Project workflow

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Title: Understanding Bee-Plant Interactions: A Multi-Dimensional Analysis

Introduction:

Animal pollinators, particularly bees, play a crucial role in the producing global food crops (Klein et al., 2007) and maintaining ecosystem health and biodiversity by facilitating plant reproduction (Biesmeijer et al., 2006). Understanding the dynamics of bee-plant interactions is essential for conservation efforts, agricultural productivity, sustainable development and ecosystem resilience (Patel et al., 2021, Huang et al., 2021).

In this study, we utilize the Oregon Bee Atlas (OBA) dataset which is a citizen science project in which trained volunteers catch bee species around Oregon which is then verified by experts before logging its information and preserving the specimen (Best et al., 2021, 2022). This dataset covers the state of Oregon in the Pacific Northwest of the US, spanning two years (2018-2019) and includes information on bee species, the plants they were foraging on, date caught, and sex. Combined with other open datasets, OBA can provide a valuable opportunity to explore various aspects of bee-plant interactions and their implications for ecosystem functioning.

Research Questions Using the Dataset:

1. **Basic Species Distribution and Abundance:** We aim to identify the most commonly observed bee species and examine their distribution across different plant species. Additionally, we will assess trends in bee abundance over the two-year period.
2. **Temporal Changes and Seasonal Patterns:** We will investigate general temporal and seasonal patterns in bee/plant abundance and foraging activity during these two years.
3. **Foraging Preferences by Bee species:** By analyzing the dataset, we seek to determine whether certain bee species preferentially forage on specific plant species.
4. **Sexual Dimorphism and Foraging Behavior:** We will explore differences in foraging behavior between male and female bees and investigate whether they forage on different plant species.
5. **Identification of Keystone Plant Species:** Using simulation models, we will assess the potential consequences of the extinction of different plant species, identifying the keystone plant species that are most critical for supporting bee populations. This analysis will involve simulating the removal of these plant species from the ecosystem and evaluating the impact on bee species richness, abundance, and diversity.
6. **Pollinator Network Analysis:** Through the construction of a plant-pollinator network using additional datasets, we will visualize the interactions between bee species and plant species and analyze how the network structure changes over time or in response to environmental factors. This analysis will involve data from sources such as the Global Biodiversity Information Facility (GBIF) (https://www.gbif.org/) for pollinator occurrence records (Pocock et al., 2012).

Research Questions Using Additional Open Datasets:

1. **Climate and Foraging Patterns:** By integrating climate data, we aim to understand how climatic factors influence bee foraging behavior and whether there are changes in foraging patterns in response

to climate variability. This analysis will involve data from sources such as the National Climatic Data Center (NCDC) (https://www.ncdc.noaa.gov/) for climate data (Parmesan et al., 2003).

2. **Land Use and Foraging Behavior:** We will investigate the impact of land use (e.g., urbanization, agriculture) on bee foraging preferences and abundance, as well as differences in bee foraging behavior between different types of land use. This analysis will involve data from sources such as the United States Geological Survey (USGS) (https://www.usgs.gov/) for land use data.

3. **Population and Bee occurances:** We will investigate the impact of population on bee and plant availability. Potentially highlighting the sampling bias of this dataset.

4. **Conservation and Management:** Using IUCN lists to identigy bee and plant species at risk, we will see the above analysis for these endangered species.

In conclusion, this study aims to provide a comprehensive analysis of bee-plant interactions using a multi-dimensional approach, combining primary dataset analysis with additional open datasets. The findings will contribute to our understanding of the complex relationships between bees and plants. This is particularly important now in Oregon as the incidences of forest fires have increased in the past decade. A new multifaceted strategy can be employed in the reestablishment of burnt lands which can not only provide a wildfire resistant foliage but also maintain plant diversity.

Workflow

The workflow for our project will closely follow the research questions listed above - we will first start by cleaning the OBA dataset and performing analysis on that before using it in conjunction with other open source datasets to draw further conclusions. We will use the data cleaning steps as outlined in Dorey et al., 2023.

References:

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