BTO Research Report No. 603

The Biodiversity in Glasgow (BIG) Project

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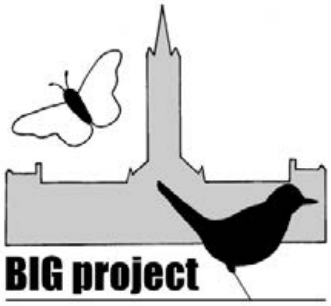

September 2011

BTO Scotland
School of Biological & Environmental Sciences, University of Stirling, Stirling, FK9 4LA

Registered Charity No. SC039193
British Trust for Ornithology

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Published in September 2011 by
British Trust for Ornithology (Scotland)
School of Biological & Environmental Sciences, Cottrell Building,
University of Stirling, Stirling. FK9 4LA

ISBN 978-1-908581-14-3

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1 INTRODUCTION

Urbanization has been defined as the large scale replacement of natural and seminatural habitats with urban development (Shochat et. al. 2006). As the level of urbanization increases at a global scale, the composition of biodiversity is becoming increasingly homogenised whilst the more specialist species dependent on semi natural habitats are being lost (Pauchard et. al. 2006). Moreover, urbanisation was argued to be ultimately the most important causal factor behind the extinction of species in the last century (Mazluff et. al. 2001).

Yet the value of the urban environment is becoming increasingly recognised of being of value for biodiversity. The English Song Thrush population, for example, is now mainly found in suburban habitats such as green spaces and gardens (Mason 2000). There are even cases of species which have their last remaining strongholds within the built environment such as the Black Redstart[1]. In addition, brownfield sites are known to be important for invertebrates including nationally scarce species (Gibson 1998). There are real threats to urban biodiversity however through the loss of existing green spaces in towns and cities e.g. 'infilling' (Pauliet et al. 2005). Furthermore, some urban bird species are in serious decline in some parts of the UK, e.g. House Sparrow and Starling (Crick et al. 2002). Urban green spaces are therefore increasingly appropriate targets for research and conservation efforts.

The importance of urban biodiversity has also been highlighted in the Scottish biodiversity strategy, a 25 year plan for the conservation and enhancement of biodiversity in Scotland. This document sets out five main objectives: halting the loss of biodiversity; increasing awareness of biodiversity and engaging people in conservation; restoring and enhancing biodiversity in urban, rural and marine environments; ensuring that biodiversity is taken into account in all decision making and; ensuring that existing knowledge on biodiversity is available to all policy makers and practitioners (Scottish Government 2004). The Scottish Biodiversity Forum, in its implementation plans for 2005-2008, have also highlighted that urban green spaces are often poorly managed and sometimes dominated by non-native invasive species which are generally of low value for urban wildlife (Scottish Government 2005). Consequently, urban environments such as green spaces and corridors, offer huge potential for improvement through schemes to conserve and enhance biodiversity.

Glasgow is an ideal city in which to study urban biodiversity. Over 20% of the area of Greater Glasgow is green space; including 74 parks, over 30 allotment spaces and several other sites of potential importance to urban biodiversity, such as river corridors, woodlands, cemeteries and communal gardens[2]. In terms of nationally recognised status of nature conservation, it holds 5 Sites of Special Scientific Interest (SSSIs) and 7 Local Nature Reserves (LNRs). At a regional level, it also has 46 and 49 Sites of Importance for Nature Conservation (SINCs) at the City and Local level respectively. A recent strategic review carried out by Glasgow City Council (GCC) identified ecology and environment as a key issue in the strategic development of park management, with a particular emphasis on identifying amenity grass and road verges that could be managed in such a way to improve biodiversity (GCC 2005). Furthermore, there is a commitment to include biodiversity as an integral part of any development projects for Glasgow's parks. In addition, the Glasgow Biodiversity Partnership has issued a Local Habitat Statement on "Built Up Areas and Gardens", as part of their Local Biodiversity Action Plan (LBAP) process, which not only highlights the threats to urban biodiversity but also the general need to raise awareness and understanding of biodiversity in the wider community[3].

[1] http://www.blackredstarts.org.uk
[2] http://www.glasgow.gov.uk/en/AboutGlasgow/Factsheets/Glasgow/Environment.htm.
[3] http://www.glasgow.gov.uk/NR/rdonlyres/5CF1528F-ABBC-4F8F-A3CC-AD6CFD8E98CB/0/LBDAPurban.pdf

The Biodiversity in Glasgow (BIG) project was set up as a collaboration between BTO Scotland, Butterfly Conservation Scotland and Glasgow City Council and ran from January 2007 to April 2009. The main aim of the project was to carry out the largest ever volunteer survey of the birds, butterflies and their associated habitats within the green spaces of the city. This information was then used to determine the key habitats for enhancing bird and butterfly diversity within green spaces. Therefore the aims of this project were to:

Survey the bird and butterfly communities in the public green spaces of Glasgow by involving local volunteers.

Determine which urban habitats are the most important in terms of enhancing bird and butterfly diversity within green spaces.

Raise awareness of the value of urban biodiversity at a local and a national level.

Provide habitat management recommendations for the management of green spaces.

2 METHODOLOGY

2.1 Recruitment

Volunteers were recruited by a number of means. Colours leaflets, produced jointly by BTO and BCS, were distributed by GCC at a range of venues throughout the city including libraries, museums, and educational establishments. GCC also targeted potential volunteers by sending an internal e-mail to all members of staff. A number of articles promoting the project were also written for a range of newspapers, magazines and newsletters including: The Herald, The Scotsman; Evening Times, The Scots Magazine, Scottish Bird News, Glasgow Biodiversity Newsletter, SEPA View, Butterfly Conservation in Scotland Newsletter and BTO News. Recruitment talks were also given to local groups including: the Glasgow RSPB group and the Glasgow Natural History Society. In addition, a web page hosted on the BTO website was set up which was updated regularly to provide information of training events and publication of newsletters[4].

2.2 Training

Training new volunteers was a major component of the BIG project. Both BTO and BCS have extensive experience of running survey and identification training courses for volunteers. Training days were designed to cover basic species identification and survey methodology. In 2007, four training days were held for both birds and butterflies which were run by BTO Scotland and BCS respectively. An additional training day was also held in 2008. The venues were selected to cover different geographic regions of the city and were provided by GCC for free. Over the two years, a total of 108 and 88 people were trained for birds and butterflies respectively, many of whom had never taken part in a survey before.

Volunteers who attended the bird training days were provided with a colour manual of the birds most likely to be seen in Glasgow City with important diagnostic features marked accordingly. CDs of bird songs and calls (as used for the Breeding Bird Survey) were also given to volunteers to help learn the more common bird species by sound. Similarly, volunteers who attended the butterfly training days were provided with a colour identification leaflet of the butterflies and day flying moths of Glasgow (which was part funded by GCC as part of another initiative).

2.3 Site allocation

Green spaces included in the BIG project were assigned, with help from Glasgow City Council, to one of the following categories: parks, cemeteries, public gardens, woodlands and open spaces. The category of open space describes the various combination of a wide range of possible habitats which are not intensively managed including: wetland, raised bog, burns, woodlands, heathlands, pasture and open water. Unfortunately, due to access issues it was not possible to survey brownfield sites. Green spaces were allocated to volunteers according to proximity to either where they lived or areas they regularly visited. All sites fell within the administrative region of GCC and over 90% were also owned and managed by GCC. In total, 112 and 102 sites were allocated to volunteers surveying for birds in 2007 and 2008 respectively. Similarly a total of 108 and 90 sites were allocated to volunteers surveying butterflies in 2007 and 2008. Where ever possible volunteers were encouraged to take on sites to survey both birds and butterflies.

Ordnance Survey maps of all green spaces were provided to all volunteers, courtesy of Glasgow City Council, on the strict basis that they would not be used for any other purpose and all maps had to be returned at the end of the project. The size of green spaces ranged from 1.5 to 167.8 ha. It was felt,

[4] http://www.bto.org/survey/special/glasgow_biodiversity/index.htm.

however, that it was unrealistic for volunteers to cover sites greater than 80 ha (see Chamberlain et al. 2005). Therefore two of the sites were divided into two: Cathkin Braes Country Park (East and West), and Pollok Country Park (North and South). In addition Kelvingrove Park was also divided up into two sections (East and West) at the request of the volunteers who felt that the site was too big and too complex to be realistically covered by a single person.

2.4 Survey methodology

2.4.1 Bird surveys

Volunteers were recommended to make a pre-survey visit in early April in order to record habitats present at their allocated site (see Appendix 1 for habitats categories that were recorded). They were required to estimate the percentage cover of the different habitats that fell within their site to the nearest 5%. It is important to note that habitats at different strata could overlap, so % cover did not necessarily sum to 100% for a given site (e.g. mature trees could have an underlying shrub layer, and the % cover of each would be recorded separately). In addition, they were requested to record the percentage of different boundary types which surrounded their site and the percentage of the boundary which is adjacent to different habitat types (<10%, 11-25%, 26-50%, 51-75% and >75%).

Three further visits were then made: mid-April to mid-May, mid-May to mid-June and mid-June to mid-July. It was recommended that survey visits were carried out between dawn and 09:00 but if this was not possible, observers were required to choose a time of day that was convenient and carry out future surveys at this fixed time. Volunteers were requested to walk a survey route in such a way that they covered the whole site to within 50m ensuring that they did not double count any birds (this could either be done walking in a zigzag fashion or in parallel lines). Although all species were recorded, records of domestic and known escaped birds were not of interest and were therefore not included in subsequent analysis.

2.4.2 Butterfly surveys

Volunteers were recommended to undertake a pre-survey in early to mid-May in order to set up their transect routes, which form the basis of the butterfly survey methodology. Transects were to be devised so that they should take no longer than about 60 minutes to walk, be no more than 2 km, and cover a fair representation of the habitats and other features present at the site. In addition, volunteers were also asked to estimate the percentage cover of the different habitats that fell within their site to the nearest 5% (using the same categories that were used for birds)

A minimum of four monthly visits were recommended in order to coincide with the flight period of most species likely to be encountered: mid-May-mid-June, mid-June to mid-July, mid-July to mid-August and mid-August to mid-September. Using the same transect set out in the pre-survey visit, volunteers were requested to walk at a slow, steady pace counting all butterflies seen within 2.5m either side of the transect line and 5m ahead. In addition to butterflies, day-flying moths were also recorded by some volunteers.

Transect counts were to be carried out between 10:45 and 15:45 hours BST and in good weather conditions (warm, bright, dry and wind speeds less than 5 on the Beaufort scale). The suggested minimum for walking butterfly transects in Scotland is 11°C, providing there is 60% sunshine or it is bright enough to cast a shadow. Above 17°C transects can be walked in any conditions, provided it is not raining. Wind speeds and percentage sunshine were to be recorded on the transect forms.

Data from the forms were entered into *Transect Walker*[5], software specially developed for the United Kingdom Butterfly Monitoring Scheme (UKBMS)[6]. Data entry was problematic and time-consuming as the habitat classifications used for the BIG project were not the standard ones used by the UKBMS and interpretation by the inputters was required, when usually volunteers are required to enter their own data.

[5] www.ukbms.org/transect_walker_v2.htm
[6] www.uk.bms.org

3 RESULTS

3.1 Birds surveys

3.1.1 Bird survey form return rates

In 2007, 79 of the allocated 112 green spaces were surveyed giving a return rate of 70%. For two green spaces, however, the observers had only recorded presence or absence data and for three green spaces information of % cover of the different habitat types were not recorded. In 2008 a total of 67 of the 102 allocated green spaces were surveyed, yielding a similar return rate of 65%. For one green space, however, the observer had only recorded presence or absence of bird species and for another three sites information of % cover of the different habitat types were not recorded. On closer inspection of the data, it also became apparent that visits were sometime carried out later than the dates recommended in the survey protocol. Therefore only survey data from mid-April to the end of July are reported here. The full datasets are to be made available on the National Biodiversity Network web pages however.

3.1.2 Birds Species recorded in Glasgow

In total there were 86 bird species recorded in 77 green spaces in Glasgow in 2007. The most commonly occurring species was Blackbird which was present in over 97% of all sites. Thereafter the most commonly occurring species were Magpie, Robin, Great Tit, Woodpigeon, Carrion Crow, and Chaffinch which occurred in over 80% of all sites (see Table 1). In 2008, a total of 77 bird species was recorded in 66 green spaces in Glasgow. The most commonly occurring species was the Magpie which was present in 100% of the sites. Thereafter the most commonly occurring species were Blackbird, Woodpigeon, Blue Tit, Robin, Carrion Crow, Great Tit, and Chaffinch which all occurred in over 75% of all sites (see Table 2). This was almost identical to 2007.

3.1.2.1 Species Highlights

A total 91 species of bird were recorded during the BIG project of which 15 were UKBAP and 4 LBAP species (see Table 1 and 2). Moreover, 47 species were also listed as Birds of Conservation Concern (BOCC, see Eaton *et al.* 2009 for further information). These key lists not only include species which have become synonymous with the urban environment such as Starling, House Sparrow and Common Swift but also included those which are more commonly associated with rural habitats including Tree Sparrow, Skylark and Yellowhammer.

The Starling was found in over 65% of surveyed green spaces in both years. This species is red listed, under the BOCC assessment, due to a decline of more than 50% in the UK population over the last twenty five years[7]. The most important breeding habitats for Starling are villages and towns[4] and it would be expected that this species would be well represented in Glasgow.

The House Sparrow, a red listed species of BOCC, was recorded in over 30% of sites in both survey years. It has dispersed with man from its natural range of Europe and Asia to the Americas and New Zealand. In more recent history it has readily adapted to living in the urban environment and within the UK, the House Sparrow is mostly found in villages and towns[4]. House Sparrows have declined seriously in more southerly regions of the UK, but in Scotland there have been some increases over

[7] http://www.bto.org/psob/redlist.htm

the past few decades (Baillie et al. 2009), although there have been local declines in urban populations, e.g. Edinburgh (Dott & Brown 2000).

The Common Swift was also recorded in over 30% of sites in 2007 and 2008. This species is another urban specialist and is mostly found in town and villages. This species until recently was not listed as a species of conservation concern[8]. Collation of long term trend information for the Swift had been problematic due to problems associated with locating nests and highly weather-dependent foraging behaviour.

Skylark, as well as having LBAP and UKBAP status, is a red listed species under the BOCC assessment and was recorded at 6 sites. This species is largely associated with moorland, arable fields, bogs and heathland[9] which are habitats not generally associated with the urban landscape. Glasgow, therefore, is fortunate to have a selection of sites that contain such habitats. Reed Bunting was found in 10 sites over the two years and is largely associated with reed beds and marshes[4]. Common Cuckoo, Lesser Redpoll and Common Linnet were only found in a few sites across the city during the BIG project.

3.1.2.2 Site information

Species lists compiled for sites in 2007 and 2008 were checked by GCC staff. There were several instances of unusual records which were then checked with the volunteer involved and discounted when necessary. Also there were several cases where the species lists of birds as part of the BIG project were lower than those held by GCC for certain sites (e.g. Hoggenfield Park in 2008).

The total number of species recorded per green space ranged from 5 to 61 in 2007 (Table 3) and 6 to 48 in 2008 (Table 4) respectively. Mean number of species (recorded per visit) was compared between the different green space types of Allotment, Campus, Cemetery, Open Space, Public Garden, Park and Woodland were fairly similar ranging from 10.8 to 16.2 (with the notable exception of a campus in 2007 which had a very low number of 2.7)

Sites with 30 or more bird species recorded in 2007 were as follows: Bishop Loch, Cathkin Braes, Darnley Mill Country Park, Dawsholm Park, Frankfield Loch, Glasgow Green Tollcross Park, Millerston, Kelvingrove Park, Possil Loch, Pollok Country Park and Ruchill Park. All of these sites, apart from Glasgow Green, Kelvingrove Park and Tollcross Park, are designated as a LNR, SSSI or SINC. Sites which had 10 or less species were as follows, Ardmay Park Auchenshuggle Wood, Cranhill Park, Cross Park, East End Campus, Garscube Allotments, Holmlea Park, Lainshaw Drive, Naseby Park, Newlands Park, Orchard Park and Mansewood High Park.

Sites with 30 or more species recorded in 2008 were Bishop Loch, Cardowan Moss, Dawsholm Park, Pollock Country Park, Possil Loch and Science Park. All or parts of these sites already have designation for nature conservation at a local or national level. Sites which had 10 or less species were as follows, Ardmay Park, Holmlea Park, Naseby Park, Newlands Park, Ruchill Golf Course and Waulkmill Glen.

3.1.2 Habitats recorded at bird survey sites

The most commonly occurring habitat types in sites surveyed for birds in both years were broadleaved trees, mown short turf, un-mown rank grass, paved area, broadleaves bushes and wildflower weedy areas which occurred in over 60% of all sites in both 2007 and 2008 (see Table 5

[8] http://www.bto.org/birdtrends2006/wcrswift.shtml
[9] http://www.bto.org/birdfacts/

and 6). The mean percentage cover of habitats according to type of green space in both years was also summarised (see Table 7 and 8) but here we only discuss green spaces with a sample size of five or more which were as follows: Parks; cemeteries; woodlands; and open spaces.

The five most abundant habitats by percentage cover for parks in 2007 were in decreasing order of importance were: mown short turf, broadleaved trees, un-mown rank grass, mixed trees and wildflower weedy areas. Similarly the most abundant habitats in parks in 2008 were mown short turf, broadleaved trees, un-mown rank grass, wildflower weedy areas and broadleaved bushes. Mown short turf was by far the most abundant habitat in parks for both years (approx. 50%) which reflect their main usage for amenity and recreation.

In cemeteries, the most abundant habitats in 2007 were: mown short turf, gravestones, broadleaved trees, mixed trees and un-vegetated walls/buildings. Again the most abundant habitats were very similar in 2008 for cemeteries: mown short turf, gravestones, mixed trees, paved areas and walls/buildings (no vegetation). Mown short turf again was the most abundant habitat in cemeteries for both years (>70%), as areas of grass around gravestones and vacant plots are more likely to be maintained by an intense mowing regime.

In woodlands the five most abundant habitats in 2007 were broadleaved trees, wildflower weedy areas, un-mown rank grass, mixed trees, and coniferous trees. This was similar to 2008 when the most abundant habitats were broadleaved trees, un-mown rank grass, broadleaved bushes, wildflower weedy areas and coniferous trees. These habitats reflect what would be expected in typical woodlands.

In open spaces, the five most common habitats in 2007 were broadleaved trees, un-mown rank grass, broadleaved bushes, wildflower weedy areas and mown short turf. A similar pattern was shown in 2008, although paved area was one of the top five most abundant habitats. The presence of mown short turf and paved areas in open spaces reflects that parts of open spaces are likely to have amenity value despite being less intensively managed compared to other types of green spaces.

3.1.3 Habitat associations of birds

Analyses were carried out to look at which habitats are most important in terms of enhancing bird diversity, as measured by species richness. In order to do so, bird counts for individual species were first summed for each site visit and then converted into presence and absence data. This was then used to calculate the total number of species recorded during each visit to a site. Habitats that were regarded of being of interest for inclusion into the analyses were those which had ecological value and could potentially be actively managed by land owners. Following Chamberlain et al. 2007, some habitat categories were combined for the analyses e.g. un-mown or rank grass and wildflower/weedy areas were summed to create a new habitat called wild areas (see Appendix 1 for how original categories were reclassified). Once the key habitats had been selected, the percentage cover data was converted into presence and absence data.

The relationship between species richness and habitats was analysed using Generalised Linear Mixed Models with a log-link function (GLIMMIX procedure in SAS 9.1). The habitats that were selected for inclusion into the model were as follows: bushes, trees, mown grass, wild, water, wetland/marsh, green space. Size of green space was also included as an explanatory term. As up to 3 visits in each of two years were carried out, site was nested within year and included as a random term in the model. Terms which were non-significant were sequentially deleted from the full model until all

terms within the model were significant, resulting in the minimum adequate model (see Appendix 2).

Bird diversity was most influenced by the size of green space: the larger the green space then the higher the number of species recorded was likely to be (see Figures 1 and 2). The presence of wild areas (un-mown rank grass or wild/weedy areas) had the greatest single effect of the habitats (as also found by Chamberlain et al. 2005); with an average of 5.2 more species in green spaces where wild areas were present (see also Appendix 2). The presence of a water body (natural or ornamental) was also found to be important. Green spaces with a water body overall had an average of 4.9 more species than those without. Furthermore, sites with a wetland/marsh area present had on average 2.8 more species than those sites without.

3.2 Butterfly and day-flying moth surveys

3.2.1 Butterfly survey form return rates

In total, 55 sites of the allocated 108 sites were surveyed for butterflies in 2007 giving a return rate of 51%. In 2008, 44 sites out of the allocated 90 sites were surveyed which gave a return rate of 49%. It is likely that the return rates were influenced by the unusually poor summer weather, notably in 2008 when levels of butterfly and moth recording were lower throughout Scotland and the UK.

A total of 203 transect recording forms were returned for the 55 sites surveyed in 2007 (some volunteers returned six forms). Weather data was only fully completed in 115 of forms (57%). Information on temperature and sunshine levels was missing from 15% and 16% of forms respectively. Although useful, this is not as important as sunshine, which was omitted from 16% of forms. 25 forms had no weather data at all. In total 81 forms recorded no butterflies, but of these, 45 were walked in unsuitable weather, or did not include sufficient weather data to determine suitability. Thus we do not know if the reason for a lack of butterflies recorded on these visits was due to unsuitable weather, or a genuine lack of butterflies. Some forms stated that in the recorders' opinion, the poor weather was the reason for no sightings, but in some cases the sites may be poor in butterflies anyway. Habitat information was not submitted for 4 of the sites surveyed for butterflies in 2007 (but one of these sites had information submitted in 2008).

148 transect forms were returned for the 44 sites surveyed in 2008. Nine of these sites recorded no butterflies or moths, however at two of these the recorders did provide some 'casual' records for the site i.e. 'off transect'. Sunshine and temperature data was missing for 14% and 24% of forms respectively. Thirteen forms had insufficient weather data to say whether the surveys were carried out under suitable conditions or not. Of these, 5 recorded no butterflies or moths. Of the transects walked in suitable weather, butterflies and/or moths were recorded on 89 forms (65%), whereas 48 forms recorded none. Habitat information was not submitted for 3 of the sites surveyed for butterflies in 2008 (but data was available from the 2007 survey).

3.2.2 Butterfly species recorded in Glasgow

In total 15 species of butterfly were recorded in 2007. The five most commonly occurring butterfly species were Small White, Meadow Brown, Green-veined White, Large White and Peacock/Small Tortoiseshell which occurred in 35% or more of all green spaces (See Table 9). Similarly 15 species of butterfly were recorded in total in 2008. The five most commonly occurring butterfly species were Small White, Meadow Brown, Green-veined White, Large White and Orange-tip/Ringlet which occurred in 30% or more of all green spaces (See Table 10).

3.2.2.1 Species highlights

A total of 17 species of butterflies were recorded during the BIG project of which two as listed as UKBAP species: the Grayling and Small Heath. Grayling was recorded at only one site on one occasion in 2007 (Eastwood Old Cemetery). Although this was a few miles away from its nearest known site within Glasgow, it was located close to a railway line which could have acted as wildlife corridor for this previously unknown site. The Grayling is on the revised UKBAP list due to its decline across the UK (Fox et al. 2007).

Small Heath was only found at two sites (Petershill Acid Grassland and Red Road Nature Park) in 2007 but pleasingly it occurred in good numbers at these sites. In 2008 Small Heath was found at 6 sites (Cathkin Braes West, Red Road Nature Park, Malls Myre, Millerston, Robroyston Park and Pollock Estate South). The Small Heath butterfly qualifies as a UK BAP species because of its recent rate of decline although it is relatively widespread in the Scottish countryside. It requires fine-leaved grasses so is usually confined to semi-natural grasslands.

Meadow Brown was recorded very early at several sites (mid-May) in 2007. As this species usually appears mid-June, it could have being confused with Ringlet which normally appears a week or so before Meadow Brown. Although these records at initial inspection seem unlikely, the earliest UK records for Meadow Brown and Ringlet in 2007 were 30 April and 7 June respectively (both in Northern Ireland) so these records are possible. In 2008, most site records commenced around early/mid-July, but at one site there was a record for 14 June. However, Meadow Brown was recorded at another site in Glasgow on 12 June by an experienced recorder, so it seems some urban sites can produce early records. Higher average temperatures typically occur in urban compared to surrounding semi-natural habitats (Haggard 1990), which could possibly act as a mechanism to encourage earlier appearance of certain butterfly species. It is also worth noting that early breeding in urban relative to non-urban populations seems to be a widespread phenomenon in many bird species (Chamberlain et al. 2009). A full assessment of whether similar effects occur in butterflies (and other insects) would be worthwhile.

One of the best results of the BIG project was that many recorders saw Ringlets at their sites (11 and 14 sites in 2007 and 2008 respectively). As this species is just colonising Glasgow, these records will help to track its movements within the city.

The BIG project also provided the first record for Glasgow of the Comma butterfly. Although it was reported at just one site in 2007 only (Todd's Well) five individuals were reported. The Comma is a generalist species that has a southerly distribution in Britain, although over the past few decades it has shown northern range expansions, almost certainly due to climate change (Warren et al. 2001). It is therefore likely to become much more widespread in the future.

Clouded Yellow was only recorded (and confirmed) at one site in 2008 (Cathkin Braes West). Two other records of this species are also known of in the same year within the city. This is a migrant species from Europe, which does not occur every year, but is now turning up more frequently than in the past.

Surprisingly, Common Blues were only recorded at two sites in 2007 (Robroyston Park and Riddrie Park Cemetery) and at just one site in 2008 (Robroyston Park). Common Blues are conspicuous butterflies and fairly widespread, although rarely abundant. There is evidence that the Common Blue has undergone a widespread decline across the UK (Botham, 2008; Fox et al. 2005).

Small Tortoiseshell was seen at 19 and 11 sites in 2007 and 2008 respectively, which was surprisingly low. The Small Tortoiseshell is declining across most of the UK, although the underlying reasons are unclear. One possibility is the recent arrival from the Continent of a parasitic fly, which BC is researching with Oxford University [10] However, low records for Peacock, with sightings at 19 and 8 sites in 2007 and 2008 respectively, meant that the poor late summer weather was possibly the main cause of the lack of sightings for both species.

Species not reported by BIG volunteers (in either year) that occur in the total list of butterflies previously recorded for Glasgow included Green and Purple Hairstreak, and Small Pearl-bordered Fritillary, but these species occur at very few sites in the city, most of which were not surveyed.

3.2.2.2 Site information

All records were checked over by BC staff and volunteers to ensure that species lists for sites were likely. Of the 55 green spaces surveyed in 2007, butterflies were recorded at 45 sites (81%). The sites with the most species recorded (eight or more) were as follows: Possil Loch, Auchinlea Park, Hurlethill, Maryhill Park, Petershill Acid Grassland, Red Road Nature Park, Robroyston Park (See Table 11). Of the 44 green spaces surveyed in 2007, butterflies were recorded at 35 sites (79%). The green spaces with the most species recorded (eight or more) were as follows: Cathkin Braes West, Malls Myre, Auchinlea Park and Robroyston Park (see Table 12).

There were only two green spaces with no records of butterflies in both years: Cross Park and Eastwood New Cemetery. Sites for which nil records were reported for 2007 were as follows: St Kentigern's, Linn Park, East End Campus, King's Park, Eastwood New Cemetery, Castlemilk Park, Barrachnie Park, Waulkmill Glen, Cross Park and Cardonald Cemetery (Table 11). Butterflies were recorded in 2008, however, for Linn Park, Kings Park, Castlemilk Park, Cardonald Cemetery and Waulkmill Glen (Table 12). Unfortunately St Kentigerns, East End Campus and Barrachnie Park were not surveyed in 2008.

Sites for which nil records were reported for 2008 were as follows: Auldhouse Park, Cross Park, Eastwood New Cemetery, Glasgow Green, Holmlea Park, Knowetap Street, Rosshall Park and Victoria Park Walkway (see Table 12). Of these sites, butterflies were recorded in Auldhouse Park, Glasgow Green, Holmlea Park, Knowetap Street and Rosshall Park in 2007 (Table 11). Victoria Park Walkway was not surveyed in 2007.

Of those sites with no or very few butterflies recorded in either year, only a small proportion were surveyed under conditions of low sunshine levels (which reduces the likelihood of observing butterflies) and therefore poor weather was unlikely to have accounted for nil records.

3.2.3 Habitats recorded at butterfly survey sites

As found for the bird survey, fewer green spaces were surveyed in 2008 compared to 2007. In addition, fewer green spaces were surveyed for butterflies compared to birds in both years of the project. The most commonly occurring habitat types surveyed for butterflies in both years were; mown short turf, un-mown rank grass, broadleaved trees, wildflower weedy areas, paved areas and broadleaved bushes (see Table 13 and 14).

The most abundant habitats by percentage cover for parks in 2007 and 2008 were mown short turf, broadleaved trees, un-mown rank grass, wildflower weedy areas and paved areas (Table 13 and 14). This was broadly similar to the pattern found for sites surveyed for birds overall.

[10] http://users.ox.ac.uk/~zool0376/small-tortoiseshell.htm).

In cemeteries the most abundant habitats in 2007 were mown short turf, graves, mixed trees, wall/building (no vegetation) and broadleaved trees, but too few cemeteries were surveyed in 2008 to qualify for further exploration of the habitat data (Table 13 and 14). The former year was broadly similar to the pattern found for sites surveyed for birds overall.

The most abundant habitats in open spaces in 2007 were un-mown rank grass, broadleaved trees, broadleaved bushes, wildflower weedy areas, mixed trees and mown short turf (Table 13). A slightly different pattern was found for sites surveyed for butterflies in 2008 as the most abundant habitats were broadleaved trees, un-mown rank grass, wildflower weedy areas, mixed trees and broadleaved bushes (Table 14). Again this was broadly similar to the pattern found for sites surveyed for birds overall.

3.2.4 Habitat associations of butterflies

Relating butterfly species richness of sites to the habitat data was not possible for a number of reasons. Firstly to avoid confusion for volunteers undertaking both bird and butterfly surveys, we used the same habitat classification for both surveys. This limited its usefulness for the butterfly and moth analysis, as they use the environment at a much a finer scale than birds (e.g. rely on the presence of particular larval and nectar plants). Secondly, butterflies are far less detectable than birds which are larger and vocalise their presence through song and calls. It was not possible therefore to get complete coverage of sites used in the BIG project for butterflies. Instead butterflies were surveyed using transect methodology derived from the UKBMS, with the intention of encouraging volunteers to repeat the transect in future years. Moreover it was likely that in a number of instances the transect route chosen did not pass through suitable habitat even though the habitat was present (e.g. inexperienced volunteers and possible problems of convenient access).

It was possible however to compare the habitat features of those sites for which butterflies were recorded to those for which nil records were obtained. Of the habitat variables recorded (see Appendix) only a two are likely to be important for butterflies: wildflower/ weedy areas and un-mown/rank grass. The means of the percentage cover of Wildflower weedy areas for sites with and without butterflies were 12% and 11% in 2007 respectively. However the means of the percentage cover of un-mown or rank grass were 17% and 4% for sites with and without butterflies which was statistically significant (Non parametric tests: $F=31.14$, $p>0.01$). This is suggestive that the area of un-mown grass could be an important determinant of whether butterflies will be present at a site. Closer inspection of the habitat data for the two sites with no records of butterflies or moths in either year (Cross Park and Eastwood New Cemetery), revealed that neither had any ‘un-mown/rank grass’, or ‘wildflower/weedy areas’. Both sites were largely dominated by mown/short turf, trees and bushes.

The percentage of ‘un-mown/rank grass’, or ‘wildflower/weedy areas’ varied considerably (10-100%) for the sites with the most records of butterflies or moths. If we make the reasonable assumption that the presence of butterflies and moths requires ‘un-mown/rank grass’, or ‘wildflower/weedy areas’, then it appears that so long as there is some suitable habitat, then some species may occur.

3.2.5 Day-flying moths recorded in Glasgow

3.2.5.1 Species recorded in Glasgow

Of the 55 green spaces surveyed in 2007, 9 species of day-flying moths were recorded at 15 sites (Table 17 and Table 19). Similarly in 2008, 10 species of day-flying moths were recorded at 10 of the 44 sites surveyed (Table 18 and Table 20).

The most commonly seen day flying moth species in 2007 were Mother Shipton, Silver-ground Carpet and Latticed Heath which were seen in 5-10% of all sites (Table 17). Whereas in 2008, the most commonly seen day flying moth species were Chimney Sweeper, Mother Shipton and Latticed Heath which were seen in 5-10% of all sites (Table 18).

3.2.5.2 Species Highlights

The Chimney Sweeper was recorded at two sites in 2007 and four sites in 2008. It depends on semi-natural grasslands supporting pignut, the larval food plant.

Although the Elephant Hawkmoth is a widespread and very distinctive species, it is nocturnal, and was only recorded at one site in 2007 (Red Road Nature Park).

3.2.5.3 Site information

The best green spaces for day flying moths in 2007 were Petershill Acid Grassland and Hurtlehill with three species seen at both sites (Table 19). The best green spaces for day flying moths in 2008 were Malls Myre, Kings Park and Robroyston with three species seen at these sites (Table 20).

The 6-spot Burnet was found at two sites in both 2007 and 2008 (Barlanark Park and Cathkin Braes West, and Dawsholm and Robroyston Parks respectively). The moth requires bird's-foot trefoil, usually only found in semi-natural grasslands and would therefore have limited occurrence in Glasgow's Green Spaces. This is also the food plant of Common Blue, and both species were seen in 2008 at Robroyston Park.

4 Discussion

4.1 Recommendations for green space management

4.1.1 Birds

The size of the green space was found to be the most important feature to influence species richness. This supports the findings of Chamberlain et al. 2007 who looked aspects of London's green spaces that features influenced species richness. In existing towns and cities, this attribute cannot be easily augmented due to already existing development. There may be instances, however, where buildings adjacent to green spaces are demolished and there may be potential to landscape the remaining site so that it forms an extension to the existing green space rather than redeveloping the site. This may be impractical though when land availability is at a premium as for Glasgow City. In terms of town planning in new developments, there may be scope to incorporate larger green spaces as part of the design. Larger sites are more likely to have a greater number of habitats and consequently it is difficult to tease apart the relative importance of size in relation to diversity of habitats (Chamberlain et al. 2007).

Wild areas (un-mown grass and wild/weedy) were important habitats for species richness again corroborating Chamberlain et al. 2005; Chamberlain et al. 2007. It is likely that these habitats are important since they are likely to hold important numbers of invertebrates (Chamberlain et al. 2007). Furthermore, they could also provide seed resources, particularly outside the breeding season. Approximately 80% of sites had areas of mown grass and there would be scope to identify more areas where the cutting frequency could be reduced significantly.

The presence of water bodies was an important factor in Glasgow's green spaces which was also reported for green spaces in London (Chamberlain et. al 2005). The presence of water bodies creates opportunities for an additional waterbird community, e.g. ducks, geese, Moorhen, Coot, Grey Heron, and even scarcer species such as Kingfisher, Dipper and waders at some sites. Natural and ornamental water bodies were found in less than 40% and 20% of sites respectively. There is likely to be potential to consider creation of more water bodies at sites in order to enhance diversity of birds.

Wetland and marsh areas were also important for overall species richness and therefore, if new water features are put into place in green spaces they should ideally be accompanied by the creation of these areas. Moreover at sites which do not have wetland or marsh areas but do have water bodies, then for some of these sites there may be scope to incorporate them into the site.

4.1.2 Butterflies

The number of butterfly records for the BIG project was lower than initially anticipated. Part of this was attributable to poor weather particularly in 2008 which would have impacted the ability to detect butterflies. Also several key sites for butterflies which are owned and managed by GCC were not covered by volunteers as they were either unsuccessfully allocated or the volunteer did not return their forms at the end of the season. There are also numbers of privately owned sites that are known to be good for butterflies but have been ear marked for development, however. In addition it is also important to bear in mind that many of the volunteers were inexperienced in butterfly and moth identification and habitat assessment. This could have meant that transects may have been inadvertently positioned in habitats that are generally known to be poor for butterflies. It is also important to recognise that a lack of butterfly records at some of the sites is likely to due to a lack appropriate habitat or poor management of existing habitats.

Although more detailed vegetation sampling would have been better, the coarse habitat classification used did provide some clues as to habitat suitability. It is clear from this survey that sites with a high percentage of short mown turf are poor for butterflies and moths. Conversely sites with a large proportion of wildflower areas or rank grass are much more suitable. These observations are expected, as nectar sources and caterpillars are destroyed by regular mowing.

Some sites however seemed unexpectedly poor, despite having a high percentage of un-mown/rank grass. It is possible that these sites do not have any species-rich/semi-natural grassland, and the grassland is of amenity or agricultural origin, and thus of no value to butterflies and moths. On these sites there is little point in leaving areas to grow rank 'for wildlife', and the creation of new wildflower-rich grassland should be considered instead.

Some sites may have semi-natural grassland that is currently mown too frequently to be of value to butterflies and moths, but further survey would be needed to identify these, and indeed, they may be of value for other species under the existing mowing regime. Similarly some sites had wildflower areas but were obviously very shady, but again, site specific surveys would be required before any major change in management were implemented.

Even annual mowing of grasslands will causes losses to most butterflies and moths, except perhaps those that pupate in the soil. Thus if the site has to be mown, it is always better to have a variety cutting regimes so a proportion of the population has a chance of survival, This however means extra cost and inconvenience, so is best applied to sites where there is known interest that can be accommodated in this way.

Planting of key plant species is also important to encourage butterfly diversity. For example, two surprisingly scarce but very appealing species that were found during the surveys were Common Blue and 6-spot Burnet. The larvae of both feed on common bird's-foot trefoil, an attractive but low-growing nitrogen-fixer that can be easily introduced into poor fertility soils.

4.2 Outcomes of the project

4.2.1 Increasing volunteer engagement

One of the biggest achievements of the BIG project was the successful recruitment of new volunteers to butterflies and birds surveying in Glasgow. Volunteers had often previously felt that they lacked the skills or the confidence to get involved so the extensive training that was offered was key to the success of the project. First-time surveyors also reported taking great satisfaction in developing their identification skills as the project progressed, which really reinforces the message that the only way to truly learn is to get out there and practice! A number of volunteers have now gone on to be involved with other BTO (e.g. Garden Birdwatch and the Breeding bird Survey (BBS)) or BC schemes (e.g. UKBMS)

The BIG project also demonstrated to a new audience the biodiversity value of urban sites A numbers of volunteers actually voiced their initial misgivings over what were seemingly uninviting green spaces in the spring but by mid-summer however many of these sites had been transformed. They subsequently expressed their sheer joy at discovering the birds, butterflies and various plant species found at their site which would have been potentially overlooked by a casual visit.

As well as providing valuable information on the occurrence of species in the city, and on the habitats present, this project has also raised the important of good green space management and its

effect on biodiversity. Moreover, press releases at a national scale have drawn attention to the existence of the project and have raised the profile of the value urban biodiversity within the Scottish context.

4.2.2 Promotion of good practice in green space management

The BIG project generated a number of management prescriptions for increasing the diversity of birds found within green spaces including the provision of water bodies, wetland and marsh areas and wild areas. Whereas guidance for improving green spaces for butterflies included reducing the frequency of mowing or introducing small areas of native wildflowers and grasses. Greater numbers and a higher diversity of butterflies and birds would not only enhance biodiversity but would also add greatly to the attractiveness of such sites.

GCC have already been heavily involved with the creation of ponds, the naturalisation of the edges of water bodies (creation of wetland/marsh) and the development of SUDS (Sustainable Drainage Systems) at a number of sites. In terms of the management of grasslands, the council have also divert areas away from regular mowing at various sites and are involved with the trialling of different grassland establishment techniques (e.g. Trinley Braes, Knightwood) and cutting regimes (Hogganfield). In addition they have also created a butterfly garden at Kelvingrove (which includes the addition of areas of nettles) and have planted wildflowers including Birds-foot trefoil at a number of sites throughout the city. Much of this work has been carried out by experienced volunteers but the council have also involved schools and the general public in regular events around the city. Continued support for such schemes is therefore critical in conserving and promoting biodiversity within Glasgow.

4.2.3 Supporting wider biodiversity objectives

By informing the management of urban green space and promoting the awareness of urban biodiversity, the BIG project made a significant contribution to the LBAP process. Moreover, although the project was initially specific to Glasgow, any generic management advice will have applications for urban green spaces across Scotland and will therefore support the objectives of the Scottish Biodiversity Strategy. Therefore if lessons from the BIG project are applied to other cities and towns, then we have demonstrated how everyone's help contributes to promoting and conserving biodiversity in Scotland.

4.3 Future directions

Volunteers who participated in the BIG project will be encouraged to continue monitoring their sites for butterflies, with help and support from local BCS volunteers as part of the UKBMS scheme. The BTO will also contact all volunteers about participating in other long terms monitoring schemes (e.g. Breeding Bird Survey, Atlas 2007-2011).

In order to successfully implement changes in management of green spaces, there must be sufficient support from the people on the ground that carries out the day to day maintenance (e.g. park operations staff) and the public. Although general awareness of the biodiversity benefits of wild areas is increasing, there sometimes can be opposition to the changes in mowing regimes and the establishment of areas with more natural planting. Such habitats are sometimes viewed as being untidy and therefore, changes in practices must be accompanied by interpretation at sites. Moreover continuing to run one off events or even long term schemes where locals can get directly involved with management at sites will be key in gaining public support.

Given the increased development pressure on green spaces in urban environments (e.g. Pauliet et al. 2005), there is an increasing need to monitor habitats of relatively (or at least potentially) high biodiversity value within our cities. This is clearly important for species protection and conservation *per se*. Moreover the greater 'quality-of-life' value of bio-diverse green spaces to urban dwellers should not be overlooked (e.g. Ulrich 1984, Fuller et al. 2007). This study provides an invaluable baseline against which the impacts of novel management strategies, implemented due to the project findings, can be assessed in the future.

More widely, the project can add to our knowledge of urban species' populations and distributions in relation to wider environmental changes. The discovery of the comma within the survey is very likely a reflection of the changing climate (Warren et al. 2001). It will be fascinating to see how this species (and others) have spread in repeat surveys of Glasgow's green spaces in the future.

Acknowledgements

Firstly, we would like to thank the volunteers wholeheartedly, for giving up their time for the project. We would also like thank Glasgow City Council who provided logistic support in terms of distribution of promotional leaflets, the provision of free training venues and a large amount of staff time in giving support and advice. In particular we would highlight the efforts of Sheila Russell, Francesca Pandolfi, Carol MacLean and Jim Coyle for their help in making this project a success. Thanks also to BTO staff: Robin Anderson, Anne Cotton, Rebecca Cranston and Graeme Garner, and also to BC volunteers and staff: Richard Sutcliffe, Neil Gregory, Ian Middlebrook and Tom Prescott. We would finally like to acknowledge with grateful thanks, the financial support provided by Scottish Natural Heritage, Scottish Government, Glasgow City Council and the Robertson Trust. Advice throughout the project was also provided by Jimmy Hyslop of SNH.

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Tables

Table 1 Relative occurrence of all bird species in 2007 (given in descending order of occurrence).

Species	Percentage of sites	UKBAP	LBAP	BOCC
Blackbird	97			
Magpie	96			
Blue Tit	86			
Robin	85			
Woodpigeon	84			
Carrion Crow	84			
Chaffinch	81			
Great Tit	72			
Starling	67	UKBAP		Red list
Wren	65			
Song Thrush	62	UKBAP		Red list
Greenfinch	59			
Dunnock	58			Amber List
Feral Pigeon	57			
Jackdaw	49			
Lesser Black-backed Gull	48			Amber List
Willow Warbler	42			Amber List
Mallard	41			Amber List
Mistle Thrush	38			Amber List
Herring Gull	37	UKBAP		Red List
Goldfinch	37			
Common Swift	34		LBAP	Amber List
Barn Swallow	34			Amber List
Coal Tit	34			
House Sparrow	33	UKBAP		Red List
Long-tailed Tit	33			
Black-headed Gull	27			Amber List
Bullfinch	27	UKBAP		Amber List
Pied Wagtail	25			
Rook	25			
Moorhen	24			
Common Gull	23			Amber List
Blackcap	23			
Chiffchaff	23			
Goldcrest	23			
Mute Swan	22			
House Martin	20			Amber List
Grey Heron	19			
Great Spotted Woodpecker	18			
Whitethroat	16			Amber List
Tufted Duck	14			Amber List
Coot	14			
Treecreeper	14			

Species	Percentage of sites	UKBAP	LBAP	BOCC
Grey Wagtail	13			Amber List
Collared Dove	13			
Kestrel	11			Amber List
Reed Bunting	11	UKBAP	LBAP	Amber List
Kingfisher	11			Amber List
Sparrowhawk	9			
Common Buzzard	9			
Little Grebe	8			Amber List
Oystercatcher	8			Amber List
Garden Warbler	8			
Sedge Warbler	8			
Grasshopper Warbler	5			Red List
Meadow Pipit	5			Amber List
Sand Martin	5			Amber List
Siskin	5			
Goosander	5			
Skylark	4	UKBAP	LBAP	Red list
Lesser Redpoll	4	UKBAP		Red List
Canada Goose	4			
Cormorant	4			
Dipper	4			
Stonechat	4			
Common Cuckoo	3	UKBAP		Red List
Spotted Flycatcher	3	UKBAP		Red List
Stock Dove	3			Amber List
Whinchat	3			Amber List
Great Crested Grebe	3			
Common Pheasant	3			
Common Linnet	1	UKBAP		Red List
Wood Warbler	1			Red List
Tree Sparrow	1	UKBAP	LBAP	Red List
Lapwing	1	UKBAP		Red List
Yellowhammer	1	UKBAP		Red List
Pink Footed Goose	1			Amber List
Common Sandpiper	1			Amber List
Curlew	1	UKBAP		Amber List
Wheatear	1			Amber List
Ringed Plover	1			Amber List
Pochard	1			Amber List
Tawny Owl	1			
Water Rail	1			
Common Snipe	1			
Long-eared Owl	1			

Table 2 Relative occurrence of all bird species in 2008 (given in descending order of occurrence).

Species	Percentage of sites	UKBAP	LBAP	BOCC
Magpie	100			
Blackbird	95			
Woodpigeon	89			
Blue Tit	85			
Robin	83			
Carrion Crow	82			
Great Tit	76			
Chaffinch	76			
Starling	67	UKBAP		Red list
Dunnock	62			Amber List
Song Thrush	62	UKBAP		Red list
Feral Pigeon	62			
Wren	62			
Greenfinch	53			
Lesser Black-backed Gull	50			Amber List
House Sparrow	42	UKBAP		Red List
Jackdaw	42			
Willow Warbler	41			Amber List
Goldfinch	41			
Mallard	39			Amber List
Herring Gull	35	UKBAP		Red List
Coal Tit	35			
Barn Swallow	32			Amber List
Common Swift	30		LBAP	Amber List
Long-tailed Tit	29			
Mistle Thrush	27			Amber List
Rook	27			
Black-headed Gull	26			Amber List
Bullfinch	26	UKBAP		Amber List
Grey Heron	24			
Moorhen	24			
Blackcap	24			
House Martin	23			Amber List
Chiffchaff	23			
Goldcrest	23			
Common Gull	18			Amber List
Whitethroat	18			Amber List
Mute Swan	18			
Pied Wagtail	17			
Coot	15			
Collared Dove	15			
Tufted Duck	14			Amber List
Grey Wagtail	14			Amber List

Species	Percentage of sites	UKBAP	LBAP	BOCC
Great Spotted Woodpecker	12			
Treecreeper	11			
Sparrowhawk	9			
Skylark	8	UKBAP	LBAP	Red list
Kestrel	8			Amber List
Reed Bunting	8	UKBAP	LBAP	Amber List
Common Buzzard	8			
Kingfisher	6			Amber List
Garden Warbler	6			
Dipper	6			
Great Crested Grebe	6			
Sedge Warbler	6			
Sand Martin	5			Amber List
Spotted Flycatcher	5	UKBAP		Red List
Cormorant	5			
Goosander	5			
Meadow Pipit	3			Amber List
Little Grebe	3			Amber List
Oystercatcher	3			Amber List
Grasshopper Warbler	3			Red List
Lapwing	3	UKBAP		Red List
Common Linnet	2	UKBAP		Red List
Stock Dove	2			Amber List
Whinchat	2			Amber List
Wheatear	2			Amber List
Gadwall	2			Amber List
Wood Warbler	2			Red List
Grey Partridge	2			Red List
Canada Goose	2			
Siskin	2			
Common Pheasant	2			
Stonechat	2			
Water Rail	2			
Ruddy Duck	2			

Table 3 Total number of bird species for green spaces in Glasgow in 2007.

Site	Total species	Green space type	SINC	LNR	SSSI
Alexandra Park	28	PK	Part SINC		
Ardmay Park	8	PK			
Auchenshuggle Wood	9	WD	SINC		
Auchinlea Park	28	PK	Part SINC		
Auldhouse Park	11	PK			
Barlanark Park and Vacant Ground	26	OS	Part SINC		
Barrachnie Park	19	PK			
Bellahouston Park	21	PK			
Bingham's Pond	12	PK			
Bishop Loch	61	OS		LNR	SSSI
Broomhill Allotment Association	18	AT			
Burntfield Road	20	AT			
Cardonald Cemetery	19	CY			
Cardonald Place Farm	26	OS	SINC		
Carmyle New Park	14	PK			
Cathkin Braes Country Park East	24	PK	SINC		
Cathkin Braes Country Park West	24	PK	SINC		
Craigend Moss	13	PK	SINC		
Craigton Cemetery	13	CY			
Cranhill Park	10	PK			
Cross Park	5	PK			
Darnley Mill Country Park	46	PK	SINC		
Dawsholm Park	29	PK	SINC		
Downcraig Road Woodland	12	WD	SINC		
East End Campus	5	CS			
Eastwood New Cemetery	15	CY			
Eastwood Old	21	CY			
Festival Park	11	PK			
Frankfield Loch	39	PK	SINC		
Garscube Allotments	8	AT			
Garscube Colliery	13	OS	SINC		
Glasgow Green	31	PK			
Glasgow Necropolis	19	CY			
Haugh Hill	18	OS	SINC		
Holmlea Park	7	PK			
Househill Park	28	PK			
Hurlethill	23	OS	SINC		
Kelvingrove East	29	PK			
Kelvingrove West	21	PK			
King’s Park	19	PK			
Knightswood Park	20	PK	Part SINC		
Knowetap Street	14	OS	SINC		

Site	Total species	Green space type	SINC	LNR	SSSI
Lainshaw Drive	7	OS	SINC		
Linn Cemetery	23	CY			
Linn Park	22	PK	Part SINC		
Lochar Park	27	PK			
Malls Myre	12	WD	SINC		
Mansewood High Park	7	PK			
Mansionhouse Gardens	23	PG	SINC		
Maxwell Park	26	PK			
Millerston	32	WD	SINC		
Naseby Park	10	PK			
Newlands Park	9	PK	SINC		
Orchard Park	10	PK			
Pollok Country Park North	46	PK			
Pollok Country Park South	24	PK			
Possil Loch	34	OS			SSSI
Queens Park	21	PK			
Red Road Nature Park	20	PK	SINC		
Richmond Park	21	PK			
Riddrie Park Cemetery	16	CY			
Rosshall Park	28	PK			
Ruchill Golf Course	12	WD	SINC		
Ruchill Park	29	PK			
Sandymount Cemetery	16	CY			
Science Park	25	PK			
Sighthill Cemetery	12	CY			
Sighthill Park	21	PK			
Southern Necropolis	12	CY			
St Kentigern's	22	CY			
The Cunyon	17	OS	SINC		
Todd's Well	23	OS	SINC		
Tollcross Park	34	PK			
Victoria Park	21	PK			
Waulkmill Glen	12	OS			SSSI
Western Necropolis	17	CY	SINC		
Yorkhill Park	21	PK			

Table 4 Total number of bird species for green spaces in Glasgow in 2008.

Site	Total species	Green Space Type	SINC	LNR	SSSI
Alexandra Park	29	PK	Part SINC		
Ardmay Park	8	PK			
Auchinlea Park	24	PK	Part SINC		
Auldhouse Park	12	PK			
Barlanark Park & Vacant Ground	21	OS			
Bingham's Pond	11	PK			
Bishop Loch	48	OS		LNR	SSSI
Blairtummock Park	17	PK			
Cardonald Cemetery	14	CY			
Cardonald Place Farm	24	OS	SINC		
Cardowan Moss	31	WD	SINC	LNR	
Cathkin Braes Country Park West	24	PK	SINC		
Cathkin Braes Country Park East	14	PK	SINC		
Clouston Street	14	OS			
Cross Park	14	PK			
Dawsholm Park	36	PK	SINC		
Downcraig Road Woodland	14	WD	SINC		
Eastwood New Cemetery	14	CY			
Eastwood Old Cemetery	19	CY			
Elder Park	11	PK			
Festival Park	12	PK			
Frankfield Loch	29	PK	SINC		
Garscadden Wood	22	WD	SINC	LNR	
Garscube Allotments	14	AT			
Garscube Colliery	19	OS	SINC		
Glasgow Botanic Gardens	22	PG			
Glasgow Green	16	PK			
Hogganfield Park	27	PK	Part SINC	LNR	
Holmlea Park	6	PK			
Househill Park	20	PK			
Hurlethill	25	OS	SINC		
Jordanhill Campus	13	OS			
Kelvingrove Park East	30	PK			
Kelvingrove Park West	25	PK			
King's Park	22	PK			
Knowetap Street	12	OS	SINC		
Linn Cemetery	20	CY			
Linn Park	25	PK	Part SINC		
Malls Myre	18	WD	SINC		
Mansewood High Park	12	PK			
Maxwell Park	24	PK			
Millerston	29	WD	SINC		
Millichen Floods	18	OS			
Naseby Park	10	PK			
New Victoria Gardens	17	AT			
Newlands Park	8	PK	SINC		

Site	Total species	Green Space Type	SINC	LNR	SSSI
Orchard Park	12	PK			
Pollock Country Park North	40	PK			
Pollock Estate South	13	PK			
Possil Loch	33	OS			SSSI
Priesthill Park	14	PK			
Redroad Nature Park	15	PK	SINC		
Richmond Park	22	PK			
Rosshall Park	23	PK			
Ruchill Golf Course	9	WD	SINC		
Science Park	36	PK			
Sighthill Cemetery	15	CY			
Sighthill Park	21	PK			
Southern Necropolis	14	CY			
St Kentigern's Cemetery	21	CY			
The Cunyon	16	OS	SINC		
Victoria Park	15	PK			
Waulkmill Glen	9	OS			SSSI
Wellshot Primary School	15	OS			
Western Necropolis	21	CY	SINC		
Yorkhill Park	22	PK			

Table 5 Habitats recorded within sites surveyed for birds in 2007 and their relative occurrence within green spaces of Glasgow (given in descending order of occurrence).

Habitat type	Percentage of sites
Broadleaved trees	81
Mown short turf	77
Un-mown rank grass	75
Paved area	73
Broadleaved bushes	68
Wildflower weedy area	65
Mixed bushes	55
Mixed trees	52
Bare earth	45
Coniferous tress	42
Evergreen bushes	39
Wall/building no vegetation	38
Playground/play area	36
Evergreen trees	35
Water body (natural)	32
Formal flowerbed	30
Sports surface	23
Wetland marsh	22
Wall/building vegetation	22
Water body (ornamental)	17
Coniferous bushes	16
Gravestones	16
Untended flowerbed	13

Table 6 Habitats recorded within sites surveyed for birds in 2008 and their relative occurrence within green spaces of Glasgow (given in descending order of occurrence).

Habitat type	Percentage of sites
Broadleaved trees	84
Mown short turf	80
Un-mown rank grass	77
Paved area	73
Broadleaved bushes	67
Wildflower weedy area	66
Mixed bushes	50
Coniferous tress	48
Mixed trees	48
Bare earth	48
Wall/building no vegetation	42
Playground/play area	39
Evergreen bushes	38
Formal flowerbed	38
Water body (natural)	36
Evergreen trees	31
Wall/building vegetation	28
Wetland marsh	25
Sports surface	22
Water body (ornamental)	19
Coniferous bushes	16
Untended flowerbed	13
Gravestones	13

Table 7 Mean percentage of habitat types within different types of green spaces surveyed for birds in 2007.

Habitat type	Allotment (n=3)	Campus (n=1)	Cemetery (n=12)	Open Spaces (n=12)	Public Gardens (n=1)	Park (n=41)	Woodland (n=6)
Mown short turf	2	5	70	7	20	49	0
Un-mown rank grass	5	0	5	33	10	13	23
Wildflower weedy area	7	0	7	11	15	9	28
Broadleaved trees	7	0	13	35	70	19	53
Coniferous tress	7	0	4	2	0	2	11
Evergreen trees	5	0	5	0	10	3	1
Mixed trees	10	10	13	7	0	11	13
Broadleaved bushes	8	0	3	20	10	9	16
Coniferous bushes	3	0	1	0	0	1	0
Evergreen bushes	5	0	5	2	5	3	4
Mixed bushes	3	0	7	2	15	6	9
Formal flowerbed	43	0	2	0	0	3	0
Untended flowerbed	5	0	0	0	0	1	0
Wetland/ Marsh	0	0	0	7	0	1	1
Water body (Natural)	2	0	1	5	0	7	1
Water body (ornamental)	0	0	0	0	0	2	0
Gravestones	0	0	40	0	0	0	0
Wall/building no vegetation	5	25	10	1	0	3	1
Wall/building vegetation	0	0	5	2	10	1	0
Paved area	5	75	10	3	0	9	0
Bare earth	5	0	3	3	0	4	0
Playground/ play area	0	0	0	0	0	5	0
Sports surface	0	0	0	0	0	3	0
Other	20	0	0	0	0	1	12

Table 8 Mean percentage of habitat types within different types of green spaces surveyed for birds in 2008.

Habitat Type	Allotment (n=2)	Cemetery (n=8)	Open Spaces (n=13)	Public Gardens (n=1)	Park (n=34)	Woodland (n=6)
Mown short turf	3	70	17	50	46	4
Un-mown rank grass	5	4	23	10	14	28
Wildflower weedy area	5	8	13	5	13	18
Broadleaved trees	10	10	24	20	22	54
Coniferous tress	3	2	2	0	4	8
Evergreen trees	3	1	2	0	3	3
Mixed trees	3	18	8	40	9	4
Broadleaved bushes	13	4	8	10	10	28
Coniferous bushes	3	1	0	0	2	2
Evergreen bushes	13	6	4	0	4	3
Mixed bushes	8	5	3	15	6	3
Formal flowerbed	35	3	1	20	3	0
Untended flowerbed	5	1	0	5	1	0
Wetland/ Marsh	0	0	7	0	1	6
Water body (Natural)	0	0	6	10	9	3
Water body (ornamental)	3	0	0	0	2	0
Gravestones	0	50	0	0	0	0
Wall/building no vegetation	8	8	4	5	3	0
Wall/building vegetation	3	11	3	5	2	0
Paved area	5	14	10	15	9	2
Bare earth	8	4	3	5	5	3
Playground/ play area	3	0	5	5	5	0
Sports surface	0	0	1	0	4	0
Other	45	0	0	0	2	8

Table 9 Relative occurrence of all butterfly species in 2007 (given in descending order of occurrence).

Species	Percentage of sites	UKBAP
Small White	44	
Meadow Brown	40	
Green-veined White	38	
Large White	38	
Peacock	35	
Small Tortoiseshell	35	
Ringlet	20	
Orange-tip	18	
Painted Lady*	18	
Red Admiral*	15	
Small Copper	11	
Common Blue	4	
Small Heath	4	UKBAP
Comma	2	
Grayling	2	UKBAP

* refers to migrant species

Table 10 Relative occurrence of all butterfly species in 2008 (given in descending order of occurrence).

Species	Percentage of sites	UKBAP
Small White	41	
Meadow Brown	39	
Green-veined White	34	
Large White	34	
Orange-tip	32	
Ringlet	32	
Small Tortoiseshell	23	
Peacock	16	
Small Heath	11	UKBAP
Red Admiral*	9	
Painted Lady*	7	
Small Copper	7	
Clouded Yellow	2	
Common Blue	2	
Green Hairstreak	2	

*refers to migrant species

Table 11 Total number of butterfly species recorded in Glasgow's green spaces in 2007.

Site	Total number of species	Green Space Type	SINC	LNR	SSSI
Alexandra Park	6	PK	Part SINC		
Auchinlea Park	8	PK	Part SINC		
Auldhouse Park	1	PK			
Barlanark Park & Vacant Ground	6	OS	Part SINC		
Barrachnie Park	0	PK			
Bingham's Pond	3	PK			
Broomhill Allotment Association	3	AT			
Burntfield Road	4	AT			
Cardonald Cemetery	0	CY			
Carmyle New Park	2	PK			
Castlemilk Park	0	PK			
Cathkin Braes Country Park West	1	PK	SINC		
Craigend Moss	2	PK	SINC		
Craigton	1	CY			
Cross Park	0	PK			
Dawsholm Park	4	PK	SINC		
Downcraig Road Woodland	0	WD	SINC		
East End Campus	0	CS			
Eastern Necropolis	1	CY			
Eastwood New Cemetery	0	CY			
Eastwood Old	4	CY			
Elder Park	2	PK			
Frankfield Loch	4	PK	SINC		
Garscube Colliery	4	OS	SINC		
Glasgow Green	4	PK			
Holmlea Park	2	PK			
Househill Park	4	PK			
Hurlethill	8	OS	SINC		
Kings Park	0	PK			
Knowetap Street	6	OS	SINC		
Lainshaw Drive	5	OS	SINC		
Linn Park	0	PK	Part SINC		
Lochar Park	3	PK			
Mansionhouse Gardens	4	PG	SINC		
Maryhill Park	8	PK			
Millerston	2	WD	SINC		
Naseby Park	1	PK			
Orchard Park	3	PK			
Petershill Acid Grassland	8	OS	SINC		
Pollock Country Park South	2	PK			
Possil Loch	9	OS			SSSI
Red Road Nature Park	8	PK	SINC		
Riddrie Park Cemetery	6	CY			
Robroyston Park	8	PK	Part SINC	LNR	

Site	Total number of species	Green Space Type	SINC	LNR	SSSI
Rosshall Park	2	PK			
Ruchill Golf Course (Part)	7	WD	SINC		
Ruchill Park	7	PK			
Science Park	4	PK			
Springburn Park	1	PK	Part SINC		
St Kentigerns	0	CY			
Todd's Well	6	OS	SINC		
Victoria Park	3	PK			
Waulkmill Glen	0	OS			SSSI
Western Necropolis	1	CY	SINC		
Yorkhill Park	4	PK			

Table 12 Total number of butterfly species recorded in Glasgow's green spaces in 2008.

Site	Total Number of species	Site type	SINC	LNR	SSSI
Auchinlea Park	9	PK	Part SINC		
Auldhouse Park	0	PK			
Barlanark Park and Vacant Ground	1	OS	Part SINC		
Bingham's Pond	2	PK			
Bishop Loch	7	OS		LNR	SSSI
Botanic Gardens	2	PG			
Cardonald Cemetery	1	CY			
Castlemilk Park	2	PK			
Cathkin Braes East	6	PK	SINC		
Cathkin Braes West	11	PK	SINC		
Cross Park	0	PK			
Dawsholm Park	4	PK	SINC		
Eastern Necropolis	0	CY			
Eastwood New Cemetery	0	CY			
Festival Park	4	PK			
Garscadden Wood	3	WD	SINC	LNR	
Garscube Colliery	3	OS	SINC		
Glasgow Green	0	PK			
Holmlea Park	0	PK			
Househill Park	2	PK			
Hurlethill	2	OS	SINC		
Jordanhill Campus	1	OS			
Kelvingrove Park	6				
King's Park	1	PK			
Knowetap Street	0	OS	SINC		
Linn Park	4	PK	Part SINC		
Lochar Park	2	PK			
Malls Myre	10	WD	SINC		
Millerston	7	WD	SINC		
Pollock Estate South	4	PK			
Possil Loch	5	OS			SSSI
Priesthill Park	4	PK			
Red Road Nature Park	5	PK	SINC		
Robroyston Park	8	PK	Part SINC	LNR	
Rosshall Park	0	PK			
Science Park	3	PK			
Sighthill Cemetery	2	CY			
Sighthill Park	4	PK			
Springburn Park	4	PK	Part SINC		
Victoria Park	0	PK			
Victoria Park Walkway	0	PK	SINC		
Waulkmill Glen	3	OS			SSSI
Western Necropolis	4	CY	SINC		
Yorkhill Park	3	PK			

Table 13 Habitats recorded within sites surveyed for butterflies in 2007 and their relative occurrence within green spaces of Glasgow (given in descending order of occurrence).

Habitat type	Percentage of sites
Mown short turf	83
Un-mown rank grass	79
Broadleaved trees	77
Wildflower weedy area	75
Paved area	67
Broadleaved bushes	62
Mixed bushes	56
Bare earth	48
Mixed trees	46
Evergreen bushes	38
Wall/building no vegetation	38
Coniferous tress	37
Evergreen trees	37
Playground/play area	37
Water body (natural)	35
Formal flowerbed	33
Wall/building vegetation	27
Sports surface	27
Wetland marsh	21
Gravestones	17
Untended flowerbed	15
Water body (ornamental)	15
Coniferous bushes	13

Table 14 Habitats recorded within sites surveyed for butterflies in 2008 and their relative occurrence within green spaces of Glasgow (given in descending order of occurrence).

Habitat type	Percentage of sites
Broadleaved trees	85
Un-mown rank grass	80
Mown short turf	78
Wildflower weedy area	78
Paved area	76
Broadleaved bushes	71
Bare earth	59
Evergreen bushes	51
Water body (natural)	51
Mixed trees	46
Wall/building no vegetation	46
Playground/ play area	46
Mixed bushes	41
Formal flowerbed	39
Coniferous tress	37
Evergreen trees	32
Wall/building vegetation	32
Sports surface	32
Wetland marsh	27
Coniferous bushes	20
Water body (ornamental)	15
Untended flowerbed	10
Gravestones	10

Table 15 Mean percentage of habitat types within different types of green spaces surveyed for butterflies in 2007.

Habitat type	Allotment (n=2)	Campus (n=1)	Cemetery (n=8)	Open Spaces (n=8)	Public Gardens (n=1)	Park (n=29)	Woodland (n=3)
Mown short turf	5	10	67	9	20	46	20
Un-mown rank grass	5	0	3	34	10	14	28
Wildflower weedy area	13	0	6	13	15	12	25
Broadleaved trees	5	0	11	29	70	22	35
Coniferous tress	3	0	3	1	0	3	5
Evergreen trees	3	0	4	0	10	3	0
Mixed Trees	13	5	24	9	0	7	5
Broadleaved bushes	3	0	2	21	10	9	0
Coniferous bushes	3	0	1	0	0	1	0
Evergreen bushes	0	0	2	2	5	3	0
Mixed bushes	5	5	8	3	15	6	13
Formal flowerbed	33	5	3	0	0	2	0
Untended flowerbed	3	0	1	1	0	1	0
Wetland/ Marsh	0	0	0	8	0	2	2
Water body (natural)	0	0	1	5	0	8	2
Water body (ornamental)	3	0	0	0	0	2	0
Gravestones	0	0	47	0	0	0	0
Wall/building no vegetation	3	0	13	1	0	3	0
Wall/building vegetation	0	0	9	2	10	1	0
Paved area	3	70	10	3	0	9	0
Bare earth	3	70	5	3	0	3	5
Playground/play area	0	0	0	1	0	5	0
Sports surface	0	0	0	1	0	4	0
Other	25	0	0	1	0	1	0

Table 16 Mean percentage of habitat types within different types of green spaces surveyed for butterflies in 2008.

Habitat type	Cemetery (n=4)	Open Spaces (n=6)	Public Gardens (n=1)	Park (n=28)	Woodland (n=2)
Mown short turf	68	7	50	36	3
Un-mown rank grass	3	22	10	19	20
Wildflower weedy area	5	16	5	18	35
Broadleaved trees	4	25	20	28	60
Coniferous tress	1	2	0	4	0
Evergreen trees	3	3	0	3	0
Mixed trees	26	13	40	7	5
Broadleaved bushes	1	12	10	9	8
Coniferous bushes	1	1	0	1	0
Evergreen bushes	3	7	0	3	0
Mixed bushes	5	3	15	9	0
Formal flowerbed	3	1	20	2	0
Untended flowerbed	0	1	5	0	0
Wetland/ Marsh	0	11	0	1	10
Water body (Natural)	0	8	10	8	3
Water body (ornamental)	0	0	0	1	0
Gravestones	45	0	0	0	0
Wall/building no vegetation	4	4	5	3	0
Wall/building vegetation	1	6	5	1	0
Paved area	9	6	15	12	3
Bare earth	8	7	5	4	3
Playground/ play area	0	1	5	4	0
Sports surface	0	0	0	5	0
Other	0	0	0	1	0

Table 17 Relative occurrence of all species of day flying moths in 2007 (given in descending order of occurrence).

Species	Percentage of sites	UKBAP
Mother Shipton	9	
Silver-ground Carpet	9	
Latticed Heath	5	
Chimney Sweeper	4	
Red-necked Footman	4	
Six-spot Burnet	4	
Elephant Hawk-moth	2	
July Highflyer	2	
Yellow Shell	2	

Table 18 Relative occurrence of all species of day flying moths in 2008 (given in descending order of occurrence).

Species	Percentage of sites	UKBAP
Chimney Sweeper	9	
Clouded Border	2	
Common Carpet	2	
Latticed Heath	2	
Mother Shipton	9	
Nettle-tap	2	
Silver-ground Carpet	5	
Six-spot Burnet	5	
Udea lutealis	2	
Light Emerald*	2	

* refers to migrant species

Table 19 Total number of species of day flying moths recorded in Glasgow's green spaces in 2007.

Site	Total number of species	Green Space Type	SINC	LNR	SSSI
Alexandra Park	0	PK	Part SINC		
Auchinlea Park	0	PK	Part SINC		
Auldhouse Park	0	PK			
Barlanark Park & Vacant Ground	1	OS	Part SINC		
Barrachnie Park	0	PK			
Bingham's Pond	0	PK			
Broomhill Allotment Association	0	AT			
Burntfield Road	0	AT			
Cardonald Cemetery	0	CY			
Carmyle New Park	0	PK			
Castlemilk Park	0	PK			
Cathkin Braes Country Park West	1	PK	SINC		
Craigend Moss	1	PK	SINC		
Craigton	0	CY			
Cross Park	0	PK			
Dawsholm Park	0	PK	SINC		
Downcraig Road Woodland	1	WD	SINC		
East End Campus	0	CS			
Eastern Necropolis	2	CY			
Eastwood New Cemetery	0	CY			
Eastwood Old	0	CY			
Elder Park	0	PK			
Frankfield Loch	0	PK	SINC		
Garscube Colliery	0	OS	SINC		
Glasgow Green	2	PK			
Holmelea Park	0				
Househill Park	0	PK			
Hurlethill	3	OS	SINC		
Kings Park	0	PK			
Knowetap Street	1	OS	SINC		
Lainshaw Drive	1	OS	SINC		
Linn Park	0	PK	Part SINC		
Lochar Park	1	PK			
Mansionhouse Gardens	0	PG	SINC		
Maryhill Park	0	PK			
Millerston	1	WD	SINC		
Naseby Park	0	PK			
Orchard Park	0	PK			
Petershill Acid Grassland	3	OS	SINC		
Pollock Country Park South	0	PK			
Possil Loch	0	OS			SSSI
Red Road Nature Park	1	PK	SINC		
Riddrie Park Cemetery	0	CY			
Robroyston Park	1	PK	Part SINC	LNR	

Site	Total number of species	Green Space Type	SINC	LNR	SSSI
Rosshall Park	0	PK			
Ruchill Golf Course (part)	0				
Ruchill Park	0	PK			
Science Park	0	PK			
Springburn Park	1	PK	Part SINC		
St Kentigerns	0	CY			
Todd's Well	1	OS	SINC		
Victoria Park	0	PK			
Waulkmill Glen	0	OS			SSSI
Western Necropolis	0	CY	SINC		
Yorkhill Park	0	PK			

Table 20 Total number of species of day-flying moths recorded in Glasgow's green spaces in 2008.

Site	Total number of species	Site type	SINC	LNR	SSSI
Auchlinlea Park	0				
Auldhouse Park	0	PK			
Barlanark Park and Vacant Ground	0	OS	Part SINC		
Bingham's Pond	0	PK			
Bishop Loch	0	OS		LNR	SSSI
Botanic Gardens	0	PG			
Cardonald Cemetery	0	CY			
Castlemilk Park	0	PK			
Cathkin Braes East	0	PK	SINC		
Cathkin Braes West	2	PK	SINC		
Cross Park	0	PK			
Dawsholm Park	1	PK	SINC		
Eastern Necropolis	1	CY			
Eastwood New Cemetery	0				
Festival Park	0	PK			
Garscadden Wood	0	WD	SINC	LNR	
Garscube Colliery	0	OS	SINC		
Glasgow Green	0	PK			
Holmlea Park	0	PK			
Househill Park	0	PK			
Hurtlehill	0				
Jordanhill Campus	0	OS			
Kelvingrove Park	1				
King's Park	3	PK			
Knowetap Street	0	OS	SINC		
Linn Park	2	PK	Part SINC		
Lochar Park	0	PK			
Malls Myre	2	WD	SINC		
Millerston	0	WD	SINC		
Pollock Estate South	0	PK			
Possil Loch	0	OS			SSSI
Priesthill Park	0	PK			
Red Road Nature Park	1	PK	SINC		
Robroyston Park	3	PK	Part SINC	LNR	
Rosshall Park	0	PK			
Science Park	0	PK			
Sighthill Cemetery	0	CY			
Sighthill Park	0	PK			
Springburn Park	0	PK	Part SINC		
Victoria Park	0	PK			
Victoria Park Walkway	0	PK	SINC		
Waulkmill Glen	1	OS			SSSI
Western Necropolis	0	CY	SINC		
Yorkhill Park	0	PK			

Appendices

Appendix 1 Habitat types used in the survey.

Habitat categories recorded by volunteers	Units collected by volunteers	Term included in analyses	Units used in analyses
Bare earth and bare paths	% cover of site	x	x
Broadleaved bushes	% cover of site	BUSH	%
Broadleaved trees	% cover of site	TREE	%
Coniferous bushes	% cover of site	BUSH	%
Coniferous trees	% cover of site	TREE	%
Evergreen bushes	% cover of site	BUSH	%
Evergreen trees	% cover of site	TREE	%
Formal flowerbed	% cover of site	x	x
Graves/tombs	% cover of site	x	x
Mixed bushes	% cover of site	BUSH	%
Mixed trees	% cover of site	TREE	%
Mown Grass or short turf	% cover of site	MOWN GRASS	PRES/ABS
Paved area	% cover of site	x	x
Playground/play area	% cover of site	x	x
Sports surface	% cover of site	x	x
Un-mown or rank grass	% cover of site	WILD*	PRES/ABS
Untended flowerbed	% cover of site	+	+
Wall/building (no vegetation)	% cover of site	X	x
Wall/building (vegetation/ivy)	% cover of site	X	x
Water body (natural)	% cover of site	WATER	PRES/ABS
Water body (ornamental)	% cover of site	WATER	PRES/ABS
Wetland/marsh	% cover of site	WET	PRES/ABS
Wildflower/Weedy areas	% cover of site	WILD*	PRES/ABS
Buildings	% perimeter	x	x
Fence	% perimeter	x	x
Hedge	% perimeter	+	x
No boundary	% perimeter	+	x
Pavement	% perimeter	x	x
Wall	% perimeter	BUILD	PRES/ABS
Water body	% perimeter	WATER	PRES/ABS
Other Green Space	% adjacent	GREEN	PRES/ABS
Private Garden	% adjacent	GREEN	PRES/ABS
Railway	% adjacent	x	x
Road	% adjacent	x	x
Wall/Building	% adjacent	BUILD	PRES/ABS
Water body/River	% adjacent	WATER	PRES/ABS

x = low ecological value or reflect usage of site (e.g. amenity purposes)

+ = low value

* Wild areas were made up of two habitats: un-mown rank grass and wildflower weedy areas.

Appendix 2 Significant terms in the model.

Chi square/DF	*Intercept*	*Habitat*	*Parameter Estimates*	*F value*	*d.f.*	**Significance**
0.73	2.69	Water	-0.25***	15.72	1	***
		Wild	-0.27**	7.28	1	**
		Wetland /Marsh	-0.15*	4.26	1	*
		Area	0.01***	38.13	1	***

*** p=<0.001 ** p<0.01 and * p=<0.05

Figures

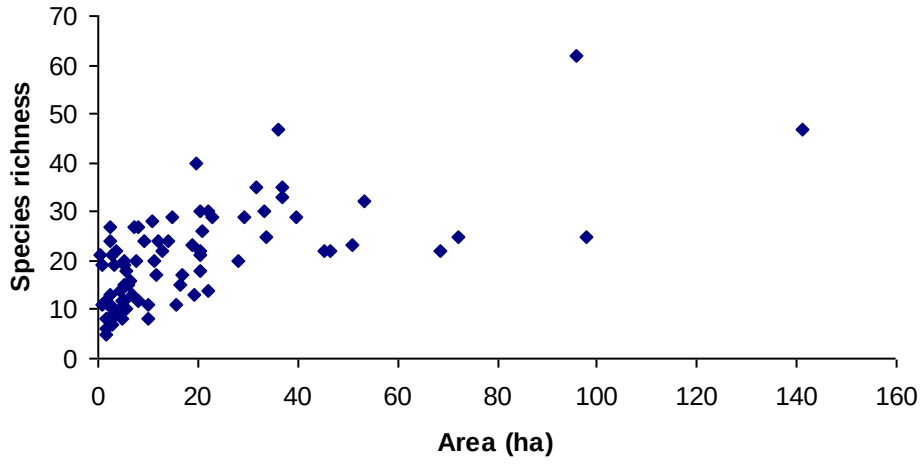

Figure 1 Number of species recorded relation to area of green space in 2007.

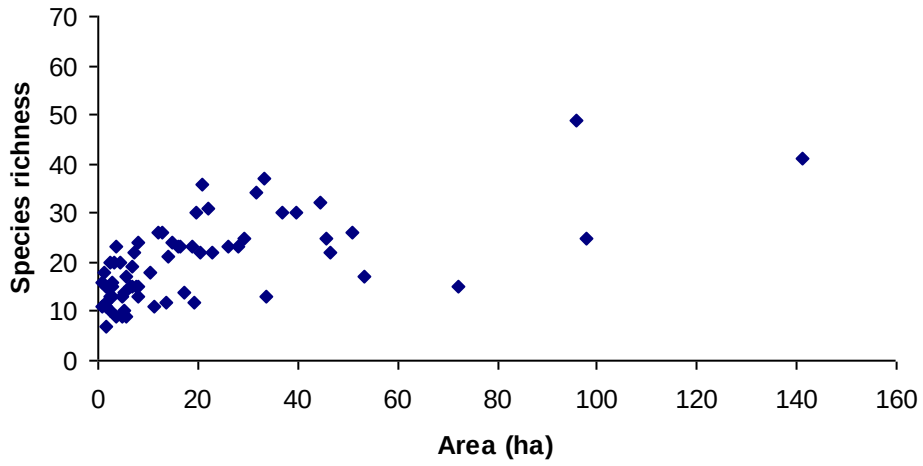

Figure 2 Number of species recorded relation to area of green space in 2008.