

Developing an Ecosystem Health Indicator for urban green space: the current state of play

Authors: Antonia Eastwood, Rob Brooker & Robin Pakeman

James Hutton Institute, Aberdeen, July 2017

Suggested citation: Eastwood, A.E., Brooker, R.W. & Pakeman, R.J. (2017). Developing an Ecosystem Health Indicator for urban green space: the current state of play. Information Note for Scottish Natural Heritage, James Hutton Institute, 8 pp.

For information contact: antonia.eastwood@hutton.ac.uk



Background and rationale for indicator

The purpose of the Ecosystem Health Indicators is to measure the state of Scotland's ecosystems with regards to their condition, function and resilience (sustainability). As spatial indicators, operating at national and regional levels, it is intended that these indicators will be used to help identify priority regions or catchments for restoration, and assess progress in maintaining or enhancing ecosystem health.

Greenspace is generally considered as open, unsealed land with some form of vegetation cover within an urban environment. It encompasses a wide range of urban habitats and land uses from natural and semi-natural woodlands (including SSSIs), private gardens, allotments and domestic gardens to street trees, football pitches and public parks.

Whilst the remit of the Ecosystem Health Indicators is focused on predominately biological and physical metrics, without reference to ecosystem services, the condition and function of urban greenspace is of particular interest to policy makers because of the large numbers and high densities of people living in UK urban environments (urban areas equate to 7% of land but are home to 80% of the population). For some city and urban dwellers, urban green spaces provide rare, or sometimes the only, opportunities for interactions with the natural environment. The evidence of the importance of urban greenspace for human well-being has been mounting for decades, with numerous studies showing the therapeutic benefits of greenspace such as stress reduction, improvements in physiological well-being, and reductions in depression as well as encouraging physical activity such as gardening or running. Other benefits of urban green space include the mitigation of air pollutants (e.g. particulates from diesel cars), storm water retention, and energy conservation (e.g. cooling in summer or shelter from wind).

Information note

Current state of green space indicators in Scotland

There are three key aspects to consider when evaluating and assessing potential urban green space metrics; quantity, quality and accessibility. For this briefing note we will focus predominately on the first two, quantity and quality, as accessibility of greenspace, whilst very important, is outwith the remit of the ecosystem health indicators, as it relates to ecosystem services.

Indicators of greenspace quantity

With regards to the quantity of greenspace, Scotland's Greenspace Map¹, has all the urban green space (for towns and cities with a population of 3000 or more) characterised, databased and mapped on an interactive GIS map. The most current map uses data provided by all Scottish councils in 2011. The urban green space is characterised into 23 different types of land use classification based on the Planning Advice Note no. 65 - Open Space typology. Examples include playing fields, churchyards, private gardens, woodlands, golf courses as well as amenity greenspace around businesses and residential areas. This comprehensive, single GIS database on Scotland's green space allows a number of potential national and regional (council) indicators on green space quantity to be calculated, mapped or graphically visualised. The table below illustrates some examples from Greenspace Scotland's two reports on the state of Scotland's green space that could be used as potential indicators. Accessibility analysis and network analysis allows neighbourhoods to be mapped according to their relationship with urban greenspace: i.e. distance to access points, accessibility according to socio-economic group (environmental justice), provision according to population density etc. The database could be used to help plan and improve greenspace provision for the needs of urban communities. This open dataset has now moved over (as of July 2017) to OS Open Greenspace and should be updated biennially². A good illustration of the types of analyses that can be conducted is an accessible greenspace study conducted in the South East of England³.

Table 1: Examples of Greenspace quantity indicators

Potential greenspace quantity and accessibility indicators	Source	Can you disaggregate the data?	Notes
Greenspace as a percentage of urban land area per authority	Greenspace Scotland	Yes	Ordnance Survey will update biannually
Amount of natural and semi-natural greenspace as a % of urban land area per authority	Greenspace Scotland	Yes	Ordnance Survey will update biannually
Percentage of people that live 5 mins from a green space	Scottish Household Survey	Yes (confidence low for small authorities)	Annual update

¹ <http://greenspacescotland.org.uk/1scotlands-greenspace-map.aspx>

² <https://osmaps.ordnancesurvey.co.uk/greenspace>

³ Mckernan, P. and Grose, M. (2007) *An analysis of accessible greenspace provision in the South East*. South East AOBNs Woodlands Programme, the Forestry Commission and Natural England.

Information note

Indicators of greenspace quality

The majority of green space indicators available in the UK and internationally focus on the quantity and accessibility of greenspace. Developing indicators for the quality of Scotland’s urban greenspace, however, is much more challenging due to the fact that urban greenspaces are so diverse, not only in the number of different functions they have, and hence land use classifications, but also within greenspace with similar functions (think about how different two back gardens can be). For example, how the quality (condition) of a sports field is measured, with regards to the criteria used, will be very different to how the quality of a play park is measured, or semi-natural woodland. These very different types of greenspace, in terms of function, require very different evaluation and monitoring criteria.

This leads us to a fundamental question when choosing a greenspace quality indicator as an ecosystem health indicator: *“When considering the quality of greenspace, specifically in relation to ecosystem health, what metrics of quality (condition) should we aim to monitor? i.e. would an excellent playing field for football score low in terms of ecosystem health if it is a rye grass monoculture?”* And leading on from this *“Should we focus our attention on green spaces in general or on certain types of greenspace; for example green corridors and semi-natural greenspaces over play parks and sports fields?”*

There are a number of guides/standards that have been produced to assist local authorities to conduct green space quality audits and develop associated monitoring programmes. These include the Green Flag Award guidance manual⁴, the CABE open space strategy and best practice guidance⁵, Greenspace Scotland’s green space quality guide⁶. Taking into consideration the quality criteria and methodologies used, the adaptability of criteria for green space type and function, and suitability for monitoring, Greenspace Scotland’s guide appears to have most potential for development into an EHI for greenspace quality (see example **D** in Table 2).

Table 2: Examples of potential quality indicators from national questionnaires and local authority audits

Potential greenspace quality indicators	Source	Can you disaggregate the data?	Notes
A Level of satisfaction/dissatisfaction with quality of greenspace - perception (%)	Scottish Household Survey, Greenspace Scotland Omnibus Survey	Yes, (confidence low for small authorities)	Annual Update
B Agreement that quality (perception) of greenspace has reduced in last 5 years (%)	Greenspace Scotland Omnibus Survey	Not to council level, but yes for CSGN.	Biennial survey since 2004, last one in 2011
C Perceptions of local	SPAN	No	Every 3 years from

⁴ Ellicott, K. (2016) *Raising the standard: the Green Flag Award guidance manual*. London: Department of Communities and Local Government.

⁵ CABE Space/Mayor of London (2009) *Open space strategies and best practice guidance*. London: Commission for Architecture and the Built Environment, and the Greater London Authority.

⁶ Greenspace Scotland and Glasgow and Clyde Valley Green Network Partnership (2008) *Greenspace quality: a guide to assessment, planning and strategic development*. Stirling: Greenspace Scotland.

Information note

greenspace as a 'good place for children to play', 'safe place for physical activity', 'place to relax and unwind', 'attractive place' (%)		2013 – discontinued?
D % of greenspaces achieving quality standard threshold (60%) for biodiverse, supporting ecological networks criteria	Local authorities - using Greenspace quality guide	Yes Applies only to green corridors, semi-natural spaces, and public parks?

One of the biggest challenges in using a single greenspace quality audit method, however, is that different local authority councils have used different, modified or bespoke quality audit methods, with different criteria, or combination of criteria and scoring methods. Some of the differences between different methods used by local authorities are highlighted in Table 3. Whereas the Greenspace Quality guide uses a comprehensive range of biodiversity criteria, the Greenflag Award criteria are somewhat less comprehensive. Another possible criticism of both these approaches is that they tend to be based on the assessor's overall judgement of a site, whether a local authority employee or a Greenflag Award judge. This may lead to inconsistencies in scoring between years and local authorities.

In the absence of a standardised approach, and as the majority of the methods use numerical scoring scales between 1-4 or 1-5, Greenspace Scotland⁷ recommended a threshold average quality standard score of between 60-70% (equivalent to the two highest scores). This would equate to the pass score of 66% to be awarded a Green Flag Award. However, the current lack of consistency and comparability across different local authorities with regards to quality audits, especially regarding biodiversity and ecosystems, makes the development of a single EHI quality indicator that can be used at different scales (local to national) currently impossible. However, this may change as more local authorities adopt the Greenspace Quality Audit approach. It would be useful at this stage to have an update of which approach local authorities are currently using.

Another possibility is to use condition monitoring data of urban SSSIs (semi-natural habitats). This methodology was tested with reasonable success for the 199 SSSIs which were identified as urban in England⁸. However, it is likely that there are fewer urban SSSIs in Scotland and so it might not be possible to downscale the results.

An alternative approach is to use perceived quality data from national surveys. A number of example indicators are listed in the table above. However, as we can see for indicators **A** and **B** indicators, respondents are asked to assess green space in general, so it is not evident whether respondents are assessing their local play ground or semi-natural woodland. Whilst a potential indicator (**C**) taken from the SPAN survey (Scotland People And Nature) asks respondents to assess quality based on type of use, it is still difficult to know what criteria people are using to assess the greenspace and how this relates to ecosystem health. Whilst the Scottish Household Survey can be scaled down to local authority (low confidence for small authorities), data from the SPAN survey cannot.

⁷ greenspace Scotland and Scottish Natural Heritage (2013) Developing Open Space Standards: Guidance and framework.

⁸ Wray S. et al (2005) Audit of the towns, cities and development workstream of the English Biodiversity Strategy. English Nature Research Report 652.

Information note

Indicators of ecological connectivity

In addition to quantity and quality indicators of urban greenspaces, levels of fragmentation and isolation of different patches of greenspace can fundamentally impact on the ecological functioning of greenspace ecosystems. Urban green space, by its very nature, is very fragmented and isolated, restricting the scope for plant and animal species to disperse effectively (reducing population viability). However, by calculating and modelling spatial and functional landscape metrics using GIS, metrics (and thus indicators) can be used to help assess, plan and improve spatial connectivity, and hence (hopefully) ecological and functional connectivity. We use *hopefully* as there are many factors other than the spatial configuration/permeability of the landscape that affects ecological functionality (e.g. availability of pollinators and dispersal agents). A number of metrics and models are currently being used to assess spatial and 'functional' connectivity in a range of rural and urban habitats in Scotland and abroad, including at the James Hutton Institute⁹, Forest Research¹⁰ and Quebec University¹¹, some research is even looking at 3D connectivity (vertical gardens). However, other than a few specific examples, in a few local authorities, the use of ecological/functional connectivity metrics for comprehensive monitoring across different scales is still limited for urban greenspace.

Using species indicators to measure urban green space quality

There have been a number of attempts to monitor changes in urban biodiversity in recent years. The State of Nature¹² annual analysis reports on the changes of abundance and occupancy of species (using estimates from biological records) in the UK per broad habitat, including urban habitats. It is unclear at this stage whether the data can be disaggregated to a national level (Scotland), but given the nature of the data it is unlikely that it can be disaggregated to the regional/local authority level. A similar problem arises with other national surveys such as the Breeding Bird Survey conducted by BTO, where sampling intensity is insufficient to disaggregate to regional areas, let alone regional urban areas.

There are a number of urban (only gardens) bird surveys that use citizen science, most notably BTO's Garden Birdwatch and RSPB's Big Garden Birdwatch. The RSPB annual survey data was used by DEFRA to develop a baseline UK indicator to look at population trends in ten common urban bird species. However, it appears to have been discontinued. An English Nature report⁵ on developing a towns and cities biodiversity workstream recommended using the BTO's survey, over the RSPB survey, as the BTO survey is conducted weekly throughout the year, whereas the RSPB survey is a one off count in January. Whilst there may be sufficient urban records in these surveys (around 500 participants take part each year) to produce a reliable national estimate for Scotland's urban bird populations, it is unlikely that the data can be disaggregated to regional level. Another issue that

⁹ See work by Alessandro Gimona in current Scottish Government's Research Program (Workpackage 1.4.2, <http://www.hutton.ac.uk/research/srp2016-21/wp142-identifying-and-understanding-multiple-benefits-and-trade-offs>).

¹⁰ Ray, D. and Moseley, D. (undated) *A forest habitat network for Edinburgh and the Lothians: the contribution of woodlands to promote sustainable development with the regional structural plan*. Forest Research.

¹¹ Dupras, J. et al. (2016) The impacts of urban sprawl on ecological connectivity in the Montreal Metropolitan Region. *Environmental Science & Policy*, **58**, 61-73.

¹² <http://www.rspb.org.uk/our-work/conservation/centre-for-conservation-science/research/projects/363867-the-state-of-nature-report>

Information note

Table 3: A comparison between different greenspace quality scoring approaches showing differences in criteria used and scoring methods

Features	Greenspace Quality Audit	Green Flag Award	West Lothian –Interim Review (2010)
Strategic Greenspace Framework	Yes	Yes	Yes
Assessment Categories	5 broad categories (Accessibility, Attractiveness, Biodiverse supporting ecological networks, Health and Well-being, Community Supported)	8 broad categories (Welcoming, Safe & secure, Maintained and clean, Environmental management, Biodiversity, landscape and heritage, Community involvement, Marketing and communication, Management)	3 broad categories (Function, Condition, Quality); 5 criteria per category
Relevant sub-criteria for biodiversity and ecosystems	Biodiverse supporting ecological networks: <ul style="list-style-type: none">) Contribute positively to biodiversity) Large enough to sustain wildlife populations) Offers a diversity of habitats) Part of a wider landscape structure and setting) Connects with wider green networks) Balance between habitat protection and access) Resource efficient 	Biodiversity, Landscape and Heritage: <ul style="list-style-type: none">) Management of natural features, wild fauna and flora) Conservation of landscape features Environment Management <ul style="list-style-type: none">) Climate change adaptation i.e. SUDs, re-naturalising water courses 	Biodiversity Interest (one criteria out of 15)
Scoring of sub-criteria	1-5 (Low, Fit for purpose, High); Can be converted to % average score per category.	0-10 (very poor to exceptional)	1-5 (low to high);
Notes	Comprehensive with regards to biodiversity and ecosystems. Can be flexibly used across different functional greenspaces. Focuses on outcomes, rather than management.	Could be more restrictive in application as appears to focus in the management of natural and landscape features of site. May not be so applicable to green space improvements such as pond or wildflower meadow creation, say in a public park.	West Lothian intend to update their audit using Greenspace quality guide

Information note

may arise with using garden bird surveys is that any trends seen may not actually reflect the quality of the urban environment but may reflect increased and improved supplementary feeding from garden bird feeders. For example, supplementary feeding has increased the number of Goldfinches in urban and suburban areas. In fact, BTO's Garden Bird Feeding survey results suggest that the marked increases in species diversity at bird feeders is down to bird feeders being more widespread and better tailored to the needs of different species.

Most recently there has been an attempt to develop an urban butterfly indicator using transect data from the UK Butterfly Monitoring scheme¹³, but again the small number of transects in Scotland may limit its use. BTO has also recently been exploring trends in urban butterflies across the UK. Whilst only currently at the UK level, data may be sufficient to explore national trends in Scotland, but again not at the regional level¹⁴. An UK wide pollinator indicator is also currently in development, however, its focus is likely to be on agricultural and semi-natural habitats.

There are a number of citizen science initiatives such as BeeWalk¹⁵ and Beewatch¹⁶ as well as specific monitoring/research projects in cities such as Edinburgh across Scottish cities, however, without compatibility and integration it is unlikely these surveys can produce a national or regional indicator.

Summary and recommendations

In summary, the data and GIS analytic tools to monitor the *quantity* of urban greenspace at local, regional and national scales to inform decision-making are well advanced. However the comparability, integration and intensity of monitoring with regards to green space *quality* in terms of ecosystem health are still limited.

As local councils are duty-bound to report on urban green space accessibility and quality we recommend that the first step in progressing an indicator for urban green space quality is for all local authorities to use one quality audit methodology, i.e. the Greenspace Scotland quality audit guide. We recommend this quality audit as it currently offers the most comprehensive assessment of biodiversity and ecological features of local authority green spaces.

Lastly, there doesn't appear to be either enough monitoring *per se*, or adequate integration of the monitoring programmes that do exist, to provide species trend data for urban green space that could be assessed at local or regional levels. However, there may be opportunities to develop national greenspace indicators for species such as birds and butterflies with organisations such as the BTO.

Acknowledgements: This report was funded by the Rural & Environment Science & Analytical Services Division of the Scottish Government through the Strategic Research Programme, 2016-2021.

¹³ Dennis, E.B et al (2017) Urban indicators for UK butterflies. *Ecological Indicators* **76**,184-193.

¹⁴ Personal communication from Simon Gillings, BTO Head of Population Ecology and Modelling (June 2017)

¹⁵ <http://bumblebeeconservation.org/get-involved/surveys/beewalk>

¹⁶ <http://homepages.abdn.ac.uk/wpn003/beewatch/index.php?r=user/auth>