The ecological significance of urban fringe belts

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Abstract. *Fringe belts form at the edge of urban areas during periods of slow urban growth. They become embedded within the urban fabric when expansion resumes. One of their characteristics is the co-location of a number of different, low-intensity land uses (for example, parks, cemeteries and institutions). This paper investigates the ecological characteristics of fringe belts. Focusing on the Edwardian fringe belt of Birmingham, UK, research shows that habitat patches within the fringe belt are different from those elsewhere in the city in at least two respects: first, in the demographic structure of their tree population, which suggests that many of the habitats have been subject to less major disturbance than those elsewhere in the city; and secondly, in their much larger average number of species recorded per patch, even after taking patch size into account.*

Key Words: urban morphology, ecology, land use, Edwardian fringe belt, Birmingham

The purpose of this paper is to examine the ecological characteristics associated with the form and process of formation of fringe belts, using the Edwardian fringe belt of Birmingham, UK as a case study. Urban morphologists have rarely explored the role of natural phenomena in the built environment, at least not explicitly. Whitehand (2009) provides a notable exception in his analysis of Barnt Green. However, the importance of these phenomena is implicit in, for example, studies of villas and their gardens (Pendlebury and Green, 1998; Slater, 1978) and boulevards and promenades (Darin, 2000; Larkham, 2000).

The first part of the paper describes briefly both fringe belts in general and Birmingham's Edwardian fringe belt in particular. The remainder of the paper considers a set of hypotheses about the nature of the ecological characteristics of Birmingham's Edwardian fringe belt and the analysis that was used to test them.

The formation of fringe belts

There is a tendency for a zone of extensive land use to develop around the edge of an urban area during periods in which its outward expansion is restricted for physical, economic or other reasons. Typical land uses associated with this zone, termed a fringe belt (M. R. G. Conzen, 1960), are institutions of various sorts, including hospitals and cemeteries, utilities such as gas and sewage works, public amenities such as parks and allotments and certain types of industry. When more intensive building activity resumes it usually occurs farther out than the fringe-belt zone which is leap-frogged and becomes embedded within the expanding urban area. This process may be repeated and several fringe belts may develop at different distances from the city centre.

Urban morphologists have been aware of this phenomenon since the study of Berlin by Louis (1936). Subsequent major contributions to the study of fringe belts, particularly in relation to the processes associated with their formation and subsequent modification, have been made by M. R. G. Conzen (1960, 1962), Whitehand (1977, 1987, 2005), Barke (1990) and others. Recent studies have sought to expand the number and range of international comparisons (see M. P. Conzen, 2009, p. 36 for a comprehensive survey), develop understanding of the processes associated with fringe-belt formation and change (Ducom, 2005) and identify new theoretical approaches to the study of fringe belts (Maretto, 2009).

Edwardian fringe belts in British cities tend to be large-scale features. They are strongly associated with a slump in house-building activity that occurred between roughly 1908 and the mid-1920s. This was initially related to a trough in the economic cycle, but was made more significant by the effect of the First World War and the recession of the early 1920s. Whitehand (1967, 1972a, 1972b) shows the effect of this set of circumstances in Newcastle upon Tyne and Glasgow. In a study of biodiversity in urban habitat fragments as part of the programme on Urban Regeneration and the Environment (URGENT), Morton and Whitehand (1999) undertook a detailed morphological examination of the Edwardian fringe belt of Birmingham. This study sought to discover the extent, land-use history and current form of the fringe belt. It complements the BUGS (Biodiversity in Urban Gardens in Sheffield) strand of the URGENT programme since one of the characteristics of fringe belts is the near absence of private gardens (see, for example, Smith *et al*., 2006 and Thompson *et al*., 2003).

Hypotheses

A number of possible explanations can be put forward for fringe belts having distinctive ecological characteristics, based on their form and development history. First, the processes associated with the formation of a fringe belt could favour the incorporation of important habitats into the urban fabric with less modification than occurs in the course of other forms of urban development. Secondly, the land uses that make up a fringe belt could be managed in different ways from land uses elsewhere in the city – ways that are beneficial to wildlife communities. Thirdly, a fringe belt as a whole could act as a unit of linked populations, the interaction of which increases the importance of habitat patches associated with it. These possible explanations suggest a number of hypotheses that were tested through empirical work.

1. Fringe belts will contain a significant amount of the green space of an urban area.
2. This green space will include a disproportionate amount of the most important sites for nature conservation.
3. This green space will be characterized by less large-scale disturbance than that elsewhere in the city.
4. This green space will be the habitat of more plant species than those found in green space elsewhere in the city.
5. The species found in this green space will be of a more rural character than those found in green space elsewhere in the city.

Fringe belts as urban green space

The area of Birmingham’s Edwardian fringe belt is 1918 ha or 7 per cent of the total area of the city (Figure 1). Of this, 53 per cent (1009 ha) comprises soft (that is, vegetated) surfaces including public, quasi-public and private open spaces. This is a much greater proportion of vegetated surfaces than in the city as a whole, where there are 3132 ha of public open space (that is, excluding, for example, educational playing fields) accounting for 12 per cent of the area of the city, and 3798 ha defined as leisure and open space (including educational playing fields), accounting for 14 per cent of the area of the city (Birmingham City Council,

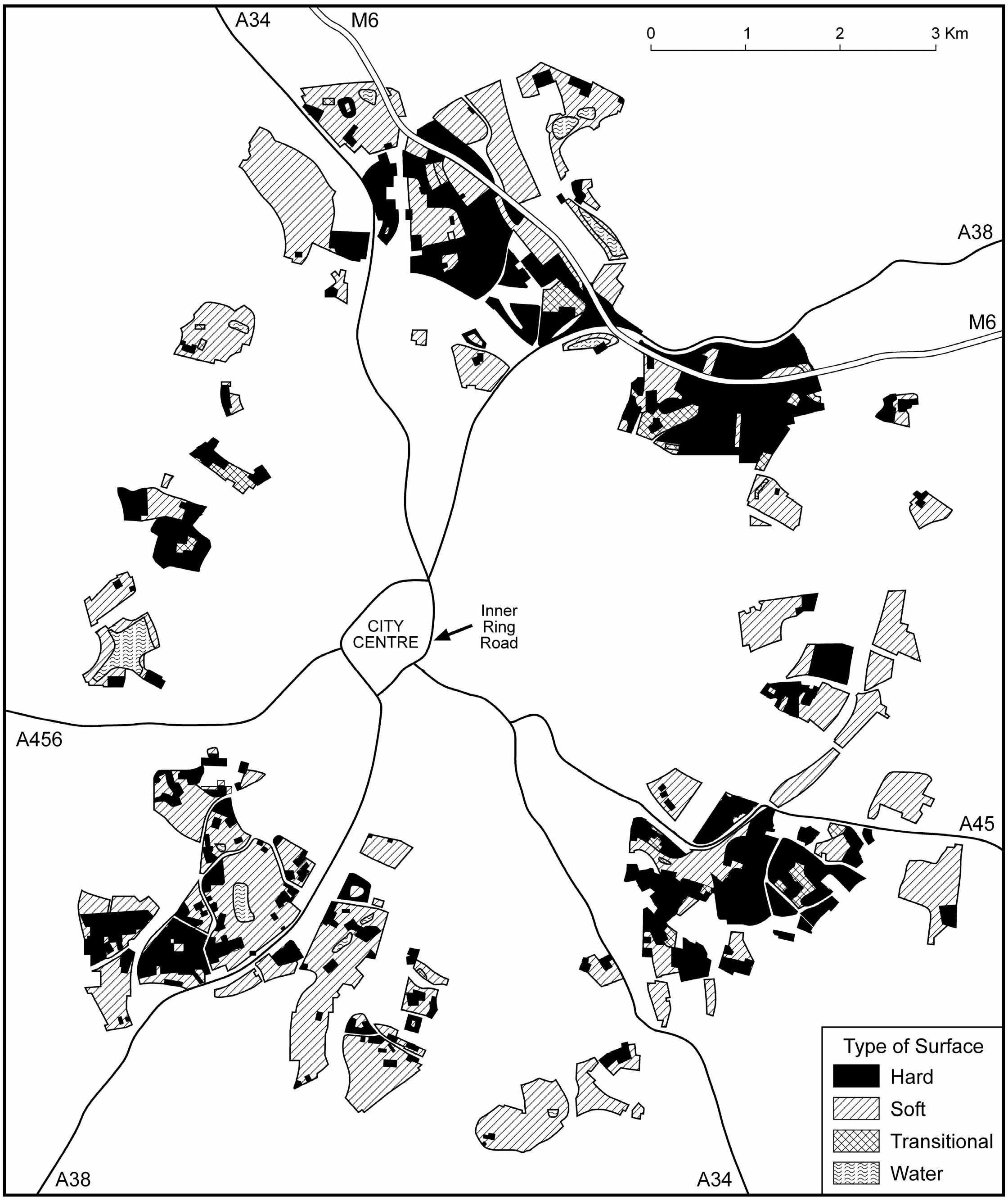

Figure 1. Types of surface in Birmingham's Edwardian fringe belt (source: Whitehand and Morton, 2006).

1993, 1997). An even broader definition of urban green space (but still excluding private gardens) is based on all habitat patches of more than 0.5 ha, irrespective of function or accessibility to the public. This comprises an area of 6212 ha, accounting for 23 per cent of the area of the city (Birmingham City Council, 1997; see also Jarvis, 1996) – still significantly less than the 53 per cent of the Edwardian fringe belt that is vegetated surfaces. In fact 16 per cent of the city's urban green space occurs within the Edwardian fringe belt although that belt occupies only 7 per cent of the area of the city.

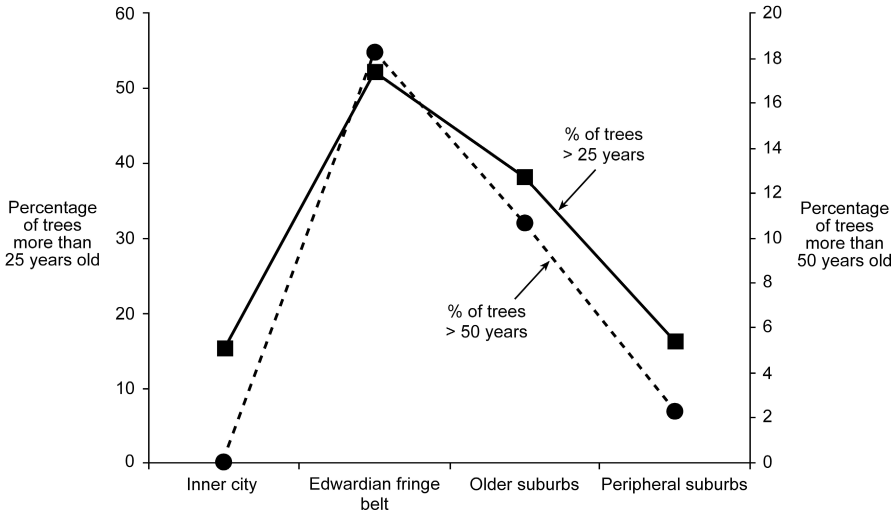

Figure 2. Transect using tree age as a measure of habitat stability.

Fringe belts as ecologically significant habitats

As part of a Nature Conservation Strategy for Birmingham (Birmingham City Council, 1997), 140 Sites of Quality were accorded one of four different designations: Sites of Special Scientific Interest (SSSI), Local Nature Reserves (LNR), Sites of Importance for Nature Conservation (SINC) and Sites of Local Importance for Nature Conservation (SLINC). The process of designation was different for the different types of site, and all but SLINCs had previously been designated in Birmingham. The Sites of Quality listed in the Nature Conservation Strategy represent those sites within Birmingham identified as having the greatest nature conservation value. Of the 138 sites within the city boundary, two are SSSIs, six are LNRs or proposed LNRs, 28 are SINCs and the remaining 102 are SLINCs.

In the central part of Birmingham there are few designated sites. Those that are present are all SLINCs that form part of larger linear features, particularly canals, that cross the city. The nearest large sites to the city centre, in all directions, occur within the Edwardian fringe belt of Birmingham. There are 24 Sites of Quality that form part of Birmingham's Edwardian fringe belt (17 per cent of the total). Thus Sites of Quality are significantly over-represented in Birmingham's Edwardian fringe belt, but no more than open space as a whole.

Fringe belts and habitat stability

In the URGENT project on the Pollution of the Urban West Midlands Atmosphere (PUMA), a database was compiled of trees that covered the former West Midlands county, excluding Coventry. The data were collected to examine the effects of both urban air quality on trees and of trees on urban air quality, and included the age of each tree (Donovan, 2003). To provide a greater volume of data on the tree population of Birmingham's Edwardian fringe belt further sampling of tree ages was carried out within the fringe belt. The data on tree ages can be depicted as a transect from the city centre to the current urban fringe (Figure 2). This transect can be used as a surrogate measure of habitat stability in different parts of the city.

There are marked differences in the ages of trees between the four concentric zones into which Birmingham was divided for this purpose (inner city, Edwardian fringe belt, older suburbs and peripheral suburbs). Both the inner city and the current urban fringe are characterized by a relatively young tree population. The inner city is also characterized by a very low tree density, only one-third of that elsewhere in the city.

The data suggest that the Edwardian fringe belt has had greater habitat stability than other parts of the city. This can be seen most clearly when comparison is made with the inner city. This can be explained by inner-city redevelopment accompanied by the removal of existing trees and their replacement by younger ones, producing a much younger demographic profile.

Though the Edwardian fringe belt became established as an approximate ring around the city in the early-twentieth century, many of the individual sites that became part of this ring acquired their first urban fringe use earlier. Yet only 18 per cent of the trees are over 50 years old. Even so, the Edwardian fringe belt has a much greater proportion of older trees than other parts of the city.

This suggests a mechanism by which distinctive ecological characteristics of fringe belts could be brought about. The data on the demographic structure of trees in Birmingham suggest that habitats in the Edwardian fringe belt tend to have longer periods since major disturbance than habitats elsewhere in the city.

Number of species in fringe-belt habitats

The presence of tree and herb species (excluding, with one exception, grasses) was recorded at 35 study sites (hereafter referred to as patches) during 2000 and 2001. Patches were selected to be representative of accessible green space in Birmingham based on land use, location and designation as a Site of Quality. There were ten in the Edwardian fringe belt (EFB); six in the inner-city (IC), which was defined as closer to the city centre than the Edwardian fringe belt; ten farther from the city centre than the Edwardian fringe belt but not in other fringe belts (OUT); seven in wildlife corridors (WC), as defined in the Nature Conservation Strategy for Birmingham (Birmingham City Council, 1997); and two in other fringe belts (OFB).

For each patch a comprehensive field walk was undertaken and all the tree and herb species observed were identified and recorded. Grasses were excluded from the collection of data because of the difficulty involved in identification, particularly in mown swards. The one exception to this was wall barley (*Hordeum murinum*). This grass is found predominantly in marginal areas rather than as part of swards and is easy to identify.

The first ecological characteristic studied was the number of species present per patch. The processes associated with fringe-belt formation and the analysis of the data on the age structure of Birmingham's tree population suggest that inner-city areas and peripheral suburban areas have been subject to recent episodes of large-scale change. Change in the Edwardian fringe belt, however, has been on a more moderate scale, forming the basis for the hypothesis that the patches that make up the Edwardian fringe belt would contain more species than patches elsewhere in the city.

In fact they account for four of the five patches with the greatest number of species and nine of the ten Edwardian fringe-belt patches have above average number of species. The differences between the groups in Table 1 are statistically significant. A chi-squared test (excluding the OFB group which had only two readings) for the observed and expected number of species produces a value of 40.35 for 3 degrees of freedom, which is significant at the 0.01 per cent level. Grouping the patches into EFB and non-EFB, a *t*-test gives a value of 3.49, significant at the 0.2 per cent level ($t_{.002, 31} = 3.375$).

Patch size is an important factor in determining the number of different species found in a patch (Forman, 1995; MacArthur and Wilson, 1967). The relationship between patch size and the number of species per patch is logarithmic (Begon *et al.*, 1985; Grieg-Smith, 1983; Krebs, 1985; MacArthur and Wilson, 1967). Regression analysis of the $\log_{10}$ (number of species): $\log_{10}$ (patch area) relationship shows a statistically significant result (significance level = 0.5 per cent) with the following equation:

$$\log_{10} (\text{no. species}) = 1.58 + 0.13 \times \log_{10} (\text{patch area}) \qquad [1]$$

Table 1. Mean number of species per patch

Patch type	**Mean number of species per patch**
Edwardian fringe belt (EFB)	54.4
Outer urban (OUT)	50.0
Other fringe belt (OFB)	42.0
Wildlife corridor (WC)	40.9
Inner city (IC)	34.2
All patches	44.4

In this study the average patch size is 4.2 ha, while the average Edwardian fringe-belt patch size is 6.2 ha. However, based on the residuals from the regression analysis of all patches, seven of the ten Edwardian fringe-belt patches had a greater number of species than would be expected based on patch size alone. Four paired *t*-tests were carried out comparing the recorded $\log_{10}$ (number of species) to the $\log_{10}$ (number of species) predicted by the regression equation. The *t*-values are contained in Table 2; of these only that for the Edwardian fringe belt is statistically significant.

This suggests that, in addition to patch size, there are further factors affecting the number of species found in Edwardian fringe-belt patches which could reflect, for example, the types of land use and management, or indeed lack of management, in fringe belts. This would still derive from the characteristics of fringe belts, particularly their forms and land uses, which are in turn reflected in other ecological characteristics such as the demographic structure of the tree population.

When all the sample patches are considered, size of patch explains a statistically significant part of the variation in the number of species recorded (significance level = 0.5 per cent and $r^2 = 0.22$ for equation 1). It is also possible to examine the effect of other landscape variables on the number of species. Five variables were tested in addition to the $\log_{10}$ (patch area): (1) the number of broad habitat types in each patch; (2) the distance in kilometres to the nearest area of open countryside; (3) the distance in kilometres to the nearest wildlife corridor; (4) the number of broad habitat types within 1 km of the patch; and (5) whether the patch was part of the Edwardian fringe belt. The broad habitat types in the patch and within 1 km of it were based on data from the Phase 1 habitat surveys held on the EcoRecord database (the biological record centre for Birmingham and the Black Country, www.ecorecord.org.uk). The habitat surveys record all habitat patches of more than 0.5 ha throughout the West Midlands and classify them on the basis of seventeen different broad habitat types. These data were used to determine the number of broad habitat types within each of the 35 patches as a measure of their habitat diversity (variable 1), and the number of patches within 1 km of each patch as a measure of the porosity of the surrounding landscape matrix (variable 4). The variable for whether the patch formed part of the Edwardian fringe belt was recorded simply as either 1 (part of the Edwardian fringe belt) or 0 (not part of the Edwardian fringe belt).

No relationship was found between $\log_{10}$ (number of species) and either the distance to open countryside or the distance to the nearest wildlife corridor. The weak correlation between $\log_{10}$ (number of species) and the number of habitat types in the surrounding landscape matrix was not statistically significant. Regression analysis of the remaining two variables in conjunction with $\log_{10}$ (patch area) showed that each had a

Table 2. Paired *t*-values for $\log_{10}$ (observed number of species) compared to $\log_{10}$ (number of species predicted by regression equation) for each patch type

Patch type	*t*-value	Degrees of freedom	Critical *t*-value (95% confidence level)
EFB	2.50	9	±2.26
WC	1.64	6	±2.45
IC	-1.05	5	±2.57
OUT	-1.53	9	±2.26

statistically significant effect on $\log_{10}$ (number of species). The three most important variables in terms of their contribution to r^2 are $\log_{10}$ (patch area), the number of broad habitat types, and whether the patch formed part of the Edwardian fringe belt. Between them these three variables produced an r^2 value of 0.52 (significance level = 0.003 per cent). Table 3 shows the results for selected multiple regressions involving these four variables.

Bastin and Thomas (1999) conducted a similar analysis using the data on the distribution of species in the West Midlands contained in the EcoRecord database. Their much larger analysis of 423 patches and 15 landscape variables produced an r^2 of 0.40, with the most important variables being the number of broad habitat types, patch size, adjacent patch similarity and patch shape. The r^2 for these four variables alone was 0.36. Austin (2002) used a combination of landscape and environmental variables as part of a regression analysis of the number of species recorded in 50 derelict sites in the West Midlands. The results showed a highly significant effect of patch area with an r^2 of 0.42, but no significant effect of the other landscape variables used. The lower degree of explanation provided by these studies in comparison with the present analysis can be explained to some extent by the greater variability of the habitat patches used in the Bastin and Thomas (1999) study, reflecting their larger sample, and the particular dispersal abilities of many of the species associated with derelict sites in the case of the Austin (2002) study. In addition, however, the present analysis includes the further variable of whether patches form part of the Edwardian fringe belt.

Without the fringe-belt variable the r^2 values are similar to those obtained by Bastin and Thomas (1999). The effect of adding the fringe-belt variable is to increase the r^2 by 0.10. Using the different models described in Table 3, $\log_{10}$ (patch area), the number of broad habitat types, and whether the patch formed part of the Edwardian fringe belt were confirmed as statistically significant independent variables in the regression analysis.

Number of rural species in fringe-belt habitats

The appearance and historical development of the Edwardian fringe belt suggest that it could be conceived as a series of pieces of relic countryside embedded within the urban fabric. It is possible to test this hypothesis by using measures of the rurality or urbanity of the species found in the study patches. Two such measures were used, one reflecting the current pattern of species distributions and the other based on the distribution of 1891 given in *The flora of Warwickshire* (Bagnall, 1891).

The urbanity index developed by Hill *et al.* (2002) as a measure of the tendency of species to be found in urban locations was used as the basis of the analysis of the current urbanity or

Table 3. r^2 values and significance levels of selected multiple regressions

Model number	Variables used	r^2 of multiple regression	Significance level of variable (per cent)
1	$\log_{10}$ (patch area)	0.22	0.46
2	fringe belt	0.21	0.63
3	no. of broad habitat types	0.19	0.87
4	matrix	0.04	25.00
5	$\log_{10}$ (patch area)	0.44	0.08
	no. of broad habitat types		4.10
	matrix		15.00
6	$\log_{10}$ (patch area)	0.54	0.36
	no. of broad habitat types		1.70
	matrix		27.00
	fringe belt		1.40

rurality of the species found in each patch. Each of the study patches was given two urbanity scores; one was simply the average of the Hill *et al.* (2002) plant urbanity indices of each of the species found in the patch and the second was a weighted urbanity score which increased the weight of those species that occurred less frequently. In both cases the higher the score, the more urban the character of the flora.

Overall, urbanity scores for Edwardian fringe-belt patches are very similar to those elsewhere in the city. The mean unweighted urbanity score for all patches is 15.13, and for Edwardian fringe-belt patches it is 15.11. Using the weighted urbanity score the means for all patches and the Edwardian fringe-belt patches are both 15.33. These mean values do, however, conceal variations within the data. The central parts of the city have weighted urbanity scores that range between 14.8 and 18.7 (mean = 17.0). There are, however, several sites with weighted urbanity scores greater than this (maximum = 23.2) farther out from the city centre, but these are restricted to the north-west, north-east and east of the city. The habitat patches in the south of the city generally have low urbanity scores (10.1 to 14.3).

Some of the spatial variation can be explained as part of an urbanity gradient from the open countryside to the city centre. Figure 3 shows an identifiable trend of increasing urbanity with increasing distance from the open countryside, but with the patches located between 3 and 7 km from open countryside exhibiting a greater range of urbanity scores than those elsewhere in the city. One possible feature that may explain the higher than expected urbanity scores in some parts of this zone may be the industrial areas that exist in the Tyseley, Witton and Washford Heath areas of the city. These industrial areas form a significant part of the Edwardian fringe belt in these parts of the city (Morton and Whitehand, 1999).

The urbanity gradient can be divided into three zones as shown in Table 4, which also shows the difference between the urbanity scores of Edwardian fringe-belt patches and non-Edwardian fringe-belt patches. Although the mean weighted urbanity score for the Edwardian fringe belt patches is lower than that for the non-Edwardian fringe belt patches that occur between 2 and 7 km from the city centre, this difference is not statistically

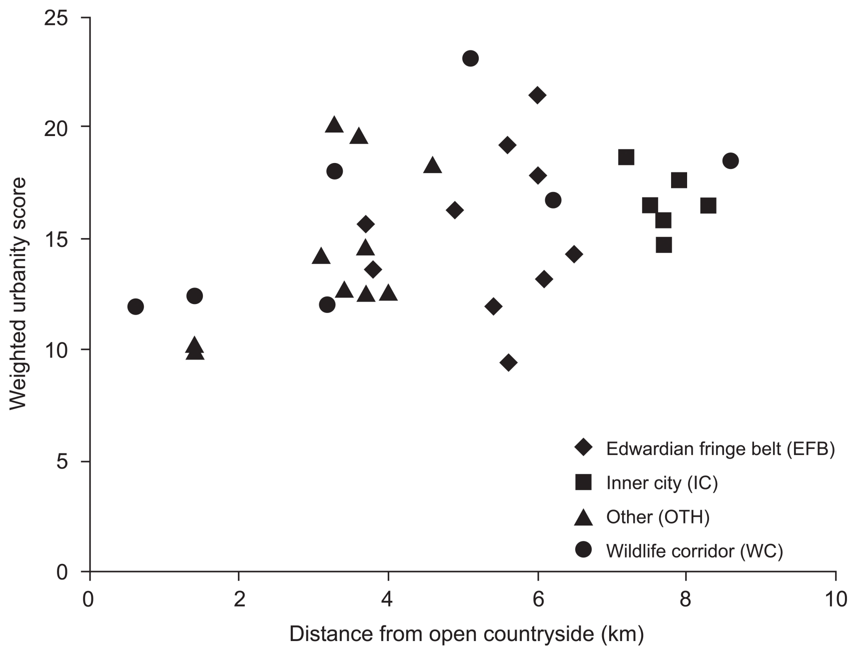

Figure 3. Relationship between urbanity score and distance from open countryside.

Table 4. Urbanity scores for Edwardian fringe-belt sites and non-Edwardian fringe-belt sites

Distance from open countryside in km	Non-EFB sites Mean weighted urbanity score	EFB sites Mean weighted urbanity score
0 – 2	11.2	No EFB sites
2 – 7	16.0	15.3
>7	17.0	No EFB sites

significant.

In addition to this large-scale variation between different parts of the city, there are also the effects of the particular site specific histories of patches. The Ackers in Small Heath and Martineau Gardens in Edgbaston, which both form part of Birmingham's Edwardian fringe belt, have very different histories and floras. The Ackers is a composite site incorporating recreational facilities and a mixture of derelict and tipping areas mostly from the BSA works and railway land. A desire to promote recreational facilities in Small Heath and the ecological value of the wildlife that had become established resulted in the site being developed as a public amenity (Morton, 2001). Martineau Gardens has been used for a variety of educational functions including a Girls' College, Teachers' Institute and Environmental Studies Centre. It is now no longer supported by the City Council but its work is continued by a local charity (Morton, 2001). Both The Ackers and Martineau Gardens have a large number of

Table 5. Commonest species recorded in 1891 and species that occurred rarely or not at all in 1891

Patch type	Species commonest in 1891 Mean %	Occurring rarely or not at all in 1891 Mean %
OUT	76.4	14.5
IC	76.1	13.7
WC	73.1	14.7
EFB	71.5	15.6

species but the urbanity score for The Ackers is 21.5 whereas that for Martineau Gardens is only 13.2.

It is also possible to assess the similarity of the flora of the study patches to those typical of Warwickshire at the end of the nineteenth century by making use of *The flora of Warwickshire*. This provides not only an indication of the presence or absence of species in 1891, but also a division of the county into eight subdivisions of Warwickshire based on river catchments. The present extent of Birmingham includes parts of two of these catchments – the River Tame and the River Blythe. The same publication gives an indication of the abundance of each of the species recorded on the basis of a series of qualitative descriptions which can be ranked.

The results of this analysis are the opposite of those that would be expected if the ecological model for fringe belts is that they retain the characteristics of rural habitats from the period of fringe-belt formation and occlusion. Instead, as a group, the fringe-belt patches have the lowest proportion of species that were most common in 1891 and the highest proportion of species that were uncommon or absent in 1891 (Table 5).

It is also possible to consider those species that were common in 1891 but were only found infrequently in the 35 patches (defined as occurring in six or fewer patches). These are the species that have experienced a decline in abundance since the beginning of the formation of the Edwardian fringe belt. The distribution of the 60 such species is shown in Table 6.

Again there is no evidence on the basis of this definition that the Edwardian fringe belt has more rural species than other parts of the city. This analysis suggests that the relationship between the Edwardian fringe belt and the urbanity scores is not as simple as originally hypothesized. It is worth noting, however, the possible importance of the habitats associated with wildlife corridors as the location of declining rural species.

The hypotheses reassessed

The following conclusions can be drawn in respect of the hypotheses set out at the beginning of the paper.

1. Fringe belts do contain a significant amount of the green space of the urban area.
2. This green space does not include a disproportionate number of the sites designated as important for nature conservation.
3. This green space is characterized by less large-scale disturbance than that elsewhere in the city.
4. Habitats in this green space contain more plant species than those found in green space elsewhere in the city.
5. The species found in this green space are not of a more rural character than those found in green space elsewhere in the city.

Table 6. Species that were common in 1891 but rare in 2001/2

Patch type	Mean number recorded	Percentage of species	Total number recorded
WC	5.9	14.4	29
EFB	5.3	9.7	31
IC	3.8	11.1	18
OUT	3.3	7.9	28
All patches	4.7	10.5	60

Taken together, these findings do not support a model of the habitat patches that form part of Birmingham's Edwardian fringe being embedded pieces of relic countryside. Closer examination reveals, however, that although complex, the findings are consistent with other characteristics of the fringe belt, particularly the higher number of species recorded in fringe-belt patches and the diverse site histories of individual patches.

There are certain particular characteristics of the Edwardian fringe belt that may have affected this divergence from the characteristic flora of the period when it was formed. First, there are the low and moderate levels of disturbance that analysis of the demographic structure of the tree population suggests characterizes fringe-belt habitat patches. This would be expected to result in greater habitat and species diversity than in other parts of the city.

Secondly, this study suggests that the composition of plant communities found at individual sites is dependent on their site histories. In particular the institutional land uses that form a significant part of fringe belts are likely to be associated with specific floras that develop at those sites. Birmingham's Edwardian fringe belt includes several parks that were established during the Victorian era. Cannon Hill Park, for example, contains over 100 different species of tree, many of which were consciously introduced (Birmingham City Council, n.d.). In addition the areas of industrial land use that form a significant part of the eastern and north-eastern parts of the Edwardian fringe belt have urban habitat types that would be expected to have different flora from that of rural Warwickshire in 1891. The impact of particular site histories on the plants found at those sites is worthy of further investigation.

In terms of its habitats, an important ecological characteristic of the Edwardian fringe belt appears to be that it provides potential for variation. Rather than providing embedded rural habitats, the most striking characteristic of the Edwardian fringe belt is the significantly larger number of species per patch, even taking patch size into account. This can be measured in terms of a single variable: the residual between $\log_{10}$ (observed number of species) and $\log_{10}$ (number of species predicted by regression equation) shown in Table 2. What has also been highlighted by the ecological analysis is that, depending on the particular local circumstances, the larger number of species recorded in fringe-belt patches can result in a variety of different outcomes in terms of the types of species found. It has been shown, for example, that there is a spatial component to the variation in urbanity and rurality, with the flora of the north and east of the city being generally more urban than those of the south and the west. This spatial pattern of plant types may well be related to the fact that the Edwardian fringe belt contains considerable amounts of industry in the north and east but little in the south and west. Hence ecological characteristics are observable at different scales, from the effects of individual site histories to cross-city differences in the urbanity of habitats.

This heterogeneity within the Edwardian fringe belt is a theme that recurs in several ways throughout the analysis. It raises questions about the way in which the fringe-belt concept is used in bringing together the study of natural and social processes in the landscape. Fringe belts are readily identifiable by urban morphologists based on development processes and the forms that result. While exhibiting a unity in these terms, fringe belts exhibit heterogeneity in terms of other factors, such as land use, with which both lay people and practising planners are more used to dealing. Heterogeneity of this type was recognized by M. R. G. Conzen (1960, 1969, p. 110) as an inevitable consequence of the particular circumstances and processes by which fringe belts are formed.

Conclusion

This analysis has shown that the habitat patches that form part of Birmingham's Edwardian fringe belt are different from those elsewhere in the city in several important respects. The most striking of these differences are:

1. The importance of the Edwardian fringe belt as a location of wildlife habitats.
2. The demographic structure of the tree population, which suggests that many of those habitat patches have been subject to less major disturbance than those elsewhere in the city.
3. The much larger average number of species recorded per patch even after taking patch size into account.

This analysis has demonstrated that the Edwardian fringe belt provides an addition to the biodiversity resource of the city. It is also likely that it is providing a number of other ecosystem benefits, such as climatic change mitigation through carbon sequestration, air quality improvements, and water runoff and quality meliorations, as well as many cultural assets, such as recreational provision and contributions to the sense of place of the area. The importance of the ecological and amenity value of the green space that forms part of the Edwardian fringe belt is increased by its location. Forming an approximate ring between 4 and 7 km from the city centre, it is the first significant area of open space as one moves out from the city centre. It therefore provides large and diverse areas of green space in close proximity to areas with both a low provision of natural green space and high levels of social deprivation (Birmingham City Council, 1997).

Given its known biodiversity benefits and its potential benefits to the ecosystem, it is unfortunate that the Edwardian fringe belt has such low recognition among planners and other policy makers, in sharp contrast to wildlife corridors which are used to articulate much of the biodiversity policy of the city. This low recognition has been caused in part by the heterogeneity of fringe belts. It has coincided with policies that have favoured the redevelopment of brownfield sites as an alternative to outward urban expansion. This has resulted in changes detrimental to a number of sites in Birmingham's Edwardian fringe belt (Whitehand and Morton, 2003, 2004, 2006). While the present study is primarily a contribution to understanding an aspect of the relationship between urban form and ecology, it also underlines the need for the findings of urban morphological research to feed into planning practice.

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Anthony Sutcliffe (1942-2011)

Tony Sutcliffe died in December 2011 after a long illness. He was a careful scholar, an original thinker and a clear communicator. He is well known to urban morphologists for a series of publications examining urban form and aspects of its creation and modification, and until his health deteriorated he attended a number of urban morphology events including seminars of the Urban Morphology Research Group at the University of Birmingham.

However, he would probably have said that he was a historian – of cities and of planning. He was Emeritus Professor of History at the University of Leicester, and had previously been Special Professor at the University of Sheffield. However he had an early academic role in Birmingham where he researched and co-wrote a volume of the city's official history.

He played a leading role, with Gordon Cherry, in establishing the field of planning history in a national and international context, through founding and guiding the Planning History Group and its transition into today's International Planning History Society. The Group began publishing a small-scale *Bulletin* which matured into a journal for members, publishing both news and short scholarly articles. In 1985 Tony and Gordon convinced a major publisher that there was a market for substantive papers in planning history, as a maturing academic field in its own right, and they established, and jointly edited until Gordon's death, a new journal, *Planning Perspectives*. Tony then continued as sole editor until 2001; thereafter he remained on the Editorial Board. He was also active in advising the Routledge book series 'Planning, History and the Environment'.

However, his interests ranged widely across traditional disciplines. He made significant contributions to the history of cinema and the history of art, reflecting a commitment to visual and experiential approaches to reality. He was also interested in international studies.

A full obituary will appear in *Planning Perspectives* 27 (2), 2012.

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