The Rogue Valley Buzzway:

Mapping Pollinator Habitat in Southern Oregon

Jarrett Taylor & Seth Campbell

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Jamie Trammell

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Introduction

For the past several decades, pollinators have been steadily declining in population primarily due to pollution, habitat fragmentation, usage of pesticides, and climatic factors (Davis, et al, 2015). Although there has been an increase in attention surrounding the Honey Bee, very little attention has been focused on native pollinators. Honey bees pollinate $20 billion in annual U.S. agricultural production and $217 billion worldwide (USDA, 2018). However, of the hundred or so crops that make up most of the world's food supply, only 15% are pollinated by domesticated bees (honey bees), 80% are pollinated by wild bees and 5% are pollinated by other wildlife (Potts et al., 2010; Buchmann and Nabhan, 1996; Ingram et al., 1996a; see also Prescott-Allen and Prescott-Allen, 1990). Wild pollinators support the growth of an overwhelming majority of crops in the agricultural sector, without which we may not be able to sustain current populations.

Currently the State of Oregon does not have an estimate for the number of bee species that reside in the state, nor does it record data on where pollinator habitat is present. However, the Oregon Department of Agriculture, Oregon State University Extension Service, Oregon Department of Forestry, and a number of other private stakeholders have created the Oregon Bee Project. The Oregon Bee Project trains and deploys citizen-scientists to collect pollinator data in hopes that research will allow them to identify the key pollinators of Oregon crops. In the Rogue Valley, there is a locally ran organization with similar interests, Pollinator Project Rogue Valley (PPRV). PPRV was created to advocate for native pollinators in the Rogue Valley and to educate

and encourage private landowners to accommodate native pollinators by planting suitable habitat.

Prior to the 1970's, the Rogue Valley had a large variety of native pollinators that could be observed across the valley at varying elevations. The abundance of these insects has since declined across the valley and the cause is still unknown (PPRV, 2017). The Western Bumblebee (Bombus occidentalis), Crotch's Bumblebee (Bombus crotchii) and Suckley's Cuckoo Bumblebee (Bombus suckleyi) are three species that have experienced the largest reductions in populations and are now endangered (PPRV, 2017). The Franklin's Bumblebee, perhaps the most affected pollinator, is an endemic species to the Klamath ecoregion and was historically observed throughout Southern Oregon and Northern California but has since disappeared (Burns, 2017). Robin Thorpe collects bee samples annually around Mt. Ashland and last observed the Franklin's Bumblebee in 2006 in the flowering meadows on Mt. Ashland's Grouse Gap. Thorpe has since paired with the U.S. Fish & Wildlife in attempts to locate these rare bumblebees where he last saw them, but has yet to rediscover them. The Western bumblebee population began declining around the same time as the Franklin's and is considered critically imperiled in the Pacific Northwest; its population is estimated to have declined more than 70 percent in the last 20 years (Burns, 2017).

Last spring, PPRV reached out to our Maps and Geospatial instructor at SOU in attempt to begin mapping areas in the valley that contain adequate pollinator habitat and those that do not. The idea to continue mapping pollinator habitat has since been adopted by us and will be continued throughout the duration of our capstone project.

The United States attained urban-majority status between 1910-1920 and has continued shifting more towards urban living ever since. As it continues to increase, with it comes negative effects within the environment and the loss of biodiversity (Kowarik, 2011). Arthropods are one group of organisms that have been drastically affected by urbanization. Within this phylum exists some of the most important species regarding agricultural production; pollinators. Insect pollinators are comprised primarily of bees, wasps, beetles, ants, flies, butterflies and moths (Cardoso, 2018). Although pollination of plants can occur from a number of sources, they are pollinated primarily by bee populations (Potts et al., 2010). As a result, the disappearance of these vital pollinator populations would present a problematic situation, that is, that we may no no longer be able to produce many of the foods we consume at the rates we demand (Cardoso, Gonçalves, 2018).

In urban areas, wild bees are often more abundant than honey bees, and thus, they pollinate the majority of flowering plants within urban areas (Davis, et al, 2015). Because wild bees represent the majority of bee pollinators in urban landscapes, urban residential spaces small and large play a pivotal role in native pollinator abundance and their diversity within these landscapes (Cardoso, Gonçalves, 2018). Traits associated with urbanization that are attributed to loss of bee diversity are increased paved areas, increased land sprawl and introduction of exotic plants (Cardoso, Gonçalves, 2018). Research done by Cardoso and Gonçalves in 2018 highlights the effects urbanization has on native bee diversity. Their research examined the change in bee species richness in Curitiba, Brazil. Curitiba has a population of greater than two million and one of the largest data sets regarding the long-term monitoring of bees. Two green areas have been studied three times since the 1980s, when Curitiba had just eight hundred thousand residents.

Over the 34 year time-period, their results indicate that two species of bees have disappeared, bee habitat dropped from 70% to 50%, large bees that nest in cavities also increased relative to small bees that nest underground, and bee species richness has declined by 45% (123 species in 1980, 63 in 2018) (Cardoso, Gonçalves, 2018).

There are approximately 4,000 species of bees native to the United states, 500 of which are unique to Oregon. Of the 4,000 species of bees listed as being native to the U.S., none are honey bees (Buchmann, Moisset, 2011). Before the European colonization of America, pollinators other than the honey bee (native bees) pollinated plants across the landscape. Honey bees were first established in America as domesticated, but over time escaped and formed their own colonies and hives. Although they are well integrated into the North American environment at this point, they still pollinate far less of our agricultural forage and are less abundant in urban landscapes than native pollinators (Buchmann, Moisset, 2011)(Davis, et al, 2015). A study performed on the most produced crops in the United States indicates that 15% are pollinated by domesticated bees (honey bees) and 80% are pollinated by wild bees. (Potts et al., 2010; Buchmann and Nabhan, 1996; Ingram et al., 1996a; see also Prescott-Allen and Prescott-Allen, 1990). This study highlights the importance native pollinators have on the production of crops within the United States.

Wild insects are also more efficient pollinators for agricultural and native forage than domesticated insects (Garibaldi et al., 2013). Wild bumblebees possess a unique ability that honeybees do not, the ability to pollinate using a technique called “buzz pollination.” This allows them to shake flowers at a certain frequency rendering them to release more pollen than would be released if a honeybee were extracting pollen. Most bumble bees also have larger bodies

which enable them to carry more pollen than other species of bees. A honeybee would have to visit a blueberry flower four times to deposit the same amount of pollen as a single visit from a queen bumblebee (Graham, 2018). As a result of this, research has shown that the presence of wild bees increases crop yields across many types of plants (Garibaldi, et al., 2013). Additionally, having high quality habitat in the surrounding area has also been found to benefit the wild pollinator community (Kennedy et al., 2013; Ricketts et al., 2008). Due to this, urban residential spaces small or large play a pivotal role in native pollinator abundance and their diversity within these landscapes.

Methodology

After beginning this project last spring and later deciding to continue it as our senior project, Jarrett and I set out to improve upon the project that had previously been established by Ollie Bucolo and our GIS class. Upon starting our capstone, our goals for the project was to create a visually appealing online map in which polygons depicted all known habitat in the Rogue Valley. We hoped to achieve primarily by reformatting the survey and participating in community based activities that would promote the project and allow for continued growth for the future of the project.

The original survey was created using Google Forms and made importing data into ArcGIS time consuming. This was because the previous survey sent data received from the survey to an Excel document and from the Excel document data had to be hand entered into ArcGIS. We hoped to eliminate the tedious tasks involved with the previous survey by reformatting the survey using another brand of software called Survey123. Survey123, like our

mapping software, is developed by ArcGIS. Because of this we are able to completely eliminate the need for an excel document and instead are able transfer the data we receive directly into our map files on ArcGIS Online. Additionally, the creation of a new survey allowed us to simplify the format of the original survey. The completion of which was to make the process of submitting a survey take less time to complete, therefore making it more appealing to fill out. This task included rewording sentences so that they were unbiased and could be primarily answered with a yes or no question, and limiting the amount of possible responses to eliminate any confusion. This component of our project also included the removal of any questions that were not important to the function of our capstone project. It is our hope that by reformatting the survey, we have improved the process by which we receive survey responses.

PPRV defines pollinator habitat as having forage that blooms continuously from spring to winter, access to water, areas with bare soil, shrubs and native plants for nesting, and that the areas is pesticide free. In the survey, respondents are asked about pesticide use, plant diversity and type and whether it is recognized as a Bee City USA property or not. It also asks if the owners intend on maintaining the property the same way for the next 5 years to ensure the map remains accurate into the near-future. Most importantly, it confirms their permission to include their property on the Rogue Buzzway Map.

From ArcGIS Pro Jarrett and I imported our Buzzway map to ArcGIS Online. The Online platform allows for the creation of a hyperlink that directs those who use it to our map for viewing purposes at any time. Known pollinator habitat/potential habitat is shaded on the map using polygons. There are 3 types of polygon included on the map. Potential Habitat (meets at least 1 of the 4 criteria require to be listed as pollinator habitat but does not contain all 4), private

pollinator habitat, public pollinator habitat, and Beehives. Potential habitat is shaded yellow, publicly accessible pollinator habitat is shaded green and privately owned habitat with restricted access is shaded red. Data concerning observed beehives and certified Bee City USA gardens is also present on the map. Beehives are indicated by the letter B, Bee City USA gardens are indicated by a red or green flag depending on land accessibility. Parks are highlighted as potential pollinator habitat unless pollinator habitat has been planted and is recognized by signage (Blue Heron Park, North Mountain Park). Southern Oregon University is highlighted as a public pollinator garden because they are the first Xerces Society certified Bee Campus USA school in the United States.

To better analyze the connectivity of pollinator habitat within the Rogue Valley, a density analysis was applied to the 120 respondents. To perform the density analysis, we first merged the shapefiles that incased both private and public pollinator gardens, we then changed the shapefiles to point addresses to allow ArcGIS to locate all of our polygons. To be considered adequate habitat the address must be within 1,000 ft (maximum forage range for bees) of at least 3 other forms of habitat.

In order to increase participation in our survey we set up a number of networking activities. So far, this includes the Pacific Northwest Pollinator Summit at Oregon State University, air time on Jackson Public Radio and a public service announcement on Rogue Valley TV. Additional events occuring in the spring include another JPR session and a Buzzway community event at the Talent Community Center. This event will include food and beverage and offer an opportunity for those who do not know about the project to learn about how they can help support pollinators in the Rogue Valley.

Conclusion & Discussion

In the Rogue Valley, there are currently three endangered species of wild bumblebees, the Western Bumblebee, the Suckley's Cuckoo Bumblebee and the Franklin's Bumblebee (PPRV, 2017). All three of these bumblebee species were, until recently, abundant in the Rogue Valley. Research performed by Cardoso and Gonçalves in Curitiba, Brazil indicated a 45% reduction in bee species richness from 1980 to 2015 and an increase in population from 800,000 in 1980 to greater than 2 million in 2015. This study does not show direct causation between urban sprawl (increased population) and loss of diversity, however, it does highlight a correlation between urban sprawl and loss of bee diversity. It is plausible that factors driving the reduction in bee populations in Brazil are also the cause for the disappearance in native bee populations in the Rogue Valley. The reason for the decline in our native bees is still unknown, but may be attributed to climate change, habitat fragmentation and other factors that come with increased urban living.

Currently, the Rogue Valley Buzzway has received 120 survey responses from across the Rogue Valley and Grants Pass. The graph below displays the distribution of our survey responses.

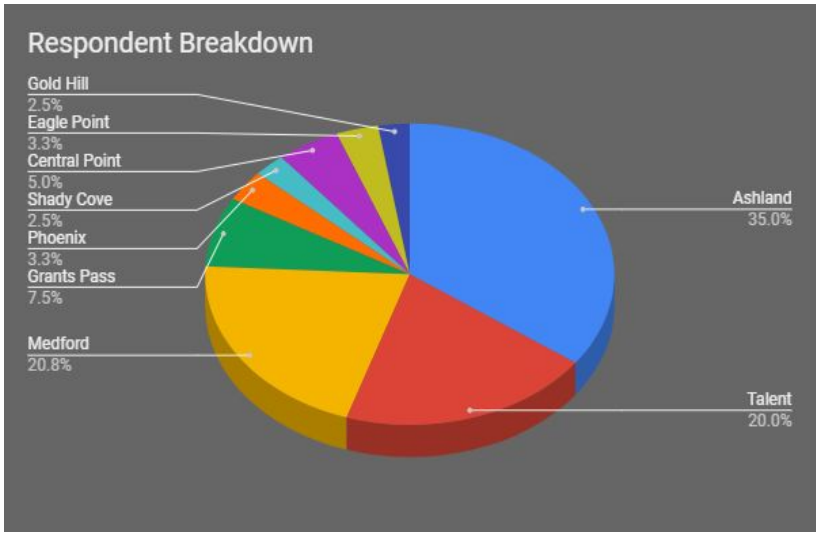

Figure 1. Percent breakdown of respondents based upon which city they reside in.

Although Grants Pass is not in the Rogue Valley, we plan on adding the data received from their community due to the city having the 4th highest number of respondents.

The map generated by our density analysis indicated that most of Ashland contains high levels of habitat connectivity, especially when compared with other cities in the Rogue Valley. Almost all of the addresses in Ashland met the requirement of 3 other forms of habitat within a 1,000 ft radius and of those that qualified, many had 8-10 features within the required zone. This is reflected in the green areas on the map. Talent showed a moderate connectivity (in comparison to Ashland) with most respondents having 4-5 features within a 1000 ft radius. Although Ashland and Talent had sufficient habitat connectivity, our density analysis in Jacksonville, Medford, and Phoenix indicated low levels of habitat connectivity. This does not prove that there

is a lack of habitat present, but instead shows the need for additional survey responses.

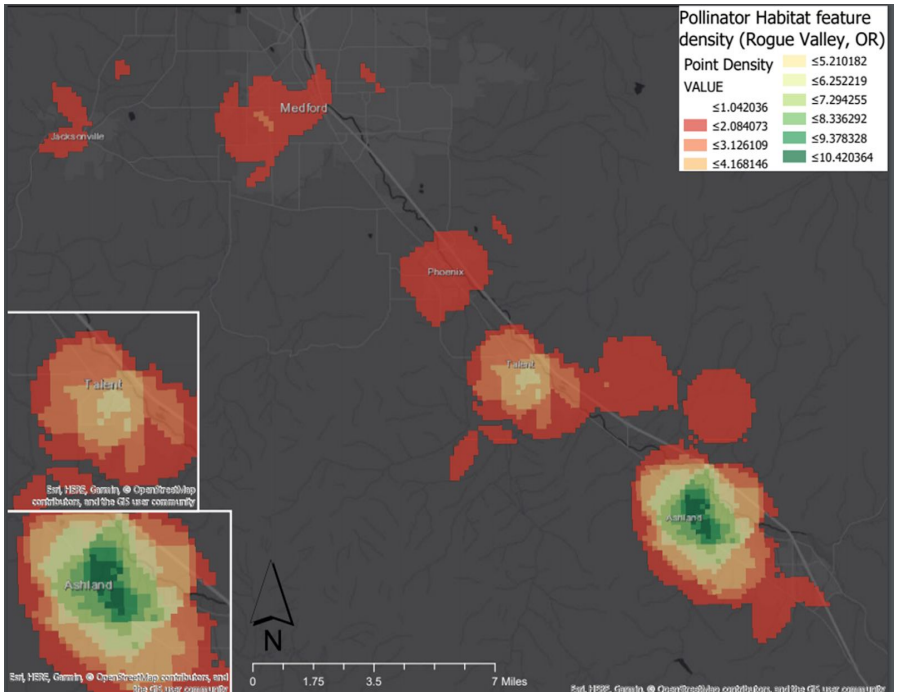

Figure 2. Density analysis based on amount of other features in close proximity to one feature (120 Respondents)

Density analysis with very specific criteria such as those used in our analysis works best in cities and has analytical bias when applied in rural areas. This is primarily due to sparse population density and further distances between pollinator habitat. Because of this and the lack of survey responses, our analysis of Central Point, White City, Eagle Point, and Shady Cove indicated that there was no habitat connectivity present. Regarding this result, it is apparent that more data is needed from these areas as well.

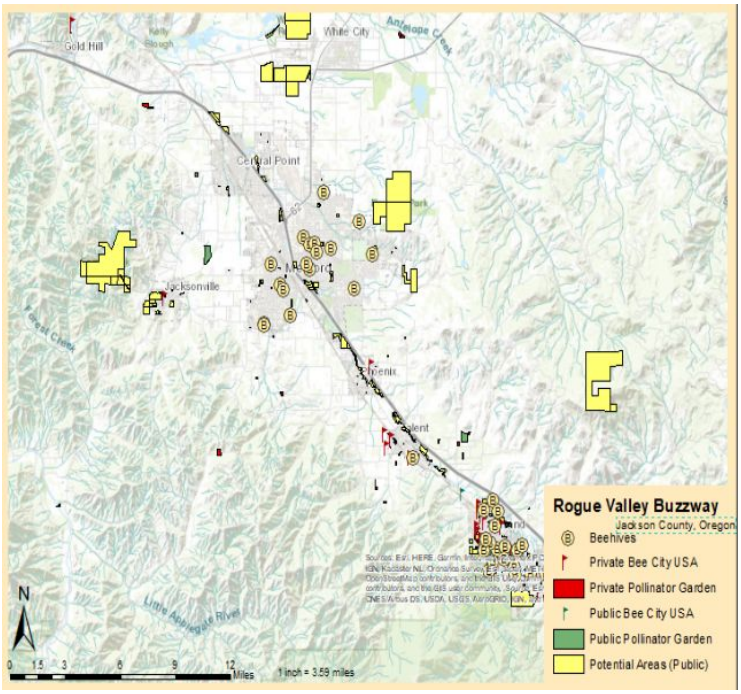

Figure 3. All recorded pollinator habitat per Pollinator Project Rogue Valley (135 respondents)

Wild pollinators are paramount to the continued success of flowering plants across the Rogue Valley. It is our hope that, by mapping the existence of pollinator habitat, residents in Jackson County will be inspired to improve pollinator habitat, and join our effort in aiding the survival of this essential group of arthropods.

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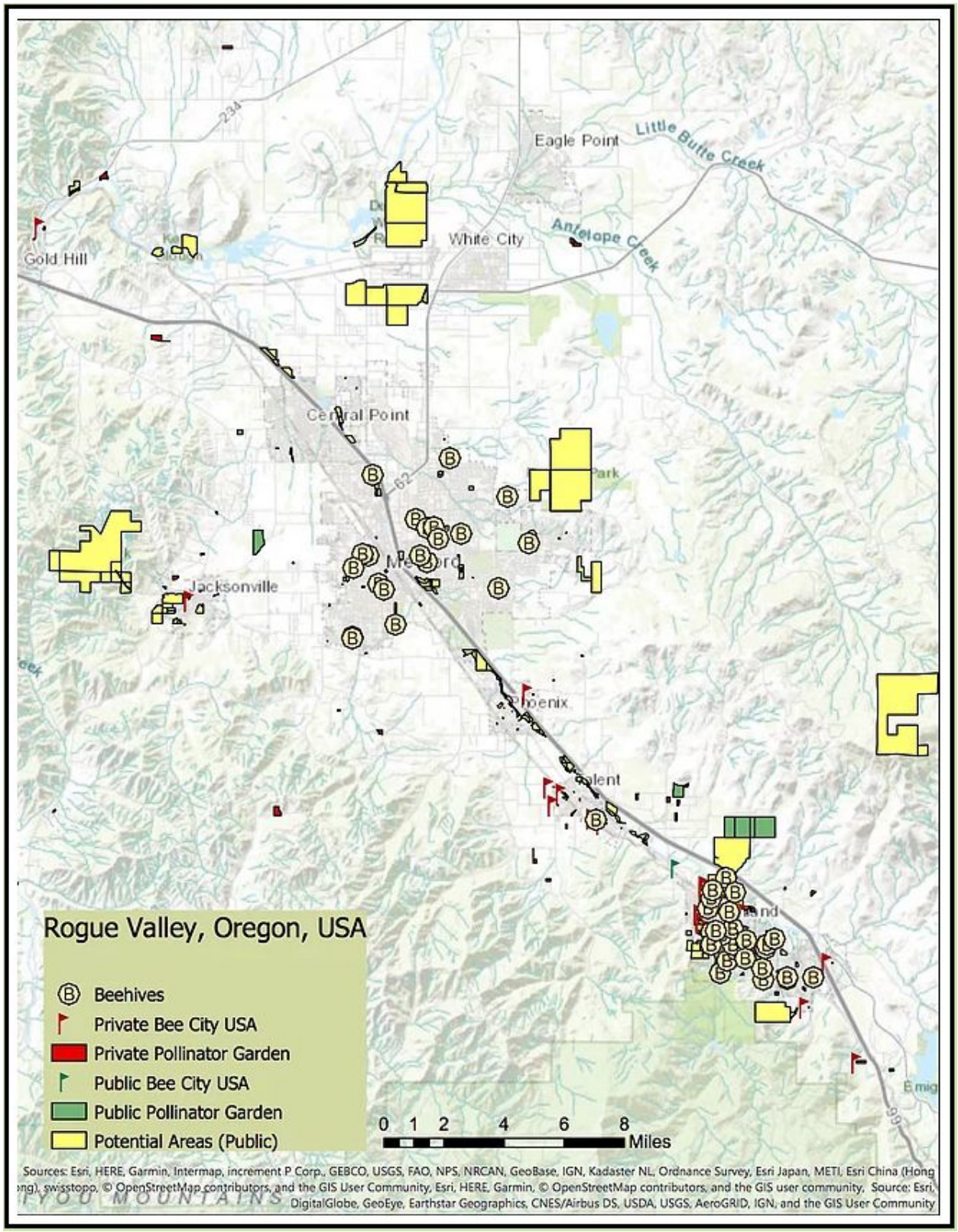
Rogue Valley, Oregon, USA
Beehives
Private Bee City USA
Private Pollinator Garden
Public Bee City USA
Public Pollinator Garden
Potential Areas (Public)
0 1 2 4 6 8
Miles
Eagle Point
Little Butte Creek
White City
Antelope Creek
Gold Hill
Central Point
Jacksonville
Phoenix
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community, Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community