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| <b>Institution:</b> The University of Edinburgh   |  |  |
| <b>Unit of Assessment:</b> UoA 5 Biological Sciences  |  |  |
| <b>Title of case study:</b> Understanding of pollinator resources and hotspots leads to Council policy changes and increased biodiversity in urban areas  |  |  |
| <b>Period when the underpinning research was undertaken:</b> 2011-2020  |  |  |
| <b>Details of staff conducting the underpinning research from the submitting unit:</b>  |  |  |
| <b>Name(s):</b>   | <b>Role(s) (e.g. job title):</b>           | <b>Period(s) employed by submitting HEI:</b> |
| Professor Graham Stone<br>Dr Damien Hicks   | Professor of Ecology<br>Research associate | 1998 - present<br>02/2014 – 05/2016          |
| <b>Period when the claimed impact occurred:</b> 2013-2020   |  |  |
| <b>Is this case study continued from a case study submitted in 2014?</b> Y/N NO   |  |  |
| <p><b>1. Summary of the impact</b></p> <p><b>Attribution:</b> Research at the University of Edinburgh on the importance and significance of urban pollinators has resulted in a greater understanding of their significance with policy changes implemented to increase urban meadow spaces and the generation of a seed mix specifically designed to attract urban pollinator species.</p> <p><b>Impact on environment:</b> Increased pollinator numbers and species richness in urban Edinburgh.</p> <p><b>Impact on society:</b> Increased awareness of the importance of pollinators and of actions by the public and landowners that can support them.</p> <p><b>Impact on policy and strategy:</b> i) Publication of a "Pollinator Strategy for Scotland", towards fulfilment of Aichi targets; ii) Use of Edinburgh parks as an example in Europe-wide policy meetings contributing to national (UK) and European Commission (EU Pollinators Initiative) strategies for enhancement of urban greenspace biodiversity and international (policy - IPBES), France, the Netherlands, and Brazil; iii) Cost savings to Edinburgh Council from relaxing mowing to allow wildflowers to grow; iv) Positive public feedback and enhancement of greenspace biodiversity by planting wildflower meadows.</p> <p><b>Impact on commerce:</b> Collaboration with Scotia Seeds to launch a new urban wild flower native seed mix.</p> <p><b>Beneficiaries:</b> Public, pollinators, green-space managers, environment.</p> <p><b>Significance and Reach:</b> Understanding pollinator resources and hotspots is crucial to maintain current and promote new urban biodiversity. This impact has been local (Scotland), national (UK) and international (policy - IPBES), France, the Netherlands, and Brazil.</p> |  |  |
| <p><b>2. Underpinning research</b></p> <p>Pollinating insects are essential for the reproduction of many plants and contribute over GBP500,000,000 annually by pollinating UK crops. The plants and wildlife, supported directly and indirectly through pollinators, provide other ecosystem services, and a healthy pollinator population is essential to maintain ecosystem function. Some pollinating insects, particularly wild bees, have shown dramatic population declines in many parts of the world in response to emerging diseases, pesticide use, and loss of natural habitats to agriculture and urbanisation. The GBP10,000,000 BBSRC/Wellcome Insect Pollinators Initiative (2011-2015) funded 9 projects that together aimed to better understand the complex biological and environmental factors that affect the health, abundance and diversity of insect pollinators. The GBP1,200,000 project 'Urban pollinators: ecology and conservation' aimed to answer three questions: <b>1)</b> How is UK pollinator biodiversity distributed across urban, farmland and nature reserve habitats? <b>2)</b> Which habitats are pollinator hot-spots in cities? and, <b>3)</b> How can urban habitats be improved for pollinators? This was a four-centre project between Memmott (Bristol), Stone (Edinburgh), Kunin (Leeds) and Potts (Reading): the first study of its kind in the world.</p>   |  |  |

The project was important in showing **(a)** that differences between these three habitat types vary among pollinator groups. For example, relative to agricultural habitats, cities harbour more bee species, but lower abundance of hoverflies [3.1]; **(b)** That some urban habitats (particularly flower-rich domestic gardens and allotments) are much better for pollinators than others [3.2]; and **(c)** That planting of urban wildflower meadows substantially enhances the nectar and pollen available to urban pollinators [3.1]. This was the first study to use quantification of nectar and pollen on a meadow scale to understand their ability to provide food resources to pollinators. The research showed that most nectar and pollen is contributed by a small subset of species that changes through the season, and that some species contribute very little. It also showed that native weeds, e.g. dandelions, contribute significantly to meadow resources in early spring [3.3]. The Stone group used these results to show that that simple city-wide interventions, such as allowing four common and nectar-rich weed species to grow by mowing less often, can significantly enhance urban pollinator abundance and resilience to species loss [3.2]. These findings are important because - at a time when urban areas are expanding and natural habitats are contracting worldwide - they identify simple interventions that could increase the diversity and abundance of urban pollinator populations.

The research on floral resources [3.3] led to follow-on NERC impact acceleration funding that developed a native urban wildflower mix designed to provide nectar and pollen throughout the season and so attract and support pollinators. Scotia Seeds now market this mix commercially.

### 3. References to the research

[3.1] Baldock, KCR, Goddard, MA, Hicks, DM, Kunin, WE, Mitschunas, N, Osgathorpe, LM, Potts, SG, Robertson, KM, Scott, AV, Stone, GN, Vaughan, IP & Memmott, J. (2015). Where is the UK's pollinator biodiversity? The importance of urban areas for flower-visiting insects. *Proceedings of the Royal Society B-Biological Sciences*, vol. 282, no. 1803, 20142849. <https://doi.org/10.1098/rspb.2014.2849>

[3.2] Baldock, KCR, Goddard, MA, Hicks, DM, Kunin, WE, Mitschunas, N, Morse, H, Osgathorpe, LM, Potts, SG, Robertson, KM, Scott, AV, Staniczenko, PPA, Stone, G, Vaughan, IP & Memmott, J. (2019). A systems approach reveals urban pollinator hotspots and conservation opportunities. *Nature Ecology & Evolution*. <https://doi.org/10.1038/s41559-018-0769-y>.

[3.3] Hicks, DM, Ouvrard, P, Baldock, KCR, Baude, M, Goddard, MA, Kunin, WE, Mitschunas, N, Memmott, J, Morse, H, Nikolitsi, M, Osgathorpe, LM, Potts, SG, Robertson, KM, Scott, AV, Sinclair, F, Westbury, DB & Stone, GN. (2016). Food for Pollinators: Quantifying the Nectar and Pollen Resources of Urban Flower Meadows. *PLoS ONE*, vol. 11, no. 6, e0158117 <https://doi.org/10.1371/journal.pone.0158117>

### 4. Details of the impact

**Impact on environment:** The UK National Ecosystem Assessment estimated the production value of insect pollination in the UK to be GBP500,000,000 per annum based on the economic value of the crops produced (2014). This economic benefit comes from commercial and wild pollination.

In Edinburgh, as of Oct 1<sup>st</sup> 2020, there are now 78 wildflower meadows (68 annual meadows and 10 perennial meadows) in Edinburgh parkland. 2019 – 2020 saw the creation and enhancement of pollinator habitat on Edinburgh's coastline; eight 500m<sup>2</sup> wildflower meadows across a 2.5km stretch of coastline link up existing pollinator-rich habitat already created by City of Edinburgh Council (CEC) [5.1 & 5.2]. This comes as a result of funding from the National Lottery Heritage Fund. **The Edinburgh Shoreline** project is a joint venture between Professor Stone, The Royal Botanic Gardens Edinburgh, CEC and Scotia Seeds and fall under the **Edinburgh Living Landscape** (ELL) initiative.

*“Edinburgh Living Landscape was initiated by the Scottish Wildlife Trust. SWT has a number of Living Landscape programs and it tries to bring together the main players to influence, at all levels, what is happening on the ground. In Edinburgh, they prepared a strategy which – crucially - was endorsed by the City of Edinburgh Council and by a number of other partners including RBGE and Edinburgh University” [5.3].*

**Impact on society:** The research identified ideal city habitats and how others could be improved by increasing the diversity of plants or changing the intensity of mowing to allow native plants to grow. The research influenced the CEC and other grassroots organisations to take a major step forward for nature conservation in Edinburgh. Discovering where pollinator hotspots are located resulted in CEC focussing efforts in these areas to make them as biodiversity-friendly as possible.

ELL is a project managed by the Scottish Wildlife Trust that ensures nature is integrated into urban neighbourhoods across Edinburgh. ELL is a partnership of CEC, University of Edinburgh (Stone), Royal Botanic Garden Edinburgh (RBGE) and Edinburgh and Lothian Greenspace Trust.

**Impact on policy and strategy:**

i) The CEC ethos is that everything the council does is for the good of the residents of Edinburgh. CEC [5.1], Head of Parks, Greenspace & Cemeteries (PG&C):

*“I am aware of strong links and benefits between green spaces in urban areas and the health and well-being of local residents. The recent lockdown due to the global pandemic perhaps highlighted this more than ever. I saw the enormous value of Graham Stone’s work and knew that his research would help to not only influence policy changes within the council but would help to highlight the benefits of urban greenspaces to Edinburgh residents.”*

As a result, CEC sought to incorporate increased biodiversity measures within the city using the research’s positive findings to win over councillors and public alike. The PG&C department took a general message of awareness of pollinators and made it specific to Edinburgh. It was particularly relevant to decision makers (councillors) and residents and an opinion change happened within the REF impact period. Over the time-period, opinion changed with the research giving the council evidence to go forward with a new policy on biodiversity measures in Edinburgh [5.1].

*“opinions do not change overnight but I have noticed a shift change, over the past 5 years, in both public perception and council attitudes to this”.*

In 2020, the head of PG&C stated that residents are now aware of the positive aspects of the CEC measures and actively want wildflower meadows in their area. They are also aware of the value that e.g. dandelions have on pollinator numbers in areas of relaxed mowing [5.1].

**CEC POLICY:** The head of PG&C policy proposals were put before the CEC Planning committee which resulted in a CEC policy changes that included:

- Specific policy banning the use of herbicides in parks to kill weeds. (Note that the only exception to this is for ground preparation for planting wildflower meadow).
- Allotment policy amended to allow beekeeping.
- In 2017, the CEC adopted the Landscape Quality Standards guidance by incorporating “Low maintenance grass” to improve biodiversity.
- Investment on creation and maintenance of wildflower meadows
- Relaxed mowing to grass verges and parkland

As well as establishing wildflower meadows as part of the CEC’s Living Landscape programme (introduced in 2014), CEC have also introduced a relaxed mowing policy. This is a reduction in the number of cuts to grass per season. New thinking around grassland

management was one policy change that was introduced by CEC which contributed to the Living Landscape programme in order to promote biodiversity in the city. In 2015, approximately 4% of council standard amenity grass (SAG), road verges and parklands were mowed every two weeks over the growing season. This changed to once per season and by 2016, 13% of SAG had been transformed into naturalised grasslands, equating to around 104 hectares. This policy change also resulted in cost savings relating to maintenance of SAG in comparison to the lower maintenance requirements of naturalised grasslands; GBP200,000, taking into account investment in machinery to maintain naturalised grasslands [5.2]. CEC used the UoE research to grow awareness of the benefit of allowing grass to grow on road verges and in parkland to attract and sustain pollinators in the urban environment. The research showed that dandelions and weeds are excellent nectar sources for pollinators.

ii) In 2015, the Scottish Government set out a Biodiversity Route Map [5.4], which detailed priority work needed to meet the Aichi Targets for biodiversity and improve the state of nature in Scotland. In this route map, they set out to publish and implement a Pollinator Strategy for Scotland [5.5i], which was launched in 2017 by the Scottish Government in collaboration with Scottish Natural Heritage. The aim was to understand the causes of pollinator decline and work towards its reversal. Stone's research on urban pollinators [3.1] and coastal meadows and his involvement with Edinburgh Living Landscapes is quoted in the 2019 Pollinator Strategy progress report [5.5ii] and is further referenced in a DEFRA report [5.5iii] [3.2 & 3.3].

iii) Stone's research on urban pollinators [3.1] was cited in two chapters of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services' (IPBES) 2016 report on "Pollinators, Pollution and Food Production" [5.6]. The Director of the Centre for Agri-Environmental Research highlights the significance of these documents:

*"This publication was the first to directly compare the abundance and species richness of pollinators in urban, agricultural and nature reserve habitats" [5.7].*

This report was formally endorsed at the 13<sup>th</sup> meeting of the United Nations Environment Program (UNEP) for the Convention on Biological Diversity [5.8] and has influenced strategies in numerous countries including UK (DEFRA), France, the Netherlands, and Brazil [5.9i-iv].

In February 2016, IPBES released their report on "Pollinators, Pollination and Food Production", as an evidence base and strategic response to decline of pollinator populations. Stone's 2015 publication "Where is the UK's pollinator biodiversity? The importance of urban areas for flower visiting insects" was cited in evidence for two sections of the report. [5.8]

iv) Two European commission reviews published in 2020 reference Stone's research [3.1 & 3.2]. The first, "A guide for pollinator friendly cities" [5.10] provides an action plan for decision makers, policy makers and land use practitioners. Stone's research emphasises the importance of urban areas and the pollinators they support. The second, "Future Brief: Pollinators: importance for nature and well-being, drivers of decline and the need for monitoring", stressed the positive impact of garden and allotment spaces on various species of pollinators. The document examined the importance of pollinators for food production and nature with respect to pollination of both crops and wild plants. It also examined reasons of pollinator decline and the importance of monitoring these in order to reverse it [5.11].

Other Scottish councils are taking similar approaches to urban greenspace management: The Scottish Borders Council published a Biodiversity Duty Delivery Report, which refers to the Scottish biodiversity route map. Dundee council has implemented a reduced grass cutting policy and refer to the Pollinator Strategy for Scotland in their Biodiversity Action Plan.

**Impact on commerce:** CEC have invested GBP80,000-90,000 in the establishment of wildflower meadows in the city that, considering there was an austerity budget in place, is substantial. The resource implications for people, machinery and time dedicated to the intensive ground preparation involved in creating a wildflower meadow is non-trivial. In 2011,



there were few wildflower meadows; between 2014–2016, one tenth of Edinburgh’s parkland was turned into wildflower meadows, requiring one single cut in Autumn compared to the sixteen cuts over Spring and Summer previously. The cost savings to Edinburgh City Council is in the GBP100,000s [5.1 & 5.2]. CEC head of PG&C approved the Scotia seed’s urban pollinator mix that was developed directly from the research for an increasing number of wildflower meadows in Edinburgh. He approved the direct costs of creating and maintaining a number of wildflower meadows at a cost of approximately GBP80,000-90,000 per annum [5.1]. Prior to the Edinburgh research, the nectar and pollen resource of seed mixes and how it changes over the season was unknown. Stone won a NERC Impact grant to translate the research [3.2] with Scotia Seeds, producers of Scottish wildflower seeds. Together they devised a new seed mix that would provide nectar and pollen throughout the season and so attract and support pollinators [5.12]. The resultant Urban Pollinator seed mix contains 22 wildflower and 6 grass species, including annual, biennial and perennial seeds. The mix produces flowers from early spring to late summer along with grasses to provide the best food for pollinators throughout the season; thus helping to create a permanent community of attractive pollen and nectar producing plants. This provides breeding grounds for insects e.g. butterflies that lay their eggs on grass and also attracts and sustains pollinators like bees and hoverflies. Scotia Seeds Urban Pollinator mix retails at GBP12.96 for 100g: GBP82.80 for 1kg and was trialled successfully in Edinburgh. Scotia Seeds confirmed that the seed mix is sold throughout Scotland to local authorities, community groups and hundreds of gardeners. Key highlights from the development of the urban and coastal seed mixes:

- 20kg of urban pollinator mix sold in 2017, increasing to 100kg annually in 2018 & 2019.
- value to the company over the REF impact period has been GBP15,000.
- a coastal seed mix has been developed and produced for cultivation of coastal wildflower meadows along the Forth shoreline.
- purchase of the coastal seed mix by CEC was GBP1,300 (supplemented with 2kg of Yellow Rattle (GBP450) and additional plants to the value of GBP500 [5.10].
- Fife Council also endorse the wildflower mixes developed by Scotia Seeds in their Biodiversity Starter Pack.

#### 5. Sources to corroborate the impact

[5.1] CEC testimonial. Parks and Greenspace Manager, Parks, Greenspace & Cemeteries, City of Edinburgh Council.

[5.2] City of Edinburgh Council data email.

[5.3] Testimonial, Urban Biodiversity Project Officer (Edinburgh Shoreline & ELL).

[5.4] Scotland’s biodiversity: a route map to 2020-pg 24-PDF.

[5.5] i) Pollinator Strategy for Scotland-PDF, ii) Pollinator Strategy for Scotland: 2019 Progress Report. pg 13-14-PDF [https://www.nature.scot/sites/default/files/2020-02/Pollinator%20Strategy%20for%20Scotland%20-%202019%20Progress%20Report\\_0.pdf](https://www.nature.scot/sites/default/files/2020-02/Pollinator%20Strategy%20for%20Scotland%20-%202019%20Progress%20Report_0.pdf) and iii) National Pollinator Strategy-evidence statements pg 65, 68, 89.

[5.6] IPBES Assessment Report-Pollinators, Pollination and Food Production- pg 51, 111, 408 & 442- PDF

[5.7] Testimonial, Professor of Biodiversity and Ecosystem Services, University of Reading.

[5.8] 13<sup>th</sup> meeting of the United Nations Environment Program (UNEP) for the Convention on Biological Diversity (agenda item 17) –PDF <https://www.cbd.int/doc/decisions/cop-13/cop-13-dec-15-en.pdf>

[5.9] Influenced national strategies (PDFs): i) DEFRA, ii) Europe, iii) Brazil, iv) EC.

[5.10] A guide for pollinator-friendly cities. pg 9 & 42

[5.11] Future Brief: Pollinators: importance for nature and well-being, drivers of decline and the need for monitoring. pg 36, 40, 41 & 58- PDF.

[5.12] Testimonial, Managing Director, Scotia seeds.