Timing of Use of Artificial Nests by Exotic Mason Bees

Stephen Hoare, Rachel Williams, and Kaitlyn Latorre

Faculty mentor: Jennifer Apple

Department of Biology, SUNY Geneseo

Introduction

Artificial nests for bees are becoming increasingly popular on the internet and at gardening stores (MacIvor and Packer 2015). These artificial nests are built to promote solitary bees, like mason bees and leafcutter bees, which use hollow cavities to rear their brood (LeCroy et al. 2020). Unfortunately the results of artificial bee nesting are not entirely positive: in a study of bee hotels in Toronto, Canada, just under half (47%) of the bees using the artificial nests were exotic (MacIvor and Packer 2015). In recent years the exotic mason bee species *Osmia cornifrons* and *Osmia taurus* have been increasing in abundance in the Eastern United States (LeCroy et al. 2020).

In spring 2020 boxes of hollow tubes for cavity-nesting bees were established at locations across SUNY Geneseo in order to support native bees (Fig. 1 and 2) and survey bee diversity (Menendez and Apple 2021). When tubes were dissected in spring 2021 and adult bees were allowed to emerge, we discovered many to be exotic (Fig.3)**.** We thought that in order to maximize support for native bee species while minimizing support for exotics, bee tubes could be set out later to prevent use by the earlier emerging exotic mason bees (Fig. 3). We used nest tube occupancy and bee survey data from 2020 and 2021 to evaluate the success of this strategy.

Fig 1. Native mason bee perched near a nest box.

Fig 2. Native leafcutter bees exiting pupal cases.

Fig 3. Exotic *Osmia* emerging from nest tube**.**

Methods

Artificial nests

In spring of 2020 boxes containing hollow tubes for cavity-nesting bees were established at 4 locations across SUNY Geneseo (Fig. 4). The locations included the back meadow and gazebo area of the Spencer J. Roemer Arboretum, the eGarden, and the no-mow-zone on the southern end of campus. In 2020 the tubes were set out in late April and one-third of these tubes were recovered in the fall for dissection and identification of occupants (Menendez and Apple 2021). In 2021 new tubes were set out at two dates: half on May 25-27 and the other half on July 13. All of the tubes were recovered in November of 2021 for dissection and identification of occupants (Fig. 5). Nest tube boxes were repeatedly photographed to record patterns of tube filling and emergence of bees. A large number of *Osmia* emerging from artificial nests were preserved and later examined to determine the relative abundance and sex ratio of two exotic *Osmia* species, *Osmia taurus* and *Osmia cornifrons*. Occupation of artificial nest tubes set out earlier in April 2020 and later in May 2021 was tracked in order to determine timing of artificial nest use by native and exotic species.

Bee bowl surveys

During spring and summer of 2021, 24 4-oz plastic containers, colored either blue, yellow, or white and filled with soapy water, were placed at 4 different locations around the SUNY Geneseo campus and allowed to sit for 9 hours (Fig. 6). Bees, wasps, and other insects attracted to the bowls and trapped in the soapy water were preserved and later identified. Bee bowl surveys began in late April, in order to detect earlier emerging mason bees, and continued into the summer. Data from these surveys was used in order to determine timing of both exotic and native mason bee species.

Fig 4. Pair of wooden boxes containing natural reed tubes.

Fig 5. Dissected nest tube.

Fig 6. Insects trapped in a bee bowl.

Results

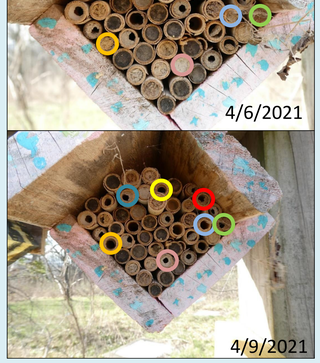


Fig 7. Photographs of nest boxes at the gazebo site of the Spencer J. Roemer Arboretum during April. Colored circles indicate tubes that developed new holes between April 6 and April 9, indicating emergence of bees in early April.

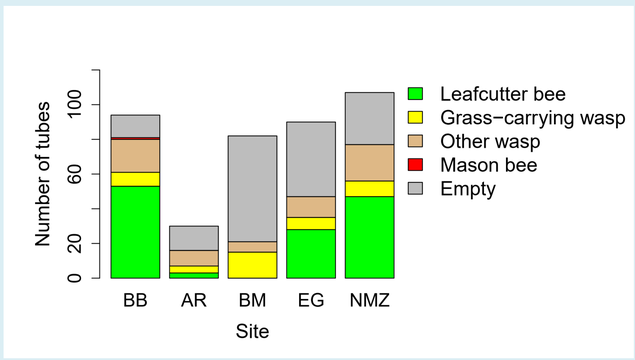


Fig 8. Results from dissection of tubes set out after May 27, 2021. Except for BB, the "Bee Barn", tubes were distributed in 3 pairs of boxes per site. AR=the Arboretum near the gazebo, BM=the back meadow of the Arboretum, EG=eGarden, NMZ=no-mow-zone. The Bee Barn, is a structure with 12 nest boxes near the Arboretum gazebo. Data are counts of tubes that were either empty or had living occupants that could be identified.

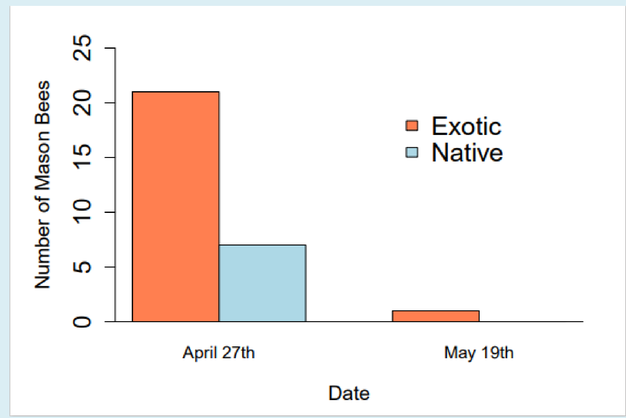
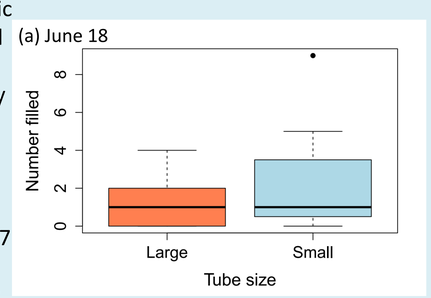
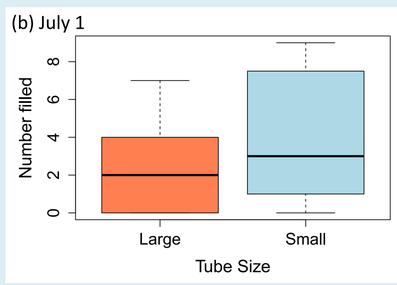


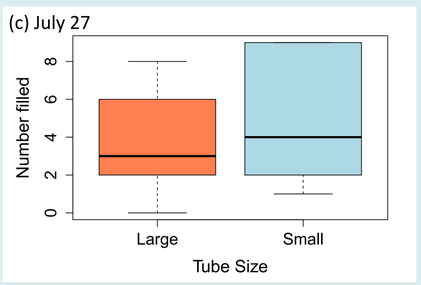
Fig 9. Results of bee bowl surveys from spring 2021. All mason bee activity declined substantially between April 27 and May 19 (χ^2= 38.724, df = 3, p<0.001). The majority of mason bees were recovered from sites within the Arboretum (89.65%).

Fig 10. Occupants found during dissection of tubes. (a) Tube with mason bees, (b) tube with leafcutter bees, (c) tube with grass-carrying wasp, (d) tube with other wasp, likely a spider wasp.

Fig 11. Large diameter (8 mm) tubes that are typically preferred by mason bees, including the exotic species, were less likely to be filled than tubes of small diameter (6 mm) that are typically preferred by leafcutter bees. (a) Tubes filled by June 18 (paired t = 2.073, df = 14, p=0.057), (b) Tubes filled by July 1 (Wilcoxon signed rank test: V = 9, p= 0.035), (c) Tubes filled by July 27 (paired t = -1.929, df = 13, p= 0.076). All tubes pictured were set out on May 27.







Discussion

Bees can emerge from artificial nest tubes in early April (Fig. 7), and in 2021 we found the first bees emerging were exotic *Osmia* mason bees. From April 13 to May 3, 2021, 409 exotic *Osmia taurus* and 27 exotic *Osmia cornifrons* were captured emerging from artificial nesting. *O. taurus* was over 15 times more common than *O. cornifrons*. This confirms trends found in other studies that found the population of *Osmia cornifrons* to have stabilized while the population of *Osmia taurus* continues to increase at a rate of approximately 17% per year (LeCroy et al. 2020). Mason bees were most active during April (Fig. 9). Since the majority of mason bees trapped in bee bowl surveys were exotic (Fig. 9), the best tactic for limiting aid to exotic bees would be to set out tubes after heightened activity levels in late April. This was shown to be at least partially effective. When tubes were set out in late May, the number of small tubes filled outnumbered the number of large tubes filled (Fig. 11). This indicates greater use of artificial nesting by leafcutter bees, which prefer small tubes, over mason bees, which prefer large tubes. Dissection of nest tubes set out after May 27, 2021, also confirms this: leafcutter bees were found to dominate the bee occupants and only one instance of a mason bee occupying a tube was found (Fig. 8). Overall, setting out artificial nesting tubes in late May seems effective in preventing use by exotic mason bees and should be implemented in the future.

References

LeCroy, K. A., Savoy-Burke, G., Carr, D. E., & Delaney, D. A. (2020). Decline of six native mason bee species following the arrival of an exotic congener. *Scientific Reports*, *10*(1), 1-9.

MacIvor, J. S., & Packer, L. (2015). 'Bee hotels' as tools for native pollinator conservation: a premature verdict?. *PloS One*, *10*(3), e0122126.

Menendez, A. A., & Apple, J.L. (2021). Evaluating the use of artificial nests by native bees. Poster presentation. Northeast Natural History Conference (virtual).

Acknowledgments

We would like to thank Alli Menendez ('21) for the construction and mounting of the majority of bee boxes on the SUNY Geneseo campus and her dissection of the 2020 bee tubes. We would also like to thank Amanda DiMatteo for help with tube dissections and bee specimen preparation.