

USING PARTICULATES ON HONEYBEES AS A MEASURE OF LOCAL AIR POLLUTION

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INTRODUCTION

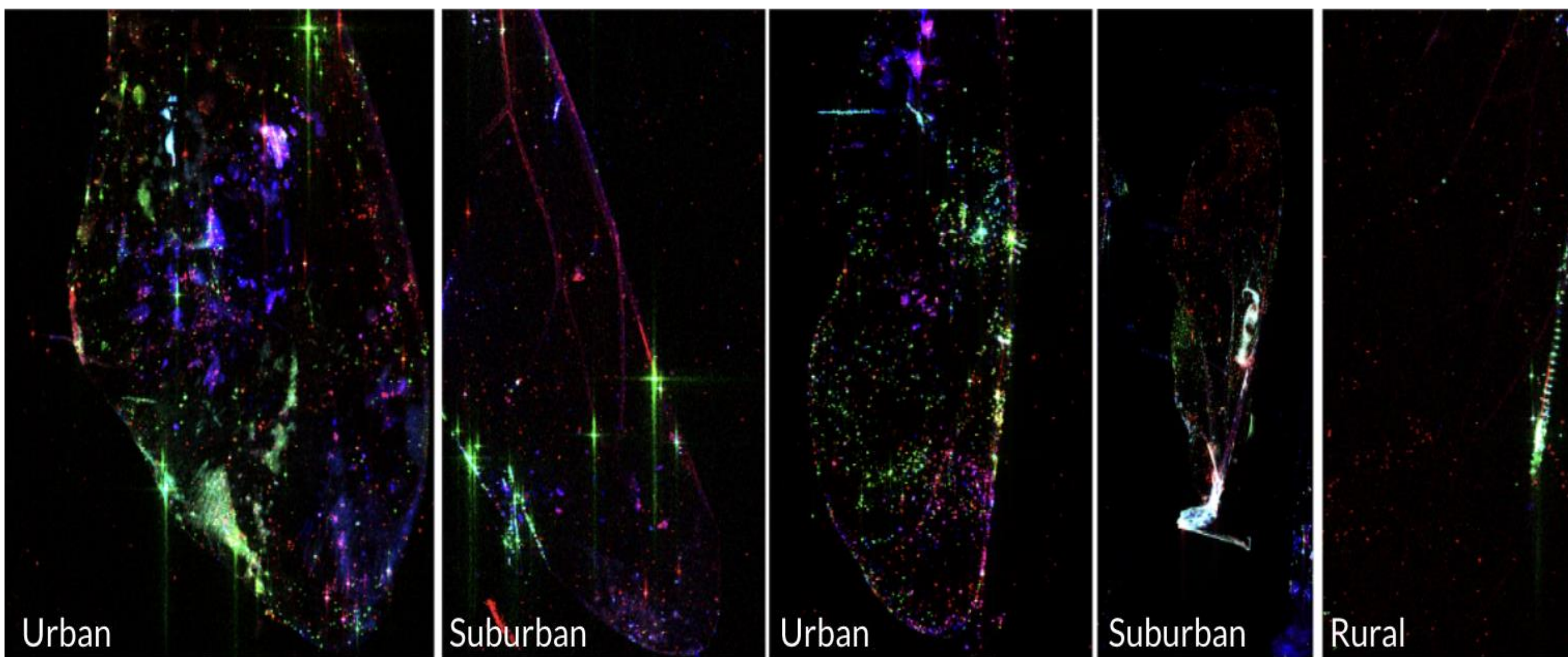
Analyzing metals collected on the wings of worker honeybees can provide insights to air pollution levels and identify pollutants. We collected bees from five areas ranging from dense urban neighborhoods to rural farmland. We then analyzed the forewings and hindwings of these bees using the Advanced Photon Source (APS) to identify metals which had accumulated on them using X-ray fluorescence spectroscopy (XRF). The bees collected from urban areas carried significant amounts of copper, zinc, iron, chromium and nickel. The bees from rural areas still carried some of these metals, but in far fewer quantities. From our data, we can conclude that while urban and rural areas contain similar metals in the environment, the quantity of metal is much higher in urban areas.

RESEARCH QUESTIONS

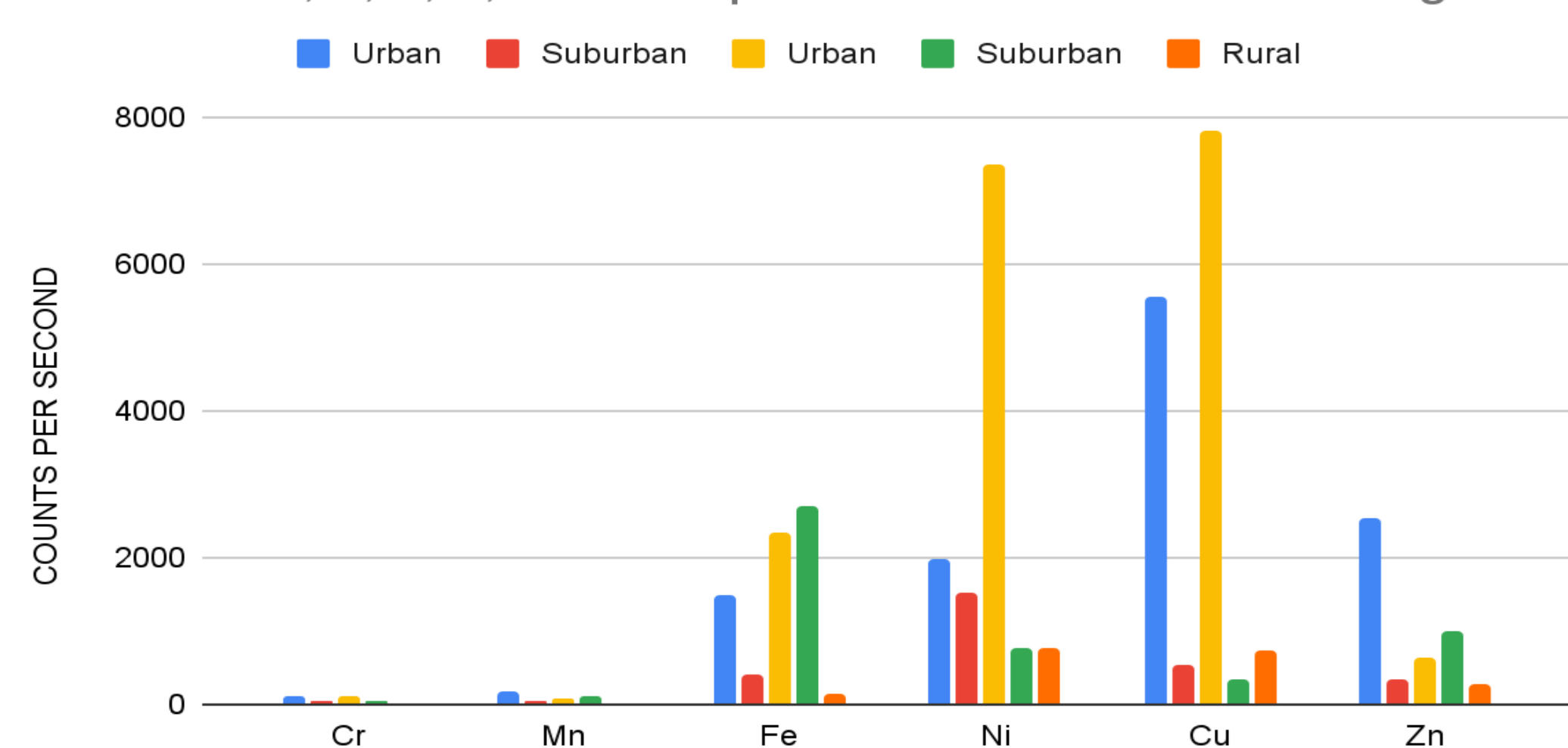
- Are metals present on the wings of honeybees and can their concentrations be measured using the APS at Argonne?
- More specifically, which metal elements are found on the wings of these honeybees?
- Is there a correlation between metals found on the bee wings in Chicago vs its more rural surrounding communities, and if so, could that be a result of different levels of air pollution?

RESULTS

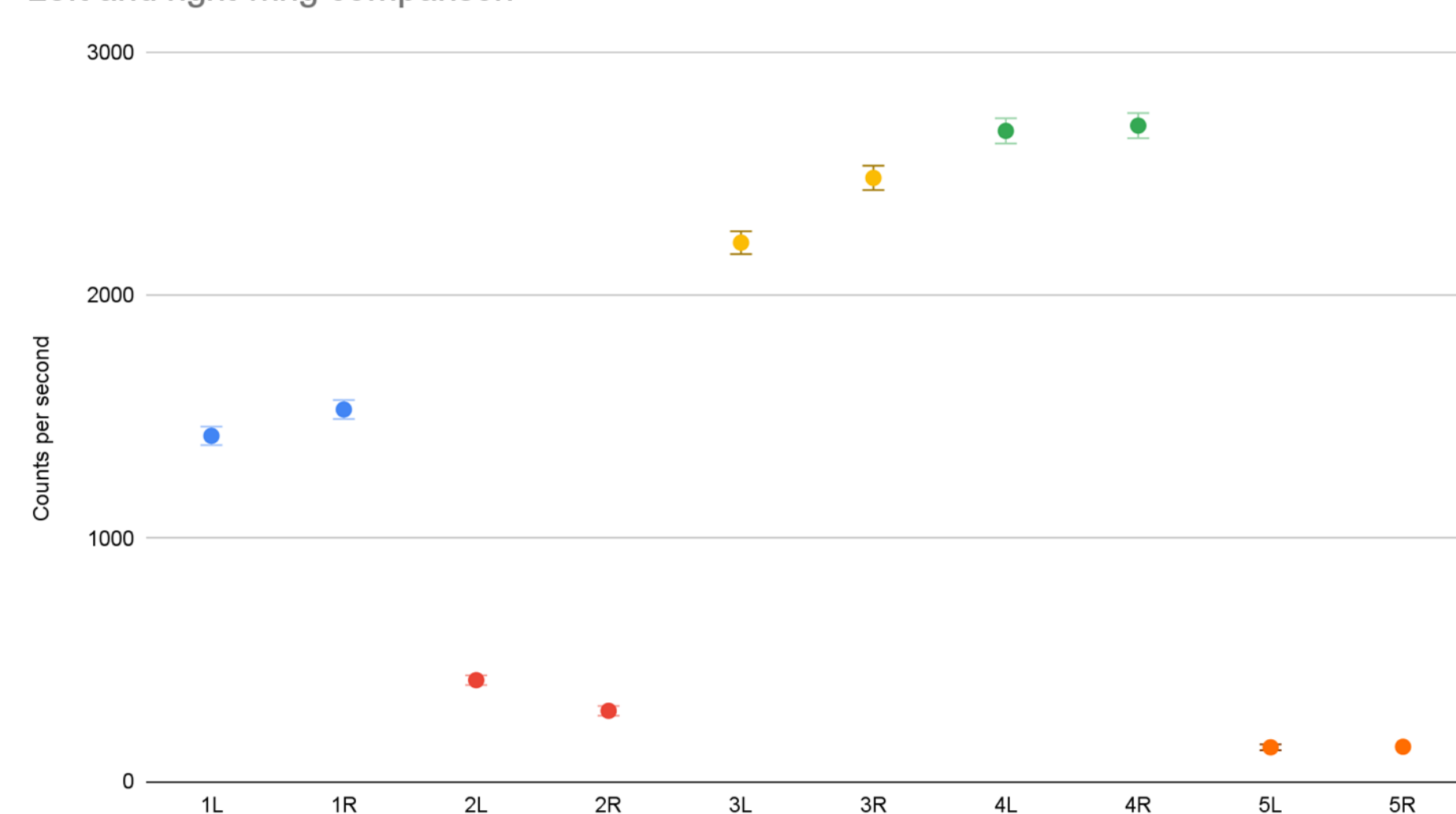
- Across all locations, traces of Cr, Mn, Fe, Ni, Cu, and Zn were detected on the wings, and there was little variation between left and right wings from each location
- Cu varied the most, with urban areas having noticeably higher counts than both suburban and rural



Locations 1, 2, 3, 4, 5 counts per second across whole wing



Left and right wing comparison



CONCLUSIONS

- Our results showed that urban areas tended to have higher concentrations of Cu and Ni, indicating that those areas have more Cu and Ni in the atmosphere to latch on to bee wings
- Rural and Suburban areas have less metallic elements in the atmosphere than those in Urban areas

FUTURE STEPS

- Collect data from more areas
- Differentiate between internal and external sources of metal on wings
- Look into particulate size and try to map to local sources of pollution

References

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EXPERIMENTAL METHODS

- Samples of multiple honeybees were obtained from five different apiaries within a 120 mile radius around Chicago
- Three of the collected samples were from rural (or suburban) apiaries (2,4,5) and two from urban apiaries (1,3)
- All honeybees were collected as living samples, which were then stored in Eppendorf tubes in a deep freezer for multiple weeks
- Using tweezers and scalpels, a pair of wings was removed from one honeybee from each of the apiary locations
- In total, ten wings were analyzed using the APS: one right wing and one left wing from each apiary location
- Each wing was mounted to metal- and halogen-free tape for analysis
- Using beamline 13-ID-E at an energy of 11,950 eV, the APS provided elemental analysis of the honeybee wings samples through X-ray fluorescence
- Using the software *Larch*, we created 4 mm by 5 mm maps of the wings using a 0.01 mm step and a dwell time of 10 msec per pixel. The maps were analyzed for the presence of specific metals