

# Effects of woody debris and its management on wild bee communities along Colorado's Front Range

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## Introduction

While floral resource limitation of wild bee communities has been explored<sup>1</sup>, nest-habitat limitation is relatively understudied<sup>2</sup>. Coarse woody debris (CWD) plays a vital role in forest and riparian ecosystems including as nest habitat for bees<sup>3,4</sup>, though few studies have explored how it impacts wild bee communities, despite their importance as pollinators in both agricultural and natural systems<sup>5,6</sup>. There was a large quantity of CWD deposited in riparian systems in Boulder County, CO, during the 2013 flood<sup>7,8</sup> and woody debris management could have strong impacts on bee communities. We explored the role of wood nest habitat in driving both cavity-nesting and non-cavity-nesting bee communities, and compared the colonization of both wood and bamboo nest blocks. We hypothesized that bee communities would be more abundant and diverse where there was more CWD, and management activities that reduced CWD would negatively impact cavity-nesting bees.

## Questions

1. How are wild cavity-nesting and non-cavity-nesting bee communities affected by CWD?
2. How does CWD management impact wild bee abundance, diversity, and nesting?
3. Do native cavity-nesting bees prefer wood or bamboo blocks?

## Methods



**Figure 1.** We sampled 23 sites on Boulder County Open Spaces along the St. Vrain River with one bamboo and wood trap nest per site, each with 40 cavities ranging from 1/16 inch to 1/2 inch, and mounted within 3 m of each other on dead wood substrate.

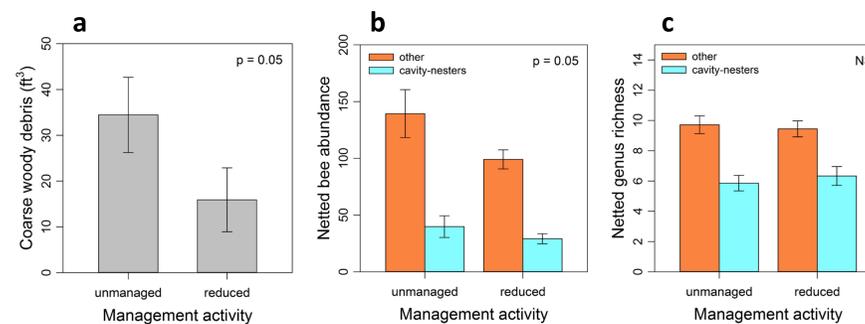
- Netted entire bee community for ~1 person-hour per month per site
- Monitored artificial nest blocks once per month from May to October
- Quantified CWD at each site using line-intercept methods modified from Woodall et al. 2008<sup>9</sup>
- Compared managed and unmanaged sites using Chi Sq/T-tests
- Explored relationships between CWD and bee communities using generalized linear models



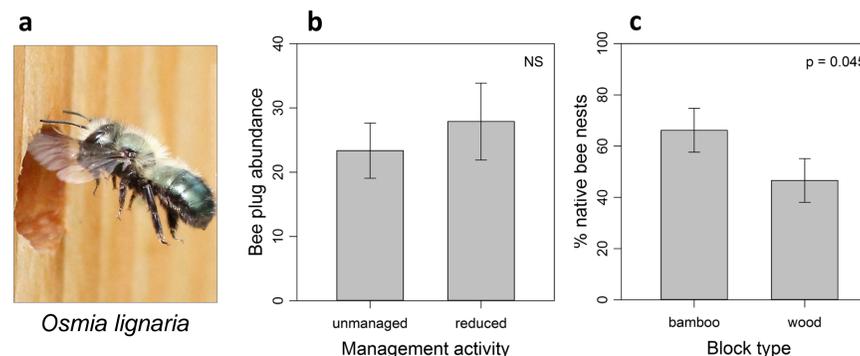
**Figure 2.** We quantified CWD at each site using three 24' line-intercept transects that radiated out from the wooden bee block.

## Results

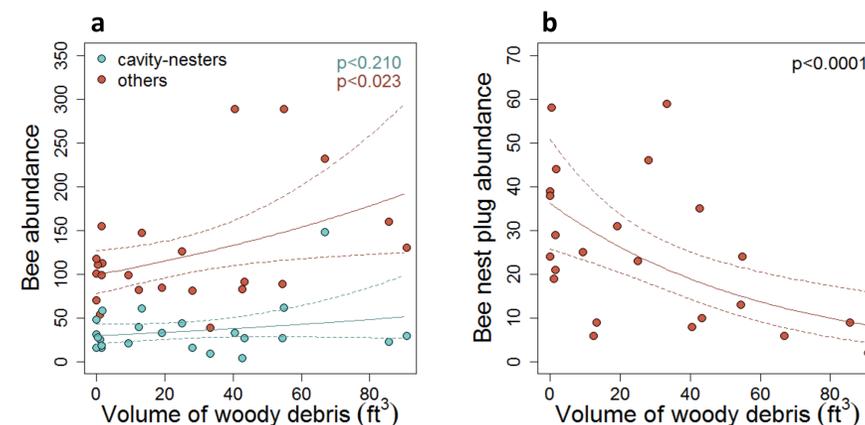
- **Netting** resulted in 3,662 total bee specimens spanning 33 genera
- The netted bee community was dominated by *Lasioglossum* (24% of all bees), *Apis* (18%), and *Hylaeus* (13%), and *Halictus* (11%)
- **Bee blocks** produced 664 nests from 7 genera
- Block nests were dominated by introduced *Megachile* (69% of all nests), *Osmia* (18%), and native *Megachile* (8%)



**Figure 3.** Sites where CWD was removed or piled for burning (i.e., reduced) had **a)** lower volumes of woody debris and **b)** fewer non-cavity-nesting bees than unmanaged sites, but no difference in cavity-nesting bee abundance or **c)** either genus richness.



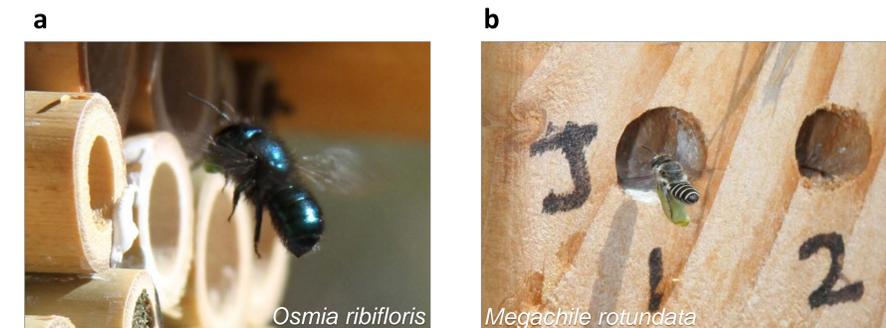
**Figure 4.** **a)** *Osmia lignaria* was the most common native bee nesting in blocks. **b)** Trap nests in unmanaged sites had fewer nests than where wood was reduced although the difference was not significant. **c)** Between nest types, bamboo had 30% more native bee nests than wooden blocks.



**Figure 5.** **a)** There was no relationship between cavity-nesting bees and CWD, though non-cavity nesting bees (other) showed a significant positive association with CWD. **b)** There was also a negative relationship between CWD and nest abundance, implying that artificial nests attract cavity-nesters where natural habitat is scarce.

## Discussion

The positive relationship between CWD and bee abundance was driven by CWD's effect on non-cavity nesting genera, suggesting that the positive effects of CWD are likely indirect and not primarily as nesting habitat. Native cavity-nesting species appeared to prefer bamboo over wooded nest blocks, however, some cavity-nesting genera captured by netting did not utilize the blocks at all, and in general the blocks represented only a fraction of the actual cavity-nesting bee richness at each site. We theorize that intensive colonization by introduced *Megachile* species (*M. rotundata* and *M. apicalis*) could have a negative effect on colonization by natives, and that this problem is stronger in wood blocks. Wood removal reduced overall bee abundance but not genus richness. Nonetheless, given CWD's positive effects on the overall bee community, we suggest finding alternative strategies to its removal in riparian ecosystems, though in areas where it must be removed, bee blocks and bamboo can at least supplement the loss of nesting habitat.



**Figure 6.** **a)** Bamboo attracted a higher proportion of natives such as *Osmia ribifloris* while **b)** wooden blocks were heavily colonized by introduced *Megachile rotundata*.

## Conclusions

- Woody debris likely benefits both cavity- and non-cavity nesting bees
- Management activities that reduce woody debris can negatively impact wild bees
- Native bees prefer bamboo nests over wooden blocks



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