Air pollution particles may be contributing to dramatic drop in global insect numbers

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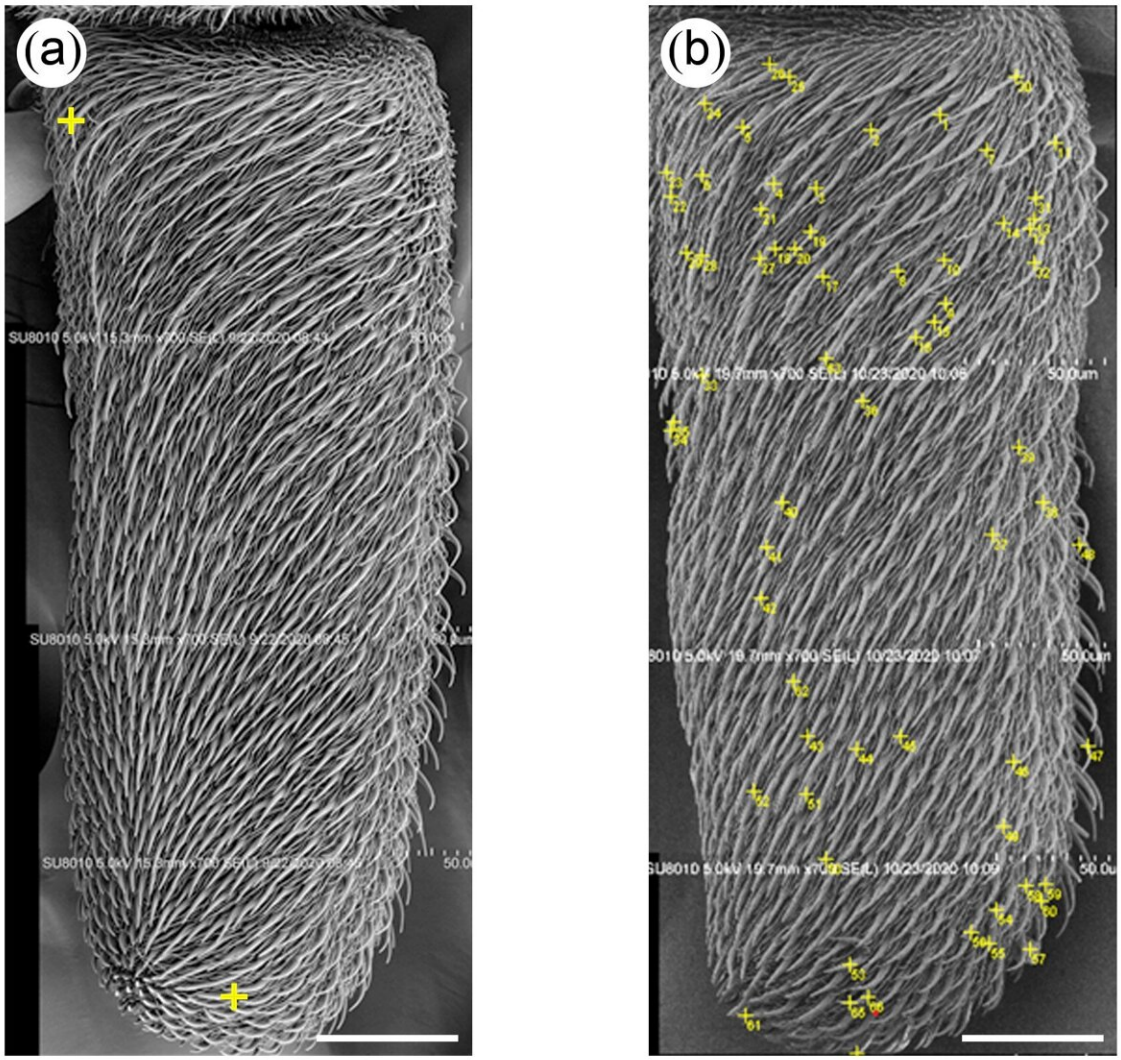

Scanning electro microscopy images of (a) clean and (b) contaminated antennae

of houseflies. Credit: University of Melbourne

The impact of air pollution on insect health and reproduction is greater than previously understood and could be contributing to global declines in insect populations, including in remote wilderness areas, new research shows.

Researchers from the University of Melbourne, Beijing Forestry University, and the University of California Davis report that an insect's ability to find food and a mate is reduced when their antennae are contaminated by particulate matter from industry, transport, bushfires, and other sources of air pollution.

University of Melbourne researcher Professor Mark Elgar, who co-authored the paper published today in *Nature Communications*, said the study was alerting humans to a potentially significant risk to insect populations.

"While we know that particulate matter exposure can affect the health of organisms, including insects, our research shows that it also reduces insects' crucial ability to detect odors for finding food and mates," Professor Elgar said.

"This could result in declining populations, including after bushfires and in habitats far from the pollution source. As well as being fascinating creatures, many insects play a critical role in pollinating plants—including almost all the crops we rely on for food—and breaking down decaying material and recycling nutrients."

The research team conducted several related experiments:

- Using a scanning electron microscope, they found that as air pollution increases, more particulate material collects on the sensitive antennae of houseflies. This material contains solid particles or liquid droplets suspended in air and can include toxic heavy metals and organic substances from coal, oil, petrol, or woodfires.
- They exposed houseflies for just 12 hours to varying levels of air pollution in Beijing and then placed the flies in a Y-shaped tube "maze." Uncontaminated flies typically chose the arm of the Y-maze leading to a smell of food or sex pheromones, while contaminated flies selected an arm at random, with 50:50 probability.
- Neural tests confirmed that antenna contamination significantly reduced the strength of odor-related electrical signals sent to the flies' brains—it compromised their capacity to detect odors.

In addition, continuing research in bushfire-affected areas in rural Victoria has shown that the antennae of diverse insects, including bees, wasps, moths, and species of flies, are contaminated by smoke particles, even at considerable distances from the fire front.

Insect antennae have olfactory receptors that detect odor molecules emanating from a food source, a potential mate, or a good place to lay eggs. If an insect's antennae are covered in particulate matter, a physical barrier is created that prevents contact between the smell receptors and air-borne odor molecules.

"When their antennae become clogged with pollution particles, insects struggle to smell food, a mate, or a place to lay their eggs, and it follows that their populations will decline," Professor Elgar said. "About 40% of Earth's landmass is exposed to particle air pollution concentrations above the World Health Organization's recommended annual average.

"Surprisingly, this includes many remote and comparatively pristine habitats and areas of ecological significance—because particulate material can be carried thousands of kilometers by air currents," Professor Elgar said.

More information: Qike Wang et al, Short-term particulate matter contamination severely compromises insect antennal olfactory perception, *Nature Communications* (2023). DOI: 10.1038/s41467-023-39469-3

Provided by University of Melbourne