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CSIRO Submission 16/555

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

Senate Standing Committee on Environment and Communications

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Introduction

CSIRO welcomes the opportunity to provide input to the Senate Standing Committee on Environment and Communications inquiry into the risks and opportunities associated with the use of the bumblebee population in Tasmania for commercial pollination purposes.

In this submission, CSIRO addresses the following terms of reference:

The risks and opportunities associated with the use of the bumblebee population in Tasmania for commercial pollination purposes, including:

a. the existing distribution and population density of exotic bumblebees;
b. productivity and economic benefits of the commercial use of bumblebees for agricultural producers;
c. the potential environmental impacts associated with the commercial use of bumblebees, including whether their use is likely to:
    i. impact the conservation status of a species or ecological community,
    ii. impact biodiversity,
    iii. cause unintended ecological impacts, and
    iv. contribute to a wider distribution of bumblebees;
d. the implications for Australia's biosecurity regime of any approval to use bumblebees in Tasmania for commercial purposes; and
f. the effectiveness of alternative pollination options; and

Note that CSIRO has addressed the terms of reference out of order, as the response to some of the earlier questions was most easily addressed by information provided for the later questions.

CSIRO response to the Terms of Reference (ToR)

a. (What is…) the existing distribution and population density of exotic bumblebee?

Bombus terrestris (the large earth Bumble bee) is native to Europe but has now established as an invasive species in Japan, Chile, Argentina, New Zealand and Tasmania. This successful invasion has been driven by people, who value the species as a pollinator of agricultural crops. In the case of New Zealand it was deliberately introduced into the wild in the late 1880's. In Chile, Argentina and Japan its spread in the wild has coincided with its importation and use in commercial greenhouses in recent times. It established in Tasmania in 1992 (Semmens et al 1993), although there were no legally permitted imports. Given that Tasmania is separated from the next nearest populations in New Zealand by 1,500km of ocean it is most likely that its arrival was assisted by humans, either by accidental transport or deliberate illegal importation. This record of on-going spread and establishment around the world demonstrates beyond doubt that it has the traits of a very effective invasive species. Invasive exotic bumblebees are widespread in Tasmania, in natural and urban environments (Hingston 2006). They have not yet established on the mainland.

c. iv. (What are…) the potential environmental impacts associated with the commercial use of bumblebees, including whether their use is likely to contribute to a wider distribution of bumblebees?

The potential for *Bombus terrestris* to establish on the mainland is great including well beyond intensive agricultural areas, as there are many habitats similar to those successfully invaded elsewhere (including Tasmania) and because a large area is considered climatically suitable, as indicated by an analysis conducted for the AHGA (2008) in their ultimately unsuccessful proposal to import *Bombus terrestris.* The scientist who conducted the analysis wrote "*It should be expected that* B. terrestris audax *would be able to establish in broader areas of Australia, possibly approaching the limits predicted from the model for* B. terrestris *as a whole*." This statement refers to a map that we do not have copyright permission to reproduce here, but which includes most of Victoria, the eastern half of NSW, a long coastal strip in Queensland, the southeast of South Australia and Southwest of Western Australia (AHGA 2008). Some of the more highly favourable areas of suitable environment overlap with significant parts of the conservation estate, including the Australian Alps National Parks. Following any introduction of *Bombus terrestris* to the Australian environment, the nexus between the bee and introduced plant species would make many habitats vulnerable to invasion.

The chief risk associated with the proposed use of *Bombus terrestris* in commercial greenhouses in Tasmania is that it will increase the probability that the species will be transferred to the mainland. Greenhouse use would increase the risk for the following reasons:

(a) Greenhouse use will bring *Bombus terrestris* into closer association with people and products that are transported to the mainland. This greatly increases the risk of an accidental transfer. For example, a single mated queen bee could be transferred to the mainland in a container, or a boxed bumblebee colony could be mistakenly stacked in among produce that is being shipped to the mainland, and there establish a new colony.
(b) If greenhouse growers in Tasmania gain an economic advantage by use of bumblebees, growers on the mainland will have a stronger incentive to access the same benefit. An unscrupulous person might then be motivated to illegally import bees to the mainland in the hope that the invasion will be followed by legitimate commercial adoption (i.e. history of the species in Tasmania would then be repeated on the mainland).

c. i-iii. (What are…) 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, or cause unintended ecological impacts

Unwanted environmental impacts of bumblebee invasion have already occurred in Tasmania (Hingston and McQuillan 1998), and the threat of greater environmental impacts from bumblebees arises because of the risk that greenhouse use in Tasmania will lead to a spread in the distribution of bumblebees to mainland Australia (see point 2, above).

In Japan and South America *Bombus terrestris* is considered a harmful invader because of the negative impact it has on local environments. It can harm native bees through direct competition for food and nest sites (Inoue et al 2008, Morales et al 2013), and can be a conduit for new diseases into the bee community (e.g. Arbetman et al 2013). In some places invasive *Bombus* have become such abundant and aggressive flower visitors, they damage the flowers of commercially important species, leading to reduced crop production and losses for producers (Saez et al 2014).

Although Australia does not have native bumblebees, it does have bees with resource needs and behaviours that could make them vulnerable to competition with invasive bumblebees. For example, resource competition between bumblebees and a native megachilid bee has been documented in Tasmania (Hingston and McQuillan 1999). Australian native bee diversity exceeds 1,500 species, and very few of these are well known to ecologists (Batley and Hogendoorn 2009) so a shortage of information makes it very difficult to estimate the scale of this potential negative impact on our fauna. Insect species are greatly under-represented on lists of endangered and threatened species because of the systemic shortage of knowledge (Stuart et al. 2010, Winfree 2010, Byrne and Fitzpatrick 2009). In other words, insect species are more likely (cf mammals and birds) to become threatened or potentially go extinct before their circumstances are understood and any recovery processes implemented by Departments of Environment.

Invasive pollinators such as *Bombus terrestris* can create a destructive ecological syndrome, simultaneously decreasing reproduction by native plants and increasing reproduction by weedy introduced species (Aizen et al 2014). For example, in Australia *Cytisus scoparius* (Scotch broom) is a weed of concern in a number of states, and is known to be well pollinated by bumblebees. The potential for bumblebees to accelerate the spread of Scotch Broom was one of the primary reasons that the NSW government listed introduction of *Bombus terrestris* as a key threatening process (Adam 2004). The listing states that:

> "Species and populations in NSW that may become threatened by the presence of Large Earth Bumblebees promoting the spread of Scotch Broom include endangered species *Epacris hamiltonii*, the Bathurst Copper *Paralucia spinifera*, the Ben Halls Gap National Park Sphagnum Moss Cool Temperate Rainforest Endangered Ecological Community, and the vulnerable terrestrial orchid *Chiloglottis platyptera."*

Another risk relates to the introduction of new pathogens into the Australian environment. At one level it could be assumed that the risk of introducing new pathogens into Tasmanian bees is ameliorated by using bumblebees from the Tasmanian population rather than importing bumblebees from oversea. However, the use of bumblebees in commercial operations may change the dynamics of disease transfer within existing populations, because bumblebees will be transported and managed in Tasmania in a way that differs radically from their current free-living circumstances. This could increase the risk of disease transfer from bumblebees to managed European honeybees (*Apis mellifera*) in and around the managed greenhouse environment. Such an event would be harmful to Tasmania's highly valued honeybee industry, and would ultimately risk transfer of

diseases to mainland honeybee populations. Further, any incursion of Tasmanian bumblebees onto the mainland would create a new pathway for disease transfer from Tasmania to the other states.

Multiple viruses including Deformed wing virus (DWV), Slow bee paralysis virus (SBPV) and Acute bee paralysis virus (ABPV) are common to both honeybees and bumblebees (McMahon et al 2015; Parmentier et al 2016), and pathogen spill-over has already occurred into other pollinators (Singh et al 2010). Furthermore, DWV, SBPV and ABPV are serious pathogens in Varroa-infested honeybee colonies overseas, playing a major role in their final collapse and death (Martin 2001; Gisder and Genersch 2015). These viruses are not known in Australian honeybees (Roberts et al 2015) but Tasmania's bumblebee population has not been tested. Should these viruses be present in bumblebees, and then transfer to honeybees this would compound detrimental effects of Varroa should it arrive in future.

Braula fly (*Braula coeca*) is a significant honeybee pest that currently occurs in Tasmania, but not on the mainland. Accidental transfer of Tasmanian bumblebee queens on to mainland Australia would also present a significant risk of introducing this pest. Bumblebees are not a natural host for this fly, but they may act as a carrier. *Braula coeca* is listed in the AUSVETPLAN as a Category 4 emerging animal disease (except Tasmania), with potential to cause international trade losses and local market disruptions.

b. (What are the…) productivity and economic benefits of the commercial use of bumblebees for agricultural producers?

In agriculture, *Bombus terrestris* is used in many countries around the world as a pollinator, especially for greenhouse crops. There are some crops (e.g. greenhouse tomatoes) for which this species is a more effective pollinator than the widely available managed pollinator, the European honeybee, *Apis mellifera*. There have been applications in the past for *Bombus terrestris* to be imported into Australia to support greenhouse pollination (such as in 2006). These have been rejected by the Australian government because of the potential negative impacts. Bumblebees will not provide benefits to growers outside of the greenhouse environment, because their use is not allowed. Excessively abundant bumblebees, such as can occur where the species invades, can have negative impacts on productivity of some crops (Saez et al 2014). As argued under point 4, use of *Bombus* in greenhouses creates some risks (especially disease transfer) that would have negative impacts on beekeepers (i.e. those managing honeybees).

d. (What are…) the implications for Australia's biosecurity regime of any approval to use bumblebees in Tasmania for commercial purposes?

As outlined previously, commercial use of *Bombus* in Tasmanian greenhouses would create increased risk of *Bombus* being transported from Tasmania to the mainland, resulting in an increased need for biosecurity controls between Tasmania and the mainland. This is because the likelihood of negative economic and environmental impacts from invasive *Bombus* on the mainland might become high enough that risk mitigation would be required. Pest insects and bee diseases are already among the targets for internal biosecurity controls in Australia. Preventing a *Bombus* incursion on to the mainland could become a new target, requiring new strategies from biosecurity agencies. Due to the small size and cryptic nature of *Bombus* (i.e. it naturally shelters inside flowers, leaves and crevices) it can easily "hide" in greenhouse materials which would suggest the need for significant biosecurity controls.

f. the effectiveness of alternative pollination options

Bumblebees are valued in horticulture because they can “buzz pollinate” certain flowers (such as tomato) which the honeybee cannot. Therefore they are more effective on a per-visit basis. However, the “buzz pollination” behaviour occurs in many other species of bee, including many native Australian species. The Australian blue-banded bee (*Amegilla*) has been examined as an alternative pollinator (Bell et al 2006, Hogendoorn et al 2006) as has a native Carpenter bee (Hogendoorn et al 2000). Research shows that these species are effective pollinators, but their commercial adoption is not possible until methods have been developed to rear and supply them in sufficient number. The problem is not that rearing the bees is necessarily infeasible, but rather that there has been very limited research in this area to date. It may be that appropriate Australian pollinators are available, but their commercial adoption has not been sufficiently investigated and developed because there has been ongoing hope (among growers) that a *Bombus* system will one day become available in Australia. In other words, the possibility of adopting the imported technology (greenhouse *Bombus* pollination) may have suppressed investigation of other options.

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