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- This is the first systematic Australian study of its kind that traces the source of contaminating metals in NSW bees, their honey and wax, as well as in local soils and dust, demonstrating that these pollutants are being recycled into food and ecological systems
- Across Sydney, lead pollution was found to be due to former leaded petrol emissions and was highest in bees from CBD and inner west suburbs, whereas the honey collected from hives across Sydney contained negligible lead, indicating that bees are filtering this contaminant and therefore limiting its passage into honey
- Lead concentrations in honey from Broken Hill city bees were more than ten times the maximum measured in Sydney, and the bees from this region also had much higher lead levels compared to Sydney bees, with the contaminating source identified as ongoing mining emissions in Broken Hill

A new study led by researchers at Macquarie University and published in the prestigious journal *Environmental Science* & *Technology* is the first Australian research of its kind to trace the source of contaminating metals, including lead, in honey bees and their products.

Specifically, the researchers used an isotopic source tracing method to analyse contaminating metals in soil and dust in Sydney in Broken Hill, and for the first time, in bees, as well as their honey and wax.

"The results were unequivocal — they showed clearly the different sources and origins of lead across the study areas. The lead isotopes showed that background honey bees and their products contained natural lead levels, whereas those from Sydney and Broken Hill were clearly contaminated by legacy petrol sources and ongoing mining emissions, respectively," said Professor Mark Taylor, leader of the research team at Macquarie University which undertook the study.

The study found that bees located in inner-city regions of Sydney fared worse than those in other areas, with bees in the CBD, Surry Hills and Newtown possessing 230–440  $\mu$ g/kg of lead. The inner west residential and industrial area of Marrickville had bees with around 150–350  $\mu$ g/kg of lead, and the mixed industrial, commercial and residential land use suburb of Mascot had bees with an average of 263  $\mu$ g/kg of lead. The coastal residential suburbs of Coogee and Randwick fared better, with their bees only possessing an average of 125 and 146  $\mu$ g/kg of lead respectively.

"The suburbs with the lowest lead levels measured in their bees were Galston and Gordon, with 50 and 56  $\mu$ g/kg respectively, which is likely due to the fact that these suburbs are both located near national parks with less legacy contamination from traffic pollution and human activities nearby. We also found elevated levels of other trace contaminants including arsenic, zinc and manganese in Sydney city samples," explained Professor Taylor.

In comparison, Broken Hill bees possessed much higher levels of lead than those in Sydney, measuring concentrations of around 2570  $\mu$ g/kg, and also produced honey with much higher

amounts of lead as well, due to the active mining operations in the region.

"Honey collected from hives across Sydney contained negligible amounts of lead and didn't exceed a concentration of 22  $\mu$ g/kg. However, the amount of lead found in the honey of Broken Hill city bees, which had an average concentration of 295  $\mu$ g/kg, was more than ten times the maximum of the bees measured in Sydney," said Professor Taylor.

"The large difference in honey lead concentration demonstrates that local active sources, such as the ongoing lead mining in Broken Hill, can have a substantial impact on the level of metals measured in local food products and ecological systems. There are very limited contemporary lead emissions in Sydney, which means that air lead levels are approximately 30 times lower than those in Broken Hill, which is why bee contamination was markedly lower," Professor Taylor added.

The researchers also found that dead worker bees were more contaminated than live worker bees, and also that worker bees were more contaminated than drone bees, indicating that contamination accumulates in bees as they forage in the environment and age.

"The fact that their honey contains much less lead than their bodies tells us that the bees are filtering this contaminant and therefore limiting its passage into honey. We do not know if the bees behaviour and activity was impaired by the levels of contamination found. This will form part of our follow-up research," Professor Taylor concluded.

Zhou, Xiaoteng; Taylor, Mark Patrick; Davies, Peter J; Prasad, Shiva. Identifying sources of environmental contamination in European honey bees (Apis mellifera) using trace elements and lead isotopic compositions. *Environmental Science & Technology*. January 2018.

https://lighthouse.mq.edu.au/media-releases/tracing-leadcontamination-in-nsw-bees-and-their-honey