# Buzz Off: How Honeybees Are Ousting Native Bees from the Pollination Throne

A recent study by Page and Williams - **“Honeybee introductions displace native bees and decrease pollination of a native wildflower"** - examined the previously ill-documented indirect effects of honeybees (*Apis mellifera*) on the effective pollination of the wildflower *Camassia quamash* (*Liliaceae*) which is native to North America[1].

## INTRODUCTION

The anthropogenic introduction of species to an area can cause disturbances at all levels of an ecosystem, both directly and indirectly[2,3]. Due to the threats facing bees, such as those presented by agriculture and land-use change, bee conservation efforts are common. As such, there has been an increasing number of introduction events[4]. And managed bee colonies are common outside of the original range of the species[5]. Although the direct impacts of these introduction events on the native flora and fauna has been well studied, existing research has often failed to consider the indirect effects of such events[3].

These introduction events can have a positive impact on the ecosystem, such as rescuing native plant species when wild bee populations are in severe decline[6], however, they can also have negative consequences. Honeybees often steal nectar from native plants without pollinating them correctly[7] therefore negatively impact the effectiveness of pollination. Therefore, an understanding of both the direct and indirect impacts of an introduction event is vital in order to assess the suitability of honeybee introductions as a conservation strategy.

Researchers Page and Williams investigated the direct and indirect impacts of a honeybee introduction on the pollination of *C. quamash* plants in the Western U.S[1]. This included the comparative pollination effectiveness of *C. quamash* by native bees (local non-*Apis* bees) and introduced honeybees, as well as the impact of the honeybees on the native bees' behaviour and distribution.

## METHODS

Page and Williams generated a gradient in honeybee abundance across meadows in Central Sierra Nevada. *C.quamash* were sampled at one-hectare subplots.

Pollinator species, including both native bees and honeybees, were netted and identified to assess abundance. Those plants that were open were tagged and then collected later to test for nectar and pollen availability. As a control, unvisited plants were also collected.

Pollen tubes and seed sets were counted under epifluorescence microscopy after 72 hours to ensure pollen tube growth after pollination.

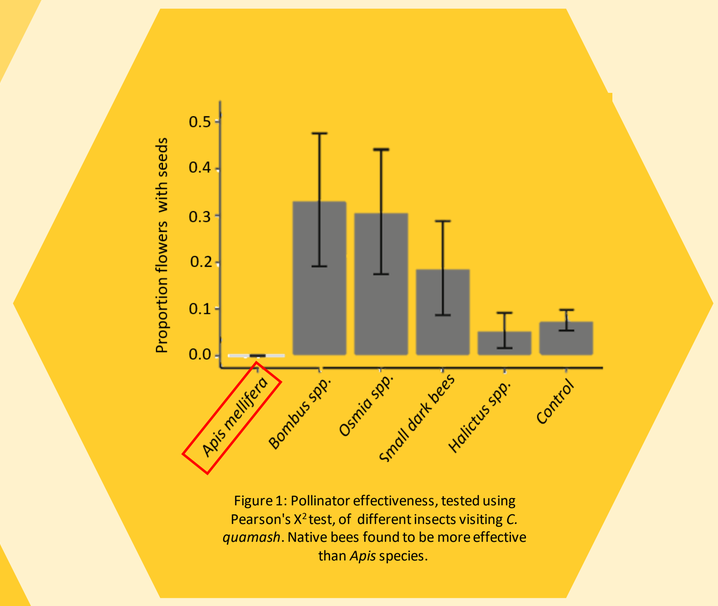


Figure 1: Pollinator effectiveness, tested using Pearson's $X^2$ test, of different insects visiting *C. quamash*. Native bees found to be more effective than *Apis* species.

## RESULTS

The indirect effects of honeybee abundance were seen in the reduced probability of observing visible and measurable pollen. For every additional honeybee introduction, the chance of detecting measurable nectar was reduced by 2.9%.

From testing the effectiveness of pollination in different bee species, honeybees were found to be the least effective when compared to *Bombus* and *Osmia* species (Fig 1). Honeybees were found to contact 14.6% of stigmas compared to the 76.7% contact of native bees. Native bees were also found to significantly increase the number of pollen tubes growing in *C.quamash* whereas honeybees were found to have no effect on pollen tubes.

Furthermore, the visitation of native bees was found to be negatively associated with increased honeybee abundance where it is estimated that 0.03 fewer native bees visited per hour (Fig 2).

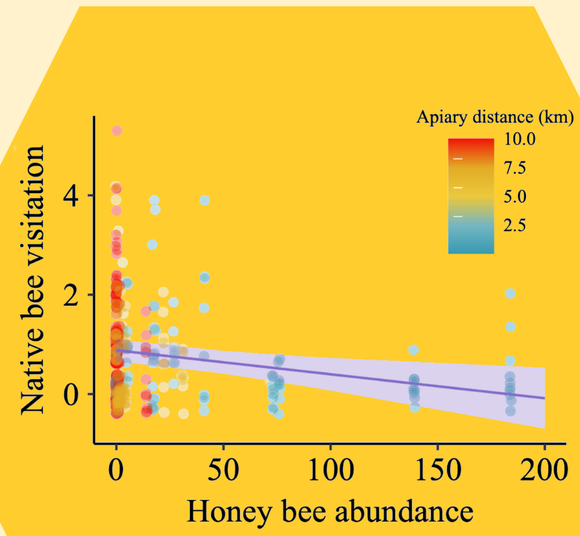


Figure 2: The relationship between native bee visitation (bees per plant per 10 mins) and honeybee abundance (bees per hour per $m^2$). Coloured points show the raw data and purple line and shading show linear effects mixed model and error respectively. As honeybees increased in abundance, the visitation of native bees was reduced at *C.quamash*.

## FUTURE RESEARCH

Future investigations should extend Page and Williams investigation to assess both the direct and indirect effects of honeybees on a range of flowering vegetation. This would allow the indirect effects to be studied under different conditions. Furthermore, future research should investigate whether the negative indirect effects are specific honeybee behaviours or would be the same of any non-native introduced pollinator species.

Lastly, although the honeybees have a negative effect on the pollination of *C. quamash* and the native bees, they may also have positive impacts on other species. The introduction of honeybees has led to increases in host plant abundance[9], highlighting their positive effects on ecosystems. Thus, further investigation should investigate whether their removal would have a more damaging effect.

## CONCLUSION

Page and Williams work revealed some of the negative indirect effects of non-native honeybee introduction[1]. They found that honeybees often 'robbed' the plant of nectar without making contact with the pollen. This meant they were less effective pollinators of *C.quamash* than native bees despite their higher frequency of visits (fig 3).


FIgure 3: Diagram showing the reduced pollen quality leading to reduced plant reproduction resulting from honeybees replacing native bees in pollinating *C.quamash*.

Furthermore, the higher frequency of honeybee visitations to *C. quamash* lead to a more rapid depletion of nectar and pollen resources. The authors hypothesised that this contributed to the competitive exclusion of native bees from these patches, causing them to move elsewhere. This paper was novel in looking at the mechanisms driving the indirect negative effects (resource depletion) however it only focused on one species of plant and therefore, this may not be a suitable proxy for all other systems. Other research has shown that introduced honeybees are effective pollinators of *Pedicularis densispica*, however this paper only studied direct effects[8].

The work of Page & Williams is particularly important due to the widespread nature of introduced honeybee populations globally. There are large, concerted efforts globally to sustain honeybee populations via managed introductions into new habitats, but it is vital to understand what impact these conservation efforts will have on the surrounding ecosystems.
In attempting to preserve this keystone species, we may cause far more considerable damage to numerous other plant and insect species. Research like this allows for a more complete understanding of the ecological impacts at play when introducing a new species, that should be fully considered before action is taken to avoid irreparable damage.

## REFERENCES


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