

Honey as a Biological Record of the Environment

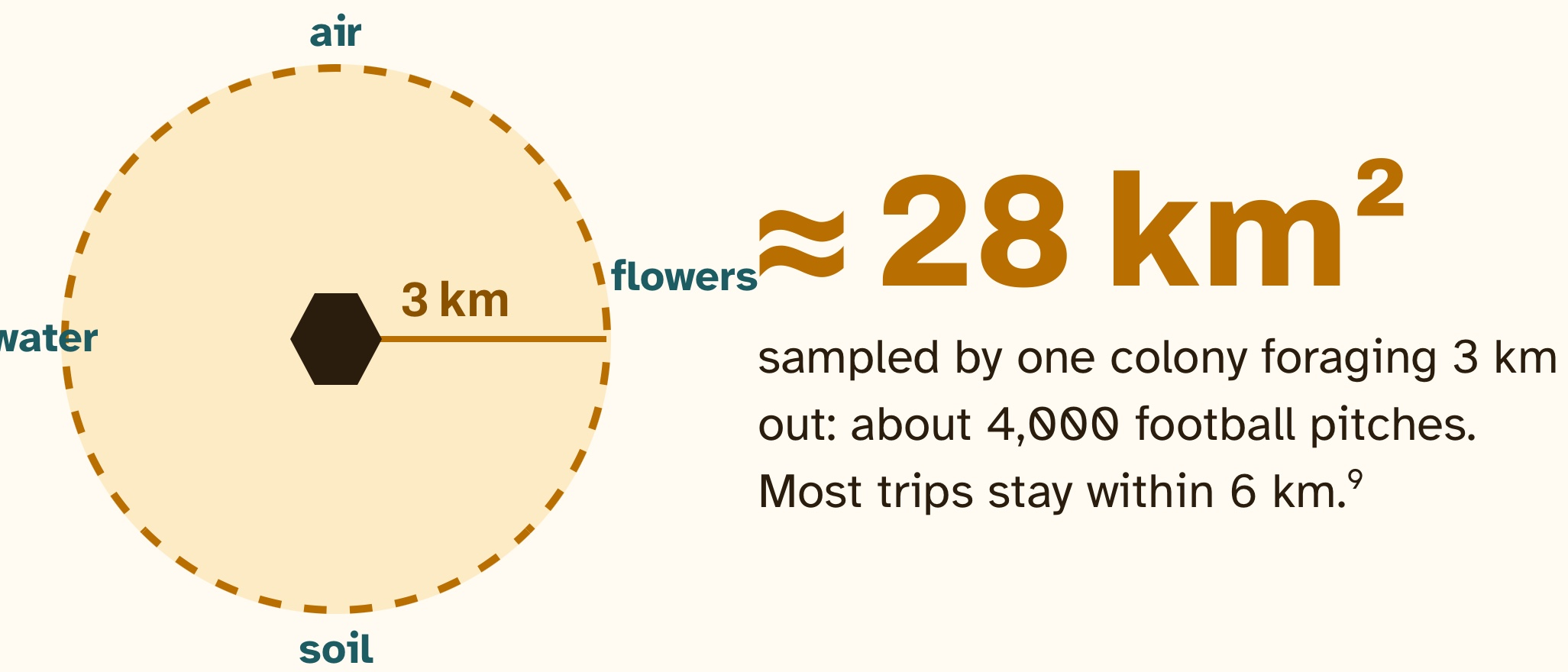
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Introduction

Honeybees fly kilometres from the hive to collect nectar, pollen and water. Along the way they pick up whatever is in the air, soil, water and flowers, and some of it ends up in honey.^{3,4} That makes every jar a small record of its local environment.

Research question: What do contaminants in honey reveal about the environment, and how well can we detect and regulate them?



Approach

A literature review of six peer-reviewed sources (2001–2025), supported by a 198-sample worldwide honey survey⁷ and an EU honey-fraud investigation.⁸ For each contaminant we recorded its source, its route into honey, how it is detected and how it is regulated.

Results

1 · Five kinds of contaminant, five sources

Pesticides	From treated crops. The most common: 150+ compounds found in bee colonies. ⁵
Heavy metals	Lead, cadmium, mercury, arsenic from industry, mining and polluted water. ⁶
PCBs	From coolants, lubricants and motor oil. Persist for decades. ⁶
Antibiotics	From beekeepers treating bee disease. ⁵
Microbes	From soil, dust and handling, e.g. botulism spores. ⁵

2 · Neonicotinoid pesticides found worldwide



Share of 198 honey samples containing at least one neonicotinoid. All were below human food limits, but 48% were above 0.1 ng/g, a level that can harm bees.⁷

46% of 320 honey samples imported into the EU were suspected of being diluted with cheap sugar syrups.⁸

Discussion

Land use leaves a fingerprint. Honey from cities and industrial areas holds more heavy metals than rural or organic honey. Sunflower and canola regions show more pesticide residue.⁶

Not all contamination is environmental. Antibiotics and syrups come from beekeepers and producers, so they must be separated out before honey is read as a pollution signal.^{5,6}

The rules don't match. Pesticide limits for honey differ between countries, and many antibiotics have no honey-specific limit.⁶

Pesticides, antibiotics	GC-MS, LC-MS
Heavy metals	AAS, ICP-MS
Coming next	Biosensors, Raman, portable field kits

How each contaminant is detected. No single test finds them all, so labs combine methods.^{1,6}

Conclusion

Honey is both a food worth protecting and a low-cost pollution sensor. Pesticides are the most common contaminants; heavy metals and PCBs last the longest.

Next steps: faster field tests, shared international residue limits, and long-term honey monitoring to track change over time.

References

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