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AN INTRODUCTION TO CAVITY-NESTING BEES IN THE PUGET SOUND REGION

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Abstract

Cavity-nesting bees are important pollinators, contributing billions of dollars in global pollination services each year. Adequate nesting resources across agricultural and natural landscapes are essential for the survival and reproductive success of these pollinators, and the pollination services they provide on farms. In the Puget Sound Region of Washington state, cavity-nesting bees are likely significant contributors to pollination services. However, compared to other parts of the United States, relatively little is known about cavity-nesting bee diversity in the Puget Sound Region, or techniques that could be used to conserve them. Here, we provide profiles of the major groups of cavity-nesting bees found in the Puget Sound Region and examples of artificial and natural nest resources for these species. We also provide information on how citizen science can enhance our understanding of cavity-nesting bees through monitoring, thereby contributing to the conservation of these pollinators throughout the Puget Sound Region.

Introduction

Wild bees are important pollinators that provide billions of dollars a year in global pollination services (Goulson et al. 2015). However, many wild bee species are threatened by habitat loss due to agricultural intensification and urbanization (Mader et al. 2010; Goulson et al. 2015). In turn, research has shown that providing suitable nesting resources on, and around, farms can boost wild bee abundance and related pollination services to crops (Potts et al. 2005; Winfree et al. 2011). However, the diversity of cavity-nesting bees, and nesting requirements associated with each species, remain poorly understood in the Puget Sound Region of Washington state (Cane et al. 2007). This guide summarizes cavity-nesting bee biology (Section I), identification (Section II), nesting habitat (Section III), and conservation through citizen science (Section IV). We do not cover floral resources for bees, or details on ground-nesting bees. However, websites with such content can be found in the *Useful Internet Links* section of this guide. The objectives of this guide are to increase bee conservation and literacy in the Puget Sound Region.

Cavity-Nesting Bee Biology

Approximately 30% of bee species build aboveground nests in hollow or pithy stems, and tunnels left in wood by herbivores (Cane et al. 2007). Beginning in spring, adult bees emerge and build nests that are divided into individual brood cells, each provisioned with an egg. Adult bees collect pollen and nectar to provision nests, and when eggs hatch the larvae feed on these resources before pupating. These cells are sealed with materials such as leaf tissue, mud, resin, or rocks, shown in Figure 1 (Cane et al. 2007). Adult cavity-nesting bees are solitary and usually do not care for their offspring beyond supplying pollen and nectar. Emergence continues throughout the summer season and tapers off in the fall, depending on the bee species. This season-long emergence may help promote pollination over a long period of time.

Figure 1. An x-ray image of a cavity-nesting bee tunnel divided into individual brood cells with developing larvae and sealed with leaf tissue.

Cavity-Nesting Bees of the Puget Sound Region

To date we have identified five major groups of cavity-nesting bees on farms in the Puget Sound Region. Many of these bees are known to be important pollinators. The groups listed here are considered to be the dominant groups found on farms, but do not account for all cavity-nesting bee species. Many of these groups possess key morphological characteristics and utilize specific nesting materials (Table 1).

In this section, we profile each of these groups to aid in identification by farmers and gardeners. In Section III we provide further details on creating habitat for cavity-nesting bees.

Table 1. Examples of materials used by cavity-nesting bees to build nests and their key identification traits.

Common Name and Genus	Nesting Material	Key Identification Traits
Mason bees, *Osmia* spp.	Moist soil and mud	Body robust and may be shiny metallic (Figure 2), drab and striped (Figure 3), or bright yellow colored (Figure 4). Pollen carrying hairs on bottom of abdomen (Figures 2, 3, and 4).
Leaf-cutter bees, *Megachile* spp.	Leaves and petals	
Wool carder bees, *Anthidium* spp.	Plant hairs	
Small carpenter bees, *Ceratina* spp.	Masticated (chewed) plants	Very small in size, abdomen club shaped with nipple-like end (Figure 5). Pollen carrying hairs on legs.
Masked-faced bees, *Hylaeus* spp.	Cellophane-like material	Very small in size, smooth black body with yellow markings (Figure 6). Carries pollen internally.

Mason bees, *Osmia* spp.

Description: There are approximately 19 species of mason bees in the Puget Sound Region. Most are metallic blue or green, with a short robust body (Bosch and Kemp 2001; Roof and DeBano 2016). The pollen-carrying scopal hairs found on the underside of the abdomen can also be used to easily identify mason bees (Figure 2). Bees within this group seal brood cells using a variety of materials, among them moist soil or mud.

Figure 2. Mason bee adult. This individual has the metallic body color common to this group. Arrow indicates scopal hairs located on the abdomen, which is a common feature shared with leaf-cutter and wool carder bees.

Leaf-cutter bees, *Megachile* spp.

Description: There are approximately nine species of leaf cutter bees in the Puget Sound Region. Generally, this group is comprised of dark or drab bees (i.e., not metallic) that have stripes on the abdomen (Figure 3). Similar to mason bees, leaf-cutter bees have pollen-carrying scopal hairs on the underside of the abdomen. Leaf-cutter bees cut pieces of leaves and petals to seal brood cells, although other materials can also be used.

Figure 3. Leaf-cutter bee adult. This individual has the drab body color and striping on the abdomen common to this group. Arrow indicates scopal hairs located on the abdomen.

Wool carder bees, *Anthidium* spp.

Description: There are approximately three species of wool carder bees in the Puget Sound Region. Coloration of individuals in this group is often a bold yellow with a black striping pattern on the abdomen (Figure 4). Wool carder bees will also have pollen-carrying scopal hairs on the bottom side of the abdomen. Bees within this group collect trichomes (i.e., plant hairs) from plants in the family *Lamiaceae* to seal their brood cells.

Figure 4. Wool carder bee adult. This individual has the bold yellow and black striping pattern common to this group. Arrow indicates scopal hairs located on the abdomen.

Small carpenter bees, *Ceratina* spp.

Description: There are approximately two species of small carpenter bees in the Puget Sound Region. These bees carry pollen on hairs on the legs, and are typically quite small (< 8 mm). Key to identification is the club-shaped abdomen with a nipple-like end (Figure 5). The body color can often be metallic blue, black, or green. This group uses masticated (chewed) plant materials to seal brood cells.

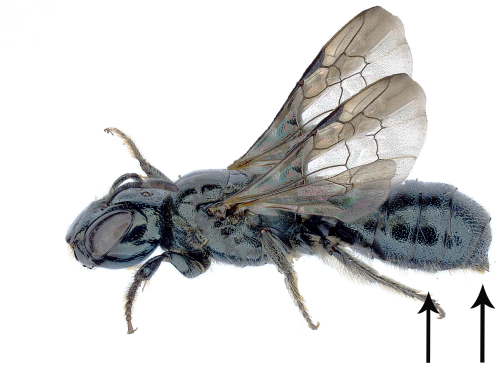

Figure 5. Small carpenter bee adult. Arrows indicate the club-shaped abdomen with a nipple-like end common to this group.

Masked-faced bees, *Hylaeus* spp.

Description: There are approximately five species of masked-faced bees found in the Puget Sound Region. Bees are generally quite small (between 5 and 7 mm in length), and body color is mainly black, with bright yellow and white markings. This group will often have “diamond-shaped” yellow markings on their face (Figure 6), and they collect pollen internally (i.e., not in hairs on the abdomen or legs). Masked-faced bees produce a cellophane-like material to seal brood cells.

Figure 6. Masked-faced bee adult. Arrow indicates the bright yellow markings common to this group.

Restoration of Habitat for Cavity-Nesting Bees

Research now indicates that farmers can incorporate plants into the landscape along a farm or garden border to increase bee biodiversity and pollination to nearby crop plants (Potts et al. 2005; Winfree et al. 2011). Trees and shrubs such as elderberry, sumac, box elder, roses, and hydrangea provide natural cavities for cavity-nesting bees (Vaughan and Black 2007; MacIvor 2016). Roses, azaleas, ash, and other plants with thin, smooth leaves can supply leaves for leaf-cutter bees (Serrano 2014). Select plants that have pre-existing hollow stems for mason, leaf-cutter, wool carder, and masked-faced bees. Small carpenter bees will excavate their own nests in plant stems with pithy tissue. Farmers and gardeners can also conserve cavity-nesting bees through the introduction of artificial habitat. For example, cavity-nesting bees will readily occupy wooden blocks with drilled holes, bundles of plant stems, and rolled cardboard tubes (Figures 7 and 8).

Our research from the Puget Sound indicates that cavities 4–11 mm in diameter and 90–140 mm in depth provide nesting habitat for a diversity of species. Wooden blocks are highly durable and attractive to bees. However, bundles or groupings of loose stems and tubes can provide a less costly and easy to manage alternative (Figure 8). Farmers and gardeners should also take steps to prevent the buildup of pests and disease in artificial nest substrates, as these pests may reduce the health of bee populations over time. See the *Additional Reading* section for detailed instructions on artificial and natural habitat restoration and how to maintain disease-free bee populations.

Figure 7. A purpose-built structure with wooden blocks inside. Chicken wire is used to exclude birds from developing homes, and the structure is painted blue to attract potential nest occupants.

Figure 8. Example of a rolled cardboard tube bundle used in our now complete citizen science project: The Pollinator Post Project.

Citizen Science for Monitoring Cavity-Nesting Bees

Citizen science, the involvement of the public in research, can be used to effectively monitor cavity-nesting bees, aiding in the understanding and conservation of these important pollinators (Gardiner et al. 2012). From 2015 to 2017, we worked with farmers and gardeners to collect data on the diversity of cavity-nesting bees in home gardens of the Puget Sound Region. The goal of this project was to help gardeners identify key nesting resources needed to conserve cavity-nesting bees, and improve pollination to nearby crops. Our preliminary results indicate that citizen scientists in the Puget Sound Region can help researchers identify species of critical restoration concern, and better understand long term trends in cavity-nesting bee biodiversity. To see the results of this project, visit our website: www.nwpollinators.org.

Conclusion

Cavity-nesting bees are important wild pollinators, but many species are in jeopardy due to the loss of suitable habitat both within and around farms. However, cavity-nesting bees can be conserved through increased awareness of these pollinators, their habitat needs, and the conservation and augmentation of nesting habitat. Monitoring these species is an important component to any conservation plan, and citizen science may facilitate conservation and restoration of many cavity-nesting bee species in farms and gardens. We encourage you to get involved in bee conservation whenever possible to help reduce the risk of species loss in the Puget Sound Region.

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