Wildlife Gardening Forum

Conference
"Garden Wildlife in the International Year of Biodiversity"

17th November 2010 Royal Horticultural Society Conference Centre

Summaries of Contributions

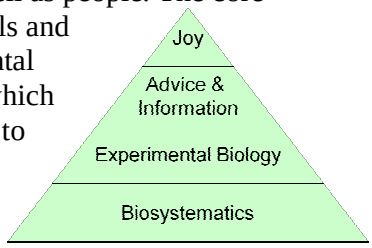
Roger Williams **Royal Horticultural Society.**

Science, gardening and biodiversity

Why should we care about garden biodiversity? Ecosystem Services, the processes that keep the biosphere inhabitable for us are vitally important – well illustrated by the apocalyptic cartoon Wall-E, where the eponymous robot is left behind to clean up a planet destroyed and abandoned by humans.

Biodiversity delivers ecosystem services, and the sustainability to pass on what we enjoy to future generations. The cost to the world of not preserving ecosystems and biodiversity has recently been estimated at between £1.2 and £2.8 trillion a year[1]. But it is also a source of wonder, joy and delight, and the biodiversity in gardens is usually the first that children encounter. Gardens are important for biodiversity, and biodiversity is vital for gardens. Gardens contain species we like, such as butterflies and ladybirds, but also things we don't such as stinging nettles, slugs and honey fungus. People need help to understand how garden ecology works.

The RHS Science Strategy is designed to help biodiversity as well as people. The core need is biosystematics – knowing exactly what species of animals and plants we are dealing with. Above this layer we need experimental studies to understand how these creatures work together, from which we can then offer sound evidence-based advice and information to gardeners. But we don't want to lose sight of the end product – the sheer joy and satisfaction that a garden and its inhabitants can give. According to BMW "Joy likes "AND" not "OR", and so it should be with gardening. There is no reason why we should not have biodiverse and sustainable gardens that are also beautiful and a source of joy.



Encouraging wildlife is one of the RHS Science Strategy's top 5 themes, and the Forum-initiated Plants for Bugs project is an excellent example of what we hope to achieve. The RHS sees a key role for the Forum, and is actively participating with RHS entomologist Andy Salisbury now heading the Forum's Research Group, identifying information needs and new potential collaborative projects.

Dr Roger Williams is planted at rogerwilliams@rhs.org.uk

[1] www.nhm.ac.uk/nature-online/biodiversity/why-conserve-biodiversity/index.html

Helen Bostock **Royal Horticultural Society. Plants for Bugs Project Manager**

Ladders, holes and pitfalls: year one for the RHS Plants for Bugs project.

Forum members first heard of this project at the conference in March 2009, and those attending the Wisley conference in November last year will have seen one set of experimental plots.

The Plants for Bugs experiment is designed to test the role native and non-native plants have for garden wildlife. About 30% of the plants in our gardens are British natives. Are the other 70% useful for wildlife or just bystanders?

The experiment is a statistically powerful design, with two replicate sites, each with 18 3x3m planted plots. Each plot is planted with an assemblage of typical garden plants of one of three categories:

a) British Natives (eg hemp agrimony *Eupatorium cannabinum)*
b) Near natives plants from the northern hemisphere; non native but closely related (eg Joe Pye weed *Eupatorium purpureum)*
c) Exotics - plants from the southern hemisphere; non-natives, unrelated but similar in habit to the native species (eg *Verbena bonariensis)*

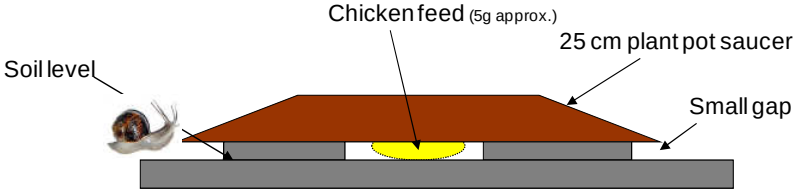
Setting up the plots

A plants for bugs volunteer tending one of the near-native plots

The experiment is now nearing the end of its first year of monitoring. No results can be announced yet, because it will be running for three years and the data will require full analysis before release.

Four forms of monitoring for wildlife are in use:

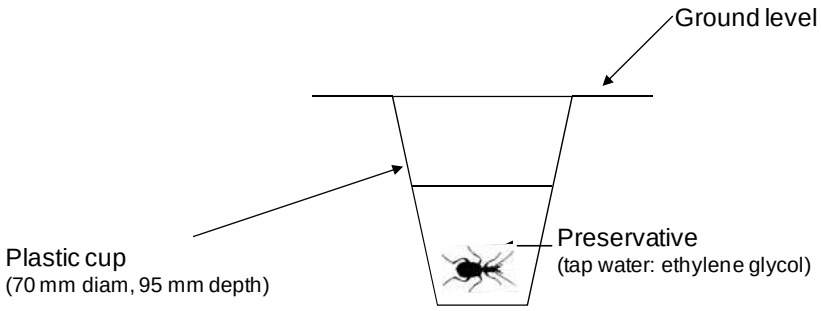
1. Gastropod traps for slugs and snails



One trap is deployed 5 times per season in each plot, left for 48 hours to collect gastropods. Slugs are identified in the field, snails are brought to the lab for

determination. So far only 45 gastropods have been identified, far fewer than expected. It is likely the dry summer and Wisley's dry sandy soils may to blame.

2. Pifall traps for ground beetles (Carabidae), woodlice and other ground-living fauna



One pitfall trap is set in the centre of each plot 5 times each season, and left for 2 weeks. The creatures captured are sorted and identified in the laboratory, (a notoriously tedious process). So far >6000 insects have been counted; and >100 species identified, including 30 species of ground beetle and four species of woodlice.

3. Vortis suction sampler for epigeal (above ground) arthropods – e.g. flies, aphids, caterpillars, true bugs, leafhoppers, beetles and their larvae

The suction nozzle is hovered above the plants in the plots, with a ten second sample time in the central area, and 10 second sweeps along each side. This is repeated 5 times in each season

Andrew Salisbury wielding the mighty Vortis suction sampler

Like pitfall traps, samples have to be analysed in the lab. So far >2000 invertebrates have been counted and 70 species identified

4. Flying insect visitors - Bees (honey, bumble, solitary), wasps, butterflies, flies (incl. hoverflies)
The sampling is performed by standing for eight minutes at the sides of each plot (4x 1min per side in morning and afternoon), observing the insect visitors, which are identified in the field.. Again the surveys are repeated five times each season. During 2010, >2300 invertebrates were observed visiting the plots; with 7 species of bumble bee and 12 species of butterfly.

Quite a number of hurdles have been encountered and overcome in this very original experiment. The exceptionally cold start to the year, plus the summer drought, caused some mortality especially among the exotics, and a volunteer watering team was set up to keep the plants alive. The wooden edging boards used to contain and define the plots proved an obstacle to ground insects. This was cured by boring 5,760 1.25 inch diameter holes in the boards in less than a month.

Difficulties were found with taking overhead photographs of the plots for recording plant growth. This was solved using a very tall tripod-ladder, enabling non-acrophobic team members to photograph from directly above the centre.

Tripod ladder in use

In 2011 and beyond, the field work and lab analysis will continue, helped by Sarah Al-Beidh, who joined the project under the Knowledge Transfer Partnership with Reading University. Spin-off projects including soil fauna are considered, and the web pages and blog are expanding. See: www.rhs.org.uk/plants4bugs

Helen Bostock blooms in a flowerpot at helenbostock@rhs.org.uk

Jan Miller **Saith Ffynnon Wildlife Plants.**

Importance of brownfield sites and how to mimic them in the garden.

I have been a volunteer for Butterfly Conservation for over 10 years, and during that time have studied a number of brownfield sites. Recently I published a book on 'Gardening for Butterflies, Bees and other beneficial insects' which is unashamedly a large, colourful, 'coffee table' book because I am trying to get across to the general public who still think insects are nasty, stinging creepy-crawlies that we could well do without. This talk is a much-abridged version of one section of the book.

So what is a brownfield site?

- Any site that has been altered by Man's activity.
- Includes derelict areas in towns, quarries, brick-pits, disused railways, disused factories and airfields.

And why are they important for biodiversity?

- Our green rolling fields are now a desert for wildlife; intensive farming has led to much of our countryside becoming cold, monoculture rye-grass, with little larval food or habitat for insects, and this has led to a decline of invertebrates that feed wild birds, bat, amphibians, reptiles and small mammals.
- Brownfield sites have as many associated Red Data and Nationally Scarce invertebrate species as do ancient woodlands.[2]
- Buglife has led some high profile campaigns for the Thames Gateway area, and although their court case to save the Thurrock Marshes from development failed, it earned the charity a major award.[3].

What are the main features of brownfields that makes them so attractive to wildlife? They are a habitat mosaic that has:

- Different temperature gradients within short distances
- Bare ground for warmth and burrowing
- Many nesting and hibernation sites
- Wild larval foodplants
- Nectar sources throughout the year
- not sprayed, fertilised or ploughed
- sharp drainage, bare seedbed,
- Infertile; little competition from other plants.
- Undisturbed
- Often polluted so dominant weeds tend not to grow there.

I have studied two brownfield sites in North-east Wales near where I live where these can be clearly seen; Wrexham Industrial estate and Rhydymwyn ex- mustard gas production facility (now called Rhydymwyn Valley Nature Reserve) Both these sites

[2] www.buglife.org.uk/conservation/currentprojects/Habitats+Action/Brownfields
[3] www.buglife.org.uk/News/newsarchive/newsarchive2009/westthurrockaward

have higher populations of many rare wild plants, invertebrates, amphibians, mammals and birds than any of the surrounding countryside.

Wrexham Industrial Estate – a mix of still-used and demolished building sites, with naturally seeded goat willow, knapweed with tormentil and barren strawberry. The site has the largest colony of the grizzled skipper butterfly (UK BAP) in Wales.

How to make a brownfield habitat in a wildlife garden
Several people have developed this idea over the last 20 years; they fall into two main groups;

Rubble beds/mounds – Jack Doyle made chalk banks from his local chalk quarry waste in Hertfordshire, and seeded with a wildflower and grass mixture; Richard Scott at Liverpool Wildflower centre took his idea but used crushed shells from the local seafood industry. I have experimented with mounds of left-over builders' rubble, covered with limestone chippings and planted in plug plants with very little soil. Andrew George made similar concrete and waste material on an old landfill site at Cary Moor in Somerset and sowed a wildflower mixture. Within a couple of years the small blue butterfly appeared apparently from nowhere to use its larval food plant (kidney vetch) growing there.

My garden brownfield mound, planted with a mixture of wild and cultivated plants, such as yarrow, perennial wallflower, marjoram, candytuft, Sedum, thymes and teasel. It has proved attractive to many butterflies and other insects, including the common blue and small copper butterflies which did not previously make use of the garden.

Green or Brown roofs
There is some controversy over how important habitat connectivity or wildlife corridors are for flying insects. But Dusty Gedge, of green roof fame, says – if the habitat is good, even on an urban rooftop, that is more important for insect colonisation than the nearness of similar habitats. Dusty constructs green roofs on large industrial city buildings, as well as showing how people can make small ones on garden sheds.

There is much interest in how this can absorb pollutants from the air, soak up excess rainfall as well as insulate the buildings.

David Perkins also gave a very interesting talk at the last WLGF conference when he showed pictures of his rubble roofs at the Roots & Shoots project in Lambeth, London.

So what are the realistic prospects for Brownfield conservation? We have to recognise that Brownfield sites *will* get developed. What we can do is contribute to survey and management plans before development. Then developers will be required to mitigate or protect important areas. We have succeeded in doing this on Wrexham Industrial Estate where Butterfly Conservation, the North Wales Wildlife Trust, the developers, the County Council, Chester Zoo, environmental consultants and other interested individuals sat round a meeting table and drew up a management plan for the whole estate. Where the developers wanted to build on particularly sensitive areas we advised and volunteered to remove turf and replant it in a protected area of the estate; and the developers paid for this to be done.

Creation of brownfield habitat in parks & gardens

- In cities – green and brown roofs.
- Adopt or create a rubble site and study its wildlife, rather than tidy it up.

I am rather worried about 'Guerilla Gardening' – it's great to see such community spirit, but I'm afraid they may be destroying the natural biodiversity of the 'waste' areas they prettify. Maybe we could have a compromise where raised beds or containers could be planted with colourful garden plants along the front of such urban brownfields, and an interpretation panel put at the front to explain why the area is being 'left' and what creatures may be seen there. I have produced a generic panel for the butterfly gardens I make for schools and parks so that they can insert a couple of photos of their own project volunteers, plus sponsors' logos, but the whole board can be reproduced for about £250 rather than the £2,000 they would need to do their own from scratch. You could also have a notice board and a website where local people can contribute their own sightings and photos.

These urban brownfield nature reserves may have to be temporary- but that's OK; if we move onto the next one right away, or overlap, then the wildlife have the chance to survive and move to the next site.

More information on all these points is available in 'Gardening for Butterflies, Bees and other beneficial insects' by Jan Miller-Klein, pub. Saith Ffynnon Books, ISBN 978-0-9555288-0-4. *website* *www.7wells.co.uk*

So far the book has been taken up by the natural history press, but so as not to just preach to the converted, I need to get it into the general gardening press and popular press. I would be grateful for suggestions from anyone who has any ideas on how to do this. jan@7wells.org

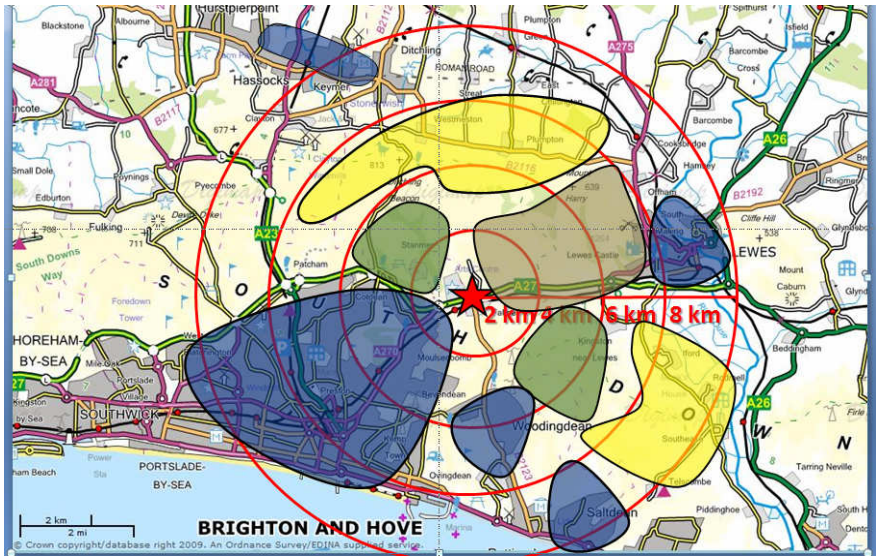
Margaret Couvillon **Laboratory of Apiculture and Social Insects (LASI)**
University of Sussex

How good is the British countryside for our honey bees?

Pollination by animals, including bats, hummingbirds, butterflies and flies, is vitally important for plants, and the most important pollinators are bees, especially the honey bee. Global annual honey bee pollination is valued at £27bn, and in the UK at about £190m. Honey bees pollinate many of our food plants, some, like almond depend on them, others, like coffee benefit greatly.

Beekeeping is declining, from a million managed hives in Britain in 1920, to only 250,000 in 2006. There are many reasons for the decline, including American foulbrood and *Varroa* which have destroyed many colonies. More importantly, changes in land use have severely depleted the countryside as a resource for bees. Land has been lost under development, and forage has reduced with the loss of traditional hay meadows to silage, and especially the reduction in use of white clover. Heather-rich uplands have been overgrown with grass, or ploughed for crops, and the extensive fertilisation of pasture favours fast-growing grass over nectar bearing flowers. Over 90% of our unmanaged grassland has been lost in the last half century.

The LASI project is monitoring bee foraging patterns from 2009 to 2011, determining changes in foraging patterns and generating seasonal maps of habitats visited by bees. The foraging sites are located using the bees' own waggle-dances which indicate the distance to the site, and the flight angle to reach it, relative to the sun. Bees returning from a good foraging site perform the waggle dance, which the investigators film, then "decode" to allow the site to be plotted against maps of the area.



Eight kilometre foraging circle around the University of Sussex, with some areas of urban, woodland, farmland and nature reserves marked.

The study has confirmed bees forage up to 12-14km from the hive, but they only fly as far as they have to, and the distance varies greatly across the year, being greatest in August (average distance: 4km), and least in March (average distance: 700m). The foraging patterns reflect flowering heterogeneity and availability of forage in different areas at different times. The longer flights in August, to gardens and nature reserves,

indicate the low food availability nearby. In September and October, bees make great use of ivy close to home. In March when forage sources are at a premium, bees make much use of snowdrops and crocuses, available on the University campus. These are non-native species characteristic of gardens, so in the crucial spring period gardens are of great importance to modern bees. Bees visit urban and suburban areas most frequently in the summer, because they contain such abundant pollen and nectar sources. They are least likely to visit gardens in May, when farmland oil-seed rape is an abundant source of food.

Additionally, Mihael Garbuzov's research at LASI is now focusing on bees in gardens. Bees are visiting a good variety of plants, including *Angustifolia* and *intermedia* lavenders (not the French lavenders), but the most popular plant is (non-native) borage. The honey bee is a very generalist forager, so efforts to help bees find food will be likely to help all other flower-feeding insect species.

The first conclusions from the study indicate that honey bees forage over large areas, but the pattern changes greatly according to season and availability. Urban habitats are important as well as rural habitats. The results demonstrate the importance of flower availability throughout the foraging season, especially August, and highlight the importance of conservation of semi-natural flower-rich grasslands. It is also very clear that in today's landscape, urban gardens and parks are significant especially in late summer when other sources of food are minimal.

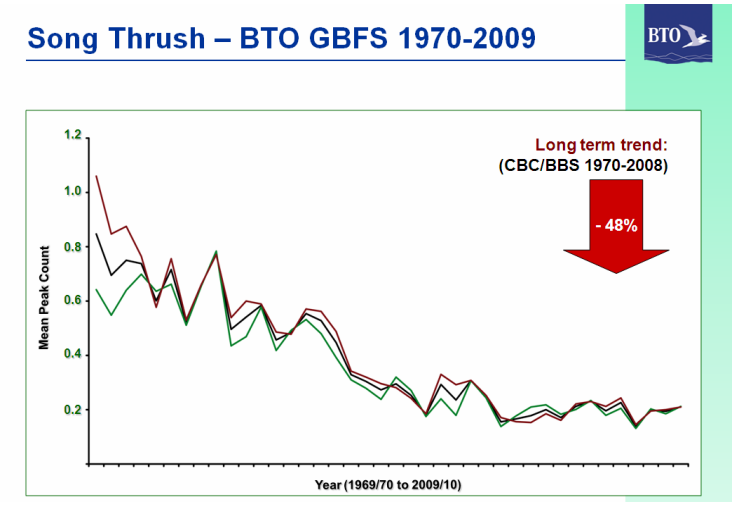
Studies will continue, collecting further dance data, and improving calibration of the waggle dance, since a few of the bees at present seem to forage offshore! There will also be some refinement through analysing pollen brought back by dancing foragers.

Dr Margaret Couvillon buzzes about at M.Couvillon@sussex.ac.uk

Mike Toms **British Trust for Ornithology.**

Conservation status of garden birds

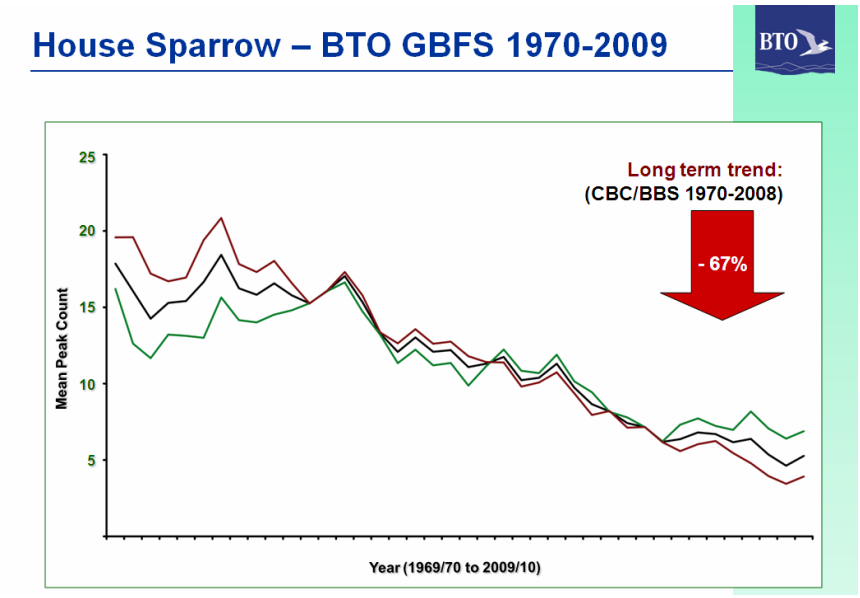
Birds are probably the most familiar form of garden wildlife, and a major source of motivation for wildlife gardeners. Unfortunately, many garden birds show the same pattern of declining numbers as is seen in rural environments.



The 48% decline in song thrush numbers is practically identical in suburban and rural garden settings

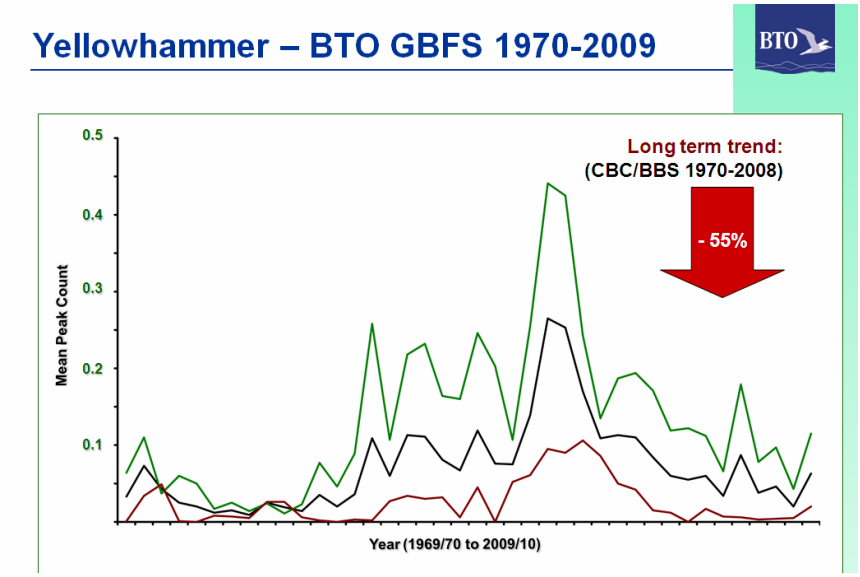
Green line- rural gardens, red line suburban and black line combined.

The same trend – or worse - is seen in house sparrow, where decline started in 1980. Whatever is going wrong in the countryside seems to be happening in gardens as well.



Green line- rural gardens, red line suburban and black line combined.

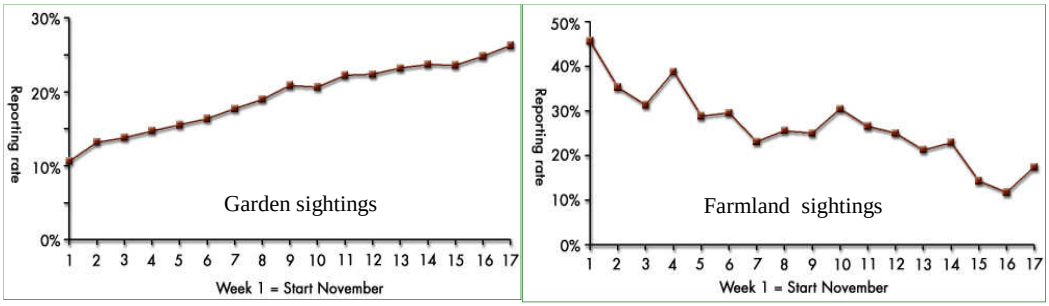
Yellowhammers have declined overall by 55% since 1970, but their frequency in gardens showed a trend of *increase* during the 1980s, when other birds were in decline.



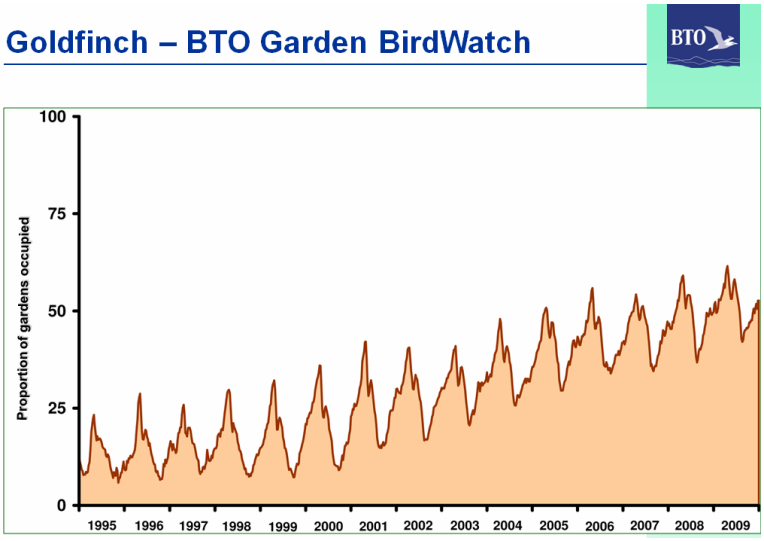
Green line- rural gardens, red line suburban and black line combined.

The trend was most marked in rural gardens, raising the question that gardens might buffer farmland birds from decline in their normal habitat. Only 4-5% of gardens host yellowhammers, but they are most likely to be seen in the winter, when farmland seed supplies are at the lowest.

Goldfinch show a different picture. They are partial migrants, and young birds probably make the decision to stay or fly south depending on the quality of their environment. As the winter progresses (from the beginning of November in the graphs below) the sightings of goldfinch on farmland progressively decrease, while the numbers in gardens increase.



Goldfinch data from the BTO Winter Walks and Garden BirdWatch surveys

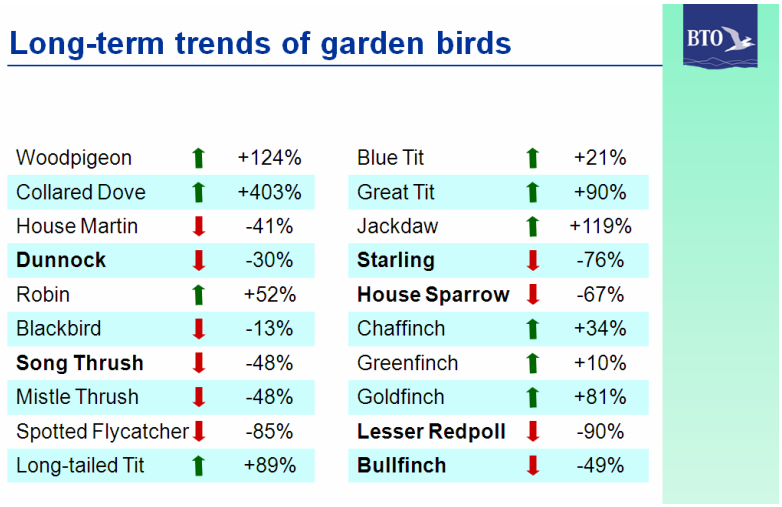


The BTO Garden BirdWatch has found a steady increase in garden goldfinch since 1995, and they are now seen in about half the gardens recorded. It is likely that the increasing sophistication of bird seed-feeders

has contributed to this. Goldfinch eat small seeds, and the move to diversify bird feeding to include seeds such as Nyger rather than just providing peanuts may well be a contributory factor.

Birds are extremely mobile within their landscape, so it is very likely their use of gardens for feeding may be inversely linked to the availability of food elsewhere. Coal tits for example use gardens in the winter, but in years when sitka spruce seed-set is very good, fewer choose to visit gardens. We should see the use of gardens by birds as a component part of larger landscape-level exploitation.

Long term trends for garden birds are surprisingly variable. The table below shows overall results from the Common Bird Census and Breeding Bird Survey from 1962 to present



Large declines are apparent for spotted flycatcher, starling, house sparrow and lesser redpoll, while numbers of woodpigeon, collared dove, robin, long-tailed tit, great tit, jackdaw and goldfinch have notably increased. Some declining species, such as lesser redpoll and bullfinch, could perhaps be helped by providing specialist food, in the same way as for the goldfinch.

So are gardens genuinely good for birds? This could be considered at several levels. The evidence for supplemental feeding appears positive:

	Response to supplemental food		
Breeding parameter	% positive (n)	% negative (n)	% no effect (n)
Lay date	57.6 (34)	1.7 (1)	40.7 (24)
Clutch Size	44.4 (28)	1.6 (1)	54.0 (34)
Egg size/quality	37.8 (14)	0.0 (0)	62.2 (23)
Incubation time	22.2 (2)	0.0 (0)	77.8 (7)
Hatching success	45.0 (9)	0.0 (0)	55.0 (11)
Chick growth rate	56.7 (17)	3.3 (1)	40.0 (12)
Fledging success	63.6 (28)	0.0 (0)	36.4 (16)

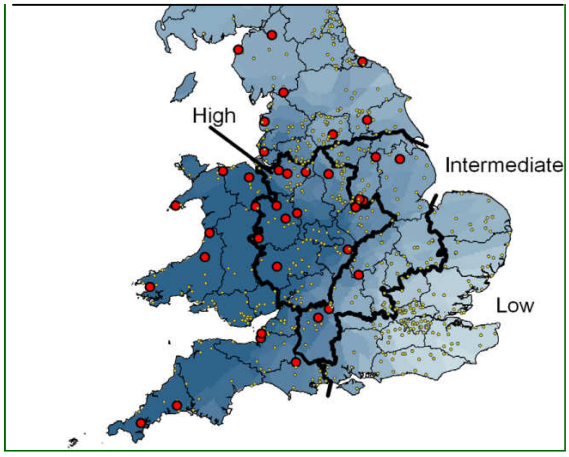
Data from Robb et al 2008[4]

[4] Robb, McDonald, Chamberlain & Bearhop (2008) Front Ecol Environ 6: 476-484

In this study, supplemental feeding had a predominantly neutral or positive impact on all the breeding parameters from bringing birds into breeding condition earlier, through to fledging success. For blue tits, provision of nest boxes and feeding stations increases local breeding success, but the overall picture may be more complex. Supplemental feeding could increase reliance on external food sources, and increase disease transmission through feeders. Boosting numbers of certain species could have impacts on other species through increased competition and attracting more predators. On balance, it seems likely that supplemental feeding ***is*** generally beneficial

Gardens of course contain skilful predators – cats. They undoubtedly kill many garden birds, but perhaps they are merely replacing the impacts of the weasels, corvids and other predators that assail countryside birds.

It may be that disease transmission is a greater issue, as birds are brought into unnaturally close contact through visiting feeding stations. This is a well documented problem for greenfinch which are susceptible to trichomoniasis acquired through visiting contaminated feeders.



Incidence of trichomoniasis in greenfinch

Woodpigeons are a natural reservoir for the parasite, and the problem is worst in the west of England and Wales, and least in the south east. Up to 25% of greenfinches can be lost annually to trichomoniasis in high incidence areas, and the use of bird feeders may be counterproductive for greenfinch in these areas. We need more studies, and until then it would be sensible to take a wider view of the role of bird feeders in gardens.

It seems an increasing number of species are being observed in gardens – the wood lark for example. We need a better understanding of how birds use gardens, how they affect their breeding season, and their breeding success. But even if fewer pairs successfully rear broods in gardens compared with for example woodlands, this may still be an advantage, because the unsuccessful birds, competitively excluded from the best territories, will nonetheless be gaining breeding experience. In order to give the best advice to gardeners, we need to build up our evidence base.

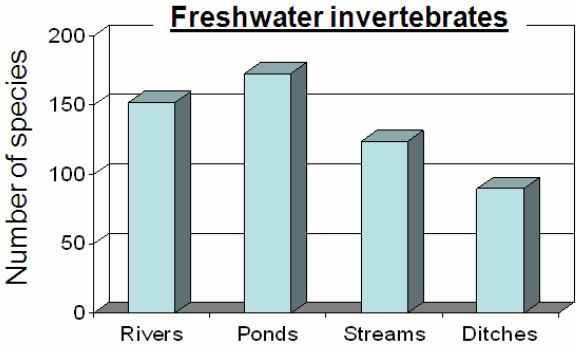
Mike Toms nests at michael.toms@bto.org

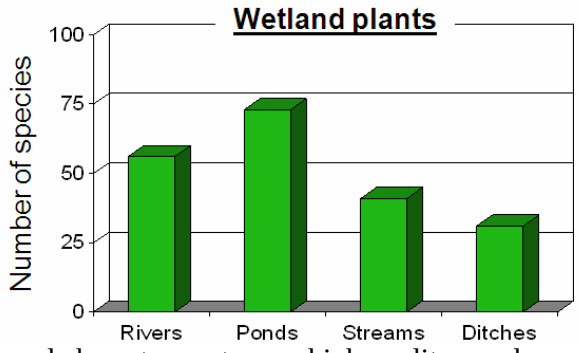
Jeremy Biggs **Pond Conservation.**

What's really living in your garden pond? First results from Pond Conservation's detailed garden pond research programme.

It is often stated that putting in a pond is one of the best things to do for wildlife in a garden, and also that gardens ponds can contribute to conserving fresh water biodiversity. The evidence base for these assertions (apart from amphibians) is however remarkably small. Pond Conservation has set out to assess the role of ponds in gardens, asking:

- How rich are garden ponds?
- How do garden ponds compare to ponds in the rest of the landscape?
- Are garden ponds important for any particular groups of plants or animals?
- Are garden ponds more or less polluted than ponds in the rest of the landscape?
- How badly are garden ponds affected by alien species?
- How should we go about making the best garden ponds, and managing those that already exist to most benefit wildlife?





In the national context, two thirds of all freshwater species can live in ponds, more than in lakes or rivers. The graphs to the left show the results of Pond Conservation's series of studies on the River Cole catchment system.

Ponds contain 100 UK BAP species, compared with 71 in rivers, and only 42 in lakes.

The bad news however, is that the Countryside Survey has shown that since 1996, 80% of countryside ponds are rated poor, while 75% of rivers are rated only moderate or worse. Ponds have also got worse since 1996. Fortunately, it is easy and cheap to create new high quality ponds provided simple measures are taken to ensure high water quality. New ponds with clean water quickly become biodiversity hotspots and form clean water oases in landscapes where rivers, lakes and streams are polluted.

There are probably five times more ponds in modern gardens than in the countryside. Most are small, <3m diameter, so what contribution do they make to biodiversity? Pond Conservation has launched the Big Pond Dip, with help from Natural England, the Ornamental Aquatic Trade Association and the Environment Agency. This is a programme of professional scientific research, coupled with public participation surveys focused on garden ponds. The aim is:

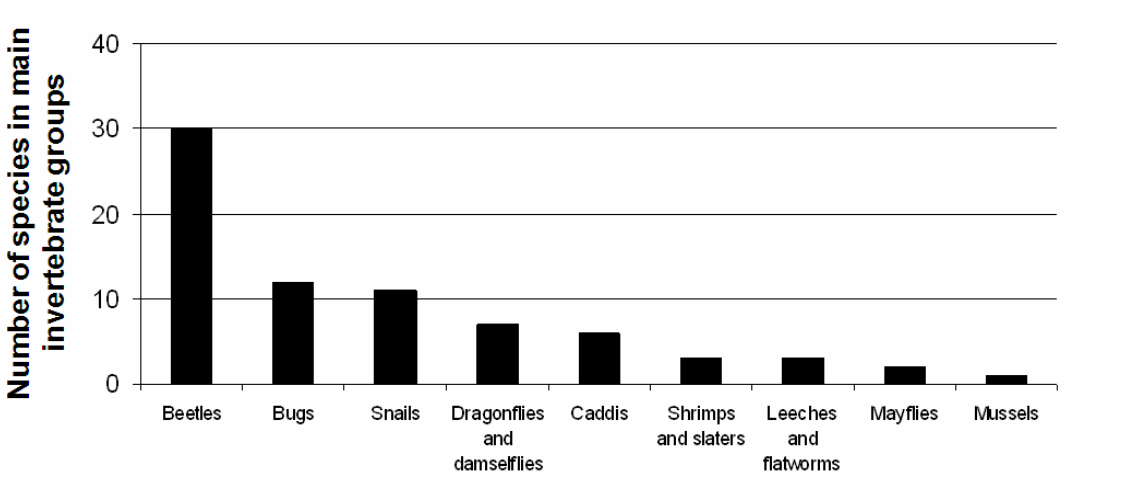
- to find out what lives in garden ponds

- use this information to do some good: get new high quality ponds into gardens
- get people more engaged with freshwater wildlife

The public survey asks people to score their ponds for the easily recognised animal groups mayflies, caddis, alderflies, dragonfly and damselfly larvae, water beetles, water bugs, pond skaters, freshwater shrimps, water slaters, pond snails and "wigglies" (worms, fly larvae and leeches).

The "professional" survey examined in detail a number of ponds in the Abingdon (Oxfordshire) area, recording their biodiversity, their size and depth, and their water quality. Clean water ponds supported more species than ponds with lower water quality, reflecting similar findings in the wider countryside. For ponds of 3 m^2 or more, size or depth had little influence on the variety of species found. In the Abingdon survey the very smallest ponds had fewer species but all of these ponds also had poor water quality – it is likely that if unpolluted they would have a wider range of species. Many Abingdon ponds were rather species-poor, dominated by American freshwater shrimp (*Crangonyx psuedogracilis*), two-spotted water slater (*Asellus aquaticus*), great pond snail (*Lymnaea stagnalis*) and dancing midge larvae (family Chironomidae).

Altogether the ponds contained 75 freshwater invertebrate species, which initially seems modest (42%) compared with the 175 species found in the River Cole catchment ponds only 25km away.



Abingdon Pond Survey: Species number by taxonomic group

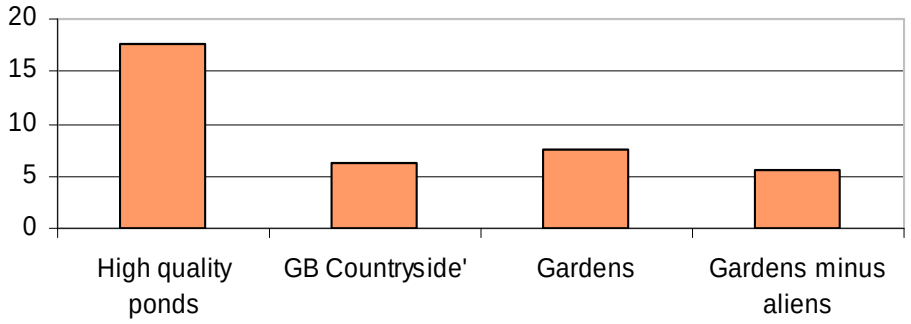
However, the 175 Cole catchment species were sampled from 40,000 m² (4 hectares) of habitat, while the Abingdon ponds totalled only 150m². This set of little ponds is really doing rather well, with nearly half the species in the much larger sample of rural countryside.

For the first time we can now compare garden ponds with others in the landscape

Pond type	Average number of invertebrate species
Garden average	9
Garden best	22.6
Countryside average	23.8
Unpolluted ponds	34.7

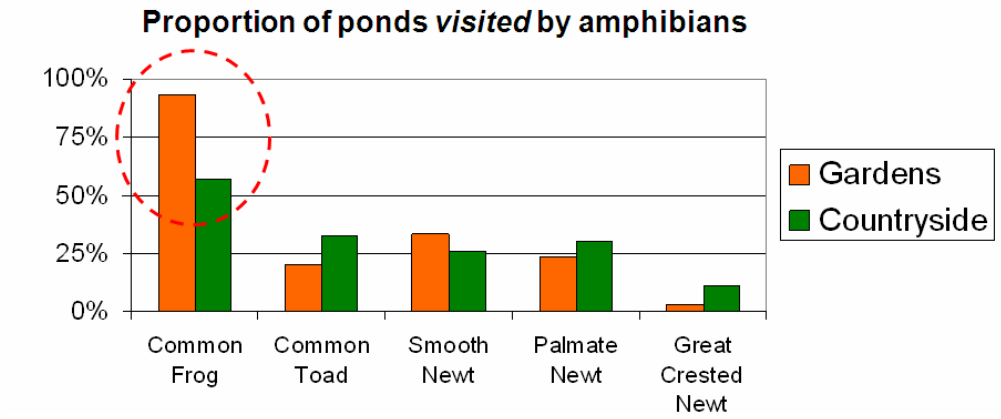
Garden ponds still rate rather low, but it is interesting to compare them with *comparably sized* rural ponds. The best garden pond of 8.6 m^2 with 22.6 species actually had *more* species than a naturally created and unpolluted New Forest tree fall pool of 8.0m^2 with 20 species.

If good garden ponds pull their weight for invertebrate animal species, the same cannot be said for their plants. They contain few native plant species, and 60% contain alien species, compared with only 10% of the countryside ponds. However, this is not the main factor lowering animal biodiversity, which is certainly pollution in both rural and garden settings. In fact, while garden ponds contained less than half the plant diversity than *good* countryside ponds, even without their aliens added, they contained about the same number of plant species as *average* countryside ponds.



Comparative data for all wetland plants (submerged, floating-leaved, emergent)

All the ponds in the Abingdon survey had amphibians at least visiting (although not necessarily breeding).



This is similar to results for ponds in the wider countryside as shown by the National Amphibian and Reptile Recording Scheme (NARRS).

The cleanest garden ponds had an average of 3.4 breeding species of dragonflies and damselflies, well above the GB countryside average of 1.96. They also contained some rare and significant species, supporting the argument that garden ponds could have a larger role to play in freshwater conservation. Two ponds had been naturally colonised by the Smooth Ram's-horn snail (*Gyraulus laevis*), which is nationally 'local', and a specialist in new ponds. Two species of Nationally Scarce water beetles were found, and three others whose status has recently been upgraded but which are still seen as indicators of good quality ponds. Ponds with a nationally scarce species are Priority Ponds under UK BAP. The garden ponds with breeding toads (17%) and

great crested newts (3%) recorded by NARRS would also qualify as Priority Ponds. Although generally not good for native plants, one Abingdon pond contained a nationally local plant, Blunt-flowered Rush (*Juncus subnodulosus).*

We can therefore conclude so far that

- The good garden ponds are surprisingly good
- The bad ones – which are the majority - are pretty dull
- The best garden ponds, despite being comparatively tiny, are as good as the countryside average (though note the degraded state of the countryside)
- Size for size, good garden ponds look pretty much like other high quality small ponds (cf New Forest small ponds)

Given their size, gardens are making a surprisingly large contribution to landscape level aquatic biodiversity – 42% of the species seen in a set of bigger countryside ponds. *Very* tentatively scaling up there may be:

- 1.5 million ponds with dragonflies or damselflies
- Similar number of sites with mayflies and water beetles
- 2 or 3 million Common Frog sites
- Perhaps several hundred thousand Common Toad breeding sites
- BUT there may be 1-2 million locations for non-native plants, some of which are dangerously invasive

It looks like small garden ponds can sometimes be valuable habitats, but most garden ponds are polluted, with only five out of 30 in the Abingdon survey having conductivities below 150. Garden ponds don't have to be poor and polluted – it is easy to make good ponds, and with 2 or 3 million ponds out there, there is plenty of room for improvement. We definitely need more and larger scale garden pond surveys to give the best advice, but we can already say that:

- Ponds can be any depth from 0.2 m up – shallow ponds are often richer than deeper ones
- Deeper ponds need to be bigger to achieve a good shape with shallow sloping margins.
- Most of the best ponds are low conductivity
- Ponds with lots of leaves and low dissolved oxygen are pretty poor for the groups we've looked at
- Pond edges are tricky to get right
- Plants, especially aquatics in garden ponds are poor; aquatics are especially difficult to establish well (hence the many aliens).

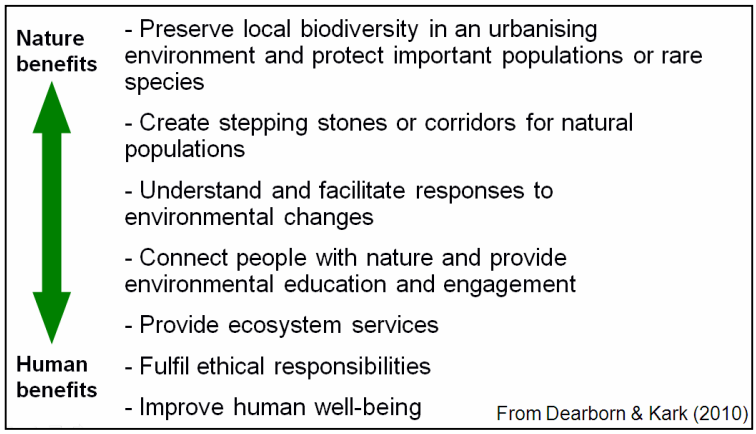
In conclusion, garden ponds can make a contribution to biodiversity – but it could be a lot bigger. They *could* be a significant clean water refuge in generally polluted landscapes. Better design, especially better water quality, would help them make a bigger contribution. And…a lot of fun can be had with them!

Dr Jeremy Biggs lives on a lily pad at jbiggs@pondconservation.org.uk

Mark Goddard **Leeds University.**

Scaling up from gardens: Avian diversity in a residential ecosystem

Given that we only have a fixed budget for conservation, why should we bother to conserve biodiversity in cities? A recent paper[5] has suggested seven reasons on a continuum of benefits to nature and benefits to humans:



Continuum of benefits to Nature and People

To those who believe that conservation action should focus on more natural or wilder landscapes, the many benefits to people clearly show that a 'compact city' approach to urban planning that excludes most urban green space will also exclude a great many opportunities for engaging people and improving well-being

But what about gardens themselves, why are gardens important?

Firstly, gardens are a major component of the city landscape – previous research has showed they cover approx 25% of the urban area of 5 UK cities, and nearly 50% of the green space in some cases. In Leeds, I have calculated that gardens cover c. 40 km² or 30% of the urban area. In total, UK gardens contain > 28 million trees, 4.7 million nest boxes and 3.5 million ponds.

We know that individual gardens can contain tremendous diversity, for example the >1700 animal species recorded by Jennifer Owen in a single garden in Leicester over 15 years[6]. In the face of agricultural intensification, urban habitats are now becoming significant for the conservation of some declining UK species. Gardens and other built-up habitats have been shown to support a large component of the populations of a number of breeding species, e.g. blackbird (33%), starling (54%), greenfinch (38%) and house sparrow (62%). The fact that about half of Britons feed the birds shows the importance of private gardens for engaging people with nature

Previous studies on garden ecology tend to fall into three categories:

1. Long-term studies of a single garden (e.g. Owen 1991[6], Miotk 1996[7])
2. Short-term studies of multiple gardens (e.g. BUGS and BUGS II, Univ of Sheffield, UK)

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[5] Dearborn, D. C., and S. Kark. 2010. Motivations for Conserving Urban Biodiversity. Conservation Biology 24:432-440)

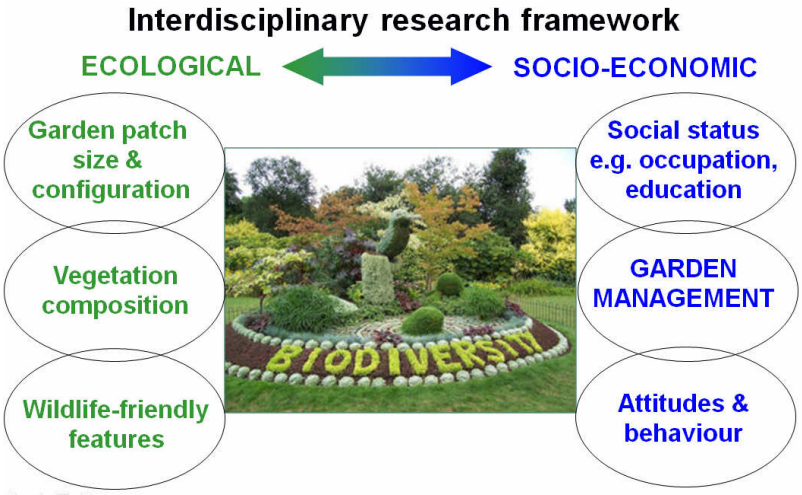
[6] Owen, J. 1991 The ecology of a garden: The first fifteen years. Cambridge University Press

[7] Miotk P. 1996. The naturalized garden – a refuge for animals? – first results Zoologischer Anzeiger 235: 101–116.

3. Long-term studies of multiple gardens focusing on national trends (e.g. BTO Garden Birdwatch)

What has not been studied so far is the contribution of gardens in aggregate to biodiversity – because gardens are not separate entities but combine to form interconnected patches of green space that need to be studied at the appropriate, i.e. landscape scale. The individual garden is the scale at which householders manage their patch. This is the scale at which most research has been done into garden biodiversity. However, if we were to manage all biodiversity at this scale it would represent a 'scale mismatch' (Borgstrom et al. 2006[8]) since the suburban ecosystem does not end at the garden fence. Gardens do not exist in isolation.

The aim of my PhD research is to assess the ecological and socio-economic factors that drive biodiversity within private gardens at multiple spatial scales within the city of Leeds, UK.



This presentation will mainly discuss the results of bird surveys carried out last year. Other groups surveyed included bees and hoverflies. Methods used include:

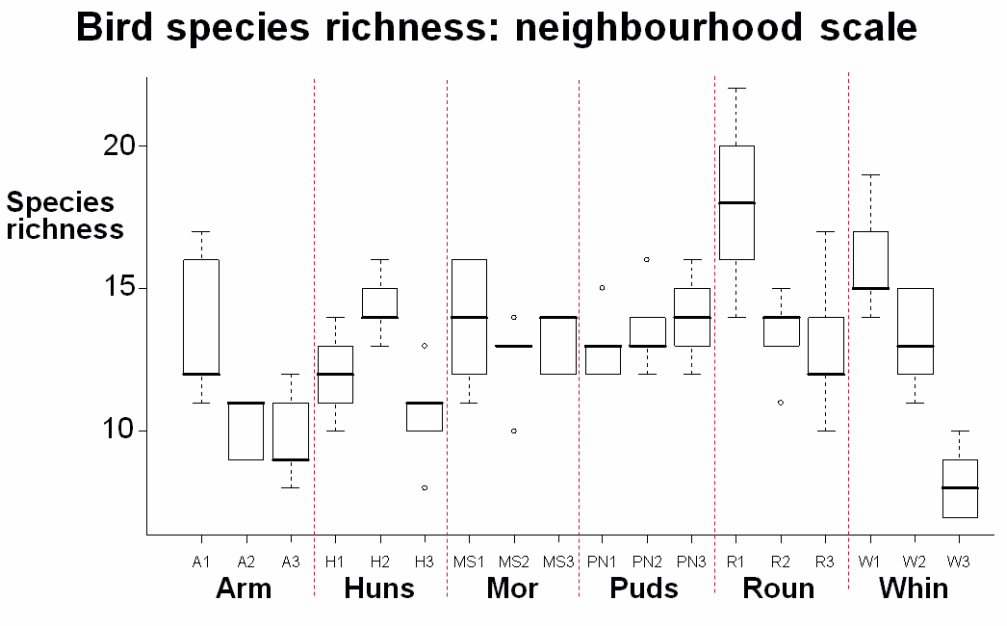
1. GIS and landscape metrics quantify the spatial configuration of garden patches
2. Aerial photographs quantify vegetation structure
3. Ecological survey of mobile taxa in gardens and streets
4. Census data and questionnaire survey investigate the influence of socio-economic factors on garden management
5. Semi-structured interviews explore attitudes driving garden management and mechanisms for encouraging 'wildlife-friendly' gardening

Sampling was conducted in a nested sampling design based on UK census geography Six wards were selected on the basis of variation in landscape and socio-economic variables, and 3 neighbourhoods selected within each ward. With 5 gardens selected per neighbourhood for ecological survey, this gave 90 gardens across Leeds. Some of the gardens are very small and contain very little vegetation. Others are small but packed full of flowers (mainly exotics!) Some are large and well-vegetated, and some contain wildlife-friendly features such as ponds.

[8] http://www.ecologyandsociety.org/vol11/iss2/art16/

Variables were examined at different scales. At the garden-scale land cover and vegetation structure were noted, with wildlife-friendly features and management intensity. At the *n*eighbourhood-scale socio-economic census data were gathered, and landscape metrics used to quantify the surrounding landscape at 250m, 500m, 750m, and 1000m scales.

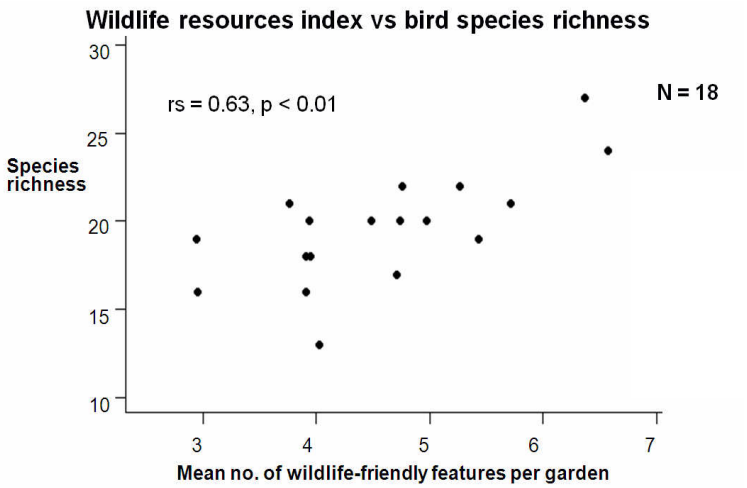
A total of 38 bird species were recorded during garden point counts and street transects At the garden scale species richness ranged from 7 – 22 (mean 12.9, N = 90), while at the neighbourhood scale species richness ranged from 14 - 28 (mean 20.8, N = 18) At the largest (ward) scale, species richness ranged from 24 in Armley to 30 in Roundhay (mean 27, N = 6).



This figure shows the bird species richness for the 18 neighbourhoods within the six wards. The more affluent neighbourhoods in each ward are on the left, and the least affluent on the right. Roundhay 1 is the most affluent neighbourhood and is the most diverse, and the number of bird species generally decreases as you move to less wealthy areas within Roundhay as in Armley and Whinmoor, but this does not hold true for all wards – socio-economic status is not the only factor driving bird species richness.

At the garden scale, as other studies have suggested, bird species richness rises with the height of the largest vegetation stratum.

At the neighbourhood level, bird species richness shows a significant correlation with the average number of wildlife-friendly garden features per garden, such as bird boxes, feeders, ponds, compost heaps.

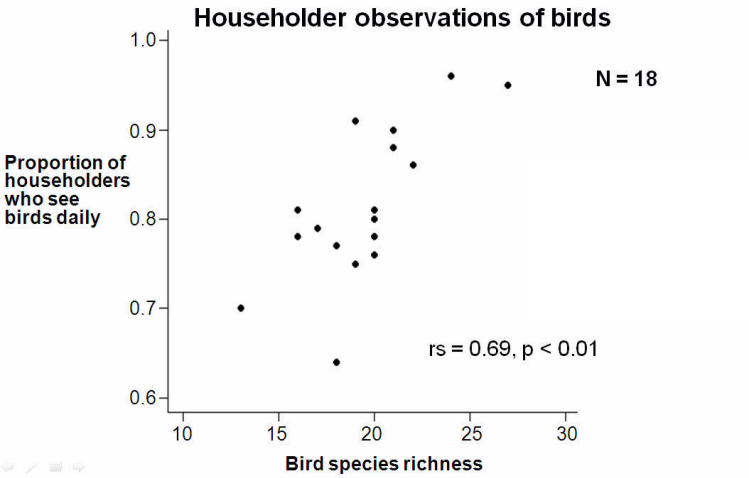


Bird species richness correlates with the average number of wildlife friendly features per garden at the neighbourhood level

At the landscape level several correlations were significant at the 5% level. At the 500m scale bird species richness increases with the mean size of garden patches (patch defined as the contiguous area of gardens) – a classic species-area relationship.

At the 1000m scale, bird species richness increases as habitat connectivity increases, in other words when garden patches are close together and not very fragmented.

There is a correlation between bird species richness and the proportion of people who hold managerial or professional jobs. Perhaps the more affluent people create higher species richness through their garden management, or they choose to live in more species-rich (leafy?) neighbourhoods. In a parallel way, bird species richness declined steeply and significantly with increasing neighbourhood population density. It's worth noting that this relationship does not hold for all taxa, e.g. solitary bees



Finally, this graph shows a positive correlation between the proportion of householders who report seeing birds every day in their gardens and the species richness of birds.

This could suggest that people notice birds more often in neighbourhoods that contain more species, or that the people living in more biodiverse neighbourhoods take more interest in the birds visiting their gardens.

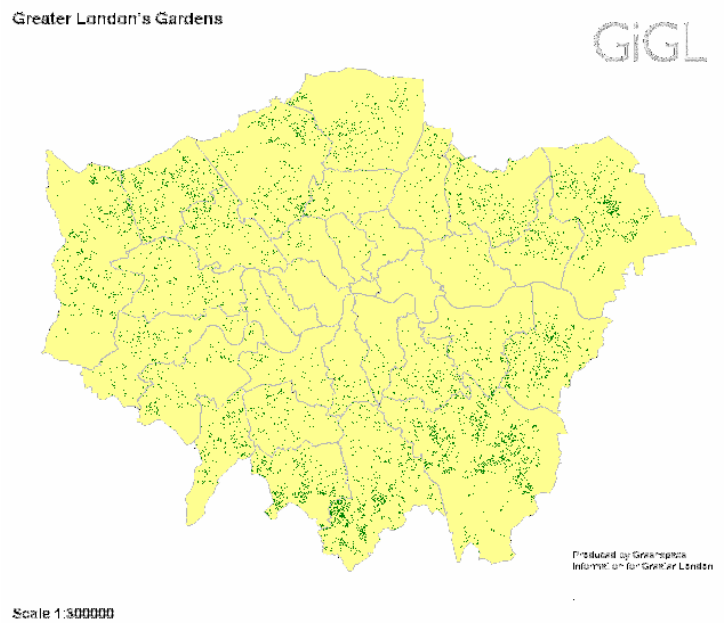
In summary, the results so far show that bird diversity is related to both ecological and socio-economic factors operating at a range of spatial scales. Coordinated, multi-scale management of gardens and neighbourhoods is required to maximise bird diversity. This could be encouraged through top-down incentives such as tax breaks and improved planning regulation, and with bottom-up initiatives such as community participation projects and wildlife-friendly neighbourhood award schemes.

Contact Mark in cell AA37 in a spreadsheet at bsmag@leeds.ac.uk

Chloë Smith and **Elaine Hughes** **GiGL and London Wildlife Trust**

The Gardens Research Project - Investigating the nature of London's gardens using aerial photography and GIS

The Gardens Research Project is a partnership of the London Wildlife Trust with funding from Royal Society of Wildlife Trusts, the Greater London Authority (GLA), and Greenspace Information for Greater London (GiGL)[9].



Greater London's area of gardens. Based upon the Ordnance Survey 1: 10 000 map with the permission of The Controller of Her Majesty's Stationery Office. License No. LA100032379. Produced by Greenspace Information for Greater London.

A growing evidence base supports the role of gardens in maintaining biodiversity. Urban wildlife benefits from the availability of habitats in gardens. Gardens are a major land use in residential areas and their internal make-up therefore influences local environmental conditions such as surface runoff. It is important that we understand and maintain these roles as our climate changes. Last, but not least, local people gain numerous health, welfare and leisure benefits from gardens.

The project's aim was to assess the different types of ground cover in a sample of gardens across the capital to gain an understanding of how people in London use their gardens, what the levels of vegetation to hard surfacing were, whether front and back/large or small gardens are different in these respects. The same information was gathered for two time periods to estimate rates of change. As far as we know this is the first London-wide study of its kind,

Partners were particularly interested to provide evidence of the land use in gardens across London in order to:

- compare garden land to other open space in the city as a potential wildlife resource

[9] See www.wildlondon.org.uk, www.london.gov.uk and www.gigl.org.uk

- address concerns about the hard surfacing of gardens – is it really happening? At what rate? In what kind of garden?
- understand more about the variation in gardens and use this evidence to focus action

There are over 3 million garden plots in London, so a complete survey would be impossibly time consuming and expensive, while private ownership makes access to a representative sample challenging. Aerial photography allows visual comparison of gardens from across London without problems of access. Systematic sampling of a proportion of gardens from the whole of London is possible allowing observations to be scaled up to estimate the total areas of specific land cover in London's gardens.

Aerial imagery is available for London for the 1998-99 and 2006-2008 periods. They can be directly inputted into Geographic Information System (GIS) software for comparison with Ordnance Survey MasterMap data showing property boundaries.

There were a number of limitations that needed to be considered during design and interpretation.

- There is a limit to the detail visible from aerial photographs. Some features we had hoped to see were not discernable.
- Interpretation of garden surfaces could be confused
- Shadows were a particular problem because of the urban environment. It is difficult to make comparisons if there is too much shadow in the data set.
- Building lean was also a particular problem in the residential environment.
- There was a difference in resolution between the photographs from the two study periods. More recent photographs are better quality, but the older photographs must be used as the baseline for comparison.

Ground surveys of volunteers' gardens were used to guide interpretation of photographs and define appropriate land cover categories for recording. Some features or surfaces were grouped together into a higher level category as a consequence of this comparison. Some features or surfaces such as ponds could not be adequately identified from the aerial photographs and were therefore not recorded.
Vegetation categories were identified, including lawn, tree canopy and other vegetation (shrubs, hedges etc). Hard surfaces (patio, paving etc.) and built structures in garden were recorded, Miscellaneous land covers were recorded as 'other', and there was also a category for unknown land cover due to shadow, building lean or other anomalies where these were not more than 20% of the total garden area.

The process of data collection began with the identification of the appropriate sample of gardens from across London. This was defined using MasterMap polygons and was stratified by borough and included a range of different garden sizes.

These garden plots were identified in the GIS and visually assessed. Percentage cover of the various categories present was estimated to nearest 5%. Where gardens were unsuitable for further analysis due to a large area of unknown land cover the next largest garden in the borough was used as a replacement to avoid biasing the sample towards certain kinds of garden.

The study allows average areas of land use types to be calculated borough-by-borough and scaled up to London as a whole. The data will provide % cover values which can be used for analysis of garden type and change

Though the findings of the project were embargoed at the time of the conference, indication can be given of how the results will be used.

- The data on the size and the composition of garden land will help focus discussion about current status, rates of change and concerns for the future.
- The trend of paving can be considered in the context of London-wide analysis for the first time.
- Similarly, the impacts of development on back gardens can be considered in a proper context
- We can define the typical make-up of a London garden, and use this as a platform for discussion about enhancing gardens for wildlife and climate change adaptation

Chloë Smith can be found in a GIS polygon at chloe.smith@gigl.org.uk

June Greenway **Sheffield University.**

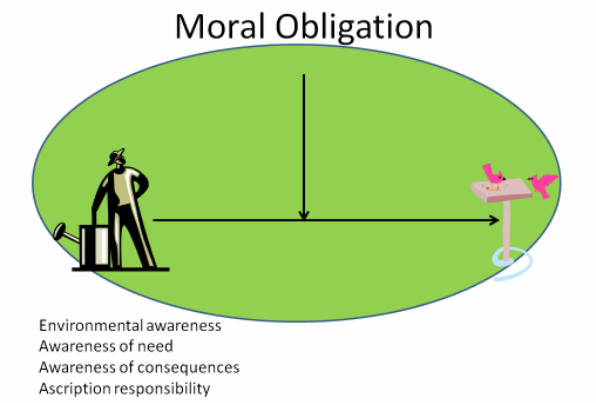
The social science of wildlife gardening: Why some people choose to practice while others do not.

This presentation discusses some of the findings from a four year research project I carried out with the University of Sheffield and sponsored by the RHS, which focussed on urban gardens and sustainable development, together with a range of garden practices, including wildlife gardening.

Previous studies have documented the extent and spatial configuration of gardens, their high level of biodiversity and the presence of scarce 'red-listed' species. Although we know much about the role that private urban gardens play in maintaining biodiversity, very little is known about why some people choose to practice wildlife gardening while others do not, or how the practice could be increased. These two questions provided the focus of my research.

A number of explanations have been suggested as to why people choose to practice environmentally beneficial behaviours. The Plant for Life Environment Report 2008[10] for example found that gardeners were concerned about climate change, loss of wildlife habitats and practices that are harmful to wildlife. Such gardeners have

- environmental awareness
- awareness of the need to reduce harm to the environment and wildlife
- awareness of the consequences of their own gardening practices in terms of either harming or benefiting other people, wildlife and the environment
- a sense of responsibility to act to reduce harm

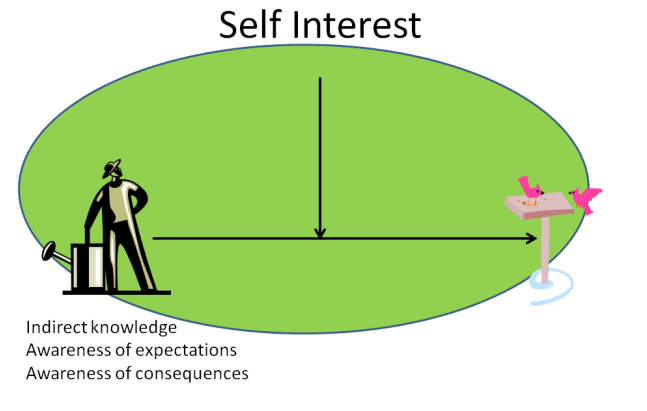


Here the explanation works as follows. When we know that things we care about are threatened, and that we can act to reduce harm by practicing wildlife gardening, we feel a sense of shame or guilt for not doing so. This in turn increases our sense of responsibility and obligation to act to reduce harm, and if the context is conducive we start to act.

An alternative explanation can be found in behaviour research which focuses on benefits to the individual and society rather than moral obligation, assuming that people are motivated by self-interest and fear of social disapproval.

According to this explanation we need to believe that a practice has benefits, so we need at least indirect knowledge of wildlife gardening practice. We have to be aware of expectations from family or friends to practice, and be aware of the consequences of

[10] see www.the-hta.org.uk/file.php?fileid=428



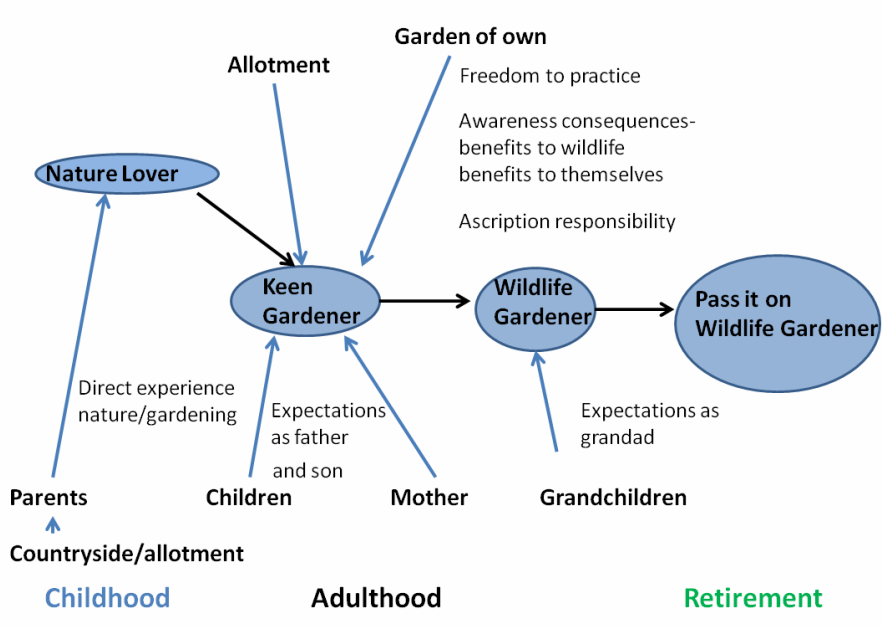
meeting or failing to meet their expectations, in terms of social approval or disapproval. Whether we then practice or not will depend on whether we care about the benefits that practice will bring to ourselves and whether we value social approval or fear social disapproval.

Both these explanations tell us nothing about where the knowledge and awareness of need and consequences come from and presuppose that people have access to the resources they need, together with the skills and freedom needed to practice wildlife gardening.

Additionally, in the real world causes of change are likely to be multiple rather than single and the process of behaviour change may be repeated and ongoing rather than compressed into a single founding moment.

Let us look at some case studies. Mr H, a wildlife gardener, is retired, with a relatively small garden of 65m², packed up to the gunnels with fruit trees, shrubs, a vegetable patch and numerous pots.

After retirement he now spends more time looking after his grandchildren and has more opportunities, which bring great satisfaction, to share his experiences and interest in nature and gardening with them. His and his wife's interest in gardening and wildlife started with growing up in families with allotments in the Rivelin Valley on the edge of the Peak District, where as a child he was allowed to play unsupervised while adults gardened. He recalled how he was sometimes asked to go and collect leaves to make leaf mould with his brothers and cousins, and hours later would come back with empty bags because they had spent all their time looking at insects they had found in the leaves.



Mr H's principal wildlife gardening influences.

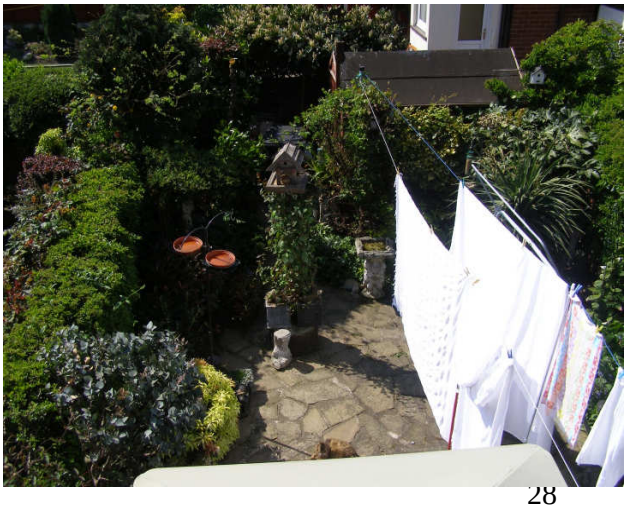
These direct experiences of nature provided an unlimited source of attraction, stimulation and challenge from which he developed a great deal of knowledge and a life-long interest in the natural world. As he grew older he trailed badgers with his friends and was encouraged to garden in his parent's allotment, again broadening his knowledge while developing an interest in gardening.

With a young family, Mr and Mrs H gave their garden over to the children, and Mr H got an allotment of his own. Now it was gardening that provided opportunities to experience nature, and as he said **"***We used to take all the kids up there didn't we? Used to spend days up there***".** But as his mother got older and her health deteriorated, an increasing amount of time was spent caring for her and he gave up his allotment. By this time his children had grown and left home, and he and his wife were now able to use their garden as they wished. Initially they concentrated on covering the boundary fences and put in pyracantha and ivy. At the time plants were chosen as he said "*because we saw it and we liked it"* and not for their wildlife value.

Mr and Mrs H knew that sparrows were in decline, but seeing lots of starlings and sparrows visiting their garden they were not aware of a need to provide for 'at risk' garden birds However, from watching the birds in their garden they did know which plants birds were feeding on, and retained even *"HORRIBLE"* ivy because the sparrows, in particular, loved it.

Mr H also put in a large pond 9x4ft and 2 foot deep specifically for fish. But as he explained **"***I'll stand frogs messing in my pond; fair enough I'll stand that. The good they do round the garden is brilliant. Very rare we get slugs, snails".*
As his wife said **"***we don't use chemicals so birds take me greenflies and frogs take me slugs"***.** But it's clear as they talk that they don't just encourage wildlife for slug and pest control, they also love the exuberance of the starlings using their waterfall for a bath, while the sparrows stand at the edge and have a shower. Mrs H made fat-cakes and fed the birds first thing, before she had her own breakfast and her fat-cakes "*always go down a treat"*. Mr and Mrs H don't even have to be in the garden to enjoy the wildlife as they often sit in their conservatory where can see it all going on.

For the majority of people interviewed who practice some form of wildlife gardening, this could be explained by internal (or intrinsic) values of nature first and foremost, and also affiliation to family and friends. These reflected their upbringing, interests and lifestyle, rather than any external sources such as the media, education or work. That is not to say that the external sources had no effect but that, in the main, internal values predated external influences.



Mr and Mrs S demonstrate how moral sentiments of affection, concern and responsibility for wildlife can arise spontaneously from common experiences and everyday pleasures of urban nature in their own garden,

This is their small garden, 50m², crammed with shrubs and perennials. They are keen gardeners, members of the

National Trust and they also do charitable work for a donkey sanctuary and have an old dog and a few cats.

They were the only interviewee's who had a dovecote and Mrs S explained how her half-dozen birds were quite tame. In addition they have numerous bird tables, baths and nest boxes and explained **"***we have loads of blackbirds and they come and have a bath and I put apples out. And they come…I love it."* Again, for Mr and Mrs S, their care for the birds is not based on knowledge or concern for their conservation status. When I was talking to Mrs S about sparrows and starlings being on the 'at risk' list she replied **"***Well Mrs C was saying how they've plummeted again, well they haven't round here because we've got LOADS, and loads of sparrows."*

They put in a tiny pond some years ago after their children had left home, and at the time it was very much a garden rather than wildlife feature, but they researched what plants to put round it, because in Mr S's words **"***We like everything to look natural - like look how they (frogs etc) like it"*.

Mr and Mrs S's pond

In the first year they had seen frogs and newts in the pond, but in the second year all the spawn was frosted off. They developed more of an interest in the pond now that it was providing a home and breeding place for frogs, to the extent that this year they put the spawn in a bowl which they take in every night, and set next to the pond during the day. So far they have counted 5 frogs and they are pleased that their effort has paid off. Their notions of need, consequences and responsibility all come from their direct experience of, and concern for, wildlife in their garden.

During my research I encountered all general wild life gardening practices. But there was also a woman who was so concerned that her blackbird was wooing a reflection of himself that she put curtains up in her garage window. There were also a few people with very overgrown gardens who explained their lack of garden maintenance in terms of concern not to harm wildlife with strimmers, and used phrases like "*So long as the birds are happy, I'm happy."*

I was able to compare people who were not actively seeking to encourage wildlife in their gardens with the practitioners. These people were predominantly using their gardens for social purposes such as play and sitting out rather than "gardening", and had either no knowledge of the need to provide food or habitats for wildlife or contested this need by talking about sparrows and starlings as common garden birds. That is not to say they don't appreciate wildlife in gardens, but it is not something they seek out, and for non-practitioners other uses and relationships are much more important.

Research by the BUGS project[11] found that higher commitment to wildlife gardening was associated with larger garden size and the proportion of land covered by gardens. In my study the wildlife gardeners had gardens from 16m² to over 1000m² but those with gardens of 70m² or less felt constrained by garden size, with over 1/3 saying they would extend their practices if they had a bigger garden.

For non-practitioners, garden size made no difference. The findings suggest two possible explanations for the association between wildlife gardening and garden size. Those who value opportunities to experience nature, and are already wildlife gardeners seek out larger gardens in order to extend opportunities in terms of the size, extent and variety of planting, and wildlife gardening choices such as putting in a pond or letting areas go wild.

For those who are not yet wildlife gardeners, larger gardens provide more opportunities to experience garden wildlife because of the size, extent and variety of planting *(see Marks Goddard's presentation showing that the "leafiest" areas of Leeds had the highest number of bird species visiting gardens).* If more birds feed in your garden and you can see certain plants used for food, this may increase your awareness of need, and sense of responsibility to retain food sources and/or provide additional sources of food.

In summary, people who are actively seeking to encourage wildlife in their garden often had direct experience (physical contact with natural settings and wildlife) from a very early age. For the majority it was family members who encouraged the child's interest and experience of nature, themselves passing on cultural traditions such as gardening, allotmenteering, bird watching and bird feeding that had been passed down from their parents.

Whether in the countryside, allotment or garden, these encounters with the natural world provided an unlimited source of attraction, stimulation and challenge for children, engendering a sense of fascination, wonder and joy (as well as fear) which create emotional connections to nature. As they develop experience, knowledge builds, their interest develops and their values of wildlife gardening and nature are formed.

Ken Thompson has argued the impact of gardeners on wildlife is small compared with that of farmers, but that "*The real importance of gardens is that they hold wildlife where people are"*. I would agree that much of the significance of gardens is represented by this opportunity they afford.

Most people establish their relationship with nature in the garden, just from being there, through gardening and watching garden wildlife, as well as deliberate actions to encourage wildlife. When interviewees talked about "*my baby blackbird"*, "*my friend the fox", "Colin the crow", "Peg-leg the pigeon"*, and emotions like love, they are saying something about the strength and importance of these relationships.

Nearly 80% of the population of England live in urban or semi-urban settings and for most access to nature is dependent on urban nature. According to the Survey of English

[11] Gaston, K.J., Fuller, R.A., Loram, A., MacDonald, C., Power, S and Dempsey, N (2007). Urban domestic gardens (XI): variation in urban wildlife gardening in the UK. *Biodiversity and Conservation 16, p* 3227-3238

Housing[12] 85% of all households have access to a garden (2004), and for many people living in cities it is in their own garden that nature is most easily accessed. The potential for getting people interested in the wildlife where they live is enormous. But how could we do it?

I heard Steve Head talking on the radio at the beginning of 2010 explaining how five years ago the Wildlife Gardening Forum was very species led, but that increasingly the agenda has widened to embrace the benefits of wildlife gardening to people's health and well-being. However, the behaviour change message cannot be "*do it because it's good for you or because it will make your garden more interesting*". These are things that people find out for themselves from their experience of wildlife and gardens. If we want to encourage an enduring commitment to wildlife gardening, the overwhelming message for children and adults from my research is to provide:

- ongoing opportunities for spontaneous play or activity in natural settings
- ready access to nearby nature, in gardens, parks or brownfield sites, allotments or woods and countryside
- family or extended family sharing experience and interests with their children

Dr June Greenway's habitat is reached at june.greenway@ntlworld.com

[12] www.communities.gov.uk/documents/housing/pdf/151258.pdf

Steve Head **Wildlife Gardening Forum**.

So what *IS* the role of gardens in biodiversity conservation?

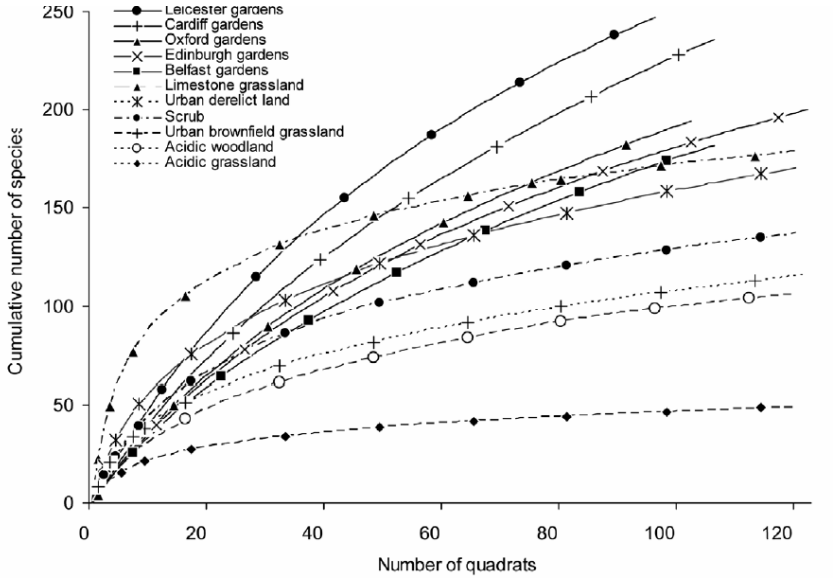
This unashamedly polemical essay reflects my personal frustration that many conservationists do not yet take gardens seriously as a resource for a huge variety of relatively non-specialist wildlife species. I argue that gardens are immensely species-rich, constitute a very large resource by area, are highly interconnected for mobile species, and as part of the urban environment, are going to increase in the future rather than decline.

The good news is that without doubt, gardens are highly biodiverse, as we have learnt from other presentations (today and in the past), and in many published studies. In her ground-breaking study of her suburban Leicester garden, Jennifer Owen[13] recorded

- 422 species of plants
- 364 species of butterflies and moths
- 251 species of beetles
- A total of 2,204 species in 34 groups

Allowing for the many obscure groups she couldn't study, she estimated that about 8,450 species of *insects alone* could be found in gardens. She found 20 species that were new to Britain – and four that were new to science. Jennifer Owen's work indicates that 5 to 40% (by group) of all our animal species can be found in gardens. That one pioneer can discover such extraordinary and hitherto unexpected diversity in her own back yard emphasises how scientifically neglected garden habitats have been.

Gardens also pack more plant species together than other British habitats. The extended BUGS 2 project has shown that the plant species diversity (native plus alien species) in all sets of city gardens examined exceeded that in 4 traditionally conserved semi-natural habitats and that of urban derelict and brownfield grassland. The same study showed that counting native species only, urban derelict ground closely approached the plant species diversity of limestone grassland[14]



Cumulative species curves for quadrats in 5 city gardens, urban derelict land brownfield grassland, and 4 semi-natural habitats[14]

[13] The Ecology of a Garden: The first fifteen years. Cambridge University Press 1991

[14] Loram, A., Thompson, K., Warren, P.H. & Gaston, K.J. (2008) Urban domestic gardens (XII): The richness and composition of the flora in five cities. *Journal of Vegetation Science* 19, 321-330.

Although it is very early days, Pond Conservation's work on garden ponds (see Jeremy Biggs' presentation) shows that garden ponds *can* be comparable in diversity to high quality countryside ponds of similar size.

Clearly, gardens are remarkably biodiverse, but why? It is likely that many factors come into play. I would suggest that these are likely to include:

- **Contrived plant diversity.** Gardeners like me cannot resist cramming as many interesting plant species into a small space as we can, and we are greatly encouraged in this by the horticultural trade.
- **Permanent early successional states.** Only neglected gardens are allowed to "get on with it" without interference. Vegetable and flower beds are regularly or annually disturbed, turned over, and bare ground created. We create a mosaic of different successional states in our gardens, and this must increase their biodiversity.
- **Variety of structure**. BUGS showed that that "vegetation – especially tree cover – is likely to provide benefits for the widest range of (invertebrate) taxa"[15]. Gardens pack in a number of imitations of semi-natural habitats (see below) into a small area. Artificial features such as ponds, compost heaps, walls and hedges are particularly beneficial for wildlife[16]
- **Domestic lawns.** These occupy a high proportion (eg 60% in Sheffield)[17] of most gardens, are often species rich and "In most respects, lawns behaved much more like semi-natural grasslands than like cultivated flower beds and borders"[18].
- **Food supply**. Many garden plants are chosen for the attraction of their seed or berries, and gardens are managed to produce fruit or vegetables from which wildlife generally extracts a tithe. Many birds use gardens as a supermarket, but may nest elsewhere. The amount of vegetation (and compost and detritus) in most gardens is high, forming productive bases for many food chains.
- **Garden diversity** Gardens differ greatly from one to another – according to the interests and diligence of their owners. BUGS found the number of species in each study garden was generally low compared to the species list summed over all the gardens[15], so this garden variability seems to be true for the wildlife too.

Garden features can reproduce many important classic British habitats:

- **Mature trees**. These hugely valuable assets provide some of the benefits of woodland, especially if they are allowed to carry dead wood.
- **Hedges and shrubs.** Multi-species hedges allow a disproportionate number of smaller woodland tree species to coexist in a small area, and give some of the character of woodland edge habitats, generally richer for flying insects than the inside of a wood.
- **Lawns**. As noted above, lawns approximate grazed grassland, and can be species rich if managed appropriately.

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

[16] Thompson, K. 2006 No Nettles Required: The Reassuring Truth about Wildlife Gardening. Eden Project books.

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

[18] 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.

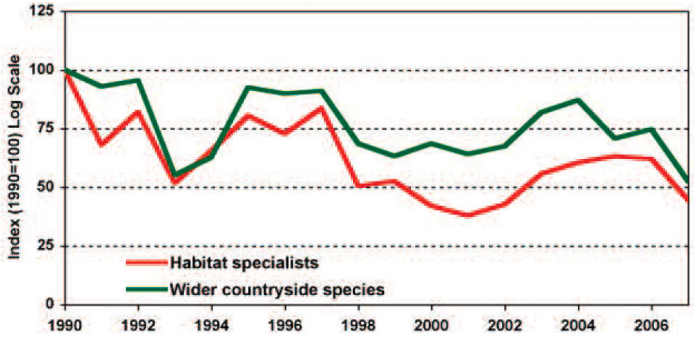
- **Veggie patch and borders**. These disturbed areas mimic naturally cleared or open ground, where the dominance of grasses is not established, and ephemeral "weed" species can flourish
- **Ponds.** Garden ponds can in most respects take a similar role as ponds in the wider landscape.
- **Compost heaps**. These mimic a well developed forest-floor habitat where there is an accumulation of decaying material supporting many invertebrates and fungi.
- **Rockery.** Rockeries can mimic bare rock and scree habitats, particularly helpful to allow insects and reptiles to sunbathe, while providing crevices for solitary wasps and bees, and hibernation refuges for amphibians. The same is true for stone or brick walls.

There is of course **Bad News** for wildlife and gardens. We have to acknowledge that gardeners, with their insatiable appetite for novelty, have been responsible for importing a number of ecologically invasive and damaging non-native species, which are causing major problems in semi-natural habitats. Notorious examples include *Rhododendron ponticum, Myriophyllum aquaticum and Fallopia japonica* among many others. Climate change is likely to make this even more of a concern.

36% of UK homeowners move house between 3-10 times in their lives[19] In the year before 2008-2009, just under two million households moved into their current accommodation[20] actually - a *reduction* of 21% compared with the previous year, reflecting economic hard times.

When people take on their "new" garden, they generally want to make fairly drastic and rapid changes, with much encouragement from the television garden makeover industry. At worst, these changes can remove habitat to replace it with concrete, paving or decking. At best, it is likely that some of the existing beneficial features for wildlife may be removed. For this reason, it would never be sensible to consider gardens a safe refuge for conserving rare native plants – which are in any case often very exacting in their ecological needs. Gardens however are the ideal places to conserve old cultivars, which constitute an important aspect of biodiversity. The International Daffodil Register lists over 29,000 cultivars of this popular garden plant, but the RHS *Plant Finder* lists only 1950 cultivars as currently available, which represent only 6.5% of the total number listed in the Register[21].

For the few taxa where we have monitoring data, garden wildlife seems to be declining along with that of the wider countryside. This is true for birds (see Mike Toms' presentation) and for once common butterflies.



Populations of butterflies in SW England 1990-2007, separating habitat specialists associated with specific semi-natural habitats from generalist species which could occur in gardens[22]

[19] RBS Offset Moving Frequency Index
[20] English Housing Survey 2008-2009
[21] Thanks to John Davis of the RHS for this.
[22] Botham, M.S., Brereton, T.M., Middlebrook, I., Cruickshanks, K.L., Harrower,

The small tortoiseshell butterfly is in long-term decline, reduced to only 39% of its 1976 levels[22]

We must also accept that gardens will never support many of the iconic rare species like avocets, otters, the swallowtail and purple emperor butterflies that are flagship conservation species[23]. **But this is where I want to get controversial.**

Some hard-line conservationists still consider normal gardens irrelevant to biodiversity conservation. Saying – and I paraphrase *"Any advice to gardeners other than directing them to create native plant species sanctuaries for rare insects is a sell-out"*.

It is my personal view that UK conservation has always focused far more on rare species than maintaining overall ecosystem function. Huge efforts have been expended (sometimes unsuccessfully) on flagship rare species whose loss would be regrettable but not significantly affect ecosystem function. Examples could include *Maculinea arion eutyphron* – the English Large Blue, *Lycaena dispar dispar* the English Large Copper butterfly, and *Cypripedium calceolus*, the native Lady's Slipper Orchid. For the first two, efforts have even included replacing lost native stock with different sub-species or races from Europe.

At the same time, we have (until very recently), ignored the decline in once abundant species and habitats such as frogs, toads, the small tortoiseshell butterfly, and unimproved neutral grassland. Verily, we are a nation of conservation stamp collectors; compiling impressive lists of rare species and Species Action Plans to fret about while "ordinary" countryside as a whole decays. Conservationists must not ignore the common-or-garden species in favour of heroic last ditch preservation of oddities. Or is their focus more related to shock-horror style campaigning for funding?

UNEP defined Biodiversity[24] as:

> "the variety of life on Earth. It includes diversity at the genetic level, such as that between individuals in a population or between plant varieties, the diversity of species, and the diversity of ecosystems and habitats."

but goes on to note:

> "Biodiversity also incorporates human cultural diversity, which can be affected by the same drivers as biodiversity, and which has impacts on the diversity of genes, other species and ecosystems."

So gardens **are** valid habitats – part of the urban human ecosystem influenced by our cultural diversity. They are also remarkably ancient.

Gardens have been evolving with wildlife for 13,000 years, since the settled proto-agricultural Natufian culture of the eastern border of the Mediterranean[25]. The scale of the earliest cultivation would have been much closer to horticulture in gardens than large scale modern agriculture. This is 6,000 years longer than Britain has been an

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C., Beckmann, B., & Roy, D.B. 2008. United Kingdom Butterfly Monitoring Scheme report for 2008. CEH Wallingford

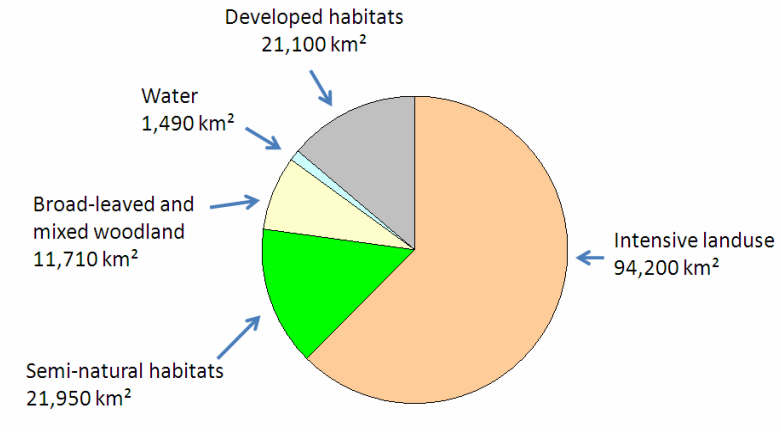
[23] Unless you are a City Banker and use your bonuses to garden at a landscape level.

[24] UN Environment Programme publication GEO4 (2007)

[25] Bar-Yosef, O. 1998 The Natufian culture in the Levant, threshold to the origins of agriculture. Evolutionary Anthropology 6: 159–177, 1998

island and evolving its own "native" flora and fauna, and about 10,000 years longer than semi-natural habitats like chalk grassland and coppiced woodland have had to develop since the Iron Age. Even gardens in the modern sense of places for pleasure and relaxation have a huge antiquity. The garden painted in the 1400BC tomb of Nebamun at Thebes looks very familiar, with a pond containing fish, ornamental aquatics, ducks, paths, and fruit and shade trees. The garden depicted in the House of the Vetii at Pompeii (79AD) even has ornamental fences and formally spaced shrubs. We must accept that gardens, although continuously evolving, have a very long track record.

The urban environment occupies a depressingly large part of England and Wales, about the same as all semi-natural habitats put together



Defra: Estimated stock of broad habitats in the UK: 1998 [26]

Intensive landuse includes agriculture and conifer plantations.

Within urban space, gardens occupy about 22-27% by area and 35-47% of urban greenspace[27]. They therefore cover about 25% of the combined area of all semi-natural habitats. Combined with their known high species richness, gardens constitute a massive resource, even if its full potential has yet to be realised.

The urban environment is highly connected in England, as can be seen in the low resolution Countryside Information System plot below showing the percentage of built-up area per square kilometre.
The main urban areas are highly coherent, and the principal communication routes are mapped out by high density (darker) strips.

Built-up and gardens dataset from the Countryside Survey 2000 Land Cover Map (www.cis-web.org.uk)

[26] Source: Countryside Survey 2000
[27] Loram, A., Tratalos, J., Warren, P.H. & Gaston, K.J. 2007. Urban domestic gardens (X): the extent & structure of the resource in five cities**.** *Landscape Ecology 22*, 601-615

The pattern is maintained at the much more detailed individual kilometre-square level. This degree of connectivity makes gardens especially relevant as corridors and stepping stones that could facilitate the adaptation and migration of species under constraints of climate change, although this is an important research topic yet to be addressed.

Another thought to ponder is that the UK (especially England) already has nearly the highest population density in Europe:

	Population density /km²	Area km²	Population
Netherlands	393	41,526	16,622,900
England	389	130,410	50,762,900
Belgium	337	30,510	10,274,595
United Kingdom	244	244,820	60,587,000
Germany	233	357,021	82,217,800
Italy	192	301,230	59,715,625
Poland	124	312,685	38,625,478
France	111	547,030	63,601,002
Spain	88	504,782	45,061,270
Greece	81	131,940	11,306,813
Republic of Ireland	60	70,280	4,234,925
Norway	14	324,220	4,743,193
Russia	8	17,075,200	142,008,838

European Population density[28]

High populations are only manageable with high density urban settlements. What is more, the UK population is predicted to rise to 77 million by 2050, making it the largest (and for England) the densest population in western Europe[28]. Clearly the urban environment and its habitats, already huge in Britain, are set to increase. Can we say this of any other habitat type?

I feel strongly that:

- Urban habitat area is rising globally - especially in the UK[29] ***It isn't going to go away.***
- Yes! We MUST conserve what small areas of semi-natural habitat are left.
- But we MUST NOT ignore our biggest habitat - the urban habitat - its Gardens and Green Space (GAGS), and the massive volunteer army of rangers and habitat managers (ie gardeners) who can be helped to appreciate and encourage wildlife.

The challenges for the Wildlife Gardening Forum include:

- Protecting the present area and environmental quality of GAGS
- Understanding how to increase the biodiversity and conservation value of GAGS with the support of gardeners
- Helping GAGS support adjoining semi-natural habitats

[28] Population Reference Bureau June 2010

[29] Average increase across English Counties is 13.2% from 1991-2016. e-Digest of Environmental Statistics, 2003 see:www.defra.gov.uk/evidence/statistics/environment/land/download/xls/ldtb06.xls

- Building biodiversity into new development design using GAGS
- Putting GAGS central to climate-change policy as corridors and stepping stones
- And of course Preaching the Good News to everyone

The next few paragraphs might suggest some ways forward.

The native/exotic species debate will fizzle out when we have decent data so we can speak from a sound evidence base. Even so, we could already point to some native plants that are both genuinely "garden worthy" and very likely to contribute to conserving biodiversity. Dark mullein *Verbascum nigrum* is an admirable tall and stately yellow flowering plant. It is the food plant for the striped lychnis moth *Shargacucullia lychnitis*, a UK BAP species, and to the handsome mullein moth *Cucullia verbasci*[30]. Hemp agrimony *Eupatorium cannabinum* is a splendid pond side plant, and food for 10 moths[31], including the Nationally Scarce moths the scarce burnished brass *Diachrysia chryson*, Jersey tiger *Euplagia quadripunctaria* and Kent black arches *Meganola albula*. If your garden is within or close to the distribution of these rare species, planting hemp agrimony could be of genuine benefit. Rosebay willow herb *Epilobium angustifolium* is a handsome weed that will take over a neglected garden with its promiscuous seeding, so most gardeners remove it. If they could tolerate it at the back of a bed it would look good, and support the large elephant hawkmoth *Deilephila elpenor*, which is magnificent as a caterpillar as well as an adult.

On the other hand there are some popular garden exotics that ARE good foodplants as well as sources of nectar or pollen. Jennifer Owen found *Buddleia* was much the best food plant for larval moths in her garden, supporting 18 species, compared with only 12 species feeding on all the plants in the Rosacea[13]. The two next best species were also aliens. Unfortunately, Tim Crafer's valuable food plant list for British Lepidoptera[31] does not include many alien garden species; presumably for lack of published data (Crafer lists only three species using *Buddleia* for example). An extended study of the more popular garden exotics as foodplants could be immensely valuable. Of course Crafer lists nearly 170 polyphagous butterfly and moth species that eat almost anything, probably including many common exotics.

Can we change our rather bizarre attitude to lawns? The garden press is full of advertisements for products and services that guarantee a perfect, flawless (striped) green lawn, essentially by eliminating biodiversity. Such lawns burn up and look depressing in a half-way decent summer, and require a somewhat testosterone-driven approach to management.

My lawn at Besselsleigh, Oxfordshire, full of primrose, lady's smock and fairly well behaved dandelions.

[30] Thanks to Mark Parsons of Butterfly Conservation for these suggestions
[31] Crafer, T.2005. Foodplant list for the caterpillars of Britain's Butterflies and Larger Moths. Atropos publishing

Could we instead promote – if not the very difficult creation of "wildflower meadows" – at least the pleasures of diversifying the sward?

We have already seen how lawns intrinsically behave like grazed grasslands, and it takes relatively little effort to encourage species like clover, primroses and cowslips to spread, eventually providing a succession of flowers from early spring into summer, providing beauty as well enhanced biodiversity. When their seed has set, you can still mow the lawn and put a deckchair and gin-and-tonic on it.

Landlife[32] has shown us that municipal green areas do not need to stay as boring ryegrass swards fit only for emptying dogs, but can be enlivened with wildflower planting. The impact goes way beyond beauty or enhanced biodiversity, and increases community pride and wellbeing and reduces vandalism. This sort of thinking needs much wider use in urban land management

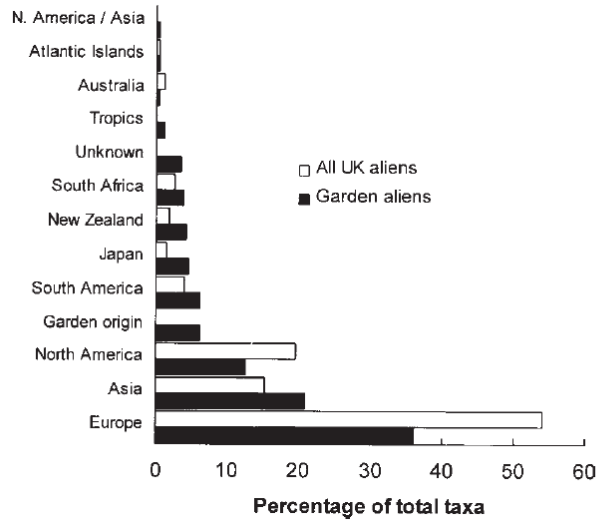
Another important opportunity lies in providing advice for planners and developers. Most developments have long straight roads with back-to back houses, tiny gardens and little in the way of communal green space. The plan opposite is of an affordable housing development by Devonshire Homes at Barnes Close Mead in Dulverton (in Exmoor National Park). Here tarmac is minimised, the houses cluster around the access, and their gardens adjoin communal greenspace *and allotments*, which in turn link through retained hedges to the meadows beyond. There is even a pond and reed bed as part of a sustainable urban drainage scheme.

The landscape approach described by Mark Goddard at this meeting will be needed to tackle the opportunities offered by garden connectivity for species migrating under climate change. In this context however, it is worth noting yet another of Jennifer Owen's findings. She examined the native range of the alien species in her garden, and found that of 214 alien species 91 (42.5%) were of European or near middle eastern origin.[13] The BUGS research in Sheffield recorded 289 alien plant species, of which over 35% were European, and over 55% from Europe and Asia[33]. These are precisely the plants which would become ecologically appropriate to this country if scenarios of rising temperature come to pass.

[32] www.wildflower.co.uk

[33] 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.

If the separation of the British Isles from the continent had been 2000 years later, giving more time for migration, many of the European garden aliens would probably now be regarded as natives. This reserve of potential replacement species already present in gardens could be seen as either a massive threat of alien invasion, or a fortuitous pre-adaptation to climate change. Either way, it is worthy of evaluation.



The origins of the 289 alien taxa recorded in 120 1-m²quadrats in 60 private gardens in Sheffield, UK, compared to origins of all UK alien taxa[33]

Another role of wildlife gardening in climate change may have a more direct human benefit. Urban green space, "Green" or "Brown" roofs and the more recent "Green Walls" offer effective energy saving climate control for overheating cities, as well as helping to improve rain run-off management.[34] While green infrastructure may be driven by human need, the potential benefits for urban wildlife could be very substantial. The best green roof studied in Basel supported 79 beetle and 40 spider species, 20 of which were Red Data Book rarities.[35]

So: my take-home messages are:

- The garden habitat is ancient, diverse, abundant, under-studied and has growing significance for conservation, communities and climate change. Be proud of it, and don't treat it as third-class for conservation.
- Our job in the Forum is to help people understand this and take long term action *Bringing Wildlife Closer to Home*
- BUT – hard-line conservationists – Please remember the dozens of functions gardens have for their owners and don't EVER try to tell real Gardeners that their gardens should be managed just for wildlife!!

Dr Steve Head is hibernating under a hedge at wlgf@stephenmhead.com, and describes his condition as "Very snug".

[34] Gill, S., Handley, J.F., Ennos, A.R. and Pauleit, S. (2007). Adapting cities for climate change: the role of the green infrastructure. Built Environment 33, 97-115.

[35] Brenneisen, S. 2006. Space for Urban Wildlife: Designing Green Roofs as Habitats in Switzerland Urban Habitats, 4:27-36

The National Launch of Jennifer Owen's book
"Wildlife of a Garden: A Thirty-Year Study"

Ken Thompson **Sheffield University.**

Jennifer Owen's "invention" of Garden Ecology

Dr Jennifer Owen is Wildlife Gardening's Godmother.

Here she is seen receiving the Royal Horticultural Society's Veitch medal, presented by their President Elizabeth Banks. The medal is awarded annually to "*persons of any nationality who have made an outstanding contribution to the advancement and improvement of the science and practice of horticulture"*

With her late husband Denis, Jennifer moved and studied around the world. While based in Sierra Leone, she noticed that her domestic garden had more wildlife in it than the surrounding rainforest. She realised that nobody knew what lived in gardens, and that up to then, nobody had cared enough to find out. Indeed Charles Elton, the Oxford based scientist sometimes termed "the Father of Animal Ecology", dismissed gardens as biological deserts.

Moving back to Leicester in the 1970s, Jenny Owen decided to do something about his omission. With enormous prescience, she did not set out to discover what she could get into her garden if she did X, Y or Z special wildlife-friendly things, she asked "If I go about gardening in a standard way like everyone else, what will I find?"

Here is a photo of part of Jenny Owen's "ordinary" suburban garden. It has a lawn (with clothes line) flower and vegetable beds, fruit trees and a greenhouse.

They say genius is 1% inspiration and 99% perspiration. On that basis Jenny Owen ***is*** a genius, having backed the inspiration with 30 years of careful ecological study, an achievement likely never to be exceeded or even equalled. She did not start with any preconceptions or prejudices – for example that alien plants would be useless. Instead she observed and caught everything that moved, and noted what it was doing and what it was eating. So she found that 9 of the top 15 plants for moth caterpillars were alien species.

Jennifer's garden was visited by a quarter of all insect species known in Britain. As she appreciated, this was not a random selection, but biased towards the commoner species, albeit with quite a few rarities. Her garden fauna tended to be the highly

adaptive, generalist and mobile part of our wildlife. Some conservationists use this to be sniffy about gardens, but they are very seriously mistaken.

Gardens ARE a valuable habitat in their own right, and nicely complement the more conventionally conserved semi-natural habitats where the rare specialists struggle on. To criticise gardens for not supporting rare chalk grassland species is as silly as criticising chalk grassland for not hosting ancient woodland species.

Let us hope that Jennifer's new book[36] will be widely read. It is certainly much more attractive and engaging than her rather academic (but extremely important for that very reason) previous book. It deserves to be read carefully, and to change people's attitudes. Gardens are incredibly important for British wildlife, and Jennifer Owen is the person who made this clear to us all.

Dr Ken Thompson tends a plot of biodiversity at ken.thompson@sheffield.ac.uk

Video of Jennifer Owen talking about her book.[37]

I first became interested in gardens when we lived in Africa over a total of 9 years, and we found that our garden in West Africa was richer in butterflies even than the surrounding rain forest, because the garden attracted not just the forest species, but the savannah species as well, so it was extraordinarily rich. When we came back to this country it was automatic to look at our newly acquired garden here in exactly the same way, and we very quickly found out that it was just as rich as our garden in Africa. Perhaps not as many species of butterfly of course, but still extremely rich. In 1972, when I started looking at the garden here, I honestly had no idea it would go on so long, but it became a sort of exponential process. The longer you go on, the more valuable the database becomes and the more you want to continue. And of course, over the years we have discovered a fantastic number of really interesting things.

Screenshot from Jennifer Owen's video recorded for the Conference in her Leicester home.

One of the groups that comes to mind as being particularly important, is the little ichneumonid parasitic wasps, of which 533 species were found in the space of three years. Now of course I couldn't identify these myself, and this tells you a story about the whole study, because it was dependent on the good will and cooperation of an expert on parasitic wasps who was able to identify them for me. Not only were there so many species, but some of them were new to science, so new species turned up in my very ordinary Leicester garden.

[36] Jennifer Owen 2010. Wildlife of a Garden: A Thirty Year Study Royal Horticultural Society
[37] Many thanks to Mike Grant of RHS Publications for making a copy of this video available to me to transcribe.

Another group I think is particularly interesting is one of the more familiar ones. I think everyone knows and recognises a hoverfly, but through Malaise trapping I identified 94 species of hoverfly in my garden, and some of them have been extraordinarily common in some years. I think the best years were in the 1970s when the malaise traps caught over 6,000 hoverflies in a year. A lot of them were very common species of course, but there were always the odd things that would turn up. Imagine my surprise when – I think it was in 1987 – an enormous banded black and yellow hoverfly was caught in the trap. It turned out to be a thing called *Sericomyia silentis*, which actually comes from the moorlands of the north of England and Scotland. What was it doing in my back garden? I shall never know, but it was certainly here.

I think the butterflies have been quite interesting too. Twenty three species in all have turned up in the garden, most of them the ordinary things like cabbage whites, peacocks and small tortoiseshells and so on, but sometimes there have been some very interesting and odd things. In the 1975 drought year, a silver-washed fritillary turned up in the garden. That was a real oddity, and I think it happened because in the drought year a lot of insects were running short of nectar and so were roaming far and wide away from the normal places they frequent. And another interesting thing about butterflies is that for years my late husband said "You wait, we will have speckled woods in the garden", and sure enough, the year he died, they turned up in the garden.

In the early years we tried to compile a list of garden birds, and my husband had a very good ear for birds flying overhead at night, so we were able enormously to augment the garden list by adding the things he heard at night. The garden bird list has really run down recently, because I don't think there are as many birds around as there used to be.

Over the years, I think that the frequency and numbers of insects has suffered an enormous decline from what I think of as the glory years of the 1970's, when the garden was just full of butterflies, hoverflies, bees, wasps and so on. Since then the numbers of most groups have dropped off very much indeed. The only two groups that continue to increase in number all through the thirty years of the garden study are the beetles and the solitary wasps, not the striped ones that plague picnics, but the ones that nest alone. These two groups have continued to rise in numbers throughout the study. But as I say, by and large there has been a decrease in numbers and decline in the insects that visit the garden.

I do think that gardens are immensely important for preserving our native wildlife in this country, because after all, more and more of the country is given over to gardens. I think most people nowadays are pretty friendly to the wildlife that share their gardens with them. So gardens can make an enormous contribution to the wildlife of the country, and I think the outlook is probably good on the whole.