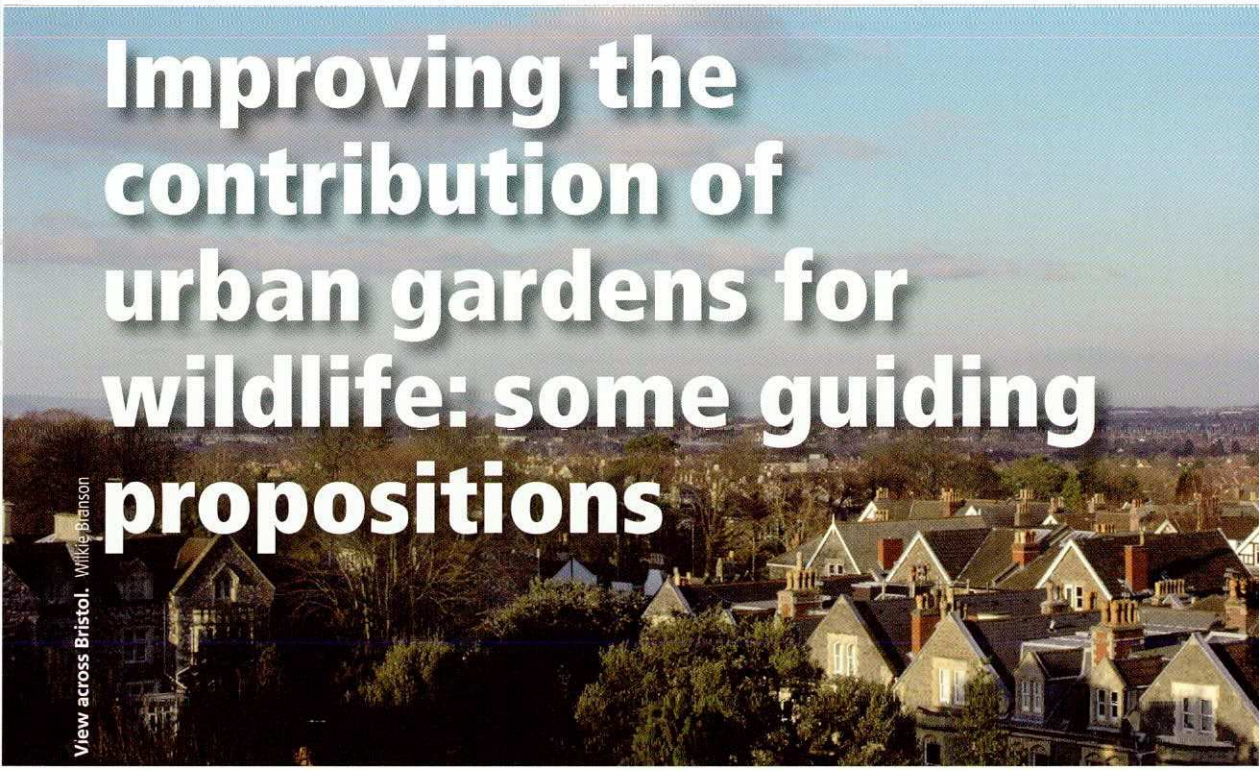
Improving the contribution of urban gardens for wildlife: some guiding propositions



View across Bristol. Wilkie Branson

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Domestic (private) gardens in urban and suburban areas of the UK have assumed an increasing importance in the minds of conservation biologists, policy-makers and wildlife-managers. There are several reasons for this.

First, gardens are a conspicuous component of our urban green space and therefore need to be considered when formulating conservation strategies, such as Local Biodiversity Action Plans, for urban and suburban regions. Examples where this has occurred include the Devon Biodiversity Partnership (1998), Essex Biodiversity Partnership (1999), Birmingham and The Black Country Biodiversity Action Plan Steering Group (2000), Wrexham County Borough Council (2002), and Edinburgh Biodiversity Partnership (2004). Given that houses with their associated private gardens have long been held to be highly desirable as dwellings in the UK, and continue to be so, this conspicuousness is unlikely to change fundamentally in the foreseeable future (Kellett 1982; Bhatti & Church 2004).

Secondly, it is becoming increasingly apparent that some species that have suffered marked population declines in the wider countryside (most notably in farmland) are found in significant numbers in urban and suburban areas, and particularly in domestic gardens. Examples are the Common Frog *Rana temporaria*, Song Thrush *Turdus philomelos* and Hedgehog *Erinaceus europaeus* (Swan & Oldham 1993; Doncaster 1994; Gregory & Baillie 1998; Mason 2000).

Thirdly, green spaces are important to the quality of life of those people who live in urban and suburban areas, and there is growing evidence that access to such spaces can have measurable effects on their physical and mental health (Ulrich *et al.* 1991; Dunnett & Qasim 2000; Takano *et al.* 2002; Jackson 2003; Bird 2004; Germann-Chiari & Seeland 2004; Land Use Consultants 2004). Domestic gardens may be particularly significant in this regard, given their importance as sites for privacy and personalised relations with nature (Bhatti & Church 2004).

A suburban garden with an excellent combination of features for wildlife, including areas of long grass, flowery borders and mature shrubs and trees. Richard Revels

Finally, domestic gardens often provide the main contact that people have with wildlife, and may be significant in stimulating an interest in habitat management and conservation (Cannon 1999; Miller 2005).

The potential for all these effects to be of wide importance is clear from the fact that about 90% of the UK human population is resident in urban and suburban areas (ODPM 2001).

Often framed in the context of 'wildlife gardening', the popular media (including books, magazine articles, radio and television programmes and websites) is replete with recommendations as to how domestic gardens should be managed for the benefit of wildlife (e.g. Knight 1954; Gibbons & Gibbons 1988; Baines 2000; Packham 2001; English Nature 2003; www.snh.org.uk/about/initiatives/ab-init02.asp), and there is much other such material (Ryall & Hatherell 2003). However, whilst much of this advice is of significant value, it tends to focus on the details of specific activities, features or species which may be of use in promoting particular wildlife components in gardens, rather than examining the more generic, underlying principles that emerge from studies of garden biodiversity, and which can be used to guide management approaches in general.

Our goal here is to provide some initial propositions, with supporting evidence, to begin to fill this gap. To do this, we draw in part on the findings of two recent studies. The first, the Biodiversity in Urban Gardens in Sheffield (BUGS I) project, sought to determine the size and nature of the resource that domestic gardens provide for wildlife and 'ecosystem services' (i.e. that result in benefits for human society, such as climate and hydrological regulation, nutrient-cycling and pollination), the factors that influence biodiversity in gardens, and whether some simple recommended techniques serve to produce positive effects for wildlife on a time frame short enough to interest many garden owners (Thompson *et al.* 2003, 2004, 2005; Gaston *et al.* 2004, 2005a, 2005b; Smith *et al.* 2005, 2006a, 2006b, 2006c). The second project, Biodiversity in Urban GardenS (BUGS II), has taken this work further in examining the extent to which some of the findings of BUGS I can be generalised across five further cities in the UK (Loram *et al.* in press).

Gardens are major contributors to urban green space

Typically, between 20% and 25% of the urbanised areas of cities in the UK, and between 36% and 47% of the overall green space within those areas, is covered by domestic gardens (Gaston *et al.*

2005b; Loram *et al.* in press). These statistics have a number of important potential consequences. First, domestic gardens are likely to be fundamental in the maintenance and/or restoration of biodiversity, and in the provision of ecosystem services in urban and suburban regions. Secondly, infilling, 'backland' developments and the loss of front gardens to hard-standings have the potential to reduce substantially the coverage of valuable habitat features and soft surfaces in urban and suburban regions, with direct implications for biodiversity and ecosystem services (e.g. run-off and temperature regulation), and downstream consequences for urban economies (e.g. costs of handling run-off, costs of heating and air-conditioning buildings). Thirdly, gardens may play an important role in connecting other components of urban green space, such as public parks and protected areas. More specifically, the movement patterns of many organisms through urban areas are likely to include gardens, and whether some species persist in viable populations may depend on the combined private and public resource of these green spaces.

Small gardens can play a key role

The majority of domestic gardens are small but, because of their large number, in aggregate they account for the majority of the overall garden area and thus contribute disproportionately to urban green space (Gaston *et al.* 2005b; Loram *et al.* in press). A far greater impact on the value of gardens for biodiversity and ecosystem services is thus likely to follow from the activities in a given proportion of small gardens than in a similar proportion of large ones. It is more important to consider gardens *en masse* than to consider the merits of individual garden plots.

The division of ownership of the garden resource can be an advantage

By its nature, management of the overall garden resource in any urban region is highly divided amongst the owners and tenants of the numerous properties. For significant impacts to be made on this space, therefore, multiple individuals have to act. However, and perhaps more significantly, the large number of individual gardens means that safeguarding and improving biodiversity and ecosystem services in even a relatively small proportion of these gardens could have major impacts. For example, the establishment of new ponds in just 10% of the gardens in the urban area of Sheffield would result in the addition of 17,500 such habitat patches (albeit typically small ones), at a density of c.120 per km^2 (Gaston *et al.* 2005b).

Diversity between gardens is as important as that within

The number of land-cover types in a garden increases with its area, and the proportional coverage of different types changes in idiosyncratic ways with garden size (Smith *et al.* 2005). This means that, as housing density increases and gardens become smaller in line with current planning policy (Kellett 1982; DETR 1999), the extent of some land-cover types in gardens in a neighbourhood will increase, whilst others will decline, and some will disappear altogether. In particular, the coverage of some of the biologically important habitat features, such as neglected areas, tends to suffer.

This suggests that, particularly in areas of higher housing density, it would be useful to encourage people to diversify in the kinds of gardens they create, rather than all gardens being managed in a similar way, especially if the latter simply leads to them all comprising small patches of many different land-cover types. Entire gardens, or large parts thereof, given over to individual land-cover types, with different gardens providing coverage of different types, would be ecologically more valuable.

Such diversification may be difficult to achieve, given social pressures for conformity and imitation. These pressures often result in strong similarities in the structure and features of individual gardens in a locality (Julien & Zmyslony 2001), Also, each garden owner will tend to try to include examples of all the features that they enjoy in the one garden to which they have access. However, there may be good opportunities to develop a concerted national volunteer programme in which participants commit to develop 'habitat' gardens, following appropriate advice and guidelines, providing a counter to encouragement for other kinds of garden 'makeover'. Notwithstanding, individualism in garden management should be championed, and conformity discouraged.

Garden management can be as important as garden size and location

Small gardens can be just as rich in wildlife as large ones (Smith *et al.* 2006a, 2006c). Of course, there

is more wildlife in large gardens, but, if large and small gardens are sampled in the same standard way, it is not easy to tell them apart. There are two reasons for this. First, to a good approximation, small gardens behave like parts of large gardens, essentially because urban gardens form a large interconnected network of green space. Secondly, the effect on wildlife of the garden management can easily swamp out factors relating to area. Large gardens can be wildlife-poor and small ones wildlife-rich for this reason alone.

The powerful influence of management can also mean that garden location is a poor predictor of levels of biodiversity – city-centre gardens can contain much the same wildlife as suburban ones (Smith *et al.* 2006a, 2006c). This is not to say that the context in which gardens are embedded does not exert an important influence (just as does the landscape context of urban parks and protected areas). All else being equal, suburban gardens are richer in species than are urban ones, and rural gardens are richer still, particularly for more mobile taxa (e.g. Toms 2003). However, all else is seldom equal.

These are encouraging messages, in that they mean that all gardens can contribute to the provision of biodiversity and ecosystem services in urban areas. Indeed, given the general decline in the cover of green space with increasing urbanisation, gardens in highly urbanised areas may be disproportionately important.

Neglect needs to be acceptable

Gardens are much tidier places than is the landscape in which the native wildlife of the UK has evolved. This means that some important habitat components are scarce in gardens. Consider two examples: long grass and dead wood. More than a half of the coverage of urban gardens is grass, which attracts a high proportion of the management conducted in these spaces, and much of the associated expenditure (Gaston *et al.* 2005b). However, whilst some grass-feeding organisms (e.g. larvae of some species of butterfly) may be quite common in gardens, lawns typically do not provide suitable breeding habitat. Long grass is required. Likewise, in some cities a half or more of gardens contain substantial-sized trees, and often several of them (Gaston *et al.* 2005b). However, despite the large numbers of species in the UK that are dependent on such resources, most gardens entirely lack dead wood of any kind. Generally speaking, gardens would be improved as wildlife habitats if more dead plant material (wood, fallen leaves, plant stems) was left and areas, or even some entire gardens, remained unmanaged or only lightly managed (e.g. areas of grass cut only once per year). Again, strong social pressures would need to be overcome. One attempt to conduct a formal replicated experiment on the effectiveness of leaving areas of uncut grass in gardens had to be abandoned because of the resistance of the garden owners (explicitly selected to be a representative sample) to such a manipulation (Gaston *et al.* 2005a).

Three-dimensional complexity is vital

One of the most constant messages from studies of the determinants of biodiversity in domestic gardens is the positive effect, particularly on a wide range of invertebrates, of the presence of trees, large shrubs and hedges (Smith *et al.* 2006a, 2006c). Thus, the simplest way in which the biodiversity of gardens could be increased is through the introduction of vegetational three-dimensional complexity. This would require both the establishment of appropriate plants and an investment in the time required to allow them to grow and mature. The wildlife potential of new housing developments would be greatly enhanced by concerted efforts to retain existing mature vegetation (in a healthy state). Likewise, potential new and old gardens would benefit from the provision of carefully sited plants that would quickly provide structural height, depth and variation. Whilst clearly some plants provide far more exploitable resources for wildlife than do others, in general, the provision of any complexity is better than none.

Much garden wildlife does not distinguish natives from aliens

Gardens typically have an ecologically unusual assemblage of plant structure and diversity (Thompson *et al.* 2003, 2004; Smith *et al.* 2006b). Not only are the majority of species non-natives, but most occur in extremely small numbers (often just a single plant), resulting from the desire of many gardeners for high floral diversity. There are good reasons to champion increases in the numbers of native species that are grown, including that these are more likely to provide resources which

A garden border planted for wildlife does not have to include only native plants. Inset **Bumblebee feeding on a globeflower *Echinops*.** Richard Revels

are suitable for native species of invertebrates that feed on plants. In addition, many of our invasive plant species have their origins in gardens (Weber 2003; Smith *et al.* 2006b) and more may jump the garden fence given the opportunities provided by climate change. However, this should not be taken to mean that gardens with few native plants are not valuable for native wildlife.

Gardens with few native plant species can be just as rich in invertebrates as those with many native plants (Smith *et al.* 2006a, 2006c). There are probably several overlapping reasons for this. One is certainly that the great majority of garden animals are predators, parasitoids, detritivores or pollinators, which do not depend closely on particular plant species. Another is that many garden herbivores are generalists, prepared to consume a range of different plants. Also, many garden plants from the northern temperate climates of North America, Europe and Asia are quite closely related to native British species. In the average Sheffield survey garden, 87% of the alien plants came from families that also contained native British species, while half had native relatives in the same genus (Smith *et al.* 2006b). For example, the gardens contained at least four alien species in the native genus *Campanula* (bellflowers), five alien species of *Clematis* (but not the native Traveller's-joy *C. vitalba*), four alien *Veronica* (speedwells) and four alien *Papaver* (poppies). This means that in the average urban garden even native herbivores that are confined to a single plant genus may find their requirements met by an alien plant. Finally, some alien plant species may confer positive benefits on some invertebrates, for example, by extending flowering seasons.

As with the provision of three-dimensional complexity, providing a diversity of plant species is in general more significant than the matter of whether those species are native or alien in origin.

'Wildlife-friendly' is good, 'not wildlife-friendly' is not bad

There is much demand for the production of lists of 'wildlife-friendly' plant species, lists of species which can be advocated as particularly valuable in the provision of resources to native species of

Gardens are becoming increasingly important for species, such as the Hedgehog, which are being lost from the wider countryside. Richard Revels

wildlife (e.g. English Nature 2003; Countryside Council for Wales 2004; Creeser 2004). However, such lists need to be placed in context. They do not carry the implication that species which are not listed do not provide valuable resources. In particular, 'wildlife-friendly' is often equated with the native status of the plant species, and, as discussed above, many alien plant species can be equally useful. Also, wildlife-friendly often seems to mean 'pollinator-friendly'. Unsurprisingly, gardeners are assumed to want to encourage butterflies and bees and not slugs, aphids, bugs and caterpillars, which leads to two problems. Only a small proportion of garden wildlife consists of pollinators, and most gardeners (whether interested in wildlife or not) are keen to grow plenty of flowers. In other words, gardening is inherently pollinator-friendly. Finally, some plants that appear regularly on lists of wildlife-friendly species are already extremely abundant and widespread in urban areas (e.g. Butterfly-bush *Buddleja davidii*, Common Nettle *Urtica dioica*), and there may be greater dividends from planting other species.

Whilst the championing of wildlife-friendly plants may serve to encourage a wider participation in wildlife-gardening and consideration of environmental issues, it is not the entire or the only way of addressing them.

Refuges and breeding sites do not have to be rectangular

A substantial industry has developed around the provision of artificial nestboxes, roosting boxes and overwintering boxes for a diverse cast of animal species (bumblebees, lacewings, ladybirds, butterflies, birds, bats, Hedgehogs). At times, one might be forgiven for wondering how such creatures ever managed to raise offspring and survive inclement conditions without them. For some species, in some places, at some times, these boxes can, nonetheless, certainly work effectively. However, whilst their merit in providing a readily observable indicator of the activity of certain species in the garden is considerable, this must be balanced against the fact that, whereas some kinds of boxes have a high likelihood of being occupied in the average garden within a season or two, others seem to be much less reliable, and may never be used (e.g. Gaston *et al.* 2005a). Part of this variation may arise from the sensitivity of species to the surroundings and location in the garden. This suggests that the return on investment in specific boxes/refuges will likely be greatest in conjunction with a more holistic strategy of habitat provision. More broadly, many of the strategies suggested above will provide equally good, if less readily monitored, resources for many of the same species that might use boxes, perhaps in greater quantity.

Conclusion

Gardens are rather poorly studied compared with many 'natural' vegetation types, but all the evidence points to their potential importance as a major resource for wildlife in urban areas. Our aim here is to propose some strategic ideas as to how we go about capitalising on that potential. There is scope for endless debate about the merits or demerits of a specific plant, nestbox design or type of pond, but in the end these need to be embedded within a set of broad principles for which there is evidence-based support. Development of such a framework then provides guidance within which decisions about what to do in an individual garden, and how to plan whole residential developments, can be integrated. We hope that the propositions here provide a first step towards such a framework.

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References

Baines, C 2000 *How to make a wildlife garden*. Frances Lincoln, London

Bhatti, M, & Church, A 2004 Home, the culture of nature and meanings of gardens in late modernity. *Housing Studies* 19: 37-51

Bird, W 2004 *Can green space and biodiversity increase levels of physical activity?* Report generated by the Royal Society for the Protection of Birds endorsed by the Faculty of Public Health of the Royal Colleges of Physicians of the United Kingdom. (www.rspb.org.uk/policy/health)

Birmingham and the Black Country Biodiversity Action Plan Steering Group 2000 *Biodiversity Action Plan for Birmingham and the Black Country*. Birmingham and The Black Country Biodiversity Action Plan Steering Group, Birmingham

Cannon, A 1999 The significance of private gardens for bird conservation. *Bird Conservation International* 9: 287-298

Countryside Council for Wales 2004 *Plant for wildlife – Wildlife on your doorstep – Follow the simple guide to wildlife gardening*. http://www.ccw.gov.uk/

Creeser, R 2004 *Wildlife friendly plants*. Collins & Brown, London

DETR 1999 *Planning policy guidance 3: Housing*. Department of Transport, Local Government and the Regions, London

Devon Biodiversity Partnership 1998 *The nature of Devon. A Biodiversity Action Plan*. Devon County Council, Exeter

Doncaster, C P 1994 Factors regulating local variations in abundance: field tests on hedgehogs (*Erinaceus europaeus*). *Oikos* 69: 182-192

Dunnett, N, & Qasim, M 2000 Perceived benefits to human wellbeing of urban gardens. *Hort-Technology* 10: 40-45

Edinburgh Biodiversity Partnership 2004 *The Edinburgh Biodiversity Action Plan 2004-2009*. Edinburgh City Council, Edinburgh

English Nature 2003 *Plants for wildlife-friendly gardens*. English Nature, Peterborough

Essex Biodiversity Partnership 1999 *Essex Biodiversity Action Plan: A wild future for Essex*. Essex Wildlife Trust, Colchester

Gaston, K J, Smith, R M, Thompson, K, & Warren, P H 2004 Gardens and wildlife – the BUGS project. *British Wildlife* 16: 1-9

Gaston, K J, Smith, R M, Thompson, K, & Warren, P H 2005a Urban domestic gardens (II): experimental tests of methods for increasing biodiversity. *Biodiversity and Conservation* 14: 395-413

Gaston, K J, Warren, P H, Thompson, K, & Smith, R M 2005b Urban domestic gardens (IV): the extent of the resource and its associated features. *Biodiversity and Conservation* 14: 3327-3349

Germann-Chiari, C, & Seeland, K 2004 Are urban green spaces optimally distributed to act as places for social integration? Results of a geographical information system (GIS) approach for urban forestry research. *Forest Policy and Economics* 6: 3-13

Gibbons, B, & Gibbons, L 1988 *Creating a wildlife garden*. Hamlyn, London

Gregory, R D, & Baillie, S R 1998 Large-scale habitat use of some declining British birds. *Journal of Applied Ecology* 35: 785-799

Jackson, L E 2003 The relationship of urban design to human health and condition. *Landscape and Urban Planning* 64: 191-200

Julien, M, & Zmyslony, J 2001 Why do landscape clusters emerge in an organized fashion in anthropogenic environments? *Landscape Research* 26: 337-350

Kellett, J E 1982 The private garden in England and Wales. *Landscape Planning* 9: 105-123

Knight, M 1954 *Bird gardening: How to attract birds*. Routledge & Kegan Paul, London

Land Use Consultants 2004 *Making the links: greenspace and quality of life*. Scottish Natural Heritage Commissioned Report No.060 (ROAME No. F03AB01)

Loram, A, Tratalos, J, Warren, P H, & Gaston, K J In press Urban domestic gardens (X): the extent and structure of the resource in five cities. *Landscape Ecology*

Mason, C F 2000 Thrushes now largely restricted to the built environment in eastern England. *Diversity and Distributions* 6: 189-194

Miller, J R 2005 Biodiversity conservation and the extinction of experience. *Trends in Ecology and Evolution* 20: 430-43

ODPM 2001 *Habitat UK national report*. http://www.odpm.gov.uk/stellent/groups/ odpm_planning/documents/page/odpm_plan_606539-02.hcsp

Packham, C 2001 *Chris Packham's back garden nature reserve*. New Holland, London

Ryall, C, & Hatherell, P 2003 A survey of strategies adopted by UK Wildlife Trusts in the promotion of gardening for wildlife. *The Environmentalist* 23: 81-87

Smith, R M, Gaston, K J, Warren, P H, & Thompson, K 2005 Urban domestic gardens (V): relationships between landcover composition, housing and landscape. *Landscape Ecology* 20: 235-253

Smith, R M, Gaston, K J, Warren, P H, & Thompson, K 2006a Urban domestic gardens (VIII): environmental correlates of invertebrate abundance. *Biodiversity and Conservation* 15: 2515-2545

Smith, R M, Thompson, K, Hodgson, J G, Warren, P H, & Gaston, K J 2006b Urban domestic gardens (IX): composition and richness of the vascular plant flora, and implications for native biodiversity. *Biological Conservation* 129: 312-322

Smith, R M, Warren, P H, Thompson, K, & Gaston, K J 2006c Urban domestic gardens (VI): environmental correlates of invertebrate species richness. *Biodiversity and Conservation* 15: 2415-2438

Swan, M J S, & Oldham, R S 1993 *Herptile sites Volume 1: National amphibian survey final report*. English Nature Research Report No.38. English Nature, Peterborough

Takano, T, Nakamura, K, & Watanabe, M 2002 Urban residential environments and senior citizens' longevity in megacity areas: the importance of walkable green spaces. *Journal of Epidemiology and Community Health* 56: 913-918

Thompson, K, Austin, K C, Smith, R H, Warren, P H, Angold, P G, & Gaston, K J 2003 Urban domestic gardens (I): Putting small-scale plant diversity in context. *Journal of Vegetation Science* 14: 71-78

Thompson, K, Colsell, S, Carpenter, J, Smith, R M, Warren, P H, & Gaston, K J 2005 Urban domestic gardens (VII): a preliminary survey of soil seed banks. *Seed Science Research* 15: 133-141

Thompson, K, Hodgson, J G, Smith, R M, Warren, P H, & Gaston, K J 2004 Urban domestic gardens (III): Composition and diversity of lawn floras. *Journal of Vegetation Science* 15: 371-376

Toms, M 2003 *The BTO/CJ Garden Birdwatch Book*. British Trust for Ornithology, Thetford, Norfolk

Ulrich, R S, Simons, R F, Losito, B D, Fiorito, E, Miles, M A, & Zelson, M 1991 Stress recovery during exposure to natural and urban environments. *Journal of Environmental Psychology* 11: 201-230

Weber, E 2003 *Invasive plant species of the world. A reference guide to environmental needs*. CABI Publishing, Wallingford

Wrexham County Borough Council 2002 *Garden habitat action plan*. Wrexham County Borough Council, Wrexham

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