Preliminary Evaluation of Exclusion as a Technique to Reduce Carpenter Bee Damage

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Abstract: Female carpenter bees are wood-destroying insects that build gallery nests in exposed, dry wood. Although solitary, these bees often nest in aggregations, with offspring reusing their birth nest or creating a new nest nearby. Combined with possible damage from foraging woodpeckers, extensive carpenter bee tunneling can result in aesthetic damage to wood and reduce its structural integrity. For management of this insect, pest professionals apply insecticidal dusts to gallery openings, which kills adult bees and offspring, as well as secondary pests that may occupy used galleries. However, some homeowners and pest professionals seek alternative management methods based on philosophical, economic or health reasons. The use of traps made from scrap wood and plastic bottles is an alternative method intended to reduce carpenter bee populations that was evaluated by NYS IPM Program staff in 2016. While effective at capturing both males and females, not all bees were trapped, permitting further damage and reproduction. In addition, a number of non-target arthropods were captured in traps. Therefore, in 2017 exclusion to plug existing nest entrances was attempted in the spring, when reproductive females were foraging and possibly laying eggs. The timing of this intervention could displace females that were actively creating new galleries and kill developing offspring entombed in the sealed nest. Exclusion was attempted at nine sites and included a total of 389 nest openings. Sites were located in Suffolk County (2) and Westchester County (7). Eight different products were evaluated for their ease of application and aesthetic qualities. Products will be examined in the winter of 2018 to determine if they were breached and if new nest sites were created nearby. Sites will be visited again in spring of 2018 to determine the longevity of applied materials.

Background and Justification:
The Eastern carpenter bee, *Xylocopa virginica* is a wood-destroying insect that emerges from overwintering sites in the spring. Carpenter bees forage for nectar and may provide early season pollination services. However, female bees are considered pests because they create half-inch wide burrows that extend from four to six inches in exposed, dry wood. Because offspring often return to the same site as their birth (site fidelity) and may lengthen existing galleries, individual burrows up to ten feet long have been reported. Further, suitable locations may have multiple burrows when females create new galleries or branches on existing galleries. This results in aesthetic, and more important, physical

damage that can weaken the integrity of wood, especially if woodpeckers attempt to feed on bee larvae (Figure 1).

The public tends to fear carpenter bees because they are considered stinging insects. While female bees have a stinger, they rarely use it. On the other hand, male bees are aggressive, dive-bombing people, animals, and other male bees that approach galleries. Despite this aggressive behavior, male bees do not have a stinger and pose no stinging threat to people (they can bite if held).

Female carpenter bees start to damage wood in the spring, and pest management professionals are called to manage infestations. The most common technique used to manage these insects is to apply insecticide dust into the burrow openings. Female bees entering the nest, and newly emerged offspring exiting the nest contact insecticidal dust and die. While effective, this technique is a reactionary response to bees that have created new burrows or utilize existing openings, and therefore does not reduce the risk of structural damage.

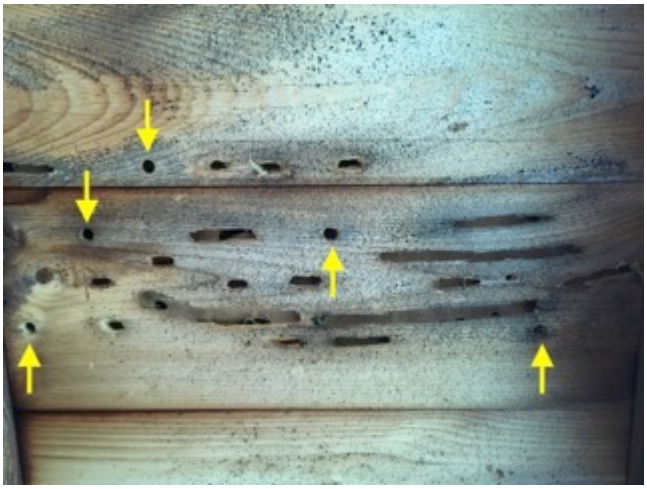

Fig. 1. Damage associated with carpenter bees (yellow arrows) and woodpeckers feeding on bee larvae.

Passive traps are alternative management tools that have been proposed to address carpenter bees problems. However, these traps may not catch all bees in an area, and may not limit damage. Timed exclusion of female bees that have recently created a gallery and are provisioning offspring may provide long-term management of bee populations. Ideally, exclusion could entomb developing larvae in the nest, and require females to create new burrows that might deplete their resources. Combined with trapping, it is possible that this technique could enhance the effectiveness of population reduction efforts. Therefore, a preliminary evaluation of exclusion was attempted to determine if this method reduced the number of existing galleries permanently.

Objectives:

- Determine the ease of use and aesthetic qualities of several products to seal openings. Products should be readily available to the public and not require special training or tools for application.
- Determine the ability of carpenter bees to overcome sealants by chewing.
- Document the number of nest sites to determine if new nests are created in response to exclusion of old sites.

Activities:

Sealant Selection: A total of eight products were evaluated for their ease of use and aesthetic qualities:

- Loctite PL 500 Landscape Construction Adhesive (295 ml tube applied with caulk gun)
- Loctite PL 510 Wood Construction Adhesive (295 mL tube applied with caulk gun)

- DAP Dynaflex 230 (300 mL clear indoor/outdoor sealant; applied with caulk gun) and DAP Dynaflex 230 (162 mL clear indoor/outdoor sealant squeeze bottle)
- Minwax Stainable Wood Filler (177 mL squeeze bottle)
- Liquid Nails LN-700 (118 mL squeeze bottle with applicator)
- DAP Bondex Concrete Patch (162 mL squeeze bottle of gray material)
- One inch square piece of cloth: pushed into opening with a flathead screwdriver

Monitoring & Data Collection: A data sheet was created to gather information about carpenter bee nest sites (Appendix A, Figure A1). The intended goal was to determine if bees prefer certain types of wood, wood surface coatings, wood thickness, height from the ground, orientation of the opening in relation to the ground or structure, and cardinal direction of the opening on the building. For some sites, detailed maps were drawn depicting the location of nest sites (Appendix A, Figures A2-A3). While this is useful for recording which product was used in what opening, it also helps to show the clumped distribution of nest sites in certain areas.

Sealant Efficacy: Sealants will be examined in winter 2018 to determine if carpenter bees were able to breach the material during the 2017 season. Sealants will be evaluated again in spring 2018 when carpenter bees are active.

Results and Discussion: Nine sites with carpenter bee populations were recruited for the study, yielding a total of 389 nest sites sealed with different materials from 2-10 May 2017 (Table 1). For the purpose of this experiment, only round openings created by carpenter bees were sealed, while larger openings created by woodpecker foraging were left open (Figure 2). It is not known if carpenter bees will use these openings to access galleries or not.

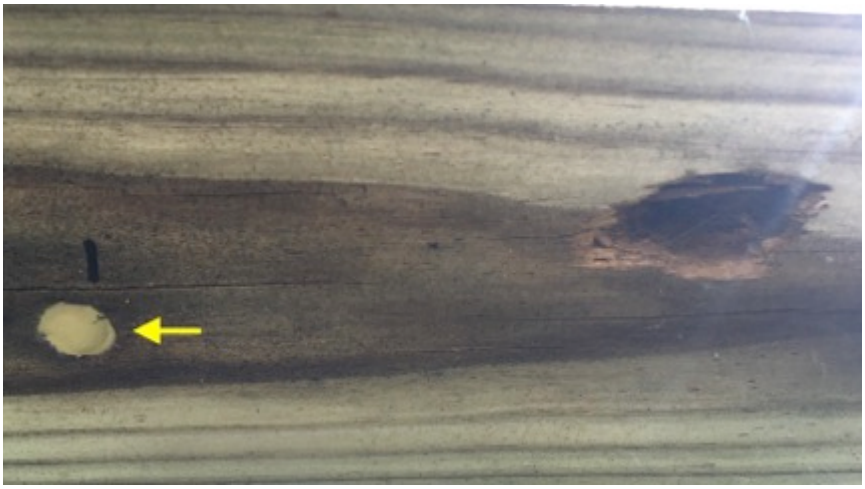

Fig. 2. Round openings created by carpenter bees (lower left) were sealed in this experiment, while holes created by woodpeckers (right) were not.

Table 1. Locations and number of nest sites sealed in Suffolk and Westchester Counties.

Suffolk County		Westchester County	
Site Name	**# Nest Sites**	**Site Name**	**# Nest Sites**
Sagtikos Hall	39	Croton Point Park	50
Private Residence	6	Mountain Lakes Park	237
		Sunset Nursery School	5
		Teatown Lake Reservation	21
		Private Residence 1	24
		Private Residence 2	2
		Private Residence 3	5

Nest openings were found in a variety of lumber types, including 1x6, 1x8, 2x4, 2x10, and 4x4. Wood at one site was stained, at two sites was painted, and at the remaining sites had no exterior treatment. Openings occurred at a variety of heights from the ground, ranging from 1.82 to more than 6 meters (6 to 20+ feet). The position of nest openings was also variable, with 87% (296/340) facing down, and the remaining 13% (44/340) facing the side toward (21/23) or away (2/23) from the structure. In instances where an overhang was present, more than half of the openings (55.3%, 188/340) were located at the exterior edge, but carpenter bees had also created nests closer to the building at distances of up to 1.3 meters (~4.4 feet) from the edge. The majority of holes that were sealed, 91.8% (312/340) were considered old based on the color of the opening compared to the rest of the wood. Whereas newer openings were light in color, old openings had a dark, aged appearance. Finally, some openings were closed off with mud plugs (16), likely from a wasp parasite of carpenter bees or other insects exploiting the opening to cache a food source, such as grass wasps (5 openings).

Sealant Selection: Some products proved easier to use than others. Listed below are the products tested and considerations for their usefulness to seal carpenter bee nests. They are listed in a subjective order of best to worst. One challenge with all products except the cloth was positive pressure of intact carpenter bee tunnels. Intact tunnels had one way in and out, making it a closed system. Applying a sealant to this was difficult in some instances because the product would meet resistance from air inside the nest. If woodpeckers had damaged the tunnel and created another opening, this was not an issue.

- One inch square piece of cloth: Very easy to use, and did not have the same air pressure resistance problem as other products. Did not fit snugly into openings, which could be adjusted by using more material.
- DAP Dynaflex 230: Easy to use and clean up. Consistency allows product to remain in openings after application. Dries clear so it appears that openings persist, which could confuse carpenter bees. Clear material does not contrast with wood appearance. Material is soft and flexible upon drying, which might be a disadvantage.
- Loctite PL 510 Wood Construction Adhesive: Good product, easy to apply, dries to firm solid material. Light color of dry material compared to most wood types might be a disadvantage (Figure 3).

- DAP Bondex Concrete Patch: Easy to use, easy to apply. Consistency allows product to remain in openings after application.
- Minwax Stainable Wood Filler: Material was slightly dry, but able to put into holes. Product was intact during a visit months later.
- Loctite PL 500 Landscape Construction Adhesive: Not a good product for this purpose. Material is gray and contrasts strongly with wooden structures. Material continues to ooze out of tube after caulk gun trigger released, making for a messy cleanup. Product does stay in opening and dries to firm solid.
- Liquid Nails LN-700: Product was difficult to use because it was too soft and did not stay firmly in opening.

Fig. 3. While wood colors vary on these pieces of roofing, the white dots from sealant may provide too much contrast and negatively affect the aesthetic of the structure.

In ecological terms, carpenter bees are considered solitary insects, but are social nesters. Specifically, carpenter bees do not form a colony, do not have a single queen, and each female is technically capable of producing her own offspring. However, multiple females may share the same gallery, especially if those females are closely related. Dissections of galleries have shown that while some are linear, others are branched, which may allow individuals to lay eggs in different parts of the nest. Regardless, females are able to identify their own nest site among numerous openings and return to this from foraging. During this project, we observed females returning to nest sites that had just been sealed were highly 'confused.' Females would fly near the opening and sometimes land to investigate. However, females did not attempt to remove substrate, even when a piece of cloth was loosely placed in the opening. Although observations were made over a limited amount of time, it is possible that this confusion could lead to death of the female from exhaustion: either from buzzing near her opening but not landing and resting, from attempting to build a new gallery, or from predation due to increased exposure. Subsequently, her offspring could die too if they were not provided with sufficient resources.

At this stage in the project, it is not possible to draw conclusions about the efficacy of exclusion as a technique to reduce carpenter bee populations and ultimately damage. However, based on preliminary observations of female behavior around newly sealed openings, it seems that this technique could be combined with trapping to reduce numbers of carpenter bees, especially since females may be unable to expend the energy required to create another nest. Injecting sealants into galleries might also restore some of the structural integrity lost to carpenter bee tunneling. This could extend the life of a piece of lumber, which might be important for historic buildings or situations where replacement costs are too high.

The next steps of this project will evaluate the durability of the materials used over one year, document the number of new openings at each site, and determine if this technique is a reasonable alternative to insecticide applications. A future question related to this work is whether openings should be sealed on warm sunny days when females are out foraging and come back to sealed nests, or if nests should be sealed on cool, cloudy days when females and males are inside galleries.

References:

Gerling, D, & H Hermann. 1978. Biology and Mating Behavior of *Xylocopa virginica* L. (Hymenoptera, Anthophoridae). Behavioral Ecology and Sociobiology 3(2): 99-111.

Prager, SM, & FF Hunter. 2011. Relationships between Nest Architecture and Behavior in *Xylocopa virginica* (Hymenoptera: Apidae). Journal of Insect Behavior 24: 293-306.

Appendix A

Fig. A1. Data collection sheet used to obtain information about the carpenter bee openings. The intended goal of this sheet was to collect information about current nest sites to document preferences for certain types of wood, wood surface coatings, wood thickness, height from the ground, orientation of the opening in relation to the ground or structure, and cardinal direction of the opening on the building [Note: this data has not yet been analyzed].

Site Name: ________ Date ________ Contact ________

Height from ground: A=0-3' B=4-6' C=7-9' D=10-13' E=14-16' F=17-19' G=20+
Wood Treatment: 0=no treatment 1=painted 2=stained 3=polyurethane
Opening Location: bottom or side of wood Opening Direction: Facing away or to building

#	Location	Cardinal Direction	Wood Treatment	Opening Location	Opening Direction	Mud in Opening?	New/Old	Edge/Interior	Distance from edge	Height	Wood Dimension	Fill Material

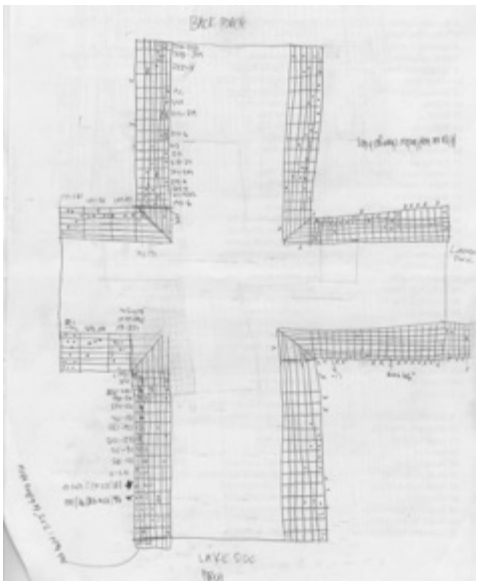

Fig. A2. Location of carpenter bee nest openings on overhangs of wood structure.

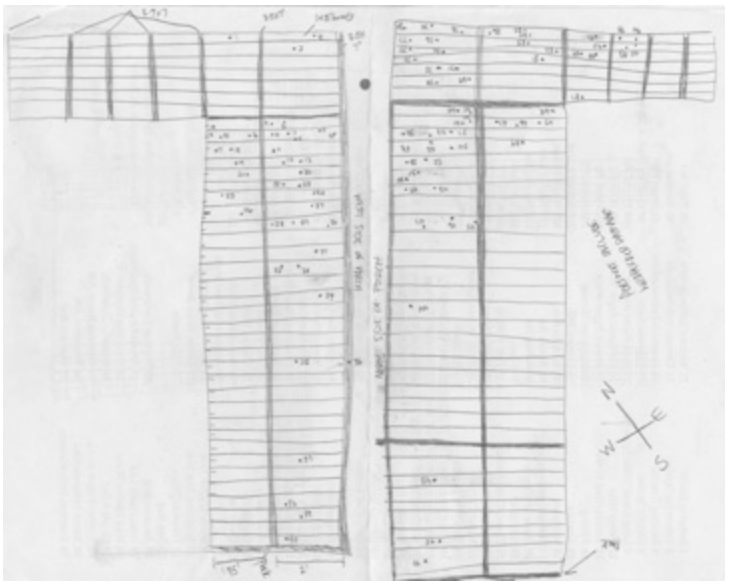

Fig. A3 Location of carpenter bee nest sites on an overhang.