Hansen Park
Heritage Garden

The Heritage Garden at Hansen Park
iNaturalist Project Report

Heritage Garden Program

Benton Conservation District

May 2023

Author Note

This report was prepared by Donna Lucas and Lisa Hill under the supervision of Heather Wendt, Assistant Manager, Benton Conservation District. Address questions or comments to:

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Photo Credit: Lisa Hill and Donna Lucas

DISCLAIMER: This report presents the process and results of building a data base for a project using the platform iNaturalist. All identifications should be considered tentative.

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Acknowledgements

This adventure into the amazing world of biodiversity in the Heritage Garden at Hansen Park is made possible by the vision and generosity of numerous Tri-Citians and a global network of professional and amateur scientists.

Creation and Maintenance of the Garden

The Heritage Garden Program wishes to thank the City of Kennewick and the City's Parks and Recreation Department. Without their vision and ongoing commitment, the garden would not exist. Each summer while caring for the garden we receive many comments of appreciation from the public. They love the garden.

The design of the Hansen Park Heritage Garden was led by the program's Director Heather Wendt in collaboration with numerous community groups including the Columbia Basin Chapter of the WNPS, the Benton Franklin Master Gardeners and the Tri-Cities Herb Club to name a few. The garden was designed with the objective of educating the public about native plants and the biodiversity of the Columbia River Basin.

Generous donations of time and funding keep the garden well-groomed and constantly improving. Thanks go to Benton CD volunteer gardener's Donna Lucas, Lisa Hill, Jenni Heerink and Heather Wendt along with Scout Troop 219. Special thanks go to Jane Abel and Donna Lucas for their donations of plants to the garden. We would also like to thank the Basin Bloomers Garden Club, Washington Conservation Society, Columbia Basin Chapter Washington Native Plant Society, and the Lower Columbia Basin Audubon Society for their generous financial contributions to the garden. The garden is honored to be the home of the first female Eagle Scout project conducted by Kendalyn Bybee who with community support built a garden shed on site.

The garden is truly a product of many in our community. And for those who can't speak for themselves, a special thank you from the many critters who use this oasis of biodiversity. The garden is not only lovely to walk through, but also a home and eatery for many.

Biodiversity Study and this Report

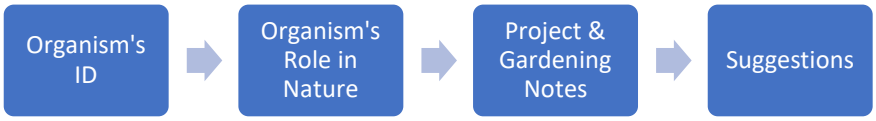
Without iNaturalist, it is likely this study would not be underway. The platform and community of iNaturalist made it possible for us, a couple of enthusiastic citizen scientists, to perform this study. With iNaturalist we were able to define a project area and easily fill it with observations. We will continue to do so. Moving forward we will strive to encourage others to join in this adventure using iNaturalist to grow the garden's data base. The iNaturalist platform makes it easy to present one's observations. Thank you to the world-wide community of experts and knowledgeable citizen scientists who guide the user to the most likely ID of each observation.

A special thank you to Dr. David James, Associate Professor, Department of Ecology, Washington State University. He took the time to review this report and provide feedback. We look forward to working with him as we expand the garden's insect data base.

Elspeth Jensen, editor, whose assistance improved the quality and readability of this report.

Summary

This document presents the results of an ongoing citizen scientist biodiversity study of the Heritage Garden at Hansen Park. The observations and identification efforts are documented in the iNaturalist Project – Heritage Garden at Hansen Park. Creating this report makes it possible for readers to see what is in this project without needing to navigate the iNaturalist website. It also provided us with a means by which to go from organism ID and function in Nature, to ideas on how we might improve the iNaturalist project and adjust our gardening practices to support biodiversity in the garden.



This is the process used in this report, going from determining what an organism is, to its role in the garden, to how we might improve the iNaturalist project and better support the biodiversity of the garden.

A primary purpose of this ongoing study is to consider the importance of urban gardens that are rich in native plants in supporting fauna. Side benefits of the study are educating the public, inspiring others to join the adventure that iNaturalist provides, and gaining a more intimate knowledge of the workings of the garden. Understanding who's who among the garden's fauna and what they are doing assists the gardeners in adopting best practices that improve the health of the garden and its biodiversity while controlling pests.

Since the garden was constructed in 2018, an unexpected plethora of wild organisms has been discovered living in or visiting the garden. Through 2022, over 170 animal organisms (i.e., essentially all living organisms that are not plants, fungus, or lichens) in the garden have been tentatively identified to species level. And a pleasant surprise is that most are native species.

Walking through the garden and enjoying the flowers and shrubs as they change through the seasons is a treat. But there is so much more going on. The closer you look, the more you will learn, and the happenings of a complex ecosystem come into view. Who lives where? Who is hunting whom? What is that bee doing that keeps flying back and forth over a ground nest. Did it build the nest or is it an unwelcome intruder? Look at the many species in the garden that eat aphids! There are so many different sizes, shapes, and colors of wasps.

Following his review of this report, Dr. David James, Associate Professor, Department of Entomology, Washington State University, reported back to us:

> *"It's a great document that proves how valuable even small gardens can be in creating reservoirs of insect diversity and function! I must admit I am surprised at just how diverse the fauna has become in just 3 or 4 years! I would like eventually to write your project up for a scientific paper (with you all as co-authors), because it is an important and valuable demonstration of what can be done by creating a native garden. And this is an important thing that anyone can do for insect conservation."* ~ Dr. David James

We will continue to look for new species of animals and henceforth will be looking for fungus, lichens, and uninvited plants (aka weeds) as we expand the data base.

The garden isn't just a pretty place for people to visit, it's also a functioning ecosystem.

Introduction

This report tells a story of the Heritage Garden at Hansen Park from its creation in 2018 through 2022. The focus is on examining the biodiversity in the garden after just a few years. We are using iNaturalist to determine the IDs of organisms found in the garden. With these IDs we are learning the roles these organisms play in the garden's ecosystem. This knowledge base is helping us find ways to improve the project, engage the public, and adjust gardening practices to benefit the garden's biodiversity.

About the Garden

The Heritage Garden at Hansen Park (HGHP) is in the southwest end of Hansen Park -- 602 S. Columbia Center Blvd., Kennewick WA. It was created in 2018 with the conversion of 20,000 square feet (approx. 0.5 acre) of the city park. Hansen Park is operated by Kennewick Parks & Recreation (KP&R). The Benton Conservation District (BCD) and KP&R work together to manage the garden. A team of vetted volunteer gardeners perform routine maintenance of the garden under the supervision of the BCD. The garden is somewhat formal and maintained accordingly. Visitors frequent the garden and often comment on how much they enjoy and appreciate it. The primary funding sources for the garden are grants and donations.

Aerial view of the Heritage Garden at Hansen Park.

The garden was designed consistent with principles of the Heritage Garden Program and serves as a demonstration garden. Heritage Gardens are landscaped areas designed to honor the cultural and natural heritage of the Columbia River Basin while using sustainable gardening practices with an emphasis on water-smart landscaping. These gardens promote the use of native plants, sustainable landscaping and gardening techniques, and educate our community about the natural history and biodiversity of the Columbia River Basin. Learn more: Hansen Park Garden, Heritage Garden Website, Heritage Garden Facebook Page.

In the spring of 2020 we created an iNaturalist project within the boundaries of the garden.

About iNaturalist

iNaturalist is a platform for sharing and learning. "One of the world's most popular nature apps, iNaturalist helps you identify the plants and animals around you. Get connected with a community of over a million scientists and naturalists who can help you learn more about nature! What's more, by recording and sharing your observations, you'll create research quality data for scientists working to better understand and protect nature." (Ueda, 2022)

"[iNaturalist is] a crowdsourced species identification system and an organism occurrence recording tool. You can use it to record your own observations, get help with identifications, collaborate with others to collect this kind of information for a common purpose, or access the observational data collected by iNaturalist users.

> **Vision** - iNaturalist's vision is a world where everyone can understand and sustain biodiversity through the practice of observing wild organisms and sharing information about them.
>
> **Mission** - iNaturalist's mission is to build a global community of 100 million naturalists by 2030 in order to connect people to nature and advance biodiversity science and conservation." (Loarie, 2022)

iNaturalist is a joint initiative by the California Academy of Sciences and the National Geographic Society. The URL for iNaturalist is https://www.inaturalist.org/.

About the Project

The iNaturalist project for the HGHP is a "collection" project. Collection projects have a central page that displays all the observations made within the boundary set for a location. "Any observation that fits the requirements of the project will be displayed on the project's page… A collection project is, in essence, a saved Observations Search that looks snappy and offers useful outreach features, such as a banner and icon, a creator-determined URL, and a journal which can be used to communicate with those who are following the project." (Seltzer, Managing Projects, 2022)

The project's banner as of the end of 2022.

URL for the HGHP Project
https://www.inaturalist.org/projects/heritage-garden-at-hansen-park

HGHP Project Goals

To better understand and show the value of this urban garden to wildlife.

To create a public resource for aspiring naturalists and citizen scientists to take part in an adventure of discovery in the garden.

All observations submitted to iNaturalist that meet the criteria of the project and are within its physical boundary will show up in the project. It is not necessary to be a member of the project for one's observations to show.

Through 2022, taxa included in the project were animals, fungi, and lichens. Plants were excluded because this is a garden exhibiting plants that were cultivated by people, i.e., not wild organisms. In 2023 we added filters to allow "wild" plants (aka weeds) into the project. The addition of weeds will make the project more complete and provide a resource to help the volunteer gardeners identify the weed population in the garden and better understand how best to manage each weed species. Also, as of 2023 we are filtering out European honey bee observations. These bees are not wild organisms since someone is raising them.

"…wild/naturalized organisms exist in particular times and places because they intended to do so (or because of intention of another wild organism). The main reason we try to mark things like this is because iNaturalist is primarily about observing wild organisms, not animals in zoos, garden plants, specimens in drawers, etc., and our scientific data partners are often not interested in (or downright alarmed by) observations of captive or cultivated organisms." (Seltzer, Help - Frequently Asked Questions, 2022)

About this Report

The first edition of this report presents observations from 2019 through 2022. We hope to revise or supplement this report with periodic updates.

Observations are sorted by taxonomical classifications to provide an orderly presentation (see the table of contents). Not all observations are presented in the report. Generally, only a single image we judged to best show a family, species, or genus is shown in the report. Embedded in each photo is a link to that observation in the project. To see all observations in this project (there are over 500) go to the project page and click on "View All." Grid mode is a good way to quickly see all the observations.

Truncated excerpts from knowledgeable sources are provided on most observations. These excerpts provide a brief introduction to the organism. The associated references will provide additional information for readers who are interested. These *excerpts are presented in italics*. Note that we made no effort to edit these excerpts.

We provide our own commentary (not italisized) on organisms in cases where we found some aspect of the observation especially interesting or of possible value in better understanding biodiveristy in the garden.

Projects and gardening notes are presented when information on the organisms and/or our observations suggest actions we may want to take to improve the project or adjust gardening practices to enhance biodivserty and control pests.

Project Note –

Possible ways to improve this iNaturalist project are presented in highlighted boxes as "Project Notes." These notes come from concepts presented in the report and are addressed in the project plan, see Appendix A.

Gardening Note –

We present "Gardening Notes" for consideration in enhancing biodiversity in the garden (an objective of Heritage Gardens) or dealing with pest problems based on concepts presented in the report. These notes and gardening suggestions are summarized in Appendix B.

And as if gardening, photographing Nature and making like a citizen scientist weren't fun enough, occasionally something extra-special happens. We've used the iNaturalist bird icon to bring attention to these special observations.

Now as to what this document isn't, this report is not a field guide. We present photographs of organisms we observe in the garden. We endeavor to get each identification as correct as possible before recording it on iNaturalist. Many observations in this project have been reviewed by knowledgeable individuals and likely are correct. Some have received no reviews or reviews were inconclusive. Using iNaturalist, we are taking a journey to better understand the biodiversity in the garden and presenting to you the status of this journey.

DISCLAIMER: This report presents the process and results of building a data base for a project using the platform iNaturalist. All identifications should be considered tentative.

About the Authors

The authors are vetted volunteer gardeners at the Heritage Garden in Hansen Park. They are also photographers and iNaturalist enthusiasts. This is an ideal combination of skills and activities for discovering and documenting organisms. We work closely with the plants, keeping an eye out for organisms, and keep our cameras nearby. We note in iNaturalist what plant the organism was visiting and what it appeared to be doing. We are not biologists, botanists, nor entymologists, but by using iNaturalist have learned much about the biodiveristy in the garden.

Photographs

All photographs presented in this report were taken within the boundary of the garden. All were taken by the authors with one exception, an image by Jane Abel who was the first to record wild organisms in the garden. The images in this report shall not be used without the prior approval of the photographer. If you'd like to use an image, please ask.

Methods

For the most part, our approach to finding and photographing organisms revolves around gardening sessions. Only occasionally were trips made to the garden with the sole purpose of recording observations. Combining photographing with gardening has the advantages of a commitment to a routine schedule (the garden requires regular attention) and working near the plants where organisms can be hiding and otherwise missed.

Once hot weather sets in, which is most of the summer and can be brutal in the afternoons, the gardening schedule shifts to early morning, and we have left the garden by noon. This means we may be missing organisms that become most active in the heat of midday. This gardening schedule also means we are not capturing images of organisms at night.

Project Note – Schedule added photographing sessions at times of the day when not gardening.

We use quality cameras and multiple lenses to take the photos, then we process the images using Photoshop and other software to bring out details. The processed images are uploaded to iNaturalist with a suggested identification of each organism. This is the point at which review by the iNaturalist community begins.

iNaturalist Review Process

Each observation uploaded to iNaturalist goes through a data quality assessment process. Ideally each observation goes from "Needs ID" status to "Research Grade."

"The Data Quality Assessment is a summary of an observation's accuracy, completeness, and suitability for sharing with data partners. The building block of iNaturalist is the verifiable observation… Verifiable observations are labeled 'Needs ID'… Observations become 'Research Grade' when the community agrees on species-level ID." (Frequently Asked Questions, 2022)

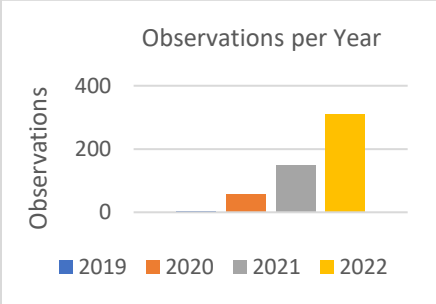
Because reviewers must work from images rather than having the organism in hand, there are limitations on getting agreed-to identifications. For some species, accurate identification requires

viewing the organism through a microsope or even performing a DNA analysis. We only take photos. Specimens are not removed to be analyzed or put into a collection.

History of Data Collection

In 2019 there were just three observations, all made by Jane Abel. Donna Lucas started adding observations in April 2020. In May of that year, we set up the iNaturalist project for the garden. Lisa Hill started adding observations in August 2021. In 2022, Donna and Lisa made a dedicated effort to add as many observations as possible. To date, only a couple of observations by others have been submitted for this location.

Project Note – Encourage the public to participate in this project.

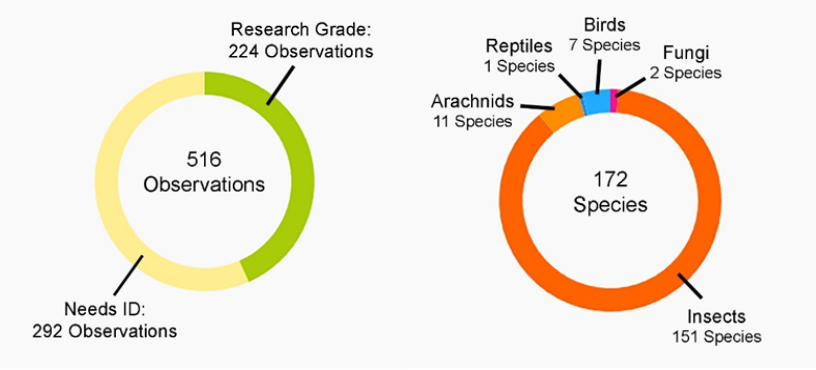


Results

RG Research Grade
Needs ID tentatively
i Introduced

Each observation in this report is labeled with "Research Grade" or "Needs ID" consistent with the status of the observation in iNaturalist. The tentative identification is provided. In addition, if iNaturalist lists the organism as introduced, we've included that designation with the image. Note that the "**i**" stands for introduced, not invasive. "An introduced species (also known as an exotic species) is an organism that is not native to the place or area where it is considered introduced and instead has been accidentally or deliberately transported to the new location by human activity." (Introduced species, n.d.) "An invasive species is an introduced, nonnative organism… that begins to spread or expand its range from the site of its original introduction and that has the potential to cause harm to the environment, the economy, or to human health." (Invasive Species, n.d.)

As of the end of 2022, this project reached a total of 516 observations submitted (this includes multiple observations of some species). Of these, 224 reached research grade, leaving 292 needing further identification to get to species level. Of the 172 species reported in this project, insects were by far the largest group with 151. The other groups were 11 species of spiders, 7 species of birds, 2 species of fungi and 1 reptile.



Breakdown of the project's observations as of the end of 2022.

Observations: Animals (Kingdom Animalia)

Birds (Class Aves)

We started adding birds to the project in 2022. Seven species of birds were recorded within the boundaries of the garden. Others were seen, but we were unable to get photographs of them. Documenting just seven species was somewhat disappointing. Except for three large pines, the garden's shrubs and trees are not large enough, nor close enough together to provide the cover that birds need. As the garden matures, we expect it to become more inviting to birds.

Gardening Note – Consider how the garden could be managed or changed to better attract birds.

Project Note – Schedule photographing sessions just for birds.

Two food sources stood out as appreciated by birds: berries on the western serviceberry (*Amelanchier alnifolia*) and insects that the Say's Phoebes were capturing from the tops of flowers. We would see other birds quickly flying in and out of shrubs, such as currant, but were unable to document their presence.

Gardening Note – Avoid the use of pesticides. Insects are an important food source for baby birds.

ORDER CHARADRIIFORMES (SHOREBIRDS AND ALLIES)

CHARADRIIDAE FAMILY (PLOVERS AND LAPWINGS)

Genus *Charadrius* (Typical Plovers)

"A shorebird you can see without going to the beach, Killdeer are graceful plovers common to lawns, golf courses, athletic fields, and parking lots… Feeds primarily on invertebrates, such as earthworms, snails, crayfish, grasshoppers, beetles, and aquatic insect larvae… Killdeer nests are simple scrapes often placed on slight rises in their open habitats… Often seen in dry, flat landscapes, running and halting on the ground in search of insects and earthworms… Killdeer are some of the best-known practitioners of the broken-wing display, an attempt to lure predators away from a nest by feigning injury. Pairs of Killdeer tend to stay together for one to a few years. Killdeer Sounds" (Killdeer, n.d.)

Photos © Lucas

RG Killdeer Family
Charadrius vociferus

Early in the spring of 2022 a pair of Killdeer were patrolling the garden, apparently determined to nest there. They stayed and eventually laid a total of four eggs in a depression in the gravel. The nest was within a few feet of the busiest path in the garden, yet only a few visitors noticed. In May we saw at least three fledglings running around the garden.

ORDER COLUMBIFORMES (PIGEONS AND DOVES)

COLUMBIDAE FAMILY (PIGEONS AND DOVES)

Genus *Zenaida* (Zenaida Doves)

"A graceful, slender-tailed, small-headed dove that's common across the continent. Mourning Doves perch on telephone wires and forage for seeds on the ground; their flight is fast and bullet straight… Typically nests amid dense foliage on the branch of an evergreen, orchard tree, mesquite, cottonwood, or vine. Also quite commonly nests on the ground… Mourning Dove Sounds" (Mourning Dove, n.d.)

Photo © Lucas

RG Mourning Dove
Zenaida macroura

A pair of Mourning Doves returns each year, nesting in the same place in one of the Ponderosa pines. Their preferred nesting material from the garden is broken flower stems from the snow buckwheat. They've selected a very dense part of the tree, making it impossible to photograph the nest. We settled for a preening session atop the garden shed to document their presence in the garden and verify ID.

ORDER GALLIFORMES (LANDFOWL)

ODONTOPHORIDAE FAMILY (NEW WORLD QUAILS)

Genus *Callipepla* (Crested Quails)

"Often seen scratching at the ground in large groups or dashing forward on blurred legs, California Quail are common but unobtrusive. They flush to cover if scared… Pairs of California Quail call antiphonally, meaning that the male and female alternate calls, fitting their calls into a tightly orchestrated pattern… As an adaptation to living in arid environments, California Quails can often get by without water, acquiring their moisture from insects and succulent vegetation… Mainly a seedeater; also eats leaves, flowers, catkins, grain, manzanita and poison oak berries, acorns, and invertebrates such as caterpillars, beetles, mites, millipedes, and snails… You'll normally see California Quail walking, running, or scratching at the ground and leaf litter for seeds and other food… California Quail Sounds" (California Quail, n.d.)

A pair of California Quail were photographed running along the edge of the garden, foraging briefly. They appeared bothered by the photographer and possibly the long lens.


Photos © Lucas

RG California Quail
Callipepla californica

ORDER PASSERIFORMES (PERCHING BIRDS)

BOMBYCILLIDAE FAMILY (WAXWINGS)

Genus *Bombycilla* (Waxwings)

"To attract waxwings to your yard, plant native trees and shrubs that bear small fruits, such as dogwood, serviceberry, cedar, juniper, hawthorn, and winterberry… Because they eat so much fruit, Cedar Waxwings occasionally become intoxicated or even die when they run across overripe berries that have started to ferment and produce alcohol. Cedar Waxwing Sounds" (Cedar Waxwing, n.d.)

A group of Cedar Waxwings would watch the garden from the tops of trees nearby. Individuals appeared to take turns flying into the western serviceberry shrub to feast on the berries. The berries were especially large and plentiful in 2022 possibly due to an unusually wet spring.

Photo © Lucas

RG Cedar Waxwing
Bombycilla cedrorum

ICTERIDAE FAMILY (NEW WORLD BLACKBIRDS AND ORIOLES)

Genus *Euphagus* (Rusty and Brewer's Blackbirds)

"Brewer's Blackbirds eat mostly seeds and grains, but like many small birds they also eat lots of insects while they're plentiful in summer… Although they are common within their range, Brewer's Blackbirds populations declined by approximately 1.6% per year for a cumulative decline of about 57% between 1966 and 2019… Brewer's Blackbird Sounds" (Brewer's Blackbird, n.d.)

A Brewer's Blackbird landed on the garden fence, checked out the photographer's long lens and opted to leave.

Photo © Lucas

RG Brewer's Blackbird
Euphagus cyanocephalus

Turdidae Family (Thrushes)

Genus *Turdus* (Typical Thrushes)

Photo © Lucas

RG American Robin
Turdus migratorius

"Although robins are considered harbingers of spring, many American Robins spend the whole winter in their breeding range. But because they spend more time roosting in trees and less time in your yard, you're much less likely to see them… Because the robin forages largely on lawns, it is vulnerable to pesticide poisoning… Particularly in spring and summer they eat large numbers of earthworms as well as insects and some snails… Robins also eat an enormous variety of fruits, including chokecherries, hawthorn, dogwood, and sumac fruits, and juniper berries. One study suggested that robins may try to round out their diet by selectively eating fruits that have bugs in them. American Robin Sounds" (American Robin, n.d.)

Photo © Lucas

RG American Robin Fledgling
Turdus migratorius

Hansen Park is quite open, offering few places for vulnerable wildlife to hide. At least two fledgling American Robins were spotted hiding out in the shrubs and grasses along the dry stream bed in the garden. They blended in well and would not have been noticed except for the noise made by their parents.

Robins enthusiastically ate berries from the western serviceberry.

Tyrannidae Family (Tyrant Flycatchers)

Genus *Sayornis* (Phoebes)

"Say's Phoebes live in dry, sparsely vegetated areas including, sagebrush flats… This phoebe's diet consists almost entirely of insects such as beetles, grasshoppers, crickets, flies, and bees. They sally from low perches to snatch insects in midair or pounce on insects on the ground… The pair investigates potential nest sites together. They look for a protected ledge or pocket in caves, cliff faces, dirt banks, bridges, barns, and other buildings. The most important feature is shelter from above… Males escort females around to potential nest sites. He flutters his wings while chattering to the female until she selects a spot to build a nest… The Say's Phoebe is common throughout arid regions of the West. Say's Phoebe Sounds" (Say's Phoebe, n.d.)

In June of 2022 the garden had new visitors, a family of Say's Phoebes. This delightful family of three or four made daily visits to the garden, arriving in the morning to catch insects. When not resting on the fence, the adults would hover over the taller flowers picking off insects. The fledglings just sat, waiting to be fed. Photographing the family was fun. They seemed unconcerned about the photographer with a large telephoto lens.

RG Say's Phoebe Family
Sayornis saya

Photos © Lucas

The Say's Phoebe parents kept busy catching insects for the fledglings. In the first two photos, the captured insects are visible on their beaks. These insects could be the rather abundant *Lygus* bugs, but that's just a guess.

> *Gardening Note – Avoid using insecticides. Birds and their progeny rely on insects as a food source.*

Reptiles (Class Reptilia)

"Racers can be found from southern Canada to Guatemala. There are many subspecies of racers, each of which have very different ranges. The western yellow-bellied racer (Coluber constrictor mormon) is a subspecies that can be found in eastern Washington as well as California, Nevada, western Colorado, Oregon, and southern British Columbia. Racers are most often found in dry sunny areas with cover… Young racers start out eating small animals, mostly insects, spiders, small frogs, small reptiles, and young rodents. As they grow, they can eat larger animals… Despite its name, racers usually move at a speed of only 4 miles per hour… Main threats include pesticide use, which threatens the insect-eating young, and habitat loss." (Western Racer, n.d.)

Photo © Lucas

RG Western Yellow-bellied Racer
Coluber constrictor ssp. mormon

We spotted one snake in the garden. This somewhat surprising observation took place in the summer of 2020. There are insects and small mammals in the garden that could be a food source for snakes. However, the garden is managed such that its habitat is not ideal for them. At the time of this sighting, there was a large undeveloped lot near the garden. We suspect that the snake came from this vegetated lot. This area has since been developed with apartments, reducing the chances of seeing snakes in the future.

Mammals (Class Mammalia)

No mammals have been recorded in the iNaturalist project, but we have seen mice and pocket gophers in the garden. The mice are elusive and harmless, living under the large snow buckwheat shrubs. The pocket gophers are extremely destructive and chased out as soon as possible by frustrated gardeners. Pocket gophers, feeding on roots, destroyed an entire row of echinacea and have killed other plants in the garden. Although not compatible with a garden like the HGHP, pocket gophers do serve an important role in nature.

"Gophers are not simply pests, but also are important parts of the ecosystem. They increase soil fertility by mixing plant material and fecal wastes into the soil. Their burrowing aerates the soil and decreases its compaction. They can help speed up the formation of new soil by bringing minerals to the surface. They increase the ability of soil to soak up water. They also serve as food for a variety of animals including owls, coyotes, weasels, and snakes." (Cox, 2009)

The garden is also frequented by *Homo sapiens* and *Canis lupus familiaris*, resulting in pleasant greetings, expressions of appreciation and scholarly chats about the garden's flora and fauna.

Spiders (Class Arachnida)

ORDER ARANEAE (SPIDERS)

"Spiders (order Araneae) are air-breathing arthropods that have eight legs, chelicerae with fangs generally able to inject venom, and spinnerets that extrude silk. They are the largest order of arachnids and rank seventh in total species diversity among all orders of organisms… Unlike insects, spiders do not have antennae… Unlike most arthropods, spiders have no extensor muscles in their limbs and instead extend them by hydraulic pressure… Spiders use a wide range of strategies to capture prey: trapping it in sticky webs, lassoing it with sticky bolas, mimicking the prey to avoid detection, or running it down. Most detect prey mainly by sensing vibrations, but the active hunters have acute vision, and hunters of the genus Portia show signs of intelligence in their choice of tactics and ability to develop new ones… Spider silk provides a combination of lightness, strength and elasticity that is superior to that of synthetic materials… An irrational fear of spiders is called arachnophobia." (Spiders, 2023)

AGELENIDAE FAMILY (FUNNEL WEAVERS)

"Most of the Agelenidae are very fast runners, especially on their webs… Agelenids build a flat sheet of nonsticky web with a funnel-shaped retreat to one side or occasionally in the middle… Although the web is not sticky, it is full of entangling filaments that the spider continually lays down when passing over. The filaments catch in the least projections on a prey insect's body or limbs. The web also is springy, and whether perching on the sheet or awaiting prey in its retreat, the spider reacts immediately to vibrations…" (Funnel Weavers, 2022)

Photo © Lucas

Needs ID tentatively:
Typical Funnel Weavers
Subfamily *Ageleninae*

Genus *Eratigena*

"[Hobo spider individuals] construct a funnel-shaped structure of silk sheeting and lie in wait at the small end of the funnel for prey insects to blunder onto their webs. Hobo spiders sometimes build their webs in or around human habitations… there is little evidence that the hobo spider is a dangerously venomous species... as of 2017, the CDC no longer lists the hobo spider among venomous species." (Hobo Spider, 2022)

Photo © Lucas

RG i Hobo Spider
Eratigena agrestis

Araneidae Family (Orbweavers)

Genus *Argiope* (Garden Orbweavers)

"The genus Argiope includes rather large spiders that often have a strikingly coloured abdomen… The etymology of Argiope is from a Latin word argentum meaning silver. The carapace of Argiope species is typically covered in silvery hairs, and when crawling in the sun, they reflect it in a way that gives them a metallic, white appearance... As most orb weavers, they own a third claw which is used to weave their complex webs… Their webs are relatively big, usually with zigzag patterns in them." (Garden Orbweavers, 2022)

Photo © Hill

RG Banded Garden Spider
Argiope trifasciata

Cheiracanthiidae Family (Long-legged Sac Spiders)

Genus *Cheiracanthium*

"[Yellow sac spiders] are often pale, entelegyne, and ecribellate. They have eight eyes in two rows… The legs are usually long and slender… These spiders were once considered of medical concern, but studies have shown that they are not medically significant to humans." (Rose, 2022, p. 435)

Photo © Hill

Needs ID tentatively:
Longlegged Sac Spider
Genus *Cheiracanthium*

Dysderidae Family (Woodlouse Hunter Spiders)

Genus *Dysdera*

"The woodlouse spider (Dysdera crocata) is a species of spider that preys primarily upon woodlice. Other common names refer to variations on the common name of its prey, including woodlouse hunter, sowbug hunter, sowbug killer, pillbug hunter and slater spider… They spend the day in a silken retreat made to enclose crevices in, generally, partially decayed wood, but sometimes construct tent-like structures in indents of various large rocks. Woodlouse spiders hunt at night and do not spin webs. Rather than spinning their webs at night, they use this time to search warm places for prey… Their diet consists principally of woodlice which—despite their tough exoskeleton—are pierced easily by the spider's large chelicerae." (Woodlouse Spider, 2022)

Photo © Hill

RG i Woodlouse Spider
Dysdera crocata

GNAPHOSIDAE FAMILY (GROUND SPIDERS)

"All ground spiders lack a prey-capture web and generally run prey down on the surface. They hunt at night and spend the day in a silken retreat… Ground spiders hunt by active foraging, chasing down and subduing individual prey items. They are adapted to hunting large and potentially dangerous prey, including other spiders, which they subdue by using their silk. When hunting, ground spiders produce thick, gluey silk from their enlarged spinnerets and attempt to use it to entangle their prey in swathing attacks, often applying their webbing to their prey's legs and mouths. By immobilizing potential prey in this manner, ground spiders can subdue proportionally large creatures while reducing risk of injury to themselves from their prey's attempts to fight back." (Ground Spiders, 2022)

Photo © Hill

Needs ID tentatively:
Ground Spiders
Family *Gnaphosidae*

MIMETIDAE FAMILY (PIRATE SPIDERS)

"Pirate spiders… typically feed on other spiders… Mimetidae usually hunt by picking at the strands on their prey's web to simulate the movements of either a trapped insect or a potential mate. When their prey comes to investigate, they are instead captured and eaten." (Pirate Spiders , 2022)

Photo © Hill

RG Western Pirate Spider
Mimetus hesperus

OXYOPIDAE FAMILY (LYNX SPIDERS)

"Most [Lynx spider] species make little use of webs, instead spending their lives as hunting spiders on plants. Many species frequent flowers in particular, ambushing pollinators, much as crab spiders do. They tend to tolerate members of their own species more than most spiders do, and at least one species has been identified as exhibiting social behaviour… Most of them have large spiny bristles on their legs and in many species the bristles form almost a basket-like structure that may assist in confining the prey that they grasp, and protect the spider from its struggles… Lynx spiders, in spite of being largely ambush hunters, are very speedy runners and leapers, alert and with good vision." (Lynx Spiders, 2022)

Photo © Lucas

RG Western Lynx Spider
Oxyopes scalaris

SALTICIDAE FAMILY (JUMPING SPIDERS)

Genus *Phidippus*

Phidippus audax

"Phidippus audax or the bold jumping spider is a common species of spider belonging to the genus Phidippus, a group of jumping spiders easily identified by their large eyes and their iridescent chelicerae. Like all jumping spiders, they have excellent stereoscopic vision that aids them in stalking prey and facilitates visual communication with potential mates during courting… Bold jumping spiders are solitary carnivores that use their highly specialized eyesight to actively hunt and stalk prey. They prey on a variety of insects and non-insect terrestrial arthropods such as caterpillars, dragonflies, grasshoppers, and other spiders... Unlike most spiders, bold jumpers do not build webs to catch prey." (Bold Jumping Spider, 2023)

Photo © Lucas

RG Bold Jumping Spider
Phidippus audax

Phidippus johnsoni

"Phidippus johnsoni, the red-backed jumping spider, is one of the largest and most commonly encountered jumping spiders of western North America… It is one of the species of jumping spiders that are mimics of mutillid wasps in the genus Dasymutilla (commonly known as "velvet ants")… This species constructs conspicuous tubular silken nests… They remain inside these at night and during bad weather. Molting, egg laying and sometimes courtship and mating occur inside these nests." (Johnson's Jumping Spider, 2021)

Photo © Lucas

RG Johnson's Jumping Spider
Phidippus johnsoni

THOMISIDAE FAMILY (CRAB SPIDERS)

"Members of this family of spiders do not spin webs, and are ambush predators. The two front legs are usually longer and more robust than the rest of the legs. The back two legs are smaller, and are usually covered in a series of strong spines. They have dull colorations such as brown, grey, or very bright green, pink, white or yellow. They gain their name from the shape of their body, and they usually move sideways or backwards." (Crab Spiders, 2022)

Photo © Lucas

Needs ID tentatively:
Genus *Mecaphesa*

Insects (Class Insecta)

"[Insects] are the largest group within the arthropod phylum. Insects have a chitinous exoskeleton, a three-part body (head, thorax and abdomen), three pairs of jointed legs, compound eyes and one pair of antennae. Their blood is not totally contained in vessels; some circulates in an open cavity known as the haemocoel. Insects are the most diverse group of animals; they include more than a million described species and represent more than half of all known living organisms." (Insects, 2023)

ORDER COLEOPTERA (BEETLES & WEEVILS)

"Order Coleoptera… is the largest order in the class Insecta with over 250,000 described species. Obviously, with this many species, there is a wide range of diversity in this order with respect to size, morphological characters, biology, and behavior. However, the order is typically characterized by a pair of elytra (hardened front wings) and a pair of membranous hind wings. They have chewing mouthparts that may be slightly modified for various functions and undergo complete metamorphosis." (Order Coleoptera - Beetles, n.d.)

Gardening Note – Several species of beetles and weevils may damage plants. Watch for infestations and learn to ID the adult and larval stages of those that could become pests.

Beetles

BUPRESTIDAE FAMILY (JEWEL BEETLES)

"Buprestidae is a family of beetles known as jewel beetles… because of their glossy iridescent colors. The family is among the largest of the beetles, with some 15,500 species known in 775 genera…" (Jewel Beetles, 2022)

Photo © Lucas

RG *Buprestis viridisuturalis*

CERAMBYCIDAE FAMILY (LONGHORN BEETLES)

"The longhorn beetles… are a large family of beetles, with over 35,000 species described. Most species are characterized by extremely long antennae… The scientific name of this beetle family goes back to a figure from Greek mythology: after an argument with nymphs, the shepherd Cerambus was transformed into a large beetle with horns…" (Longhorn Beetles, 2023)

Genera *Cortodera*, *Crossidius* & *Lepturobosca*

Photo © Lucas

Needs ID tentatively:
Genus *Cortodera*

Photo © Hill

RG *Crossidius pulchellus*

Photo © Lucas

Needs ID tentatively:
Genus *Lepturobosca*

Coccinellidae Family (Lady Beetles)

"About 400 species of lady beetles are found in North America. Several species have been introduced to control pests. Almost all lady beetles prey, as both larvae and adults, on soft-bodied pests such as aphids, mites and scales. One larva can consume hundreds of prey during its development. Because of their voracious appetites and ability to multiply rapidly, lady beetles can control even large infestations of pests. They are important predators of orchard pests, especially aphids. The two most common species in the Northwest are the convergent and transverse lady beetles." (Lady Beetles, n.d.)

Project Note –Seek out more lady beetle species, including the larva.

Gardening Note – Transfer lady beetles to plants with aphid infestations.

Genera *Coccinella* & *Hippodamia*

The image to the right is of lady beetle larva eating black aphids on Wyeth buckwheat (*Eriogonum heracleoides*).

Photo © Lucas

Needs ID tentatively:
Genus *Coccinella*

Photo © Lucas

RG Convergent Lady Beetle
Hippodamia convergens

Elateridae Family (Click Beetles)

"[Elateridae or click beetles] are a cosmopolitan beetle family characterized by the unusual click mechanism they possess… A spine on the prosternum can be snapped into a corresponding notch on the mesosternum, producing a violent "click" that can bounce the beetle into the air. Clicking is mainly used to avoid predation, although it is also useful when the beetle is on its back and needs to right itself. There

are about 9300 known species worldwide, and 965 valid species in North America… Click beetle larvae, called wireworms, are usually saprophagous, living on dead organisms…" (Click Beetles, 2022)

Genus *Melanotus*

Photo © Hill

RG Genus *Melanotus*

MELOIDAE FAMILY (BLISTER BEETLES)

"Blister beetles are beetles of the family Meloidae, so called for their defensive secretion of a blistering agent, cantharidin. About 7,500 species are known worldwide. Many are conspicuous and some are aposematically colored, announcing their toxicity to would-be predators… The larvae are insectivorous, mainly attacking bees… The adults sometimes feed on flowers and leaves of plants of such diverse families as the Amaranthaceae, Asteraceae, Fabaceae, and Solanaceae." (Blister Beetles, 2022)

Genus *Lytta*

Lytta vulnerate

Photo © Hill

RG *Lytta vulnerate*

SCARABAEIDAE FAMILY (SCARABS)

"Scarabs are stout-bodied beetles, many with bright metallic colours… They have distinctive, clubbed antennae composed of plates called lamellae that can be compressed into a ball or fanned out like leaves to sense odours. Many species are fossorial, with legs adapted for digging..." (Scarabs, 2022)

Scarab beetles are preyed upon by scoliid wasps. See scoliid wasp found in the garden.

Genus *Euphoria*

Euphoria inda

"Euphoria inda, the bumble flower beetle, brown fruit chafer or Indian cetonia is a species of beetle in the family Scarabaeidae. It is found in North America. While in flight, adults of this species do not lift their elytra, creating a buzzing sound as the hindwings vibrate inside. The adult beetle is a pollinator and feeds on pollen, nectar, sap and damaged fruits." (Bumble Flower Beetle, 2022)

Photo © Lucas

RG Bumble Flower Beetle
Euphoria inda

Genus *Ligyrus*

Ligyrus gibbosus

"Ligyrus gibbosus is broadly distributed across North America… This species damages a broad range of plants as both larva and adult… Eggs are laid in soil… at the base of a host plant… Sunflowers appear particularly susceptible…" (J.B. Dunlap, 2016)

Photo © Lucas

Needs ID tentatively:
Carrot Beetle
Ligyrus gibbosus

Tenebrionidae Family (Darkling Beetles)

"The number of species in the Tenebrionidae is estimated at more than 20,000 and the family is cosmopolitan in distribution… Tenebrionid beetles occupy ecological niches in mainly deserts and forests as plant scavengers. Most species are generalistic omnivores, and feed on decaying leaves, rotting wood, fresh plant matter, dead insects, and fungi as larvae and adults... The larvae, known as mealworms or false wireworms, are usually fossorial, heavily armored and nocturnal. They may possibly be an important resource for certain invertebrates and small mammals." (Darkling Beetles, 2023)

Subfamilies *Alleculinae* & *Pimeliinae*

Photo © Hill

Needs ID tentatively:
Comb-clawed Darkling Beetle
Subfamily *Alleculinae*

Photo © Lucas

Needs ID tentatively:
Subfamily *Pimeliinae*

Weevils

CURCULIONIDAE FAMILY (TRUE WEEVILS)

"The Curculionidae are a family of weevils, commonly called snout beetles or true weevils. They are one of the largest animal families… Adult Curculionidae can be recognised by the well-developed, downwards-curved snout… They have elbowed antennae that end in clubs… Most weevils feed on plants as larvae and adults… When disturbed, adult curculionids often play dead by lying motionless on their backs… Many species of weevils are common household and garden pests, but don't harm people, pets, or buildings." (True Weevils, 2022)

Photo © Lucas

Needs ID tentatively:
Family *Curculionidae*

We found small larvae (est. 1/4") that appeared to be boring through the roots of dead and dying blanket flowers (*Gaillardia* spp.) An insect taxonomist on iNaturalist, whose research focuses on the weevils, identified it as a true weevil. We started examining the roots of dying plants and found larvae in several other blanket flower plants.

Gardening Note – When unhealthy plants are dug, check roots for damage and a possible cause such as too much water or insect damage.

Genus *Larinus*

Larinus obtusus

Photo © Lucas

RG Blunt Knapweed Flower Weevil
Larinus obtusus

ORDER DERMAPTERA (EARWIGS)

FORFICULIDAE FAMILY (COMMON EARWIGS)

"There are 2,000 species of earwigs worldwide, found on every continent except Antarctica. They make up the insect Order Dermaptera, and are characterized by wings they rarely used and the distinctive pincers that freak out so many people… There are 10 native species of earwigs in the United States, and they're benign or even helpful creatures. They eat vegetation as well as other insects. But it's a non-native earwig, the European earwig (Forficula auricularia), that most of us in North America will encounter... a Washington State University study found that European earwigs can even be beneficial. Researchers found that they prey on aphids, significantly reducing damage in commercial apple orchards… they're very protective and meticulous mothers." (Miller, 2020)

Gardening Note – Although earwigs may damage plants, the damage is minor. They can be helpful in controlling aphids. Ignore them in the garden unless significant damage to plants.

Genus *Forficula*

Forficula auricularia

Photo © Lucas

RG i European Earwig
Forficula auricularia

ORDER DIPTERA (TRUE FLIES)

AGROMYZIDAE FAMILY (LEAF-MINER FLIES)

"The Agromyzidae are a family commonly referred to as the leaf-miner flies, for the feeding habits of their larvae, most of which are leaf miners on various plants... These are small, sometimes minute, flies, at most 0.9 to 6.0 mm in length… Agromyzidae larvae are phytophagous, feeding as leaf miners, less frequently as stem miners or stem borers… The shape of the mine is often characteristic of the species and therefore useful for identification." (Leaf-miner Flies, 2023)

Photo © Lucas

Needs ID tentatively:
Family *Agromyzidae*

BOMBYLIIDAE FAMILY (BEE FLIES)

"The Bombyliidae are a family of flies, commonly known as bee flies… Adults generally feed on nectar and pollen, some being important pollinators, often with spectacularly long proboscises… Unlike butterflies, bee flies hold their proboscis straight, and cannot retract it… Many Bombyliidae superficially resemble bees and accordingly the prevalent common name for a member of the family is bee fly… Adults favour sunny conditions and dry, often sandy or rocky areas. They have powerful wings and are found typically in flight over flowers or resting on the bare ground exposed to the sun. They significantly contribute to cross pollination of plants, becoming the main pollinators of some plant species of desert environments." (Bee Flies, 2023)

Photo © Hill

RG *Hemipenthes lepidota*

Photo © Hill

Needs ID tentatively:
Tribe *Villini*

Photo © Hill

Needs ID tentatively:
Genus *Villa*

CALLIPHORIDAE FAMILY (BLOW FLIES)

"The name blowfly comes from an older English term for meat that had eggs laid on it, which was said to be flyblown. The first known association of the term "blow" with flies appears in the plays of William Shakespeare… Calliphoridae adults are commonly shiny with metallic colouring… Little doubt remains

that these flies use nectar as a source of carbohydrates to fuel flight… Larvae of most species are scavengers of carrion and dung, and most likely constitute the majority of the maggots found in such material… Maggot debridement therapy (MDT) is the medical use of selected, laboratory-raised fly larvae for cleaning nonhealing wounds… Calliphoridae are, alongside managed and wild bees, likely to be the main crop pollinating insect…" (Blow Flies, 2023)

Photo © Lucas

Needs ID tentatively:
Greenbottle Flies
Genus *Lucilia*

Chironomidae Family (Non-biting Midges)

"This is a large taxon of insects; some estimates of the species numbers suggest well over 10,000 world-wide. Males are easily recognized by their plumose antennae... Larval stages of the Chironomidae can be found in almost any aquatic or semiaquatic habitat…" (Non-biting Midges, 2023)

Photo © Lucas

Needs ID tentatively:
Family *Chironomidae*

Chloropidae Family (Frit Flies)

"The Chloropidae are a family of flies commonly known as frit flies or grass flies... These are usually very small flies, yellow or black and appearing shiny due to the virtual absence of any hairs. The majority of the larvae are phytophagous, mainly on grasses…" (Frit Flies, 2022)

Photo © Lucas

Needs ID tentatively:
Subfamily *Oscinellinae*

Photo © Hill

Needs ID tentatively:
Genus *Thaumatomyia*

Conopidae Family (Thick-headed Flies)

"The Conopidae, usually known as the thick-headed flies, are… the sole member of the superfamily Conopoidea… The majority of conopids are black and yellow, or black and white, and often strikingly resemble wasps, bees, or flies of the family Syrphidae… A conopid is most frequently found at flowers, feeding on nectar… The larvae of all conopids are internal parasites, most of aculeate (stinging) Hymenoptera. Adult females aggressively intercept their hosts in flight to deposit eggs… The female's abdomen is modified to form what amounts to a "can opener" to pry open the segments of the host's abdomen as the egg is inserted…" (Thick-headed Flies, 2023)

Photo © Hill

RG *Thecophora propinqua*

Photo © Lucas

Needs ID tentatively:
Genus *Zodion*

Photo © Lucas

Needs ID tentatively:
Complex *Physocephala marginata*

Dolichopodidae Family (Long-legged Flies)

"Dolichopodidae generally are small flies with large, prominent eyes and a metallic cast to their appearance… Most have long legs… Adults of the Dolichopodidae live largely in grassy places and shrubbery. The flies occur in a wide range of habitats, near water or in meadows, woodland edges and in gardens… Adults often are seen in a characteristic predatory posture standing high on their legs… The adults are predators, feeding on small invertebrates including Collembola, aphids, and the larvae of Oligochaeta. Species of the genus Dolichopus commonly prey on the larvae of mosquitoes…" (Long-legged Flies, 2023)

Photo © Lucas

RG *Condylostylus occidentalis*

Muscidae Family (House Flies and Allies)

"Adults can be predatory, hematophagous, saprophagous, or feed on a number of types of plant and animal exudates. They can be attracted to various substances including sugar, sweat, tears and blood. Larvae occur in various habitats including decaying vegetation, dry and wet soil, nests of insects and

birds, fresh water, and carrion… The housefly, Musca domestica, is the best known and most important species… Larvae mainly develop in decaying plant material or manure." (House Flies and Allies, 2023)

Photo © Hill

RG Tiger fly
Coenosia tigrina

Photo © Lucas

Needs ID tentatively:
Genus *Stomoxys*

Photo © Lucas

Needs ID tentatively:
False Greenbottles
Genus *Neomyia*

Sarcophagidae Family (Flesh Flies and Satellite Flies)

"[Sarcophagidae] are a family of flies commonly known as flesh flies. They differ from most flies in that they are ovoviviparous, opportunistically depositing hatched or hatching maggots instead of eggs on carrion, dung, decaying material, or open wounds of mammals… The adults mostly feed on fluids from animal bodies, nectar, sweet foods, fluids from animal waste and other organic substances…" (Flesh Flies and Satellite Flies, 2023)

Photo © Lucas

Needs ID tentatively:
Family *Sarcophagidae*

Scathophagidae Family (Dung Flies)

"The larval biology of this family is actually quite diverse, including plant feeders (leaf miners, stem borers, or feeding in seed capsules), aquatic predators, and predators on other insect larvae in wet situations - such as piles of rotting vegetable matter, seaweed, or dung. The adults are predators on other small insects, and while they are commonly seen on flowers, they are hunting prey there, rather than acting as pollinators. They are, in fact, one of the better predators of blow-flies; thus, they are beneficial agents of biological control..." (Dung Flies, 2023)

Photo © Hill

Needs ID tentatively:
Golden Dung Fly
Scathophaga stercoraria

Syrphidae Family (Hover Flies)

"Although bees get most of the press when it comes to pollination, recent research has shown that flies are also extremely important and carry out about one-third of our pollination services. Among the flies, syrphids are usually the most important pollinators… In addition to the value of pollination services… About one-third of all syrphids larvae… are predators of soft-bodied insects like aphids and scales and as such bring huge benefits in natural and biological control of pests." (Skevington, 2019, p. 12)

"Hover flies, also called flower flies or syrphid flies, …are often seen hovering or nectaring at flowers; the adults of many species feed mainly on nectar and pollen, while the larvae (maggots) eat a wide range of foods. In some species, the larvae are saprotrophs… In other species, the larvae are insectivores and prey on aphids, thrips, and other plant-sucking insects." (Hover Flies, 2023)

"Adults are similar in size and color to wasps and bees. They mimic these insects as a form of protection from predators." (Schuh, n.d.)

Genus *Dasysyrphus*

Dasysyrphus intrudens (confusing conifer fly) and two other species *"are our only Dasysyrphus species with markings that cross the abdominal margin… Adults are found in forest, meadow, bog, sandy and tidal flats… Larvae are not known but likely feed on aphids and soft-bodies insects. Dasysyrphus intrudens is certainly a complex of species, but the boundaries between those species are not clearly defined…"* (Skevington, 2019, p. 414)

Photo © Hill

Needs ID tentatively:
Complex *Dasysyrphus intrudens*

Genus *Eristalinus* (Lagoon Flies)

"Eristalinus species are easily distinguished by their patterned eyes… There are 93 species globally… Larvae occur in freshwater seepages and brackish pools as well as in sewage ponds (where they are important in the turnover of waste)." (Skevington, 2019, p. 92)

"Eristalinus (Lathyropthalmus) aeneus (Common Lagoon Fly)… has a distinctive spotted pattern on its eyes and an overall greenish sheen… Introduced from Europe. Adults often land on bare ground, rock, or low vegetation and may be found nectaring on yellow composites, white Apiaceae, or Salix." (Skevington, 2019, p. 92)

Photo © Hill

RG Common Lagoon Fly
Eristalinus aeneus

Genus *Eristalis* (Drone Flies)

"[Eristalis] species are known as drone flies (or droneflies) because they bear a resemblance to honeybee drones. Drone flies and their relatives are fairly common generalist pollinators…" (Drone Flies, 2022)
"The bumblebee mimics are all easily distinguished from other Eristalis species by the dense yellow pile on the periphery of the thorax and scutellum…" (Skevington, 2019, p. 106)

Eristalis arbustorum

"Eristalis arbustorum… was introduced to North America around 1885. Ubiquitous in urban and rural settings on many flowers." (Skevington, 2019, p. 114)

Photo © Hill

RG European Drone Fly
Eristalis arbustorum

Eristalis hirta

"This widespread western species [Eristalis hirta] also occurs sporadically in the boreal forest and tundra across northern North America, Europe, and Asia. It is found in raised bogs, ditches, and temporary pools." (Skevington, 2019, p. 118)

Photo © Hill

RG Black-footed Drone Fly
Eristalis hirta

Eristalis tenax

"Eristalis tenax is native to Europe but now is cosmopolitan. It can often be found sunning on leaves or resting on flowers and visits a very wide variety of flowers. Larvae live in a wide range of aqueous to semiaqueous habitats including dung. Common Drone Flies are known to be migratory and overwinter as adults." (Skevington, 2019, p. 110)

Photo © Hill

RG i Common Drone Fly
Eristalis tenax

Genus *Eumerus*

"*This diverse Old World genus of 266 species has a least 76 species awaiting description from Africa… Only three species have made it to the New World. All are introduced… Eumerus larvae feed on bulbs and roots…*" (Skevington, 2019, p. 238)

Photo © Lucas

RG *Genus Eumerus*

Genus *Eupeodes* (Aphideaters)

"Adults [of Eupeodes species] are flower visitors and can be found in a wide variety of habitats. Larvae are often found feeding on arboreal aphids; however, some species are more generalist feeders and also feed on ground-layer aphids found on many species of shrubs and herbaceous plants." (Skevington, 2019, p. 422)

Photo © Hill

RG Western Aphideater
Eupeodes fumipennis

Eupeodes volucris

"Adults [of Eupeodes volucris] are found in forest, prairie, meadow, field… There are multiple generations per year." (Skevington, 2019, p. 422) This reference notes numerous plants that this fly is found on.

Photo © Lucas

RG Large-tailed Aphideater
Eupeodes volucris

Genus *Scaeva*

"Adults [of Scaeva affinis] are known from forest, field, prairie and tundra habitats… Larvae feed on aphids…" (Skevington, 2019, p. 418)

Photo © Lucas

RG White-bowed Smoothwing
Scaeva affinis

Genus *Sphaerophoria* (Globetails)

"Sphaerophoria species are small, narrow, black and yellow syrphines. They have long, slender, black, parallel-sided abdomens with simple yellow abdominal markings… They often can be found in low vegetation. Larvae are *aphidophagus, often feeding on ground-layer aphids."* (Skevington, 2019, p. 390)

Photo © Hill

RG Forked Globetail
Sphaerophoria sulphuripes

Genus *Spilomyia* (Hornet Flies)

"Spilomyia species are distinctive flies that mimic wasps. They are easily distinguished from other wasp mimics by their patterned eyes and preapical spur on the metafemur… Larvae are found in rot holes in deciduous trees." (Skevington, 2019, p. 132)

Photo © Hill

RG Western Hornet Fly
Spilomyia citima

Genus *Syritta*

"This genus is easily recognized by its distinctive metafemora. Syritta larvae feed on decaying plant material (compost, manure, silage)." (Skevington, 2019, p. 206)

Syritta pipiens

"Syritta pipiens, sometimes called the thick-legged hoverfly, is one of the most common species in the insect family Syrphidae… They are fast and nimble fliers, and their larvae are found in wet, rotting organic matter… The species is also commonly found in human-created environments… wherever there are flowers. This species is an important part of its native ecosystem as adult Syritta pipiens flies are critical pollinators for a variety of flowering plants and the species supports parasitism by various parasitic wasp species. Thus, they play an important role in environmental functionality, and can serve as bio-indicators, in which their abundance can reflect the health of the environment. Syritta pipiens looks like many predatory hoverfly species, yet is not predatory." (Common Compost Fly, 2022)

Photo © Hill

RG i Common Compost Fly
Syritta pipiens

Genus *Syrphus* (Common Flower Flies)

"Adults of some species are ubiquitous and can be found on flowers of a wide variety of plants. Larvae feed on a variety of ground-layer arboreal aphids." (Skevington, 2019, p. 442)

Syrphus torvus

"Syrphus torvus is a common species of hoverfly found in the Holarctic. The adults feed on pollen and nectar, but the larvae feed on aphids… Eyes have numerous hairs… It is synanthropic in suburban gardens with mature trees and in urban parks… The larva feeds on aphids on trees, bushes and shrubs. Adults feed on pollen and nectar and are particularly attracted to yellow and white flowers." (Hairy-eyed Flower Fly, 2022)

Photo © Hill

RG Hairy-eyed Flower Fly
Syrphus torvus

Genus *Toxomerus* (Calligrapher Flies)

"These small flies [of genus Toxomerus] are commonly encountered at flowers and are immediately recognizable by their distinctive abdominal markings… Most larvae of this genus are predatory, feeding on aphids and other soft-bodied insects." (Skevington, 2019, p. 380)

"Toxomerus marginatus, also known as the calligrapher fly, is a common species of hoverfly. It is found in many parts of North America. The larvae are predators of thrips, aphids, and small caterpillars. Adults feed on a wide range of flowers." (Margined Calligrapher, 2022)

Photo © Hill

RG Margined Calligrapher
Toxomerus marginatus

Tachinidae Family (Bristle Flies)

"The Tachinidae are a large and variable family of true flies… Over 1,300 species have been described in North America alone. Insects in this family commonly are called tachinid flies or simply tachinids. As far as is known, they all are protelean parasitoids, or occasionally parasites, of arthropods, usually other insects." (Bristle Flies, 2022)

Photo © Hill

Needs ID tentatively:
Tribe *Tachinini*

Photo © Hill

Needs ID tentatively:
Tribe *Gymnosomatini*

Genus *Archytas*

"Archytas apicifer adults feed on flower nectar, and are also known to be pollinators of some flowers. Like many other tachinid flies, A. apicifer larvae are internal parasitoids of the Forest tent caterpillars and fall webworms in addition to the tomato fruitworm, corn earworm, and cutworms." (Archytas apicifer, 2022)

Photo © Hill

RG *Archytas apicifer*

Genera *Cylindromyia* & *Gymnosoma*

Photo © Hill

Needs ID tentatively:
Genus *Cylindromyia*

Photo © Lucas

Needs ID tentatively:
Genus *Gymnosoma*

Genera *Linnaemya* & *Phasia*

Photo © Lucas

Needs ID tentatively:
Genus *Linnaemya*

Photo © Hill

Needs ID tentatively:
Genus *Phasia*

Tipulidae Family (Large Crane Flies)

"Larval habitats include all kinds of freshwater, semiaquatic environments… Some Tipulinae, including Dolichopeza, are found in moist to wet cushions of mosses or liverworts. Ctenophora species are found in decaying wood or sodden logs. Nephrotoma and Tipula larvae are found in dry soils of pasturelands, lawns, and steppe… Larvae can be important in the soil ecosystem, because they process organic material and increase microbial activity. Larvae and adults are also valuable prey items for many animals, including insects, spiders, fish, amphibians, birds, and mammals." (Large Crane Flies, 2023)

Photo © Hill

Needs ID tentatively:
Marsh Crane Fly
Tipula oleracea

ORDER HEMIPTERA (TRUE BUGS, HOPPERS, APHIDS, AND ALLIES)

ALYDIDAE FAMILY (BROAD-HEADED BUGS)

"Alydidae are generally of dusky or blackish coloration. The upperside of the abdomen is usually bright orange-red. this color patch is normally not visible as it is covered by the wings; it can be exposed, perhaps to warn would-be predators of these animals' noxiousness: They frequently have scent glands that produce a stink considered to be worse than that of true stink bugs (Pentatomidae). The stink is said to smell similar to a bad case of halitosis... These bugs mainly inhabit fairly arid and sandy habitat, like seashores, heathland, steppe and savannas. Their main food is seeds, which they pierce with their proboscis to drink the nutritious fluids contained within." (Broad-headed Bugs, 2021)

Photo © Hill

Needs ID tentatively:
Alydus eurinus

APHIDIDAE FAMILY (APHIDS)

"[Aphids] are small… soft-bodied insects that feed from sucking plant juices... They vary in color, and may be green, pink, white, gray, yellow, brown, or black. Even within a species, they often vary in appearance or color. Some individuals are winged ('alates'), while other adults of the same species are not. Aphids are often found in large colonies… Aphids are resistant to insecticides, and their populations explode when insecticides have killed off their natural enemies… They may multiply rapidly when the host plant has been fertilized heavily… Control Methods: Natural: There are many naturally occurring enemies of aphids. There are predators, such as ladybeetle adults and larvae, lacewing adults and larvae, syrphid fly larvae, and minute pirate bugs. There are also many parasitoids that specialize in attacking aphids, such as tiny aphidiid wasps." (Stoner)

We found a large infestation of black aphids on wild buckwheat (*Eriogonum* sp.). See our lady beetle observations for an image of larva eating aphids.

> *Gardening Note – Avoid using insecticides and over fertilizing. These will cause the aphid population to increase.*

> *Gardening Note – Move lady beetle adults and larva to aphid infested or susceptible plants.*

> *Gardening Note – Use a strong stream of water to knock aphids off plants.*

Photo © Lucas

Needs ID tentatively:
Family *Aphididae*

Cicadellidae Family (Typical Leafhoppers)

"[Leafhoppers] are plant feeders that suck plant sap from grass, shrubs, or trees. Their hind legs are modified for jumping, and are covered with hairs that facilitate the spreading of a secretion over their bodies that acts as a water repellent and carrier of pheromones… Leafhoppers mainly are herbivores, but some are known to eat smaller insects, such as aphids, on occasion." (Typical Leafhoppers, 2022)

Photo © Lucas

Needs ID tentatively:
Genus *Ceratagallia*

Photo © Lucas

RG *Xerophloea peltata*

Geocoridae Family (Big-eyed Bugs)

"Predaceous on mites and a wide variety of small insects… Bigeyed bugs develop through three life stages. Eggs hatch into nymphs, which develop through five increasingly larger instars… Bigeyed bugs are found mostly on low-growing plants, including many field and row crops and in gardens. Adults and nymphs feed by sucking prey's body contents through their needlelike mouthparts. Bigeyed bugs feed on bug nymphs, flea beetles, insect eggs, small caterpillars, and all stages of aphids, mites, and whiteflies. Bigeyed bugs also feed harmlessly on pollen, seeds, and plant juices and are not plant pests… Bigeyed bug abundance can be increased by planting flowering species (insectary plants) that provide blossoms throughout the growing season." (Bigeyed Bugs, n.d.)

Photo © Hill

RG Western Big-eyed Bug
Geocoris pallens

Lygaeidae Family (Seed Bugs)

"Small milkweed bugs eat a variety of foods, including flower nectar, sap from milkweed seeds, and a variety of scavenged foods. They are also predators of caterpillars as well as the adults, larvae, and pupae of flies, bees, and beetles… As with other true bugs, this insect uses its long, strawlike mouthparts to pierce its foods and suck nutritious juices... their contrasting black and bright orange colors are a warning to potential predators. As they feed on milkweeds, whose sap contains toxic chemicals, their bodies are able to sequester the toxins so that a predator that eats them will be sickened." (Small Milkweed Bug, 2023)

Photo © Lucas

Photo © Hill

RG Small Milkweed Bug
Lygaeus kalmii
(Nymph and Adult)

Miridae Family (Plant Bugs)

"A huge, abundant family of true bugs, plant bugs, or mirids, are often overlooked — except by gardeners and farmers. Most mirids eat plants, and some are agricultural pests. As a group, they're an important food source for birds and other insectivores. In North America north of Mexico, there are about 2,000 species, in more than 220 genera, in this large, diverse family… Many species of plant bugs… primarily suck the juices of plants, but they may also eat other insects, as the opportunity arises. Some of these species are being studied as biocontrol agents against more serious agricultural pests." (Plant Bugs - Mirids, n.d.)

Photo © Lucas

Needs ID tentatively:
Lygus Bugs
Genus *Lygus*

Pentatomidae Family (Stink Bugs)

"…the pentatomids have piercing sucking mouthparts, and most are phytophagous, including several species which are severe pests on agricultural crops. However, some species, particularly in the subfamily Asopinae, are predatory and may be considered beneficial… The American name "stink bug" is specific to the Pentatomidae, and refers to their ability to release a pungent defensive spray when threatened, disturbed, or crushed." (Stink Bugs, 2022)

Photo © Lucas

Needs ID tentatively:
Family *Pentatomidae*
(Nymph)

"Report BMSB: As of November 2020, brown marmorated stink bug (BMSB) has been recorded in 29 Washington state counties; with most along the I-5 corridor. If you see a BMSB, please send a photo, general location (inside or outside of house or car, backyard, park, etc.) and the address it was found to: tfrec.reportBMSB@wsu.edu." (Brown Marmorated Stink Bug, n.d.)

Project Note – Seek out more stink bug species, including nymph form. Report to WSU confirmed BMSB observations.

Genus Thyanta

Thyanta custator

Photo © Hill

Photo © Lucas

Needs ID tentatively: Red-shouldered Stink Bug
Thyanta custator (Nymph and Adult)

Thyanta pallidovirens

Photo © Lucas

RG *Thyanta pallidovirens*

Genus *Zicrona*

This is the only iNaturalist observation in Eastern WA.

Photo © Lucas

Needs ID tentatively:
Genus *Zicrona*

Reduviidae Family (Assassin Bugs)

"… almost all [Reduviidae] species are terrestrial ambush predators… they have a relatively narrow neck, sturdy build, and a formidable curved proboscis (sometimes called a rostrum). Large specimens should be handled with caution, if at all, because they sometimes defend themselves with a very painful stab from the proboscis… The most distinctive feature of the family is that the tip of the proboscis fits into a ridged groove in the prosternum, where it can be used to produce sound by stridulation. Sound is made by rasping the proboscis against ridges in this groove stridulitrum (stridulatory organ). These sounds are often used to discourage predators." (Assassin Bugs, 2022)

Photo © Lucas

Needs ID tentatively:
Spined Assassin Bug
Sinea diadema

Rhopalidae Family (Scentless Plant Bugs)

"[Rhopalidae] differ from the related coreids in lacking well-developed scent glands. They are usually light-colored and smaller than the coreids... They live principally on weeds, but a few (including the boxelder bug) are arboreal… They are not considered economically important." (Scentless Plant Bugs, 2021)

Photo © Hill

Needs ID tentatively:
Genus *Harmostes*

ORDER HYMENOPTERA (ANTS, BEES, WASPS, AND SAWFLIES)

"Wasps, ants and bees are placed in the order Hymenoptera, and recognized as the first major branch of all insects that undergo complete metamorphosis (egg, larva, pupa, adult). The order name is Greek and translates to 'marriage wing' a reference to how the forewing and hindwing are joined to produce one functional flying pair." (Eaton E. R., 2021, p. 12)

Ants

FORMICIDAE FAMILY (ANTS)

> *Project Note – Seek out ants. We have only one observation.*

Photo © Lucas

Needs ID tentatively:
Fusca-group Field Ants (Complex *Formica fusca*)

Bees

"Are Bees Just Hairy Wasps? Yes! Sawflies evolved into parasitoid wasps, which then gave rise to the stinging parasitoids… From those stinging wasps arose bees, beginning sometime in the middle of the Cretaceous period… approximately 125 million years ago." (Eaton E. R., Wasps, 2021, p. 18)

ANDRENIDAE FAMILY (MINING BEES)

Genus *Andrena* (Mining Bees)

"Bees in this genus are commonly known as mining bees due to their ground-nesting lifestyle… All Andrena are ground nesting, solitary bees. They seem to have a preference for sandy soils. The genus includes no parasitic or social species, though some nest communally or in aggregations. After mating, each female bee digs a burrow, collects pollen to form firm, round provisions for the larvae to eat and places them in cells lined with a shiny secretion. Larvae do not spin a cocoon and they overwinter as adults… Many Andrena are host-plant specialists." (Mining Bees, 2022)

Photo © Hill

RG Prunus Miner
Andrena prunorum

Photo © Hill

Needs ID tentatively:
Subgenus *Cnemidandrena*

Photo © Lucas

Needs ID tentatively:
Genus *Andrena*

Photo © Hill

Needs ID tentatively:
Subgenus *Cnemidandrena*

The reddish critters seen on the bee are larvae of a Meloe oil beetle known as a planidia or triungulin (meaning three-clawed). Planidia wait on flowers for foraging bees. They attach themselves to a female bee, or if attached to a male they will transfer to a female when the bees mate. These larva are not parasites on the adult bee, but rather are clinging to the bee and will be carried back to its nest. There they will drop from the bee and consume the bee larvae and any food provisions.

Genus *Perdita* (Fairy Bees)

"Perdita are usually quite small… and often brightly colored with metallic reflections and/or yellow or white markings, and among the few lineages of bees incapable of stinging. Most species are extreme specialists (oligoleges) with respect to pollen and will only collect pollen from a few closely related species or genera of plants. Many species in this genus are called fairy bees. They may be parasitized by Neolarra cuckoo bees, which lay eggs in their nests given the opportunity." (Fairy Bees, 2022)

Our observation, in subgenus Cockerellia and believed to possibly be *Perdita (Cockerellia) lingualis*, was documented while on Cusick's sunflower (*Helianthus cusickii*).

Photo © Lucas

Needs ID tentatively:
Subgenus *Cockerellia*

Apidae Family (Honey Bees, Bumble Bees, and Allies)

Genus *Anthophora* (Common Digger Bees)

"The bee genus Anthophora is one of the largest in the family Apidae… All species are solitary, though many nest in large aggregations. Nearly all species make nests in the soil, either in banks or in flat ground; the larvae develop in cells with waterproof linings and do not spin cocoons. Males commonly have pale white or yellow facial markings, and/or peculiarly modified leg armature and hairs." ((Common Digger Bees, 2023)

Photo © Lucas

RG *Anthophora curta*

Photo © Lucas

Needs ID tentatively:
Genus *Anthophora*

Photo © Lucas

Needs ID tentatively:
Urbane Digger Bee
Anthophora urbana

Genus *Apis* (Honey Bees)

"…within the genus Apis of the bee clade, all native to Afro-Eurasia. After bees spread naturally throughout Africa and Eurasia, humans became responsible for the current cosmopolitan distribution of honey bees, introducing multiple subspecies… Honey bees represent only a small fraction of the roughly 20,000 known species of bees. The best known honey bee is the western honey bee, (Apis mellifera), which was domesticated for honey production and crop pollination." (Honey Bees, 2022)

Photo © Lucas

RG i Western Honey Bee
Apis mellifera

"European honeybees, being very abundant, and effective foragers, with the ability to exploit a wide range of flowers, can outcompete native bees for nectar and pollen resources. 'This impact of competition with a super-abundant, domesticated and feral introduced bee, when combined with pressures from habitat loss as a result of increasing urbanisation and agriculture, especially livestock agriculture, places some native bee species at risk of becoming endangered or even extinct…' 'European honeybees have been introduced around the world and pose an added threat to many native bee species already at risk of declining numbers or even extinction due to increasing urbanisation.'" (Introduced honeybee may pose threat to native bees, 2021)

"The relationship between humans and bees commonly intersects through the practice of beekeeping. Honey bees, in this case 'European' honey bees, are 'livestock' that have been domesticated over

hundreds of years, perhaps thousands. As with dairy cows, pigs, sheep, dogs and cats, humans long ago recognized the value in cultivating a wild creature – a flying insect." (Strommer, 2021)

We see many European honey bees in the garden. We don't have a way to quantitatively measure their impact on the native bees as they forage for the same resources, but they frequently appear to vastly outnumber the native species. These honey bees belong to beekeepers and as such, are flying livestock, not wild organisms.

Project Note – iNaturalist's vision statement specifies "observing wild organisms." Honey bees are not wild, just unsupervised. We have excluded them from the project.

Genus *Bombus* (Bumble Bees)

"A bumblebee (or bumble bee, bumble-bee, or humble-bee) is any of over 250 species in the genus Bombus… Most bumblebees are social insects that form colonies with a single queen. The colonies are smaller than those of honey bees, growing to as few as 50 individuals in a nest… Like their relatives the honeybees, bumblebees feed on nectar, using their long hairy tongues to lap up the liquid; the proboscis is folded under the head during flight. Bumblebees gather nectar to add to the stores in the nest, and pollen to feed their young. They forage using colour and spatial relationships to identify flowers to feed from. Some bumblebees steal nectar, making a hole near the base of a flower to access the nectar while avoiding pollen transfer. Bumblebees are important agricultural pollinators, so their decline in Europe, North America, and Asia is a cause for concern. The decline has been caused by habitat loss, the mechanisation of agriculture, and pesticides." (Bumble Bees, 2022)

Gardening Note – To aid bumble bee populations, avoid using insecticides.

Photo © Lucas

RG Hunt's Bumble Bee
Bombus huntii

Photo © Lucas

RG Nevada Bumble Bee
Bombus nevadensis

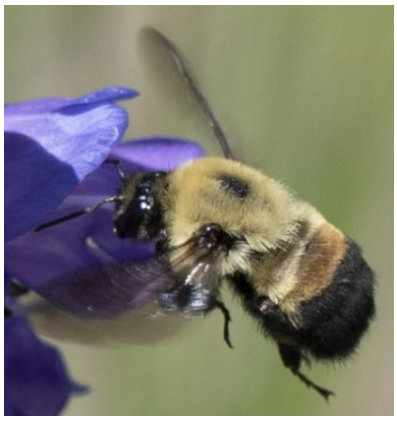


Photo © Lucas

RG Brown-belted Bumble Bee
Bombus griseocollis

Photo © Hill

RG Yellow-faced Bumble Bee
Bombus vosnesenskii

Genus *Diadasia*

"Species of Diadasia are oligolectic, specialized on a relatively small number of plant species. Their host plants include asters, bindweeds, cacti, mallows, and willowherbs, although mallows are the most common and likely ancestral host plant for the whole genus." (Genus Diadasia, 2022)

Photo © Lucas

RG Globe Mallow Bee
Diadasia diminuta

Tribe *Eucerini* (Longhorn Bees)

"The Eucerini (often called long-horned bees) are the most diverse tribe in the family Apidae, with over 32 genera worldwide that were previously classified as members of the family Anthophoridae. All species are solitary, though many nest in large aggregations, and large "sleeping" aggregations of males are found occasionally. Most genera are distinctive in the unusually long male antennae from which the tribe derives its name (eucer- means true horned)." (Longhorn Bees, 2021)

Photo © Hill

Needs ID tentatively:
Genus *Melissodes*

Genus *Nomada* (Nomad Bees)

"… Nomada is one of the largest genera in the family Apidae, and the largest genus of kleptoparasitic 'cuckoo bees.' Kleptoparasitic bees are so named because they enter the nests of a host and lay eggs there, stealing resources that the host has already collected. The name "Nomada" is derived from the Greek word nomas (νομάς), meaning 'roaming' or 'wandering.' Nomada parasitize many different types of bees as hosts, primarily the genus Andrena… As parasites, they lack a pollen-carrying scopa, and are mostly hairless, as they do not collect pollen to feed their offspring. Like non-parasitic bees, adults are known to visit flowers and feed on nectar. Given the lack of scopa and general behavior, they are considered poor pollinators. They are often extraordinarily wasp-like in appearance…" (Nomad Bees, 2022)

When viewing images on the computer monitor, details not readily seen in the field occasionally show up. Such was the case with the image of this nomad bee. The immediate reaction… what in the world is on that bee's feet? The mystery was solved after some research, those are pollinia, masses of cohering pollen grains that are sticky. This is an unfamiliar mechanism of pollination to most of us. This type of pollination is seen in many species of milkweed and in orchids. This nomad bee was on butterfly milkweed (*Asclepias tuberosa*).

Photos © Lucas

RG Genus *Nomada*

Genus *Triepeolus* (Longhorn-cuckoo Bees)

"Medium-sized bees; matte-black bodies with bold white stripes made of matted hair. Cleptoparasites on Melissodes and other fall-flying Eucerini. No floral preferences as they do not collect pollen; frequently seen hovering near the ground where their hosts may be nesting. In the evening and early morning may be found grasping plant stems with their mandibles, legs tucked up beneath the body." (Carril, 2021, p. 224)

Photo © Hill

Needs ID tentatively:
Genus *Triepeolus*

COLLETIDAE FAMILY (PLASTERER BEES)

Genus *Colletes* (Cellophane Bees)

"The genus Colletes… is a large group of ground-nesting bees of the family Colletidae… They tend to be solitary, but sometimes nest close together in aggregations. Species in the genus build cells in underground nests that are lined with a cellophane-like plastic secretion, a true polyester…" (Cellophane Bees, 2022)

Photo © Lucas

RG Genus *Colletes*

HALICTIDAE FAMILY (SWEAT BEES)

"Worldwide: 206 species. US and Canada: 10 species. Sociality: Solitary, communal, or social. Some sweat bees have solitary nests, others nest communally, and some are primitive social, nesting in colonies… Social and communal nests typically occur in large aggregations in exposed, well-drained, compacted soil…. Females line nest brood cells with secretions from their Dufour's gland… Sweat bees are generalist foragers that visit a wide variety of flowering plants, from spring through autumn. They often forage on open flower forms, where pollen and nectar are easy to access." (Holm, Bees, 2017)

Sweat bees are busy building nests in the garden. The images below are from the buckwheat bed which consists of sandy loam. The sandy loam with a light layer of chip is favored by the bees. This observation was identified as sweat bee (*Halicitidae* family) by Zach Portman, professional bee taxonomist at the University of Minnesota, via his Nesting Bees project on iNaturalist. Unsurprisingly, the bit of bee that is visible in the closeup photo was insufficient to get the ID to genus level.

Insects
Order *Hymenoptera* (Ants, Bees, Wasps, and Sawflies)
Bees - *Halictidae* Family (Sweat Bees)

Genus *Agapostemon* (Striped Sweat Bees)

"The genus Agapostemon (literally 'stamen loving') is a common group of Western Hemisphere sweat bees, most of which are known as metallic green sweat bees for their color." (Striped Sweat Bees, 2021)

Photo © Hill

RG Wide-legged Sweat Bee
Agapostemon femoratus

Photo © Hill

Needs ID tentatively:
Texas Striped Sweat Bee
Agapostemon texanus

Photo © Hill

RG Bicolored Striped Sweat Bee
Agapostemon virescens

Genus *Halictus* (Furrow Bees)

"The genus Halictus is a large assemblage of bee species in the family Halictidae… Nests are typically burrows in the soil, with several ovoid 'cells' in which pollen mixed with nectar is provided as food for the developing larvae; a single egg is laid on a pollen mass, and the cell is sealed… Like most ground-nesting bees, the brood cells are lined internally with a waterproofing secretion." (Furrow Bees, 2021)

Photo © Lucas

Needs ID tentatively:
Subgenus *Seladonia*

Photo © Lucas

RG Ligated Furrow Bee
Halictus ligatus

Photo © Lucas

RG Orange-legged Furrow Bee
Halictus rubicundus

Photo © Hill

Needs ID tentatively:
Tripartite Sweat Bee
Halictus tripartitus

Genus *Lasioglossum*

"Lasioglossum is the largest of all bee genera, containing over 1700 species… Most Lasioglossum species nest in the ground… Social behavior among species of Lasioglossum is extraordinarily variable; species are known to exhibit solitary nesting, primitive eusociality, and social parasitism…" (Lasioglossum, 2021) *"They differ from Halictus by the location of hair bands on the segments of their abdomen. Lasioglossum has bands of hair on the innermost portion of each segment, whereas Halictus has bands of hair on the outermost portion of each segment (apical). Identifying Lasioglossum to species is difficult because they look similar."* (Leung, 2004)

Photo © Lucas

Needs ID tentatively:
Genus *Lasioglossum*
(Dr. John Ascher commented, "cf. Evylaeus sensu lato [likely Sphecodogastra]")

Photo © Lucas

Needs ID tentatively:
Genus *Lasioglossum*

In-ground bee nests are a common sight in the sand and sandy loam beds in the garden. Figuring out who is making and using them is a challenge. The bees enter and exit very quickly.

Shown here are multiple nests in a shared location. Note that most entrances are blocked with loose sand, presumedly to keep intruders out.

Photos © Lucas

Sand piles around the top of the nests are about 1.5 inches across. The entrance of the open one is slightly larger than 1/8 inch in diameter.

These nest may or may not be the work of *Lasioglossum* bees. We have put them under *Lasioglossum* because of the following observation.

On a special day in May of 2021, finally, after months of trying, we succeeded in documenting a bee at the entrance to a nest. Dr. John Ascher identified the organism in this observation as a *Lasioglossum* bee. What appeared to be another bee, or possibly a wasp, was blocking the entrance. The bee above the entrance was persistent about wanting to get in. The insect blocking the entrance was not budging. Is this a case of one should remember to shut the front door before leaving home… or is the bee on top the intruder… perhaps a social parasitism thing is going on…? The photographer moved on before this drama resolved itself.

Photos © Lucas

Genus *Sphecodes* (Blood Bees)

"Sphecodes is a genus of bees… the majority of which are black and red in colour and are colloquially known as blood bees. Sphecodes bees are kleptoparasitic on other bees, especially bees in the genera Lasioglossum, Halictus and Andrena. The adults consume nectar, but because they use other bees' provisions to feed their offspring they do not collect pollen." (Blood Bees, 2022)

Photo © Lucas

RG Blood Bees
Genus *Sphecodes*

Several blood bees were observed flying close to the ground, racing back and forth over the location of multiple in-ground nests, presumedly looking for opportunities to commit a bit of thievery. These bees are very small, quick, and never seem to land, making photographing them a challenge.

Megachilidae Family (Mason, Leafcutter, Carder, and Resin Bees)

Photo © Hill

Megachilidae bee shown carrying pollen on the scopa.

"Megachilidae is a cosmopolitan family of mostly solitary bees. Both that their pollen-carrying structure (called a scopa) is restricted to the ventral surface of the abdomen (rather than mostly or exclusively on the hind legs as in other bee families), and their typically elongated labrum is characteristic of this family. Megachilid genera are most commonly known as mason bees and leafcutter bees, reflecting the materials from which they build their nest cells (soil or leaves, respectively); a few collect plant or animal hairs and fibers, and are called carder bees, while others use plant resins in nest construction and are correspondingly called resin bees. All species feed on nectar and pollen, but a few are kleptoparasites (informally called "cuckoo bees"), feeding on pollen collected by other megachilid bees. Parasitic species do not possess scopae. The motion of Megachilidae in the reproductive structures of flowers is energetic and swimming-like; this agitation releases large amounts of pollen." (Megachilidae, 2022)

Genus *Anthidiellum*

"Anthidiellum are tiny but robust black and yellow or red bees, known for hovering conspicuously near plants before landing. They are abundant in the summer, but are generalists and will visit many different kinds of flowering plants. Nests are external structures attached to rocks, branches, or leaves. Nest is made of resinous material and is shiny, fairly smooth, and not always large, containing only one or two cells. Males are hard to miss, as they establish territories and patrol constantly, flying in a straight line for several meters and then hovering in place for a period, before flying in another direction to a new spot to hover. If an insect or other "intruder" is spotted, males will bowl into them. Patrolling is broken up by periods of time resting within his territory, or taking nectar from flowers." (Carril, 2021, p. 140)

All iNaturalist observations of the California rotund-resin bee in Washington were made in the Tri-Cities by this report's three photographers. All but two of the observations were made in the garden.

Photo © Hill

RG California Rotund-Resin Bee
Anthidiellum notatum ssp. robertsoni

Genus *Anthidium* (Carder Bees)

"Anthidium is a genus of bees often called carder or potter bees, who use conifer resin, plant hairs, mud, or a mix of them to build nests… They fly all summer and make the nests in holes in the ground, walls or trees, with hairs plucked from plants." (Carder Bees, 2022)

Ours is the only iNaturalist observation in WA of the spotted woolcarder bee.

Photo © Hill

RG Spotted Woolcarder
Anthidium maculosum

Photo © Lucas

RG i European Woolcarder Bee
Anthidium manicatum

Genus Ashmeadiella

"Small compact black bees, typically seen in late spring and summer. Many are specialists, especially on Asteraceae, but generalists also occur. Nests are made in wood or stems, in burrows in the ground, or under rocks. These bees are occasional inhabitants of bee hotels." (Carril, 2021, p. 112)

The garden is one of only two locations in WA where this species has been recorded in iNaturalist.

Photo © Hill

Needs ID tentatively:
Genus *Ashmeadiella*

Genus *Coelioxys* (Sharptail Bees)

"Coelioxys are not common, but striking when seen, because of their black-and-white markings and distinctive body shape, which features a very pointed abdomen. Coelioxys are cleptoparasites of Megachile and are mostly associated with wood- or twig-nesting species. In most cases, a female visits a nest while the host bee is away. She uses her pointed abdomen to make an incision in the leaf-lining of a completed nest cell, and then inserts an egg through the opening." (Carril, 2021, p. 130)

Photo © Lucas

RG Red-footed Cuckoo Leafcutter
Coelioxys rufitarsis

At the time this observation was made, it was the first on iNaturalist in Eastern WA. Now it is one of three.

Genus *Megachile* (Leafcutter, Mortar, and Resin Bees)

Photo © Lucas

Needs ID tentatively:
Genus *Megachile*

"This is one of the largest genera of bees, with more than 1500 species in over 50 subgenera. The alfalfa leafcutter bee (Megachile rotundata) is managed on a commercial scale for crop pollination, and has been introduced by humans to various regions around the world. Nests are sometimes constructed within hollow twigs or other similarly constricted natural cavities, but often are in burrows in the ground. Nests are typically composed of single long columns of cells, the cells being sequentially constructed from the deepest portion of the tunnel outwards. The female places an egg in each cell with a supply of food, generally pollen, sometimes mixed with nectar. She builds a cap and walls off the cell. The larva hatches from the egg and consumes the food supply. After moulting a few times, it spins a cocoon and pupates, often after several months of hibernation as a prepupa. It emerges from the nest as an adult. Males, which are typically smaller and emerge in advance of females, die shortly after mating, but females survive for another few weeks, during which time they build new nests." (Megachile, 2022)

We added a bee house to the garden. It was used by a few bees in the summer of 2021. The cocoons were collected in the fall and stored for the winter. About a dozen bees emerged late in the spring. One of these was photographed before it flew off and posted on iNaturalist (see image below). An ID has not been confirmed.

No bees used the house in 2022.

Gardening Note – Spring 2023 we moved the beehouse to the east side of the shed.

Fall 2021 we collected leaf cutter bee cocoons from the garden's bee house. The individual compartments are wrapped with leaf pieces. The bees use leaves and petal pieces from different plants.

Spring 2022 this bee was one of about a dozen that emerged from the collected cocoons.

Genus *Osmia* (Mason Bees)

Photo © Lucas

Needs ID tentatively:
Genus *Osmia*

Photo © Lucas

Needs ID tentatively:
Subgenus *Melanosmia*

"Mason bees are named for their habit of using mud or other 'masonry' products in constructing their nests, which are made in naturally occurring gaps such as between cracks in stones or other small dark cavities. When available, some species preferentially use hollow stems or holes in wood made by wood-boring insects… Over 300 species are found across the Northern Hemisphere… Osmia species are frequently metallic green or blue, although many are blackish and at least one rust-red… When the bees emerge from their cocoons, the males exit first. The males typically remain near the nests waiting for the females, and some are known to actively extract females from their cocoons. When the females emerge, they mate with one or several males. The males soon die, and within a few days the females begin provisioning their nests… Osmia females typically nest in narrow gaps and naturally occurring tubular cavities… They do not excavate their own nests. The material used for the cell can be clay, mud, grit, or chewed plant tissue." (Mason Bees, 2023)

Rearing mason bees in bee houses is a popular hobby. Our lack of success in enticing them to use our bee house suggests we should make some changes.

"The optimal location to hang your mason bee house is 6 to 7 feet off the ground, preferably under an eave of your house, garage, shed or some other shelter… We also recommend that you hang your house so it gets south or southeastern sun exposure. Morning sun exposure will encourage your bees to start foraging earlier in the day without needing to extend excess energy… You will also need to make sure your bees have the right nesting materials available to seal up their development chambers inside the tubes. Mason bees require mud with a heavy clay texture. If this is not naturally occurring in your area, you can purchase bags of clay-mud to mix and put out for your bees. They are sensitive to the moisture level of the mud, so be sure to water it frequently." (Keeping Mason Bees, 2019)

> *Gardening Note – Provide clay-mud mix for mason bees. Locate the mix where it will remain moist.*

Wasps

"What is a Wasp? …a wasp is an insect that is neither a bee nor an ant that has a narrow (constricted) waist and a sting. In addition to aculeate wasps, other types of wasps include primitive (waistless) wasps and parasitic wasps (wasps that lay their eggs directly in or on their prey) … Aculeate wasps are closely related to the group of insects credited with most flower pollination – bees. Bees are essentially hairy aculeate wasps…" (Holm, Wasps, 2021, p. 10)

BRACONIDAE FAMILY (BRACONID WASPS)

"The Braconidae are a family of parasitoid wasps. After the closely related Ichneumonidae, braconids make up the second-largest family in the order Hymenoptera, with about 17,000 recognized species… One analysis estimated a total between 30,000 and 50,000, and another provided a narrower estimate between 42,000 and 43,000 species… Females often have long ovipositors, an organ that largely varies interspecifically. This variation is closely related to the host species upon which the wasp deposits its egg… Thousands of species of insects are used as hosts by braconid wasps… The family seems to date from early Cretaceous… It underwent extensive diversification from mid or late Cretaceous to early Cenozoic, correlating with the radiation of flowering plants and associated insect herbivores, the main hosts of braconids." (Braconid Wasps, 2022)

Subfamily *Agathidinae*

"[Agathidinae are] often colorful wasps, clad in red and black, with black or smoky wings. At 6-10 mm, they are small in size, but larger than many other kinds of braconid wasps. They are also frequent visitors to flowers, which sets them apart from most others in the family Braconidae. They make use of those elongated mouthparts to probe for nectar. The female wasps also hunt caterpillars to lay their eggs. Typically, one wasp larva develops as an internal parasite of a host caterpillar, though some species are gregarious, several larvae sharing the same caterpillar host." (Eaton E. R., Wasp Wednesday: Agathidinae, n.d.)

Photo © Lucas

Needs ID tentatively:
Agathidinae

CHRYSIDIDAE FAMILY (CUCKOO WASPS)

"Commonly known as cuckoo wasps or emerald wasps, the hymenopteran family Chrysididae is a very large cosmopolitan group (over 3000 described species) of parasitoid or kleptoparasitic wasps, often highly sculptured, with brilliant metallic colors created by structural coloration. They are most diverse in desert regions of the world, as they are typically associated with solitary bee and wasp species, which are also most diverse in such areas. Their brood parasitic lifestyle has led to the evolution of fascinating adaptations, including chemical mimicry of host odors by some species." (Cuckoo Wasps, 2022)

Genus *Hedychrum*

"Wasps in the genus Hedychrum are common in habitats with sandy soil where their hosts Eucerceris and Cerceris nest in the ground… Hedychrum females search for nests being provisioned with beetles by the host female… After discovering a nest, they enter the nest, then lay an egg in an open cell provisioned with prey… The larva kills the host wasp egg (or larva) then consumes the beetles cached in the nest cell. Hedychrum cuckoo wasps also frequently visit flowers for nectar… and demonstrate a preference for shallow, white flowers." (Holm, Wasps, 2021, p. 367)

Photo © Lucas

Needs ID tentatively:
Genus *Hedychrum*

In the garden, this wasp was observed on the "shallow, white flowers" of snow buckwheat (*Eriogonum niveum*).

Genus *Holopyga*

"Holopyga have a bright green head, thorax, and abdomen with blue highlights… The known hosts of Holopyga are ground-nesting sand wasps… Holopyga often spend the night partially or completely curled up in a ball clasped to a plant stem, grass blade or seed head." (Holm, Wasps, 2021, p. 369)

Photo © Lucas

Needs ID tentatively:
Genus *Holopyga*

Crabronidae Family (Square-headed Wasps, Sand Wasps, and Allies)

"Crabronids are the most diverse of the stinging parasitoid wasps, and classification of this large family has been problematic… Cicada killers, beewolves, horse guards, and the organ pipe mud dauber are familiar examples of the varied life histories of crabronids. All are stinging parasitoids and many species display elaborate behavior in courtship, host-seeking, and nesting." (Eaton E. R., Wasps, 2021, p. 241)

Genus *Bembix*

"Bembix sand wasps are bluish-white and black striped ground wasps which dig solitary burrows in sand to rear their young. Bembix sand wasps specialize on catching flies… to provision their nest burrows as their larvae grow. They paralyze or even kill flies with their sting, then stuff the prey in their solitary burrows as available for their developing young to eat. Their life history differs from other predatory wasps, which accumulate larval provisions first (mass provisioning) and then seal up the nest burrow with larvae inside. Adult bembix wasps feed on flower nectar. They are very fast diggers in sand, able to disappear below the surface of loose sand within seconds." (Ullman, n.d.)

Photo © Lucas

Needs ID tentatively:
Genus *Bembix*

Photos © Lucas

Series of images showing a Bembix wasp digging her burrow into a sandy bed in the garden.

Burrows of ground-nesting bees are a common sight in the garden. The first observation of a sand wasp constructing a burrow was made in 2022. She put on a show for visiting students.

Bembix americana

Photo © Hill

Needs ID tentatively:
American Sand Wasp
Bembix americana

"The females have long tarsal rakes on their forelegs for moving sand during nest excavations. A female typically excavates multiple, unicellular (occasionally multicellular) nests in her lifetime. In sites with bare, loose sand, a large aggregation of many nests is common. Barring any disturbance, these aggregation sites are often used year after year by subsequent generations. The female excavates an angled burrow (6 to 14 in deep) that terminates in a large, oval cell. She searches for flies, captures one, stings it, then flies it back to her nest… She continues to monitor the feeding of her larva in the open nest until the larva spins a cocoon, a signal to her she may backfill the nest and begin excavating the next nest… Male American sand wasps 'sun dance,' a performance that takes place around the nest site as they wait for females to emerge." (Holm, Wasps, 2021, p. 77)

Genus *Larropsis*

"The genus Larropis includes 25 species north of Mexico, most in the western U.S. Females provide for their offspring by paralyzing camel crickets and burying them in burrows that may be the crickets' own." (Kaufman, 2007, p. 338)

This observation in the garden is one of only two iNaturalist observations of this species in WA.

Photo © Hill

Needs ID tentatively:
Genus *Larropsis*

Genus *Tachytes* (Sand-Loving Wasps)

"The larger species in the genus often have huge green eyes. These insects have been referred to as "sand-loving wasps" in some literature, but they nest in a variety of soil types. I think they deserve the name "green-eyed wasps" because that characteristic is more vivid, even if it does not apply to every species. Males in particular have very large eyes, the better to detect passing females or rival males… The female wasps excavate burrows in the ground… Several individual cells are arranged along the length of the burrow… All North American species provision those cells with immature grasshoppers… katydid nymphs… or pygmy mole crickets…" (Eaton E. R., Green-eyed Wasps, Tachytes, n.d.)

Photo © Lucas

Needs ID tentatively:
Genus *Tachytes*

Tachytes distinctus

"Tachytes distinctus nests in sandy sites… the female reuses an existing opening in the ground to establish her nest… she lengthens the burrow, then excavates one or more cells. She stocks the nest with a number of grasshoppers, then lays an egg on one of the grasshoppers before backfilling the cell. In two to three days the egg hatches, then the larva begin feeding on one of the grasshoppers." (Holm, Wasps, 2021, p. 121)

Photo © Hill

Needs ID tentatively:
Tachytes distinctus

Genus *Cerceris* (Typical Weevil Wasps and Allies)

"The adult female Cerceris wasp generally digs a nest in the soil and provisions it with living prey items she has paralyzed with venom. The prey are usually beetles, and sometimes bees... The faces of the females are frequently modified with unusual projections… which can take the shape of conical bulges to elongated curving 'horns'." (Cerceris, 2021)

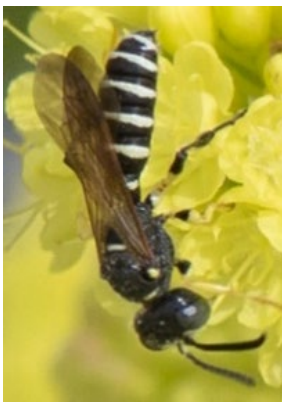


Photo © Lucas

Needs ID tentatively:
Genus *Cerceris*

Genus *Ectemnius*

"Ectemnius species excavate nest tunnels in pieces of dead wood such as stumps, fallen tree trunks, rotting logs and sometimes building timbers or posts with the help of the mandibles. Nesting aggregations can be large and dense, and sometimes more than one female has been recorded using a common nest entrance. In most species the brood is supplied with Diptera from several different families." (Ectemnius, 2020)

Photo © Lucas

Needs ID tentatively:
Genus *Ectemnius*

Genus *Philanthus* (Beewolves)

"Beewolves… are solitary, predatory wasps, most of which prey on bees, hence their common name. The adult females dig tunnels in the ground for nesting, while the territorial males mark twigs and other objects with pheromones to claim the territory from competing males. As with all other sphecoid wasps, the larvae are carnivorous, forcing the inseminated females to hunt for other invertebrates (in this case bees), on which she lays her eggs, supplying the larvae with prey when they emerge. The adults consume nectar from flowers." (Beewolves, 2021)

Photo © Hill

RG Pacific Burrowing Wasp
Philanthus multimaculatus

Philanthus gibbosus

"Philanthus gibbosus… is the most common and widespread member of the [Philanthus] genus in North America… P. gibbosus are often observed to visit flowers and other plants in search of insect prey to feed their young. The prey that P. gibbosus catches is then coated in a layer of pollen and fed to the young wasps." (Hump-backed Beewolf, 2022)

We captured an image of a hump-backed beewolf grasping her prey, a cellophane bee.

Photo © Lucas

RG Hump-backed Beewolf *(Philanthus gibbosus)* with prey, cellophane bee (genus *Colletes*), that she captured on snow buckwheat.

Philanthus ventilabris

"The female selects a nesting site in compacted soil in a variety of soil types… The nest burrow is typically angled with several individual cells (usually less than ten) that branch off the main burrow. In addition to the nest burrow, the female excavates a nearby accessory burrow. When leaving the nest to forage for prey, she closes the nest entrance to conceal its location but leaves the accessory burrow open… Several bees are cached in each prepared cell, and when a cell is fully provisioned, the female lays a single egg on one of the prey." (Holm, Wasps, 2021, p. 145)

RG Flat-collared Beewolf
Philanthus ventilabris

Gasteruptiidae Family (Carrot Wasps)

"These wasps have odd hindlegs, with greatly swollen tibiae. The length of their ovipositors varies substantially… Carrot wasp larvae are mostly predators of wood-nesting solitary wasps and bees, or they feed on the nest provisions of those wasps. Adults are found near the nesting sites of their hosts or on flowers… 9 [species] live in the Pacific Northwest." (Peterson, 2018, p. 466)

Genus *Gasteruption*

"Wasps in the genus Gasteruption get their common name, carrot wasp, from their preference for visiting plants in the carrot family (Apiaceae)… Gasteruption preferentially lay their eggs in aboveground nests in cavities in wood or plant stems. Gasteruption females have a long ovipositor that is able to penetrate through various nesting substrates. The female searches dead wood… containing nesting cavities of the host… [she] pushes her ovipositor through the material forming the cap of the nest… After hatching from its egg, the carrot wasp larva consumes the host (egg or larva) then either begins feeding on the provisions in the cell or invades one of the adjoining cells to consume another host larva." (Holm, Wasps, 2021, p. 383)

Photo © Hill

Needs ID tentatively:
Genus *Gasteruption*

ICHNEUMONIDAE FAMILY (ICHNEUMONID WASPS)

"These are small to large, slender, delicately built wasps… Just behind the stigma, the veins often form an outline resembling a horse's head… Ichneumon wasps commonly develop as parasitoids… There are… about 1,000 species in the Pacific Northwest, making it one of our most diverse insect families. Identification of most species is extremely difficult." (Peterson, 2018, p. 461)

Genus *Pimpla*

Photo © Hill

Needs ID tentatively:
Pimpla sanguinipes

POMPILIDAE FAMILY (SPIDER WASPS)

"Spider wasps are medium to large, long-legged wasps that usually have dark, slender bodies that may have red, yellow, or white markings. Most have dark-tinted wings… They are hyperactive and often flit their wings as they walk about… Spider wasps are parasites only of spiders. A female will paralyze a spider and then bury it in a tunnel she has excavated or in an existing crevice, along with an egg. There are… 77 [species] which occur in our area." (Peterson, 2018, p. 472)

Genus *Tachypompilus*

Photo © Lucas

Needs ID tentatively:
Genus *Tachypompilus*

SCOLIIDAE FAMILY (SCOLIID WASPS)

"These stout, medium to large-sized wasps are mostly dark with yellow or red bands on their metasomas. They are often quite setose… The larvae of scoliid wasps are external parasites of the ground-dwelling larva of scarab beetles… Females burrow into the soil to find the beetle larvae, and prior to laying an egg, paralyze the larva with a sting. Adults often visit flowers. There are 3 [species of scoliid wasps] in our area." (Peterson, 2018, p. 474)

See scarab beetles found in the garden.

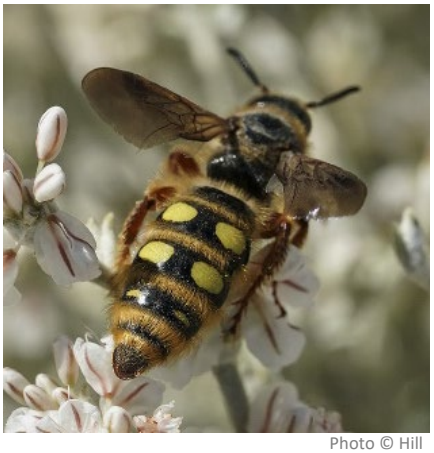


Photo © Hill

RG *Crioscolia alcione*

Sphecidae Family (Thread-waisted Wasps)

"These medium to large, slender wasps each have a long, thin, tube-like waist… Their dark bodies often have bright markings… These mostly solitary wasps build nests of mud, dig burrows in the ground, or nest in natural crevices, provisioning their nests with spiders, crickets, katydids, grasshoppers, or butterfly and moth larvae. There are… 54 [species of thread-waisted wasps] in our area." (Peterson, 2018, p. 478)

Genus *Ammophila* (Thread-waisted Sand Wasps)

"Ammophila is the type genus of the subfamily Ammophilinae of the hunting wasp family Sphecidae. Ammophila is a large and cosmopolitan genus, with over 200 species, mostly occurring in the warmer regions of all continents apart from Antarctica." (Thread-waisted Sand Wasps, 2022)

Photo © Lucas

Needs ID tentatively:
Genus *Ammophila*

Genus *Chlorion*

"Although generally not closely associated with humans, they are found wherever their hosts (Gryllus crickets) are found… Chlorion is usually found in open areas… they may not necessarily hunt in the same habitat as they nest…" (Balaban, 2004)

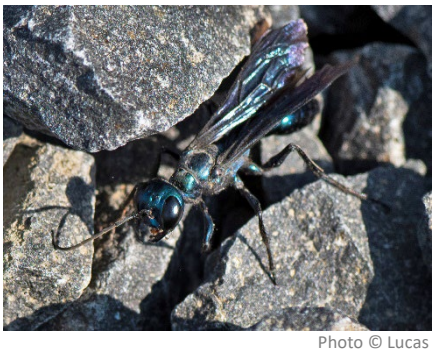


Photo © Lucas

RG Steel-blue Cricket-hunter Wasp
Chlorion aerarium

"Watch for the females scouring the ground and peering into nooks and crannies in search of crickets. Once she locates one, she stings it into weak paralysis and flies it or carries it to a simple burrow she excavated previously… The female places several crickets in each cell, closing the cell with a plug of soil between forays. A single egg is laid on one of the victims… Both genders fuel their frenetic activity mostly on fermenting plant sap oozing from wounded shrubs… I still remember well my first encounters with them back in The Dalles, Oregon… Emerging from the tall grass… I saw a female on the ground. She shines like a living jewel, her body in vivid metallic blue with shimmering blue and violet wings that flicked nervously as she searched for prey." (Wasp Wednesday: Chlorion aerium, 2010)

The garden does have crickets that are heard but seldom seen.

Insects
Order *Hymenoptera* (Ants, Bees, Wasps, and Sawflies)
Wasps - *Sphecidae* Family (Thread-waisted Wasps)

This magnificent wasp has been observed three times hunting in the garden, presumedly for crickets. She is big, beautiful, and fun to watch. With great speed she ran feverishly through the rocks checking between crevices for prey. She stopped briefly on a south-facing rock, possibly to rest and/or warm up. We hope to see this species again.




Photos © Lucas

Genus *Podalonia* (Cutworm Wasps)

"Podalonia is a genus of parasitoidal wasps… present worldwide with the exception of South America. These wasps are similar to the related sand wasps (Ammophila), but they have a much shorter petiole and the abdomen is slightly stronger… The females lay their nests in the sand. They normally incubate in large, hairless caterpillars of moths (Noctuidae)." (Cutworm Wasps, 2021)

Photo © Lucas

Needs ID tentatively:
Genus *Podalonia*

Photo © Lucas

Needs ID tentatively:
Genus *Podalonia*

Genus *Prionyx*

"Prionyx… are known to hunt and feed on grasshoppers. Prior to laying their eggs the female Prionyx stings a grasshopper causing paralysis. She will then bury the grasshopper in a burrow she has excavated, lay an egg on the body, and then seal the burrow. When the egg develops it feeds on the grasshopper until it has matured, and then pupates." (Cutworm Wasps, 2021)

Photo © Hill

Needs ID tentatively:
Genus *Prionyx*

Photo © Hill

Needs ID tentatively:
Prionyx thomae

Prionyx atratus

"This sphecoid wasp is unusual because it hunts for prey prior to excavating a nest. The female hunts grasshoppers… After capturing a grasshopper, she stings it multiple times to immobilize it. Because the grasshopper is usually larger and heavier than the female wasp, she is unable to fly with it. She drags the prey… The female hides her prey… in vegetation while she excavates the nest burrow in a site with sandy or gravelly soil… Her completed nest is shallow and terminates in one cell. She retrieves the grasshopper hidden nearby, places it in the prepared cell, then lays a single egg on one of the prey's hind legs… Both the male and female spend the night clinging to vegetation." (Holm, Wasps, 2021, p. 169)

Photo © Hill

RG *Prionyx atratus*

Genus *Sceliphron* (Black Mud-dauber Wasps)

Sceliphron caementarium is also called the black and yellow mud dauber.

"Long, black and yellow body with smoky-brown wings… Uses mud to build clusters of tube-shaped nests, provisioning each with several to many spiders, laying an egg in each tube, and then sealing it. Often seen visiting flowers and wet pavement." (Peterson, 2018, p. 478)

Photo © Lucas

RG Yellow-legged Mud-dauber Wasp
Sceliphron caementarium

Vespidae Family (Hornets, Paper Wasps, Potter Wasps, and Allies)

Genus *Ancistrocerus*

"Ancistrocerus is a widely distributed genus of potter wasps present in many biogeographical regions of the world… The name of this genus (meaning "hooked horn" for the back-curved last segments of the antennae characteristic of males of this genus and most other potter wasp genera) has been widely used as root in the construction of many other genus-level names for potter wasps…" (Ancistrocerus, 2022)

Photo © Hill

Needs ID tentatively:
Complex *Ancistrocerus catskill*

Photo © Lucas

Needs ID tentatively:
Genus *Ancistrocerus*

Genus *Euodynerus*

"Euodynerus hidalgo constructs its nest in a cavity in wood… The female also readily uses supplemental or trap nests comprised of hollow tubes or plant stems. She typically establishes her nest near a source of damp sand; each cell is partitioned with packed sand grains bonded together with the female's saliva… She lays an egg at the back of the cavity in the first empty cell, then begins searching for caterpillars to provision the cell. When the nest is fully provisioned… she may create a vestibular cell near the entrance before closing off the nest entrance with sand grains. This mason wasp hunts pyralid moth larvae (caterpillars)…" (Holm, Wasps, 2021, p. 273)

Photo © Lucas

RG Hidalgo Mason Wasp
Euodynerus hidalgo

Photo © Hill

RG *Euodynerus hidalgo ssp. viereckii*

It was fascinating to watch this Hildalgo mason wasp hunt on top of a flower head. The wasp spent several minutes tearing into the disc florets of a blanket flower cultivar (*Gaillardia* spp.).

She would tear out pieces from the center, stick her head in, continue, move over to the side, come back. She was not observed catching anything, but after she left, dissection of the flower revealed moth larva. See moth larvae observation.

Genus *Leptochilus*

Leptochilus is a genus of small-sized potter wasps.

This individual appeared to be collecting something from a hole in the side of a Munro's globemallow bud. It stayed at this location for quite some time, sticking its head into the hole.

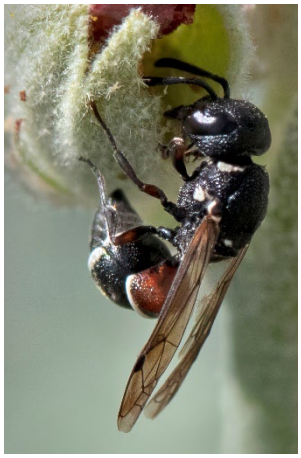


Photo © Lucas

Needs ID tentatively:
Genus *Leptochilus*

Genus *Polistes* (Umbrella Paper Wasps)

"[Genus Polistes is] the single largest genus within the family Vespidae, with over 300 recognized species and subspecies... although generally not aggressive, they can be provoked into defending their nests. All species are predatory, and they may consume large numbers of caterpillars, in which respect they are generally considered beneficial. (Umbrella Paper Wasps, 2022)

The golden paper wasp is a beautiful wasp that stands out and is a welcomed sight when found competing with the many European paper wasps.

Note to readers: We have been unable to find basic information on the golden paper wasp (*Polistes aurifer*). Please let us know if you are aware of a resource.

Photo © Hill

RG Golden Paper Wasp
Polistes aurifer

Polistes dominula

"Polistes dominula is native to Europe; an introduced population was discovered in Boston, MA in 1978. Since then, this paper wasp has rapidly expanded its range westward. A second population introduced in the Northwest has resulted in the wasp now being found in most states and provinces of North America… Polistes dominula is prevalent in disturbed habitats where it readily nests in aboveground cavities in or on structures… Nest foundresses may reuse an old nest rather than build a new nest… Nest foundresses and workers hunt a variety of insects, and compared to native paper wasps that primarily hunt caterpillars, the prey preferences of Polistes dominula are much broader." (Holm, Wasps, 2021, p. 347)

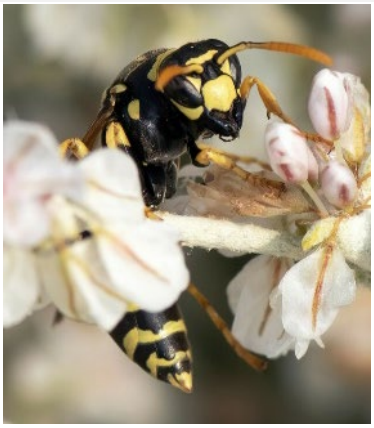


Photo © Lucas

RG i European Paper Wasp
Polistes dominula

Introduced species can be innocuous, this is not the case when it comes to the European paper wasp. Read a few articles on them and several undesirable features come to light such as outcompeting native species and capturing and eating desirable species such as butterflies. Besides the ecological damage they present, *P. dominula* does not make for safe company in a public garden setting. This is a species we want to keep out of the garden.

Gardening Note – Periodically search for European paper wasp nests and destroy them.

Genera *Pterocheilus* & *Stenodynerus*

Photo © Lucas

RG *Pterocheilus quinquefasciatus*

Photo © Hill

Needs ID tentatively:
Genus *Stenodynerus*

ORDER LEPIDOPTERA (BUTTERFLIES AND MOTHS)

Butterflies

Based on descriptions of butterflies we observed, the caterpillars of several make folded-leaf nests. Skippers are an example. *"Larvae of most grass-feeding (hesperine) and spread-wing (pyrgine) skippers make nests by strategically silking together the edges of grass blades or by cutting away portions of a leaf and attaching to the same or another leaf with silken thread strands. …silken thread strands that support these nests can become easily recognizable as compared to moth caterpillar silken nests."* (Skipper Nests, n.d.)

"Overwintering pupae are formed… on, close to, or under the ground surface, or on branches. In all cases, overwintering eggs and pupae are cryptic to minimize the chances of hungry birds or mice finding them. When larvae enter diapause in late summer or autumn, they seek out or create refugia where they will spend the winter. Common refugia include curled leaves, seed pods/shells, crevices under rocks, and soil." (James, 2011, p. 25)

> *Gardening Note – Consider how to preserve the refugia of desirable species when grooming the garden.*

> *Project Note – Document and learn to ID the caterpillar refugia of butterflies and moths.*

HESPERIIDAE FAMILY (SKIPPERS)

Genus *Atalopedes*

"Atalopedes campestris… is a small grass skipper butterfly… Male is orange, edged with brown, and has a large brown-black stigma. Female is darker with lighter markings in the center of the wing… The host plants used by the sachem caterpillar are various grasses …" (Sachem, 2021)

Photo © Lucas

RG Sachem
Atalopedes campestris

Photo © Hill

RG Sachem
Atalopedes campestris

Genus *Burnsius* (New World Checkered-Skippers)

"Females [of Burnsius communis] lay eggs singly on leaf buds and tops of leaves. Adults roost exposed on a tall plant beginning in late afternoon. Caterpillars make folded-leaf nests in which they live and feed, and fully-grown caterpillars hibernate… Caterpillar Hosts: Several plants in the mallow family (Malvaceae) including globemallows (Sphaeralcea)… Adult Food: Nectar from white-flowered composites including… fleabane, and asters…" (Common Checkered-Skipper, n.d.)

Photo © Lucas

RG Common Checkered-Skipper
Burnsius communis

Genus *Heliopetes*

"Caterpillars feed on leaves and live in shelters of rolled or tied leaves... Caterpillar Hosts: Various mallows including globemallows (Sphaeralcea), hollyhock (Althaea), and mallow (Malva)." (Northern White-Skipper, n.d.)

Photo © Hill

RG Northern White-Skipper
Heliopetes ericetorum

Genus *Hesperia* (Branded Skippers)

"Females [of juba skippers] deposit eggs singly on or near the host plant. Caterpillars eat leaves and make nests of silked-together leaves… Caterpillar Hosts: Slender hairgrass (Deschampsia elongata), needlegrass (Stipa), foxtail brome (Bromus rubens), and bluegrass (Poa pratensis). Adult Food: Nectar from flowers including rabbitbrush." (Juba Skipper, n.d.)

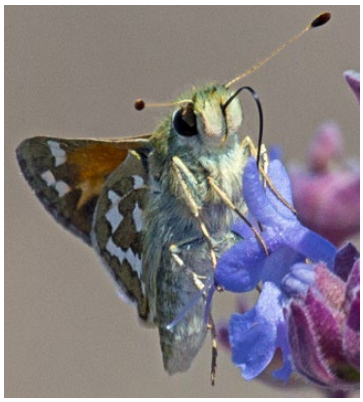


Photo © Abel

RG Juba Skipper
Hesperia juba

Genus Pholisora

"Adults [of common Sootywing] bask with the wings spread open. To find receptive females, males patrol near the ground in sunny places; mating takes place in the morning and afternoon. Near midday, females lay eggs singly on the tops of host plant leaves. Caterpillars live and feed within shelters of folded leaves. Caterpillars of the second brood overwinter in their silk-lined leaf shelters and pupate within them in the spring…" (Common Sootywing, 2023)

Photo © Lucas

RG Common Sootywing
Pholisora catullus

Genus *Polites*

"To watch for females [of the sandhill skipper], males perch all day in low grassy areas. Females deposit eggs singly on the host or on nearby plants. Caterpillars feed on leaves and take shelter in nests of tied leaves. Chrysalids hibernate. Caterpillar Hosts: Various grasses including Idaho fescue…" (Sandhill Skipper, n.d.)

Photos © Hill

RG Sandhill Skipper
Polites sabuleti

LYCAENIDAE FAMILY (GOSSAMER-WINGED BUTTERFLIES)

Genus *Brephidium* (Pygmy-Blues)

"Males patrol over the host plants all day to find receptive females. Females lay eggs all over the host but particularly on the uppersides of leaves. Caterpillars eat all parts of the plant. Chrysalids hibernate… Caterpillar Hosts: Chenopodium album, saltbush species (Atriplex), and others in the goosefoot family (Chenopodiaceae). Adult Food: Flower nectar." (Western Pygmy-Blue, n.d.)

Photos © Hill

RG Western Pygmy-Blue
Brephidium exilis

We sighted western pygmy-blue butterflies in the garden in October of 2022. A small group of butterflies were photographed sunbathing and nectaring on common yarrow (*Achillea millefolium*). As reported in the Tri-City Herald: The Western Pygmy-Blue is the tiniest butterfly species in North America, 'about the size of your pinky fingernail,' according to Dr. David James, associate professor of entomology for Washington State University in Prosser. This is an unusual find in our area. A project is underway to study the butterfly's advances into Washington State. It is not known if they will manage to survive our winters and create a sustained population. (Cary, 2022)

All records in WA are in the Lower Columbia Basin. We will be watching for this special visitor to return!

Genus *Icaricia*

"Males [of Acmon blue butterflies] patrol near hosts for females. Eggs are laid singly on leaves or flowers of host plants. Caterpillars feed on leaves, flowers, and developing seeds, and are tended by ants. Second-stage caterpillars hibernate… Caterpillar Hosts: Various species of buckwheats (Eriogonum nudum), lupines (Lupinus), trefoils (lotus), and milkvetches (Astragalus)." (Acmon Blue, n.d.)

Gardening Note – Several host plants of the Acmon blue are growing in the garden. We should learn to recognize life stages and avoid discarding them when caring for the garden.

Project Note – Watch for and document Acmon blue caterpillars being tended by ants.

Photo © Lucas

RG Acmon Blue
Icaricia acmon

Genus *Strymon* (Scrub-Hairstreaks)

"Males [of the gray hairstreak] perch all afternoon on small trees and shrubs to seek receptive females. Eggs are laid singly on flowers of host plant. Young caterpillars feed on flowers and fruits; older ones may eat leaves. Chrysalids hibernate... Caterpillar Hosts: Flowers and fruits from an almost endless variety of plants; most often from pea (Fabaceae) and mallow (Malvaceae) families…" (Gray Hairstreak, n.d.)

Photo © Lucas

RG Gray Hairstreak
Strymon melinus

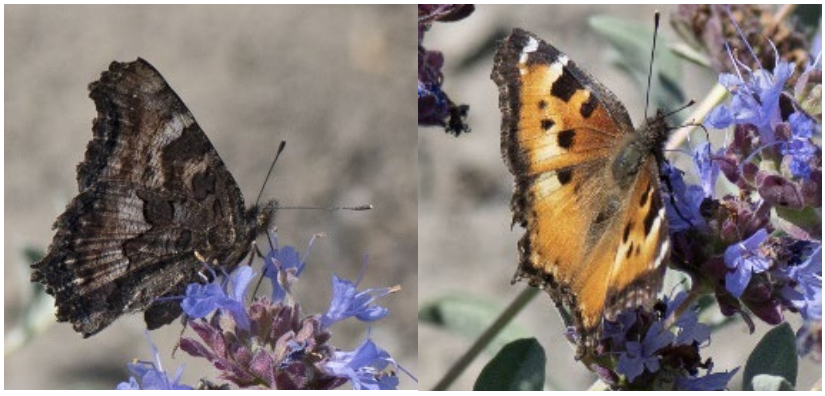
Photo © Hill

RG Gray Hairstreak
Strymon melinus

Nymphalidae Family (Brush-footed Butterflies)

Genus *Nymphalis* (Tortoiseshells)

"Males [of the California tortoiseshell] perch in the late afternoon to look for females. Eggs are laid in bunches on the host plant; caterpillars eat leaves and feed together when young. Adults hibernate... Caterpillar Hosts: Various species of wild lilac (Ceanothus)…" (California Tortoiseshell, n.d.)



Photos © Lucas

RG California Tortoiseshell
Nymphalis californica

Pieridae Family (Whites, Yellows, and Sulphurs)

Genus *Colias* (Clouded Yellows)

"Males [of the orange sulphur] patrol for receptive females, who lay eggs singly on top of host plant leaves. Most feeding takes place at night. Young caterpillars chew holes in the tops of leaves, then later feed from the leaf tip. Older caterpillars eat half of the leaf before moving to the other half. Chrysalids overwinter… Caterpillar Hosts: Plants in the pea family (Fabaceae)…" (Orange Sulphur, n.d.)

Photo © Hill

RG Orange Sulphur
Colias eurytheme

Genus *Pieris* (Garden Whites)

"Males [of the cabbage white] patrol for females. Females lay single eggs on undersides of host leaves. Chrysalids hibernate… Caterpillar Hosts: Many plants in the mustard (Brassicaceae) family and occasionally some in the caper family (Capparidaceae)." (Cabbage White, n.d.)

Photo © Lucas

i Needs ID tentatively:
Cabbage White
Pieris rapae

Moths

We have only a few observations of moths. Possibly we could see and record more if we tried mothing.

"How to start mothing: Moths far outnumber butterflies and are much more varied, and learning about the many species in your own area is a fascinating and enjoyable hobby. Moths have also received far less attention than butterflies and, as a result, less is known about them and where they occur. This means that the information you collect about your local moths can make a real contribution to knowledge and can directly help conservation." (Mothing, n.d.)

Project Note – Consider night time sessions to increase the number of moth observations.

Crambidae Family (Crambid Snout Moths)

Genus *Mimoschinia*

"Mimoschinia is a genus of moths of the family Crambidae. It contains only one species, Mimoschinia rufofascialis, the rufous-banded pyralid moth or barberpole caterpillar, which is found in the Caribbean, from Alberta to British Columbia, south to Texas and California and in Mexico… Adults have been recorded on wing from January to October, with most records from June to September. The larvae feed on various Malvaceae species…" (Rufous-banded Crambid Moth, n.d.)

Malvaceae species in the garden include Munro's globemallow which is quite abundant.

Photo © Lucas

Needs ID tentatively:
Rufous-banded Crambid Moth
Mimoschinia rufofascialis

Geometridae Family (Geometer Moths)

Genus *Synchlora*

"The larvae [of the wavy-lined emerald] feed on a wide variety of plants, including the flower heads of composite flowers and other flowering plants, as well as shrubs and trees. Recorded food plants include Aster, Rudbeckia, Liatris, Solidago, Artemisia, Achillea and Rubus species. They attach bits of the plant tissue on which they are feeding along their backs. The species overwinters as a partially grown larva." (Wavy-lined Emerald, n.d.)

Photo © Lucas

Image showing location of camouflaged caterpillar on common yarrow. Potential ID is Synchlora aerata.

Photo © Hill

Needs ID tentatively:
Genus *Synchlora*

This was an exciting and fun find. Several of the recorded food plants are present in the garden. We hope to see this sneaky caterpillar again.

Project Note – Look for Synchlora larvae on Liatris, Artemisia and Achillea.

Noctuidae Family (Cutworm Moths and Allies)

Genus *Heliothis*

"Adults [of the darker-spotted straw moth] are reported to be both nocturnal and diurnal in activity, and while most often are taken at night, may be found feeding and ovipositing during the day. Like other species of the genus, the larvae feed on the flowering parts and seeds of the host." (Heliothis phloxiphaga, n.d.)

Photo © Hill

Needs ID tentatively:
Darker-spotted Straw Moth *Heliothis phloxiphaga*

Genus *Pseudanarta*

"This species [Pseudanarta crocea] is widely distributed in many types of open habitat throughout much of western North America. It is often abundant on open sagebrush steppe, in juniper woodlands, and in open ponderosa pine forests at low to middle elevations east of the Cascades... No information is presently available regarding larval foodplants of this species, but it is probably a specialist feeding on native bunchgrasses (Poaceae) based upon closely related species… The flight period of P. crocea is the fall. It first appears in late August and flies to early October in the Pacific Northwest. It is nocturnal and comes to lights. Moths are often seen flitting about the yellow flowers of rabbitbrush (Ericameria nauseosus, Asteraceae) in the early evening." (Pseudanarta crocea , n.d.)

Photo © Hill

RG *Pseudanarta crocea*

In iNaturalist, only four observations of this moth have been made in WA.

Pyralidae Family (Pyralid Snout Moths)

Genus *Homoeosoma*

"The caterpillar of the sunflower moth, Homoeosoma electellum, damages the flowers of echinacea and sunflower. Newly hatched larvae are pale yellow, but darken to shades of brown or purple with longitudinal white stripes. Look for mats of webbing on the face of flowers for signs of larval feeding… Flowers are susceptible in the early stages of bloom, and females lay their eggs at the base of the florets. The newly emerged larvae feed on pollen and florets. The larvae begin tunneling into seeds… Later [maturing larvae] bore into the head and consume receptacle tissue and seeds. Many overlapping generations occur throughout the summer… Flowers do not last long and seed heads are not formed…" (Sunflower Moth Caterpillar, n.d.)

Photos © Lucas

Needs ID tentatively:
American Sunflower Moth
Homoeosoma electella

Webbing on the face of flowers, often with curled petals are seen in the garden on blanket flower (*Gaillardia* spp.) and possibly other flowers. These conditions suggest the presence of this caterpillar. We have seen wasps hunting for these caterpillars in the flower heads of blanket flower. See observation of Hidalgo mason wasp hunting.

Sphingidae Family (Sphinx Moths)

Genus *Hyles*

"[White-lined sphinx adults] usually fly at dusk, during the night, and at dawn, but they will also fly during the day. Caterpillars pupate in shallow burrows in the ground… Caterpillar Hosts: A great diversity of plants including… apple (Malus), evening primrose (Oenothera)…" (White-lined Sphinx, n.d.)

This caterpillar was found on pale evening primrose.

Photo © Hill

RG White-lined Sphinx
Hyles lineata

ORDER MANTODEA (MANTISES)

MANTIDAE FAMILY (MANTIDS)

Genus *Mantis*

"All praying mantids are indiscriminate ambush predators and will consume anything they can capture. They do not distinguish between 'good' and 'bad' insects when searching for a meal which is why they are not useful for pest management." (Challenging the Conventional Wisdom About Praying Mantids, n.d.)

"[Praying mantids] value as beneficial agents for home gardens is questionable. They do feed on flies, moths, grasshoppers, crickets and spiders, but they also feed on insects attracted to flowers… mantids are not effective at controlling caterpillars, aphids or spider mites…" (Mantids of Eastern Washington, 2023)

Photo © Lucas

RG i European Mantis
Mantis religiosa

"The two large praying mantises in Washington State are introduced species, and while they are an interesting and acceptable presence in our gardens, they aren't effective or specialized enough to control any species of insect…" (Washington State Department of Agriculture, n.d.)

Praying mantids are introduced, indiscriminate predators, mostly feeding on insects that are beneficial to the garden and/or beneficial to the other fauna hunting in the garden, such as birds and wasps. There are only a few problematic insect species of concern in the garden such as root weevils and aphids. Praying mantids will not help with these. Our conclusion is that they do more harm than good for the garden's ecology.

> *Gardening Note – Gardeners should destroy praying mantis egg cases.*

ORDER NEUROPTERA (ANTLIONS, LACEWINGS, AND ALLIES)

CHRYSOPIDAE FAMILY (GREEN LACEWINGS)

"Adults are crepuscular or nocturnal. They feed on pollen, nectar and honeydew supplemented with mites, aphids and other small arthropods, and some, namely Chrysopa, are mainly predatory… Eggs are placed on plants, usually where aphids are present nearby in numbers… Immediately after hatching, the larvae moult, then crawls up the egg stalk to feed. They are voracious predators, attacking most insects of suitable size, especially soft-bodied ones (aphids, caterpillars and other insect larvae, insect eggs, and at high population densities also each other)… the larvae are colloquially known as 'aphid lions' (also spelled 'aphidlions') or 'aphid wolves'…" (Green Lacewings, 2022)

Photo © Lucas

Needs ID tentatively:
Tribe Chrysopini

> *Gardening Note – Encourage the green lacewing population. Possibly transfer adults to locations where aphids are a problem.*

ORDER ODONATA (DRAGONFLIES AND DAMSELFLIES)

Dragonflies

AESHNIDAE FAMILY (DARNERS)

Genus *Anax* (Green Darners)

The green darner dragonfly is Washington's official state insect.

"The green darner or common green darner (Anax junius), after its resemblance to a darning needle, is a species of dragonfly in the family Aeshnidae. One of the most common and abundant species throughout North America… It is well known for its great migration distance from the northern United States south into Texas and Mexico." (Green Darners, 2022)

Photo © Lucas

RG Common Green Darner
Anax junius

LIBELLULIDAE FAMILY (SKIMMERS)

Genus *Sympetrum* (Meadowhawks)

"Meadowhawks are the only small red dragonflies seen over most of North America and all across Eurasia… Perching with wings drooped forward is common, even when on tips of grass inflorescences where pennants perch with wings level or raised." (Paulson, 2009, p. 456)

Photo © Lucas

RG Band-winged Meadowhawk
Sympetrum semicinctum

"Band-winged Meadowhawk: Only meadowhawk with extensive orange-brown patches at bases of all wings… Individuals of both sexes at times fly back and forth over clearings up to 30 feet above ground… Both sexes tend to perch higher than other meadowhawks, males high on twigs and leaves at breeding sites… Habitat [is] open ponds and marshes, usually permanent but sometimes small seepage areas; in open or wooded country. Also spend much time in grassy meadows." (Paulson, 2009, p. 472)

Damselflies

COENAGRIONIDAE FAMILY (NARROW-WINGED DAMSELFLIES)

Genus *Enallagma* (Bluets)

"This large genus of small to medium-sized damselflies is found primarily in temperate North America… Typical species are mostly blue, the amount of black variable with species." (Paulson, 2009, p. 76)

"Tule Bluet: Common bluet of marshes with much black on abdomen… Typical bluet in habits, with males and tandem pairs perching all over shore and emergent vegetation and flying well out over open water…" (Paulson, 2009, pp. 82-83)

Photo © Hill

RG Tule Bluet
Enallagma carunculatum

ORDER ORTHOPTERA (GRASSHOPPERS, CRICKETS, AND KATYDIDS)

ACRIDIDAE FAMILY (SHORT-HORNED GRASSHOPPERS)

"Grasshoppers have large heads sporting short, thick antennae… Most species have wings… Many grasshopper males perform display flights, making clicking sounds while hovering… When threatened, grasshoppers often regurgitate fluid from their digestive crop, commonly called 'tobacco juice.' Grasshoppers are herbivorous… 200 [species of grasshoppers] live in our area." (Peterson, 2018, p. 117)

Genus *Trimerotropis*

"The pallidwinged grasshopper, Trimerotropis pallidipennis (Burmeister), ranges from southwestern Canada to Argentina, making it the most widely distributed bandwinged grasshopper in the New World. In North America the primary habitats of this grasshopper lie in the deserts of the West… Vegetation of habitats consists of shrubs, forbs, and grasses with a preponderance of bare ground on which these grasshoppers commonly bask and rest. Outside their usual rangeland habitats, pallidwinged grasshoppers find favorable environmental conditions in weedy city lots… The pallidwinged grasshopper feeds on a variety of forbs and grasses." (Grasshoppers, n.d.)

Photo © Lucas

Needs ID tentatively:
Pallid-winged Grasshopper
Trimerotropis pallidipennis

GRYLLIDAE FAMILY (TRUE CRICKETS)

"The true crickets have flattened bodies with long, thin antennae. Their flattened profiles result in part because the wings are held flat over their bodies… Males sing by rubbing the front wings together… Most true crickets are omnivores that scavenge for dead bits of plants and animals… 15 [cricket species] occur in our area." (Peterson, 2018, p. 115)

Photo © Hill

Needs ID tentatively:
Field Crickets
Subfamily *Gryllinae*

Observations: Fungi Including Lichens (Kingdom Fungi)

After noticing fungi growing in 2022, this kingdom was added to the project.

ORDER AGARICALES (COMMON GILLED MUSHROOMS AND ALLIES)

AGARICACEAE FAMILY (FIELD MUSHROOMS AND ALLIES)

Genus *Leucoagaricus*

"Leucoagaricus leucothites, the white dapperling, or white Agaricus mushroom, is a species of agaric fungus. …the species is suspected of being poisonous due to gastric-upset-causing toxins. It could also be confused with the deadly Amanita ocreata… It generally appears in civilized areas such as gardens and parks, but sometimes is found in forests." (White Dapperling, 2022)

Photo © Lucas

RG White Dapperling
Leucoagaricus leucothites

NIDULARIACEAE FAMILY (BIRD'S NEST FUNGI)

Genus *Cyathus*

"Cyathus is a genus of fungi in the Nidulariaceae, a family collectively known as the bird's nest fungi. They are given this name since they resemble tiny bird's nests filled with 'eggs', structures large enough to have been mistaken in the past for seeds. However, these are now known to be reproductive structures containing spores. The 'eggs', or peridioles, are firmly attached to the inner surface of this fruit body by an elastic cord of mycelia… Species of Cyathus are also known as splash cups, which refers to the fact that falling raindrops can knock the peridioles out of the open-cup fruit body… Cyathus species are saprobic, since they obtain nutrients from decomposing organic matter. They usually grow on decaying wood or woody debris, on cow and horse dung, or directly on humus-rich soil…" (Cyathus, 2022)

Photo © Lucas

Needs ID tentatively:
Genus *Cyathus*

Observations: Plants (Kingdom Plantae)

In 2023, this kingdom was added to the project to allow the recording and identification of weeds species in the garden.

Intentional plants in the garden are cultivated, that is, they are there because humans chose to grow them. Cultivated plants are not wild organisms and as such should not be included in our iNaturalist project. Initially, we simply excluded all plants from the project.

The uninvited weeds, however, are wild. Our iNaturalist project would be more complete with these included. Additionally, adding photos and IDs of these to our project will help the gardeners identify the weeds more easily and distinguish them from our cultivated plants. Beyond IDing, learning more about each weed will be useful in knowing how best to control it. Is it an annual or a perennial? Does it have a tap root? When does it start spreading seeds?

We added weeds by adding to the project's "Included Taxa" just those plant species that are known weeds in the garden. (Again, all other plants remain excluded.) This is the initial list going into Spring 2023. If we ID additional weed species, they will be added.

Project Note – Add to the project weeds at various stages of maturity.

Fledgling killdeer exploring the garden.

THE END

Glossary of Terms

aculeate
“Aculeates share the characteristic feature of a sting. This evolved from the ovipositor of more primitive Hymenoptera, becoming a venom-transmitting weapon for hunting, defence, and aggression.” (Entomologists' glossary, n.d.)

aphidophagus
feeding on aphids

crepuscular
“Crepuscular animals are those that are active during the twilight of dawn and dusk. Crepuscular insects include many moths and also some beetles, such as dor beetles.” (Entomologists' glossary, n.d.)

cryptic
“Concealed, camouflaged, or not easily recognized.” (James, 2011, p. 404)

diapause
“A physiological condition in which development or activity is suspended; nonresponsive to normally favorable stimuli…” (James, 2011, p. 405)

ecribellate
Not possessing a cribellum (the cribellum produces cribellate silk). (Rose, 2022, p. 596) See reference for illustration.

entelegyne
Spiders that have more complex genitalia. (Rose, 2022, p. 596) See reference for more detailed descriptions.

eusocial
“Eusocial insects are those insects that live in a colony with only some individuals capable of reproducing. Usually there is a division of labour with different individuals undertaking different roles, such as defence or foraging.” (Entomologists' glossary, n.d.)

fossorial
“Fossorial is a phrase used to describe the legs of some insects and other invertebrates that are modified for digging. Fossorial limbs can be found on insects such as mole crickets. The fore limbs are enlarged and powerful and well adapted for digging.” (Entomologists' glossary, n.d.)

hematophagous
feeding on blood (hematophagous, n.d.)

i introduced
“An introduced species (also known as an exotic species) is an organism that is not native to the place or area where it is considered introduced and instead has been accidentally or deliberately transported to the new location by human activity.” (Introduced species, n.d.)

kleptoparasitic
“A kleptoparasite is an animal that steals food or prey from another animal. Insect kleptoparasites include bees (often called Cuckoo bees) that lay their eggs in the cells of other bees. For example, Sharp-tailed Bees (bees in the Genus *Coelioxys*) are kleptoparasites as their larvae grow up on food stolen from Leaf-cutter Bees.” (Entomologists' glossary, n.d.)

labrum
“The labrum is often called an insect's upper lip. The labrum is flattened piece of cuticle at the base of the insect's "face" and above the mouthparts. The labrum partially or completely obscures the mandibles and helps hold food in a position when the insect feeds.” (Entomologists' glossary, n.d.)

metasoma
the hind region of the body of some invertebrates (metasoma, n.d.)

Needs ID
“Needs ID” observations have media, location, and date, but still require community consensus on a precise identification.

oligolecty
“The term oligolecty is used in pollination ecology to refer to bees that exhibit a narrow, specialized preference for pollen sources, typically to a single family or genus of flowering plants… Oligolectic pollinators are often called oligoleges or simply **specialist pollinators**.” (Oligolecty, 2022)

oligoleges
Oligolectic pollinators are often called oligoleges or simply **specialist pollinators** (see oligolecty).

oligophagous
“A species that uses several closely related host plants.” (James, 2011, p. 406)

ovipositor
“The ovipositor is a tubular structure that is used for laying eggs. The ovipositor is attached to the abdomen of insects and the eggs pass down the tube. In parasitoids the ovipositor can be used to pierce the skin of another animal, such as a caterpillar, and the egg of the parasitoid can then be laid inside the host organism. Insects that possess ovipositors include many of the solitary wasps, crickets and many species of fly. The species of bees, ants and wasps that sting (remember that not all bees, ants and wasps sting) do so using a modified ovipositor.” (Entomologists' glossary, n.d.)

ovoviviparous
producing eggs that develop within the maternal body (as of various fishes or reptiles) and hatch within or immediately after release from the parent (ovoviviparous, n.d.)

parasitoid
A parasitoid is an organism that lives on or in a host organism and ultimately kills the host. (Entomologists' glossary, n.d.)

petiole
In entomology, petiole is the technical term for the narrow waist of some hymenopteran insects, especially ants, bees, and wasps in the suborder *Apocrita*. (Petiole , n.d.)

phytophagous
feeding on plants (phytophagous, n.d.)

pollinium (plural pollinia)
a coherent mass of pollen grains often with a stalk bearing an adhesive disk that clings to insects (pollinium, n.d.) See detailed explanations and images at https://collection.ento.vt.edu/2016/08/05/milkweed-pollinia-revisited/.

protelean
(See parasitoid)

RG research grade
In iNaturalist, "research grade" observations have media, location, a date, and a community consensus on a precise identification (usually at species level). Learn more at https://www.inaturalist.org/pages/help#quality.

saprobic
living in or being an environment rich in organic matter and relatively free from oxygen (saprobic, n.d.)

saprophagous
feeding on decaying matter (saprophagous, n.d.)

scopa
a group or arrangement of short stiff hairs on the body surface of an insect that usually functions like a brush in collecting something (as pollen) (scopa, n.d.)

scrape
"The simplest nest construction is the scrape, which is merely a shallow depression in soil or vegetation. This nest type, which typically has a rim deep enough to keep the eggs from rolling away, is sometimes lined with bits of vegetation, small stones, shell fragments or feathers… Eggs and young in scrape nests, and the adults that brood them, are more exposed to predators and the elements than those in more sheltered nests; they are on the ground and typically in the open…" (Bird nest, 2022)

setae, seta (singular)
Bristles or hairs. (James, 2011, p. 407)

setose
bristly with stiff hair-like processes (see setae)

social parasitism (aka brood parasitism)
"Brood parasitism, also called social parasitism, is the exploitation by one individual (the brood parasite) of the parental care of another (the host). Brood parasites can deposit eggs in the nests or broods of another individual of the same (conspecific brood parasitism) or of a different (interspecific brood parasitism) species. Hosts often raise young of the brood parasite, typically at the expense of their own young." (Robinson, 5 February 2013)

sphecoid wasps

“The Spheciformes is a paraphyletic assemblage of insect families which collectively comprise the ‘sphecoid wasps’. Larvae are carnivorous. These are all the members of the superfamily Apoidea, which are not bees and which in older classifications were called the ‘Sphecoidea’.” (Spheciformes, 2021)

stigma

cf. Pterostigma. “The pterostigma is a dark pigmented spot on the leading (front) edge of the wings of some species of insect. The spot is towards the wing tip and often stands out due to its colouration. Experiments have shown that the pterostigma, being heavier than surrounding areas of the wing, helps the insect when gliding. In particular the pterostigma reduces vibrations within the wing.” (Entomologists' glossary, n.d.)

synanthropes

an undomesticated organism and especially an animal (such as a mouse, pigeon, or raccoon) that lives in close association with people and benefits from their surroundings and activities (synanthrope, n.d.)

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Appendix A – iNaturalist Project Improvement Plan

The purpose of this appendix is to present actions we should consider for improving or expanding the iNaturalist project for the garden. Project notes made throughout this report are summarized at the end of this appendix. These notes are the basis for the following recommendations.

Vary Timing of Photographing Sessions

Most of the observations submitted through 2022 were photographed during or after gardening sessions. We should consider adding times that expand what we observe. For example, very early morning sessions could catch insects sleeping or too cold to escape our viewing efforts, mid-afternoon sessions during the summer could catch insects that are active in extreme heat after we've left the garden, early evening and night-time sessions likely would produce insects we have yet to photograph. This extra commitment would be a stretch for the gardeners. We need to reach out to others to assist.

Encourage Public Participation

Objectives of our effort include introducing the public to the biodiversity of the garden (it's so much more than just pretty flowers) and to the capabilities of iNaturalist (it's fun to be a citizen scientist). Our plan is to present this information on a webpage via the Heritage Garden Program website. Beyond that we may want to present the ideas to selected nature and garden related organizations, and to educators.

Seek & Discover

This report identified several areas where we could be more complete in seeking out organisms to submit to the project. These are:

- Seek out more lady beetle species, including the larva.
- Seek out more stink bug species, including nymph form.
- Seek out ants. Are they tending other organisms?
- Seek out stages of *Lepidoptera* including leaf nests.
- Seek out additional *Synchlora* larvae on *Liatris*, *Artemisia* and *Achillea*.

Exclude European Honey Bees

As of 2023, this species is excluded from the project.

Go Mothing

We could increase moth observations by "mothing" at night. And this could be much fun! We will need to learn how to do it, how to take photos, get permission to be in the park after dark, and find a small, interested group for a trial run. Go Mothing! Attract Moths with a White Sheet: https://www.youtube.com/watch?v=FypN2flPx2c

Add Weeds

As of 2023, selected weeds are added to the project.

Appendix A
iNaturalist Project Path Forward

Use the Journal

We have yet to use the journal that is part of our iNaturalist project. We should give it a try to see if and how it could be useful. This would be a good way to document aspects of the project that don't show up in our observations for example:

- Heard and saw a mouse under the snow buckwheat today, unable to take a photo.
- Goldfinches were eating Cusick's sunflower seeds today, unable to get a photo.
- We gave a citizen-scientist tour (that is, not a cultivated plant tour) to students…
- Last night we did our first mothing event in the garden. How it went…

Organism Activity by Plant Associations & Dates

We have been good about noting in observations the plant the organism was seen on. New contributors need to be encouraged to continue this practice. We may want to attempt summarizing these associations and/or when insect species are most active in the garden.

Story Telling

Consider going beyond taking images for the sole purpose of identifying the organism. Watch for and try to document behaviors. Is there something interesting going on? Is there something of interest on the organism? Making and documenting these discoveries will make our story of the garden more complete and more interesting and could be of interest to researchers.

Examples in this report are: lady beetle larva eating black aphids, nomad bee with pollinia attached, wasp hunting worms in a flower head, wasp hunting for crickets, wasp building in-ground burrow, beewolf with captured prey, hitchhikers on a mining bee, camouflaged caterpillar.

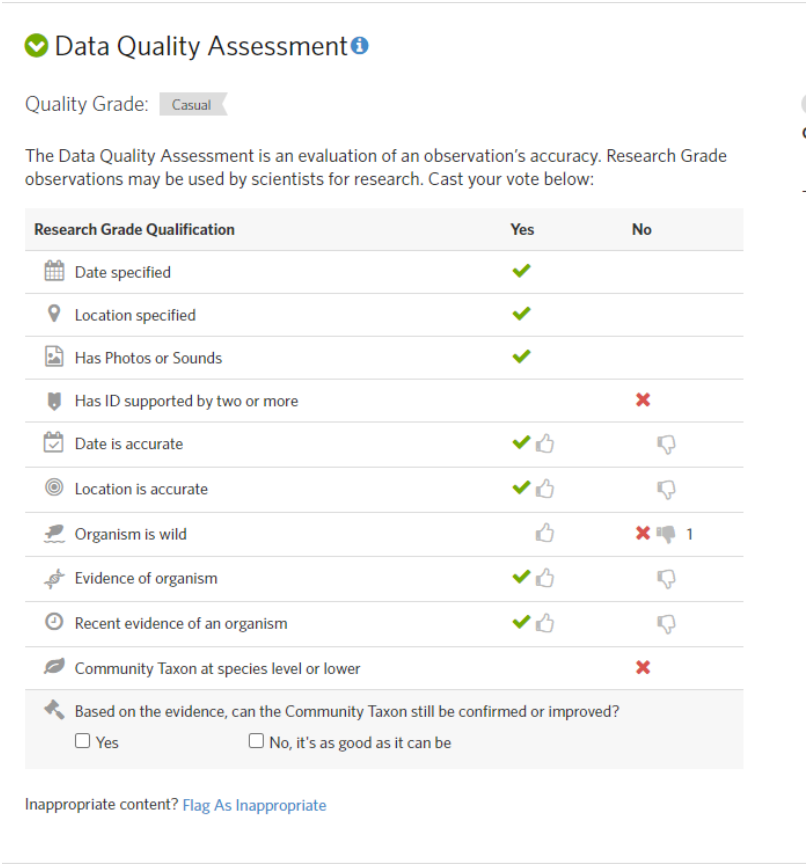
Researchers and citizen scientists have projects for topical observations. Our efforts can add to their data base. Consider adding relevant garden observations to such projects. Examples of iNaturalist projects of possible interest:

> Megachile bee leaf cuts – "Leafcutter bees, genus Megachile, are named for their habit of cutting pieces of leaves to line their nests. Although we are learning more about the distribution of the bees themselves, we know very little about the plant species they use."
>
> Nesting bees – "A collection of observations of nesting bees and bee nests. Anyone is welcome to contribute and any bees are welcome. The one exception is please no honeybees in langstroth hives just because those are so common and artificial."
>
> Spider Wasps with Prey – "This project is for gathering observations of spider wasps with prey to further understanding of spider wasps and host spider relationships."
>
> Sleepy bee slumber parties – "This a project to collect pictures of sleeping (or sleepy) bees. Multiple bees are preferred, but single bees are good too. Everyone + anyone is welcome to contribute."
>
> Beetles with pollen – "This project aims to compile observations on beetles that have pollen grains attached to their bodies."

Check for Cultivated Plant Observations Marked Incorrectly

As a courtesy to the researchers who use iNaturalist, we should consider periodic review of plant observations made in the garden. It is important that the "cultivated" box be checked for the garden plants. Researchers using iNaturalist's data may waste time on observations that show up as wild in the data base when the organism was put in that location by people.

A review of plant observations made in the garden was performed on 2/14/2023. There were only two and both were cultivated plants in the garden. Neither had been marked as such. This appears easy to correct, just mark **X** on the data quality assessment entry, "Organism is wild" as shown below. You need not contact the owner of the observation to make the correction. Their observation will change to "Casual" because it is captive/cultivated. If local interest in using iNaturalist increases, occasional checks may become more important.



List of Project Notes from Main Text

Project Note – Schedule added photographing sessions at times of the day when not gardening.

Project Note – Encourage the public to participate in this project.

Project Note – Schedule photographing sessions just for birds.

Project Note –Seek out more lady beetle species, including the larva.

Project Note – Seek out more stink bug species, including nymph form. Report to WSU confirmed BMSB observations.

Project Note – Seek out ants. We have only one observation.

Project Note – iNaturalist's vision statement specifies "observing wild organisms." Honey bees are not wild, just unsupervised. We should exclude them from the project.

Project Note – Document and learn to ID the refugia of butterflies and moths.

Project Note – Watch for and document Acmon blue caterpillars being tended by ants.

Project Note – Consider night time sessions to increase the number of moth observations.

Project Note – Look for Synchlora larvae on Liatris, Artemisia and Achillea.

Project Note – Add to the project weeds at various stages of maturity.

Project Note – Consider using the journal.

Appendix B – Gardening Suggestions

As we learn more about who is living in the garden and what they are up to, we can put this knowledge to work to better manage the garden. Modifying our gardening regimes will improve plant health, enhance biodiversity, and make the garden a better place for the public to visit.

The gardening suggestions below should be approved by the Benton Conservation District before implementation. Approved suggestions should become part of the training for the vetted gardeners. "Hansen Park Heritage Garden Maintenance Guide" (Wendt, 2018) may need to be revised and/or these recommendations could be incorporated into a training plan for vetted gardeners.

Gardening Suggestions

No Insecticides

Insecticides should not be used in the garden. Natural predators of the few pests we've found will also die from the use of insecticides, a counterproductive path to take. Insecticides will sicken and even kill birds who are feeding off the insect population. The only pest we've seen on plants are aphids. They tend to be resistant to insecticides. If used, insecticides will kill the natural enemies of the aphids causing the aphid population to explode. (See aphids.) The one exception to this suggested rule is control of European paper wasps whose nests should be promptly destroyed. Insecticide use may be necessary to remove these nests safely. (See more: European Paper Wasp Control.)

Gopher Control

Gophers do a useful service in Nature but wreak costly and frustrating havoc in the garden. We hope this problem lessens now that the nearby vacant parcel has been developed. Gardeners need to remain vigilant to signs of possible gopher activity in or near the garden, and immediately report suspected gopher mounds to the BCD.

Praying Mantis Control

Many of us were taught that praying mantises are good visitors to our landscapes. This is a myth. Praying mantises are indiscriminate ambush predators and will consume anything they catch whether friend or foe to the garden. They are useless for pest management, doing more harm than good, preying on the many beneficial insects in the garden. They don't even eat aphids. Gardeners should, at a minimum, destroy their egg cases to keep the population down. Consider killing or relocating adults. *Eliminate a mantis… Save a native pollinator*. (See our praying mantis observation.)

European Paper Wasp Control

This introduced species has spread rapidly across the US and successfully outcompetes our native wasps. There is nothing of value they do in the garden. They present a hazard to the public and to the gardeners. Periodically seek out and destroy European paper wasp nests. Report nests to the BCD to determine the best path forward to minimize the risk of stings. This species is abundant in the garden, as is the case most everywhere, and will be continually looking for places to build nests. This needs to be a sustained, frequent effort.

Aphid Control

Do not use insecticides, they will make the infestation worse. (See aphids.) Aphids have not been a problem except for one infestation in the buckwheat garden. That they have not become a problem could be due to the presence of several insects that prey on them. Aphid eating insects that we've observed in the garden include: lady beetles, earwigs, long-legged flies, hover flies, leafhoppers, big-eyed bugs, green lacewings. It is possible that birds are helping to keep them under control, but we have not observed this.

Aphids multiply quickly. Routine checks of plants by gardeners are recommended. Aphids can be removed by wiping them off or flushing them onto the ground with a spray of water. Also consider transferring the adults and larva of lady beetles and lacewings to infested plants.

Weed Control

In 2023 we added weeds to the project. Gardeners are encouraged to photograph weeds in various stages of growth. Use iNaturalist to get confirmation of the plant's ID, learn how best to control it, and share this information with the vetted gardeners.

More Birds Please

By the end of 2022 we documented just seven species of birds in the garden, and two of these appeared to merely be passing through. Creation of a flower bed for hummingbirds has been approved and funded. This bed will be constructed in 2023. We are hoping to see more hummingbirds soon. This should be a fun addition for the public. This bed will include a water source for the garden's fauna.

The garden contains several berry-bearing plants that the birds enjoy. As these and other shrubs mature and fill in, the birds may find the garden's habitat more enticing.

A habitat more conducive to achieving a ground population of insects would be appreciated by some species of birds. However, this type of habitat is not consistent with maintaining a formal garden. Understory "debris" such as leaves, pine needles and sticks would create improved biodiversity, but also could be a fire hazard and to some, an eye sore. This is not a feasible option in this public park.

Assist the Native Wasps and Bees

Ground Nesters – We have documented sweat bees and sand wasps using the sand and sandy-loam beds for nest construction. There are only a few beds in the garden that are suitable for this purpose. Also, most of the garden has an underlayment of landscape fabric, making those areas unsuitable for ground-nesting insects. Creation of a new bed featuring just local native plants has been approved and funded. This bed will be constructed in 2023. It will nearly double suitable area for ground-nesting insects and will be constructed with them in mind. The soil to be used is appropriate for the ground nesters.

Bee House – The bee house had few takers in 2021 and none in 2022. Before flowers start blooming in Spring 2023, consider moving the bee house to the east-facing wall of the shed. The optimal location to hang the house is 6 to 7 feet off the ground, preferably under the eve of the shed. The goal is a southeastern sun exposure with some shade in the hottest hours of the day.

Water Source – A dedicated water source would help the native bees and wasps. A water retention feature near the new hummingbird bed is suggested. It needs to be fashioned to minimize death by drowning.

Mason Bee Mud – Establish a clay-mud source for mason bees. It should be moist most of the time. Suggest locating it the area of the grama grass where overhead sprinklers are used. It could go into or near the hummingbird bed to keep it visible as opposed to being placed in tall grass. Locate the mason bee mud near the bee house.

Check the Roots of Dead and Dying Plants

While removing dead and dying plants, we discovered weevil larva in some of the roots. We don't have enough information to draw conclusions about the significance of weevils in the garden. Until we found the weevil larva, it was assumed that the plants that were struggling were getting too much or not enough water, or maybe they were old, maybe the landscape fabric was too close… lots of speculation. The point being that when gardeners remove plants due to poor health/death, don't just pull or dig and discard them, first examine the roots and the soil it was growing in and consider what may have killed it. This added effort may be futile, but so is replanting again and again without fixing a problem.

Avoid Over Fertilization

The need to not overfertilize seems obvious relative to plant health. Being aware that over fertilizing may increase pest problems is another consideration. The timing, type, and amount of fertilizer applied to plants in the garden should be approved by the BCD.

Protect Life Stages of Butterflies

Butterflies visit the garden to feed and decide they've found a great place to raise their progeny. Eggs, leaf-tents, caterpillars, and cocoons of desirable species of butterflies may get tossed during garden cleanups. We recommend that gardeners learn to recognize life stages. Then we need to figure out how best to protect these organisms from being discarded with the trimmings.

List of Gardening Notes from Main Text

Gardening Note – Consider how the garden could be managed or changed to better attract birds.

Gardening Note – Avoid the use of pesticides. Insects are an important food source for baby birds.

Gardening Note – Avoid using insecticides. Birds and their progeny rely on insects as a food source.

Gardening Note – Several species of beetles and weevils may damage plants. Watch for infestations and learn to ID the adult and larval stages of those that could become pests.

Gardening Note – Transfer lady beetles to plants with aphid infestations.

Gardening Note – When unhealthy plants are dug, check roots for damage and a possible cause such as too much water or insect damage.

Gardening Note – Although earwigs may damage plants, the damage is minor. They can be helpful in controlling aphids. Ignore them in the garden unless they cause significant damage to plants.

Gardening Note – Move lady beetle adults and larva to aphid infested or susceptible plants.

Gardening Note – Avoid using insecticides and over fertilizing. These will cause the aphid population to increase.

Gardening Note – Use a strong stream of water to knock aphids off plants.

Gardening Note – To aid bumble bee populations, avoid using insecticides.

Gardening Note – Spring 2023 we moved the beehouse to the east side of the shed.

Gardening Note – Provide clay-mud mix for mason bees. Locate the mix where it will remain moist.

Gardening Note – Periodically search for European paper wasp nests and destroy them.

Appendix B
Gardening Considerations

Gardening Note – Consider how to preserve the refugia of desirable species when grooming the garden.

Gardening Note – Several host plants of the Acmon blue are growing in the garden. We should learn to recognize life stages and avoid discarding them when caring for the garden.

Gardening Note – Gardeners should destroy praying mantis cases.

Gardening Note – Encourage the green lacewing population. Possibly transfer adults to locations where aphids are a problem.

Appendix C – A Resource for Educators

If our report has inspired you as an educator, this appendix provides ideas for class activities, excursions, and using the iNaturalist app Seek with students. Before you get started, consider also checking with others in your school and our many local nature organizations; someone in your community may already be using iNaturalist and/or Seek, and may have ideas to share.

What is Seek?

iNaturalist has an identification app called Seek, available for Apple and Android devices. When pointing the Seek camera at organisms (animals, insects, plants, fungus, etc.), the app provides species identification suggestions live, using iNaturalist's database. The app also allows the user to participate in challenges and earn badges. iNaturalist recommends Seek for beginners and students, as Seek doesn't require an account, isn't age-restricted, and doesn't post online, as iNaturalist does.

How to Use Seek

While we post online to the iNaturalist site for the Hansen Park Heritage Garden project, we have found Seek to be useful in making IDs in the field. It is very easy to use and gives the user immediate feedback. We have gathered the resources below to help you get started with the app.

Seek by iNaturalist User Guide, by iNaturalist [pdf] @ bit.ly/3mwuYUv.

Identify Wildlife with Seek by iNaturalist, by Outside Chronicles [video] @ bit.ly/3xyPeH3.

How to Use the Seek with Students, by Crystal Cove [video] @ bit.ly/3YWrI2E.

Accounts and Students

Having students make and use iNaturalist accounts can be complicated, and iNaturalist requests extensive teacher oversight--to ensure contributed data is quality and useful, observations have been identified, copyright violations are avoided, posted content is appropriate, etc. Because of this, Seek is preferable for school activities and assignments, but interested, older students can be pointed toward resources for making an iNaturalist account at home, which would allow them to observe more and contribute data to the site. Students 13+ (or with parental permission) can create an iNaturalist account through Seek--further instruction is in the Seek user guide.

Activities for Students

Below are some basic activities and ideas to help you get started, adapted from iNaturalist's Teacher Guide.

Browse Local Observations on iNaturalist: Together as a class, or individually, have students browse local observations made on iNaturalist. Consider creating an assignment or activity involving searching for local observations.

Use the Seek App: There are many ways you might use Seek with students. Consider using Seek during observational field trips, or have students use the app at home and incorporate and bring in their findings to the classroom. More specified ways to use Seek can be found in the Seek resources above.

Observe, Sketch, Identify: If you're looking for a simple activity that isn't screen-based, iNaturalist suggests having students, especially elementary-aged students, observe plants, insects, etc., then sketch what they find, and potentially attempt an identification via field guides or other books and resources.

Plan a Class Excursion: Consider having your class visit an outdoor space close to your school campus to observe and identify organisms. This can be most any outdoor area where the students can find plants and/or animals, especially insects. You might step outside the school building and try to identify the plants on the school grounds. You might travel to a garden and try to identify the cultivated plant species and check for insect visitors. Or travel to a naturally growing habitat and Seek out native plants. The larger the variety of plant species in the area, the better for making lots of observations. Lots of plant species flowering likely also means lots of visiting insects.

Plan a Field Trip to a Public Heritage Garden: Teachers of older students, particularly high school science teachers, may want to plan a field trip to a public Heritage Garden. These gardens contain plants native to Washington State, giving students a chance to learn about plants they may see when hiking or on trips in our area. Often native fauna may be found visiting the native plants.

Public Heritage Gardens

WSU Master Gardener's Native Plant Heritage Garden (created 2013) and *WSU Master Gardener's Xeric Demonstration Heritage Garden* (created 2014) – These two gardens are side-by-side in the demonstration garden located behind the library at 1620 S. Union Street, Kennewick. The map shows the location of the two Heritage Gardens and a route to reach them. There are many gardens and different plants maintained by the WSU Master Gardeners. All are good places to use the Seek app to find and record plant and animal species.

Columbia Center Rotary Indicator Garden (created 2016) – This garden is located between the Consolidated Information Center parking lot and the Ste. Michelle Wine Estates WSU Wine Science Center in Richland. From GWW, turn east onto University Drive at the wine center. Drive past the wine science center then turn right onto Crimson Way. Park in the lot at the Consolidated Information Center. It's a short walk to the garden. Certification is pending.

Hansen Park Heritage Garden (created 2018) – This Heritage Garden is in the south-west end of the City of Kennewick's Hansen Park. Most student groups should park in the lot off Columbia Center Blvd. From the parking lot walk the paved path to the garden. If your group is small (3 cars or less) you can try the alternate parking off Georgia Street. This lot is closer to the garden but is small. Its use varies greatly depending on the time of day.

Heritage Garden Program personnel may be available to provide a tour of a public Heritage Garden. To check on availability, contact Heather Wendt, heather-wendt@franklincd.org, (509) 430-3693. Please provide as much lead time as possible.

Additional Resources

Teacher's Guide, by iNaturalist [webpage] @ bit.ly/3EeE1zo.

Ask A Biologist, by Arizona State University [website] @ bit.ly/3XGV6sp.

The Amateur Entomologists' Society, out of the UK [website; includes the option to join their Bug Club from the USA] @ bit.ly/3xrjq75.

Using Seek with Students, by the Natural History Museum of Utah [website] @ bit.ly/3KcQcAk.