

In summary

The proposal: Australian senator Jacqui Lambie has been calling for the federal government to allow a 'trial' of bumblebee pollination of tomatoes in Tasmanian glasshouses.

The bee: The large earth bumblebee (*Bombus terrestris*) is a large social bee native to Europe. It has formed a large feral population in Tasmania after arriving accidentally or being illegally introduced in 1992. It is recognised as a serious threat to Australian biodiversity and also potentially to some primary industries.

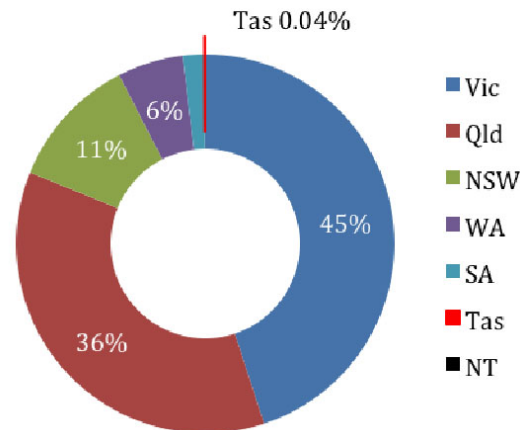
The law: Under the Environment Protection and Biodiversity Conservation (EPBC) Act, it is illegal to possess or use bumblebees because they were not legally imported. In 2008, the federal environmental minister rejected an application by the Australian Hydroponic and Greenhouse Association to add the large earth bumblebee to the list of legal imports. To allow the proposed glasshouse trial therefore will require amending the EPBC Act.

The problems: If the EPBC Act is amended to allow the possession and use of illegally or accidentally imported species, that will create a huge perverse incentive to illegally introduce bumblebees to the mainland (and also other invasive species that may have commercial value). It will also create more pressure to import new bumblebee varieties.

What is the real reason for this proposal?

No need for trials: It is already well established that bumblebees are efficient pollinators of tomatoes, as has been demonstrated in many other countries.¹ A trial will yield no new information.

Tomato production (hectares)



No benefit for Tasmania: Tasmania has an extremely small tomato industry. According to the Australian Bureau of Statistics, in 2011-12 there were just 18 tomato growers in Tasmania and just 3 hectares of tomatoes grown commercially (presumably all in glasshouses).² Other glasshouse crops that might use bumblebees for pollinators are also very small in Tasmania.³ Because Tasmanian glasshouses are small there is no great productivity gain in using bumblebees instead of current methods (a vibrating wand).

Conclusion

The proposal is a 'foot in the door' strategy to remove impediments to introducing and using bumblebees on mainland Australia. If the ban on using illegally imported species is removed, this will create a strong incentive to shift them illegally to the mainland and to introduce new varieties of bumblebees.

Legal background

Illegal to possess: Under the EPBC Act, the use of bumblebees in Tasmania is illegal. This is because it is an offence under section 303GN to possess a live non-native specimen that was not lawfully imported or is the progeny of specimens that were not lawfully imported.

Applications to import: There have been three applications to import bumblebees into Australia – 1995, 1997 and 2005. All were refused because of high invasive risks.⁴ The most recent was refused in 2008 under the EPBC Act.⁵

Perverse incentive for illegal introductions

Circumventing the import ban: Probably the main reason bumblebees have not been illegally introduced to the mainland is the ban under the EPBC Act of using species that have not been approved for import. This proposal can be regarded as a way of circumventing that ban if it results in a change to the EPBC Act allowing use of species not permitted for import.

Risks of illegal introductions: A 1997 application to import bumblebees to the mainland stated that there was a high risk of illegal importation: 'there is a good chance of illegal importation and release by impatient tomato growers who would wish to enjoy the obvious benefits of bumblebee pollination'.⁶ The NSW scientific committee also noted the risk of 'deliberate introduction as a pollinating agent'.⁷

Pressure for new variants: The Tasmanian bumblebee population is inbred, probably because it is descended from a single fertilised queen.⁸ If it is approved for commercial use, there is likely to be considerable pressure on the government to allow the

importation of new varieties and it would create an incentive to illegally introduce new variants that are likely to exacerbate environmental impacts.

Broader implications: Amending the EPBC Act to allow use of illegally or accidentally introduced species would raise expectations more generally that illegally introducing a species would lead eventually to its use being permitted.

Environmental risks

'[It] is clear that *B. terrestris* is an invasive species wherever it has been introduced and studies have been made (New Zealand, Israel, Tasmania, Japan, Chile, Argentina).⁹

Broad recognition: The bumblebee is listed as a key threatening process in NSW and as a potentially threatening process in Victoria.¹⁰ More than 80 scientists worldwide have authored or co-authored peer-reviewed papers that express environmental concerns about the large earth bumblebee, mostly based upon their own field research.¹¹

Invasive features: The large earth bumblebee can form colonies of more than 1000 individuals.¹² It has high dispersal ability (it spread 25 km/year in Tasmania)¹³, high reproductive capacity, early seasonal emergence and long activity periods, high adaptability (as shown by generalist foraging habits and broad environmental tolerances), and probably few natural enemies in its invasive range.¹⁴

Demonstrated or potential impacts:

- competition with native bees and other insects, and birds for floral resources¹⁵



Bumblebees have been viewed as an invasive species wherever they have been introduced. Photo by johan, available under a Creative Commons Attribution-Noncommercial license

- weed spread (weeds that have become more invasive in Tasmania since *B. terrestris* arrived but are not serious weeds on the mainland include *Rhododendron ponticum*, *Solanum marginatum*, *Buddleja davidii*, and *Agapanthus praecox*)¹⁶
- displacement of local bee species¹⁷
- less effective pollination and reduced seed set and fruit quality of native plants¹⁸
- Invasion and spread of parasites and pathogens¹⁹

Risks to primary industries

Weed spread: The introduction of novel pollinators is likely to lead to increased seed production of some

weeds that currently lack an efficient pollinator.²⁰ Bumblebees could be an ideal pollinator for weeds that currently occur in low densities or haven't yet escaped from gardens. Some weeds likely to benefit are poisonous or prickly, and problematic for the dairy and grazing industries (eg *Datura* species).

Reduced honey production: The Australian Honeybee Industry Council opposes the introduction of the bumblebee.²¹ It could compete for nectar and pollen with the honeybee, and because it can forage at lower temperatures and start foraging earlier in the morning, it would have a competitive advantage over managed honeybees. It could host new parasites and pathogens of other bees (a particular concern if there is incentive for illegal imports).

Alternative pollination options

Native bee options: Much progress has been made to develop a native bee pollinator for glasshouse tomatoes. Two species of blue-banded bees, *Amegilla holmesi* and *A. chlorocyanea*, are as effective as bumblebees in pollinating greenhouse tomatoes.²²

There are still a few impediments to using these species in glasshouses (eg. glasshouse designs, pesticide use) but funding for the project ceased in 2009.²³ Instead of agitating to introduce a harmful invasive species, tomato growers should be funding research to develop this safe alternative.

Sources

Australian Bureau of Statistics (2013) 7121.0 - Agricultural Commodities, Australia, 2011-12. (<http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/7121.02011-12?OpenDocument>).

Australian Hydroponic & Greenhouse Association (2008) Executive summary. Proposal to import *Bombus terrestris* into mainland Australia for crop pollination purposes. (<http://www.protectedcroppingaustralia.com/documents/Final.pdf>)

Bell M, Spooner-Hart R, Haigh A. (2006). Pollination of greenhouse tomatoes by the Australian bluebanded bee *Amegilla* (*Zonamegilla*) *holmesii* (Hymenoptera: Apidae). *Journal of Economic Entomology* 99: 437-442.

Buttermore R. (1997) Observations of successful *Bombus terrestris* (L.) (Hymenoptera: Apidae) colonies in southern Tasmania. *Australian Journal of Entomology* 36: 251-254.

Buttermore R, Pomeroy N, Hobson W, et al. (1998). Assessment of the genetic base of Tasmanian bumble bees (*Bombus terrestris*) for development as pollination agents. *Journal of Apicultural Research* 37, 23-25.

Carruthers S. (2005) "Top of the Range" truss tomatoes. *Practical Hydroponics and Greenhouses*. No. 80. (<http://www.hydroponics.com.au/issue-80-top-of-the-range-truss-tomatoes/>)

Carruthers S. (2014) New bumblebee campaign [online]. *Practical Hydroponics and Greenhouses*, No. 145: 16-19.

Centre for international Economics (2007) The future development of the Australian honeybee Industry. Submission to the House of Representatives Agriculture, Fisheries, and Forestry Committee Inquiry into the Future Development of the Australian honeybee industry. Prepared for the Australian Honeybee Industry Council.

Dafni A, Kevan P, Gross C, Goka K. (2010). *Bombus terrestris*, pollinator, invasive and pest: An assessment of problems associated with its widespread introductions for commercial purposes. *Applied Entomological Zoology* 45: 101-113.

Garrett P. (2008) Bumblebee rejected for live import. Media release, Minister for the Environment, Heritage and the Arts, 26 October 2008 (<http://www.environment.gov.au/minister/archive/env/2008/mr20081026.html>).

Goodwin S, Steiner M. (1997) Introduction of *Bombus terrestris* for biological pollination of horticultural crops in Australia. A submission to AQIS and Environment Australia, Gosford IPM Services, Gosford.

Hingston AB, Marsden-Smedley J, Driscoll DA, et al. (2001) Extent of invasion of Tasmanian native vegetation by the exotic bumblebee *Bombus terrestris* (Apidae: Apidae). *Austral Ecology* 27, 162-172.

Hingston AB, McQuillan PB (1998) Does the recently introduced bumblebee *Bombus terrestris* (Apidae) threaten Australian ecosystems? *Australian Journal of Ecology* 23, 39-549.

Hingston A. (2006) Is the exotic bumblebee (*Bombus terrestris*) assisting the naturalization of *Agapanthus praecox* ssp. *orientalis* in Tasmania? *Ecological Management and Restoration* 7: 236-238.

Hingston A. (2007) The potential impact of the large earth bumblebee *Bombus terrestris* (Apidae) on the Australian mainland: lessons from Tasmania. *Victorian Naturalist* 124: 110-116.

Hogendoorn K, Steen Z, Schwarz M. (2000) Native Australian carpenter bees as a potential alternative to introducing bumble bees for tomato pollination in greenhouses. *Journal of Apicultural Research* 39: 67-74.

Hogendoorn K, Gross C, Sedgley M, Keller M. (2006) increased tomato yield through pollination by native Australian *Amegilla chlorocyanea* (Hymenoptera: Anthophoridae). *Journal of Economic Entomology* 99(3): 828-833

Hogendoorn K, Coventry S, Keller M. (2007) Foraging behaviour of a blue banded bee, *Amegilla chlorocyanea* in greenhouses: implications for use as tomato pollinators. *Apidologie* 38: 86-92

Hogendoorn K, Bartholomæus F, Keller. (2010) Chemical and sensory comparison of tomatoes pollinated by bees and by a pollination wand. *Journal of Economic Entomology* 103(4): 1286-1292.

Hingston A, Low T. (2006) Comments on the proposal by the Australian Hydroponic & Greenhouse Association to import *Bombus terrestris* onto mainland Australia for crop pollination purposes. *Invasive Species Council*.

NSW Scientific Committee (2004) Introduction of the large earth bumblebee, *Bombus terrestris* - key threatening process listing. (<http://www.environment.nsw.gov.au/determinations/BombusTerrestrisKtpDeclaration.htm>)

Sedgley M, Keller M, Hogendoorn K, et al. (2004). Domestication of blue-banded bees for greenhouse pollination. *Practical Hydroponics and Greenhouses* 77: 64-65.

Simpson S, Gross C, Silberbauer L. (2005) Broom and honeybees: an alien liaison. *Plant Biology* 7: 541-548.

Velthuis H, Van Doorn A. (2006) A century of advances in bumblebee domestication and the economic and environmental aspects of its commercialization for pollination. *Apidologie* 37(4): 421-451.

References

1 Velthuis et al. (2006)

2 Australian Bureau of Statistics (2013). According to Carruthers (2005), in 2005 Australia had 243 hectares of tomatoes as 'protected' crops.

3 The Australian Hydroponics and Greenhouse Association (2008), which applied to import bumblebees says 95% of use is in greenhouse tomato crops - 'tomatoes are a high value crop, needed to justify the cost of bumblebee production'. According to Carruthers (2014), bumblebees could also be used by capsicum, eggplant and berry growers. According to ABS

(2013), in 2011-12, there were 4 hectares of capsicums and 33 hectares of strawberries in Tasmania. Data for eggplants and other berries was not provided but production is small.

4 Hingston (2005) refers to the first two proposals.

5 The environment minister in a media release (Garrett 2008) said that (a) bumblebees could have posed a serious risk to the Australian environment, native bee populations and native bird species, that the scientific evidence and advice suggested that the environmental and economic risks were significant and the risks of them escaping into the environment and spreading weeds were too great.

6 Goodwin & Steiner (1997)

7 NSW Scientific Committee (2004)

8 Buttermore et al. (1998)

9 Dafni et al. (2010)

10 See <http://www.depi.vic.gov.au/agriculture-and-food/pests-diseases-and-weeds/pest-insects-and-mites/keep-victoria-bumblebee-free> (Victoria) and <http://www.environment.nsw.gov.au/determinations/BombusTerrestrisKtpDeclaration.htm> (NSW)

11 The references are listed in Hingston and Low (2006).

12 Buttermore (1997)

13 Hingston et al. (2002)

14 Dafni et al. (2010)

15 Hingston & McQuillan (1998)

16 Hingston (2006), Hingston (2007).

17 Dafni et al. (2010) citing Dafni and Shmida (1996), Hingston (2007), Matsumura et al. (2004), Hingston and McQuillan (1999), Hingston (2007).

18 Dafni et al. (2010), citing Ne'eman and Dafni (1999), Ne'eman et al. (2000), Hingston et al. (2004), Kenta et al. (2007), Hingston and McQuillan (1998), Hingston, (2007), Hopper and Burbidge (1986), Gross (1992), Gross (1993a,b), Houston (1993), Gross and Mackay (1998).

19 Dafni et al. (2010) citing Goka, 1998, 2010; Goka et al., 2000, 2001, 2006; Okada et al., 2000; Schmid-Hempel et al., 2007; Yoneda et al. (2008)

20 Simpson et al. (2005)

21 Centre for international Economics (2007)

22 Sedgley et al. 2004; Bell et al. 2006; Hogendoorn et al. 2006, Hogendoorn et al. 2007.

23 See www.aussiebee.com.au/blue-banded-bee-update-2012.html.