

Institution: Coventry University (CU)		
Unit of Assessment: 14		
Title of case study: Supporting native biodiversity through garden-based citizen science		
Period when the underpinning research was undertaken: 2013-2020		
Details of staff conducting the underpinning research from the submitting unit:		
Name(s):	Role(s) (e.g. job title):	Period(s) employed by submitting HEI:
Katharina Dehnen-Schmutz	Associate Professor	2014-Present
Gemma Foster	Research Assistant	2013-Present
Judith Conroy	Research Assistant	2016-Present
James Bennett	Associate Professor	2008-Present
Tim Sparks	Professor in Environmental Change	2011-18
Barbara Smith	Associate Professor	2015-present
Period when the claimed impact occurred: August 2013-Dec 2020		
Is this case study continued from a case study submitted in 2014? N		

1. Summary of the impact (indicative maximum 100 words)

Biodiversity decline requires action from governments and citizens alike. Research at Coventry University (CU) has focused on two important aspects of UK biodiversity: the plight of bumblebees which have undergone drastic declines over the past eighty years; and the risk posed to native biodiversity by invasive garden plants. Through an innovative combination of digital technology and citizen science, CU's research resulted in three key impacts. First, it led to increased awareness and people changing their gardening behaviour to improve habitats for bumblebees and to better manage the spread of invasive garden plants; second, it enabled wildlife and gardening charities to improve their advice to people and organisations concerning behaviours to support biodiversity; third, it contributed to the Government's Non-native Invasive Species Strategy and provided data to support management of invasive plants by non-governmental organisations.

2. Underpinning research (indicative maximum 500 words)

Two key strands of research have identified ways to support the UK's native biodiversity:

Planting for Bumblebees

Bumblebees are important insects, contributing to agricultural pollination worth c.£650m annually in the UK. Unfortunately, bumblebee populations continue to decline, due to the loss of 97% of the UK's wildflower meadowland since 1930. Allotments and gardens are increasingly important habitats for bumblebees and cover over one million acres of land in the UK, but little is known about which species use these spaces, or which flowering plants are the most important sources of nectar and pollen.

Research led by Foster [R1, internal funding, 2013-14] was the first to provide evidence on bumblebee foraging preferences in UK allotments and gardens cultivated for food, establishing the importance of including floral resources within these spaces. The approach was expanded in the following 'Blooms for Bees' project (G1), a collaboration with the Royal Horticultural Society, Bumblebee Conservation Trust and Garden Organic. This was the first to use an app to engage

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UK gardeners in timed-count surveys specifically to explore bumblebee floral preferences. Over 7,000 members of the public downloaded the app, submitting over 2,500 plant surveys and 5,000 bumblebee records, verified by one of the UK's leading bee experts, Steven Falk. This verification process guaranteed the high quality of the data and generated recommendations to improve the accuracy of future citizen science and pollinator monitoring projects [R2].

Data collected revealed the importance of gardens for supporting a wide range of bumblebee populations, including rarer species marked as conservation priorities under the UK Biodiversity Action Plan. The results generated recommendations for bee-friendly planting, including alternative bedding plant options. This is especially important as most commercial bedding plants are bred for appearance, holding limited value for insects.

Gardeners Preventing Plant Invasions

In 2010 it was estimated that problems caused by invasive species cost the British economy £1.7 billion annually, and the 2020 assessment of UK biodiversity indicators found that the pressure from invasive species continues to increase. Of the total number of species in the British flora, 2500 non-native plants now outnumber native species and almost half (1195) are horticultural introductions escaped from gardens. In 2014 Dehnen-Schmutz participated in a national horizon-scanning exercise to identify and rank alien invasive species, and this recommended that plants grown in gardens should be included in future assessments (R3). A key challenge is that whilst the invasion process of these plants starts in gardens, it is unfeasible to perform assessments on all 70,000 plant taxa cultivated in UK gardens. To address this problem, Dehnen-Schmutz pilot-tested the globally first citizen science study demonstrating that gardeners could be involved directly and given the skills to identify and report potentially invasive ornamental plants [R4, internal funding, 2015]. She also organised an expert workshop within the programme of the COST Action Framework 'ALIEN Challenge: European Information System for Alien Species'. The research evaluated the effectiveness of policies to prevent future plant invasions from ornamental horticulture, the main source of harmful invasive plants in the UK and globally [R5, R6].

Based on her research, Dehnen-Schmutz recommended the implementation of a permanently available tool Plant Alert (www.plantalert.org), allowing gardeners to submit records of invasive plants. This was adopted and is now maintained by the Botanical Society of Britain and Ireland, enabling gardeners to monitor new and emerging invasive ornamentals efficiently and helping respond to the expectation that climate change will heighten the naturalisation potential of many widely-planted ornamental plants in the future [R5]. Launched in 2019, Plant Alert received 480 records by the end of 2020, in addition to the 201 received in the pilot study.

3. References to the research (indicative maximum of six references)

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- R1. Foster, G., Bennett, J., & Sparks, T. (2017) An assessment of bumblebee (*Bombus* spp) land use and floral preference in UK gardens and allotments cultivated for food. *Urban Ecosystems* 20:425–434. DOI: <https://doi.org/10.1007/s11252-016-0604-7>
- R2. Falk, S., Foster, G., Comont, R., Conroy, J., Bostock, H., Salisbury, A., Kilbey, D., Bennett, J. and Smith, B. (2019) Evaluating the ability of citizen scientists to identify bumblebee (*Bombus*) species. *PloS One*, 14(6). DOI: <https://doi.org/10.1371/journal.pone.0218614>
- R3. Roy, H.E., Peyton, J., Aldridge, D.C., Bantock, T., Blackburn, T.M., Britton, R., Clark, P., Cook, E., Dehnen-Schmutz, K., et al. (2014) Horizon scanning for invasive alien species with the potential to threaten biodiversity in Great Britain. *Global Change Biology*, 20(12): 3859-3871. DOI: <https://doi.org/10.1111/gcb.12603>
- R4. Dehnen-Schmutz K. & Conroy, J. (2018) Working with gardeners to identify potential invasive ornamental garden plants - testing a citizen science approach. *Biological Invasions* 20: 3069–3077. DOI: <https://doi.org/10.1007/s10530-018-1759-3>

R5. Hulme, P., Brundu, G., Carboni, M., Dehnen-Schmutz, K. et al (2017): Integrating invasive species policies across ornamental horticulture supply-chains to prevent plant invasions. *Journal of Applied Ecology* 55: 92-98. DOI: <https://doi.org/10.1111/1365-2664.12953>

R6. van Kleunen M., Essl F., Pergl J., et al., Dehnen-Schmutz K. (2018): The changing role of ornamental horticulture in alien plant invasions. *Biological Reviews* 93: 1421-1437, DOI: <https://doi.org/10.1111/brv.12402>

G1: Foster, G. (PI), Conroy, J., Bennett, J., Smith, B., (2016-18). Blooms for Bees – a citizen science project to promote and improve gardening for bumblebees. Heritage Lottery Fund. Total grant: £99,700.

4. Details of the impact (indicative maximum 750 words)

CU's research has led to 1) increased awareness and people changing their gardening behaviour to support biodiversity; 2) wildlife and gardening charities improving the advice they give to people; 3) non-governmental organisations and UK Government integrating the results and tools developed into national strategies for biodiversity protection.

1. Supporting Biodiverse Gardening

Blooms for Bees (BfB) trained several thousand members of the public, particularly through the project's monitoring app. The innovative nature of the technology was key to its impact. Noted by the Principal Scientist of the Royal Horticultural Society (RHS), "[P]artnering on the Blooms for Bees project has demonstrated the potential of smartphone technology in combination with citizen science to deliver useful data on pollinator and plant relationships" (S1). Recorders' bumblebee identification accuracy improved from 24% for their first identification, to 44% by the tenth submission upwards (S2).

Over 2,600 households from across the UK requested bee-friendly plants and seeds, providing additional forage for bumblebees in 2017. 141 participants responded to the end of project questionnaire; the majority stated they had taken new actions to support bumblebees, either growing more bee-friendly flowers, improving nesting habitats, or eliminating use of chemicals (S2).

The Department for Environment, Food and Rural Affairs (Defra) recognised the contribution that BfB made to raising public awareness, awarding the project a 'Bees' Needs Champions Award' for exemplary initiatives which support pollinators (S3). Findings were reported widely in the press (S4) and gardening presenter/journalist Kate Bradbury dedicated several pages to BfB in a gardening manual she authored, drawing on CU evidence to give guidance on pollinator-friendly planting (S5).

Similarly, Plant Alert raised awareness about invasive ornamental plants through national press, TV and radio (S4). The approach also received international interest: in the European and Mediterranean Plant Protection Organisation Newsletter, in a newsletter for Dutch professional gardeners/landscape planners, and as a best practice example in a Spanish guide on citizen science (S6). The head of Defra's Protected and Invasive Non-Native Species Team acknowledged that "Plant Alert provides a key role in raising awareness amongst gardeners of the potential harm associated with some non-native plants, and the need to garden, contain and dispose of them responsibly" (S7).

2. Advice and Advocacy

The RHS (500,000 members) and Bumblebee Conservation Trust (BBCT, 7,000 members) used results of BfB to strengthen their advice on planting to encourage biodiversity (S1, S8). The RHS used the results in their annual (2019) review of their Plants for Pollinators list, accessed online

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by 70,000 people each year and confirmed that “a number of recommendations and decisions were taken as a result of the Blooms for Bees trials” (S1). The BBCT used the results to ‘reinforce’ their planting advice: “we are now able to say that in nationwide research we’ve been involved with, species ‘x’ came out as good, rather than having to rely on second-hand information from others. One thing that has come entirely from the Blooms work is that we now mention dahlias as a good bedding-plant option” (S8). The BBCT is also updating its Bee Kind tool which recommends bee-friendly plants to gardeners, schools, businesses and local authorities by “updating the scoring algorithm to incorporate some of the findings from the Blooms analysis” (S8).

Through BBCT, the project’s bumblebee records are shared with the National Biodiversity Network, the UK’s largest partnership for nature, meaning that data is accessible for the long-term. Due to the data’s high-quality, which is “of known provenance and verified reliably” (S8), it is also accepted by the Bees, Wasps and Ant Reporting Society, contributing to the mapping and monitoring of changes in bumblebee populations.

3. Supporting National Biodiversity Strategies

Plant Alert directly supports the prevention and management of invasive ornamental plant species, as recommended by R3. Defra’s 2019 non-native species Horizon Scanning exercise, which Dehnen-Schmutz contributed to, included horticultural plants present in gardens for the first time. Defra recognise this as “an area for concern” where there are “significant gaps in our knowledge of those plants in gardens which may be becoming invasive” (S7). For example, new species have been recommended for risk assessments such as chocolate vine (*Akebia quinata*), shortlisted in the Horizon Scanning 2019 and commissioned in November 2020.

The permanent addition of Plant Alert to recording efforts in Britain and Ireland is key to its impact: the Botanical Society of Britain and Ireland’s (BSBI) Head of Science, commented that many citizen science projects are “time-limited due to project funding and the data collected are often only available to the researchers involved in the projects” (S9). In contrast, records received through Plant Alert are integrated into BSBI’s database and accessible to other researchers and specialist users, whilst the maps are publicly available. Moreover, “Plant Alert is our first specifically designed recording scheme to include records of ornamental plants in gardens. This is important evidence as most non-natives in Britain and Ireland start as ornamentals in gardens and subsequently spread into surrounding habitats, with some having serious impacts on native biodiversity” (S9).

Because Plant Alert is integrated into the BSBI database, the data is available to the GB Non-native Species Information Portal, “which is a key tool within the GB Non-native Invasive Species mechanism and essential to our understanding of trends and spread in NNS [Non-native Species] and our reporting under the EU Invasive Alien Species Regulation” (S7). BSBI confirmed that “reports received through Plant Alert have already informed the decision process” (S9). Plant Alert contributes to key actions of the GB Non-native Invasive Species Strategy (Defra 2015), including Action 3.6 (adopt and implement a clear process for regular horizon scanning of emerging threats, involving a broad range of stakeholders) and Action 4.3 (continue to work with existing recording networks and citizen science initiatives to improve surveillance for non-native species). Plant Alert is web-linked to the national “Be Plant Wise” campaign, recommended by the RHS as one of ‘7 Actions by Gardeners’ and included in Aberdeenshire Council’s ‘North East Non-Native Species’ advice on invasive plant management (S10).

5. Sources to corroborate the impact (indicative maximum of 10 references)

S1. Testimonial. Principal Scientist (Entomology), RHS.

S2. Foster, G. and Conroy, J. (2019) Blooms for Bees – Evaluation Report. Coventry: Centre for Agroecology, Water and Resilience, Coventry University. Available online at

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http://www.bloomsforbees.co.uk/wp-content/uploads/BloomsForBees_EvaluationReport_FinalJuly2019.pdf [Accessed 19.03.21].

S3. 'Bees Needs Champions Award, 2017', Department for Environment, Food and Rural Affairs; letter, Parliamentary Under Secretary of State for Rural Affairs and Biosecurity.

S4. Combined PDF. Illustrative examples of press coverage list for Blooms for Bees and Plant Alert.

S5. Extract, Kate Bradbury. Wildlife Gardening: For Everyone and Everything. Bloomsbury, 2019. Pp. 37-38. (Scanned pages)

S6. Combined PDF. International coverage of Plant Alert.

S7. Testimonial. Head of Protected and Invasive Non-Native Species Team, Department for Environment, Food and Rural Affairs.

S8. Testimonial. Science Manager, Bumblebee Conservation Trust.

S9. Testimonial. Botanical Society of Britain and Ireland, Head of Science.

S10. Examples of webpages and advice linking to Plant Alert