

Proposal for E³ PhD studentship (Deadline 4 pm, Friday 14 October 2016)

1. Project title

The Gardener's dilemma: how should we manage urban green spaces to best benefit plants, pollinators, and people?

2. Supervisors with affiliations

Dr Matt Bell and Prof. Graham Stone, Institute of Evolutionary Biology, University of Edinburgh.

3. CASE partnership with Scottish Wildlife Trust

4. Primary supervisor contact email Matt.Bell@ed.ac.uk

5. Project background – Urban landscapes make up 9% of the UK, and are growing throughout the World. Initiatives that enhance urban landscapes for wildlife will thus play an increasingly important role in supporting biodiversity. Recent work in the UK has shown that urban spaces can support high abundances of flowers and associated insects (Baldock et al. 2015), raising the possibility that, with suitable management, cities could become net exporters of pollinators to surrounding countryside and farmland. A key question is how to use available land and financial resources to best enhance urban green spaces such as parks, road verges and gardens for people, pollinators, and other wildlife. This project will explore the relationship between management cost, biodiversity value, and public perception of alternative green space management strategies in Scottish cities.

A key question for green space managers is how to allocate financial and human resources to management of areas under their control. Should they invest in expensive management strategies that can only ever be applied to a small proportion of available space, or apply cheaper alternatives to larger areas? The answer to this question depends on the balance between costs per unit area and the benefits to people and wildlife of alternative management strategies – which are currently little known. This project will identify these relationships. The student will work closely with city councils to quantify the costs associated with different management strategies, and use a range of survey techniques to quantify the relative benefits of these strategies for people and wildlife. The approach will combine collection of data for common green space types with experiments involving management treatments of known and differing costs –including the planting of wildflower meadows (Hicks et al. 2016). The resulting datasets will be used to model the consequences for biodiversity and public perception of alternative strategies for a given budget.

The management strategies compared will incorporate variation in set-up costs (ground preparation, costs of alternate seed mixes), intensity of management (mowing, weeding, litter collection), aesthetics (flower colour) and conservation significance (planting of native *versus* non-native plants). Biodiversity benefits will be quantified by surveys of plants, pollinators and birds. Public perception of alternative management types will be assessed using appropriately designed surveys.

This project will build on the excellent working relationship established between Edinburgh University, Edinburgh City Council, and the Scottish Wildlife Trust over five years of work on urban pollinators. The aim will be to generate results of lasting benefit and direct use to green space managers, planners and developers.

6. Key research questions

- a. What is the relationship between the management cost of urban green spaces and the benefits for people and wildlife?
- b. What is the best way to use a given budget to improve urban habitats for people and wildlife?
- c. Which aspects of Green space management for biodiversity matter most to people?

7. Methodology, including a timetable for the programme of research

Timetable: **Year 1:** Development of core skills in statistics and experimental design. Identification of green space management strategies to be compared, through liaison with the Edinburgh City Green space team. Implementation of management treatments in plots across Edinburgh. Transect-based sampling of plants and pollinators. **Year 2.** Analysis of data from year 1. Establishment of management treatments for year 2. Collection of data on bird use of plots, and collection of questionnaire-based data on human perception of alternative management strategies. **Year 3.** Analysis of data from year 2. Development of models exploring biodiversity and human perception outcomes of using alternative Greenspace management strategies, and of differing levels of investment. At the start of the year, the supervision team will develop a thesis completion timetable, with frequent deliverable time points to develop time management skills. We will encourage the student to submit a publication during Year 3 to focus development on key analytical and writing skills. **Year 4.** We aim for the thesis to be submitted by 6 months into year 4.

8. Training: A comprehensive training programme will be provided comprising both specialist scientific training and generic transferable and professional skills. This project will provide training in experimental design, data management, statistical methods for handling, analysing and interpreting large datasets, taxonomy & systematics, fieldwork, and questionnaire-based analysis of human perceptions. The student will also receive valuable experience in working closely with the green space managers who would apply the results of this research.

9. Requirements – We seek a candidate with strong interests in conservation biology, strong quantitative, analytical and interpersonal skills, and interest in fieldwork.

10. Further reading or any references referred to in the proposal

These papers can be obtained on-line or by emailing Graham Stone (graham.stone@ed.ac.uk).

Baldock KCR et al. (2015) Where is the UK's pollinator biodiversity? The importance of urban areas for flower visiting insects. *Proceedings of the Royal Society B* 282, 20142849 <http://dx.doi.org/10.1098/rspb.2014.2849>

Fortel L, Henry M, Guilbaud L, Guirao AL, Kuhlmann M, et al. (2014) Decreasing Abundance, Increasing Diversity and Changing Structure of the Wild Bee

Community (Hymenoptera: Anthophila) along an Urbanization Gradient. *PLoS ONE* 9(8): e104679. doi:10.1371/journal.pone.0104679

Hicks DM et al. (2016). Food for pollinators: quantifying the nectar and pollen resources of urban flower meadows. *PLoS ONE* 11(6): e0158117. doi:10.1371/journal.pone.0158117.

Vanbergen AV *et al.* (2013) Threats to an ecosystem service: pressures on pollinators. *Frontiers in Ecology and the Environment*. 11, 251-259.

11. A project summary - (30 words max) which could be used for advertising

Urban landscapes are growing, and can be important resources for biodiversity. This project will explore the costs and benefits of alternative city green space management strategies for people and wildlife.