FFR120 Simulation of Complex Systems | 2025-12-08

Pollution Impact on Honeybee Pollination

Studying how air and light pollution impact honeybee navigation, the efficiency of pollination, and plant biodiversity

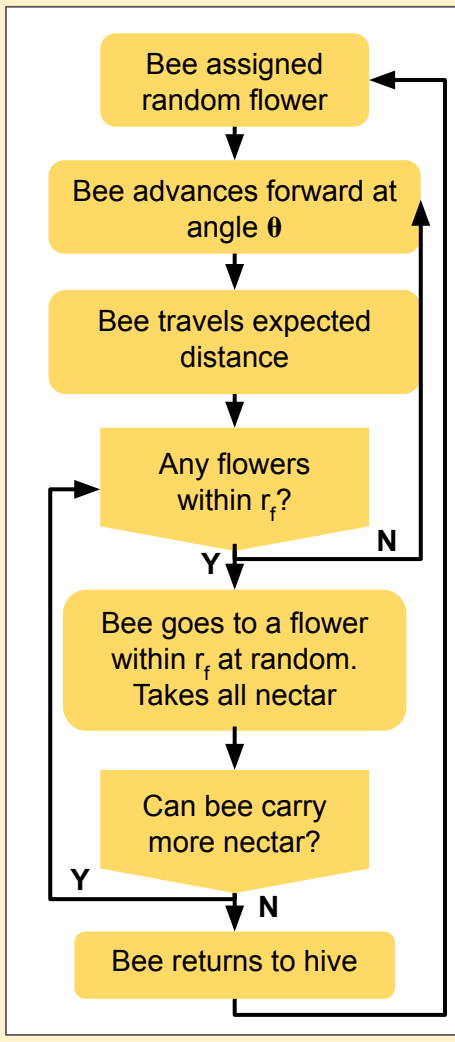
Benjamin Billton, Augusta Fhager, Abigail Kruegle

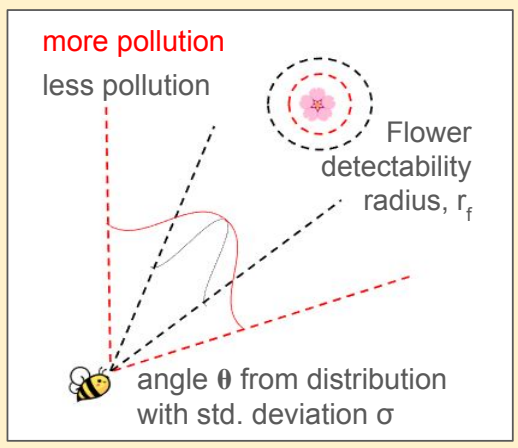
Why does it matter?

Pollination services are essential for global food production and biodiversity, and may contribute more than €200 billion annually to the global economy [1]. Pollinating animals are impacted by rising levels of environmental pollution. We hope to understand how pollution affects honeybee and plant ecosystems, so we can better support this complex system.

Method: Agent Based Modeling

Pollution	Honeybee Impact	Method of Modeling
Disrupts polarized light	Harder for bees to directionally navigate	Increased angle variability σ
Disrupts flower odour	Harder for bees to find local flowers	Decreased flower detectability radius, r_f



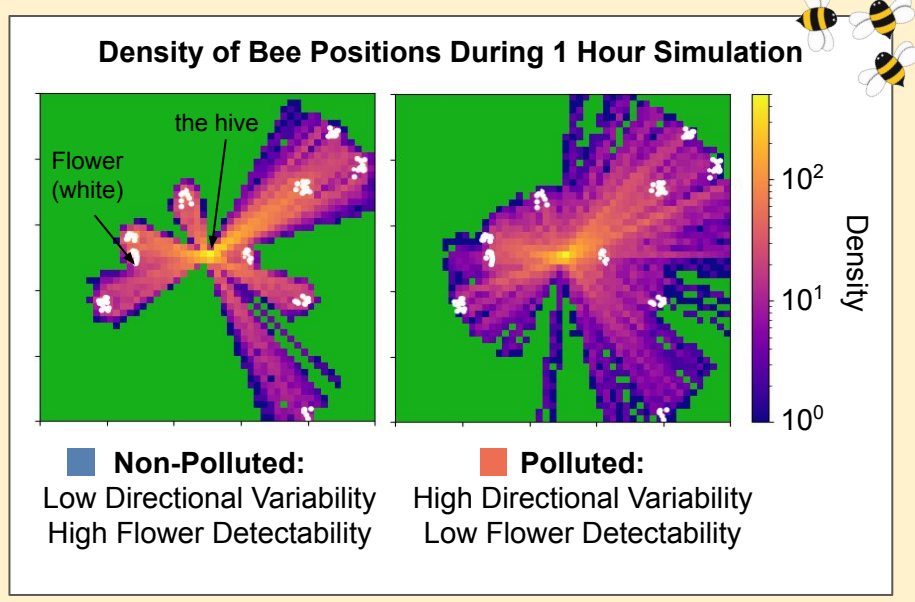


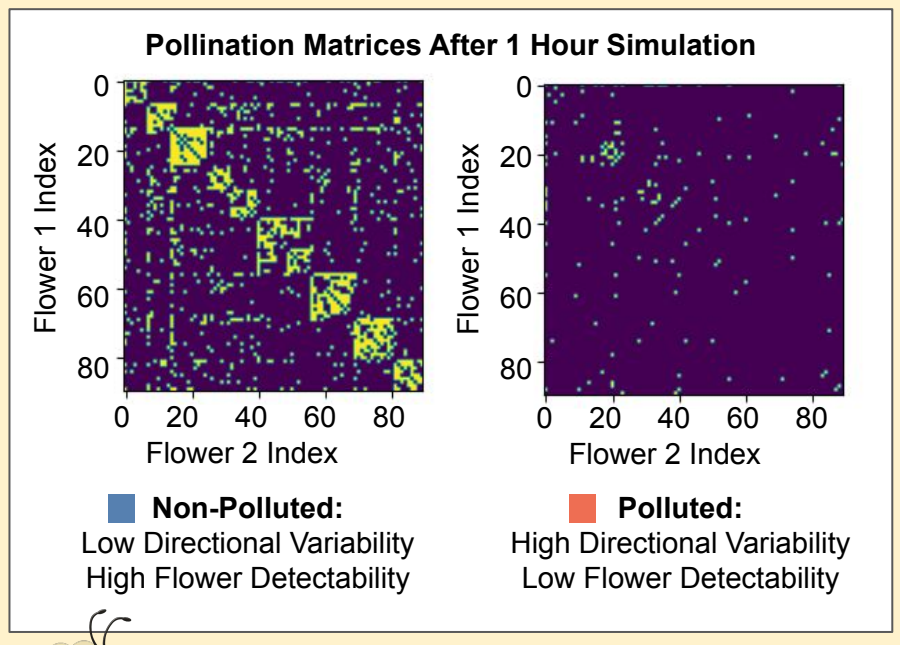
Success Metric:
Pollination Score, P

$$P = \frac{1}{N_{bees}} * \sum d_{pollination}$$

Local biodiversity tends to increase as flowers cross-pollinate across greater distances

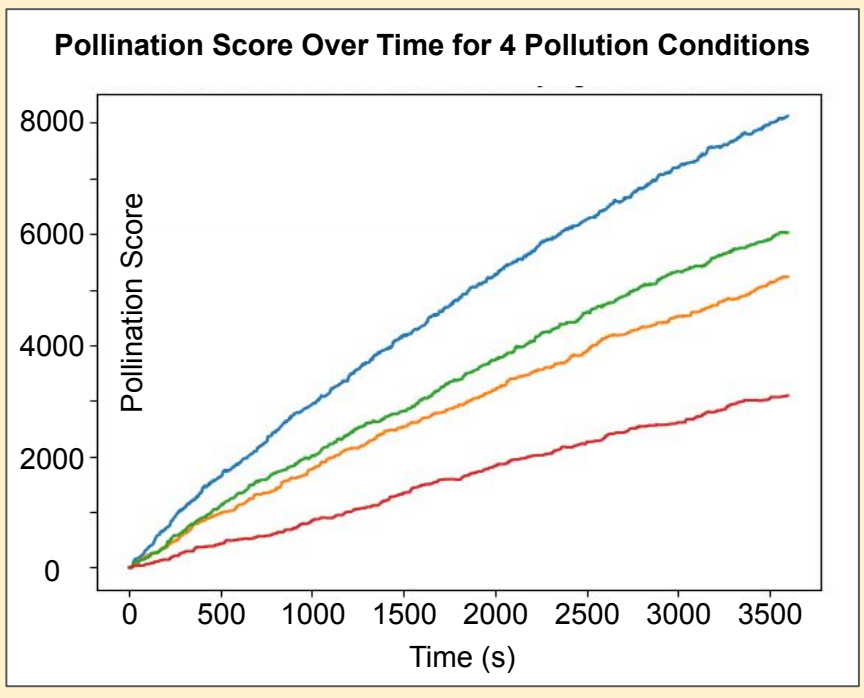
Simulation Findings

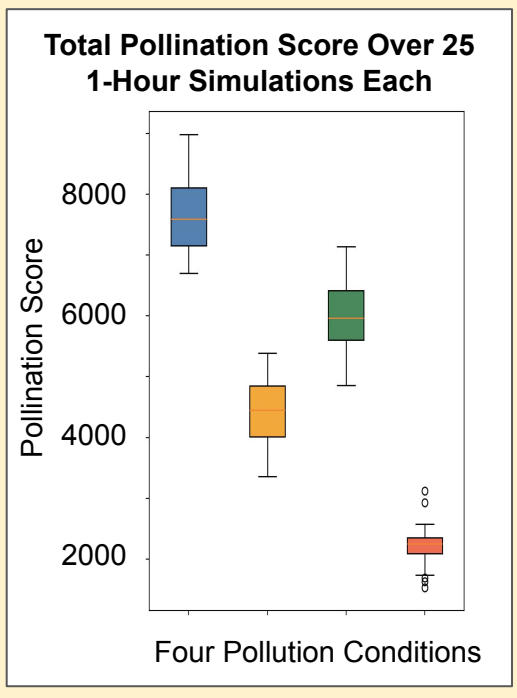




Results

Good Direction, Good Detection
Good Direction, Poor Detection
Poor Direction, Good Detection
Poor Direction, Poor Detection





Conclusions

More pollution
↓
Greater uncertainty of direction and smaller flower detection range
↓
Fewer distant flowers visited in the same amount of time
↓
Lower pollination score
↓
Interpreted as less biodiversity

References
[1] Newton, Adrian C. et.al (2019). Impacts of deforestation on plant-pollinator networks assessed using an agent based model.