Institution: Queen Mary University of London (QMUL)

Unit of Assessment: A5 **(**Biological Sciences)

Title of case study: CS1 - Commercial bumblebee trade – protecting Britain's native pollinators

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

In 2005/06, Chittka's team evaluated the hazard of imported foreign bumblebees sold for commercial pollination in the UK and demonstrated a severe risk of them displacing native pollinators. The impact of this work for the **UK environment** is significant, since it resulted in a **DEFRA policy review**, mandatory licensing for using non-native pollinators by **Natural England**, and legal changes which place a fine of up £5,000 and/or 6 month custodial sentence for the uncontrolled use of such pollinators. As a result, all major commercial providers of pollinators now sell a UK native subspecies of bumblebee, *Bombus terrestris audax*.

2. Underpinning research (indicative maximum 500 words)

Although invasive species have long been a major focus of ecological research, before ~2005, little consideration had been given to the potentially adverse effects of introducing non-native subspecies of beneficial organisms such as pollinators. In the face of **global declines of pollinators**, including some species of bumblebees, it is more important than ever to pay closer attention to the potential impacts of the establishment of introduced non-native pollinators. This is especially so since the pollination services by these insects play a central role in global food security (the global value of bumblebee pollinated tomato plants alone was already estimated at 12 billion Euro annually a decade ago; Velthuis & van Doorn 2006 Apidologie 37: 421). The extensive trade in bumble bees as pollinators of a wide range of glasshouse crops and other arable plants (tomatoes, courgettes, cucumber, strawberries, egg plants, melons, peppers, sweet peppers, blueberries, apricots, almonds, apples, cranberries, raspberries, red currant, black currant, cherry, peach, pear, plum and others) has involved the importation of **40,000-50,000** colonies of **non-native bumblebee colonies** to the UK annually [f].

Such **massive importation** of non-native commercially reared subspecies of *Bombus terrestris* could endanger native bumble bees through **competitive displacement**, **hybridization** between native and non-native pollinators, and the **import of parasites** with which native pollinators might be poorly adapted to cope. Our studies (performed between 2003 and 2006 by P.I. Prof Lars Chittka, and various team members, most notably PhD student Tom Ings, who was funded by a QMUL PhD studentship) made a direct ecological comparison between commercially imported and native *B. terrestris* colonies. In particular, we compared the nectar-foraging performance and numbers of offspring of commercial and native colonies growing under identical field conditions. Non-native colonies performed exceptionally well under UK field conditions, with **substantially higher nectar foraging rates than native colonies** [a, c]. Non-native colonies also **produced more new queens than native ones** [a], and native queens did not mate selectively with members of their own population, increasing the **risk of introgression** [b]. The high reproductive success of commercial colonies indicated that there is a substantial risk that they will become established and **spread within the UK**. Furthermore, their superior foraging ability and large colony size could lead them to **out-compete native bumble bees** [a, c]. Clearly the **invasive potential of non-native subspecies** of otherwise beneficial organisms should not be overlooked. With respect to the importation of commercial bumble bees, we immediately recommended a precautionary approach: native species and subspecies should be locally reared and the use/disposal of bees should be strictly regulated.

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

a) Ings, T.C., Ward, N.L., & Chittka, L. Can commercially imported bumble bees out-compete their native conspecifics? 2006 *Journal of Applied Ecology*, 43, 940-948;

b) Ings, T.C., Raine, N.E., & Chittka, L. Mating preference in the commercially imported bumblebee species *Bombus terrestris* in Britain (Hymenoptera: Apidae). 2005 *Entomologia Generalis*, 28, 233-238;
c) Ings, T.C. Schikora, J., & Chittka, L. Bumblebees, humble pollinators or assiduous invaders? A population comparison of foraging performance in *Bombus terrestris*. 2005 *Oecologia*, 144, 508-516.
d) "Advice to growers – The use of bumble bees for pollination of crops in the UK" – International Biocontrol Manufacturers Association (IBMA)
e) www.syngenta.com/global/Bioline/en/products/allproducts/Pages/Beeline.aspx
f) DEFRA Risk assessment *Bombus terrestris* https://secure.fera.defra.gov.uk/nonnativespecies/downloadDocument.cfm?id=42
g) "Plight of the bumblebee"; *New Scientist* – issue 2560 (13th July 2006) www.newscientist.com/article/mg19125602.900-plight-of-the-native-bumble-bee.html

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

Our findings were widely publicized in the **popular scientific press** (see e.g. the above article in *New Scientist* 2006); and the **daily press**, for example The Telegraph: www.telegraph.co.uk/expat/expatfeedback/4200756/British-bees-threatened-by-foreign-species.html. These articles triggered an **emergency meeting** between representatives of DEFRA (Department for Environment, Food and Rural Affairs) and the breeders in 2007 at which the implications of the research were presented by another member of Chittka's team, Dr Nigel Raine. The meeting led to a **policy review** by DEFRA. An **important response** from the commercial pollination industry, published after seeking advice from the Chittka laboratory, was produced by the **International Biocontrol Manufacturers Association (IBMA),** which according to their own website is a "worldwide association of biocontrol industries producing microorganisms, macroorganisms, semiochemicals and natural pesticides for plant protection and public health" (www.ibma-global.org/index.html), and whose "Invertebrate Biocontrol Agents (IBCA) Professional Group" comprises all the main commercial bumblebee-producing companies. The IBMA **generated a pamphlet** "Advice to growers - The use of bumble bees for pollination of crops in the UK" which ultimately led to commercial bumblebee breeders (e.g. Koppert, Biobest, Agralan) now all selling native bumblebees (*Bombus terrestris audax*) for the UK market. A copy of this pamphlet can be found on the Syngenta website on page 3ff at www.syngenta.com/global/bioline/SiteCollectionDocuments/Products/B43%20-%20Beeline.pdf

As a result, commercial providers of bumblebee pollinators now require end-users to ensure that non-native pollinators are only used in enclosed spaces, and several companies now breed to UK native population *Bombus terrestris audax*. For example, we quote from the above website:

"Advice to growers (Revised January 2009):
The use of bumble bees for pollination of crops in England
Following negative press coverage UK during 2006 concerning the potential impact of commercial bumble bees on native bee populations, the producers and importers of bumble bees have discussed the issues raised with Defra, Natural England and other stakeholders
The provisions of the Wildlife and the Countryside Act 1981 apply to the commercial bees because they are of sub-species not native to Great Britain. Section 14 of the Act makes it an offence to release, or to allow to escape, into the wild 'any animal which is of a kind which is not ordinarily resident in and is not a regular visitor to Great Britain in a wild state' without an appropriate licence. As such, any release of the bees into the wild may be an offence under the Act. That could include a release in a greenhouse, from which the bees might easily escape."

More recent policy changes by **Natural England**, again based in part on our research on the dangers of non-native pollinators, now make it mandatory to apply for a license if non-native pollinators are used in spaces that are not fully enclosed, and set strict conditions for their usage and disposal, as well as penalties for non-appropriate use: "The maximum penalty available for an offence under the Act is, at the time of the issue of this licence, a level 5 fine (£5,000) and/or a six

month custodial sentence"

Source: www.naturalengland.org.uk/Images/wml-cl22_tcm6-34782.pdf

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

1. **Non-native Species Policy, DEFRA:** This individual has provided a confirmation letter documenting the specific link between research from the Chittka lab, the press coverage of it in *New Scientist* magazine and the DEFRA policy review

2. **Wildlife Management Senior Specialist, Natural England:** This individual has provided a confirmation letter documenting the contribution of research from the Chittka team to Natural England's policy in relation to the release of non-native bumblebees.

3. The DEFRA Risk assessment *Bombus terrestris* document makes explicit reference to our work on the **risks of hybridisation** and **invasive potential** associated with the introduction of commercial pollinators; see refs 8, 17 and 28 of document on the DEFRA website: https://secure.fera.defra.gov.uk/nonnativespecies/downloadDocument.cfm?id=42

4. The website of one of the commercial pollinator providers, Syngenta Bioline Bees, makes reference to the 'negative press', (e.g. the *New Scientist* article mentioned above) they had received as the result of our studies, and their subsequent revision of policies. www.syngenta.com/global/bioline/SiteCollectionDocuments/Products/B43%20-%20Beeline.pdf

5. The major commercial bee provider Koppert Biological Systems now offers shipping the native population, *Bombus terrestris audax* for commercial pollination as of 2011, as a direct result of our findings: www.koppert.com/news-biological-systems/biological-control/detail/native-bumblebee-available-for-growers-in-uk-and-ireland/

6. The same applies to the company Biobest: www.biobest.be/producten/166/3/0/0/

7. The same applies to the company Agralan: www.agralan-growers.co.uk/fruit-hive-bombus-terrestris-audax-179-p.asp