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Pollinator Power: Supporting Bees Through Ecoregion Specific Planting Guides

**by
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**Submitted to Scripps College in Partial Fulfillment of the Degree of
Bachelor of Arts**

**Professor Tran
Professor Macko**

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I. Motivation and Background

The pollination of flowering crops by bees is an invaluable ecosystem service that supports biodiversity and much of the global agricultural system. Pollinators move pollen between the male structures of a plant to the female structures of a plant of the same species. This fertilizes the female plant, which then produces the next generation. This process also provides the pollinator with the nectar or pollen it needs to survive. While some plants transfer pollen through different means, the majority of plants need help from pollinators to reproduce. Depending on the means of pollination, pollination can be classified as abiotic or biotic. Abiotic pollination occurs without the assistance of living organisms, through agents like wind or water. Around 80% of pollination is biotic-- at least 100,000 different species of animals pollinate the estimated 250,000 species of flowering plants in the world (Penn State). Pollinators promote local biodiversity in their ecoregions and are vital to many of the essential crops used for human consumption. Klein et al. found that 87 crops, 70% of the 124 most important food crops used for human consumption globally, are dependent on pollinators (Klein, 2007). Insect pollination is a production practice used extensively by farmers all over the world for producing crops (Kearns, 1998).

Widespread pesticide usage, climate change, and destroyed habitats are leading to a loss in biodiversity and a considerable decline in pollinator communities. It is imperative for us to increase education around the significance of pollinators,

and work to reverse the anthropogenic causes of dwindling pollinator populations. While bees have long been a vital part of preserving biodiversity and sustaining human agricultural systems, the plight to save the bees has generated considerable buzz in the last few years related to the recent phenomenon of Colony Collapse Disorder. During the winter of 2006-2007, beekeepers began to report unusually high losses of 30-90 percent of their hives. As many as half of affected colonies demonstrated symptoms inconsistent with any known causes of honeybee death (EPA, 2017).

The problem is clear--the bees are disappearing. The question becomes what does that mean, and how do we fix it? The large scale answer must include a careful consideration of current agricultural practices and the factors that are contributing to losses in biodiversity. But on a small scale, everyone can help support local pollinator populations-- as long as they have access to the right media to guide them. For my thesis project, I decided to build a website that allows users to input their zip code in order to receive information on which types of native pollinator-friendly plants are best suited to grow in their specific ecoregion. I started with the ecoregions of California, but the project is scalable to include other regions. I intended to create a web based experience that not only conveys beautiful educational information, but also a sense of urgency and a clear set of next steps gardeners of any experience level can follow. Additional features could include planting guides, embedded YouTube planting videos, and links to local

plant nurseries. This digital interface will serve as an educational tool with a clear call to action, through which a user can easily navigate information relevant to their planting needs. As Cristina Portugal writes in *Design, User-Experience and Teaching-Learning*, “Today it is possible to really elaborate a knowledge that allows to coincide, overlap, or to put in dialogue knowledge areas normally set apart by culture, but generously amalgamated by Design”(Portugal, 2013). I want to combine planting knowledge usually disseminated through word of mouth, in niche gardening circles, or in uninspiring lists online, with the accessibility and simplicity of a well designed website. This project allowed me to focus specifically on how digital media could be widely circulated and easily modified, and be viewed across platforms, on any device, regardless of location.

A few years ago, Whole Foods Market in University Heights, Rhode Island imagined what grocery shopping would look like in a world without pollinators. They removed all products from their shelves that are pollinator dependent, which resulted in a majority empty store. From 453 products, 237 were pulled off the shelf-- some of the most popular ingredients being Apples, onions, avocados, lemons, limes, carrots, mangos, melons, zucchini, summer squash, celery, cucumbers, cauliflower, kale, and green onions. (Whole Foods, 2014) A study conducted at the University of California at Berkeley showed that globally, "animal-pollinated crops contain the majority of the available dietary lipid, vitamin A, C and E, and a large portion of the minerals calcium, fluoride, and iron worldwide.

The yield increase attributable to animal-dependent pollination of these crops is significant and could have a potentially drastic effect on human nutrition if jeopardized” (Eilers, 2011). This is a clear problem-- pollinators are invaluable to many of the crops that constitute a varied and nutritious diet. If people were instilled with the same urgency that they would feel if say, chicken and beef populations were disappearing at alarming rates, then we could make considerable changes to how we support the animals that pollinate our food. A holistic approach to saving the bees that are imperative to a healthy and colorful diet should include moving away from intensive pesticide practices and reimagining how we maintain agricultural and urban landscapes.

To understand the importance of supporting local pollinators, specifically various types of bees, it is useful to view this topic within the larger context of environmental activism and education, specifically related to pesticides and resisting climate change. While my project is aimed towards small scale gardeners, it is important to understand the role pollinators play in global ecosystem services and their role in worldwide food production to truly understand the consequences of diminished pollinator populations. Scientists like Rebecca Erwin have been expressing concern that climate change could not only be impacting physical landscapes for pollinators, but also interrupting the temporal landscape of bee and flower interactions. She indicates that this timing mismatch could occur if flowers bloom earlier due to earlier snow melts, and bees do not start pollinating earlier,

that creates a disconnect that could leave flowering plants at risk of not reproducing. (Fessenden, 2015) In addition to climate change, the current conversation about protecting pollinators is also tied to a long running debate on appropriate insecticide, fungicide, and pesticide usage. In the last few years, a class of insecticides called neonicotinoids that often coat corn and soybean seeds before planting have been highly criticized as bee killers, and a moratorium has been placed on their usage in the EU until further research is conducted. A European Food Safety Authority (EFSA) scientific report determined that three of the most commonly used pesticides clothianidin, imidacloprid and thiamethoxam, pose “high acute risks” for bees (EFSA, 2013). The neonicotinoid pesticides are at the core of the harmful pesticide residue found in beehives. A shift to more sustainable and ecological farming practices would reduce insect damage by shifting away from a monoculture system that hinders ecosystem diversity. Avoiding pesticides and overuse of chemical fertilizers would result in healthier bees, which would improve pollination and enhance the crop yield and quality.

While much of the focus around supporting pollinators revolves around agricultural systems, promoting various species in more urban regions. From the larger issues of industrial scale pesticide usage and large scale degradation of biodiversity, we can zoom into the issues of land management that can be tackled on a stage as small as a backyard. In Dennis vanEngelsdorp’s popular 2008 TED Talk “A Plea for Bees”, he encourages homeowners to reconnect with our

environments, and “make meadows and not lawns” (vanEngelsdorp, 2008) . As a community, shifting away from what vanEngelsdorp describes as “useless” biosystems, and plant thoughtful pollinator gardens could have a significant effect on sustaining local pollinators in various environments. Best Bees, a company that delivers beehives to anyone who wants them, is also interested in involving everyone from the cities to the countryside in the fight to save pollinators. This model allows us to consider how bees could easily fit into future of urban living. Founder Noah Wilson-Rich reports that according to their data, their urban bee populations produce high quality honey at a rate comparable to those in rural environments (Wilson-Rich, 2012).

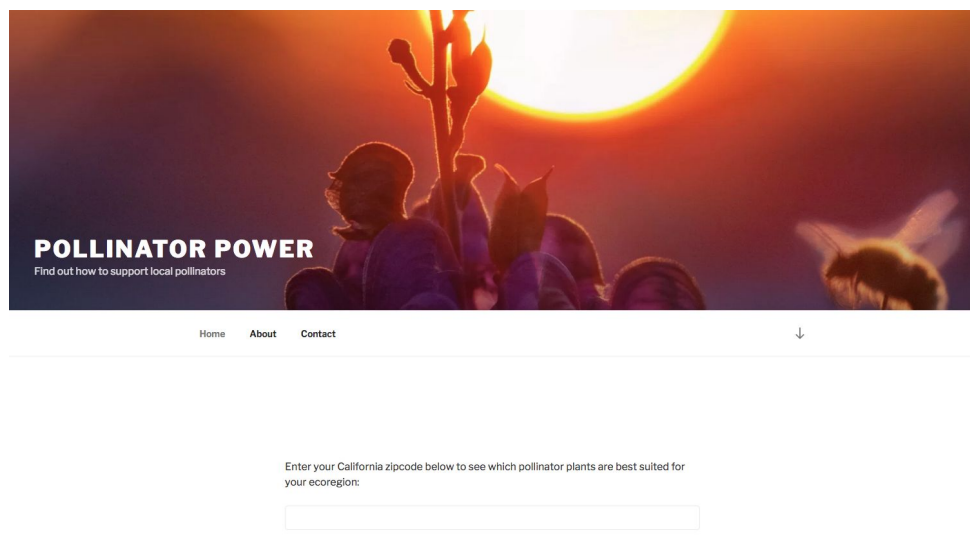
There have been several interesting media campaigns related to raising awareness around the importance of pollinators in the last few years. The ice cream giant Haagen-Dasz explained that many of their most popular flavors rely on bee pollination. The rolled out a multimedia campaign, including a vanilla honey ice cream flavor, seed paper advertisements, and video commercials, and teamed up with prominent research groups at the Xerces Society and UC Davis (Haagen-Dasz)(Levitt, 2008). The week long #BeesNeeds campaign in the UK encourages people to take five actions to help make the environment friendlier for insect pollinators (GOV.UK, 2016).

- 1. Grow more flowers, shrubs and trees**
- 2. Let your garden grow wild**
- 3. Cut your grass less often**
- 4. Don't disturb insect nest and hibernation spots**
- 5. Think carefully about whether to use pesticides**

Five steps from Bees Needs campaign

During National Pollinator Week of this year, June 19-25, Beyond Pesticides and the Center for Food Safety are partnered with different restaurants to launch the Made by Pollinators campaign, which is designed to increase consumer awareness around how to protect pollinators. The restaurants involved actively support local and organic farming practices, and featured items on the menu that are pollinator dependent. This movement brought attention to restaurants that prioritize sustainable ecological systems, and showed the public how much of an impact pollinators have on the ingredients and experiences they enjoy (Beyond Pesticides, 2017). Inspired by these campaigns, I see the merit of designing material that is widely accessible to a large demographic, and provides clear action items to its audience. While designing my web based pollinator promoting site, I encountered web services online that similarly correlate zip code to ecoregion specific plants. However, the sites that I have interacted with are text heavy and occasionally visually lacking. For example,

content.yardmap.org/ecoregions, a project based at the Cornell Lab of Ornithology, identifies ecoregions based on zip code, and there are many region specific pollinator planting guides online. However, these websites cater towards a niche population of gardeners who already know about the importance of attracting pollinators. I am focused on distributing this information widely, to small children interested in the environment, adults who have never planted anything before, and everyone in between.



Screenshot from my website, PollinatorPower.com

II. Production

When starting production of Pollinator Power, I knew that a website was the most logical platform for the project. Because I wanted to work with so many zip codes, it seemed like the project would be database dependent, and thus best suited for a digital interface. From the various ways to create a website, the two main options I evaluated were to:

- Create a basic webpage using HTML, and use CSS and Bootstrap to style it.
- Use a web hosting platform (like WordPress, Weebly, Wix, Medium) in conjunction with my own customizations and plugins.

I ultimately chose the second option, and opted to use Wordpress.org to develop my site. I bought the domain name PollinatorPower.com and hosting services through HostGator. I made this choice primarily because of a WordPress plugin I found called WP Triggers. This plugin allows you to create an input box, and display different results based on what the user submits. This plugin is the basis of my zip code search functionality. WordPress was also a fruitful choice because of how easy it is to customize and style the sites—there are countless plugins, and most of the themes are fully responsive on any sized device. Utilizing my background in Computer Science, I was able to independently research how to code and design the layout I wanted, and construct the user experience I wanted.

In the initial stages, I was unsure about what I wanted a visitor to the site to experience and how much information I wanted them to interact with. I started by curating the images per ecoregion, and displaying them in a visually appealing grid

layout. I was committed to only using striking, high resolution images. After showing the website to various peers and professors, I decided that I didn't want to inundate the user with extensive and complicated planting information, but rather present them with beautiful images that will inspire them to learn more, and start planting.

Comparable websites that I have visited do a great job of providing a lot of high level gardening information, but in my opinion, are not extremely accessible to those who have very little planting experience, or feel indifferent about putting in effort to help out their local pollinators. I want people of any age/experience level to visit my site, and be inspired to start planting pollinator-friendly plants.

At first, I was interested in creating a website that would accept zip codes from across the country—but I quickly realized how extensive my data set of zip codes would be. I realized that having access to a preexisting database would be ideal, and after doing extensive searching, I found one website that relied on a database of information similar to what I wanted to use. I contacted them, but they told me that their information was proprietary and they were unable to share it with me for legal reasons. This prompted me to make my first major pivot, in which I decided to focus only on California zip codes and ecoregions, and expand my scope if time permitted.

Once I settled on the tools I wanted to use and user experience I wanted to achieve, the production process went smoothly. I gathered images that were either public domain images on Flickr or photos that I had taken around Claremont and in the Rancho Santa Ana Botanic Gardens. I created photo galleries per each ecoregion, and used WP Triggers to link the page to the appropriate set of zip codes. The website

currently displays galleries for each zip code, and represents five of the main California ecoregions (Coastal Shrub, Coastal Woodland, American Desert, Dry Steppe, Sierran Steppe). After getting feedback from professors and peers, I decided that upon hovering over an image, I wanted people to be able to see the type of plant and the amount of sunlight it requires. With the combination of high quality images, and basic planting information, a user should be equipped to plan out a garden and grow the plants that appeal to them. As a supplement to my website, I made a set of pressed flower cards. I laminated cards that encapsulated real flowers that I had pressed, alongside a QR code that links back to my website, PollinatorPower.com.



Flower Cards with QR Codes

These cards function as a sort of business card, or physical representation of my site. In the future, I think it would be interesting to make sets of these cards as collectibles, or a way to strengthen your plant identification skills. I plan on continuing to maintain

and add to my website in the future, and would like to add more zip codes and planting information, as well as other things like starter seed kits, or merchandise of which the profits are donated to some pollinator friendly organization. I have reached out to Rancho Santa Ana Botanic Garden, Alameda County Master Gardener, Amigos de los Rios, and The Gardens at Lake Merritt with the link to my website, have recently been contacted by a representative of Pollinator Posse. I am looking forward to the ongoing development of the site and future collaborations, and hope to inspire as many California bee supporters as possible.

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