STRATEGIC PLAN 2

A Strategic Plan for Keeping Oregon's Bee Pollinators Healthy (2022-2027)

OREGON DEPARTMENT OF AGRICULTURE

Oregon State University Extension Service

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Definitions

Bee: Insects in the superfamily Apoidea and in the Apiform group. There are at least 632 species of bees in Oregon, including five managed species, a number of introduced species and a wide range of native species. Bee biodiversity varies across the state, with the highest diversity in the southern and eastern regions of Oregon. Bees in the state can be characterized as **managed bees** (*Apis mellifera, Bombus vosnesenskii, Osmia lignaria, Megachile rotundata, Nomia melanderi*), species that are **wild bees** (i.e., reproduce without human management), **native bees** (i.e., species that occurs naturally in a region) and **exotic bees** (i.e., species introduced to Oregon from another region).

Habitat: land with suitable nesting substrates from which the bees can access adequate floral forage and nesting materials over the course of their individual or colonial lifespans, and that enables them to complete their development with minimal disturbance.

Land Manager: anyone who manages larger parcels of land (i.e., greater than 5 acres), including but not limited to agricultural crop growers, rangeland managers, foresters, woodland owners, golf course superintendents, landscapers, public gardens.

Licensed Pesticide Applicator: anyone who has a license issued by Oregon Department of Agriculture to: (a) buy, apply or supervise the use of Restricted Use Pesticides, (b) advise others on the use of Restricted Use Pesticides, (c) apply pesticides to someone else's property (private or public land), (d) apply pesticides as a public employee using machine-powered equipment and/or applying Restricted Use Pesticides and/or (e) apply pesticides on school properties.

Managed Pollinator Protection Plan (MP3): voluntary program to reduce pesticide exposure to bees through timely communication and coordination among key stakeholders, including beekeepers, growers, pesticide applicators, and landowners. Guidance on the plans come from a federal-state partnership between US Environmental Protection Agency (EPA) and state government associations.

Pollinator Advocate: a person who has been trained in pollinator outreach through OSU Extension and who logs their outreach effort using a centralized volunteer database.

Pollinator Steward: a person who has been trained in advanced land management techniques to promote pollinator health through OSU Extension. Pollinator Stewards must pass a comprehension test and either implement a series of new pollinator protection practices on their land or outreach to other land managers.

Pesticide: a substance or mixture of substances intended to destroy, repel or prevent a pest. Among pesticides, insecticides are a type of pesticide that works against insects, herbicides work against weeds and fungicides work against fungal plant pathogens.

Pesticide exposure/risk: exposure is the likelihood that bees come into contact with pesticides when visiting bee-attractive bloom, gathering nesting material, foraging for water, or occupying the nest. Risk, in contrast, is the likelihood that exposure leads to lethal or sub-lethal negative impacts to bees. Pesticides vary in their exposure and risk to bees, although both are considered under EPA's new risk assessment framework for pesticides.

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EXECUTIVE SUMMARY

Oregon has one of the most diverse, vibrant, and dynamic group of bees in the U.S. (**Section 1**). This not only includes familiar bees, like honey bees and bumble bees, but three other managed species and at least 600 wild species. This level of species richness is supported by the diversity of both natural and managed habitats found within the state, including the more than 200 crops grown in Oregon. However, declines in honey bee populations, colony collapse disorder, concerns about wild bee populations, and a series of high-profile bee kills from the misuse of pesticides have catalyzed efforts to protect and improve pollinator health (**Section 2**). The formation of the Oregon Bee Project (Project) is a response to these concerns, state legislation and federal directives (**Section 3**).

The Project addresses these concerns and directives through its core mission to **bring together Oregonians around a science-based strategy for protecting and promoting wild and managed bees through education, bee-friendly practices, and research.** The Project has no regulatory authority, but focuses on education, training and outreach. The Project also evaluates the impact of these programs through surveys and tracking bee populations and their health.

The Project developed a Strategic Plan in 2018 to direct education and outreach activities to ensure the health of Oregon bees. Over the course of this plan:

- Trained 7,500 licensed pesticide applicators on how to use the Pollinating Insect Hazard Statement on insecticide labels to mitigate exposure to bees.
- Trained 2,500 gardeners and right-of-way managers on how to encourage bee habitat.
- Trained over 200 Master Melittologist volunteers who have created over 100,000 new native bee-plant host records for the state of Oregon. The volunteers have also created over 50 educational online 'Bee Blurbs" and engaged the public at over 20 face-to-face events.
- Initiated a youth engagement initiative in partnership with OSU Food Hero, titled "Explore Bees of Oregon", that connects bees to Oregon's agricultural production.
- Distributed six educational postcards to over 25,000 Oregonians (Bees of Oregon, Bees of Oregon Trading Cards, Responsible Orchard Bee Management, Protect Bees - Read Pesticide Labels, Four Bee-Safe Gardener and Landscaper Tips, Where are the Bees in the Forest).
- Published new publications including "Forest Bees and Pollinators" (ODF, Woodland Fish and Wildlife), "Enhancing Urban and Suburban Landscapes to Protect Pollinators" (OSU Extension, EM 9289) and "Asian Giant Hornet (*Vespa mandarinia*): A Potential Threat to Honey Bee Colonies in Oregon" (OSU Extension, EM 9297)
- Released 200 episodes of the weekly PolliNation podcast

A core of the Project's first Strategic Plan (2018) was to establish a set of activities to help Oregonians adopt bee-friendly practices. The Project's second Strategic Plan (2022-2027) fills out these activities. Over the next five years, the Project will focus on facilitating specific activities to accomplish the five goals:

1. **Goal: Protect bees from toxic pesticide exposure.**
   - 1.1. **Objective - Increase label comprehension:** Increase comprehension of pollinator hazard and risk statements on pesticide labels among licensed pesticide applicators.
   - 1.2. **Objective - Mitigation against exposure:** Increase adoption of practices that help reduce pesticide

exposure to pollinators while maintaining adequate levels of pest control to homeowners and professional land managers.

1.3. **Objective - Increase coordination between beekeepers and pesticide applicators:** Increase industry-level and site-level coordination between beekeepers and pesticide applicators to prevent exposure of honey bees to pesticides.

2. **Goal: Enhance bee habitat.**
   2.1. **Objective - Expand training:** Provide land managers and the public with training opportunities that are increasingly specific to different contexts (e.g., small and large farms, urban and rural, east and west of the Cascades) and are coordinated across different agencies and nonprofits.
   2.2. **Objective - Connect land managers to resources:** Provide a more direct connection between a wide range of land managers, from gardeners to woodland owners, on funding and technical support to create bee habitat. Moreover, the Project will support initiatives that better direct resources to land managers.
   2.3. **Objective - Increase the effectiveness and lower the cost of restoration efforts:** Restoration efforts will be better directed to meet different objectives for bee habitat by improving habitat establishment and identifying plants that provide nectar and pollen resources for managed bees, or that support a wide diversity of wild bees and species at risk.

3. **Goal: Slow the introduction, spread and impact of exotic bees, and bee diseases and pests.**
   3.1. **Objective - Expanded monitoring and surveillance:** In addition to routine survey of honey bee pests established in the first Strategic Plan, there will be an annual survey of orchard mason bees for diseases and pests and survey of native bee populations for exotic bees.
   3.2. **Objective - Expanded training:** Beekeepers will have 50% more trainings compared to 2018 on diseases and pest management. 50 veterinarians will be trained on brood disease and diagnostics. Master Gardener trainings on orchard bee management will be expanded.
   3.3. **Objective - Improve multi-agency response to exotic bees and new and emerging bee pests and diseases:** 100% of reports of newly introduced bees or bee pests and diseases will be shared among partner agencies within 48 hours of initial report and, once reported, agencies will coordinate their communication and response plan.

4. **Goal: Expand our understanding of the bees of Oregon.**
   4.1. **Objective - Checklist of Oregon Bees:** Create a checklist of the wild bee species of Oregon.
   4.2. **Objective - Checklist of Oregon Plants:** Create a checklist of the plants visited by Oregon bee species for nectar and pollen.
   4.3. **Objective - Survey:** Create a program to track changes in bee communities over time.
   4.4. **Objective - Education:** Expand educational opportunities for amateur melittologists and the general public to learn about the bees of Oregon.

5. **Goal: Make the Oregon Bee Project sustainable.**
   5.1. **Objective - Educational materials:** Obtain sufficient funding to pay for educational materials, including postcard info-graphics and seed packs.
   5.2. **Objective - Coordination:** Maintain sufficient funding to pay for 0.2 FTE program coordinator.
   5.3. **Objective - Taxonomist:** Funding to pay for a taxonomist to head up the Oregon Bee Atlas.

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The Project will accomplish these goals by broadly engaging Oregonians and connecting the dots among existing efforts from various groups, including extension, industry, conservation, research, local governments, and agencies by coordinating the following general actions (**Section 4**):

1. **Train & Engage:** The Project will expand training to urban and rural land-managers and beekeepers on how to reduce pesticide exposure, increase habitat and decrease losses to diseases and parasites. The Project will also provide training to volunteer groups (e.g., Master Gardeners, Melittologists, Beekeepers and Naturalists) on native bee taxonomy and survey methods to enhance our understanding of regional bee biodiversity. Volunteers will also engage people in their region to provide an accessible overview of how pollinator health is being addressed in Oregon. Finally, there is considerable information available to the public on bees, but it is spread across many sources. The Project will continue to maintain and update its website that helps different audiences locate necessary information and resources.
2. **Develop Decision-Making Support and Diagnostic Tools for Pollinator Stewardship:** Making real-time decisions around bee pollinator stewardship can be complicated. The Project will continue to develop user-friendly decision support tools to help land managers make real-time decisions on the ground. This includes new extension materials on bee stewardship that are specific to different land management contexts (Bee Protection Protocols), as well as to the diseases and pests of managed bees that have been an important driver of bee losses. The Project will also continue to take the findings from the Oregon Bee Atlas easier to use and accessible for land managers using an interactive website.
3. **Recognize & Learn From Innovators:** The Project is working to showcase Oregon farms, forests, industries, and urban landscapes that implement practices that promote bee health. A key feature of these showcase initiatives will be the development of voluntary, industry-specific Bee Protection Protocols, as well as an advanced Pollinator Steward program, which identify outstanding contributions to bee stewardship. We will also work with existing bee-friendly certification programs to ensure Oregon land managers are recognized for their efforts across the nation.
4. **Wild Bee Survey:** While there are avenues for determining the health of managed bees through surveys, we still lack methods to determine the status of wild bees. Moreover, little is known about the floral preferences of Oregon's wild bees, which is important information for restoration and for marketing plants grown in the state as of high value to bees.

We outline how we will measure our progress against the Project's goals in **Section 5.** The Project, along with this plan, are designed to be dynamic, changing and adapting as new data are collected, new input is received, challenges are overcome, and new challenges arise. **Section 6** outlines how the Project will receive feedback from stakeholders around the state over the next five years.

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1. OREGONIANS AND THEIR BEES

A brilliant, but often overlooked, native metallic sweat bee (*Agapostemon virescens*) Photo T. Shahan

Oregonians are interested in bees and their health, yet the rich endowment of bee species in the state remains a little-known fact. Unlike many agricultural states, Oregon maintains a high level of bee biodiversity. Although the Pacific Northwest lacks a comprehensive list of bee species (like most states), scientists estimate that the number in the region exceeds 800, a tally rivaling the total number of species found across all the states east of the Mississippi. However, only a few of these bees, like managed honey bees and wild bumble bees, are familiar to most Oregonians. Many go unnoticed.

Abundant and diverse bee populations in Oregon are partially a result of the way Oregonians manage their urban and rural landscapes. For one thing, gardeners, landscapers, nurseries, golf course superintendents and municipal governments have been busy over the last decade expanding pollinator habitat in cities. Furthermore, agricultural practices and crops contribute greatly to the diversity of pollinators; with over 220 different crops grown in the state, Oregon's agricultural lands are a patchwork of bee-attractive crops adjacent to natural areas. This mix provides habitat to support abundant and healthy bees, as well as natural pollination services to support Oregon agriculture. Bees collect nectar and pollen from crops like clover seed, orchard fruits, berries, alfalfa, and squash, and their visits, in turn, contribute to production of fruits and seeds. Finally, land managers working with forests, utility right-of-ways, and roadside vegetation are learning how their practices contribute to pollinator health. Whether they know it or not, Oregonians are connected to their bees.

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The honey bee. Photo T. Shahan

Oregon beekeepers play a direct role in ensuring pollinators remain a dynamic part of Oregon's unique specialty crop sector. The honey bee is the most recognizable bee species in the state, and our state's 80,000 colonies produce an abundance of products such as honey, wax, propolis, and pollen. Moreover, our beekeepers are uniquely invested in the success of crops grown in the state, with over 75% of their income coming from rental fees paid by growers from over a dozen different crops. These rentals are strongly connected with the competitiveness of some of the state's most delicious crops, including Columbia Gorge cherries and pears, Hermiston watermelons, Willamette Valley blueberries and caneberries, and south coast cranberries. Honey bees also play a key role in boosting yields of seed crops, notably Willamette Valley vegetable and clover seed, and central Oregon hybrid carrot and onion seed. The seeds from these crops are planted throughout the US and worldwide.

Beekeeping has also experienced explosive growth in Oregon cities and honey bee colonies are a regular fixture in community gardens, on rooftops, and in backyards. In response, pollinator gardens are sprouting up in Oregon backyards and public areas to provide areas for honey bees to forage for pollen and nectar.

Honey bee pollination in Oregon includes sweet cherry (top), meadowfoam (second from top), radish seed (center), onion seed (second from the bottom) and backyard fruits and vegetables (bottom).

MONTH OF BLOOM

FEBRUARY
- Almond

MARCH
- Peach
- Vegetable seed (Cabbage, Kale, Turnip and Mustard)

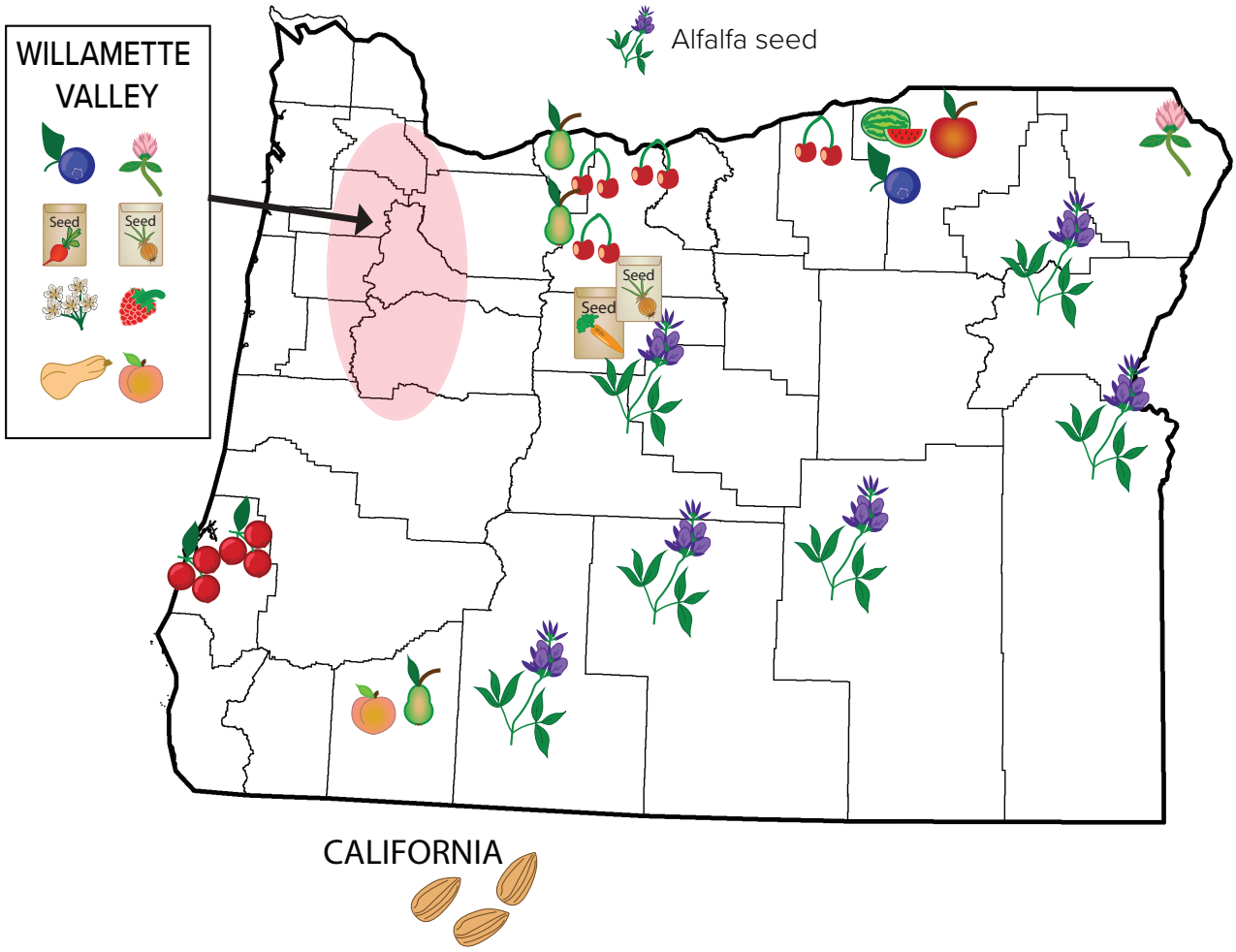
APRIL
- Cherry
- Apple
- Pear
- Blueberry
- Caneberries

MAY
- Meadowfoam
- Vegetable seed (e.g., radish)

JUNE
- Clover seed
- Cranberry
- Watermelon
- Alfalfa seed

JULY
- Onion seed
- Carrot seed
- Watermelon

AUGUST
- Pumpkin/Squash
- Watermelon



Major Oregon crops that rely on managed bee species for increased yields. Graphic: I. Korrmann

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The alkali bee. Photo C. Hedstrom

The managed bees in Oregon go beyond honey bees. Beginning in the 1950s alfalfa seed growers in the Pacific Northwest, in conjunction with Oregon State University, began developing nesting beds for the solitary native alkali bee (*Nomia melanderi*). These remarkable bees remain the *only* managed ground nesting bee in the world. In addition, by the 1960s these same growers also learned how to manage a solitary twig-nesting bee, the alfalfa leafcutting bee (*Megachile rotundata*), on a large scale. Combined, these two solitary species power the state's alfalfa seed sector. More recently, Oregon cherry and pear growers have been learning to manage a native solitary twig nesting bee, the blue orchard bee (*Osmia lignaria*). Cavity nesting blue orchard bees have also proven a terrific species for backyard and community gardens. In response, Oregon Master Gardeners and some Soil and Water Conservation districts have been active in training homeowners to care for and propagate these bees.

All of this is to say that bees are important to Oregon and Oregonians appreciate their bees. The Oregon Bee Project Strategic Plan is about "connecting the dots" among the efforts that already exist in the state; between the incredible diversity of our bees, the desire to learn more about who these bees are, the innovators who already integrate bee-protection into their businesses and the extension staff and educators who want to help others follow in these innovators footsteps.

Alfalfa leafcutting bees in Eastern Oregon pollinating alfalfa seed (top), nesting blue orchard bee (center), Oregon Master Gardener volunteer with an educational blue orchard bee nesting center at Jackson Bottom Wetland Preserve west of Portland (bottom). Photos: A. Melathopoulos and M. Alloy.

2. CHALLENGES BEES FACE

Oregon's bees have been subject to some of the same pressures experienced in other states. One such pressure is from pests and diseases associated with non-native bees, and native bees that are used for crop pollination. Pest and disease are of great concern and represent a chronic threat to our pollinators- for once they become established in an environment, they are likely there in perpetuity. Honey bee colonies, for example, have been beset by significant new pest and disease pressures over the last few decades, and this has led to poor colony survival and substantially increased beekeeper input and labor costs. Challenges with pests and diseases have also been implicated with lower returns of alfalfa leafcutter bees and the rapid decline of some of our native bee species, most notably the Western Bumble Bee (*Bombus occidentalis*) and Franklin's Bumble Bee (*Bombus franklini*) in Western Oregon. Our native and managed mason bees face a similar threat from non-native mason bee pests such as the Houdini fly (*Cacoexenus indagator*). In addition non-native bees themselves represent a threat to our pollinators. Negative impacts of non-native bees include direct competition with our native and managed pollinators for nest sites and floral resources, as well as the risk of spreading or increasing their disease and parasite loads.

Bees are also susceptible to some pesticides that are used in agriculture, forestry, vector control, and landscape management. In 2013 and 2014 a series of bumble bee poisoning incidents associated with the treatment of a common urban shade tree (i.e., linden) drew attention to exposure risks associated with not just foliar contact applications, but also the use of systemic pesticides. The treatments associated with these incidences that included pre-bloom soil and basal bark applications of two systemic insecticides applied well before bees were ever visiting the treated area. These incidents prompted both pesticide regulators and educators to rethink how these products may pose a risk to bees. Most notably, the U.S. Environmental Protection Agency (EPA) instituted a comprehensive risk assessment of all new pesticides for bees and provided guidance to states to develop Managed Pollinator Protection Plans (MP3s). These developments have created new requirements for the education of licensed pesticide applicators, as well as an emphasis on pesticide applicators and beekeepers to develop proactive communication to prevent exposure of bees with bee-toxic pesticides.

Much attention has been directed to neonicotinoid insecticides and some newer systemic pesticides, however, research on honey bees has indicated that no single pesticide class is associated with impacts on honey bee health, but rather, a combination of many products that may accumulate in colonies over time or directly impact foraging bees. Growers of Oregon's specialty crops, however, often have limited registered pesticide options available to them, creating challenges for maintaining low pest pressure at the same time as protecting bee health.

Perhaps the largest issue facing bees, however, is loss of habitat. While some areas of Oregon provide nectar and pollen resources for bees, these nutritional resources can be scarce in other areas or only available at certain times in the season. Good nutrition increases bee survival and leads to higher reproductive output, which in turn mitigates stresses associated with diseases, parasites, and pesticides.

The challenges associated with retaining bee habitat will likely be compounded by climate change. In Oregon, climate change is resulting in increased average temperatures, longer duration of hot days, earlier spring and later fall seasons, inconsistent precipitation timing and volume, longer duration of dry days, and wetter winter and drier summer seasons, and increased atmospheric CO^2. Climate change

influences bees by changing the phenology and duration of flowering for many plant species, as well as the wintering success of bees, their emergence times and days when temperatures are sub-optimal for flight and foraging. Climate change may also result in shifting ranges of exotic bees and plant species, resulting in lower performance from native species. Also, commercial honey bee colonies are experiencing longer periods in the late summer without forage, resulting in poor overwintering success.

Finally, although we know considerably more about the factors influencing bee health compared to 15 years ago, there remains high levels of uncertainty around how all these factors interact to influence bee populations on the ground. Not only do we lack the tools to measure key variables at meaningful spatial scales (e.g., the distribution of native bee species across the state, disease levels in managed bee stocks, actual pesticide exposure to bees, etc), but we lack specific, research-based recommendations for practices that land managers can use to offset these negative effects in a cost-effective manner.

Drought tolerant and Oregon-grown bee plants like Phacelia tanacetifolia can help reduce the challenges bees face. Photo: A. Melathopoulos.

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3. THE OREGON BEE PROJECT

Since the lives of Oregon bees are entwined with the lives of Oregonians, any effort to keep the state's bees healthy necessarily involves many people. The Oregon Bee Project was initiated in 2017 by the Oregon Department of Agriculture (ODA), Oregon Department of Forestry (ODF) and Oregon State University (OSU) Extension Service and emerged out of the recognition that many Oregonians were already taking steps to protect bees. What was missing was a way to connect these individual efforts and build upon them with additional resources.

A key touchstone for the Oregon Bee Project was the Oregon Task Force on Pollinator Health, which highlighted the need to engage Oregonians broadly on pollinator health and develop educational programming for the public, land managers, beekeepers and pesticide applicators. The Task Force indicated the need for a range of new initiatives in the state, such as educating homeowners and landscapers on how to manage urban pests in a way that minimizes impacts to bee pollinators, improving pesticide exposure reporting and providing beekeepers with new pest and disease diagnostic services.

Young Oregonian holding a native bee at an Oregon Bee Project outreach event at the Oregon Zoo,
Photo: A. Melathopoulos.

The Oregon Bee Project takes its lead from the Task Force and starts from the premise that in order to keep our bees healthy, many people need to work together on an ongoing, collaborative, and statewide basis, including growers, beekeepers, pesticide applicators, entomologists, government agencies, educators such as the Extension service, gardeners, landscapers, and all others who are actively engaged in caring for our bees. To date, partners of the Project include state agencies, such as the Oregon Department of Transportation (ODOT), as well as numerous individuals from regional groups such as the Oregon Clover Commission, Farm Bureau, Oregon Association of Nurseries (OAN), Oregonians for Food and Shelter, Oregon Golf Course Superintendents Association (OGCSA), the Oregon State Beekeepers Association, Pollinator Partnership, Portland Metro, Soil and Water Conservations Districts (SWCDs), the Specialty Seed Growers of Western Oregon (SSGWO), the Xerces Society, and many more. This Plan outlines the various elements of how this collaboration will look and identifies key goals and elements of the Project.

The Project additionally addresses a federal directive outlined in the U.S. Environmental Protection Agency's (EPA) Policy to Mitigate the Acute Risk to Bees from Pesticide Products (2017) for states to develop and implement local pollinator protection plans to address potential pesticide exposure to bees at and beyond the site of application. EPA will monitor the success of these pollinator protection plans in mitigating risks to

bees from highly toxic pesticides on an ongoing basis and use this information when deciding whether or not further label restrictions are necessary.

3.1 Project Goals

The Project's goals are to:

1. **Protect bees from pesticide exposure.**
2. **Enhance bee habitat.**
3. **Slow the introduction, spread and impact of exotic bees, and bee diseases and pests.**
4. **Expand our understanding of the bees of Oregon**.
5. **Make the Oregon Bee Project sustainable.**

These goals will be achieved through voluntary efforts and collaboration, using the interest, dedication, and commitment that Oregonians have already shown toward learning more about bees and how to protect them. Fulfilling these goals would go a long way to increase the health and productivity of Oregon bees.

The activities outlined below will be implemented over the next five years, along with proposed metrics for impact assessment. These assessments will be shared with state and federal pesticide regulators to assess the overall progress of state Managed Pollinator Protection plans (Section 5). However, it is important to note that in most instances, quantitative measures or direct links to the impacts from the Project's activities will be difficult to obtain. Additionally, many of these activities and the proposed assessment criteria are new to the state; in such instances, it will be necessary to collect baseline data before trends can be established and specific benchmarks can be set.

3.2 Plan Scope

The Plan covers all agricultural lands, including lands where bees are managed under contract, state and privately managed forests, right-of-ways, urban landscapes, and areas that are treated by vector control districts. The Plan includes the five managed bee pollinator species in the state, including those managed by large-scale commercial operators and those species that people manage for pleasure and direct use such as backyard honey bee and mason bee beekeepers. The Plan also encompasses the wild and native bees of Oregon.

Pollination of crimson clover fields in the Willamette Valley, Oregon. Photo: A. Melathopoulos.

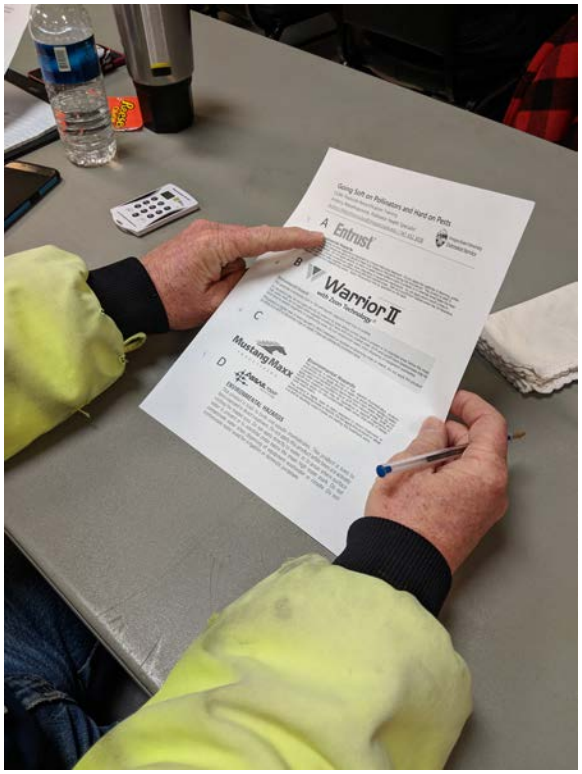
4. ACTIVITIES

The activities outlined below are designed to address the five goals of the Project (Section 3). Each sub-section concludes with the proposed metrics that will be used to assess whether the activity is helping the Project meet these goals, followed by a methodology for evaluating each metric. The different methodologies used in the Project's metrics are described in Section 5.

4.1 Training and Engagement

4.1.1 Licensed pesticide applicators

The Oregon Department of Agriculture (ODA) awards core pesticide recertification credits for training on how to safely apply pesticides around pollinating bees. These credits are necessary for pesticide applicators to maintain several types of pesticide applicator licenses. More recently, ODA has allowed credits associated with creating pollinator habitat to qualify for credits. People seeking to obtain certain types of pesticide applicator licenses are additionally required to study pollinator protection information and are tested on their comprehension. Since the first Strategic Plan the Project has expanded its outreach materials to include Spanish versions to ensure equal access to educational materials and opportunities.



Core recertification training for pesticide applicators includes new interactive modules where applicators work through examples of pesticide labels.
Photo: A. Melathopoulos.

The Project has developed new training materials that provide an opportunity for pesticide applicators and others to work through Oregon-specific scenarios that pose the highest risk of exposing pollinators to pesticides. The focus in each scenario is to understand how pesticide exposure to bees can occur, pesticide properties that affect risk, and residual toxicity. The training will also prepare applicators to assess mitigation options that enable good pest control with minimal impact to bees, including specific measures to facilitate communication between pesticide consultants, land managers, pesticide applicators, and beekeepers.

To date, 7,500 licensed pesticide applicators were trained on how to use the Pollinating Insect Hazard Statement on insecticide labels to mitigate exposure to bees and 2,500 right-of-way managers have been trained on how to encourage bee habitat.

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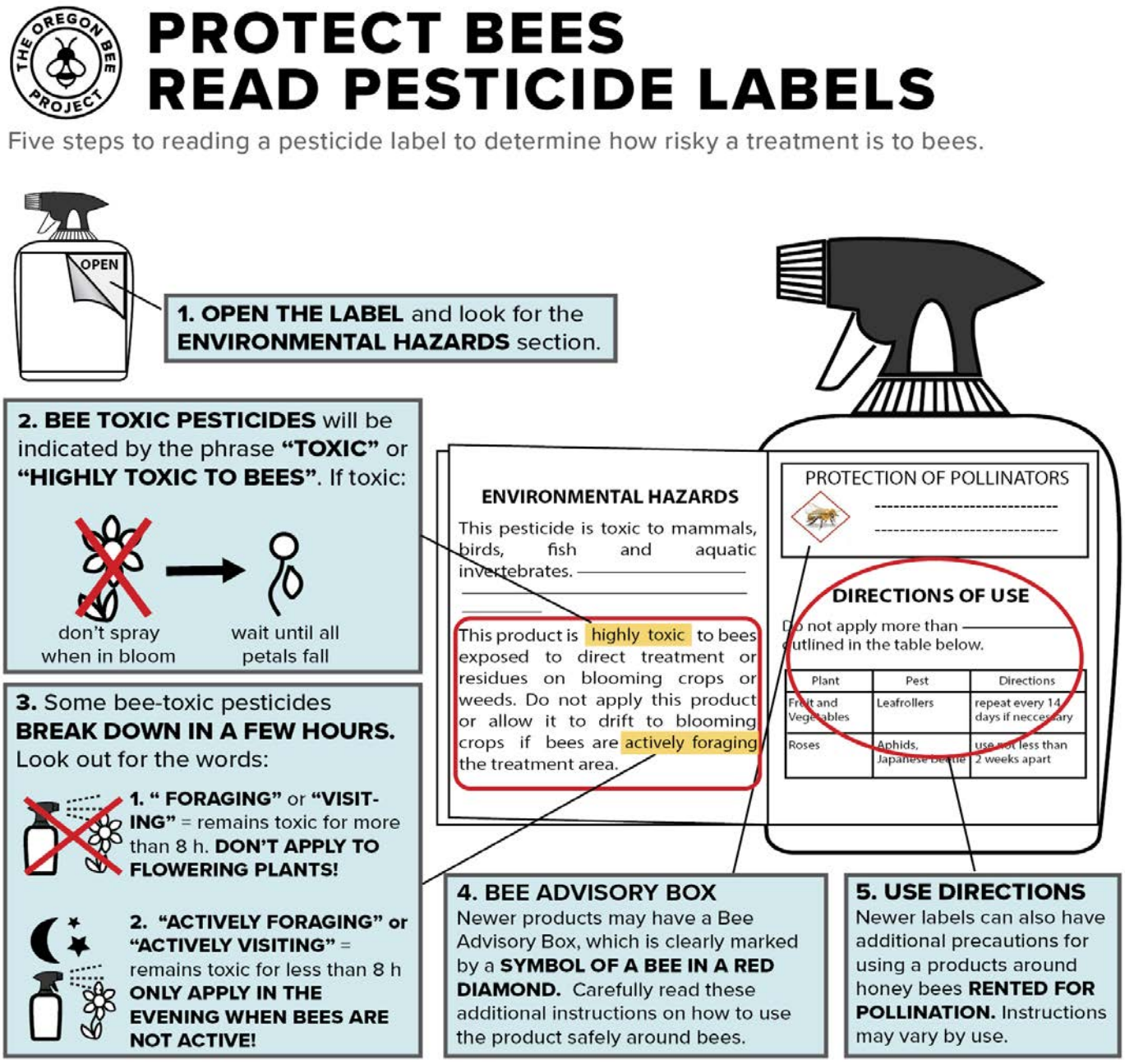


A new training infographic (provided in English and Spanish) that accompanies training and helps retain information about how to read a pesticide label for warning against bee pollinatiors.
Graphic by: I. Kormann, A. Melathopoulos, R. Kachadoorian and G. Uribe

4.1.2 Land managers

There is considerable interest among land managers with regard to developing inexpensive and effective techniques to establish and maintain pollinator habitat. The Project will develop new land management resources in parallel with the Pollinator Stewards (Section 4.3.1) and in close collaboration with partner groups already involved with pollinator habitat restoration initiatives, such as Soil and Water Conservation Districts and Natural Resources Conservation Service (NRCS).

Mid-Columbia cherry producer using a mustard crop to improve soil health between the replanting of trees. The mustard provides nectar and pollen for native bees. Photo A. Melathopoulos

4.1.3 Beekeepers

The Project will work with the Oregon Master Beekeepers, Oregon State Beekeepers Association, and Oregon bee supply companies to promote trainings to educate beekeepers on best beekeeping practices. Trainings will be focused on new beekeepers, as their colonies are especially vulnerable to nutritional deficiencies and higher disease and pest loads due to lack of experience. In addition, the Project will provide new resources to professional beekeepers engaged in crop pollination on how to effectively communicate with pesticide applicators to reduce the risk of pesticide exposure.

Beekeeper education will focus on fostering basic skill development among new beekeepers and how to promote better communication with pesticide applicators and land managers during crop pollination. Photo A. Melathopoulos

4.1.4 Volunteers

Volunteers in the OSU Master Gardener, Beekeeper and Naturalist programs provide considerable service back to the communities they live in. In many counties, these volunteers are currently the primary source of face-to-face engagement around bee pollinator health.

We also know very little about most of the wild bees in the counties where our volunteers live. Unlike many other states, where a small subset of crops dominates agricultural landscapes, sequential blooming of crop plants in parts of Oregon (e.g., blueberry, followed by clover seed), a diversity of typical and specialty crops, and verdant urban landscapes have contributed to robust wild pollinator populations. But without surveying, there is no way of documenting changes in their populations over time.

OSU Master Melittologist volunteers combining their knowledge of Oregon bees with public engagement. Photo: A. Melathopoulos.

In order to increase and coordinate a bee sampling effort in the state, the Project developed the **Oregon Bee Atlas** in 2018 that brings together:

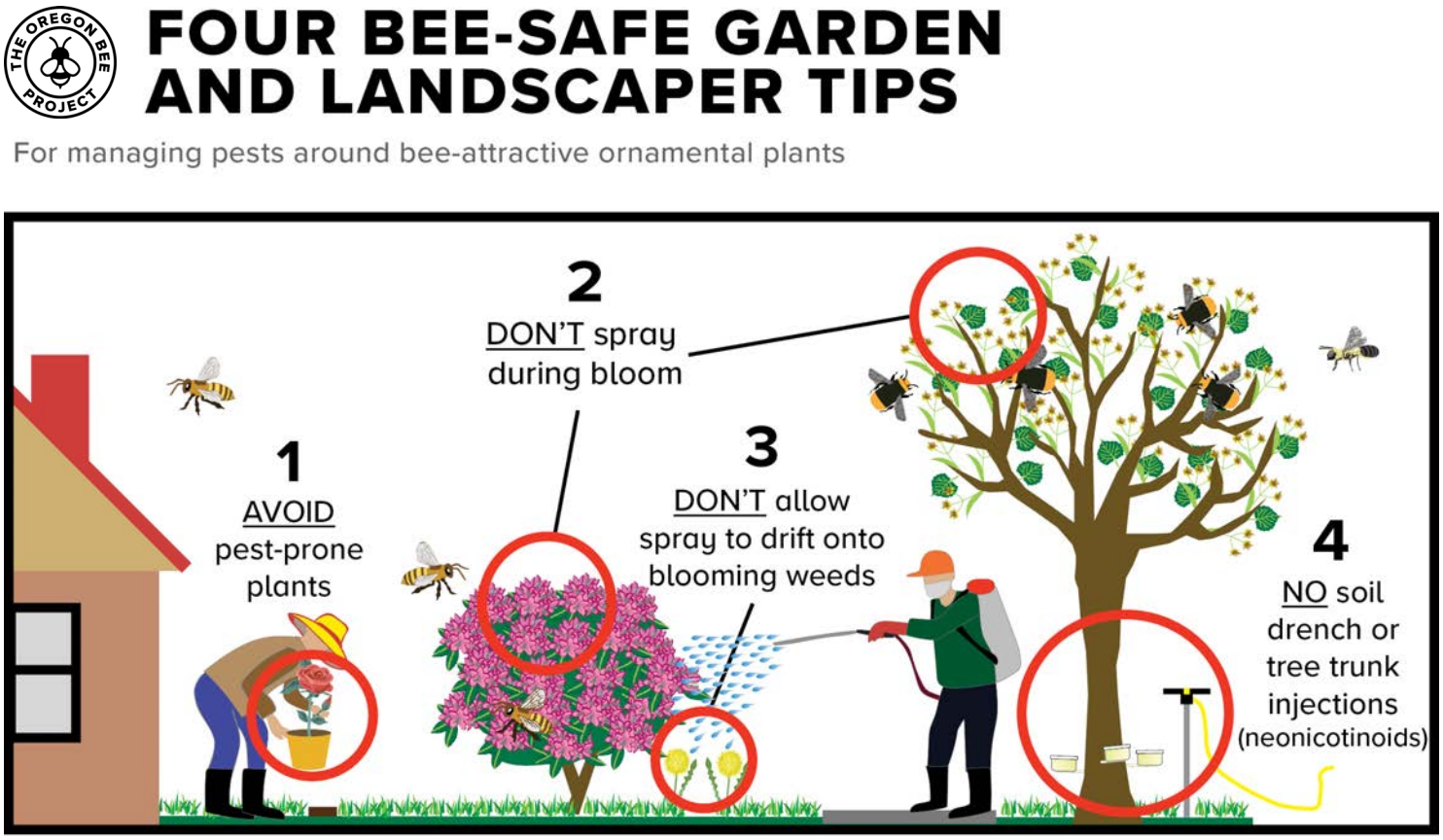
a) historical baseline data about bees based on museum specimens and literature citations, with

b) newer observational data from volunteer Master Melittologists living across Oregon.

As this initiative matures, volunteers will be dispatched to survey areas around the state that historically have not been sampled. Records will be housed on a publically accessible website operated by the **Oregon State Arthropod Collection**. Through the Oregon Bee Atlas, the Project has not only developed the state's first survey of wild bees, but also a regional network of advanced volunteers who function as a resource for science-based information on the bees of their county.

4.1.5 The public and unlicensed pesticide applicators

The Project will continue to develop new resources for a broad audience, that highlight Oregon's bee diversity and what Oregonians can do to help keep Oregon bee-friendly. This includes additions to the



Example of infographics for the public to understand how to help bee pollinators in their backyard. These infographics (available in English and Spanish) can be distributed by volunteers within their counties (e.g., at Master Gardener Plant Clinics) or distributed through Oregon Bee Project social media channels.
Graphic by: I. Kormann, A. Melathopoulos, R. Kachadoorian and G. Uribe

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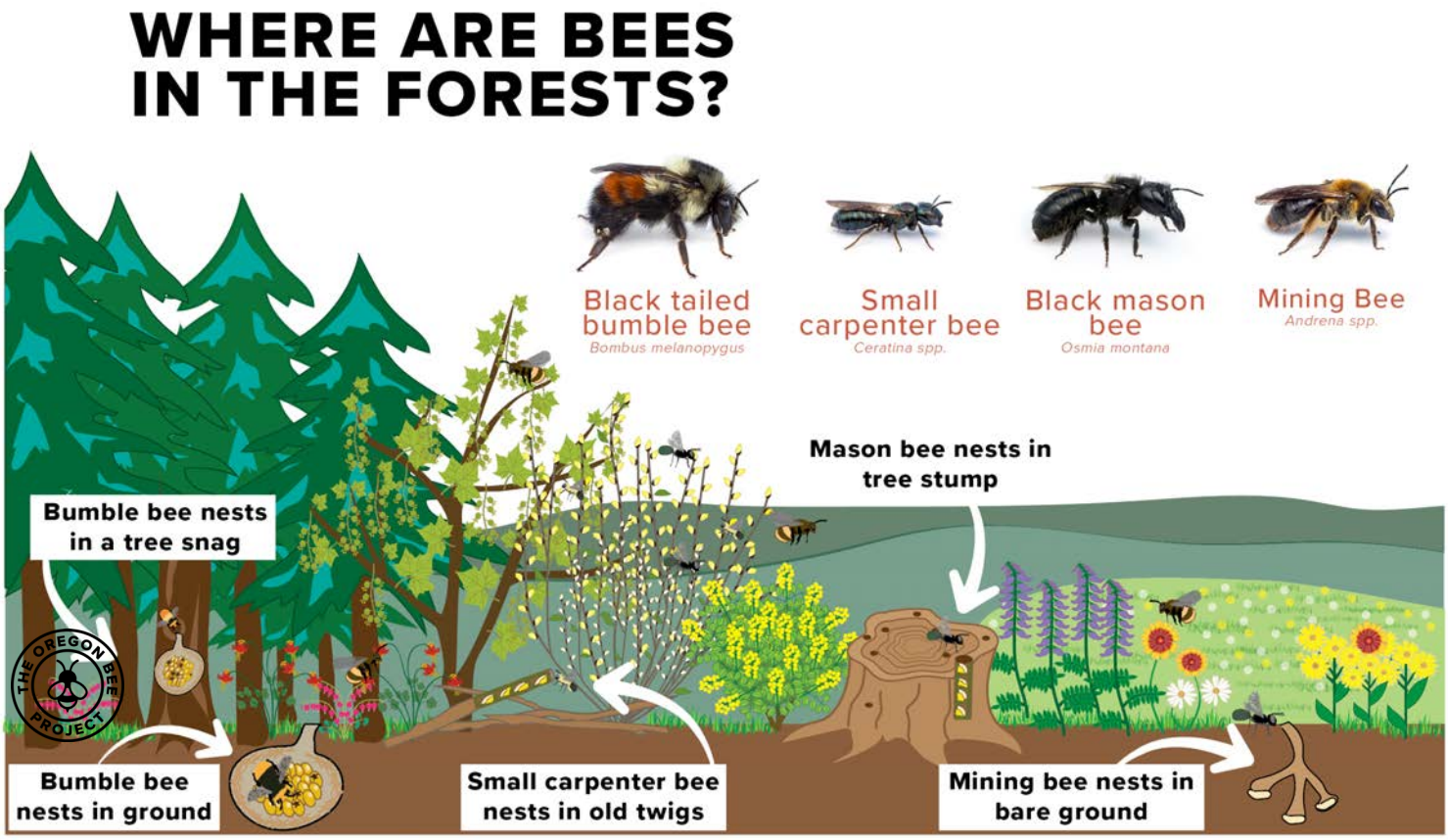
Project's series of digital and print infographics that will provide basic information about the risk of pesticide use on bee-attractive flowers; region-suitable and bee-attractive plant lists; and bee-friendly landscape designs. These infographics have been distributed across social media channels and made available for volunteers to distribute them as postcards. To date, 6 educational postcards that have been distributed to over 25,000 Oregonians (Bees of Oregon, Bees of Oregon Trading Cards, Responsible Orchard Bee Management, Protect Bees - Read Pesticide Labels, Four Bee-Safe Gardener and Landscaper Tips, Where are the Bees in the Forest). Most recently, the Project has worked collaboratively with the OSU Food Hero program on the **Explore the Bees of Oregon** initiative, which brings the story of bees and Oregon agriculture to youth across the state.

Pollinator resources from the Project, partner agencies and other groups, has been consolidated at the Project's new website (www.oregonbeeproject.org). In order to facilitate broad access, the website includes both English and Spanish language resources.

Volunteer Master Melittologists are currently being trained and supplied with material to engage the public around the diversity of bees in Oregon. Outreach material include a display of curated bees from the region, infographic cards that describe the common bee species of Oregon and practical tips to help bees (available in English and Spanish) and interactive, tabling at public events. Since many of the Project's volunteers belong to larger service organizations, particularly the Oregon Master Gardeners, Master Naturalists and Master Beekeepers, they can now view a short video on bee protection in Oregon and receive outreach materials after completing a short quiz.

Master Melittologist volunteers have also started to produce their own outreach materials (Bee Blurbs) that have been viewed by thousands of Oregonians. We hope to expand this form of outreach and education programing through the Pollinator Stewards program (Section 4.3.1).

The Explore the Bees of Oregon coloring book is part of a broader initiative to educate young Oregonians on the connection between bees and agriculture.
Graphic by: Food Hero



Example of public infographic designed to highlight the connection between land management practices in Oregon and bee biodiversity. Graphic by: I. Kormann, A. Melathopoulos, C. Buhl

Bee habitat created by seeding slash piles in Clatsop County. Photo by: A. Melathopoulos (Hampton Lumber)

4.2 Decision Support

4.2.1 Exotic bee and bee disease and pest diagnosis

Managed honey bees are under considerable pressure from several pests and diseases. Beekeepers can manage many of them by combining advanced diagnostic tools with rapid turnaround times of sample results. The **OSU Honey Bee Lab** has established an advanced pest and disease diagnostic service for Oregon beekeepers, enabling them to both get ahead of existing problems and build capacity to rapidly identify future threats to the beekeeping industry.

The OSU Honey Bee Lab's Ramesh Sagili collecting bee samples from commercial bee colonies in commercial hybrid onion seed fields in Central Oregon.
Photo: L. Ketchum

The OSU Pollinator Health Lab initiated a survey of orchard bee cocoons in 2021. The survey enumerates commercially available cocoons in Oregon for common and exotic bee diseases and pests, as well as exotic bees, such as *Osmia cornifrons*.

Finally, the Oregon Bee Atlas (Section 4.4) is detecting exotic bees through submissions from Master Melittologist volunteers.

4.2.2 Bee Protection Protocols

Pollinator protection plans around the U.S. have identified better communication among beekeepers, pesticide applicators and land managers as a key pillar of increasing pollinator health. Some states have adopted systems for mapping the location of honey bee colonies as a way to help growers and pesticide applicators locate colonies in the landscape, in order to help facilitate direct dialogue between these two groups. Due to the agricultural and landscape diversity in Oregon, beekeepers and land managers are best positioned to determine the kind of practices that maximize yield and minimize negative effects to honey bees. Mapping the location of honey bee colonies is presently considered unfeasible given the frequent movement of colonies across the Oregon landscape for pollination. Instead, increased opportunities for information exchange will be identified in the development of industry-specific Bee Protection Protocols and be translated into communication checklists for growers, pesticide consultants, pesticide applicators and beekeepers.

The Oregon Bee Project, in conjunction with the Oregon State Beekeepers Association, has started approaching Commissions/Associations to develop Bee Protection Protocols for key crops that require pollination services; crops that are attractive to honey bees, but do not require pollination services (such as Christmas Trees); landscape plants; and vector control districts. The goal will be to promote industry-to-industry dialogue that results in Bee Protection Protocols. Protocols will include recommended practices related to:

1. Honey bee pollination (e.g., colony strength, timing and departure of colonies, placement of colonies),
2. Pest management activities that take place during bloom (e.g., identifying pests and diseases around bloom and how to manage them in ways that reduces honey bee exposure) and
3. Communication among growers, crop consultants and beekeepers, including: 1) the need to periodically revisit the protocol, create a communication checklist (e.g., the timing of communication, key areas that should be discussed), and 2) elements to include in a pollination contract identified.

Kristine Buckland (OSU's Vegetable and Specialty Seed Crop Specialist) records notes from a meeting to develop a Bee Protection Protocol for the Specialty Seed Growers of Western Oregon (SSGWO). The meeting included SSGWO members, members of the Oregon State Beekeepers Association (OSBA), crop consultants, Ramesh Sagili of the OSU Honey Bee Lab and staff from Oregon Department of Agriculture.
Photo A. Melathopoulos

The Bee Protection Protocols have been promoted to the public in order to highlight the attention land managers devote to bee protection. An example of this are seed packs distributed to the public to promote the Bee Protection Protocols by western Oregon seed producers.

Seed pack distributed to the public promoting the Oregon Clover Commission and SSGWO Bee Protection Protocol. Photo A. Melathopoulos

4.2.3 Bee health extension

There is considerable information available to land managers and those who advise them (from crop consultants, to regional agencies, to Master Gardener volunteers) on how to protect bee pollinators. Much of this information is spread across a number of disparate sources, has not kept pace with recent developments in the field and/or lacks the specificity needed to be implemented on the ground. In order to provide these land managers and their advisors with better decision making support, OSU Extension has developed, and will continue to develop, educational material:

- New training publications produced during the first Strategic Plan included "Forest Bees and Pollinators" (ODF, Woodland Fish and Wildlife) "Enhancing Urban and Suburban Landscapes to Protect Pollinators" (OSU), "Trees and Shrubs for Fall and Winter Bloom" (OSU) and "Asian Giant Hornet (*Vespa mandarinia*): A Potential Threat to Honey Bee Colonies in Oregon" (OSU)
- Planned publications include new publications on plants for Oregon bumble bees, bee stewardship in agricultural lands, keys to Oregon bee genera and bumble bee species and complete redesign of "How to Reduce Bee Poisoning from Pesticides" (PNW 591).

4.3 Learning from and recognizing innovators

Initial stakeholder consultations by the ODA and OSU Extension Service in 2017 revealed that many people were already actively working to improve the health of bee pollinators in the state but were not being recognized for their efforts. Many land managers were already providing habitat for bees, had good communication with their local beekeepers, were using pesticides judiciously around bloom time, and had strong comprehension of the risks to honey bees specified on the pesticide label. Yet without recognition, there was little incentive to encourage others to adopt these bee-friendly practices, let alone inspire other

land managers to expand the scope of practices they were already using.

As a result, a key element of the Project is to identify specific Oregon land managers or industries that have already gone the extra mile to protect pollinators and provide them resources and recognition.

4.3.1 Pollinator Steward Program

In the first Strategic Plan, the Oregon Bee Project administered a two year pilot project known as the Flagship Farm program. The program showcased 21 growers who were leaders in bee protection in Oregon. At the conclusion of the program, growers indicated that what they hoped for from the Flagship Farm program were more educational opportunities and chances to network with other farmers. As a consequence, when the program concluded, OSU Extension started to work on a new program that focused on creating advanced educational opportunities for farms, woodlands and gardens interested in pursuing advanced techniques in bee protection - Pollinator Stewards. The Pollinator Steward program was initiated in 2021 with woodland owners and is set to expand in 2022. The program consist of self-paced online training and field days course coupled with options for volunteer activity and creating new pollinator habitat. Completion of the requirements qualify the participant for recognition as an Oregon Bee Project Pollinator Steward.

4.4 Wild Bee Survey

Land management practices are known to affect wild bee populations, yet wild bee populations are poorly sampled, making it impossible to resolve whether changing these practices are leading to overall pollinator community declines or recoveries outside of regions with high-level of historic sampling effort. But Oregon also presents unique challenges for detecting changes in native bee populations in agricultural settings, given that this region includes 12 distinct ecoregions that are dissected by two broad mountain ranges, resulting in distinct pollinator communities. In light of these challenges, it is perhaps not surprising that Oregon lags behind other parts of the US in terms of sampling effort with only a handful of restricted studies having taken place since the 1980s. In contrast to states in the eastern U.S., Oregon lacks basic identification resources and expertise and there is no comprehensive inventory of the bees living in the state.

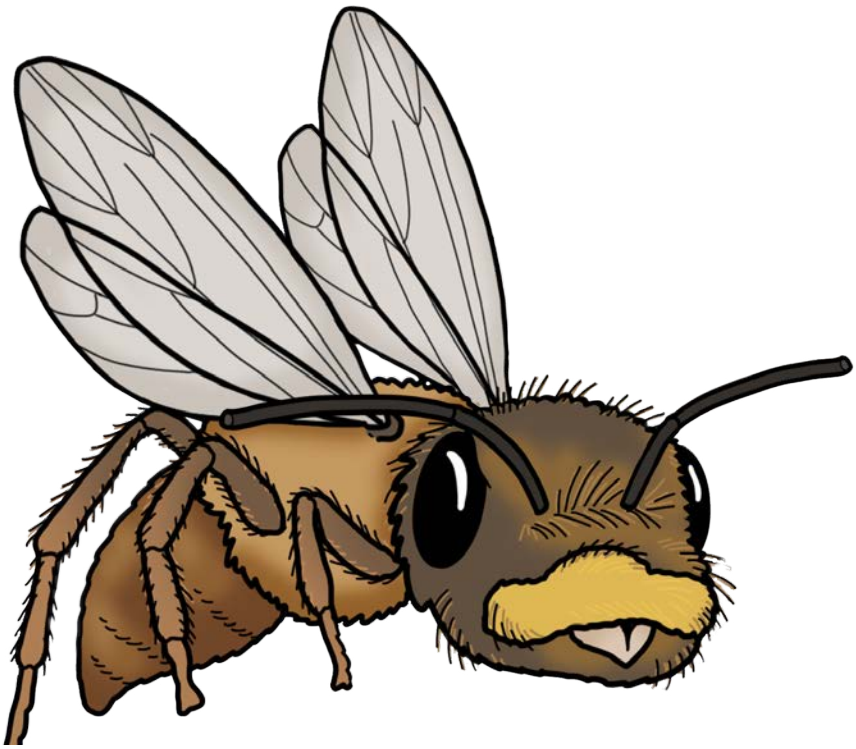
Fortunately, the Project steering committee discovered intense interest in native bees across the regions from a diverse set of groups including the public, service organizations and untrained professionals with state agencies. While the use of untrained ‘community science’ has grown in popularity, it has had limited success in delivering a uniform census of insect communities. Many community science biodiversity inventories come to a point where volunteer effort and records become disorganized and specimen verifications become backlogged, resulting in many valuable observations being lost.

In 2017, the Project launched the Oregon Bee Atlas in partnership with the OSAC. The Atlas is a community science-based bee biodiversity survey, with volunteers recruited primarily through the Oregon Master Gardeners, Master Naturalists and Master Beekeepers. In order to overcome the previous limitations of community science-based surveys, the Oregon Bee Atlas is structured around the coordination of five components/activities: (1) an organized network of motivated citizen scientists, (2) a strategic survey goal spanning the regions, (3) a mechanism for extracting high-quality observations and records from survey efforts, (4) a mechanism to evaluate new records for relevancy and accuracy and (5) connectivity to authoritative taxonomy. The Atlas has achieved its goal of creating solid infrastructure to provide community

scientists: a) a path to increase their knowledge and capacities, b) a plan for including people of different experience levels, c) an easily accessible database of bees found in the region, d) a mechanism to combine photographic and specimen records into a curated archival repository and regionally specific reference native bee collections for learning and outreach, species lists, and keys useful to the region.

The Atlas trained over 300 Oregonians in techniques for surveying wild bees, organized into 14-regionally-based teams around Oregon. The program has been exceptionally popular with the public and was featured on Oregon Public Broadcasting's program Oregon Field Guide in 2018 (The quest to find every kind of bee in Oregon). Nevertheless, the Atlas faced issues similar to other high-level community science programs. Despite our exceptionally high data quality, we had a high number of 'dabblers' in 2018 who only episodically collected, producing few specimens, virtually all of which were common species. This phenomenon has been observed in many bird-based community science projects. By modifying and intensifying our training in 2019 and transitioning the volunteer program to a Master Certificate program in 2020 (the Master Melittologists) we have doubled the number of volunteers submitting larger collections and have increased the scientific significance of the bees collected.

To date, Atlas Master Melittologists have collected over 100,000 new museum-quality native bee specimens from every county in Oregon. In two years of survey, volunteers have collected specimens constituting at least 400 different species (approximately 60% of the known species known to the state), including dozens of species whose presence in Oregon had not been recorded for decades. Remarkably, most of these specimens were captured when the bee was visiting flowers, and volunteers have generated a database of photo-vouchers of these host plants, enabling an unprecedented view of the plant-pollinator networks on the scale of a state. This makes the Atlas not only the largest volunteer native bee inventory in the US, but also, the largest effort to document bee-plant interactions anywhere in North America.



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5. CONNECTING ACTIVITIES, GOALS AND METRICS

The ultimate measure of success of the Oregon Bee Project would be higher survival and productivity of managed bee stocks and the continued diversity of the Oregon's wild bee species into the future. In addition to directly measuring pollinator population changes, success would also entail documenting increasing habitat for bees and reducing pesticide exposure. But how could this be measured? For example, measuring changes in habitat and pesticide exposure directly is unfeasible given the size and complexity of land management in Oregon. The US Environmental Protection Agency, the Pesticide Program Dialogue Committee, the Association of American Pesticide Control Officials and committees, and State Lead Agencies, such as ODA, have been working together to develop measurements of program success for the different efforts taking place in states, tribes, and territories across the US. Through ODA's involvement in these national discussions, the Project will develop a set of metrics that will be compatible with measures used in other states, allowing Oregon to participate in periodic national surveys, but in a manner that is tuned-in to the specific constraints and concerns of our state. Consequently, the Project will focus on the measuring the following key variables over the next five years to track the success of the plan:

Goal 1: Protect bees from toxic pesticide exposure.

1.1 **Increase label comprehension:** Increase comprehension of pollinator hazard and risk statements on pesticide labels among licensed pesticide applicators.

1.2 **Mitigation against exposure:** Increase adoption of practices that help reduce pesticide exposure to pollinators while maintaining adequate levels of pest control to homeowners and professional land managers.

1.3 **Increase coordination between beekeepers and applicators:** Increase industry-level and site-level coordination between beekeepers and pesticide applicators to prevent exposure of honey bees to pesticides.

Activities supporting Goal 1:

1. Train licensed pesticide applicators to understand risk statements on pesticide labels and utilize strategies that mitigate exposure risk to pollinators (Objectives 1.1, 1.2).
2. Develop a Pollinator Stewards curriculum to train land managers on integrated pest management (IPM) techniques and label comprehension to reduce pesticide exposure (1.1, 1.2).
3. Develop a Pollinator Advocate curriculum and outreach material to provide volunteers with skills and outreach resources to educate non-licensed applicators (e.g., home gardeners) on how to reduce pesticide exposure to pollinators (1.2).
4. Develop industry-specific Bee Protection Protocols (1.2, 1.3).

Metrics for success in achieving Goal 1:

- Number and trends of pesticide incidents involving bees that are reported and confirmed.
- Number and type of pesticide applicators trained and their "pre" and "post" training scores in pesticide label comprehension.
- Number of Pollinator Stewards trained in advanced mitigation techniques.
- Number of people receiving printed literature or viewing/listening/watching material online focused on reducing bee pesticide exposure.
- Number of people interacting with Pollinator Advocates, and when feasible, audience surveys

indicating the intention to adopt practices that reduce pesticide exposure as a result of these interactions. The Pollinator Advocates will provide feedback on their outreach efforts on a regular basis.

- Number of Bee Protection Protocols developed.
- Adoption rates of Bee Protection Protocols, measured through surveys.
- Participating beekeeper feedback, measured through surveys.

Goal 2: Increase bee habitat

2.1 Expand training: Provide land managers and the public with training opportunities that are increasingly specific to different contexts (e.g., small and large farms, urban and rural, east and west of the Cascades) and are coordinated across different agencies and nonprofits.

2.2 Connect land managers to resources: Provide a more direct connection between a wide range of land managers, from gardeners to woodland owners, on funding and technical support to create bee habitat. Moreover, the Project will support initiatives that better direct resources to land managers.

2.3 Increase the effectiveness and lower the cost of restoration efforts: Restoration efforts will be better directed to meet different objectives for bee habitat by improving habitat establishment and identifying plants that provide nectar and pollen resources for managed bees, or that support a wide diversity of wild bees and species at risk.

Activities supporting Goal 2:

1. Train licensed herbicide applicators on the principles of vegetation management to promote bee habitat (Objectives 2.1, 2.2).
2. Provide letters of support for Oregon researchers applying for funding to identify improved techniques for creating bee habitat and improving plant species selection on working and state lands (2.2).
3. Create new educational materials for the public and land managers on how to create bee habitat. These materials will focus on areas not previously covered. These may include workshops and short videos on the creation of specific habitat types: hedgerows, seeding and managing a cover crop, seeding and managing bee pasture, etc (2.1).
4. Develop guidance documents and outreach tools to encourage forest landowners to incorporate pollinator habitat on forest lands while still fulfilling Forest Practice Act requirements (e.g., Wildlife Food plots [ORS 527.678]) (2.1, 2.2).
5. Develop a Pollinator Stewards curriculum to train land managers to create pollinator habitat and access funding from regional, state, and federal programs. Pollinator Stewards who develop new pollinator habitat will be promoted by the Oregon Bee Project (2.1, 2.2).
6. Develop a Pollinator Advocate curriculum to provide volunteers the skills and outreach resources for educating the public on how to create pollinator habitat. Resources will include pollinator seed mix packs of annual and perennial seed mix packages suitable for urban pollinator habitat (2.1, 2.2).
7. Maintain a regional contact list for technical and funding resources on creating bee habitat on the Oregon Bee Project website (2.2),
8. Work with producer groups, the Natural Resource Conservation Service, Soil and Water Conservation Districts and conservation groups to develop one or more new Conservation

Implementation Strategy (CIS) proposal(s) for other parts of the state. Several existing CISs in the state have had pollinators added as an additional goal (e.g. Oak Woodland strategies). The Project will assist efforts to better define bee enhancing practices in existing CISs, but also to create new bee-focused CISs where there is producer interest (2.2).

9. Use data from researchers and from the Oregon Bee Atlas to identify key forage plants to support different taxa of bees across different regions of Oregon (2.3).
10. Information will be shared regularly with Oregon seed producers to help facilitate the production of top plants for Oregon wild and managed bees. The Project will assist seed producers obtain grants to overcome production challenges and increase market size.

Metrics for success in achieving Goal 2:

- A tool for land managers to use bee-plant associations to most efficiently select the plants to meet different bee-health objectives (e.g., for honey bee pasture, for specific bee genera, to promote high bee biodiversity, etc).
- Number and type of pesticide applicators trained and their pre- and post-training scores on creating pollinator habitat and changing practices, categorized by industry (e.g., landscapers, right-of-way managers).
- Number of forest managers enrolled in Wildlife Food Plot or other pollinator habitat enhancement programs, and the total acres of pollinator habitat they create and maintain.
- Number of Pollinator Stewards trained in creating pollinator habitat and the total acres of pollinator habitat they create and maintain.
- Number of people reached by the Pollinator Advocate Program and other statewide efforts and the number of people intending to create more habitat through these efforts.

Goal 3: Slow the introduction, spread and impact of exotic bees, and bee diseases and pests.

3.1 Reduced disease and pest levels: Fewer than 5% of honey bee colonies will have American Foulbrood. Varroa mite levels will be maintained below economic thresholds for 75% of colonies. Chalkbrood levels in mason bees and alfalfa leafcutting bees will be maintained below 2%.

3.2 Expanded training: Beekeepers will have 50% more trainings compared to 2018 levels on diseases and pest management. 50 veterinarians will be trained on brood disease and diagnostics.

3.3 Improve multi-agency response to exotic bees and new and emerging bee pests and diseases: 100% of reports of newly introduced bees or bee pests and diseases will be shared among partner agencies within 48 hours of initial report and, once reported, agencies will coordinate their communication and response plan.

Activities supporting Goal 3:

1. Develop a honey bee pest and disease syllabus for the Master-level of the Oregon Master Beekeeper program. Five volunteers per year will be certified in these competencies and train an additional 50 beekeepers per year on how to reduce honey bee diseases and parasites to low levels (Objectives 3.1, 3.2).
2. Pollinator Advocates and Master Gardeners will provide presentations and workshops on managing pests and diseases of orchard mason bees, and train over 50 beekeepers per year (3.1, 3.2).

3. Re-establish the reporting pathway for newly introduced bees (including Africanized honey bee, but also other wild species not native to Oregon) and bee pests and diseases with a specific notification protocol. Documented introductions of pests and diseases known to affect bees will be flagged by cooperating agencies, triggering notifications to the OSU Pollinator Health (non-Apis) and Honey Bee (Apis) labs, the Oregon Department of Agriculture's Insect Pest Prevention and Management Program, the USDA, and the Oregon Invasive Species Council within 48 hours of initial report (3.1, 3.3).
4. Proactively develop an invasive bee and bee pest communications and response plan in the event such organisms are found in Oregon. Document to be shared with OSU Pollinator Health (non-Apis) and Honey bee (Apis) labs, ODA, ODF, Oregon Invasive Species Council and appropriate pollinator groups (3.3).
5. Develop standards for the importation of non-Apis bees (excluding the leafcutter bee (Megachile rotundata)) produced outside the state of Oregon. These standards would include phytosanitary restrictions and tracing geographic origin of imported bees. We will also support industry-developed certification systems to prevent the spread of exotic mason bees and mason bee products (3.1).
6. Annual public report on new invasive pests to bees including data gathered by all partners.

Metrics for success in achieving Goal 3:

- Annual colony loss reports from NASS and survey conducted by OSU Pollinator Health/Honey Bee Lab for commercial beekeepers.
- Annual PNW Honey Bee Survey to track hobby beekeepers.
- Number of participants participating in outreach and workshops provided by Project partners on honey bee and mason bee pests and diseases.
- Incidents of exotic bees and bee pests and diseases in annual survey to mason bee producers.
- Annual meeting among OSU Pollinator Health (non-Apis) and Honey Bee (Apis) labs, Oregon Department of Agriculture's Insect Pest Prevention and Management Program, the USDA, and the Oregon Invasive Species Council to review communication and response plans to exotic bee and bee pest and disease over the past year.

Goal 4: Expand our understanding of the bees of Oregon

4.1 Checklist of Oregon Bees: Create a checklist of the wild bee species of Oregon.

4.2 Checklist of Oregon Plants: Create a checklist of the plants visited by Oregon bee species for nectar and pollen.

4.3 Survey: Develop a program to track changes in bee communities over time.

4.4 Education: Expand educational opportunities for amateur melittologists and the general public to learn about the bees of Oregon.

Activities supporting Goal 4:

1. Develop a Master Melittologist curriculum and training program to increase the number of people qualified to survey and identify native bees and to educate the public on the diversity of bees in Oregon (Objectives 4.1, 4.2, 4.4).
2. Develop two new taxonomic keys for Oregon (4.1, 4.2, 4.3)
3. Maintain a publicly accessible web portal that shows where bees have been found across the state,

as well as their preferred plant hosts (4.1, 4.2, 4.4).

4. Increase the number of outreach events statewide, using specimens collected across the state to increase awareness of Oregon bees (4.4).

Metrics for success in achieving Goal 4:

- Species richness and diversity of bees collected.
- Spatial distribution of bees collected.
- Rarity of bees collected.
- Number of plant-bee interactions and identification of key bee plants by eco-region.
- Number of Oregonians educated in bee sampling, taxonomy, or general bee life-history.
- Number of specimens deposited in the Oregon State Arthropod Collection.
- The number of individuals who successfully complete the Master Melittologist Program by demonstrating competency in basic specimen prepration, data curation and taxonomy.
- Development of a robust statewide survey protocol that is integrated with national efforts to survey native bees.

Goal 5: Make the Oregon Bee Project sustainable.

5.1 Educational materials: Obtain sufficient funding to pay for educational materials, including postcard info-graphics and seed packs.

5.2 Coordination: Maintain sufficient funding to pay for 0.2 FTE program coordinator.

5.3 Native Bee Taxonomy: Funding to pay for a taxonomist to review Atlas collections and prepare data for public release.

Activities supporting Goal 5:

1. Raise a minimum of $10,000 per year using a 501(c)3 account at the OSU Agriculture Research Foundation to support Project coordination and printing of educational materials.
2. Raise a minimum of $50,000 per year using a 501(c)3 account at the OSU Foundation to support the taxonomist position and an additional $50,000 through federal grants.
3. Create an Oregon bee license plate to support the taxonomy position with any additional revenue supporting honey bee research at OSU.

Metrics for success in achieving Goal 5:

- Oregon Bee Project is able to sustain the costs of distributing educational materials, coordination of activities and native bee taxonomy through to 2027.

6. ORGANIZATIONAL STRUCTURE

The Oregon Bee Project's success depends on multiple levels of collaborators and supporters. In order for this project to truly make an impact, state partners will work alongside Oregonians in every region of the state. We recognize that collaborators will provide a diverse set of experience in their capacity to contribute, including playing a coordinating, steering or advisory, or other participatory role.

Steering Committee: The Steering Committee is responsible for the planning & operation of Oregon Bee Project programs and coordinating with partners. The Steering Committee consists of the OSU Pollinator Health Extension Specialist (chair), two members from the ODA representing the Insect Pest Prevention and Management (IPPM) and the Pesticides Program, and a member from ODF. Members of the Steering Committee are experts in the fields of pollinator health, honey bees and wild bees, ecology, pesticides, land management, and public policy. The Steering Committee's responsibilities also include:

- working in alignment with the Mission of the Project,
- meeting on monthly basis to discuss the progress and direction of the Project,
- providing an annual progress report on the objectives of the Plan to the Advisory Committee,
- ensuring the Advisory Committee is convened at least once a year,
- ensuring a meeting is convened with other key state agencies (ODOT and ODFW)
- identifying the most appropriate Advisory Committee members to help with Mission-oriented activities across the state, and
- helping facilitate networking among Advisory Committee members and organizations outside of the Project.

Advisory Committee: Members of the Advisory Committee support the development of the Project by providing feedback and expertise. The Advisory Committee is comprised of diverse representatives and pollinator health experts and researchers, both national and regional; industry groups; land management experts such as farmers, beekeepers, Soil and Water Conservation Districts (SWCD), Natural Resources Conservation Service (NRCS) and conservation groups; traditionally underrepresented groups; and at least one member of the general public. The Advisory Committee's responsibilities include:

- working in accordance with the Mission of the Project,
- attending an annual meeting to review progress on the Plan,
- reviewing progress reports and provide feedback to the Steering Committee,
- responding to Steering Committee requests on Project deliverables,
- distributing information about the Project through their networks, and
- helping develop priorities and identify program gaps.