Joe Kisbye
March 5th, 2012
Professor Jensen
Ecology Midterm

We often consider bees, as so many things close to nature, a hindrance. Parents shelter their children from them, fearing tears or allergic reactions; a stray bee within the home lends to frenzy and raised voices; a hive located on a prospective property is considered a liability. And yet, bees provide an unfathomably irreplaceable ecological service: pollination. Pollinators, and bees especially, pollinate approximately two-thirds "of the world's 1,500 crop species are and directly or indirectly essential for an estimated 15-30% of food production" [1]. What's more, United States Fish and Wildlife Service (FWS) approximate that only fifteen percent of this pollination is done by *controlled* colonies of bees, leaving the remaining eighty-five percent on the shoulders of wild pollinators, largely wild and native bees [2]. In trying to place a figure on their exact worth, the United States has valued the services of managed honeybees (those kept or bred into human care), when supplemented by unmanaged bees, at $1.6 billion [3]. This, figure, however, doesn't take into consideration bees outside of human care, the subject of this essay, who account for much of the world's pollination. When wild bees are removed from the equation, the value of the ecosystem service spiked: without the pollination provided by unmanaged bees, the figure rises to $8.3 billion [3]. Such discrepancy displays exactly how much we take the ecosystem service that unmanaged bees provide for granted. And yet bees are seeing a dramatic decline in their numbers: since 1990 wild honeybees' population has decreased by approximately twenty-five percent [3]. In 1994, for example, California had such a perilously low number of honeybees that the government had to bring in managed pollinators for neighboring states to manage its $800 million almond crop [3]. The United States Department of Agriculture (USDA), in addressing the decrease in bee population and species richness, considers our current state one of an impending pollination crisis" [4]. Which raises the questions: what exactly is causing the wide-scale decrease in bee population? And what can be done to combat the worldwide threat?

Unfortunately, the cause of wild bees' decline is still widely unknown, although studies have confirmed the sources of a few of their antagonists. Amongst these causes are Africanized, or "killer," bees, which are a crossbreed of a number of Western honeybees that were initially, and accidentally, released in Brazil and have since spread across the globe [5]. While they mainly affect human-managed apiaries, these bees carry parasites and foreign diseases from their point of origin that, needless to say, can be widely devastating to native species as the new bees bring with them not only competition for limited resources but antigens to which the native bees are likely unused [4, 6]. What's more, these exotic bees are highly aggressive, and small swarms have been shown capable of conquering hives and colonies alike [5]. However, these foreign variables are only one part of the larger problem that native bees face.

Another cause of the degradation of wild bees is widely agreed to be the large-scale use of pesticides. Highly toxic to bees, pesticides such as "carbamates,

organophosphates, chlorinated cyclodienes and neonicotinoids" are shows to be highly lethal to pollinators [7]. What's more, pesticides have been proven to have more discreetly negative affects, including damages to bees' ability to utilize learn olfactorily, to forage, and to reproduce [7]. This lattermost point is only made more dramatic by bees' already low rates of reproduction. Adding insult to injury, these poisonings can take up to four years to recover from fully [2]. As this weren't enough, pesticides have the effect of reducing the number of flowering plants and the amount of nectar they produce, limiting the food source available to an already infringed upon species [7, 4].

Finally, habitat degradation has been shown to significantly affect bee populations. It goes without saying that taking wild or otherwise unadulterated land and repurposing it for any reason disrupts the ecosystems within it. As development of land for domestic and agricultural uses continues, bees see their food and nesting sources disappearing [3]. Developing land is also usually indicative of other modern practices, namely, for the purposes of this essay, pesticide use in agricultural and urban settings alike. The USDA cites a 2006 *Science* article that outlines "what appears to be a major decline in bees in England and The Netherlands (possibly a 30% loss in species richness since 1980), especially among specialist bees, and a corollary decline in wild plant species that require insect-pollination" [6]. Likewise, Costa Rica saw a decline from seventy to thirty-seven species within degraded forests in a fourteen-year span [4]. Such degradation, as we've seen over the years, lends itself to a vicious cycle and one that we see very clearly in our relationship to bees. With the degradation of a natural habitat, the pollinators unsurprisingly struggling to survive; with fewer species of bees our reliance on those remaining intensifies (a dangerous dependence, as we saw with California); with fewer pollinators, the flowering plants that depend of them for reproduction struggle, and in turn further diminish the bees' habitat.

However, there are a number of potential solutions both on the small- and large-scale that help to combat the atrophy we're seeing with bee populations today. On the personal level, planting native and flowering flora in public or personal gardens helps to supply bees with a more plentiful ecosystem and more resources [8, 9]. What's more, seeding plants that flower at various times throughout the year can provide a more consistent food and nesting source for bees [8]. Limiting one's own use of or support of institutions that utilize pesticides is another method of exerting individual influence on a large-scale system. Similarly, espousal of pollinator-friendly practices in everyday interactions or in writing to local government is not to be discredited. These are relatively low-cost methods to combat wild bee degradation, but they, as such, are limited in efficiency unless done on a large-scale.

Other methods of fighting the breakdown of naturally occurring bee pollination exist on a larger-scale. Notably among them, a 2000 study that revealed not only the decrease in naturally occurring pollination on "conventional" farms, but an increase seen in organic farms placed near areas of bees' natural habitats [1]. The experiment, taking place in Central Valley, California (an area visited approximately thirty-nine native and honeybee species from around the area) and using watermelon (which requires heavy pollination) studied farms near (N, containing

approximately thirty-percent of a natural habitat within a one kilometer radius) and far (F, approximately one-percent) from bees' natural habitats, and organic (O, in compliance with the California Organic Foods Act) as well as conventional (C ,using three pesticides of moderate to high toxicity to bees) farms. The farm sets studied were as follows: organic near (ON), organic far (OF), and conventional far (CF). No cases of conventional near were studied. However, the study presents some incredibly significant data: the 2001 data yielded that all ON watermelon farms could be pollinated proficiently without need of managed hives, while only half of OF farms had such success and no CF farms could provide sufficient pollination without externally managed sources, suggesting that high-maintenance, "conventional" farming methods actively discourage pollination and that the separation of bees from a natural habitat negatively affects their ability to pollinate [see Appendix] [1]. What's more, even with the non-managed honeybee's presence, the data in no way supports a decline in population or diversity of the bees, meaning that the species weren't actively competing with one another.

Evidence such as this stresses not only the inefficiency of the large-scale, pesticide employing, far-removed farms currently in use, but also the relative ease with which a transition could be made. The initial cost of shifting to such a method, though, may remain daunting in the minds of those farmers unwilling to let go of their impractical methods, but costs can be diverted in a number of ways. Within the United States specifically, "restoration costs might be partially defrayed through the Conservation Reserve Program" or similar government or private institutions [1]. What's more, an estimate provided by the aforementioned study suggests that by reducing honeybee rentals fifteen to fifty percent could save farmers a collective $30.1 million in money to be lent to or help recoup the immediate costs of the transfer.

While incentives are a natural part of reasoning, though, the fact remains: our bees are in trouble. With the introduction of aggressive "killer bees," our unwillingness to let go of pesticides, and our continued degradation of natural land, we shouldn't be surprised that the population and species variety of wild bees is decreasing. Luckily, there are still things we can do to reverse or at least preserve bees before they go completely extinct. Because without our native pollinators, we have no plants, no animals, no life.

Appendix

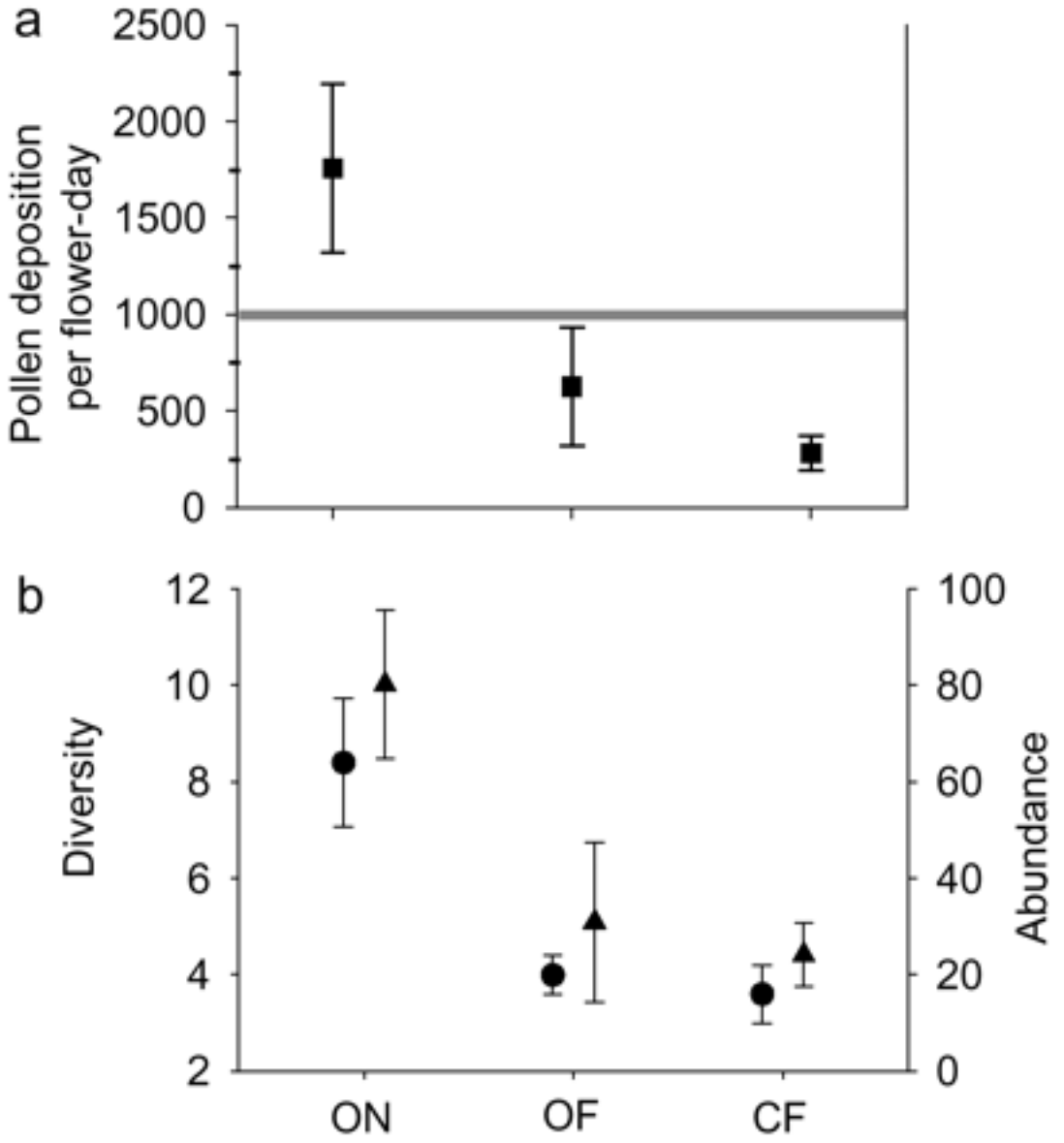

Figure (a) shows the minimum pollination required for the watermelon of the study, and pollen deposition along the y-axis and the farms on the x. The ON farm's range placed well above minimal pollination, the peak of the OF farm's coming to a producible point, and the CF farm's too low for production. Figure (b) shows special diversity as a circle, with visitation abundance as a circle. Figures taken from the 2001 study [1].

Bibliography

1. Proceedings of the National Academy of Sciences of the United States of America "Crop pollination from native bees at risk from agricultural intensification" Page http://www.pnas.org/content/99/26/16812.full.pdf+html Accessed March 4, 2012

2. United States Fish and Wildlife Service "About Pollinators" Page, http://www.fws.gov/pollinators/PollinatorPages/AboutPollinators.html Accessed March 4, 2012

3. Ecological Society of America "Pollination Fact Sheet: Revealing secrets about the birds and the bees" Page, http://www.esa.org/ecoservices/comm/body.comm.fact.poll.html Accessed March 4, 2012

4. Pest Management at the Crossroads "Our Forgotten Pollinators: Protecting the Birds and Bees" Page, http://www.pmac.net/birdbee.htm Accessed March 4, 2012

5. Wikipedia "Africanized Bee" Page, http://en.wikipedia.org/wiki/Africanized_bee Accessed March 4, 2012

6. United States Department of Agriculture "Agricultural Research Service" Page, http://www.ars.usda.gov/Research/docs.htm?docid=18398 Accessed March 4, 2012

7. Beyond Pesticides "Pollinators Program" Page, "Pollinators and Pesticides" PDF Brochure, http://www.beyondpesticides.org/pollinators/ Accessed March 4, 2012

8. King County, Washington "Pollinators" Page, http://www.kingcounty.gov/environment/animalsAndPlants/biodiversity/defining-biodiversity/species-of-interest/pollinators.aspx Accessed March 1, 2012

9. Pollinator Partnership "Pollinator Friendly Planting Guide" Page http://www.pollinator.org/guides.htm Accessed March 4, 2012