GROWING KNOWLEDGE

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Figure 1. Aaron Anderson's study plots at OSU's North Willamette Research and Extension Center, in August of 2019. Despite no supplemental irrigation and drought conditions, Douglas' Aster (*Symphyotricum subspicatum*, in the foreground) retains its long-lasting blooms..

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Native plants, bees, and microbes

The OSU Garden Ecology Lab studies the health of garden environments

BY GAIL LANGELLOTTO

THE GARDEN ECOLOGY LAB at Oregon State University (OSU) studies the plants, insects, animals, people, decisions, and management practices that either improve or degrade a garden's ability to promote environmental and human health.

An underlying premise of our work is that gardens are important and understudied systems, that are key to building more sustainable, healthy and just communities.

Currently, we have four active research projects. In this article, I provide a brief update on each project, with a specific focus on our native plant studies.

Native plants and pollinators

Ph.D.-candidate Aaron Anderson studies the insects that are associated with Willamette Valley native plants. Over the course of a long term field study (2017-2019), he collected and identified about 40,000 insect specimens!

He is currently working through the analysis of this massive data set, so that we can create an infographic that can be used by gardeners and green industry professionals, to select native plants that support an abundant and diverse assemblage of beneficial insects, without attracting an excess of herbivorous pests.

Aaron's first paper from his dissertation is currently »

"accepted, pending revisions" in the journal *HortTechnology*. This paper reports on his survey of gardeners' impressions of the aesthetic value of his study plants, and includes five specific recommendations for native wildflowers that Pacific Northwest nurseries might consider growing and marketing as pollinator plants.

These plants are globe gilia (*Gilia capitata)*, California poppy (*Eschscholzia californica)*, Douglas aster *(Symphyotrichum subspicatum*), Oregon sunshine (*Eriophyllum lanatum*) and common yarrow (*Achillea millefolium*). These plants all fell within the 'sweet spot' of being attractive to both pollinators and to gardeners.

Out of the candidate native wildflowers we recommend, many gardeners noted that they already had common yarrow and California poppy in their gardens, which may reflect their higher market availability. However, substantially fewer gardeners said that they already had Douglas aster, Oregon sunshine, or globe gilia in their garden. This further reinforces the idea that these plants show an opportunity for nurseries to consider propagating and marketing these natives as bee-friendly plants.

Aaron also found that sharing short messages, related to the bees that were found on each native plant, greatly increased gardeners' impressions of what had previously been considered an undesirable plant. All native plants included in our survey increased in attractiveness, after gardeners were exposed to such messages.

The increases we observed in the attractiveness scores suggest that a significant subset of gardeners consider ecological traits (such as attractiveness to bees) as a component of a flower's beauty, and that a minimal amount of education can significantly sway gardeners' opinions on native plants. Based on these results, nurseries and garden stores may be able to increase the palette of native plants that gardeners find attractive and suitable for planting by sharing brief messages about the ecological benefits these plants provide.

Bees on native plants and cultivars

In 2020, Ph.D. student Jennifer Hayes completed her first field season of research, which is a monumental accomplishment during this time of COVID restrictions on our work. Early in the year, Jen finalized her list of study plants, which included one native species and 1–2 hybrids or native cultivars. Although we started with a much broader list of potential study plants, so many native plants did not have native cultivars or appropriate hybrids available for sale.

Once Jen and her crew put the plants in the ground, a new set of challenges emerged. For example, the native yarrow emerged with bright pink flowers, which suggested that these plants were not true natives. In addition, the *Sidalcea* cultivars that Jen and her crew planted came up looking decidedly different than the *Sidalcea* native.

Given the unexpected results, Jen went on a journey to the OSU Herbarium. She learned that the Willamette Valley's native *Sidalcea malviflora* has been reclassified as *Sidalcea asprella*, and that the cultivars we purchased were hybrids of *Sidalcea malviflora* (native to Southwest Oregon and California). The findings suggest a need to work with local nurseries and native plant growers to see whether or not there should be — or can be — standards for the sale of native plants.

Should native species and native cultivars be verified or share provenance? Should gardeners be asking for this information? I don't know, but I think that they're important questions to consider.

With one field season's worth of data in hand, the native cultivars were more attractive to *all* bees (with overall patterns being driven by the abundance of the European honey bee) for all floral sets, except California poppy. When we excluded honey bees from the analysis, to look at mostly native bees, no clear pattern of visitation on native plants versus native cultivars emerged.

Native California poppy was most attractive to native bees. But, native cultivars of *Sidalcea* were more attractive to native bees (keeping in mind that in 2020, our native cultivars were not cultivars of our regionally appropriate native plant). For all other plants, there was no difference.

We look forward to collecting additional data in 2021 and 2022, to see if the lack of difference in bee visits to native plants versus native cultivars holds up. Particularly for the perennials, we are finding that bee visits change so much from year to year, as the plant becomes established.

Jen's study also offered an unexpected opportunity to study gophers' preference for camas bulbs. Though Jen's gopher troubles became apparent in June, she noticed signs of gopher activity when her plants were being installed in her study plots in early spring.

By August, there had been so much gopher activity in her study plots, that she conducted a damage assessment. Every camas plot was excavated, and any remaining bulbs were counted. No

Figure 2. Jen Hayes, standing in the middle of her native plant and native cultivar study plots at the Oak Creek Center for Urban Horticulture on the campus of OSU.
PHOTO COURTESY OF OREGON STATE UNIVERSITY

bulbs were found remaining, across five *Camassia leichtlinii* 'Sacajawea', and only 49 of the 200 planted bulbs remained across her five native camas plots. Notably, 192/200 bulbs remained across her five *C. leichtlinii* 'Blue Heaven' plots.

There is a clear preference for the native *C. leichtlinii* and native cultivar 'Sacajawea' bulbs over the 'Blue Heaven' cultivar. She also noticed that any bulbs that were planted shallower than the recommended 2-3x the height of the bulb were missed by the gophers.

Garden bees of Portland

Each June, July, and August, from 2017-2019, undergraduate Isabella Messer and I travelled to 25 Portland area gardens to sample the garden bee community. Although we still have a few specimens that await identification, we have developed a pretty good picture of the garden bee community in Portland area gardens.

All together, we collected between 76 and 84 species of bees across a combined 13.2 acres (acreage of all 25 gardens, summed). A few noteworthy specimens:

• We collected one specimen of *Pseudoanthidum nanum*, which is a non-native species to our area, which seems to be establishing and spreading in Portland. Stefanie Steele from Portland State University is writing a scientific note on this apparent introduction, tracking its incipient spread in the region.

• We collected one specimen of *Lasioglossum* nr. *cordleyi* which may be a new species. The notation nr. *cordleyi* means that this specimen looks similar to *L. cordleyi*, but that the morphology of this specimen is different enough than the normal type for this species, that it catches your attention. Further study will be needed to determine if it is indeed a new species, or not.

• Some of the species we collected (as well as their ecological characteristics) suggest that gardens are healthy habitat for bees. For example, we collected 72 specimens of *Panurginus atriceps*, which is a ground-nesting, spring-flying bee. Previous studies of garden bee fauna found ground-nesting and spring-flying bees to be relatively rare. We found *P. atriceps* to be surprisingly common in our collections. This bee is a social parasite that does not collect nectar or pollen or construct a nest for their brood. Instead, they take advantage of the hard work of other bee species by laying their eggs in the nest of another female. Parasitic bees are often used as bioindicators of habitat health. They would not be present on a site, unless the site also supported their obligate hosts.

• We collected two species of bees that are listed on the IUCN red list for threatened and endangered species: *Bombus fervidus* (18 specimens) and *Bombus caliginosus* (10 specimens). I am not yet sure if their presence in urban gardens suggests that these species are recovering, that these species might be urban associates that would be expected to thrive in urban gardens, or if gardens might represent particularly good habitats for these species.

Garden microbes in soil and on skin

In the spring of 2020, Dr. Gwynne Mhuireach started her post-doctoral research in our lab. She studies how having your hands in the soil, via normal gardening activities, might change the microbiome of gardeners' skin.

She recruited 40 gardeners to participate in this study: 20 from western Oregon and 20 from the high desert. Each gardener was asked to sample their skin microbiome (by running a cotton swab over the surface of their hand) before gardening, immediately after gardening, 12 hours after gardening, and 24 hours after gardening. Gardeners also sent in soil samples, so that we could assay organic matter and soil »

Figure 3. One of our best gardens for bees was located adjacent to a golf course. This gardener's space exploded with flowering plants. Plant cover mostly negated the need for mulch, which offered benefits to ground-nesting bees. PHOTO COURTESY OF OREGON STATE UNIVERSITY

chemical characteristics.

Initial examination of her results suggest that:

- Soils have much greater microbial diversity than skin.
- The skin microbiome was much more variable, from person to person, than the soil microbiome was, from garden to garden. Individual gardeners' skin microbiome was so unique, that it might be analogous to a 'fingerprint'.
- Garden location (high desert or Willamette Valley) and garden management type (organic or conventional) were significant, but weak predictors of the soil microbiome community.
- Collection time was a significant but weak predictor of the skin microbiome community. Immediately after gardening, some gardeners showed a microbiome signal that suggested that soil microbes transfer to skin after gardening. Other gardeners showed no such signal.
- Any persistence of soil microbes on skin was short-lived, and did not show at the 12- and 24-hour sampling periods.

Over the next few years, Jen will continue her study of native plants and native cultivars, while Aaron, myself, and Gwynne are hard at work analyzing results and writing up our respective studies. If you are interested in following our work, please visit our lab website: **blogs.oregonstate.edu/gardenecologylab/**

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