Institution: University of Northampton

Unit of Assessment: 17 Geography, Environmental Studies and Archaeology

Title of case study: Pollinator conservation: impact on government policy and public practices – 1996 to 2013

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

The decline of bees, hoverflies, and other pollinators has been widely described as a "pollination crisis" (e.g. Progress Report of FAO on the Implementation of the International Pollinators Initiative – September 2012) which could have profound effects on both food security, and wild plant populations and the ecosystem services they support. Research by Professor Jeff Ollerton and colleagues into the ecology and diversity of plant-pollinator interactions has: (a) provided a scientific evidence base that has influenced national and international policies relating to the conservation of pollinator populations; (b) raised national and international public awareness of the subject of pollinator conservation; and (c) led to positive changes in UK gardening practices.

2. Underpinning research (indicative maximum 500 words)

Prior to the mid-1990s research on plant-pollinator ecology focussed mainly on single species case studies with little regard to their community context or to biogeographical patterns. These plants were often specialised, using only one or two pollinators, making for relatively neat, tractable study systems. Professor Ollerton began to question this way of looking at such interactions, pointing out that it was not representative of nature, in which most plants are pollinated by a wide range of pollinators which vary both temporally and spatially.

Discussions between Professor Ollerton and colleagues in the USA (particularly Professor Nick Waser, University of California) led to the publication of Waser *et al*. (1996) which outlined some of these concerns and initiated a process of pollination ecologists looking more broadly at their study systems, taking both community level and spatio-temporal perspectives. This paper was hugely influential and is now the most highly cited paper in pollination ecology (currently 735 citations – ISI-WoS 31st July 2013). The Waser *et al.* paper was followed by others that challenged entrenched notions about the ecology of plants and their pollinators. For example Ollerton (1996) dealt with the paradox between ecologically generalised flowers on the one hand and (apparently) consistent natural selection on flower phenotype on the other, whilst Ollerton (1998) questioned assumptions of the predictability of pollinator type from floral morphology.

A series of field expeditions (funded by grants from NERC, The Royal Society, The Leverhulme Trust, The Nuffield Foundation, The British Ecological Society, The Royal Entomological Society, the Percy Sladen Memorial Fund and small charities) led by Professor Ollerton to parts of Africa (including the Canary Islands) and South America between 1997 and 2003 resulted in (amongst others) the Ollerton & Cranmer (2002) and Ollerton *et al.* (2003) papers. Ollerton & Cranmer (2002) was the first study to question the previously widely held belief that plant-pollinator interactions are more specialised in the tropics compared to temperate regions. In fact they are not, and any apparent pattern of tropical specialisation is an artefact of under-sampling within tropical environments. Ollerton *et al.* (2003) further showed that even in regions of extraordinarily high plant diversity such as the grasslands of South Africa interactions between plants and pollinators range from specialised to generalised as they do elsewhere in the world.

The culmination of this period of research was the publication of Waser & Ollerton (2006) by the University of Chicago Press. This received enthusiastic reviews in international journals, with statements such as: "an important contribution to our understanding of plant–pollinator interactions" and "a masterful overview of a rich field in a stage of dynamic ferment". As well as acting as primary editor for half of the chapters, Professor Ollerton was first author on two of them and co-wrote two of the three linking sections.

This research has continued throughout the REF period with more of a conservation focus, funded by grants from SITA Environmental Trust (£50,000 for two PhD scholarships investigating the

biodiversity of restored landfill sites 2006-2009); the Finnis Scott Foundation (£57,000 to support a PhD studentship investigating the diversity of pollinators in the gardens of large English country houses 2009-2013); and Defra/Natural England (funding of £151,319 to support a 3 year post-doctoral fellow studying ecosystem services as part of the Nene Valley Nature Improvement Area project - 2012-current). The latter also involves a UN-funded PhD studentship studying land use and pollinator diversity, as part of Northampton's financial and in-kind commitment to the project.

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

Ollerton, J. (1996) Reconciling ecological processes with phylogenetic patterns: the apparent paradox of plant-pollinator systems. *Journal of Ecology* 84: 767-769. [citations = 125 according to ISI Web of Knowledge 31st July]

Ollerton, J. (1998) Sunbird surprise for syndromes. *Nature* 394: 726-727. [citations = 48 according to ISI Web of Knowledge 31st July 2013]

Ollerton, J. & Cranmer, L. (2002) Latitudinal trends in plant-pollinator interactions: are tropical plants more specialised? *Oikos* 98: 340-350. [citations = 80 according to ISI Web of Knowledge 31st July 2013] – Dr Louise Cranmer was a PhD student, then postdoc, with Ollerton's group at Northampton.

Ollerton J., Johnson S. D., Cranmer, L. & Kellie, S. (2003) The pollination ecology of an assemblage of grassland asclepiads in South Africa. *Annals of Botany* 92: 807-834. [citations = 81 according to ISI Web of Knowledge 31st July] – Dr Louise Cranmer was a PhD student, then postdoc, with Ollerton's group at Northampton. Sam Kellie was a postgraduate research assistant for this project, based at Northampton. Professor Steve Johnson is in the School of Life Sciences at the University of KwaZulu-Natal, and hosted Ollerton and his team during a month of field work in South Africa.

Waser, N.M., Chittka, L., Price, M.V., Williams, N. & Ollerton, J. (1996) Generalization in pollination systems, and why it matters. *Ecology* 77: 1043-1060. [citations = 735 according to ISI Web of Knowledge 31st July 2013] – Professor Nick Waser and Professor Mary Price are both emeritus Professors of Biology at University of California, Riverside. Professor Lars Chittka is Professor of Sensory and Behavioural Ecology at Queen Mary, University of London. Dr Neal Williams is Assistant Professor at University of California, Davis.

Waser, N.M. & Ollerton, J. [eds.] (2006) *Plant-Pollinator Interactions: from Specialization to Generalization*. University of Chicago Press, Chicago, USA. [citations (not counting individual chapters) = 150 according to Google Scholar 31st July 2013] - Professor Nick Waser is emeritus Professor of Biology at University of California, Riverside.

Research during this period and contributing to these outputs was funded by grants totalling £43,983 from a range of sources: British Ecological Society Small Grants Scheme (August 1996 & June 2001); Nuffield Foundation (March 1997); Royal Society (January 1999 & February 2002); Leverhulme Trust (March 2000) Percy Sladen Memorial Fund (March 2000); NERC (August 2003).

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

Impact on policy

Research published since 1996 has had an international impact on the scientific evidence base for understanding plant-pollinator interactions and has influenced the ways in which pollinator conservation and pollination as an ecosystem service have been conceived as an issue requiring national and international legislation. For example, Waser *et al*. (1996) and Ollerton & Cranmer (2002) were used as evidential material in programmes that are the basis for international conservation policy such as the Millennium Ecosystem Assessment [**1**]. The Millennium Ecosystem Assessment is currently the single most important and influential driver of international conservation policy and the recent UK National Ecosystem Assessment [**2**] arose from findings of the 2005 global Millennium Ecosystem Assessment. The UK National Ecosystem Assessment in turn has underpinned the UK Government's "Protecting biodiversity and ecosystems at home and abroad" policy [**3**] and (of particular relevance here) the "Bees and other pollinators: their health and value" policy paper which is currently being discussed [**4**] .

In the USA both Waser *et al*. (1996) and Waser & Ollerton (2006) were cited within the "Status of Pollinators in North America" report [**5**] which is driving pollinator conservation policy in the USA and was an important influence on The Food, Conservation, and Energy Act of 2008 (the "Farm Bill") that "authorizes a range of incentive-based conservation programs on agricultural land..[and].....makes pollinators and their habitat a priority" [**6**].

Public engagement with science

Professor Ollerton has disseminated his research widely, including talks to amateur societies, interviews for print and broadcast media (e.g. [**7**]) and discussions with journalists and film and television producers. This non-academic dissemination has influenced both the production of film and television documentaries and the uptake and efficacy of national pollinator conservation campaigns.

For example Professor Ollerton was a science advisor for the Walt Disney Studios feature length documentary *Wings of Life*, narrated by Meryl Streep. Professor Ollerton has also acted as a science advisor to the recent BBC Scotland television series *How to Grow a Planet*, broadcast 2012. He was a science advisor and on-screen expert in the BBC *Gardeners' World - Science in the Garden* special edition (filmed August 2009, broadcast November 2010). Professor Ollerton's particular expertise in the complexity of ecologically generalised plant-pollinator interactions influenced the work of the directors/producers and meant the focus of these programmes was rather different than it might otherwise have been [**8**]. For example, there was greater emphasis placed on wild pollinators (as opposed to managed honeybees) and the fundamental importance of nesting sites and other non-food resources was highlighted, as well as flowers that provide nectar and pollen.

Impact on gardening practices

Most recently Professor Ollerton was an advisor and on-screen expert for the BBC's award winning series *Sarah Raven's Bees, Butterflies and Blooms*. These three programmes were widely acclaimed for their efforts to raise the profile of pollinator loss in the UK and for providing some partial solutions to the problem in terms of changing the types of plants grown in both private and public gardens, and in the wider countryside. As part of this series Professor Ollerton worked with the producers, Sarah Raven herself, the Horticultural Trades Association and the Royal Horticultural Society to develop and launch the "Perfect for Pollinators" labelling system to be used by commercial plant growers, nurseries and garden centres. This initiative has the benefit of enabling gardeners to be able to make easily informed planting choices which will benefit particular pollinator species etc. In Spring 2013 Professor Ollerton's research group carried out a study (funded by the University of Northampton) to understand the impact that the RHS Perfect for Pollinators campaign had had on pollinator-friendly gardening practices [**9**]. Interviews were conducted with managers of 53 garden centres and nurseries across the UK and all said that they had plants for sale that were of potential benefit to pollinating insects. Almost 65% of outlets said that they believed the recent media interest in the decline of pollinators stimulated demand for plants and seeds that offered pollen and nectar rewards. Over 66% said they had personally noticed a difference in customer purchasing decisions as a result of the media interest in the decline of pollinators. Almost 38% of plant retail outlets said they had heard of the RHS Perfect for Pollinators logo, with 21% actually using it in the store. Of those that had heard of the logo, 30% said they were not using it because they had created their own labelling system. A survey of garden centre customers revealed that almost 98% of people were aware that pollinating insects are in decline, with approximately 80% commenting that media coverage had informed them about this issue. More than 77% said that when buying plants or seeds they particularly looked for varieties that might be beneficial for pollinating insects. To help them make their selections 76% said they relied on plant labelling such as Perfect for Pollinators, and/or staff knowledge.

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

1] Hassan et al. (2005) Biodiversity Regulation of Ecosystem Services. Chapter 11 of Ecosystems and human well-being: current state and trends: findings of the Condition and Trends Working Group of the Millennium Ecosystem Assessment. http://www.maweb.org/en/Condition.aspx.

[**2**] UK-NEA (2011) Why did we need a NEA for the UK? http://uknea.unep-wcmc.org/About/tabid/56/Default.aspx

[**3**] Defra (2013a) Protecting biodiversity and ecosystems at home and abroad. https://www.gov.uk/government/policies/protecting-biodiversity-and-ecosystems-at-home-and-abroad

[**4**] Defra (2013b) Bees and other pollinators: their health and value. https://www.gov.uk/government/publications/bees-and-other-pollinators-their-health-and-value

[**5**] Berenbaum *et al*. (2007) Status of Pollinators in North America - http://books.nap.edu/openbook.php?record_id=11761&page=R1

[**6**] USDA (2013) How NRCS is helping pollinators. http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/plantsanimals/pollinate/help/

[**7**] Tickle, L. (2012) Hedgerows direct the flight of the bumblebee. The Guardian: Research notes 30th January 2012. http://www.guardian.co.uk/education/2012/jan/30/hedgerows-flight-bumblebees-rural-planning

[**8**] Vernon, A. (2011) Letter to Ollerton from the series' director of Bees, Butterflies and Blooms.

[**9**] Erenler, H. & Ollerton, J. (2013) The impact of popular conservation campaigns: a "planting for pollinators" case study. Unpublished report, University of Northampton.