Submission to the inquiry into the risks and opportunities associated with the use of the bumblebee population in Tasmania for commercial purposes

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This submission addresses the risks and opportunities associated with the use of the bumblebee population in Tasmania for commercial pollination purposes.

Summary

A feral population of the bumblebee *Bombus terrestris* became established in Tasmania in 1992 after being imported without Australian Government approval. It is not known if this introduction was accidental or deliberate. Unsuccessful applications were made to the Australian Government in 1997 and 2005 for permission to import this species to the Australian mainland for commercial pollination purposes, and the greenhouse fruit and vegetable industry continues to promote its importation to the Australian mainland.

I am opposed to the commercial use of the Tasmanian bumblebee population because I am concerned that approving its use within Tasmania will undermine the integrity of Australia's biosecurity regime, and encourage the introduction of bumblebees to the Australian mainland. If the commercial use of bumblebees is permitted in Tasmania on the grounds that a feral population is already established, and a feral population then becomes established in another Australian State, that State could then argue for permission to use bumblebees commercially otherwise it would be at a competitive disadvantage to the State of Tasmania. Permitting the commercial use of an unlawfully introduced organism in one State, but not in another State, may be perceived by some people as contrary to Chapter IV, s.99 of the Australian Constitution: "s.99. The Commonwealth shall not, by any law or regulation of trade, commerce, or revenue, give preference to one State or any part thereof over another State or any part thereof." Hence, approving the commercial use of the unlawfully introduced bumblebee population in Tasmania may be seen by some people as an incentive to illegally import this species to the Australian mainland in the hope of also allowing its commercial use there. Indeed, the 1997 application for permission to import bumblebees to the Australian mainland, and the vice-president of the organisation that made the 2005 application, both stated that there was a good chance tomato growers would illegally introduce bumblebees to the Australian mainland.

Moreover, there seems to be an absence of direct benefits from allowing commercial use of the existing Tasmanian population of bumblebees in Tasmania. Although the economic benefits of using bumblebees for pollination of some greenhouse crops are well-established, commercial use of the existing Tasmanian population appears unlikely to be able to provide economic benefits because analysis of the Tasmanian population found that it was too inbred for commercial rearing to be economically viable. Furthermore, Tasmanian growers of greenhouse tomatoes and capsicums used bumblebees on a commercial basis in the early 2000s but this was discontinued because the bees always escaped from the greenhouses. In addition, I have not seen any analysis of whether or not the commercial use of bumblebees as pollinators is economically viable for the small areas of greenhouse crops in Tasmania.

If bumblebees are deployed in Tasmanian greenhouses escaping bumblebees will increase the density of the species in the immediate vicinity, potentially increasing the ecological impact of the species in the local area and possibility of it spreading to the

Australian mainland. I am unaware of any economic analysis of the potential ecological impacts of feral bumblebees, which include enhanced invasion of any weeds that are pollinated by bumblebees, lowered production in any horticultural crops whose flowers are damaged by bumblebees or that rely on pollination by animals that are adversely affected by bumblebees, reduced honey production through any competition and transfer of diseases from bumblebees, loss of export sales of live honeybees as a consequence of any disease transfer from bumblebees, and increased recovery costs for any threatened species that are adversely affected by bumblebees.

If the Tasmanian population is bolstered by the importation of more genetic material to make commercial rearing economically viable, the fitness of the feral population is likely to be enhanced along with its ability to cause ecological harm in Tasmania and spread to the Australian mainland. Importation of more bumblebees also risks the importation of viruses and other pathogens that affect honeybees.

Any commercial use of the Tasmanian bumblebee population on the Australian mainland is likely to result in the establishment of a feral population there, which has the potential to impact on a wide variety of flora and fauna including those of economic importance that are listed above.

Detailed comments in relation to the Terms of Reference, including:

(a) <u>the existing distribution and population density of exotic bumblebees</u>

The bumblebee *Bombus terrestris* is widespread across Tasmania, but is not established on the Australian mainland (Hingston 2007). It has been found across the full range of altitudes, and all levels of mean annual rainfall, that occur in Tasmania (Hingston *et al.* 2002; Hingston 2006a). It occurs in a wide variety of habitats, including urban and agricultural areas and all of Tasmania's major types of native vegetation (Hingston *et al.* 2002). It has invaded at least 10 Tasmanian National Parks, the Tasmanian Wilderness World Heritage Area (Hingston *et al.* 2002; Hingston 2006a), and has been found on Tasmanian offshore islands including Maatsuyker, Bruny (Hingston *et al.* 2002; Hingston 2006a), Maria (Hingston 2006a; Hingston *et al.* 2006) and Cape Barren Islands (Sandra Reid pers. comm. 2011).

The population density of bumblebees in the wild varies greatly through the year because of the patterns in their annual life cycle. Few colonies are active during the winter months in the temperate zone, when most queens hibernate. Hibernating queens emerge in spring, and then lay eggs that develop into workers that forage to support the queen and developing colony. The queen lays a number of batches of eggs through the spring/summer, resulting in an exponential increase in the size of the colony at that time of year (Cumber 1953; Donovan and Macfarlane 1984; Duchateau and Velthuis 1988). This was illustrated by 17 colonies in Hobart that produced an average of 451 bumblebees each (Buttermore 1997), and another in Maria Island National Park in Tasmania which produced at least 304 new queens and 939 workers or drones (males) (Hingston *et al.* 2006). During spring and summer, bumblebees can reach high densities in Tasmania. For example, they accounted for 43% of visits to flowers of *Gompholobium huegelii* (Hingston and McQuillan 1999), and comprised up to 92% of flower visitors to *Eucalyptus ovata* (Hingston 2007) and up to 100% of flower visitors to *Lupinus arboreus* (Stout *et al.* 2002). Individual colonies die out during summer or autumn, after new queens and drones are produced, resulting in declining population density at that time of year (Cumber 1953; Donovan and Macfarlane 1984). However, the species can be bivoltine in Tasmania such that colonies can be active from August to May (Buttermore 1997).

(b) productivity and economic benefits of the commercial use of bumblebees for agricultural producers

The economic benefits of using bumblebees for pollination of some crops, particularly those in greenhouses, are well-established (Dafni *et al.* 2010). However, use of the Tasmanian population of bumblebees appears unlikely to be able to provide economic benefits because analysis of the population in 1996 found that it was too inbred for commercial rearing to be economically viable (Buttermore *et al.* 1998). Subsequent analysis of the population in 1999 and 2000 found no evidence of immigration after the original introduction, and confirmed that the population was inbred (Schmid-Hempel *et al.* 2007). I am unaware of any more recent investigation of the genetic diversity of the Tasmanian population, or its suitability for commercial use. I am also unaware of any analysis of whether or not the commercial use of bumblebees as pollinators is economically viable for the small areas of greenhouse crops in Tasmania. In addition, Tasmanian growers of greenhouse tomatoes and capsicums used bumblebees on a commercial basis in the early 2000s (Cooke 2001; Brandsema 2004; Briggs 2004; Grube 2004; Tasmanian Crop Pollination Association Inc 2007 p.16) but this was discontinued because the bees always escaped from the greenhouses (Tasmanian Crop Pollination Association Inc 2007 p.16).

(c) the potential environmental impacts associated with the commercial use of bumblebees, including whether their use is likely to: impact the conservation status of a species or ecological community, impact biodiversity, cause unintended ecological impacts, and contribute to a wider distribution of bumblebees

Bumblebees have the potential to impact on ecosystems, and this could be exacerbated by their commercial use in Tasmania and would certainly be increased if they were imported to the Australian mainland. The magnitude of the increase in these impacts resulting from their commercial use will obviously be dependent on the extent of commercial use. Their potential ecological harm in Australia includes: competition with native animals for nectar and pollen as food sources; reduced seed production and altered gene flow in native plants; and increased seed production in introduced weed species (Hingston 2005a, 2007; Dafni *et al.* 2010). However, little research into these potential impacts has been done in Tasmania, and quantification of the existing ecological impacts is far from complete. A great deal more research on these potential impacts can be done without amending the EPBC Act to allow possession of live bumblebees.

In Tasmania, the population of bumblebees has the potential to compete with a wide variety of native animals for nectar and pollen, because the bees forage on many species of native plants (Hingston and McQuillan 1998a). This includes competing for nectar of *Eucalyptus* trees with the Critically Endangered swift parrot *Lathamus discolor* (Hingston 2007; Saunders and Tzaros 2011; IUCN 2015). Indeed, bumblebees markedly reduced nectar standing crops in two trees of *E. ovata* in an area where swift parrots foraged on this species of tree (Hingston 2007). There is also evidence of bumblebees displacing native Tasmanian bees from flowers through competition (Hingston and McQuillan 1999).

It is possible that bumblebees are altering seed production and gene flow in many species of Tasmanian native plants, because they forage on the flowers of a wide variety of these plants (Hingston and McQuillan 1998a). Although little work has been done to investigate the impact of bumblebees on seed production in native plants in Tasmania, it is known that they are significantly less effective than swift parrots at pollinating the Tasmanian blue gum *Eucalyptus globulus* (Hingston *et al.* 2004). In addition, bumblebees have often been observed removing nectar from Tasmanian plant species without contacting the plant's reproductive organs and are, therefore, unlikely to effectively pollinate these plants when doing so. This has involved bumblebees biting holes through the corollas of *Epacris impressa*

(Hingston and McQuillan 1998b), *Prionotes cerinthoides* (Johnson *et al.* 2010), *Richea scoparia* (Olsson *et al.* 2000), *R. dracophylla, Billardiera longiflora* and *Correa* sp. (Hingston 2007).

If bumblebees increase seed production in introduced weed species, this could impact on native ecosystems by exacerbating the effect of weeds displacing native plants through competition for space, light, and soil water and nutrients. Such impacts appear to be already occurring in Tasmania. Examples of weeds that appear to be becoming more invasive as a result of pollination by bumblebees in Tasmania include *Agapanthus praecox* (Hingston 2006b), *Rhododendron ponticum* and *Buddleia davidii* (Hingston 2007). Concern has also been raised regarding their capacity to enhance seed-set in buzz-pollinated members of the nightshade family (Solanaceae), foxgloves *Digitalis purpurea,* blackberry *Rubus fruticosus,* gorse *Ulex europeaus,* broom *Cytisus scoparius* and Paterson's curse *Echium vulgare* (Dafni *et al.* 2010).

Commercial use of bumblebees in Tasmania could worsen these impacts because it will increase the density of bumblebees near the site of the crop in which colonies are deployed. This will include in the vicinity of greenhouse crops because bumblebees readily escape from greenhouses (Hingston 2007; Tasmanian Crop Pollination Association Inc 2007 p.16; Kraus *et al.* 2011). Increased impacts may be most likely between late autumn and early spring when bumblebees are usually scarce (see above), but when it is possible to deploy commercial colonies (Goodwin and Steiner 1997).

Any commercial use of the Tasmanian bumblebee population on the Australian mainland is likely to result in the establishment of a feral population, which clearly has the potential to impact on a wide variety of flora and fauna (Hingston 2007; Tasmanian Crop Pollination Association Inc 2007 p.17; Dafni *et al.* 2010).

If the Tasmanian population is bolstered by the importation of more genetic material to make commercial rearing economically viable, as suggested by Buttermore and co-workers (1998), the fitness of the feral population is also likely to be enhanced (Hingston 2005b; Whitehorn *et al.* 2009). This could result in the population having a greater ecological impact in Tasmania and increased chances of spreading to the Australian mainland (Hingston 2005b).

(d) <u>the implications for Australia's biosecurity regime of any approval to use bumblebees in Tasmania for commercial purposes</u>

I regard this as the most important of the Terms of Reference in this inquiry because it could undermine the integrity of Australia's biosecurity regime. This species of bumblebee was imported to Tasmania in the early 1990s without Australian Government approval. It is not known if this introduction was accidental or deliberate. Since then there have been two unsuccessful applications made to the Australian Government to import this species to the Australian mainland for commercial pollination purposes (Goodwin and Steiner 1997; Australian Hydroponic & Greenhouse Association 2005), and the greenhouse fruit and vegetable industry continue to promote its importation to the Australian mainland (Brandsema 2014; Toby and Brandsema 2014). I am concerned that approval to use bumblebees commercially in Tasmania will lead to their introduction to the Australian mainland. If the commercial use of bumblebees is permitted in Tasmania on the grounds that a feral population is already established, and a feral population then becomes established in another Australian State, that State could then argue for permission to use bumblebees commercially otherwise it would be at a competitive disadvantage to the State of Tasmania. Permitting the commercial use of an illegally introduced organism in one State, but not in another State, may be perceived by some people to be contrary to Chapter IV, s.99 of the Australian Constitution (Commonwealth of Australia 2010): "s.99. The Commonwealth shall not, by any law or regulation of trade, commerce, or revenue, give preference to one State or any part thereof over another State or any part thereof." Hence, approving the commercial use of the bumblebee population in Tasmania may be seen by some people as an incentive to illegally import this species to the Australian mainland in the hope of also allowing its commercial use there. Indeed, the 1997 application for permission to import bumblebees to the Australian mainland (Goodwin and Steiner 1997 p.31), and the vice-president of the organisation that made the 2005 application (Carruthers 2003), both stated that there was a good chance tomato growers would illegally introduce bumblebees to the Australian mainland. Some people may also consider approval of commercial use of this species whose importation was not sanctioned by government as a legal precedent for the eventual approval of commercial use of other species that are illegally introduced to Australia and, therefore, be encouraged to illegally import other animals or plants that they hope to use for commercial purposes.

(e) <u>the potential economic outcomes</u>

The potential economic outcomes of commercial use of bumblebees in Australia are unknown. While there is potential for this to reduce production costs for some fruits and vegetables, particularly within greenhouses (Goodwin and Steiner 1997; Australian Hydroponic & Greenhouse Association 2005), this appears to not be the case if the existing population in Tasmania is used because it is too inbred for commercial rearing to be viable (Buttermore *et al.* 1998). Furthermore, Tasmanian growers of greenhouse tomatoes and capsicums used bumblebees on a commercial basis in the early 2000s (Cooke 2001; Brandsema 2004; Briggs 2004; Grube 2004; Tasmanian Crop Pollination Association Inc 2007 p.16) but this was discontinued because the bees always escaped from the greenhouses (Tasmanian Crop Pollination Association Inc 2007 p.16). I am unaware of any analysis of whether or not the commercial use of bumblebees as pollinators is economically viable for the small areas of greenhouse crops in Tasmania. Moreover, there are a number of ways in which increased numbers of feral bumblebees could cause economic harm, but I am unaware of any economic assessment of any of these potential impacts. These are detailed below and include costs associated with enhanced invasion of any weeds that are pollinated by bumblebees, lowered production in any horticultural crops whose flowers are damaged by bumblebees or that rely on pollination by animals that are adversely affected by bumblebees, reduced honey production through any competition and transfer of diseases from bumblebees, loss of export sales of live honeybees as a consequence of any disease transfer from bumblebees, and increased recovery costs for any threatened species that are adversely affected by bumblebees.

Any increase in pollination of weeds as a consequence of greater numbers of bumblebees could cause cost increases for agriculture, forestry and natural land management. Weeds already cost around $4 billion in Australia in control and lost production (Sinden *et al.* 2004).

The economic outcomes of larger numbers of bumblebees on fruit and vegetable production are not necessarily positive. For example, high visitation rates by *B. terrestris* to raspberry flowers in Argentina resulted in damage to floral styles and lower rates of drupelet production (Aizen *et al.* 2014; Sáez *et al.* 2014; cf. Lye *et al.* 2011). *Bombus terrestris* is also a poor pollinator of beans and red clover, because it bites through the flowers to access nectar (Donovan and Macfarlane 1984).

Increased numbers of bumblebees, as a consequence of their commercial use, could also adversely impact industries associated with the keeping of honeybees. Bumblebees can forage at lower temperatures than can honeybees, allowing them to reduce nectar availability to honeybees (Hingston 2007). Indeed, it has been suggested that bumblebees are competitively excluding honeybees in some situations in Tasmania (Stout *et al.* 2002). Any introduction of more bumblebees to Tasmania, to increase the genetic diversity of the population (Buttermore *et al.* 1998), is also a threat to the honey industry as bumblebees can carry viruses and other pathogens that affect honeybees (Genersch *et al.* 2006; Singh *et al.* 2010; Li *et al.* 2011; Graystock *et al.* 2013; Reynaldi *et al.* 2013; Fürst *et al.* 2014; Manley *et al.* 2015; McMahon *et al.* 2015). Indeed, an investigation into 48 commercially produced colonies of *B. terrestris* in 2011-12 found five species of pathogens that affect honeybees: deformed wing virus and *Nosema ceranae* were found in the bumblebees; while both of those pathogens and *N. apis*, American foulbrood, and chalkbrood were found in pollen in the colonies (Graystock *et al.* 2013). Many of these pathogens are difficult to detect visually and cannot be cultured *in vitro,* and can only be detected through molecular methods. As a result, colonies of *B. terrestris* that were certified as 'disease-free' often carried these pathogens (Graystock *et al.* 2013). Any disease outbreak in Tasmanian honeybees has the potential to have flow-on effects for horticultural crops that rely on honeybee pollination, as well as impacting on the live export of disease-free honeybees from Tasmania (Thomas 2014). Indeed, the Tasmanian Crop Pollination Association Inc (2007 pp.16-18) expressed opposition to the idea of introducing bumblebees to the Australian mainland because of concerns of bumblebees carrying diseases of honeybees and competing with honeybees for nectar and pollen.

Any increase in harm to a threatened species (e.g. swift parrot, Hingston 2007; Saunders and Tzaros 2011; IUCN 2015), or harm that causes a native species to become threatened, as a result of greater numbers of bumblebees will potentially increase species recovery costs.

(f) <u>the effectiveness of alternative pollination options</u>

In my opinion, a decision regarding whether or not bumblebees should be used commercially in Australia should only be influenced by the effectiveness of other pollination options if the benefits from commercial use of bumblebees in Australia outweigh the costs associated with such actions. If the benefits of commercial bumblebee use are outweighed by their costs, then there is no point in using bumblebees commercially in Australia regardless of the effectiveness of alternative pollination options. However, if research shows that the benefits of commercial bumblebee use outweigh the costs, then it needs to be considered if there are alternative options that are less likely to cause unwanted ecological impacts. As stated by Manley and co-workers (2015) "to prevent introducing invasive pathogens, native pollinator species should be used for commercial pollination and bred locally whenever possible". To date, two genera of Australian native bees (*Xylocopa* and *Amegilla*) have been investigated as potential pollinators of greenhouse tomatoes in Australia (Hogendoorn *et al.* 2000, 2006, 2007; Bell *et al.* 2006). Although both taxa showed some promise, neither is currently ready to be used as a commercial pollinator (Hogendoorn *et al.* 2000, 2007; Bell *et al.* 2006). In addition, these genera may not be suitable for use in Tasmania as neither is known to occur in Tasmania, although there are a few old Tasmanian records of *Amegilla* (Atlas of Living Australia, http://www.ala.org.au/). Research into alternative pollination options ceased around 7 years ago, due to lack of funding (K. Hogendoorn, pers. comm.).

<u>(g) any other related matters</u>

As in other bees, both queens and workers of *B. terrestris* possess a sting. The venom contains three major human allergens and is similar, but not identical, to that of honeybees (Hoffman *et al.* 2001). Hence, people who are allergic to honeybee stings, as well as those who are not, can suffer allergic reactions to envenomation by *B. terrestris* (Kochuyt *et al.* 1993; Hoffman *et al.* 2001). Any increase in the numbers of feral bumblebees as a result of their commercial use will obviously increase the probability of people being stung.

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