

Biodiversity in urban habitat patches

Objectives

To analyse the extent to which our flora and fauna utilise the 'urban greenways', both as wildlife corridors and as habitats, and to model and predict biodiversity in cities. The specific objectives are to:

- investigate the potential for using an existing database of species distribution and habitat characteristics for modelling the dynamics of wildlife in conurbations
- characterise the biota of the urban environment and develop indices which can be used to predict flora and fauna patterns in the urban environment
- analyse the richness of species, the distribution of genetic diversity, and abundance of selected species in connected and isolated habitats in order to quantify patch area and distance effects
- analyse the importance of barriers and corridors in shaping dispersal processes in the urban environment
- model the distribution of species in the urban landscape and develop spatially-explicit population and individual-based models for investigating the response and persistence of urban wildlife to changes in urban landscapes
- validate these models using field-based studies of organism dispersal and historical distribution data
- evaluate the efficacy of associative and process-based models for use in an urban biodiversity Decision Support System (DSS)
- integrate models and databases within a DSS allowing planning consultants to investigate the effects of a range of different scenarios on urban biodiversity.

Location

West Midlands

Approach

The research has been divided into three components:

- to determine a) the abundance of plant and animal species within the conurbation, and b) the impact of green spaces and connecting corridors on plant and animal (invertebrate) species
- modelling of the long-term response of plant and animal species to planned changes in the urban landscape of Birmingham
- construction of a Geographical Information System (GIS) to display the information and a DSS for easy interpretation by users.

The consortium intends to tackle the GIS/DSS at an early stage to identify species, spatial scales and timeframes of major interest to users as indicators of the impacts of urban structure changes.

Start Date/Duration

April 1998 Three years

Lead Organisations

University of Birmingham
Centre for Ecology and Hydrology
Centre for Land Use and Water Resources Research, University of Newcastle upon Tyne

Deliverables

- a handbook of recommendations on urban planning
- a GIS database of Birmingham
- a computerised DSS
- a mappable index of hemeroby, ie degree of unnaturalness, for the flora of British urban habitats
- models of species dispersal, developed as generic but realised for Birmingham
- a species database for the development and enhancement of species conservation strategies within the conurbation.

Users

Unit of Comparative Plant Ecology, Sheffield
Birmingham Urban Wildlife Trust
West Midlands Local Authorities

Further Details

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Impact Of Vehicle Emissions on Vegetation

Objectives

Pollutants derived from vehicle emissions now pose a major threat to human health and urban ecology. This project aims to evaluate the impacts of urban pollutants on vegetation, water relations and plant-insect interactions to provide generic information for future remediation and conservation of vegetation in urban areas. Specifically the project aims to:

- evaluate the impacts of urban air pollution climates on a range of plant species and their insect herbivores using a combination of roadside transects and controlled exposure studies
- study the effects of these pollutants on leaf function and enzyme activities
- determine the effects of these pollutants on leaf chemistry and plant-herbivore interactions
- identify the relative importance of different components of urban air pollution in adversely affecting plants and their insect herbivores
- evaluate the importance of vehicle pollutants as a limiting factor for lichen recolonisation of urban areas
- identify and characterise the abiotic stresses in the urban plant environment that affect growth, and the uptake and response to air pollutants
- derive initial estimates of critical levels of pollutant mixtures for urban ecosystems
- identify which types of plant species are tolerant of urban pollution climates

Location

Generic

Approach

The project will use both *in situ* and controlled environment experiments. It will evaluate impacts on a range of vegetation of contrasting morphologies and functional types. The controlled experiments will be conducted in the Solardome exposure system developed in a previous URGENT feasibility study. The *in situ* experiments will be carried out at sites in Newcastle, Manchester and Central London.

The Newcastle In Situ Studies - effects of urban pollutants on urban shrubs

Transects will be set up on a major road/open parkland interface near the University where traffic densities and pollutants are monitored. Insecticides will be used to manipulate effects of herbivory on established vegetation. Impacts of pollution atmospheres on leaf surfaces, growth and physiological processes will be assessed.

Imperial College experiments in the Natural History Museum Wildlife Garden

This group will examine the effects of urban pollutants on herbaceous plant species. Transects will be set up within the established wildlife garden and pots of other herbaceous plants will be added. A range of plant growth and physiological factors will be monitored. The effects of artificially increased daylength through street lighting will be assessed

Manchester in Situ Studies - effects of urban pollutants on trees

This study will investigate the health of plants along existing gradients. Plant growth and physiological aspects will be monitored.

Bradford University – effects on lichens and bryophytes

Impacts of vehicle pollutants, directly or indirectly via changes in bark chemistry, will be assessed by transplanting lichen and bryophyte species from relatively unpolluted sites in North Wales to the Solardomes and field sites of other collaborators.

Solardome Experiments

The Solardome provides realistic urban atmospheres, including VOCs and particulates. A range of species, including those in the field based trials will be exposed in the Solardome. Impacts of pollution treatments will be measured including visible injury, leaf canopy development and turnover, rates of photosynthesis and stomatal conductance. The Solardomes will be used to conduct controlled complementary studies to confirm *in situ* effects from the field monitoring and experiments.

Start date/duration

October 1999 Three years

Lead Organisations

CEH Bangor
 University of Newcastle
 Imperial College London
 CEH Pencuik
 University of Bradford
 Manchester Metropolitan University

Deliverables

All experimental data will be placed on an Oracle based Integrated Data System to facilitate access and transfer to other users. The project will bring the following benefits/deliverables:

- Identification of tolerant plant species for urban planting programmes
- Identification of risks to urban vegetation from invertebrate attack and influencing factors
- Development of bio-indicators of exhaust-related emissions for widespread use in cities, for spatial and temporal monitoring
- Initial estimates of critical levels of pollutants for urban areas
- Better understanding of the exchange of VOCs and deposition of particulates to foliage
- Better understanding of pest/host relationships in perturbed environments
- Pointers to future research areas (e.g. into individual components of vehicle emission control (as affecting urban vegetation/air))

Users

Local Authorities
 DETR
 English Nature
 Countryside Council for Wales
 Welsh Office

Further details

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Urban Domestic Gardens and Creative Conservation

Objectives

Gardens of domestic dwellings constitute a large proportion of 'green' space in the UK. Urban gardens could therefore play a pivotal role in maintaining biodiversity, both through provision of living space, and a network of connections between the larger green spaces of parks and waste ground. This project aims to add empirical evidence to various popular claims of methods to enhance wildlife in gardens.

The project aims to:

- Examine the relationship between features of urban gardens and the biodiversity which uses them
- Directly test the effectiveness of a set of simple habitat manipulations in enhancing biodiversity
- Examine the community structure and dynamics of garden areas on spatial and temporal scales
- Examine the responses and changes in biodiversity of garden ecosystems to urbanisation
- Examine creative conservation and urban design to generate empirical recommendations for enhancing biodiversity in urban gardens

Location

Sheffield

Approach

The project has two components - a sampling programme and experimental manipulations. 50 gardens will be selected to represent a cross section of the major types and ages of housing in the study region.

Four sampling sets will be collected;

- i) Garden Attributes
Location, type of housing, composition of surrounding habitat, aspect, slope, total area of major habitat type, management, garden history
- ii) Plant Diversity
Identification of plant species present, and classification into native and alien species, as well as intentionally planted or naturally introduced.
- iii) Fungal Diversity
Macrofungal bodies will be sampled in lawns
- iv) Animal Diversity
Including insect and bird surveys.

Five simple habitat manipulations will be conducted and associated increases in species and biodiversity sampled

- i) introduction of buddleia *Buddleia* spp. and nettles *Urtica dioica* and census of insect larvae associated with these plant introductions
- ii) development of grasses - census of increases in insects associated with uncut grass
- iii) introduction of ponds – recording of colonisation by macroinvertebrates
- iv) introduction of nesting sites for solitary wasps and bees
- v) introduction of nesting sites for bumble bees

Start date/duration

January 2000 Three years

Lead Organisation

University of Sheffield

Deliverables

Data resulting from this project will be used to:

- determine the magnitude of biodiversity associated with urban gardens
- determine the occurrence of nationally or regionally rare 'wild' fungal, plant and animal species in domestic gardens, evidence for the effect of deliberate cultivation of rare plants on the occurrence of their associated animals
- test how the sampled biodiversity in domestic gardens changes with
 - a) the setting of the garden, degree of urbanisation, composition of surrounding habitat, altitude
 - b) garden attributes, area history, present management
 - c) garden structure, habitat composition, diversity, edge effects
 - d) functional measurements of animal diversity in relation to plant diversity

The examination of the data will lead to:

- Recommendations for the management of gardens for biodiversity
- Possible media links and an opportunity to develop the public understanding of science

Users

Royal Horticultural Society
Sheffield City Ecology Unit
Henry Doubleday Research Association
Sheffield Wildlife Trust

Further details

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Non-Indigenous Species and Urban Biodiversity: From Generic Models To Practical Management

Objectives

The project aims to develop strategies for remediation and management of urban habitats. It will:

- Quantify characteristics of urban environments that underlie the observed higher plant diversity.
- Assess the relationships between indigenous and non-indigenous diversity to predict how changes in urbanisation differently affect these two components of urban floras.
- Compare the distribution of indigenous and non-indigenous plant diversity at a national and local scale thus identifying generic and specific processes underlying urban plant species diversity.
- Undertake comparative analyses of ecological traits of non-indigenous floras to identify whether these reflect particular species traits (seedbank persistence, means of introduction)
- Interpret ecological traits in relation to environmental variables identified at national and regional scales to predict the extent that urbanisation filters the pool of potential plant colonists
- Assess the impact of selected non-indigenous species on the community structure of both plants and insects within a single urban habitat type.

Location

Generic

Approach

The project involves the integration of statistical modelling GIS and field surveys using a hierarchical research strategy with analyses undertaken at national regional and local scales to produce generic insights. The project will aim to diagnose potential impacts of non-indigenous plant species in order to deliver clear guidelines to end users through testing of the following key hypotheses:

- Urbanisation will act to reduce indigenous species diversity yet increase the diversity of non-indigenous plants
- The magnitude of these changes in diversity will be modified by climate and landscape heterogeneity
- The ecological traits of non-indigenous plant species in England and Wales will differ in relation to the strength of their association with urban habitats
- The spatial distribution of non-indigenous species within a conurbation will reflect the interaction between their ecological traits and the characteristics of urban micro-environments
- Urban plant communities will reveal assembly rules associated with non-indigenous species
- Invertebrate diversity will be influenced by the non-indigenous element in urban plant communities

The project will study these hypotheses through an examination of:

- Urbanisation and plant species diversity: National Patterns
- Urbanisation and plant species diversity: Regional Patterns
- The ecological traits of urban non-indigenous plant species
- Non-indigenous plant species and the biodiversity of urban habitats

Start date/duration

September 1999 2 years and 4 months

Lead Organisation

University of Durham
University of Birmingham
CEH Monkswood
CEH Furzebrook

Deliverables

- Predictive models of the effect of land use and/or climate change on indigenous and non-indigenous flora at national scales and also specifically for the West Midlands Conurbation.
- Analytical tools to characterise and diagnose the impact of non-indigenous plant species upon ecological communities in the urban environment
- A classification scheme for appraising invertebrate biodiversity of urban habitats containing non-indigenous plant species
- Guidelines for the evaluation and management of sites containing non-indigenous species
- A handbook for the management of non-indigenous species in urban design and creative conservation programmes
- Independent verification of outputs from related URGENT research projects

Users

West Midlands Conurbation

Further details

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Developing Strategies To Enhance Sustainable Biological Processes in Contaminated Urban Soils

Objectives

- To characterise a range of urban soils in terms of (a) the activity and diversity of key groups of the soil biota, (b) the physico-chemical environment they offer to soil biota, and (c) their ability to support plant growth.
- To identify relationships between the three elements of 1 using multivariate approaches.
- To determine the responses of key taxa to environmental factors identified in 2.
- To estimate the diversity and competence of existing populations of microbial symbionts of roots within degraded soils.
- To measure the survival and performance of introduced symbiont taxa.
- To measure the effect of tree symbioses on the development of soil communities and the ability of these and of some symbiotic fungi to degrade organic pollutants.

Location

West Midlands/South Yorkshire

Approach

This project uses a combination of extensive and intensive elements - a survey of the physico-chemical and biological conditions of a range of industrially damaged sites, and an analysis of the function of a key group of the soil biota, namely, root symbionts.

The complexity of soils means that it is necessary to use a multi-dimensional and multi-variate approach to assess the 'health' of soils. Particular emphasis on key groups in the soil microbial and faunal biota, their eco-toxicological responses and the ability of soils to support plant growth will provide a sensitive means of determining the combined effects of many interacting factors on soil health in the urban environment. The project will also examine soil physical properties, nutrient availability and contaminant loads and will relate these to the biological parameters. To be able to offer guidance on rehabilitation strategies, however, it is also necessary to determine the impact of variation in soil physico-chemical parameters and biological diversity on the function and sustainability of the urban ecosystem. This requires an intensive investigation of the biological performance of a key set of species.

Planting (or occasionally, natural regeneration) of trees is a standard goal for restoration of urban sites. All trees are naturally, and often effectively obligately, symbiotic. The project will, therefore, undertake an intensive investigation of the interaction between trees and their microbial symbionts, since tree survival on degraded soils is almost certainly not related simply to their capacity to cope directly with contaminants and poor soil condition, but also the ability of their root symbionts to develop and function in the soil. The symbionts are, therefore, a critical part of the biological component of urban soils, necessary for its health and sustainable use, and can be regarded as key species.

Start date/duration

January 1998

Four years

Lead Organisation

University of York
CEH Merlewood
CEH Monks Wood
British Geological Survey
University of Reading

Deliverables

- identification of potential causal agents of biological malfunctioning of urban soil ecosystems which will ultimately permit appropriate rehabilitation strategies to be devised for polluted and otherwise degraded sites
- identification of key taxa within the soil biota for which specific enhancement programmes will be required
- definition of inoculation and management protocols involving microbial symbionts of trees to ensure successful restoration of degraded sites.

Users

Environment Agency
British Gas plc

Further Details

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Mobilisation And Transport Of Metals Between Ecosystem Compartments In The Lower Swansea Valley - A Post-Industrial Urban Regeneration Zone

Objectives

- to quantify the metal burdens in the terrestrial and aquatic compartments of the Lower Swansea Valley (LSV) ecosystem
- to determine the fluxes and pathways of metals from the terrestrial to the aquatic compartments
- to establish the role and significance of (a) large storm events and (b) biomobilisation in the mobilisation and transport of metals
- to assess the long-term success of the metal containment and stabilisation protocols implemented since the 1960s and, hence, to provide practical guidance for future rehabilitation programmes both in the LSV and elsewhere.

Location

South Wales

Approach

This project will examine the current state of the semi-natural landscapes within the regenerating urban system of the LSV. It will quantify the fluxes of metals between the various compartments and explore the success of the rehabilitation scheme which started in the 1960s. The research methods will be as follows:

- quantifying metal burdens and biomobilisation in terrestrial ecosystem compartments
- mobilisation and transportation of metals between ecosystem compartments
 - storm event strategy
 - baseflow strategy
 - metal analysis
 - supplementary analysis of continuous and archival data
- spatial extrapolation using hyperspectral remote sensing.

Start Date/Duration

April 1999 Three years

Lead Organisations

University of Wales

Deliverables

The data sets described above will be integrated within a geographical information system. This will form both a coherent spatial database on metal contamination and biodiversity within the LSV, and a modelling framework that will allow the impacts of various scenarios to be examined as an aid to practical management of the LSV by the end-users. The temporal data from the major storm events will be analysed to assess the relative significance of the various hypothesised sources of metals within the present day LSV system and, in conjunction with archival data, to assess the overall impact of individual components of the remediation/redevelopment scheme.

Users

City and County of Swansea
Environment Agency
Welsh Development Agency
Forest Research

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Monitoring Urban Land-Use and Morphology Using Remote Sensing and Geographical Information Systems (GIS)

Objectives

- monitor urban land cover and land use using satellite-sensor images
- characterise urban land cover and land use morphology using new measurement tools and GIS.

Location

South Wales and Bristol

Approach

The project has a generic approach and is divided into a number of component parts:

- production of accurate land cover maps from high spatial resolution multispectral images and ancillary sources of 'framework' data
- assessment of the quality of intra-urban vegetation based on linear (spectral) mixture modelling and 'red-edge' position techniques
- development and evaluation of graph-based structural pattern recognition techniques to identify and delineate areas of different land use from high spatial resolution optical images
- evaluation of new, interferometric Synthetic Aperture Radar datasets as a means of delineating urban areas and identifying different types of urban land use
- analysis of the derived datasets to investigate the ways in which urban and peri-urban land cover and land use (industrial, commercial, retail, residential, brownfield and green spaces) are structured, focusing on the underlying order and spatial structure that characterises the apparently irregular geometry of urban land use
- use of the detailed land use classifications to drive land use based transportation models to inform studies of urban ecology - through the study of landscape pattern, including the spatial distribution and morphology of urban green space and the impacts of its increasing fragmentation.

Start date/duration

October 1998

Three years

Lead Organisations

University of Bristol

University of Wales Swansea

Deliverables

This project will deliver a robust and appropriate approach to urban inventory analysis, developed and applied using a detailed case study within South Wales, extended eastwards from Cardiff to include the Bristol area.

Users

Ordnance Survey
Marcial Echenique and Partners Ltd
Bristol County Council
Cardiff County Council

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The Feasibility and Potential Application for an Environmental Classification of the Urban Landscape

Objectives

This study is investigating the possibility of classifying the whole of the UK urban landscape from an environmental perspective. It is investigating the appropriateness of the different methods of classification within urban studies and assessing the feasibility and potential quality of the classifications.

Approach

The study is being carried out in three stages.

Stage 1 will consider issues of domain, data availability, spatial resolution and temporal stability.

Stage 2 will evaluate the appropriate classification methodologies.

Stage 3 will recommend one or several approaches.

Start date/duration

June 1998

Six months

Lead Organisation

CEH Merlewood

Deliverables

The study will deliver an interim report on Stages 1 and 2 for use at a workshop. At the conclusion of the study, a summary report will include:

- data availability
- appraisal of the options
- recommended approach to classification
- potential applications of the classification for urban and rural planning
- proposal for full implementation, including costing and time-scale.

Further Details

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