


Nesting Patterns of Cavity-Nesting Bees and Wasps

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Introduction

The vast majority of bee species (over 90%) are solitary, and of those solitary bees around 30% make nests in the pits and holes in wood, hollow stems, stone walls, and other small, pre-made cavities they can find (Xerces Society, n.d.). A great majority of wasp species are also solitary (O'Neill, 2001). These bees and wasps, known as "cavity nesters," lay their eggs in the cavities and provision them with food for their larvae. They seal off the cavity with a cap composed of mud, leaf cuttings, or grass where the larvae develop and overwinter, emerging as adults in the spring and summer to repeat the process.

By placing artificial "bee tubes" made of hollow reeds out in the environment, we can study the patterns of where, when, and how different cavity nesters make their nests (Staab et al., 2018). For our study, we monitored tubes in five locations on the SUNY Geneseo campus: two in an area of our Arboretum with a native plant garden (referred to as Arboretum and Bee Barn), a wildflower meadow next to woods in the Arboretum (Meadow), a larger unmanaged open field (the No-Mow Zone), and a community garden bordered by manicured sports fields (the eGarden).

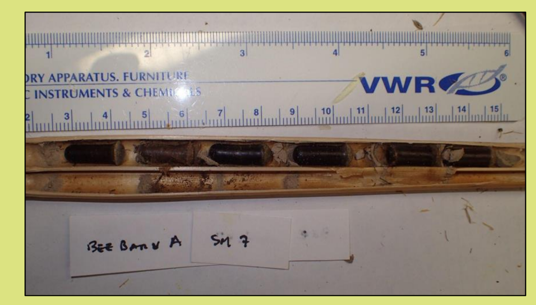
Methods

We placed two "bee boxes" in each of our locations (except at the Bee Barn, which had six). Each contained 20 "bee tubes" with diameters of either about 8mm ("large") or 6mm ("small"), each individually labeled with a color and a number. To avoid colonization by exotic mason bees (*Osmia spp.*) which nest in the spring, we did not put our tubes out until the end of May (Hoare et. al, 2022).

From the end of May until the beginning of October, we observed and photographed the tubes once a week as they became partitioned and sealed off to form larval cells. We recorded the type of material used to seal them, any visible inhabitants, and the extent of fill in each tube.

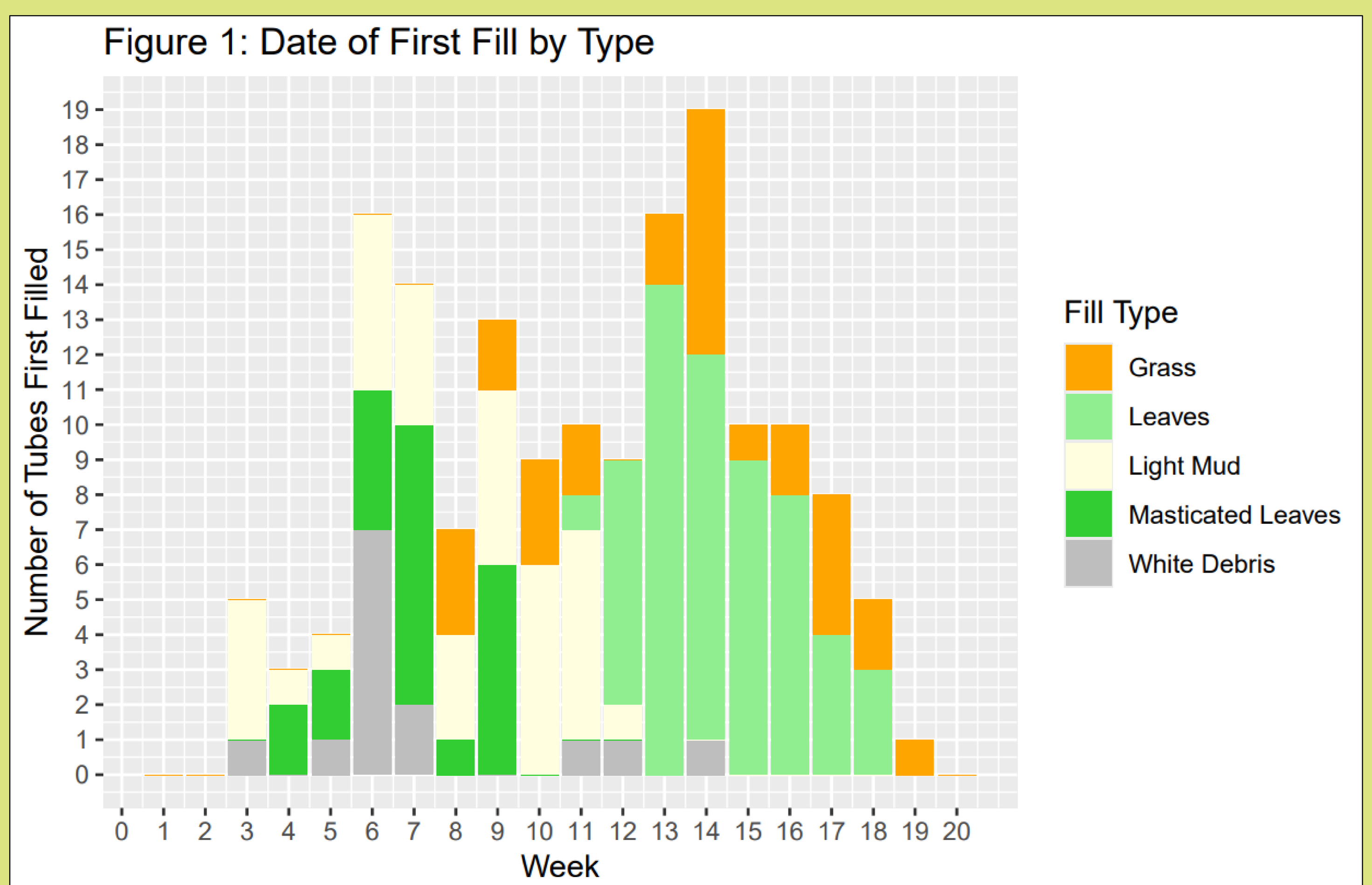
Over the winter we dissected the tubes to determine their inhabitants and recorded the order, number, and identity of all the inhabitants in each tube, as well as any parasites or other co-inhabitants we found in the tubes with them.



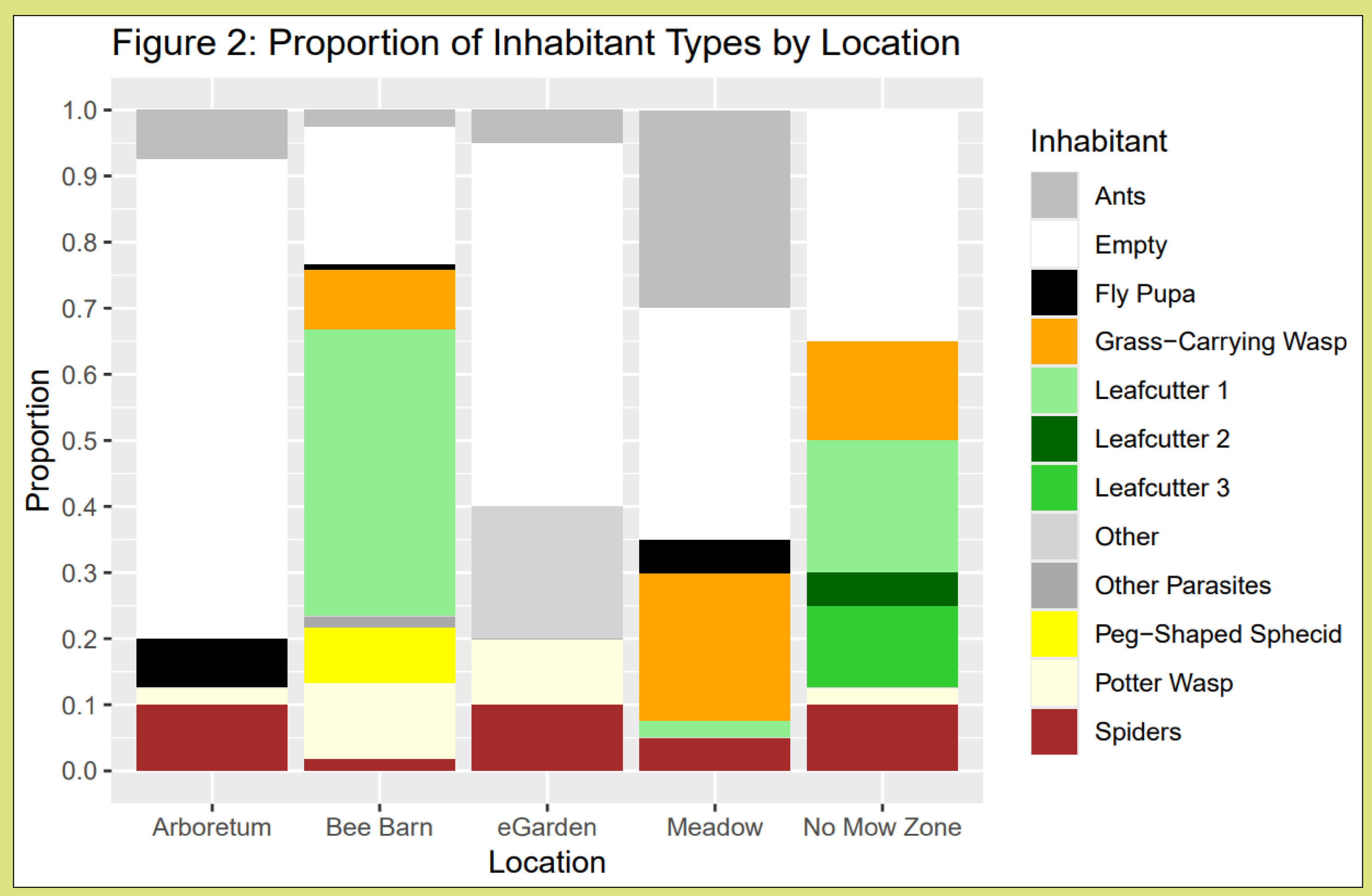


Results

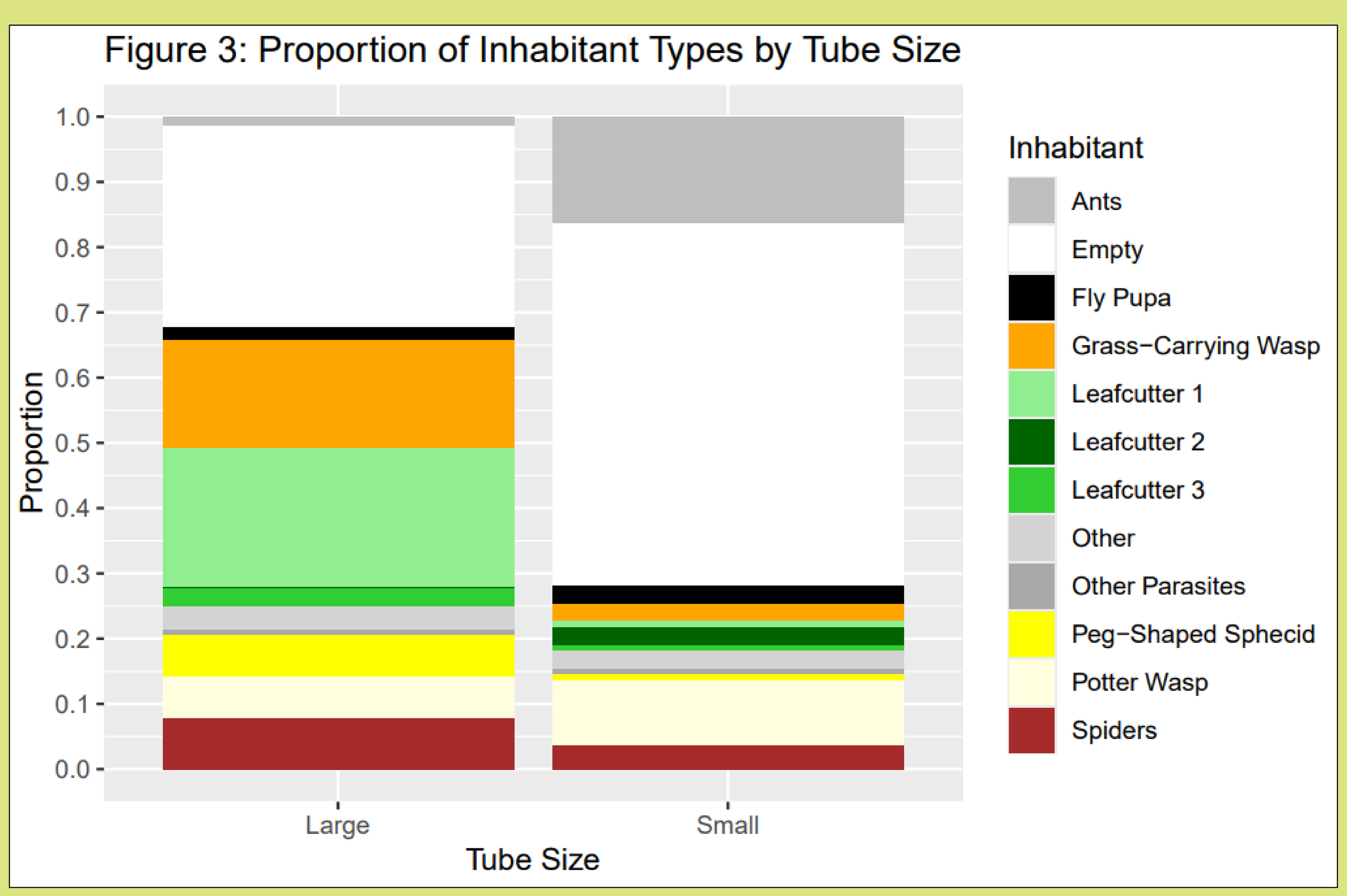
Tubes colonized in the first half of the summer were filled primarily with light mud , while tubes from the second half were filled with leaves or grass.



Leafcutter bees were most common in the Bee Barn, grass-carrying wasps dominated the Meadow, and the eGarden was dominated by potter wasps.



Most bee and wasp taxa preferred to inhabit larger bee tubes, with the exception of potter wasps. Conversely, most ants preferred smaller tubes.



The average number of offspring per tube and the number and variety of parasites differed between different inhabitant types.

Table 1: Average number of individuals per tube by inhabitant type

Inhabitant type	Grass-Carrying Wasp	Potter Wasp	Peg-Shaped Sphecid	Leafcutter Bee 1	Leafcutter Bee 2	Leafcutter Bee 3
Mean	3.21	4.5	4.2	2.55	6	7.4
Std dev	1.25	2.21	1.23	1.21	0	2.88
N	26	20	10	31	2	5

Table 2: Instances of parasitism by host inhabitant type

Parasite Type	Grass-Carrying Wasp	Potter Wasp	Peg-Shaped Sphecid	Leafcutter Bee 1	Leafcutter Bee 2	Leafcutter Bee 3
Fly Pupae	4	5	-	-	-	-
Mites	1	3	-	-	-	-
Parasitic Wasps	-	2	-	-	-	-
Beetle Parasite	-	-	1	1	-	-
Other Parasites	-	3	-	2	-	-

Discussion

Different taxa colonized the tubes at different times throughout the summer

Tracking the dates when each tube first was occupied allowed us to see that the active occupants in the first half of the summer differed from those in the second half of the summer (Fig. 1). The active occupants in the first half of the summer primarily filled the tubes with mud caps, while the second half of the summer involved a greater use of grass and leaf material. Based on our dissections, we determined the early, mud-utilizing inhabitants to be a mix of potter (or mason) wasps (Eumeninae) and an unidentified sphecid wasp with peg-shaped pupae. On the other hand, leafcutter bees (Megachilidae) and grass-carrying wasps (Sphecidae) were more common in the second half of the summer.

Differential access to vegetation determined location preferences

We also found that different habitats attracted different taxa. In particular, the grass-carrying wasps showed a strong, and unsurprising, preference for locations with easy access to large quantities of unmowed grass, as evidenced by its overrepresentation at the Meadow and No-Mow Zone locations (Fig. 2). The Bee Barn tubes showed the most overall taxa diversity, although this might be due to the larger sample size of tubes at that location. Leafcutter bees were also overrepresented at this location compared to the other locations, indicating a possible preference for the more diverse floral resources provided by the nearby native plant gardens. In contrast, the single bee boxes in the Arboretum near the Bee Barn had significantly fewer residents overall. which may be a result of the boxes suffering from disturbance from a nearby nesting bird, infestation by ants, and their relative isolation. The eGarden also had a relatively small number of bee and wasp inhabitants, possibly due to a lack of native vegetation in the area and its isolation from more natural habitats by manicured lawn. The few inhabitants there were potter wasps, which used mud, not vegetation, to cap their tubes.

Most taxa preferred large tubes, except for potter wasps

Analysis of tube size preference showed an unexpected preference by most taxa for larger tubes (Fig. 3). The grass-carrying wasps preferred the larger tubes as their eggs were laid alongside tree cricket provisions. They took up the whole tube completely. Leafcutters and the peg-shaped sphecid pupae were also more commonly found in the larger tubes, but notably the potter wasps were more frequent in the smaller tubes. These larvae have little to no protection or form of cocoon to protect themselves, which may explain why the adults preferred tighter space to lay their eggs. The aversion to small tubes by most taxa may also be related to the fact that ants, whose presence suppresses colonization by bees and wasps, preferred to colonize small tubes.

Additional analyses of the data we collected may improve our understanding of the nesting patterns of these important animals, including more detailed analysis of the phenology of specific occupants of individual tubes, rather than the broader, family-level analysis performed here. This analysis will be aided by rearing occupants this spring to determine their genus- or species-level identities. This research can serve as a very useful base of knowledge for future work on native cavity-nesters.

References

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