87.5, 100% cover), with *C. hystericina* sown in all plots. *P. lapathifolium* did not influence *P. arundinacea* invasion under any conditions. In contrast, *E. crusgalli* reduced *P. arundinacea* invasion, even at low densities and ratios, but also reduced *C. hystericina* establishment. A cover crop that depletes nitrogen rather than light may more effectively create conditions where *Carex* spp. are more successful than *P. arundinacea*. (Topic 4.6)

MIKE PETERS, RICHARD GORDON

Landcare Research, Lincoln, New Zealand

Lessons from the formation of the community-based New Zealand Ecological Restoration Network (NZERN)

In 1998 a very popular local grassroots organisation sponsored the establishment of the New Zealand Ecological Restoration Network (NZERN) to link isolated volunteers, community groups and other organisations committed to a hands on approach to restoration. The major activity of the network is to create, own and distribute shared resources which are needed by all, but that no individual group would otherwise be able to access easily. There is also an email newsletter and a web site (www.bush.org.nz) with around 24,000 pages of information about group activities, plants, nurseries, and most of the restoration sites in New Zealand. In addition to strengthening the self reliance of local groups, the network helps to avoid duplicated effort in producing written material and research, and facilitates the sharing of resources, including native plants and volunteers. During 2000, NZERN will be establishing a database for detailed ecological information eg native bird sightings, plant growth rates, pests and weeds, and management approaches at restoration sites. This database is expected to become an invaluable resource for shared learning from the hundreds of restoration experiments being conducted by voluntary and professional groups throughout New Zealand. We will reflect on the lessons learnt in establishing NZERN, its organisation and resources. (Topic 6.4)

T G PIEARCE, T BUDD, J M WILLIAMS

Department of Biological Sciences, Institute of Environmental and

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Natural Sciences, Lancaster University, Lancaster

Earthworm communities of a land restoration site treated with paper mill waste ("mineral fibre")

At Bidston Moss, Wirral, a former landfill site is being restored to community woodland in five phases over six years. Topsoil has been created by spreading a mixture of equal volumes of mineral soil and paper mill waste ("mineral fibre") prior to sowing with grasses and forbs and planting saplings. The development of earthworm communities at the site has been assisted by inoculation of selected species. Initially low numbers of surface-dwelling species were present, but as the restoration has progressed a substantial number, biomass and diversity of earthworms has become established, including a variety of ecological types. Although concentrations of copper in the paper mill waste are higher than those typical for soils, concentrations in earthworm tissue are relatively low: low availability of copper will reflect the high content of organic matter and clay, and relatively high pH, of the paper mill waste. (Topic 3.4)

E POTTS, C P WHEATER

Department of Environmental & Geographical Sciences, Manchester Metropolitan University

Carabids and spiders on reclaimed urban derelict land

The north of England has large areas of urban derelict land and where these are reclaimed, techniques are used which reduce the timescales involved in the natural colonisation by flora and fauna. In many reclamation schemes, the vegetation is monitored following management, whereas the fauna establishes through natural processes. Invertebrate communities are important components of derelict land, having major roles in the turnover of nutrients and pollination of plants. Previous work has shown that invertebrate establishment on reclaimed land lags behind that of the plants. As a result, monitoring the invertebrate communities may more accurately reflect the quality of the habitat and the success of the reclamation process, than would assessment of the vegetation. Recent studies identified carabid beetle and spiders as potential indicators of the success of reclamation management practices. Other studies have identified a role for carabids in monitoring contaminated land, involving behavioural as well as ecological changes associated with stressed environments. The current work examines carabids and spiders which have colonised a series of colliery spoil heaps, blast furnace slag heaps and pulverised fuel ash waste tips which were reclaimed to grassland and woodland over the past 50 years. (Topic 3.4)

KAREL PRACH

Faculty of Biological Sciences, University of Ceske Budejovice, and Institute of Botany, Czech Academy of Sciences, Branisovska, Czech Republic.

Prediction of spontaneous vegetation changes: a key factor in restoration programs

Knowledge of spontaneous succession is essential in restoration programs. As a first step, such knowledge can serve as a basis for decision whether to adopt restoration procedures or give a full way to spontaneous development. The latter solution is always cheaper and often leads to better results than restoration. As a second step, the knowledge of spontaneous successional processes influences which restoration measures will be realised and what will be their timing. Moreover, we must take into consideration that spontaneous succession always interferes with restoration processes and results of both are often intermingled. Spontaneous vegetation changes can be

often readily directed to achieve a desirable vegetation cover. We need to know at what stage of spontaneous succession desirable species are the best to be sown or planted to minimise their mortality due to competition with spontaneously established species or due to adverse abiotic factors. On the other hand, we need to know optimum timing for eradication or control of undesirable spontaneously established species, including invasive aliens. To achieve all these goals we need (a) detailed particular studies on spontaneous succession in a given habitat, and (b) comparative studies carried out in a higher number of successional seres to estimate general possibilities and limitations of spontaneous processes. Case studies will be mentioned in which prediction of spontaneous succession helped to suggest proper restoration measures; these concern the following habitats: dumps from strip coal mining, extracted peatlands, limestone quarries, and alluvial meadows. (Topic 1.4)

M N V PRASAD, H FREITAS

Department of Plant Sciences, School of Life Sciences, University of Hyderabad Hyderabad, India

Phytoremediation of metal contaminated ecosystems - prospects and predicaments

Phytoremediation is a general term for several ways in which plants are used to clean up the polluted or contaminated sites. Plants can take up, break down or degrade and stabilize the metals or organics polluted/contaminated ecosystems. Phytoremediation includes several processes viz. phytostabilisation, phytoimmobilisation, phytoextraction, phyto-volatilization, phytodegradation. Phytoremediation techniques have already been commercialized. Variety of plant resources are being employed for field remedial uses. For e.g. Constructed wetlands, reed beds and floating-plant systems are quite common for the treatment of various types of wastewaters and industrial effluents. Amendment of the metal contaminated soils with synthetic chelators viz., ethylenediaminetetra acetic acid, (EDTA), ethylene-glycol-diaminetetraacetic acid (EGTA), nitrilotriacetic acids (NTA), citrate, oxalate, malate, succinate, tartrate, phthalate, salicylate, acetate, ammonium thiocyanate etc. and natural clays containing aluminosilicates, oxides and oxyhydrates of iron and aluminum when applied through irrigation at specific stages of plant growth have facilitated remediation. Application of crosslinked polyacrylates, hydrogels have significantly inhibited the uptake of heavy metals by plant roots thereby avoid the metal toxicity. Metal chelator producing plants have acquired the physiological and molecular mechanisms of metal tolerance and metal accumulation. Those of the plants that hyperaccumulate metals when grown in metal contaminated and polluted terrestrial and aquatic ecosystems can clean up not only metals but also a variety of xenobiotics, thus help in environmental decontamination. *Quercus ilex* L. (Holly oak) phytomass utility and scope for clean up of metal contaminated aquatic and terrestrial sites is presented as a case study. Additionally the conventional remediation technologies, cost-benefit, prospects and problems of phytoremediation are also briefed. (Topic 3.3)

ANDREW S. PULLIN

School of Biosciences, The University of Birmingham, Edgbaston, Birmingham

Lessons from Invertebrate Restoration Programmes?

There is an increasing number of restoration programmes for single species of invertebrates, particularly high profile taxa such as butterflies. With such a high diversity of invertebrates to conserve, the value of such single species programmes has been questioned. This talk reviews a number of programmes and examines their value in

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terms of benefit to conservation and ecological knowledge. It is recognised that many restoration attempts are little more than naïve releases of individuals with little or no planning or subsequent monitoring and are of no scientific value. These should be actively discouraged, as they are damaging to the general perception of ecological restoration and inhibitory to more effective conservation efforts. However, properly planned restoration programmes have revealed new details of specialised habitat requirements of species, complex interactions among species, the impact of introduced species and human activities on communities, and the dynamics of small and isolated populations. Many species-based programmes have also brought to attention the disappearance of habitats, and flagship species have often driven conservation action for the whole community. The overriding message is that of the difficulty of achieving a successful re-establishment which emphasises the importance of putting in situ conservation first and restoration as a last resort. (Topic 4.7)

GLORIA PUNGETTI

Dept Horticulture & Landscape, University of Reading, Reading

Ecological networks - an opportunity for habitats and species restoration in Europe

In the last century the cultural landscape of Europe has rapidly changed and many species have adapted to it. However, unless habitats quality improves and landscape is restored, in the long run many species might disappear. Furthermore, the island approach to nature conservation in Europe has revealed to be a failure. It has been proved that single isolated sites of ecological importance (core areas) might be ineffective to enhance habitats and species quality. The creation of ecological corridors, on the contrary, can help the exchange of species between core areas, the occupation of empty habitats and their recolonisation after species extinction. Core areas and ecological corridors are elements of an ecological network, a principle in nature conservation that can help to integrate environmental values in land use planning for habitats and species restoration. Already used at regional and local level in many Pan-European countries, the ecological network principle has been advanced at European level with the EU Species and Habitats Directive, and the Pan-European Biological and Landscape Diversity Strategy. The principle is also central to the Life EONet project carried out by England, Italy and the Netherlands. Opportunities for habitats and species restoration in the three countries will be discussed. (Topic 1.3)

P. D. PUTWAIN, N. R. WEBB

School of Biological Sciences, University of Liverpool, and Centre for Ecology and Hydrology, Winfrith, Dorset.

Restoring Sustainable Wild Landscapes: Social and Economic Challenges

In the United Kingdom, restoration of patches of wild habitat, whether in the wider countryside or in industrial regions has tended to occur on a piecemeal basis often as a responsive activity rather than as a component of a proactive strategic planning process. The development of transport infrastructure, general industrial development, mineral extraction and restoration of derelict land have been past drivers of habitat restoration but without strategic direction. Biodiversity Action Plans provide a new driver for landscape restoration. An important component of the UK Biodiversity Action Plan is to restore and enhance, and to manage appropriately, the biodiversity of important semi-natural habitats such as lowland heathland, calcareous grassland and native woodland. A major contribution to BAP's in the national and regional context will be to re-create wild landscape with the character and biodiversity that

once existed. This strategy depends on wide local social acceptance of planned sustainable landscape objectives, and methods of achieving these using economically sustainable land management. In order to achieve the objectives of sustainable restored landscapes it will be necessary to develop a consensus and build a lasting partnership between local and regional stakeholders with common values and objectives. The paper will examine these issues drawing on data from several case studies concerning restoration of lowland heathland and community woodland in various parts of the United Kingdom. (Topic 3.5)

RICHARD PYWELL, JAMES BULLOCK

Centre for Ecology and Hydrology, Monks Wood, Abbots Ripton. Huntingdon

Diverse Grassland Re-creation on Ex-arable Land

Species-rich grasslands are now a rare habitat in the UK. Agri-environment schemes provide opportunities to re-create this habitat. This study examines the effectiveness of practical techniques to restore diverse grassland to ex-arable land over a wide variety of locations. Replicated experiments investigated: (i) the potential for natural regeneration; (ii) the ecological and agronomic performance of different seed mixtures; (iii) the effectiveness of deep vs shallow cultivation in burying fertile topsoil and weed seedbanks; (iv) the use of a nurse crop to assist the establishment of sown species. Sowing a diverse seed mixture of ecologically appropriate species was the only effective means of rapidly overcoming the lack of propagules. Plots sown with simple grass mixtures remained low in diversity throughout the study. Herbage production and quality were significantly higher on treatments sown with diverse seed mixtures compared to those sown with simple grass mixtures. Deep cultivation was effective in causing short term reductions in phosphorus and potassium over a wide variety of soil types. There was evidence to suggest the nurse crop caused a small and short-lived reduction botanical diversity. This study demonstrates that it is possible to successfully re-create and maintain diverse grassland communities on a wide variety of ex-arable soils. (Topic 4.8)

AVIVA RAHMANI

Science, Stakeholders and Art: the Ghost Nets project 1991-2000

The Ghost Nets project was a deconstruction of wildlands fragmentation, creating open lands linkage in a fishing ecosystem. That required making a sustainable working and living habitat from a former coastal town dump, on one of the remote islands in the Gulf of Maine (GOM). Wetlands restoration on the physical site culminated in a bioengineered salt marsh and led to collaborations with scientists through out the GOM. The project's success required full time residence there for ten years. Activism over the sole source aquifer and ferry management, interviews and involvement with the fishermen's lives, joining the local church choir, were all strategies of art to unravel the central metaphor of the project: how to escape the invisible, indestructible trap of familiar habits and routines by cultivating an awareness of interdependence. Ghost nets in the fishing industry are the miles of lost drift nets that stripmine the sea, continuing to trap life for many years, analogies for human behavior. The project's half life continues at <ghostnets.com>, in residencies and further collaborations to build on the premise that waterways and animal migration routes need promotion as the basis for future city planning. (Topic 6.2)

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AVIVA RAHMANI

Thinking Big with Environmental Art from the Ghost Nets project

Conceptually based environmental art, rooted in restoration ethics, has enormous untapped potential to deliver new strategies for the next century. The Ghost Nets project, 1991-2000, began as modest working habitat wetlands restoration, including a state of the art salt marsh, on a former dump site, in a fishing village, on an island in the Gulf of Maine. Using the models of the Native American Medicine Wheel and German studies of concentric ring linkages, extrapolations could be made to include larger watershed systems and allow for animal migration routes even in settled areas. The physical site is analogged virtually at <ghostnets.com>, separating the question of physical restoration from the act of literal visitation. Virtual visitors, as ecotourism must evolve to realize, are far more caring and conscientious to our common fragile habitat. The half life stage of this project is experimenting with understanding landscape scale interactions and interdependencies for the purpose of redesigning cities and transportation routes. Work with the Global Programme for Action Coalition (a UN Mandate), colleges, universities and research groups in the Gulf of Maine region is informing a developing sense of how global strategies might take shape. (Topic 1.3)

GUZMÁN-ÁLVAREZ JOSÉ RAMÓN

Universidad de Cordoba, C/ Recogidas, Granada, Spain

Looking from Cities the Rural-Made Nature: Redefining the Scopes of Landscape

Landscape modelling has been a basically rural activity. Land has been shaped in order to optimize the social use of resources. As a consequence, humans have made a social construction of nature that is constantly in flux due to the continuous reshaping of social structures and functions. Nowadays societies face an increasing set of problems in relation with advances in knowledge and technology. The image of nature has evolved towards an urban approach due to the increasing relative percentage of citizens. From cities, the perspective of nature has to do more with films sequences composed of isolated scenes of a high impact, than with landscapes as a whole, integrated by land, nature and rural uses. But this point of view tends to forget that landscapes are social creations, linked to rural purposes and, consequently, joined to the future of rural populations, economies and uses. (Topic 1.2)

GUZMÁN-ÁLVAREZ JOSÉ RAMÓN

Universidad de Cordoba, C/ Recogidas, Granada, Spain

Colonization of Mediterranean Fragmented Landscape by *Pinus halepensis*: Distances of Dispersion and Humid Cycles Effects

In defining restauration objectives and purposes, natural mechanisms must be taken in account as major forces in driving the whole evolution of the systems. In mediterranean environments, due to climate and soil constraints, the relative ability of natural communities to recolonize degraded areas is limited in an human time scale, mainly due to the failure in establishment of propagules. In this paper it is exposed the results of an investigation on the natural dispersion and establishment of *Pinus halepensis* in a roughly 200 Ha. fragmented valley composed of almond trees orchards, *maquis* communities and old-field patches. (Topic 1.4)

GUZMÁN-ÁLVAREZ JOSÉ RAMÓN

Universidad de Cordoba, C/ Recogidas, Granada, Spain

Supporting Restoration of Nature in Rural Areas in Andalusia (south of Spain): When Agriculture is the Incentive

As a consequence of the application of Europe Agricultural Policy, various programmes supporting the restoration of nature in rural areas - mainly in reserves and protected areas - have been developed. This paper exposes the content and objectives of this legislation, and the results of its application. Opportunity of incentives and relationships between agriculture and environment in these areas are also taken into account. (Topic 2.2)

JUDITH RAWLING

Urban Bushland Management Consultants Pty. Ltd. New South Wales, Australia

Reconstruction of Rare and Endangered Plant Communities: Three Case Studies from Australia

Australia has enacted legislation to protect and conserve species and ecological communities considered to be at risk. In NSW many species and some ecological communities have been listed as endangered by the Threatened Species Conservation Act 1995. Declarations inevitably lead to angst within the community and conflicting demands for land use. In an attempt to reconcile new development with environmental legislation, destruction of endangered communities has at times been allowed provided that an equal or greater area of compensatory habitat is reconstructed. While reconstruction is often vigorously opposed by hard line conservationists, this option is being increasingly adopted, and accepted by the community at large. The question is ñ does it work? This paper presents three case studies from the Sydney Region. The first centers on the salvage of threatened flora from burial sites within a Victorian Necropolis, using a bobcat to translocate ñdivotsí to new locations within the cemetery. The second describes the reconstruction of a rare coastal forest which had the misfortune to be growing on an 8-metre depth of sand within a mining lease. The third involves the reconstruction of a degraded plant community within a major railway redevelopment site. The challenge of reconstruction here was considerable, and its wisdom questionable, given the high costs involved and the long-term prognosis for survival. This paper examines the practical aspects of reconstruction, and the social and moral issues inherent in this type of restoration ecology. (Topic 3.2)

A REMESAR

CER POLIS, Universidad de Barcelona, Spain

Is the necessary social ecology possible?

Bauman (1998) introduces the “ globalization “ concept, a synthesis of two processes that occur at the same time: the globalization of the capital flows, of the free goods circulation and people, and the localization of these processes in the effective development of territory that should be understood as a process of cities in competition. The possibility of a sustainable development as agreed in the summit of Río de Janeiro, and adopted by most administrations, presupposes a reconsideration of the models of city development. In Europe a nominalistic attitude has taken place which derives from the role that the techno - bureaucracies - as representatives of the industrial and financial lobbies - have in the formulation of the European policies. A heap of experts is mediating between the administration and the society with the objective that companies, city councils, etc. adapt to environmental regulations. Another heap of experts is facilitating, inside the organizations, the setting in progress of normative procedures allowing recycling, selective waste disposal, and clean production. Given the recent processes of ‘de-regulation’, the

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European Institutions, at national and local level, have lost, in good part, the capacity to be 'creative of reality'. The creation of the reality has been left in hands of the free activity of the markets. To manage the dialectics between the global and the local, between these two 'topoi' that work completely differently, is the great challenge for sustainability. Social cohesion has very important anthropological and cultural implications in this context, to guarantee the access to the 'global city', to the city of the networks. Subsidiarity necessarily supposes a re-foundation of the processes of civic participation very far from the purely formal processes of representative democracy (Topic 6.2)

JOHN P RIEGER

California Dept. of Transportation, Project Management, San Diego, USA

Restoration in public parks benefit from public stakeholder input

Development of restoration plans for two county regional parks met with varying responses. Two river associated parks, Los Penasquitos and Sweetwater River Parks in San Diego county had severely degraded and altered riparian systems. Despite the existence of Master plans the public took exception to what and where specific efforts were focused. In Los Penasquitos park the citizens groups and local town councils supported the removal of the exotic Eucalypts adjacent to a historical ranch house. However a city councilman, running for re-election and a spontaneous opposition group opposed the proposal. The Friends of Penasquitos park were instrumental in arguing for the proposal in local papers, at City council committee and board meetings. The project was executed with some additional activities to benefit the historical structures. Conversely at Sweetwater River park the master plan called for wildlife and passive recreational uses. The site was an abandoned sand extraction site with extensive stands of the exotic giant reed, *Arundo donax*. Despite support from the parks department and politicians the local citizens were not excited about the potential changes. A series of meetings with 4 citizens groups, resulted in significant modifications. The end result was an acceptable compromise which provided various recreational activities and the creation of 15.2 hectares of willow scrub riparian habitat. Full disclosure, sound design, a willingness to discuss and compromise where it does not sacrifice the original goal of the restoration are key ingredients in getting local cooperation. (Topic 3.1)

KAREN M. RODRIGUEZ

U.S. Environmental Protection Agency, Great Lakes National Program Office, Chicago, IL, USA

Exotic Species: A Challenge to Great Lakes Restoration

More than 140 exotic aquatic species have been introduced to the Great Lakes ecosystem over the past 200 years, about one third since 1960. The primary vector for unintentional invasions of aquatic exotics is ballast water in ships, the result of intercontinental shipping made possible by the completion of the St. Lawrence Seaway in 1959. Approximately 10% of the introduced species have had profound effects on both the ecology and the economy of the Great Lakes. The zebra mussel, for example, in addition to clogging water intake pipes of municipal and industrial users, filters a tremendous amount of water. Collectively, zebra mussels have increased the clarity of the Lakes' water, thereby altering the food web. A recent invader from the Caspian and Aral Seas, *Cercopagis pengoi*, also appears to be altering the food web in Lake Ontario. Exotic species are challenging efforts of two federal and state and provincial governments attempting

to restore the health of the Great Lakes fisheries. This paper will detail efforts to coordinate binational legislation, policies, and practices to prevent and control non-indigenous species invasions in the Great Lakes. (Topic 4.2)

JOHN RODWELL, JULIAN ELLIS, JERRY HARRINGTON

Unit of Vegetation Science, Lancaster University, Lancaster

Generic ecological tools, local distinctiveness and sense of place

The National Vegetation Classification has become a standard technique for describing British plant communities which, given particular combinations of climate, soil and management conditions, are sustainable. It is also coming to be used to specify targets for habitat management and restoration, to characterise indicators of condition and develop methodologies for monitoring attainment of goals. How realistic or proper are these applications of the NVC? Focusing on the Outwood Project in West Yorkshire, this presentation will examine how generic ecological tools like the NVC can provide a framework for rediscovering local distinctiveness in plant communities and at landscape scale, and integrate those quirks of history and local culture which contribute to developing a vision for a sense of place. The Outwood Project is funded by WWF-UK as part of its Future Landscapes programme and is a partnership with Wakefield Metropolitan District Council, English Nature, the Forestry Commission and Collaborators Theatre Company, and, providing the essential drive for the whole enterprise, a diversity of local community groups (Topic 3.5)

DEANNA P ROKICH, KINGSLEY W DIXON, KATHY A MENEY, KSIVASITHAMPARAM.

Kings Park and Botanic Garden, Botanic Gardens and Park Authority, West Perth, Western Australia

Restoration of a Species-Rich Ecosystem from the Mediterranean Zone of Western Australia.

The south-west of Western Australia is one of the mega diverse regions of the world. The state is also resource rich, producing over one-third of the GDP of Australia primarily from mineral extraction. Restoration of mined lands presents major problems in terms of the areas involved, paucity of knowledge on the restoration ecology of native plants and the strong seasonal aridity associated with a mediterranean-type ecosystem. Studies undertaken by the land restoration group at Kings Park and Botanic Gardens, Perth, have enabled research of a wide spectrum of new and innovative methods for tackling post-mining restoration of bio-diverse ecosystems. By analysing soil seed-banks for optimisation of soil-borne seed recoveries, and understanding ecological processes influencing seedling establishment, a highly successful species-replacement and rehabilitation program has been established for post-mined lands. Coupled with the use of smoke-mediated germination, which in some systems produces a 42-fold increase in total germinants and a 3-fold increase in number of species, near total species replacement is a very real possibility for some mine-sites. This talk will review current restoration practises and data on the soil seed-bank, soil handling, and restoration research being utilised to restore semi-arid vegetation after sand-extraction. (Topic 3.3)

C ROSS, E LANGER, M DAVIS

Landcare Research New Zealand Limited Palmerston North, New Zealand

Rehabilitation of native forest after mining in Westland, New Zealand

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Rehabilitation techniques for native beech-podocarp forest were investigated at an open-cast coal mine on alluvial river terraces near Reefton, Westland. Annual rainfall at the site is 2900 mm. Over five years, the survival and growth of twelve, nursery-raised, woody species, and natural revegetation were examined in three substrates consisting of overburden gravel, mixed forest soils and layered forest soil. Plant growth in overburden gravel was minimal because of nutrient deficiency, although survival was high. After 5 years height growth in layered soil was nearly twice that in mixed soil. The better growth was attributed to improved drainage and improved nitrogen nutrition. Poor survival of beech species in forest soils was attributed to two root rot pathogens. Nitrogen was the major deficient nutrient in overburden materials containing little soil or organic material. A phosphorus response was obtained in gravels and mixed soils. In the fifth year of the trial, ground cover in the two soil treatments was 38-40%, while cover in the gravel was less than 1%. Tall-growing adventive rushes dominated the mixed soil. Few native species were introduced from the original forest through soil replacement. Ongoing research aims to determine the optimum timing of earthmoving operations so as to maximise natural seeding. (Topic 3.3)

CRAIG W ROSS, RANDY MACGILLIVRAY

Landcare Research NZ Ltd, Palmerston North, New Zealand

Land rehabilitation at Golden Cross gold mine, Coromandel, New Zealand – from opening to closure, a peer reviewer's perspective.

The Golden Cross gold and silver mine, located in the southern Coromandel Peninsula, New Zealand has integrated ecological principles into land rehabilitation design. The 130 hectare mine is situated adjacent to an indigenous Forest Park at the upper end of the Waitekauri River valley in a sequence of volcanic andesite and tephra, which receives approximately 3000mm of annual rainfall. The site was originally a pastoral farm, with remnants of indigenous rain forest and scrub in gullies, and small pine plantations when mining started in 1990. Mining ceased in December 1997. Land rehabilitation has been progressive, with post-mining stages continuing through 2000. The land rehabilitation design has integrated a range of land uses commensurate with providing land stability, public safety, geochemical control, protection of water resources and aquatic ecosystems, and vegetation success and succession. Corridors of indigenous tree and shrub plantings will link the valley floor to the adjacent indigenous forest-covered hills. Enhancement plantings have improved the ecological values of riparian and wetland areas down-valley of the mine. A series of wetlands, including the littoral zone of the tailings lake, are being developed. Pastoral farming has been restored on the waste rock embankment, which contains the tailings lake, to ensure the integrity of buried potentially acid-producing rock. (Topic 3.5)

C ROSS, M SMALE

Landcare Research New Zealand Limited Palmerston North, New Zealand

Native vegetation and soil recovery 20 years after large-scale rehabilitation of hydro-electric sites at Aratiatia, New Zealand

Rehabilitation of hydro-electric development sites at Aratiatia on the Waikato River near Taupo, New Zealand, provided an opportunity to study vegetation and soil recovery after 15-30 years on planted or unsuccessfully planted sites. Revegetation of 108 ha began in 1962, lasting until about 1980. A two-stage planting scheme aimed to simulate natural primary succession; four woody shrub/small tree

species were planted as a nurse crop, with seven further species interplanted about five years later. The anthropogenic soils on rehabilitated sites had parent materials from the original soil (*Taupo tephra*), with admixtures of local pumice and ignimbrite. As a result these soils were highly variable, ranging from low fertility, skeletal A/C profiles to those resembling the original soils. There was a general correlation between the quality of replaced soils and the state of vegetation, with plant health and diversity better on deeper, non-compacted soils. An exception was the tree totara (*Podocarpus totara*), which has grown well on compacted, gravelly soils. Adventive grasses and broom tended to occur on skeletal soils of thin topsoils over pumice. Machinery compaction was still evident 30 years after planting, especially on benches and former roadways. Total carbon levels in some replaced soils were similar to original soils under pasture. (Topic 3.5)

C ROSS, P WILLIAMS, R SIMCOCK

Landcare Research New Zealand Limited Palmerston North and Nelson, New Zealand

Rehabilitation of pakihi wetland after mining in North Westland, New Zealand

Pakihi wetland is open land dominated by tangle fern (*Gleichenia dicarpa*), restiads (*Empodisma minus*), sedges (*Baumea* sp), *Sphagnum* moss, sundew (*Drosera* sp) and scattered manuka (*Leptospermum scoparium*) on poorly drained, very infertile soils. A trial was established in March 1994 to test methods of rehabilitating pakihi wetland after alluvial gold mining. The trial compared two methods of soil replacement — the soil profile replaced in layers, and soil profile mixed to 60 cm, — and three revegetation methods — direct transfer of a mat of vegetation and 30 cm of topsoil, clumps of vegetation and 30 cm of topsoil and, no artificial revegetation. Recovery of pakihi vegetation in this infertile, waterlogged environment took at least three years. Spreading a mat of vegetation and soils produced the fastest recovery; 63% cover after 2 years and 87% cover after four years. Replacing clumps of vegetation gave a slower recovery, but outcomes were similar after four years (85% cover). The poorest outcome occurred where soils were replaced without vegetation; 68% cover and a high proportion of exotic rushes and manuka after four years. Mixing soil layers and replacing them in order gave similar results. Conference results will be updated to include measurements after six years recovery. (Topic 3.3)

IAN D ROTHERAM, JEFF LUNN

The Centre for Environmental Conservation, Sheffield Hallam University, English Nature, York

Positive restoration in a Green Belt opencast site: the conservation and community benefits of a sympathetic scheme in Barnsley, South Yorkshire

This paper addresses the often contentious issues of opencast coal mining in Green belt countryside, with particular reference to the North Derbyshire and South Yorkshire Coalfields. It focuses on a small opencast project on land to the south-west of Barnsley, and considers the role of local people and a sympathetic planning system, in achieving major benefits for conservation. The need to facilitate such environmental benefits, and the potential for site restoration projects are critically examined. The surprisingly positive contribution to local biodiversity, now monitored for ten years after restoration, is highlighted with reference to key groups of fauna and flora, particularly higher plants of ancient woods and meadows, and aquatic fauna such as amphibians and Odonatata. The positive and pro-active

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role of the local community in identifying the opportunity, and in turning words into actions is discussed. (Topic 6.1)

IAN D ROTHERAM, JOHN C ROSE, CHRIS PERCY

The Centre for Environmental Conservation, Sheffield Hallam University

Linking past and future: the dynamic influence of history and ecology on the restoration of a major urban heathland at Warnccliffe, South Yorkshire, UK

Warnccliffe Heath and Craggs is now a major urban nature reserve. Located on the most easterly of the Peak District Edges, though outside the Peak National Park, this is now a major Yorkshire Wildlife Trust Nature Reserve. The site incorporates a Geological Site of Special Scientific Interest, an early Medieval Deer Park, and ancient woodlands, all surrounded by and overlooking contemporary housing expansion, road and rail networks, and a mixture of heavy industry and major industrial dereliction. The history of utilisation and subsequent abandonment, the impacts of industry and urbanisation, and now management as a wildlife site, are all addressed. The contribution of the site to regional biodiversity, being a vital stronghold for locally rare species such as nightjar, red deer, green tiger beetle, adder and grass snake, is discussed, and the dilemmas for local naturalists are noted. In particular, the desire to keep the rare and vulnerable species secret, but in doing so to abandon hope of restoration and management, is noted as a serious constraint and potential threat. The importance of these species, and of local community support in helping to secure vital grant aid, and a balance of appropriate management and low-key access and promotion is addressed. (Topic 4.1)

IAN D ROTHERAM, JOHN C ROSE, CHRISTINE HANDLEY, KURT GOODMAN

The Centre for Environmental Conservation, Sheffield Hallam University. English Nature, York

Restoring urban, wet meadows: five years of recovery of a major floodland in urban South Yorkshire, UK

The Woodhouse Washlands Nature Reserve, is a major Wildlife Trust project in the shadow of the former Orgreave Colliery, in the heart of urban, industrial South Yorkshire. This case study exemplifies the historic context of abandoned and dereliction of the Rother Valley washlands, their eventual recognition in the River Rother Wildlife Strategy, and now piecemeal recovery. The triggers for practical conservation action are noted. These are examined along with the constraints on the present restoration, as a strategic floodplain site, and as a major amenity resource for local people. (Topic 5.3)

EDWIN ROWE, JULIE WILLAMSON AND MARK NASON

Institute of Environmental Science, University of Wales, Bangor LL57 2UW.

Accelerating oligotrophic habitat formation on slate waste

We are testing hypotheses for improving the restoration of slate waste. Low water-holding capacity and low nutrient availability are the main factors limiting the development of vegetation on slate waste. Creating the oligotrophic conditions necessary to maintain high levels of soil organic matter, and habitats important for wildlife, depends on increasing water-holding capacity without greatly increasing nutrient availability. Poor access to waste tips often limits substrate amendments to those which are easily portable. Unless nutrient additions are carefully regulated, vegetation growth may exceed that

which can be supported by the water-holding capacity of the waste, resulting in vegetation which is more susceptible to drought. Large additions of nutrients also result in increased rates of organic matter turnover, and thus slow the accumulation of humus. These hypotheses are being tested at Penrhyn slate quarry in North Wales, in a series of experiments using soil nutrient amendments (fertilizer, biosolids, paper waste), water-holding amendments (polyacrylamide gels, boulder clay) and plants with varying litter quality (heather, alder, birch). Measurements of soil characteristics, litter decomposition rates, and root distributions are being used to parameterise and validate a dynamic model, which will then be used to predict rates of soil organic matter accumulation. Effects of different planting regimes and soil amendments on plant and insect assemblages are being assessed using CANOCO. The project is funded by the European Union (LIFE programme). (Topic 3.3)

PH SALIOU, F ROZE

Campus Scientifique de Beaulieu, Rennes

Hedges Restoration

Different experimentationis about hedgerows restoration have taken place in Brittany (France) for a few years. Vegetation dynamic was studied after building of several new hedgebanks, after cutting invasive vegetation or after new plantations.

This original work using permanent analysis systems, shows vegetation patterns in those different conditions. Seed bank, seed input, competition between plants and landscape impact are presented. The technical ways for trees regeneration are analysed. Decrease of ruderal plants after exportation of organic matter is shown. The signification or species richness is discussed, trying to have references for future restorations. (Topic 4.8)

S SAMUEL

Forestry Commission, Northern Research Station

The use of indigenous seed sources to restore Caledonian pinewoods

Caledonian Forest, in which the endemic Caledonian Pine (*Pinus sylvestris* var. *Scotica*) is the predominant tree, is listed as a priority habitat type under Annex 1 of the European Habitats Directive. Caledonian pinewoods comprise the extreme north-westerly part of the natural distribution of Scots Pine (*Pinus sylvestris*) which is widely distributed throughout Europe and Asia. The Caledonian pinewoods are concentrated in the Scottish Highlands with the majority existing as small fragments, although some larger areas remain (e.g. in Glen Affric). The Forestry Commission has developed an inventory of nearly 80 indigenous areas totalling 16 000 hectares. A regeneration zone, into which each area might naturally regenerate, is recognised together with a further buffer zone in which the origin of planting stock would be tightly controlled. Taking these further areas into account, 125, 000 hectares of key pinewood areas are recognised. A study of variation in the component monoterpenes of resin was carried out during the late 1970s using material sampled in a wide range of the native woodlands. From this work, seven zones were recognised, two of these, in the extreme North-west and South-west of the distribution, being particularly distinct. This zonation forms the basis of the regeneration scheme in use (the New Native Pinewoods Scheme). A register of appropriate seed sources has been developed with the aim of meeting regeneration demands in a particular zone with reproductive material from the same zone. Seed may only be collected from delineated areas which meet criteria for population size, stand density and isolation from extraneous sources. Approval of grant aid

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aims to ensure that reproductive material from appropriate origins is used in artificial regeneration. Planting in the North-west and South-west exclusion zones must use stock derived from the same zone. (Topic 3.6)

E SCHERRER, T SHEAR, JH OLIVER

Restoration Ecology Program, Department of Forestry, North Carolina State University

Using microtopography to restore wetland forest communities in eastern North Carolina

We investigated a method of creating microtopography with a modified plow when restoring farmed wetlands. At two sites, microtopography was restored on four fields, with four others left flat. The soil surfaces of these fields and of nearby wetland forests (controls) were described by measuring elevation at 1 m intervals in 44 ten by ten m plots. We divided the elevation gradients into five classes - from highest to lowest: mounds, lower mounds, mid-elevation, upper troughs, and troughs - and compared: number of occurrences in each class per plot; clustering of features; extremes in height and depth of surface; average extent in surface area of topographic features; and proportion of the surface area per class. The proportions of surface area and the extremes in height and depth of topographic features of created microtopography plots were equal to those of control plots. Features of the highest and lowest classes were randomly distributed in both plot types, while mid-elevation features were regularly distributed. The extents in area of mid-elevation and upper trough classes were equal across treatments, but significantly different for mounds, lower mounds, and troughs. In many aspects, we recreated natural forest surfaces, providing features important to the establishment of wetland plant communities. (Topic 4.6)

R SCOTT

National Wildflower Centre, Liverpool

Adventures in creative conservation -Top soil stripping and other creative substrates.

This project describes the transformation of 1.7 hectares of an urban grassland on deep rich fertile soil, with a heavy weedbank, to a successful wildflower landscape. The technique represents the ultimate in low cost landscaping, it was undertaken at no cost, as the sale of the removed soil paid for the seed and landscaping of the whole area. The paper describes the development of the project and illustrates how simple sowings of wildflower species on such substrates can develop and become more diverse over time. It is one of the most successful techniques in the creative conservation armoury. Many of the problems associated with creating wildflower landscapes have been associated with the sowing of inappropriate species on rich and weedy topsoils. By establishing these landscapes on poorer substrates, management input is reduced, because of reduced biomass from vigorous grass species and wildflower species are more able to self seed. (Topic 4.4)

R SCOTT, K HASSLE

National Wildflower Centre, Liverpool

The Old Rough: New uses for urban greenspace, creative conservation and community business initiatives in Kirkby

This paper looks at the development of a piece of urban greenspace, sandwiched between tower blocks, that has remnants of old woodland with considerable potential for positive environmental change. The project work was initiated by the request of local people in Kirkby and is evolving as an exemplar of creative conservation in transforming an

urban landscape, with a simple landscape structure to one that is rich both in ecological terms and attractiveness. This Project practically demonstrates the definition of creative conservation, creating new places for wildlife to flourish and for people to enjoy. It also shows how these projects can be combined with other social and economic initiatives to result in regeneration based on a broader philosophy. The development of the project is explained from its origins and parallels the development of a community environmental business that has developed in the last two years. (Topic 5.2)

R SCOTT, SMC ROBERTSON, N PILKINGTON

CEH Merlewood Research Station, Cumbria

Saltmarsh restoration on a sensitive site: Sandgate saltmarsh, Cumbria

Following remedial construction work on a railway embankment in Morecambe Bay SSSI, Railtrack commissioned ecological assessment and advice to restore the integrity and quality of a 3km strip of saltmarsh vegetation at Sandgate Marsh. Over 1ha of sheep-grazed turf was transplanted from the Kent and Duddon estuaries. Extraction was subject to sustainable extraction consents. Native substrate was returned to the surface layer in the restoration works to match the original elevation, topography and creek patterns as closely as possible. English Nature set targets for monitoring measurements to describe spatial and vertical range of vegetation at the site, predict the time scale for recovery and evaluate restoration by field survey. Cover was successfully restored in September 1997, surviving storms and high tides. Reduced abundance of high salt marsh species, eg *Juncus gerardi*, was found in 1998 from lower elevations, in favour of *Puccinellia maritima*. Sandgate Marsh lacks plant diversity because of its low elevation, but *Parapholis strigosa*, an inconspicuous grass, was widespread in 1996. Not found in 1997, it re-appeared in 1999. Using native turf was highly effective. Under selective pressures, the species content of high saltmarsh turf modifies to meet the ecological gradients of the new site. (Topic 4.4)

K SENDA, T KENDLE

Department of Horticulture and Landscape, University of Reading

Created school biotopes in Japan

In Japan school grounds have been used positively for some forms of outdoor education for many decades. Recently a new movement has developed with an interest in establishing biotope areas within the school grounds, reflecting concern about urbanisation effects on local ecosystems and the tendency of children to lose contact with nature. Wild habitats such as ponds, woodlands and grasslands are created based on native species, and involve participation of local people. The educational benefits of created biotope areas can be compared with other possible landscape developments. The creation of biotopes can be used obviously for biology studies, but the education program often also has a conservation dimension, aiming to foster awareness and concern for the natural world. Some cities are trying to provide biotope ponds in every schoolground to improve the urban ecosystem. It is also reported that children's attachment to nature is heightened by the improved contact and awareness of the gradual change and the daily formal and informal curriculum use, become more aware of seasons with changes of seasons. Perhaps most significant is their commitment to biotope creation. More details will be reported based on interviews with schools. (Topic 6.3)

T SERJEANT

Lancashire Biodiversity Project Officer, Lancashire Wildlife Trust, Preston

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Ecological Restoration for Biodiversity Targets

The United Kingdom was one of the signatories to the Biodiversity Convention at the Rio Earth Summit in 1992. To meet its obligations under the Convention the UK has developed a highly detailed series of Species and Habitat Action Plans proposing measures to “conserve and enhance biological diversity within the UK”. The sum of all these individual plans - the UK Biodiversity Action Plan (BAP) - sets various targets for: (a) restoration and creation of certain ‘priority habitats’ and, (b) re-introduction of specified ‘priority species’ to parts of their historic range. Using examples drawn from North West England the author will outline some of the opportunities to achieve BAP targets through appropriate ecological restoration. (Topic 2.1)

P SHEPHERD, J BURNEY

Baker Shepherd Gillespie, Woodbank House, Moor Lane, Youlgrave, Derby

Guidance on preparation and presentation of Habitat Replacement Costs

An increasing number of attempts are being made throughout the UK to restore degraded habitats and create or start the process of creating a wide range of new wildlife habitats to replace past losses. Despite existing and future policy requirements and higher standards of environmental compensation where there is going to be an unavoidable loss, no standard approach to the preparation and presentation of habitat replacement costs has been developed for use by practitioners. This paper is based on a recently commissioned piece of research by English Nature in collaboration with MAFF which attempts to develop a general framework for the compilation and presentation of habitat replacement cost estimates.

The guidelines set out, firstly, a process that is useful to follow in developing cost estimates and secondly, a way of presenting the estimates. It attempts to ensure that the full cost of planning, designing, implementing and monitoring a habitat replacement project is properly and consistently estimated. The preparation of the guidance has been based on case studies of habitat restoration and creation of grazing marsh, reedbed and coastal lagoon. The paper presents the generic costs/ha of restoring the three habitats studied and discusses the shortfalls and problems of costing habitat replacement schemes. (Topic 3.1)

P SHEPHERD, G HEWSTON, N LEWIS

Baker Shepherd Gillespie, Woodbank House, Moor Lane, Youlgrave, Derby

Restoring the heathland of the ancient Sherwood Forest

Lowland heathland is a rare habitat in the UK which has suffered dramatic declines over the last 100 years. In Nottinghamshire heathland, is primarily confined to the Sherwood Sandstone areas of the county and declined by over 90% since 1922. Declines have been brought about as a result of afforestation of agriculture and urban and industrial sprawl.

The heathland of Nottinghamshire was once an integral part of the landscape of the Ancient Sherwood Forest which comprised a mosaic of oak/birch woodland, grass heath and heathland. The decline of heathland and recent recognition of its international importance has provided the impetus for the production of a Nottinghamshire Heathland Strategy, one of the first of its kind in the country. It aims to maintain a viable heathland resource within Sherwood. Surveys and the use of Geographical information Systems has enabled an inventory of the existing heathland area to be compiled and a restoration plan devised. This has prioritised over 30 sites for heathland re-creation

based on ecological, financial and opportunity criteria. This paper reviews the impact of the strategy to date and considers some of the mechanisms by which strategic objectives can be achieved. Case studies of heathland restoration within land forestry, agriculture, leisure, minerals and waste land uses are presented and discussed. (Topic 4.3)

P SHEPHERD, S LATTERWAY, N LEWIS

Baker Shepherd Gillespie, Woodbank House, Moor Lane, Youlgrave, Derby

From Coal Black to Sherwood Green? The Restoration of habitat within the Nottinghamshire Coalfield - A Review of Policy and Practice.

Following the drastic decline of the coal industry in the UK the majority of deep coal mines in operation in 1980 have been closed leaving behind large areas of colliery spoil heaps and industrial dereliction associated with the pit heads. Although the Nottinghamshire coalfield was not initially so drastically affected, pit closures in the county have continued and are still continuing today. The coal tips of Nottinghamshire are situated primarily in the Sherwood and Magnesian limestone Natural Areas and provide opportunities for the restoration of acid grassland, oak/birch woodland, mixed ash woodland, heathland, wetland, and neutral and calcareous grassland. Since 1980 over 2000 ha of colliery pit heap has become available for restoration, presenting the largest opportunity for the restoration of ecological habitats in the country since the end of the second world war. An overview of the range of restoration of coal tips in the county in terms of land-use and restored habitats is presented and how past and present restoration fits within the policy and legislative framework is discussed. Some restoration undertaken has been criticised for not maximising potential ecological benefits. The reasons why this has occurred is discussed in the context of various policies and strategies and other mechanisms that have influenced the nature and extent of ecological restoration on coal tips in Nottinghamshire. (Topic 2.2)

T SHIGEMATSU

Department of Environmental Design, Institute of Design, 4-9-1 Shiobaru, Minami-ku, Fukuoka,

Woodland improvement and restoring terraced paddy fields as wildlife habitats and sustainability by conservation volunteer activities

In mountainous Japan, people historically lived in rural mountainsides or highlands. They managed surrounding woodlands by periodical harvesting of fuel materials. Terraced paddy fields were also constructed in mountain slopes with dry stone walling. Although it destroyed natural forests, the secondary forests and the fields formed various habitats and attractive landscapes. However, nowadays it is difficult to manage them, due to the fuel revolution, rice-surplus and labour shortage in rural villages. Abandoned coppices and conifer plantations have lost bio-diversity and amenity under dense shading condition, even with erosion in the bare floor. Collapsed terraced paddy fields also tend to abandon nor to repair with concrete. Since 1975 experimental works were continued in order to restore the bio-diversity and amenity in the abandoned forests. To apply the research results to the actual situation, conservation volunteer activity was raised in 1987. Based on the remarkable response of volunteers, since 1994, international conservation working holidays were conducted jointly with BTCV. The volunteer activities, including dry stone walling, showed not only to restore the habitats and amenity landscape, but also to make people understand an importance of local

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conservation activities for sustainable human life in domestic and global. (Topic 6.4)

R SIMCOCK, C ROSS, P WILLIAMS

Landcare Research New Zealand Limited, New Zealand

Accelerating rehabilitation of native ecosystems: an overview of direct transfer successes and failures in New Zealand

Direct transfer, or community translocation, comprises salvage and replacement of intact *ĕsodsi* of vegetation with underlying soil. Variations of the technique have been used in Britain to conserve high-value heath and chalk grassland communities, and in Canada to enhance diversity of tailings ponds and introduce native plant understorey species to areas being rehabilitated. In New Zealand, direct transfer, using two to six m² sods with up to 0.7 m depth of soil, has been used to rehabilitate indigenous plant and invertebrate communities after open cast mining. This paper illustrates the key principles and gives examples of successes and failures of the method in New Zealand. Success includes translocation of insect species, including large, flightless beetles and wetas. Positive results have been achieved with a range of communities, from fern wetland and sub-alpine tussock grasslands to 5 m tall beech forest under-storey and seral shrub-land, and within a range of climates from temperate to sub-alpine. Failures include excessive death of plants because of inadequate soil depth, acidic leachates, or overly-rough handling of stripped sods by inexperienced machinery operators. Change in plant species composition has occurred where clumps of vegetation are too far apart, or shifted plants were too small. In both cases invasive weeds have smothered the original vegetation. (Topic 3.2)

W SIMONSON

Habitats Co-ordinator, Biodiversity Programme

Habitat and species restoration under the UK Biodiversity Action plan

The UK Biodiversity Action Plan is targeting the restoration/recovery of 45 priority habitats and 500 species across the terrestrial, freshwater and marine environments. This poster describes, with examples, English Nature's strategic approach to meeting the restoration targets for a range of these habitats and species. (Topic 2.1)

RS SINGH

Central Mining Research Institute, Dhanbad- 826001 INDIA

Restoration of Mined-out Coal Areas in India

In surface mining systems, it has become increasingly important that the mined waste should be utilized - by backfilling in the open pit as much as practicable. Any excessive waste materials may be dumped and terraced with stabilization by vegetation. Proper planning and establishment of a vigorous self-sustaining plant community of the region are then essential for an eco-effective reclamation of mined out areas. A three years study has been performed in five different phyto-geographical region of the country to understand the environmental management of the mined out wasteland areas with respect to long term stability of the dump slopes, control of air and water pollution, conservation and enhancement of the soil fertility, to provide forage and browse for the wildlife, preservation of bio-diversity, and maintenance of aesthetics in the coal field areas of India. Results indicate that environmental management of the mined out areas is possible if the mine planning and implementation of the greenbelt development is done scientifically in parallel with onset of mining. It helps in reducing air, water and land pollution along with substantial improvement in ecology and environment. (Topic 3.3)

RW SMALL, S TOLHURST, S MCQUEEN

Biological and Earth Sciences, Liverpool John Moores University

Grazing for Habitat Restoration: the Role of the Grazing Animals Project

In the U.K. many sites of conservation value were created by or for grazing animals including upland and lowland heath, chalk downland, pasture-woodland and meadows. Many of these habitats are marginal to current agricultural production and have become degraded through lack of grazing and encroachment of coarse grasses and scrub. In addition, many habitat creation projects, such as the re-creation of chalk grassland from arable and the re-vegetation of waste tips, require grazing and browsing if the desired plant communities are to be achieved and maintained. To counter these problems site managers are increasingly developing their own grazing projects. The use of grazing livestock for habitat management in conservation has evolved from a largely experimental technique in the 1960s to become the preferred method on many sites of conservation value. Restoration and conservation grazing schemes engender their own problems in terms of stock selection, procurement and management, stock handling facilities and staff training. The Grazing Animals Project was established in 1997 and seeks to address and alleviate these issues through a range of local, regional and national initiatives. (Topic 4.8)

A SMITH, T FARQUE

USDA Forest Service Sweet Home Ranger District, Oregon

Camas Prairie Restoration Project

The goal of the Camas Prairie Restoration Project is to promote camas (*Camassia quamash*) production through restoration of a degraded prairie wetland in an area where Native Americans historically used camas bulbs as a primary food source. Elements of the project include camas seed collection and propagation, removal of invading Oregon ash trees and non-native blackberries, prescribed burning at two-year intervals, dispersed recreation site management, and planting camas seed and bulbs. The project was initiated as an interagency and intergovernmental project involving the Bureau of Land Management, the Siletz, Klamath, and Grande Ronde Indian Nations, private contractors, Oregon State University, and Lane Community College. Restoration activities at the Camas Prairie have been ongoing for three years. In addition to growing bulbs from collected seed, and cutting back trees and shrubs, plots were installed to determine the effect of treatments on camas density. Pre-treatment cultural resources surveys revealed a 6000 year history of Native American presence at the site. Following prescribed burning, all co-operators assisted in planting camas bulbs and seed. A management plan for the Camas Prairie is being drafted using tribal involvement and review. The Linn County Sheriff's Inmate Crew assists with weed control on an ongoing basis. (Topic 4.7)

B SMITH

School of Conservation Sciences, Bournemouth University

Local provenance material

Emphasis is placed on the significance of locality when collecting or buying seed for grassland restoration. Experimental work on the re-vegetation of a limestone quarry is being conducted at a redundant site in Dorset, UK. Current theory suggests that seed should be collected within a radius of 100 metres of the site being restored. Using *Lotus corniculatus* L. as a test species, experimental work was designed to determine whether there are observable differences in morphological traits and phenotypic expression in the progeny of various provenance. The work is based on the progeny of 14 populations grown in

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controlled conditions at the Institute of Terrestrial Ecology, Dorset with supporting field trials. The paper discusses the significance of geographical and ecological distance on the variation between populations and assesses the significance for grassland restoration. The nature conservation and economic implications of these results will be evaluated. (Topic 3.6)

GF SMITH, DL KELLY, FJC MITCHELL

Department of Forestry, Trinity College, Dublin

Establishment of native woodlands in felled conifer plantations

Land use changes and increased awareness of environmental issues have led to expansion of conservation areas in the uplands of Ireland. These developments have opened opportunities for rehabilitating land where plantations of exotic conifers have been felled. Because of the scarcity and conservation value of semi-natural woodlands in Ireland, this study investigates how to establish native woodlands successfully on plantations felled 1-10 years ago. Fifteen permanent plots were established in the Wicklow Mountains of eastern Ireland, and six were located in Killarney in the southwest. Clusters of pure oak (*Quercus petraea*) and mixed oak/birch (*Betula pubescens*) seedlings were planted. The impacts of large herbivores and vegetation competition on woodland establishment are being examined by fencing and manual weeding treatments. Results to date indicate that browsing has damaged most unenclosed tree seedlings. Dense conifer logging brash, however, has reduced herbivore damage in some sites. Natural tree regeneration varies widely among the study areas, but is greater inside the exclosures and near mature woodland. In the younger clearfells there is little vegetation, particularly where spruce was the former crop. Only low numbers and abundance of oak/birch woodland species are present at any of the sites. Sitka spruce regeneration and invasion by *Rhododendron* are potential threats. (Topic 4.3)

KARL D. SMITH

Nurturing Restorations Inc, Broadview Hts., Ohio

The Guiding Light -Quantitative Behavioral Standards

We need a guiding light so we know where we are going. Quantitative Behavioral Standards (QBS) is a method that has been used successfully to clearly state how the ecosystem will be different during and after the restoration. The QBS is quantitative because it contains numbers i. e. by the end of the third growing season the average density of prairie grasses would be 6 stems or higher. The QBS is behavioral because it states the behavior of plants or animals i. e. White Oak (*Quercus alba* L.) will produce seedlings more than once every 15 years. The QBS is a standard because it can be used to determine if the restoration has or will meet the QBS. The QBS is so measurable that a person can be trained in a day or less to determine if the restoration has or will meet the QBS. Long-term monitoring is required to determine if the restoration has or will meet the QBS.

S SMITH, M WHITE

President CEO, Urban Forest Associates INC, Canada

Deciduous Southern Ontario, a Canadian Carbon Sequestration venture.

From 1996 (1993) to 1998, Urban Forest Associates, a small Reforestation Design and Management company and SER Ontario member in Toronto Canada carried out North York Hydroelectric Commission's Tree Power project, planting and maintaining 145,000 native trees and shrubs on public and private open space, particularly river valleys. In 1999, Urban Forest Associates met with then Ontario

Hydro, the Ministry of Food and Agriculture, the Royal Bank of Canada and SER to establish criteria for reforesting long-term leased farm and rural municipal properties. Financial resources for this program would come from setting up and sale of Carbon sequestration credits based on the important carbon biomass predictions for Southern Ontario deciduous forest. This paper and visual presentation will describe progress on this project. (Topic 1.2)

RUTH SPARKS

NTC ITAM Program , Fort Irwin, CA

Utilizing GIS Tools for Planning and Monitoring of Rehabilitation Projects at the U.S. Army National Training Center , Fort Irwin, California

The Integrated Training Area Management Program is responsible for rehabilitation and maintenance of training lands at the Army National Training Center. An important part of the ITAM mission is to provide a safe and realistic environment in which soldiers can conduct extensive ground combat maneuvers. Use of Geographical Information System (GIS) technology has enabled the ITAM Program to more effectively plan and monitor rehabilitation project sites. Areas that are, or may become, dust or erosion hazards are identified using a combination of aerial orthophotographs, ArcView coverages, and ground reconnaissance. Once identified, individual sites are evaluated, prioritized and site plans are developed for remedial or preventive action. Data layers including soils, roads and trails, slope, and training usage are employed both in the detection of potential problem sites as well as in project design. Upon completion of fieldwork, locations of all project components are recorded with a Differential Global Positioning System (DGPS) unit. Project site maps developed from these data are extremely valuable for continued maintenance of the site and for monitoring the effectiveness of erosion control and revegetation techniques over time. GIS related aspects of project planning, implementation and monitoring are demonstrated with a specific project site. (Topic 3.7)

CHRIS SPERRING

Hawk and Owl Trust, Bristol

Top Predators in a Modern Landscape

The Barn Owl (*Tyto alba alba*) has declined in Britain by 69% since the 1930's to the current population of around 2,500 pairs, and has become extinct in Avon. The project involved researching the relationship between the barn owl and its prey species in order to gain better understanding of the reasons behind the decline. The main problems stemmed from the increasingly intensive use of farming areas (the traditional haunt of the barn owl). The project then visited farmers to establish a network of habitats that worked alongside the intensive systems, allowing areas of grassland around the edges of field systems to form corridors of long, rough grass, the vital habitat of the barn owl's chief prey species. These areas were then linked, forming a prey-rich grassland corridor that stretched from Somerset through to Avon to allow young, distributing barn owls produced in Somerset to move into Avon by way of safe, prey-rich hunting areas. Networking (involving government bodies, businesses, farming groups and educational establishments) was essential to the success of this project. The habitat restoration gained momentum and within 18 months barn owls began breeding in Avon. The first pair to breed in the county for six years produced a record 8 offspring from 9 eggs. This quick response was mirrored in other grassland species. The untidy nature of the rough, rank grassland was affording both critical cover and feeding for many species of insect, bird, mammal, reptile and amphibian alike. In 1999, as a direct result, barn owl numbers

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have swelled to over 30 pairs. The barn owl is, however, just a popular flagship for the whole bio-diversity that exists within these habitats. (Topic 1.4)

G SPOOR, G HIRONS

Finding and assessing opportunities for wetland restoration

Royal Society for the Protection of Birds, Sandy, Beds
As more wetlands have been brought into conservation, ownership and management, there is an increasing trend for conservation organisations to acquire sites with the potential for wetland creation rather than on the basis of their existing conservation value. This paper describes how this potential is assessed by RSPB prior to acquisition and how expensive mistakes can be avoided. Key topics addressed will include the objectives of management, the information required from pre-acquisition surveys (geology, soil type, topography, water availability), the relevance of this information to the achievement of the objectives set, habitat design and water management. Other considerations such as planning, flood defence and land drainage requirements and the attitude of the local community will also be discussed. Throughout reference will be made to specific case studies. (Topic 4.6)

A SPRINGER, M AMENTT

Restoring riparian areas through landscape restoration: Influence of upland grazing, tree thinning, and fire on riparian ecosystems

In semi-arid regions where water is a limited resource for ecological restoration, changes in land management can alter hydrologic processes of recharge and discharge for riparian ecosystems. Riparian areas occupy a small percentage of the landscape, but receive all of the natural discharge from aquifers. In the semi-arid Southwestern U.S., usually less than 1 % of total annual precipitation actually recharges the aquifers that supply the low elevation riparian areas. The rest of the water evaporates, transpires, or runs off. Changes in upland grazing, tree thinning, or fire management in upland forests can change the hydrologic balance and capture the small percentage of water that is not used by transpiration but is available for aquifer recharge. We are returning fire to a small alpine prairie that has experienced extensive pine encroachment since Euro-American settlement. Before thinning the forest and returning frequent fire to the prairie, we designed experiments to study how changes in transpiration would influence changes in recharge. We used measurements of water use by trees and herbaceous plants to estimate changes in recharge that may occur due to management activities such as tree thinning and burning. Because restoration of the riparian area alone was not been successful, we had to restore the landscape to restore the associated riparian area. (Topic 4.6)

SUSAN STEINMAN

4227 M.L. King Jr. Way, Oakland, CA

RED Light, GREEN LIGHT: ECOART SIGNALS COMMUNITY-BASED RESTORATION

Restoring the ecological integrity of urban communities is critical. Poor neighborhoods suffer disproportionate physical and mental health degradation. When money is needed for jobs, housing and education, ecoart appears an unlikely tool for successful community building. The opposite is true. Ecoart is shown to be a viable pragmatic cross-disciplinary strategy for restoration of native habitat, community

health, urban beauty and hope. There are two sets of complementary ecoart methodologies: 1. "Red light" improvisational temporary installations calling attention to conservation issues. 2. "Green light" projects melding art and ecology with urban planning and landscape design. The art process involves a multi-year commitment to community building, collaboration, green education, green employment and healthy habitat restoration. These contrasting ecoart restoration strategies will be illustrated. (Topic 6.2)

D STEPHEN, L CARVALHO, M BEKLIOGLU, AE WILLIAMS, B MOSS

School of Biological Sciences, University of Liverpool

Is External Nutrient Reduction a Useful Lake Restoration Tool?

A series of three lakes in the north-west of Britain (situated in a region known as the North-West Midland Meres) has been monitored since 1990. These lakes (Mere Mere, Little Mere and Rostherne Mere) provided a good opportunity to monitor parallel changes in both shallow (Little Mere) and deep (Rostherne Mere) lakes following sewage effluent diversion. Sewage treatment works in the catchment had discharged nutrient-rich effluent into Little Mere and Rostherne Mere until diversion in 1991. The monitoring has recorded the response to this restoration measure in Little Mere and Rostherne Mere, with Mere Mere upstream acting as a control. Shallow lakes are typically resilient to change following nutrient reduction. However, the shallow lake in the system (Little Mere) responded dramatically and rapidly following external nutrient reduction. Contrary to the conventional wisdom of external nutrient control as an effective restoration tool for deep lakes, Rostherne Mere has not yet responded to the external reduction. Reasons for the responses observed in these two lakes will be discussed. (Topic 4.2)

MICHELLE STEVENS

Jones and Stokes. Sacramento, CA.

Effects of Nitrogen Fertilization on *CAREX BARBARAE* Autecology and Ethnobotany: Implications for Restoration.

White root (*Carex barbarae*) is used as both an understory dominant plant in riparian restoration and as a culturally significant plant used for basketweaving. Horticultural methods used by California Indians form the basis for this mesocosm experiment testing the effects of traditional resource management on the growth and reproduction of *Carex barbarae*. A mesocosm experiment studying plant growth in four soil types showed rhizome production was significantly lower in sandy soil. This contradicts traditional Environmental Knowledge that the longest rhizomes that are best for basketweaving are produced in sandy soil. Postulating that reduced rhizome growth in sandy soil was a result of nutrient limitation, this nitrate fertilization experiment tested plant growth and reproduction under high- and low- nutrient experiments.

Carex barbarae responses in low nutrient environments include the following: longer rhizomes, lower total biomass, increased below-ground biomass, high root:shoot ratios, increased retranslocation of nitrogen and phosphorus, higher nitrogen use efficiency (NUE) and lower fecundity. As nitrogen supply increased, total plant biomass and fecundity increased, and NUE decreased. Fertilization of restoration sites and increased eutrophication of surface water will result in shorter rhizomes that are less desirable for basketweaving. However, increased nutrient availability will increase seed and biomass production, which may be advantageous for revegetation. (Topic 3.4)

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FIONA STEWART

Are our Greenspaces safe?

Greenspaces are important for wildlife and people alike. In 1997 the Scottish Wildlife Trust carried out research on open space standards in Scottish cities which resulted in an SNH report entitled "The State of Scottish Greenspace". The Scottish Executive has addressed the need for open space provision, particularly informal areas by special mention in the planning guidance they provide. Are our greenspaces safe for future enjoyment however? The Scottish Wildlife Trust manages greenspaces at Cumbernauld new town and is gradually increasing informal greenspace with the help of the local community. This project will be discussed and its potential both in Cumbernauld and elsewhere for our greenspaces. (Topic 6.1)

M STREET

Milton Keynes Parks Trust

A flood plain forest restoration project

Forest clearance and agriculture have virtually eliminated inundation woodlands from Britain. Increased silting on flood plains and river channel improvements have removed the interacting dynamics of fluvial processes that drive the cycle of succession and reversion that maintains the very rich wildlife characteristic of natural flood plains. With reduced demand for agricultural production and concern over run-off, alternative uses for flood plains are being sort. Examples of such restoration are under way in mainland Europe allowing succession to woodland cover controlled by large herbivores. Milton Keynes Parks Trust manages 1800ha of parkland along river valley flood plains, including a 40ha site alongside the River Ouse, which provides ideal conditions for experimental restoration of flood plain habitats, especially woodlands of oak, ash, black poplar, willow, alder, elm and small leaved lime, and associated wetland habitats. A borehole survey has shown that removal of an underlying gravel deposit will allow the remodelling of the floodplain surface, and the formation of a multiple channel topographically diverse system with a mosaic of habitats to be developed in a lightly wooded landscape. By partnership with a national mineral company, the value of the deposits will be sufficient to fund the whole exercise. (Topic 4.3)

HEIKE STRELOW

Wiesenau 34, Frankfurt 60323

Ecological Art: The Need for New Forms of Cultural Co-operation

Ecological Art /Environmental Art does not fit in easily with usual art activity, but demands a special flexibility from the curator as well as the readiness of leaving the narrow boundaries of the art context. It starts with the fact that this art is difficult to show in Museum or gallery spaces and often asks for new forms of presentation. Mostly, it prefers public spaces, choosing big, ecologically explosive areas, or it subtly penetrates social structures. Thus the curator's task changes, too. In close co-operation with the artist he becomes more and more a project manager; at the same time he is confronted with new responsibilities in his function as a mediator. Projects of Ecological Art are characterised by a great need for communication. This starts with the intensive research works that have to be done before and during the realisation of a project, and in which experts of diverse disciplines are included, and continues after realisation with approaches to the population. Just as the artist, the curator/project manager must be aware that he is not so much addressing art connoisseurs, but intends to reach a much greater audience with ecological topics. All this requires a close co-operation of artist, curator and other people involved in the project, it requires an interdisciplinary way of thinking

and working, and new forms of conveyance. With concrete examples, these special forms of cultural work are here presented and analysed. (Topic 6.2)

N SYMES, J DAY, B PICKESS, N GARTSHORE

RSPB Dorset Heathland Project, Wimborne Dorset

Heathland restoration on RSPB reserves in Dorset

Threats to lowland heath in Dorset formerly centred around development for urban, industrial and leisure interests, or conversion to farmland or forestry. Large scale surveys undertaken in 1987 and 1996 found that the main threat is now the loss of open heath to woodland and scrub despite considerable efforts by conservation bodies to maintain these areas by scrub and tree clearance. Only 60,000 ha of heathland now remain in lowland England. Most woodland (and some scrub) regeneration consists of Scots pine (*Pinus sylvestris*), with scrub encroachment also by gorse (*Ulex europaeus*), bracken (*Pteridium aquilinum*) and the aliens *Rhododendron ponticum* and, more locally, *Gaultheria shallon*. Most clearance in the past has been carried out using manual methods, but increasingly, mechanisation of scrub and tree clearance have been adopted. This trend will continue to increase as the scale of the problem increases beyond the use of traditional resources to deal with it. A number of case studies are used to illustrate the extent of the problems and current solutions. The costs of such management can be substantial, although income from marketing heathland produce has been developed to offset these. (Topic 4.3)

JRB TALLOWIN, J ISSELSTEIN, REN SMITH

Institut fuer Pflanzenbau und Pflanzenzuechtung, Abteilung fuer Futterbau und Graslandwirtschaft, Universit%ot Goettingen

Providing safe sites for seedling recruitment: a key factor in fen meadow restoration.

Knowledge of species-specific requirements for semi-natural grassland seedling recruitment is poor particularly in relation to defining safe sites for germination and establishment. An experiment was conducted to identify whether species-specific conditions for seed germination and seedling establishment were required for some fen meadow species. Treatments comprised: irrigation or no irrigation, presence or absence of existing vegetation canopy and presence or absence of soil disturbance on either a species-poor grass dominated community or an existing Cirsio-Molinietum fen meadow. Higher germination was observed in the fen-meadow than in the species-poor grassland the difference being associated with the incidence of more light to the seed environment, a stronger day-night variation in relative humidity and higher soil water availability in the former. Differences in response to the experimental treatments were observed between fen meadow species and a more generalist grassland species. Soil disturbance enhanced germination generally whereas the effect of removal of the vegetation canopy was more specific. Seedling survival was generally higher in the fen meadow than in the species-poor grassland. Presence of the species-poor grassland canopy was the major factor that reduced seedling survival. Irrigation and soil disturbance were of minor importance for seedling survival in both grasslands. It was shown that safe sites for seed germination and seedling establishment of fen-meadow species existed in the fen meadow even without soil disturbance and gap creation. No such safe sites existed in the grass dominated community. The need for species specific definition of safe site characteristics at the seed germination and the seedling establishment stages was demonstrated in this study. (Topic 4.6)

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G THOMAS, G HIRONS

Royal Society for the Protection of Birds, Sandy, Beds, UK

The RSPB approach to habitat restoration: from mission statement to nature reserve

RSPB uses a targeted, objective-led approach to deliver habitat restoration for priority bird species. Using this approach, RSPB has re-habilitated or created 1900 ha of semi-natural habitat in the UK in the last 5 years.

This paper describes how priorities for conservation set in national species and habitat action plans are translated into targets for habitat restoration within a reserves acquisition strategy using the example of wet grassland. The reserves acquisition strategy guides the initial identification of potential sites for acquisition and subsequent habitat restoration. The attributes of a potential site are then assessed against a set of pre-determined criteria. For wet grassland the criteria for restoration include such factors as size, substrate type, water supply, geographical location, historical bird numbers, predicted bird numbers and land ownership patterns. Some of these factors may require detailed site investigation prior to acquisition.

Once a site is acquired, the objectives for the site and the action to achieve them are developed in a site management plan. The objectives are quantified and include time-limited targets for species number and habitat extent. Implementation of the management plan is monitored via the Countryside Management System with progress reviewed at project team and/or annual review meetings. The biological success of restoration is monitored in relation to the targets in the management plan and the contribution made to achieving the national targets in species and habitat action plans. (Topic 2.1)

W THROOP

Departments of Philosophy & Environmental Studies, Green Mountain College, USA

The Moral Assessment of Restoration Methods

This paper provides a framework for morally evaluating the methods used to restore an ecosystem. I focus on restoration activities that cause the death of sentient organisms and argue that restorationists encounter a special burden of proof when their activities result in high mortality rates. This burden of proof can be met in many cases where the goal of restoration is a predisturbance system, but the task is more difficult when the goal is healthy ecosystem processes. When lethal means are justified, restorationists face moral dilemmas; their decisions violate moral values. I argue that the appropriate response to moral dilemmas is guilt and regret. This attitude towards some restoration projects is at odds with William Jordan's celebration of restoration as "a model for a healthy relationship between human beings and the rest of nature." Thus, we should often adopt a more complex attitude towards restoration, an attitude in which the joy of joining together to help nature heal is tempered with sadness and regret at being in a situation where the death of other members of the biotic community is the only way to rectify some harm we have visited on the community. (Topic 1.1)

PM. TIKKA, T HEIKKILA, M HEISKANEN, M KUITUNEN.

Department of Biological and Environmental Science, University of Jyväskylä, Finland

Reclamation of a dry meadow: management, nutrients and the small-scale dispersal of the species

Semi-natural grasslands have become scarce in northern Europe, owing to changes in agricultural practices. The loss of semi-natural grasslands is the main threat for a quarter of the threatened plant species in Finland. We laid out an experiment to study the

establishment of grassland plants on a former, impoverished arable field. To assess their dispersal in the small scale, we planted the seeds and seedlings into marked, regularly spaced points in the experimental squares. We also studied the effects of management and the varying nutrient levels on the resulting vegetation. Grassland plants reached the highest coverages in squares treated by weeding and the lowest coverages in control squares in which their seeds or seedlings were not initially inserted. Where grassland species grew among the emerging weeds, only few of them retained coverages worth mentioning. Weedy species benefited from increasing nutrient content, further decreasing the abundance of co-occurring grassland plants. The ability of grassland species to regenerate was poor; they did not invade the control squares, and the sward was sparse even in the squares where competition by weeds was eliminated. Clearly, seeding rate must be high and the soil impoverishment very effective for creating a contiguous sward of grassland vegetation. (Topic 4.4)

DS TOMPKINS, SJ HILL, JE MASKALL, BHJ BAKAR

Department of Environmental Sciences, University of Plymouth

A preliminary biogeochemical characterisation of tin mine spoils in Malaysia and the implications for their re-vegetation

Approximately two percent of the land area of western Malaysia comprises tailings from former alluvial tin mining operations. Tin ore (cassiterite) is extracted from subsoils by suspension in water and gravity separation, producing tailings which vary in composition from fine clay to coarse sand and gravel. Although natural re-vegetation does occur on the most favourable micro-sites, it has been estimated that without intervention it could take up to two hundred years for natural forest to return. Previous approaches have examined the possibilities for converting these sites to agricultural or agroforestry use, often using exotic species. These rely heavily on ameliorating the infertile spoil, which typically exhibits low levels of macro- and micro-nutrients, low cation exchange capacity and low organic matter content. This project aims to quantify these variables and identify plant species that show some pre-adaptation to existing site conditions, thus working with, rather than avoiding the problem. Initial studies have comprised surveys of existing vegetation and collection of spoil samples at selected sites of former tin mining in Malaysia. Spoil samples have been analysed for a range of constituents and physico-chemical properties. In this poster, preliminary results are presented and the implications that they have for re-vegetation of Malaysian tin tailings are discussed. (Topic 3.3)

I TRUEMAN, E COHN

Biological Sciences, University of Wolverhampton.

Creating attractive native vegetation in towns - problems and possibilities.

The authors have created numerous examples of species-rich grassland and woodland field layers on public open spaces in Wolverhampton and Telford Long-term monitoring data will be presented to illustrate management difficulties in urban areas where typical agricultural and forestry practices are problematic. The data also illustrate the capacity for artificial communities to develop some of the properties and characteristics of semi-natural communities. Available costings which suggest that such habitats are relatively cheap to manage will be contrasted with the "paradigm shift" most local authority land managers will have to undergo to take advantage of possible savings. Difficulties in assessing public perceptions of such sites will also be discussed, particularly the role and value of species-rich vegetation in encouraging positive perceptions of urban forestry. (Topic 5.3)

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A TYE, V CORONEL

Dept of Plant & Invertebrate Sciences, Charles Darwin Research Station, Isla Santa Cruz, Galapagos, Ecuador

First steps towards restoration of an extinct population of the Galapagos endemic cactus *OPUNTIA MEGASPERMA* on Espanola Island

The flora of Espanola Island, Galapagos, is recovering after the eradication of goats some 20 years ago, but certain elements do not seem to be recuperating adequately. *Opuntia megasperma* disappeared from much of the island during the period when goats were present, including the eastern Punta Cevallos area, where historic photographs show a formerly large population. The nearest remaining adult *Opuntia* are several km from Punta Cevallos, and unassisted re-establishment of the population in the near future is unlikely. Even in areas where adult *Opuntia* remain, regeneration is zero or minimal, probably partly as a result of the diminished total population, with seed being consumed by Darwin's finches. In order to investigate the possibility of experimentally re-establishing a population at Punta Cevallos, *Opuntia* was surveyed throughout the island. Fruits collected from adults of the nearest large population were given various treatments, all of which led to some germination, showing that seed viability is not the reason for lack of regeneration. Seeds germinated best following consumption of the fruit by giant tortoises seedlings were grown on in vermiculite, and used in repatriation trials at Punta Cevallos. Survival of unprotected and caged seedlings is being monitored. (Topic 4.7)

ML UKELES

Fresh Kills, the mother of all landfills

The mother of all landfills, Fresh Kills is the largest on the planet, occupying a site of 3,000 acres. Thirteen thousand tons of garbage are brought to it every day. When completed, it will be the largest man-made structure ever built, as well as the highest point on the eastern seacoast - a social sculpture we have all wrought in common. My work is divided into several phases. Phase I involves research, ranging from pre-historical sacred mounds to ecological parameters of landscape restoration processes and bioengineering restoration techniques in relation to government regulations. Concurrently, I've begun phase II, which involves rigorous experimentation with a range of recyclables. These prospective landfill construction/art materials will be used on a huge scale, in ways not yet seen. The challenge is to determine whether they are permanent, durable, and safe, and whether they make sense at this scale artistically. The design of garbage should become the great public design of our age. I am talking about the whole picture: recycling facilities, transfer stations, trucks, landfills, receptacles, water treatment plants, and rivers. They will be giant clocks and thermometers of our age that tell the time and health of the air, the earth, and the water. They will be utterly ambitious - our public cathedrals. For if we are to survive, they will be our symbols of survival. (Topic 6.2)

JT VALENTA

Northwest Florida Water Management District

***LYGODIUM JAPONICUM* at Apalachicola River Water Management Area Florida, USA**

Invasive exotic plant species threaten the integrity of many indigenous ecosystems throughout the world. These threats are magnified on island ecosystems like in Hawaii, but can seriously disturb continental systems, for example the cerrado of Brazil, the fynbos of South Africa and the Apalachicola River in Florida where *Lygodium japonicum*

has infested different floodplain forests. Because of the lack of information available on controlling *L. japonicum*, twenty-seven herbicide efficacy plots were established on Florida River Island. Three chemicals were selected from preliminary trials and applied at three different rates. These were Garlon 3A (Triclopyramine), Garlon 4 (Triclopyrrester) and Rodeo (Glyphosate). Garlon 3A had 100% control at 42 DAT and 63 DAT and Garlon 4 had 91% control for the same periods. But, both herbicides had total re-growth after 184 DAT. Rodeo took 24 DAT to reach 75% control, 45 DAT to reach 87%, and dropped-off to 71% at 166 DAT. The District is continuing to develop control methods for *L. japonicum* focusing on Rodeo applied at different rates and different seasons. Complete eradication of *L. japonicum* is doubtful, but an effort to minimize this species effect on floodplain ecosystems is of the utmost importance, for maintaining their soundness. (Topic 4.7)

R VAN DIGGELEN, JP BAKKER, HMC VERHAGEN.

Laboratory of Plant Ecology, University of Groningen

Restoration of heath land communities by top soil removal: utopia or panacea?

The restoration of low-productive heathland and dry grassland communities has become a high-priority target in Dutch nature protection. Traditionally this target was pursued by a long-term management of mowing without fertilisation but recently the technique of the removal of the nutrient-rich top soil was developed to speed up this process. In general, a restoration of a former state seems only possible when abiotic conditions lie within the tolerance of target communities, when viable diaspores of goal species are available, and when there are enough regeneration gaps in the vegetation. The present study was set up to investigate the effect of top soil removal on these elements and their role in the process of heathland regeneration. Under certain conditions the technique seems to work. Examples of a quick recovery of degraded heathlands will be shown but the restoration was less successful in many other sites. Studies on seedbank dynamics and species dispersal enable an insight in the underlying mechanisms for this development. The actual measurement of immigration rates suggest that most new nature reserves will remain greatly undersaturated for the target communities for a long time. It is concluded that under certain conditions top soil removal is a very effective way of heathland restoration but that more often regeneration is a slow process. (Topic 4.3)

GJ VAN DUINEN

Department of Environmental Studies, University of Nijmegen

The faunistic aspects of restoration of peatlands/raised bogs.

We are studying water macrofauna (dragonflies, beetles, midges etc.) in a variety of water bodies in (cut-over) Dutch raised bog remnants in different stages of restoration and make a comparison with water fauna communities in intact raised bog systems in Ireland and Estonia. Preliminary results show similarities, but also noticeable differences in fauna communities within and between intact bogs and bogs under restoration. We are now paying attention to key factors (biotic and abiotic: vegetation, water quality) in the composition of these fauna communities, probably causal for these similarities and differences and thereby for the success of restoration measures. Results of our research will be translated into guidelines for restoration of peatlands, both on the scales of single water bodies and of complete peatland systems, to facilitate restoration and conservation of the (faunistic) biodiversity of peatlands. (Topic 4.6)

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NC VANCE, D MIKOWSKI

USDA Forest Service, Pacific Northwest Research Station, Corvallis, OR

Plant and soil properties important to restoring a degraded, Shasta red fir barrens

Grazing, logging and road building, have severely degraded a Shasta red fir (*Abies magnifica* var. *shastensis*) forest/barrens in a high elevation headwaters of the Klamath/Siskiyou ecoregion producing severe erosion and increasing sedimentation of a key fish-bearing river. Over 20 years of efforts to re-establish plant cover have failed on this approximately 50 ha area. In 1995 we began an integrated study of the environment that influenced the successful establishment of planted and colonizing plants with land managers planting native Shasta red fir seedlings, *Arctostaphylos* species and grasses (*Agrostis pallens* and *Festuca viridula*). In the forest/barrens complex, planting survival, native plant communities, canopy openness and soil physical, chemical and biological properties were analyzed and related to other environmental parameters and vegetation characteristics. Vegetation mapping showed distinct plant assemblages within forest and barrens with differences among plant community cover and composition. Soil chemical and biological properties varied significantly with soils under established Shasta red fir having significantly greater bioactivity and nutrients. We conclude that variation within a geomorphologic landscape unit is an important consideration in restoration, and at this site Shasta red fir is a most important pioneer species for colonizing the barrens and influencing the development of soil quality and plant communities. (Topic 3.4)

S VAZ

School of Applied Sciences, University of Wolverhampton

The relation between soil and plant diversity in hay meadows

My project is part of an ongoing programme of research by the University of Wolverhampton Habitat Creation Group. It aims to investigate the relation between soil and plant diversity in hay meadow by finding out which soil properties best explain the structure of this type of plant community. I have undertaken a spatial survey of a created meadow looking at both the species abundance and various physical, chemical and enzymatic soil properties. Classical multivariate analysis using ordination techniques to relate vegetation structure to environmental data (CANOCO), will allow the effect of environmental factors on community structure and diversity to be explored. The use of geostatistical analysis (GENSTAT), which is relatively new to ecology, will enable the spatial variation of soil properties to be studied in relation to the variation of species diversity and site topography. Ideally, this combined approach will enable the identification of the main factors altering community structure and diversity. This study will contribute towards habitat creation by indicating which analyses are relevant to the assessment of soil and what are the optima required in view of the successful establishment and maintenance of species-rich grassland. The information gained on the role of soil spatial heterogeneity and site aspect on species diversity may also be used to improve the assessment of site suitability to the creation of species-rich habitat. (Topic 4.4)

M VINCELETTE

QIT Madagascar Minerals, Madagascar

Restoration of tropical ecosystems in Madagascar after mining: littoral forests and wetlands: approaches and techniques

QMM SA (QIT Madagascar Minerals SA), a Malagasy company owned by QIT-Fer et Titane Inc of Canada (subsidiary of Rio Tinto plc, UK) and the Malagasy Government, are considering the development of an ilmenite orebody in south-eastern Madagascar. Ilmenite contains titanium dioxide, which is used as a pigment in paint, paper and plastic. From 1989 to 1992, QMM commissioned a team of national and international specialists to undertake baseline studies of the existing social and natural environments. These studies indicated that the remnant littoral forest is of special botanical and faunal interest but is under constant pressure from the local people for fuel and construction wood, and is consequently highly degraded. If mining were to proceed, QMM would plan to rehabilitate the mined area progressively as the surface mining advances. Both ecological restoration and exotic species plantations are being considered. QMM recognises that local villagers must feel that any rehabilitation or conservation efforts are in their best interest, if those measures are to be sustainable. In order to assess the best rehabilitation options, an extensive research and trials program has been carried out over the last few years, including mapping of forest degradation and fragmentation, forest succession research and simulated restoration trials on littoral forests and wetlands. In parallel, extensive consultations with the local villagers are in progress to better understand their needs and to identify together rehabilitation options which the villagers will support. The research achieved to date on the natural ecosystems, restoration process used for an optimal ecological restoration after mining will be presented. (Topic 3.3)

M VISSER

Department of Plant Production, University of Ghent, Belgium

Social clues to the reintroduction of native grazed perennials in Presaharian Tunisia: the recent past revisited

In Presaharian Tunisia, a showcase of accelerated desertification since the 1950s, agriculture has invaded the former collective rangelands, turning them into a patchwork of eroded private fields and range leftovers. Moreover, ongoing rural exodus and urbanisation cause fields to be abandoned without any significant spontaneous secondary succession. Given the need for local herbage and forage, this may soon trigger demand for seeds of native perennials with high grazing value, and even raise the prospect of restoring the historical rangelands. Government-funded native seed production programs try to anticipate this demand, but their target species are in fact socially disregarded. This impedes their reintroduction within private lands. Interviews of local agropastoralists renowned for their ecological working knowledge focused on the change in their perception of these species throughout the last decades. Ecologically promising species appear to have been key resources for agropastoralists. But their overexploitation, the sedentarisation - urbanization process and import of animal feeds led to their social depreciation. Agropastoralists may renew their perceptions of native perennials if emphasis is put on their virtues in terms of soil protection, forage production, low maintenance requirements, and persistence. However, if renewal happens, it will lead to restored fields very different from historical rangelands. (Topic 6.1)

S VOGEL

Department of Philosophy, Denison University, USA

Towards an environmentalism without nature

This paper argues that an environmental theory that intends to be both philosophically adequate and practically useful would be better off eschewing the concept of "nature." Defining nature as a world

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independent of and prior to human conceptualization and action turns out to produce a whole series of philosophical difficulties, in the first place; and in the second it turns out to be terribly difficult in practice to find such a world, since the actual world we inhabit seems already to have the mark of human action (and human meaning) upon it. The practices associated with environmental restoration illustrate the point here most poignantly, revealing as they do the absurdity of trying to base an environmental theory on a sharp separation between nature and the realm of human activity. Indeed such practices provide a model of the oft-criticized idea of a "social construction of nature" that show it not to be so inimical to progressive environmental theory as many think. Recognizing the essentially practical character of our relation to the world we inhabit could serve as the basis of an environmentalism that saw that world as something for which we are responsible, in both the causal and the moral senses of the word. (Topic 1.1)

LK WARD, IL MOY

Centre for Ecology and Hydrology, Dorchester, Dorset

Monitoring flowering plants in translocated chalk-grass turf and in checkerboards at Twyford Down using information from the National Vegetation Classification

Chalk-grassland turfs were translocated using specialist machinery and hand tools during construction of the M3 motorway at Twyford Down. The initial translocations were carefully planned and subsequent changes in plants and invertebrates have been monitored since 1993. Total figures mask characteristic species, so flowering plants were classified by National Vegetation Community CG2a (typical chalk grassland), or as ruderals and others. Total initial species on three translocations had survival rates of 72, 79 and 80 % after five years, but CG2a species rates were 90%, 95% and 88%. Ruderals and other species declined, and with appropriate grazing management, numbers of CG2a species increased slightly. In permanent quadrats, mean CG2a species also increased, with annual fluctuations of "2-8 species. The greater disturbance in the hand translocation was reflected in an initially poorer match to NVC community. A translocated area was experimentally increased by arranging turfs in checkerboards, and monitoring colonisation of bare areas. After five years, total CG2a species were nearly equal on the turf and bare halves of quadrats. Differing communities on adjacent turfs slowly converged and species in common rose from 30% to 60% after three years. Dynamic community adaptation at receptor sites seems inevitable because of management and habitat differences. (Topic 3.2)

A WATSON FEATHERSTONE

Founder & Executive Director, Trees for Life

The Caledonian Forest: a strategy and action for its large-scale restoration in the Highlands of Scotland

Successful restoration efforts have been underway in the remnants of the Caledonian Forest in the Highlands of Scotland since the 1960s. These initiatives are focussed on achieving regeneration of one or other of the surviving, isolated forest fragments. However, the long-term future of the Caledonian Forest, west of Inverness, and all its constituent species and ecosystem processes, can only be assured by restoration on a larger scale, through linking up some of the remnants to create a substantially greater contiguous area of forest. For 15 years the conservation charity Trees for Life has been developing, and implementing practical work towards a 250 year project to return this area to a condition of wild, natural forest. The strategy used involves natural regeneration of the trees in the old forest remnants together

with the re-establishment of 'islands' of new forest in the otherwise treeless landscape to create 'stepping stones' linking the scattered fragments. Other significant aspects of the project include measures to help restore key elements of the forest ecosystem, such as the riparian zone, the treeline shrub community and the under-represented broadleaved tree species in the forest. The long-term aim is to reintroduce mammal species, such as the beaver, lynx and wolf, which are essential to the natural sustainability of the ecosystem. The presentation will highlight the practical application of the 'Principles of Ecological Restoration' developed by Trees for Life, and the challenges to be surmounted in order to achieve the project's long term goals. (Topic 1.3)

R WATTS, K COULING, R BARKER, C HEREMAIA, C RANCE, C MEURK, R GORDON

Christchurch City Council, Christchurch, New Zealand

Waterway restoration: an integrated approach to urban asset management in Christchurch, New Zealand

Christchurch (pop. 320,000) once had extensive wetlands and waterways, valued as a source of abundant food by the Maori, but single-mindedly drained and piped by a city Drainage Board, set up for that purpose. Over a century later, the city's water managers now face the practical and financial problem of replacing the ageing surface drainage infrastructure. An asset management approach set criteria for optimising a wide range of values, which could be achieved. These included improved landscapes, protected heritage, biodiversity, recreation, and traditional cultural values, in addition to drainage and flood protection, pollution control, and better water quality. Costings were developed for traditional piping and concrete channels, and for alternative, open, landscaped channels, planted with indigenous species typical of the locality. Comparisons showed that the natural options were cheaper to establish and maintain, and satisfied multiple purpose objectives. Furthermore, the asset value of the natural solution was expected to increase with time, unlike that of the traditional approach, which would steadily decrease until replacement was again needed. The Waterways and Wetlands Restoration Programme has engaged communities and politicians, not always supportively, and led to a constructive dialogue on natural asset management between ecologists, engineers, economists and sociologists. (Topic 5.3)

NR WEBB

NERC Institute of Terrestrial Ecology

Restoration of dwarf shrub heathland to promote biodiversity

Heathland is one of the principle cultural landscapes of Western Europe. Traditional management has perpetuated ecosystems of a low nutrient status in which plant succession is arrested. Traditional management has involved a complex interaction between grazing, arable cultivation and the use of turf and plant material from the heaths. The basic system occurs throughout the European heathlands but with local variants. Today these heathlands occupy no more than 15% of their original extent as a result of land use changes, and are highly valued for their biodiversity. Much of this remaining heathland is now the subject of legislative instruments designed to protect, conserve and manage biodiversity. Furthermore, recent biodiversity initiatives have set ambitious targets to restore heathland on abandoned mineral workings, disused farmland and former forestry land. This paper will review the range of techniques available, but more importantly, will discuss the criteria to be applied in the selection of areas where there is a need to meet biodiversity targets. (Topic 4.3)

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S WEBSTER

The use of community art in the regeneration of derelict land.

Community Art is a process, which has often been overlooked by much of the arts establishment, yet it can provide a potential tool for helping communities to re-connect with their environments. Ground work has for many years been developing art with individual communities and this paper will describe some of the ways in which this experience has been applied in Changing Places. The paper will also touch on the way in which the work is stimulating an evolution in the relationships with arts funding bodies as well as describing how art has provided a vehicle for bringing together 21 widely dispersed communities through the sharing of historical perspectives and future aspirations. (Topic 5.1)

K WHALEY, C NEWELL, CD MEURK, S MYERS

Landcare Research, Auckland, NZ

Forest habitat quality in the New Zealand cultural landscape: where to from here?

In New Zealand, development over the past 150 years has greatly reduced the coverage, quality and viability of nature around urban areas. This study quantifies those attributes of natural and semi-natural wooded habitats along the rural-urban gradient. We compared patterns from two cities, Christchurch (population 320,000) and Auckland (1 million). Habitat quality was quantified by species richness, degree of weed invasion and structural integrity, and complexity. Habitat viability was related to habitat size and configuration, support of keystone wildlife, and connectivity to neighbouring habitats. There were marked differences in the proportion and quality of remaining natural areas. Auckland retains many primary, high-value habitat patches linked to large, intact forests on the periphery. By contrast, remnant forest habitat persists only in one 5 ha fragment within Christchurch, and on the southern hills. In addition, in Christchurch most habitats used by indigenous birds are small, secondary patches of mixed quality and viability, dominated by non-indigenous plant species. In both centres the number of exotic weed species and their penetration into natural habitats is dependent on habitat size, marginal intactness and degree of urbanisation. These data provide the basis for designing and restoring more diverse and viable habitat configurations in New Zealand's urban environments. (Topic 5.2)

CP WHEATER

Department of Environmental and Geographical Sciences, Manchester Metropolitan University

Invertebrate communities in limestone quarry reclamation

Limestone quarrying is an expanding business in the UK, often being concentrated in areas of particular natural beauty. Quarrying produces landforms, which are often high, walled, large in area, and untypical of the surrounding countryside. The need to reclaim such sites has led to the development of several different techniques. Several methods are targeted at the quarry walls which, in modern production quarries, are highly engineered. The aim of quarry wall reclamation is often to encourage daleside communities of plants and animals over shorter time scales than would arise with natural development of the sites. These techniques usually involve management of the geomorphology of the site, together with the introduction of appropriate plant species and some, often short term, aftercare. Whereas the vegetation communities are usually well recorded and the success of establishment evaluated, the animal communities of such sites are

often ignored. Despite this, invertebrates play a role in the development of new environments and, since they are not usually managed directly, colonise more slowly by natural dispersal. This paper examines the long-term development of some invertebrate communities in limestone quarry reclamation in Derbyshire, UK and examines the potential of these as indicators of reclamation success. (Topic 3.3)

SG. WHISENANT

Texas A&M University

Prairie restoration in the suburbs

Urban sprawl transforms farms, prairies, wetlands, and forests to impervious surfaces with little biological diversity. Thus, the desired open space and natural environment of new suburbs decrease as they grow-leaving a poorer environment and dissatisfied homeowners. Although well-planned urban developments can effectively address these problems, many families still prefer a more rural environment. Can restoration-oriented housing developments be economically successful while providing numerous environmental and educational benefits? My experiences with a development near Houston, Texas suggests they are an important restoration opportunity. However, aggressive, non-native weeds and the co-ordination and control of construction activity presented serious obstacles that had to be overcome. Our initial concerns with public perceptions of slowly developing prairies were resolved with marketing strategies that emphasised the restoration process. (Topic 5.3)

DEBRA WHITALL

USDA, Rogue River National Forest, Medford, Oregon

Defining and restoring watershed health at the basin scale: a case study

In April of 1999, a variety of government agencies sponsored a coordinated approach to providing technical assistance to all landowners within the 5.7 million hectare Rogue River basin watershed. Using existing resources, two teams were created to support this effort: the Restoration Technical Team and the Restoration Technical Pool. The Technical Pool was created to provide expertise in restoration project design, localized assessment, monitoring and education to all landowners. Participation in the Technical Pool is voluntary and includes: government employees, fee-based professionals, and local citizens knowledgeable in various aspects of restoration activities. Technical Pool members agree to provide services at little to no cost to the landowner. A Restoration Technical Pool Coordinator matches a landowner's request for assistance with the appropriate technical pool members thus ensuring that the right type of expertise is provided in a timely, cost-effective manner. The Technical Team is charged with developing a process for identifying and prioritizing watershed health needs from a basin perspective. In this context, restoration is focused on the causes of habitat degradation rather than on the effects of degradation and incorporates locally defined biological priorities. Government agencies and private landowners can then work together to identify restoration activities that improve the physical structure, biotic resources and trophic (energy) levels that support productive systems. (Topic 3.1)

PH WHITBREAD ABRUTAT, T KENDLE, J ROSE, H ROSEVEAR

Eden Project, Watering Lane Nursery, Cornwall

The development of artificial soils for use at the Eden Project

The Eden Project - a Millennium Commission Landmark project - is

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being created in a 15 ha derelict quarry in Cornwall, UK. It will display three climatic zones, an external temperate biome and humid tropics and warm temperate biomes in protected conditions. Sufficient topsoil was not locally available thus creating a demanding task in manufacturing the requisite soils with the required characteristics. Available materials included sand, lignitic clay, and greenwaste compost and composted bark. There was a requirement to produce displays that recreated the appearance and atmosphere of the material as it grows in its normal environment. First principles were to develop a material that was a physically suitable base for the vegetation types. Low fertility and low pH are also targets. Vegetation from the Mediterranean, Californian and South African regions present particular challenges as the plants must grow well but keep a stressed appearance. This is a new and challenging concept for compost formulation requiring careful trialling. Also, many South African fynbos plants are sensitive to soil phosphate. This paper will describe in detail the soil compositions and explain how these were deduced and refined by experimental work. (Topic 3.4)

MICHAEL WHITE

GES Inc., Ontario, Canada

Putting ecology and community edges on GIS

In 1989, a first attempt was made to set up a North American Great Lakes Ecological Database by Dr. Henry Regier, Science Advisory Board, International Joint Commission (www.ijc.org). Part of this database would be a community accessible component. A Ministry of the Environment, Canada, GIS Decision Making Support program, called RAISON® (Regional Analysis of Indicators of Sustainability ON a Computer) was proposed as the tool for this. The program is designed for non-expert users to interact through data quality filters with higher level GIS and data management systems. Achieving this has encouraged 10 years of work on iEGESi for RAISON, a community and subsequently an education decision support GIS tool. The programming and project design work has taken place as a partnership of Environment Canada, the University of Guelph and professional community design developers. Parallel work was being carried on for an international student GIS program, United Nations international river data management, Green Communities Health Indicators network development, international water quality management projects, and environmental and ecological community and school based projects in the Greater Toronto Area, Ontario, Canada. A number of these were linked to Ontario Society for Ecological Restoration, members or projects. The final program, called EGESNMAPS is being marketed in Canada to provide low-cost map resources and data management tools to Environmental Community groups and schools. The project is now joining its mother program RAISON in multi-language, international applications. The goals, progress and uses of this software will be demonstrated and promoted. (Topic 3.7)

TAMARA WHITTINGTON

National Park Service, Restoration Program Manager, Denver, Colorado

Ecological restoration in South Florida National Parks

The National Park Service is restoring injured coral reef systems and seagrass beds at Biscayne and Everglades National Parks in South Florida. These sensitive ecological areas sustain serious and often irreparable injuries when motorcraft ground themselves upon the corals or seagrass beds. Restoration activities for the seagrass beds, which are primarily Turtle Grass (*Thalassia testudinum*), Shoal Grass (*Halodule wrightii*), and Manatee Grass (*Syringodium*

filiforme), include filling the larger blow holes and trenches to grade with sediment of the same type and consistency as the surrounding area, stabilising the sites, and transplanting seagrass plugs from donor sites within the Parks. Shoal Grass is the colonizer and appears first at disturbed areas once the calcareous algae have stabilised the sediment. Some typical coral species found in Biscayne National Park include Star Coral (*Montastrea annularis*), Brain Coral (*Colpophyllia natans*), Large Star Coral (*Montastrea cavernosa*), and Elkhorn Coral (*Acropora palmata*). Emergency restoration for injured corals occurs quickly after the grounding incident and includes using underwater cement or epoxy to glue coral fragments back onto the framework or transplanting corals from other sites. Further restoration activities include removing rubble, filling blow holes, stabilising or replacing the reef framework, and transplanting corals. (Topic 4.5)

BRET WILLERS

Canley and Tile Hill Area Co-ordination Team, Coventry

The Canley & Tile Hill Area Action Plan: a truly bottom up neighbourhood approach to Local Agenda 21

The Canley & Tile Hill Area Co-ordination Team is one of six neighbourhood multi-agency partnerships working for the regeneration of communities living in areas of greatest need in the City of Coventry. The Canley & Tile Hill Team is made up of senior managers and representatives from many organisations. Using a variety of techniques for engaging local interest (e.g. Planning for Real, Visioning, consensus building etc.) and targeting the socially excluded in particular, the Team carries out extensive consultation with local people for the development of an Area Action Plan. The Area Plan is a commitment to collaborative action from the members of the partnership which identifies over 150 actions, changes in service delivery, initiatives and programmes for working towards sustainability by addressing social, economic, environmental and cultural issues in an integrated way. The Plan includes a diverse range of innovative approaches with emphasis on community development as an essential component of regeneration as well taking long term preventative approaches for improving people's quality of life. The environmental projects include; the conversion of a council house to a low tech ecological show home demonstrating low cost measures for improving energy efficiency, creating a wildlife garden, waste management and recycling in the home for people living on an estate. (Topic 6.4)

PF WILLIAMS, M UNDERHILL

Countryside Council for Wales

The Cardiff Bay barrage scheme and the Gwent Levels wetlands reserve

In January 1996 the UK Government announced details of the compensation package for the loss of the Taf/Ely Estuary Site of Special Scientific Interest (SSSI) to the Cardiff Bay Barrage scheme. An element of the package was a proposal for a new wetland reserve - the Gwent Levels Wetlands Reserve - that within "five years will qualify for Special Protection Area (SPA) status alongside the Severn Estuary". Proposals for the reserve were developed under the guidance of the Cardiff Bay Compensation Measures Steering Group, with representatives from the Cardiff Bay Development Corporation, Royal Society for the Protection of Birds, Wildfowl and Wetlands Trust, Environment Agency, National Farmers' Union, Country Landowners' Association and the Countryside Council for Wales. The proposals went to Public Inquiry in May 1997 and work began in July 1998. The reserve currently totals 420ha and consists of four main habitat types: reedbeds, lowland wet grassland, saline lagoons and saltmarsh. It is

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located alongside the Severn Estuary SPA, a Ramsar and provisional Special Area of Conservation, and within the Gwent levels SSSI complex. The reserve illustrates a wide range of habitat creation, re-creation and restoration techniques. The largest reedbed in Wales on a former 'brown field' site has been created; over 200ha of grazing march is being rehabilitated; and 10ha of saline lagoons or wader scrapes have been created to support some of the birds displaced by the Cardiff Bay Barrage. (Topic 4.1)

G WILSON

M J Carter Associates, Atherstone, Warwickshire

Project management of ecological restoration: experience of translocation at Durnford Quarry

The translocation by Pioneer Aggregates UK Limited of 6 hectares of neutral grassland at Durnford Quarry near Bristol is to date the largest habitat translocation in the UK and a major project management exercise in ecological restoration. The project has been planned since 1990 and was executed in the winter of 1998/99. Prior to translocation, four years of detailed floristic and invertebrate data were collected which will provide the baseline data for a research project on the performance of the translocation which will continue for at least 10 years. The translocation provides an excellent example of the scope and complexity of the management of ecological restoration projects encompassing legislation, town and country planning, politics, public relations, health and safety, security, mobile plant management, agriculture, archaeology and even ecology! The history of the project will be described to illustrate the project management issues, the practical considerations and the controls used to ensure best practice was applied. The early performance of the translocation will be discussed. (Topic 3.2)

S WINDHAGER

Lady Bird Johnson Wildflower Centre, Austin, Texas

Wildflower Center - American Style

The mission of the Lady Bird Johnson Wildflower Center in Austin, Texas, (formerly the National Wildflower Research Center) is to educate people about the environmental necessity, economic value, and natural beauty of native plants. Founded in 1982 by Lady Bird Johnson and the late Helen Hayes, the Center's original site was east of Austin and consisted mainly of two mobile office trailers, a greenhouse, and some research plots. After many years of dreaming, planning, and fund-raising, the Wildflower Center celebrated its Grand Opening in a new location south of Austin in March of 1995. The forty-two acre facility designed as a model for demonstrating total resource conservation has become an important link in the native plant conservation movement by demonstrating the possibilities of using native plants in landscapes and natural areas to thousands of visitors each year. The architectural style and selection of plant materials was based on maintaining the regional integrity of the Central Texas Hill Country. Many important lessons were learned through the design, installation, and now management of the public garden. Learn from our mistakes and successes regarding site layout, working with contractors, managing volunteers, developing educational materials, growing native plants, having plant sales, utilising the site for facility rentals, and integrating projects with all other departments. (Topic 4.4)

KEITH WINTERHALDER

Wintergreen Ecological Services, Sudbury, Canada

Ecology and the successful transformation of contaminated land.

The restoration of contaminated land may provide a challenge equal to

vegetation establishment on a "virgin" mine waste, but contaminated soil has the advantage of retaining certain properties from its former existence. On tailings, the restoration ecologist is preoccupied with identifying and eliminating the many factors limiting plant growth. In contrast, the environmental complex that a contaminated soil presents to a plant, comprises an array of limiting factors and potentially beneficial attributes, all of which interact. Initial steps towards restoration will involve the identification and amelioration of one or more clearly limiting factors, but as the restoration process progresses, unexpected negative and positive feedback will become evident. Based on close observation of these phenomena, hypotheses can be generated and tested, and the results acted upon, over a matter of decades. This leads to a deepening understanding of the structure and function of the recovering ecosystem, providing an ecological basis upon which decisions to manipulate the process can be made compatible with the desired trajectory towards a self-sustaining biotic community. These ideas are explored in the context of the restoration of the landscape in Sudbury, Ontario, which has been acidified, metal-contaminated and denuded of vegetation by 100 years of smelter activity. (Topic 3.3)

AL WISCHMEYER, L JABLONSKI, DR GEIGER, DR CONOVER.

Marianist Environmental Education Center, Dayton, OH

Using vegetation quality to assess restoration progress on the MEEC Mount Saint John /Bergamo prairie in Dayton, Ohio.

Evaluation of species establishment after 13 years is being used to determine if management intervention is necessary on the MEEC prairie (Greene County, OH). Restoration began on the 14-acre sand and gravel borrow pit from 1986-88 with 52 species, 82% being native to tall grass prairie. Burning has occurred every three years, and over 167 additional native and non-native species have volunteered or been hand-transplanted. Complete species lists were compiled in 1988, 1995, and 1999. Plant community traits of species number, species diversity, and native species composition have been analysed. Vegetation quality was determined using the floristic quality index (FQI). This method incorporates species richness and the coefficient of conservatism of native prairie species. After 13 years, 79% of the species are native, and 13 are on the Ohio Rare Plant List. Native functional groups of forbs, sedges, and shrubs have increased most in number. The mean coefficient of conservatism of the entire restoration is 4.3, which signifies the site is comprised mainly of high quality, native prairie species. The FQI increased from 35.2 in 1988 to 41.6 in 1999. The increase in vegetation quality suggests that the restoration is progressing towards a mature diverse prairie under current management practices. (Topic 3.5)

J WYNN, D CORFE

WS Atkins Consultants, Manchester

Ecological impact assessment: Promoting sustainable habitat creation and restoration

There is increasing recognition of the importance of a consideration of ecological issues during the conception, planning and design of new developments and in the restoration of damaged landscapes. This may be due to the legal requirement for a formal EIA. In other cases there may be an informal ecological assessment, where a site is known to support habitats of biodiversity interest but where the development itself does not require EIA. An ecological appraisal at the early stages of any new development or restoration proposal allows for key habitats and species to be identified and gives the opportunity to make provision for ecological mitigation and enhancement. It is essential in

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any restoration scheme to create appropriate habitats that are self-sustaining and possess good structural diversity. This ensures their continued survival with minimal management. Habitat restoration practices have moved away from the quick fix solution of the rapid greening of previously disturbed or damaged land, due to the long term failure of such an approach. A number of examples of appropriate and sustainable restoration schemes, including contaminated land and wetland restoration, which have been undertaken in answer to ecological impact assessments, are presented. (Topic 4.1)

S ZAKAI

Chairperson of "The Israeli Forum For Ecological Art", Israel.

Concrete Creek

Seasonal Stream someplace, its waters stormy in good winters, winding from the top of the mountain, kissing the vineyards, and resting in the Goddess Valley. Filled by recurrent concrete dumping, dust flowing into the ravine, and the metaphor has become a reality, coating pebbles with turbid gray cream. The State Comptroller Report about the condition of streams urges treatment of ever-flowing streams; when will be the time of concrete-lined seasonal streams? Stream dust, concrete creek, "cement-cutlets" concealing green-blue memories. The work Concrete Creek I is based on an enlargement of predesignated topographical signs from an Israeli site. It consists of 3 parts:-

Part I - Following the Discovery: installation, text, drawings.

Part II - Documentation: a photographed walk through the stream, exploring the effect of seasons, temperature, erosion and rain on the stream's condition. Responses in text, photographs, drawings and installation. Both parts are designed to be exhibited in a gallery space.

Part III - Field Work: Devising a set of activities for physical reclamation of the stream. Collaboration with scientists. Creating conditions which will prevent future pollution. Executing a site-specific work. Documentation.

The planned project is intended to be co-exhibited with the work of artist Don Harvey, who studies and responds to the river problems in his hometown of Ohio. (Topic 6.2)

XIAOYING ZHAO

The Scientific Information Centre for Resources and Environment, The Chinese Academy of Sciences

Some views on ecological restoration in China

The author considers that ecological degradation is a process in which the ecosystem and its components develop toward a direction of unsustainable utilization for human society, impacted by natural factors and/or human inputs. The ultimate result of the process is land degradation. Ecological restoration therefore has two components. The first one involves the restoration and rehabilitation of ecosystems suitable for the local eco-environment. The second involves restoring damaged and destroyed ecosystems and land by enhancing, rehabilitating, renewing and reconstructing, to improve the productivity potential and function of ecosystems. Based on analysing current statutes of ecological degradation, the progress of ecological restoration and the requirements for development of economy and society in China can be assessed. A strategy and measures for ecological restoration in future will be suggested. (Topic 1.2)