

How late-summer forest access affects *Bombus impatiens* colony success and floral preference

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INTRODUCTION

Bumble bee colonies need a constant supply of floral resources over several months

Bee habitat maintenance mainly focuses on open meadow habitats (Goulson, 2009)

Forests provide key resources like nesting and spring forage (Mola et al. 2021) but may also provide late-summer flowers

Forest blooms may be closer to the nest and less water-stressed than open habitat blooms (Webb et al. 1978)

Late-summer flowers may support bumble bees as they produce the next generation (gyne)

HYPOTHESES

Both forest and open habitats contribute substantial and different late-summer floral resources to bumble bees

Bumble bees prefer forest flowers to open habitat flowers in late-summer

Colony fitness increases with forest cover and forest floral resources

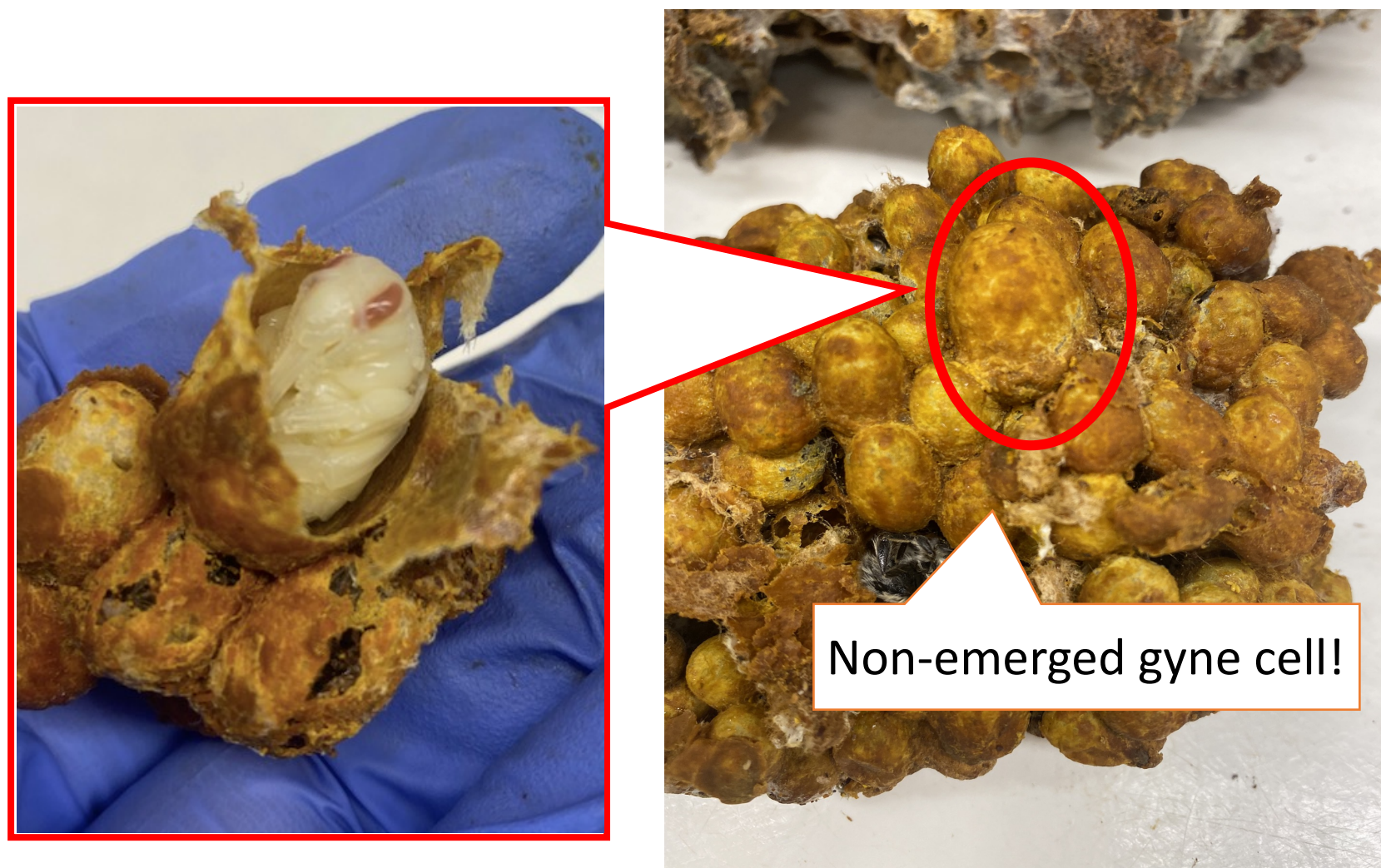
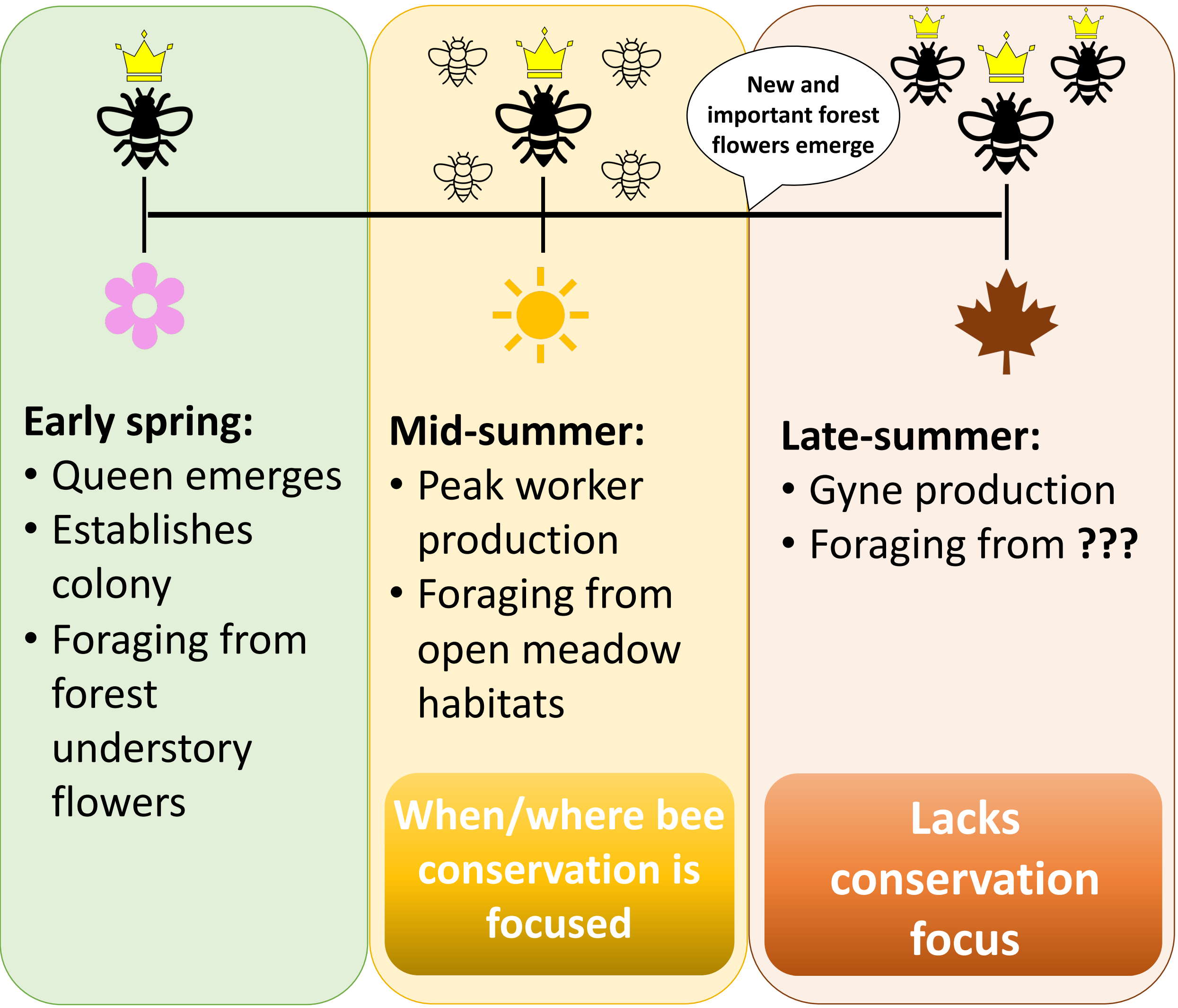


Figure 1: A look into a non-emerged gyne cell from a placed bumble bee colony.

Unknowns in the Bumble Bee Colony Timeline



METHODS

- Placed *Bombus impatiens* colonies within 10 m of forest edge at 10 sites that varied in forest composition (Fig. 2, 3)
- Quantified flowers and foraging wild bumble bee floral use along 100 m transects in forest and open habitats weekly
- Euthanized colonies and counted total brood and gyne cells after 6 weeks (Fig. 1)
- Calculated selection indices for floral species using use/availability data (Lanterman et al. 2023)

Percent forest within 1km

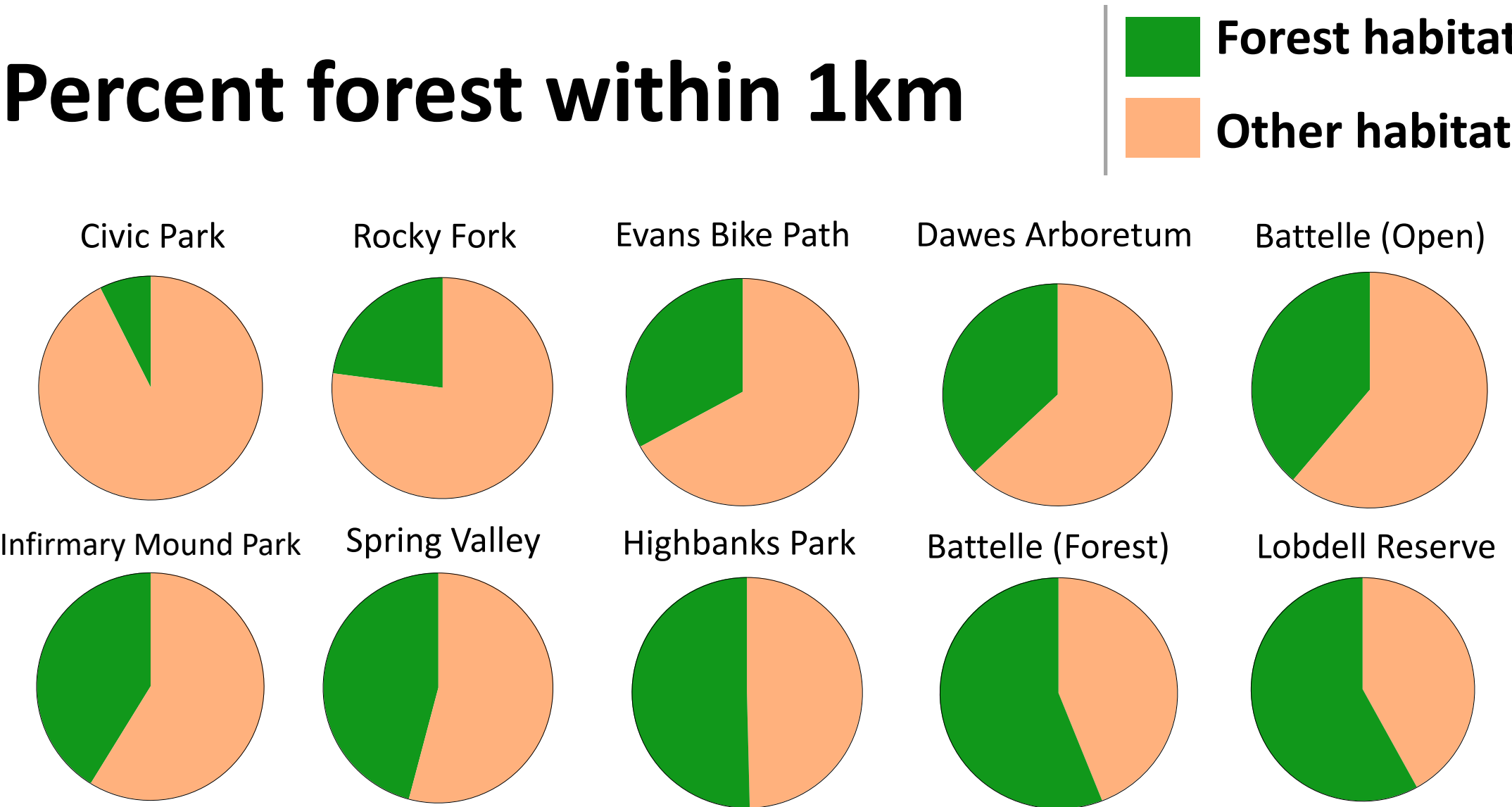


Figure 2: Percent of land cover classified as forest within 1000 m radius of placed colony. Classified using the NLCD and calculated using ArcGIS Pro.



Figure 3: A look into the basin of a pollen trap, filled with pollen collected by foraging bumble bees (Left). How sentinel colonies were set up in the field at each site (Right).

RESULTS

- Forest had 18 unique flower species and shared 4% of species with open habitat
- Forest and open habitats offered similar flower abundance (Forest = 47%, Open = 53%, $t = 0.74$, $df = 1$, $p > 0.05$)
- Average use of forest flowers was significantly more than open habitat flowers ($F_{2,20} = 11.93$, $p < 0.05$)
- Bumble bees preferred 10 flower species, 3 of which are found in forests (Fig. 4)
- Total brood and gyne cells were not significantly affected by amount of forest cover and forest resources ($F_{1,1} = 2.4$, $p = 0.18$, $F_{1,1} = 0.75$, $p > 0.05$)

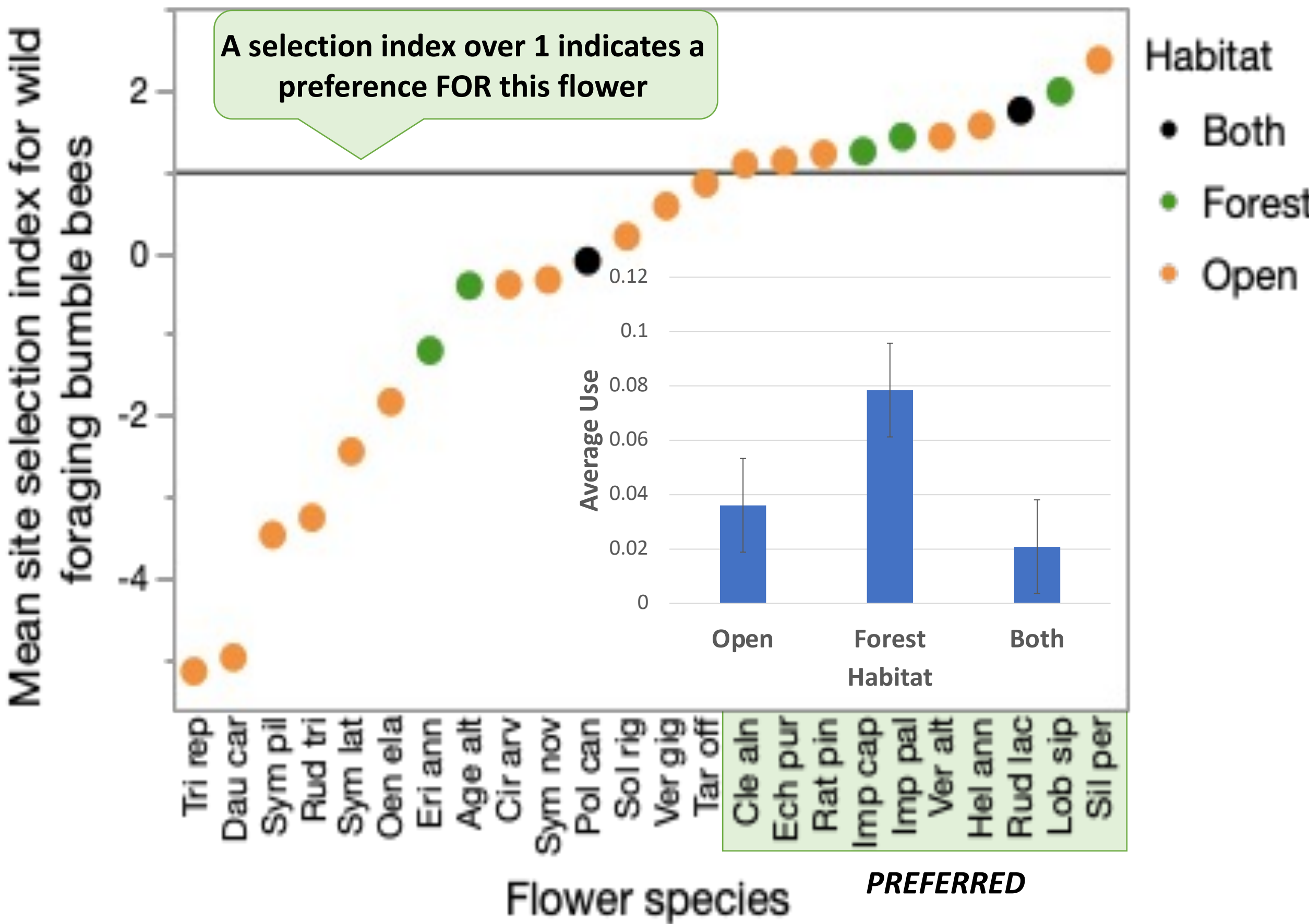


Figure 4: Mean site selection index for each flower species found. (Inset: Average use for flower species found in forest, open habitats, and both habitats).

DISCUSSION

- Forest supports an important stage in a bumble bee colonies life cycle, gyne production
- Wild bumble bees use resources from both forest and open habitats in late-summer
- Overall, bumble bees showed a preference for forest flowers over open habitat flowers
- Nevertheless, sentinel colony productivity did not increase with forest cover or forest floral resources, suggesting different foraging patterns than wild bees
- Analysis of pollen samples from each colony will add to this story, showing exactly where workers from each colony were foraging

Preferred Forest Flowers



Figure 5: Some forest flowers preferred by bumble bees. (Left) *Impatiens capensis* (Jewelweed). "Orange Jewelweed (Impatiens capensis)" by wackybadger is licensed under CC BY-SA 2.0.(Right) *Lobelia siphilitica* (Great Blue Lobelia). "File:Lobelia siphilitica 10zz.jpg" by Photo by David J. Stang is licensed under CC BY-SA 4.0.

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