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# Apicentrism in City Parks: Cultivating Honey Bee Prosperity in the Face of Colony Collapse Disorder

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*Abstract*

One of the most pertinent ecological crises of the 2010s is the frightening ambiguity of colony collapse disorder. As honey bee populations continue to be decimated in unprecedented numbers, this epidemic will exert profound effects on human populations both ecologically and economically. This thesis explores the epidemic using quantifiable and ecological information about the honey bee and pesticides. From this base, this thesis then explores pesticide use in New York City Parks in relation to the disorder. Finally, the thesis challenges readers to adopt a political and philosophical shift towards an environmental ethic that will take better care of the planet. Chapter 1 draws data from the Bee Informed Partnership on losses in the bee populations in the state of New York and the United States to discuss the severity of colony collapse disorder. Chemical pesticides and macroparasites are investigated that cause the epidemic at hand. In Chapter 2, the honey bee's ecological niche and social are explored in depth and placed in relation with the epidemic. The second part of this paper draws on the social sciences to explore the solutions necessary while combating the anthropocentric practices that bred the epidemic in the first place. In Chapter 3, this thesis explores the economic dimensions of colony collapse disorder. This thesis challenges economic thinking to encapsulate a holistic measurement of all ecosystem services provided by the honeybee and shift beyond the anthroposphere. The thesis then explores municipal and federal environmental law to define barriers to making public parks more bee-friendly in Chapter 4. The final chapter seeks to derive the lessons learned from colony collapse disorder. The case is made for a biocentric shift towards policies and strategies to make public urban spaces more friendly towards honey bees and conducive towards their success.

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*Introduction - An Indeterminate Crisis*

The North American beehive is, to the unquestioning eye, a banal and quotidian sight. One may see a hectic collective of productivity, a source of delicious honey, or even a wretched hive of pests. However, the relationship between *Homo sapiens* and *Apis mellifera* is more deeply intricate, profound, perennial, and mutualistic than that of any other mammal and insect. Human beings' current state of development would be impossible without the massive amounts of benefits with which honey bees provide their surrounding ecosystems.

When one looks at early human development across disparate continents, a striking consistency becomes apparent. On the European, African, and Asian continents, early records have been found in the form of cave paintings that show early humans interacting with early hives of honey bees. Even though there is no singular trajectory of human development on Earth, the influence of honey bees on early human beings has been uncovered with remarkable consistency. The histories of *Homo sapiens* and members of the *Apis* genus have consistently shaped one another in disparate anthro-entomologic histories on a global scale. Organized beekeeping can be dated far back to Levantine Antiquity. In a history of apiculture throughout the Middle Ages, Gene Kritsky documents that "several tantalizing discoveries suggest that people from the Levant region of the eastern Mediterranean have been continually collecting honey and beeswax for nearly 9,000 years. Three thousand years after this time of the earliest evidence of interaction between humans and bees, the practice had spread northward to the United Kingdom and Scandinavia and south to North Africa."[1] In the region that has been described as the breadbasket of human civilization, honey bees were present and already providing humans with livelihood.

[1] Gene Kritsky, "Beekeeping from Antiquity Through the Middle Ages", *Annual Review Of Entomology* 62, (2017), 250.

Beyond mere sustenance, honey was surrounded by an air of cultural mysticism. Rich, golden, viscous, and imperishable, honey was viewed as a divine substance with splendid and otherworldly qualities. On the unique nature of honey to early humans, Rachel D. Carlson observes that "before the discovery of sugar cane, its sweetness was comparable only to that of the date. But unlike the date, honey does not decay or rot and has antiseptic properties. It was used in recipes, as medicine, in religious practices, and as an offering throughout the Mediterranean world, and given the countless uses of the substance, it is not surprising the lengths to which early humans would go to obtain small amounts of honey, even before the development of apiculture."[2] Honey existed at a point of unison between evolving medicine, culinary science, and religious tradition. The fact that a single substance could fulfill such a diverse array of functions mystified early human beings. Early humans became infatuated with honey. Honey became treasured for its taste, its health benefits, its healing properties, and its spiritual aspects.

Remarkably, the ecological gifts of the honey bee extend greatly beyond the mere consumptive value of honey. In addition to the consumption and use of honey, humans have also been blessed with the gift of pollination by this keystone species. On the mutualistic relationship between humans and honeybees by which humanity receives its agricultural gifts, Rachel Carson wrote that "man is more dependent on these wild pollinators than he usually realizes… without insect pollination, most of the soil-holding and soil-enriching plants of uncultivated areas would die out, with far-reaching consequences to the ecology of the whole region. Many herbs, shrubs, trees of forests and range depend on native insects for their reproduction; without these plants

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[2] Rachel D. Carlson, "The Honey Bee and Apian Imagery in Classical Literature", (University of Washington, 2015), 1

many wild animals and range stock would find little food."[3] Honey bees are actually responsible for serving as a great mover in ecosystems. Its pollination enables plants to reproduce far more efficiently, and provide food for consumers higher up on the food chain.

It is not uncommon to see humans across the world managing domesticated bee colonies. Without a scrutinizing glance, one can easily assume that the human is assuming the role of the caretaker. Would the hive not be doomed to perish, if it weren't for this benevolent steward? Interestingly enough, the actual dynamic of care is quite the opposite. The myriad ecosystem services the honey bee provides benefit not only the human, but the entire surrounding biotic community. The ecological role that the honey bee fulfils acts to reinforce and strengthen the ecosystems in which it is present. Not only do these pollinators provide humans with myriad ecosystem services, but the entire biotic communities in the honey bees' shared ecosystems as well.

Unfortunately, human beings have not always acted as responsible environmental stewards towards the honey bee. As much as the honey bees have provided for humans, humans repay the favor by being at best ineffective and at worst enabling the crisis of colony collapse disorder. Not only is colony collapse disorder is an unprecedented impending ecological disaster for *Apis mellifera*, it threatens the very stability of the biosphere. Humanity's species name, *Homo sapiens*, is Latin for "wise man". Regarding environmental decision making, humanity must once again prove that this nomenclature is insightful and not ironic. Humans must answer this call to action and mitigate their harmful actions towards the honey bee. This ecological crossroads holds a high ideological significance - if humanity fails the honey bee, it can be said without hyperbole that humanity is failing the entire biosphere. Further damage to honey bee

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[3] Rachel Carson. *Silent Spring* (New York: Houghton Mifflin, 1962), 73.

populations will result in extremely dire consequences that will irreversibly scar the face of the Earth as it is known today.

*Chapter 1 - Colony Collapse Disorder Quantified*

In order to begin the foray into the solutions to combat colony collapse disorder, this dilemma must be quantified. In the mid 2000s, colony collapse disorder began to present itself. The North American populations of honeybees were beginning to die off in rapid and unprecedented numbers. Rowan Jacobsen documents this alarming mass die-off as "A mysterious syndrome [that] began wiping out honey bee colonies from coast to coast. The number of hives, which had been at 6 million during World War II, and 2.6 million in 2005, fell below 2 million for the first time in memory. Soon the syndrome had a name as vague as its cause: colony collapse disorder."[4]

As the epidemic continued to grow, apiculturists' beehives soon became mass graves for the failed colonies. Just what could be causing these indiscriminate mass die-offs of honey bee populations? The initial ambiguous cause sent both scientists and the general public into a panic. Scientists across the United States have been initially baffled by the crisis, since no single environmental problem could be initially deduced as the apparent driving cause. Scientists have investigated myriad causes, including but not limited to habitat destruction, biodiversity loss of various nourishing plants, infection from the Varroa mite *Varroa destructor*, the spread of viruses and other pathogens through globalization of the pollination services market, an over-reliance on harmful pesticides, and the inability of monoculture to sustain biodiversity.

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[4] Rowan Jacobsen, *Fruitless Fall : The Collapse of the Honey Bee and the Coming Agricultural Crisis* (London: Bloomsbury Publishing, 2008), 16.

Due to the keystone role of *Apis mellifera* in providing the North American landscape with pollination regulation services, the full wrath of colony collapse disorder would be utterly catastrophic on North American agriculture and biodiversity. "In the United States, the industrious European honey bee pollinates most flower species and nearly 100 [different] commercially grown crops that are vital to U.S. agriculture, including up to one-third of U.S. fruit, nut, and vegetable crops."[5] Loss of the honey bee would inevitably lead to massive food shortages and insecurity.

As various efforts have been undergone to ascertain and centralize data on dying bee population, a disturbing trend has made itself apparent in the spikes of deaths of honey bee apiaries. Annual surveys of American apiarists performed by the Bee Informed Partnership, Inc. report figures of annual loss of honey bee colonies that consistently surpass projected winter figures of acceptable loss. Apiaries of *Apis mellifera* have been dying at an accelerated rate since

[5] G. Tyler Miller and Scott E. Spoolman, *Living in the Environment,* 17th ed. (Belmont, CA: Brooks/Cole, 2012.) 204.

2006 as depicted below in Figure 1.

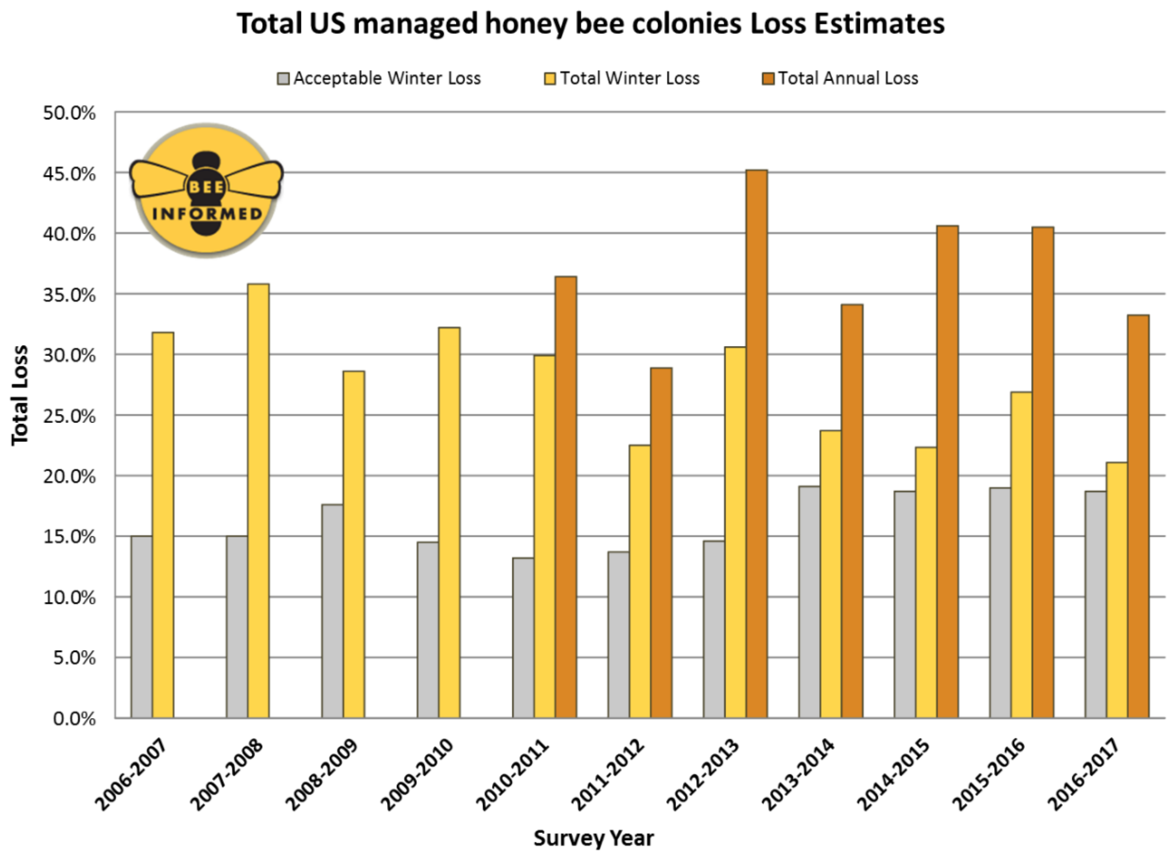


*Figure 1: Total US managed honey bee colonies Loss Estimates. Source: Bee Informed Partnership, 2006-2017.*

Figure 1 provides quantification of the aggregate bee losses since the 2006-2007 Bee Informed Partnership survey year in the United States. The time span of “Winter” that the yellow bars represent is the period of time from October 1st to April 1st. The values for total annual loss represented by the orange bars are the sum of annual summer loss paired with annual winter loss. The acceptable winter loss rate represented by the grey bars is an average of all the percentages of acceptable winter losses declared by each beekeeper. The good news the data is conveying is that the percentage of annual loss is decelerating. Approximately 21.1% of American managed apiaries were lost over the 2016-2017 winter.[6] This is a noted improvement of 5.8 percentage points over the 2015-2016 winter.[7] In addition, the figure for the 2016-2017 winter also falls below the 10-year average of 28.4%.[8] The combination of the winter loss figures with those lost during a summer period of April 1st, 2016 to September 1st, 2016 result in the figure of total bee loss of 33.2% of American colonies.[9] While the 2016-2017 period registered the second lowest rate of total annual loss in seven years, this aggregate data does not necessarily present American apiaries with a clean bill of health. The 2016-2017 period leaves the summer loss period at 12.1% and offers much less insight as to why the colonies are failing during a more favorable ecological and meteorological time period.

An important note in this discussion is that colony collapse disorder is certainly not relegated to New York state. Even though this thesis will focus on initial protocol in New York City, it is insufficient to speak about colony collapse disorder as if it is a localized problem. New York is a mere part of the country within which the terrible effects of colony collapse disorder are being documented. The entire United States has documented varying levels of decline in *Apis mellifera* populations. One can see in Figure 2 the average winter colony loss across the United States, courtesy of the Bee Informed Partnership.

[6] Bee Informed Partnership. "National Honey Bee Survey State Report; Report for year: 2016 and state: New York."
[7] Ibid.
[8] Ibid.
[9] Ibid.

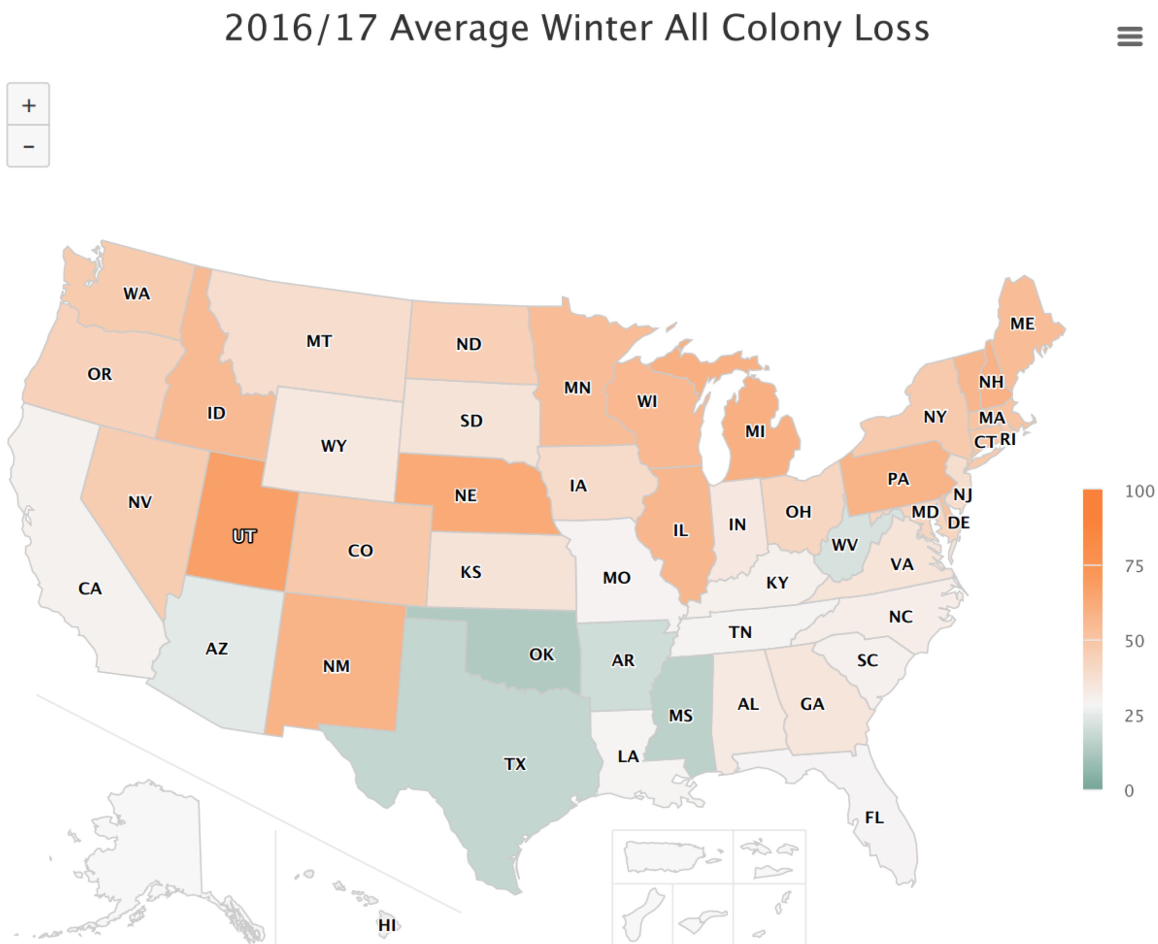


*Figure 2, 2016-2017 Average Winter All Colony Loss: Bee Informed Partnership, 2006-2018.*

While the New York average winter loss percentage of 47.2% sounds horrific, this number is hardly even the highest average loss in the United States. New York is not even in the top 10 highest average winter losses. Accounting for the average winter loss in the United States in 2016-2017, apiarists reported an aggregate average winter loss of 40.4% of honey bee colonies.[10] This figure incorporates data from 46 continental states, including one category for

[10] Bee Informed Partnership. "National Management Survey."

the District of Columbia and one for inter-state apiaries.[11] This data asserts that losing just under half of one's apiaries is disturbingly unexceptional.

When quantified on a national scale, the problem of colony collapse disorder becomes all the more confusing and alarming. What in the United States could be causing such a uniform and unprecedented die-off of honeybee populations? This species is not only known as staple of the American landscape, also for its meticulous methodology in the art of survival. All signs are beginning to point to the exponentially increasing usage of pesticides in the United States. On the dramatically increased prevalence of pesticides in the American landscape, Rachel Carson observes that "in the less than two decades of their use, the synthetic pesticides have been so thoroughly distributed throughout the animate and inanimate world that they occur virtually everywhere. They have been recovered from most of the major river systems and even from streams of groundwater flowing unseen through the earth."[12] Carson's gloomy state of contemporary ecological affairs points to the dangers of the bioaccumulation of pesticides in American ecosystems. These pesticides are the result of an increasingly industrialized agriculture. In order to understand why colony collapse disorder is ravaging the United States, one must investigate the plethora of pesticides that are present in the American landscape.

The *Millennium Ecosystem Assessment* asserts that a connection is to be made between the loss of pollinators, the prominence of pesticides, and habitat loss. "Although there is no assessment at the continental level, documented declines in more-restricted geographical areas include [...] bumblebees in Britain and Germany, honeybees in the United States and some European countries, and butterflies in Europe. The causes of these declines are multiple, but

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[11] Ibid.
[12] Rachel Carson. *Silent Spring*, 17.

habitat destruction and the use of pesticide are especially important."[13] Figure 3 from the Bee Informed Partnership measures New York State levels of pesticides compared with national levels.

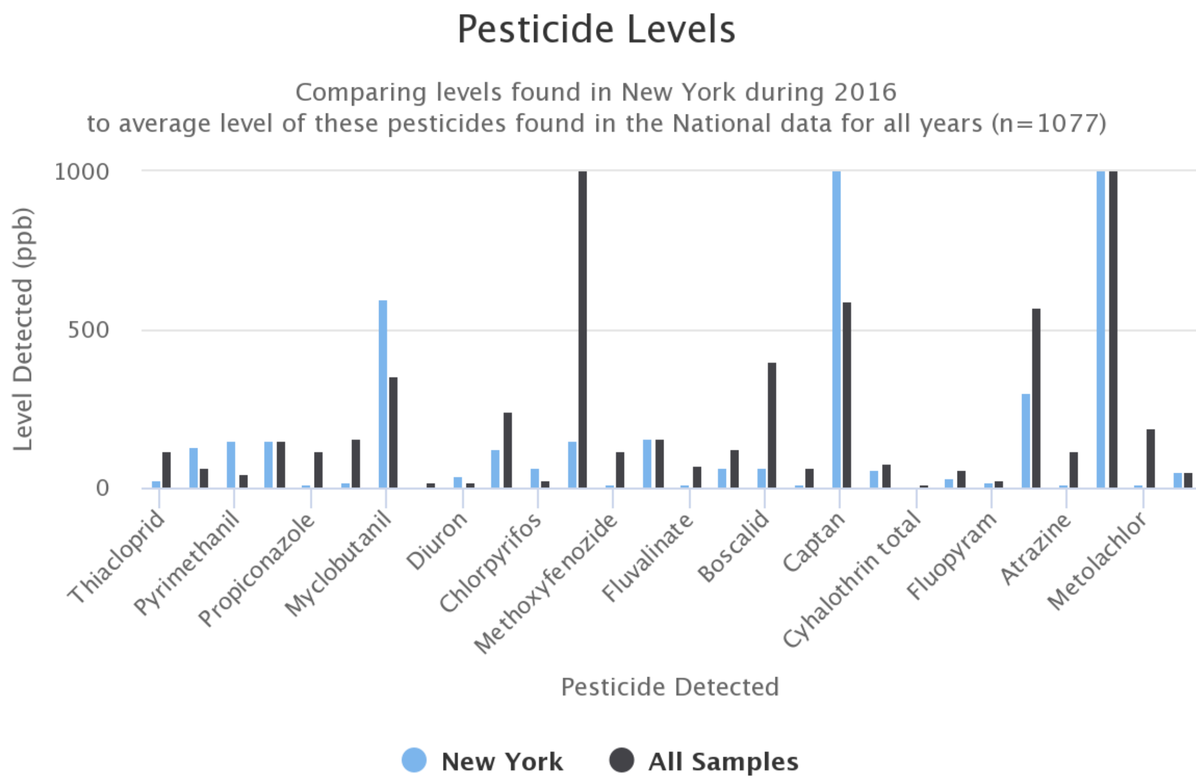


*Figure 3, Pesticide Levels in 2016. Source: Bee Informed Partnership, 2006-2017.*

The pesticides of the highest levels in New York during 2016 were myclobutanil, captan, and THPI. All of these pesticides have been known for having adverse effects on *Apis mellifera* life and ecosystems. Myclobutanil is a common fungicide. In an entomological study performed in 2016 at the University of Illinois at Urbana-Champaign, researchers found that *Apis mellifera* that had consumed triazole myclobutanil and quercetin metabolized far less thoracic ATP, which

[13] United Nations, "Ecosystem Services and Human Well-Being - Biodiversity Synthesis," In *Millennium Ecosystem Assessment* (Washington, D.C.: World Resources Institute, 2005), 25-29.

is the key source of energy for honeybee flight.[14] Compromised flight is a very dire matter for the honey bee, as it impairs their abilities to feed themselves as well as the hive. Captan is a fungicide known to contaminate and bioaccumulate within beehive structures. A study undertaken by the University of California Entomology department confirmed that not only does Captan accumulate and infect hive structures, but also inhibits larval and pupal developments in even minute amounts.[15] THPI, short for tetrahydrophthalimide, is a substance that degrades from Captan. THPI is indicated in the third pair of bars from the right between atrazine and metolachlor.  Like its parent substance, THPI is also capable of bioaccumulating in hives upon being transmitted using pollen as a conduit. Certainly, the negative impacts of pesticides are not merely relegated to the three aforementioned compounds. This is a mere cross-section of the debilitating effects pesticides can have on honey bee growth and development.

In the ecological dilemma of colony collapse disorder, scientists and apiarists are known to cast both attention and blame to *Varroa destructor,* one of the most immediate sources of harm inflicted upon bees. *Varroa destructor*, commonly known as the Varroa mite, is a parasite that feeds by latching on to the body of the honeybee and leeching its bodily fluids. Infection of Varroa mites have been known to have many both immediate and chronic harmful physical effects on honeybees, including significant weight loss in drones and an increase of susceptibility to infection.[16]

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[14] Mao Wenfu, Mary A. Schuler, and May R. Berenbaum, "Disruption of quercetin metabolism by fungicide affects energy production in honey bees (Apis mellifera)." *Proceedings Of The National Academy Of Sciences Of The United States Of America* 114, no. 10, (2017), 2538

[15] Eric Mussen, Julio E. Lopez, and Christine Y.S. Peng, "Effects of Selected Fungicides on Growth and Development of Larval Honey Bees, Apis mellifera L. (Hymenoptera: Apidae).", *Environmental Entomology*. 33, (2004), 1151-1154.

[16] P. Duay, D. De Jong, and W. Engels, "Weight loss in drone pupae (*Apis mellifera*) multiply infested by *Varroa destructor* mites", *Apidologie* 34, (2003), 61–65.

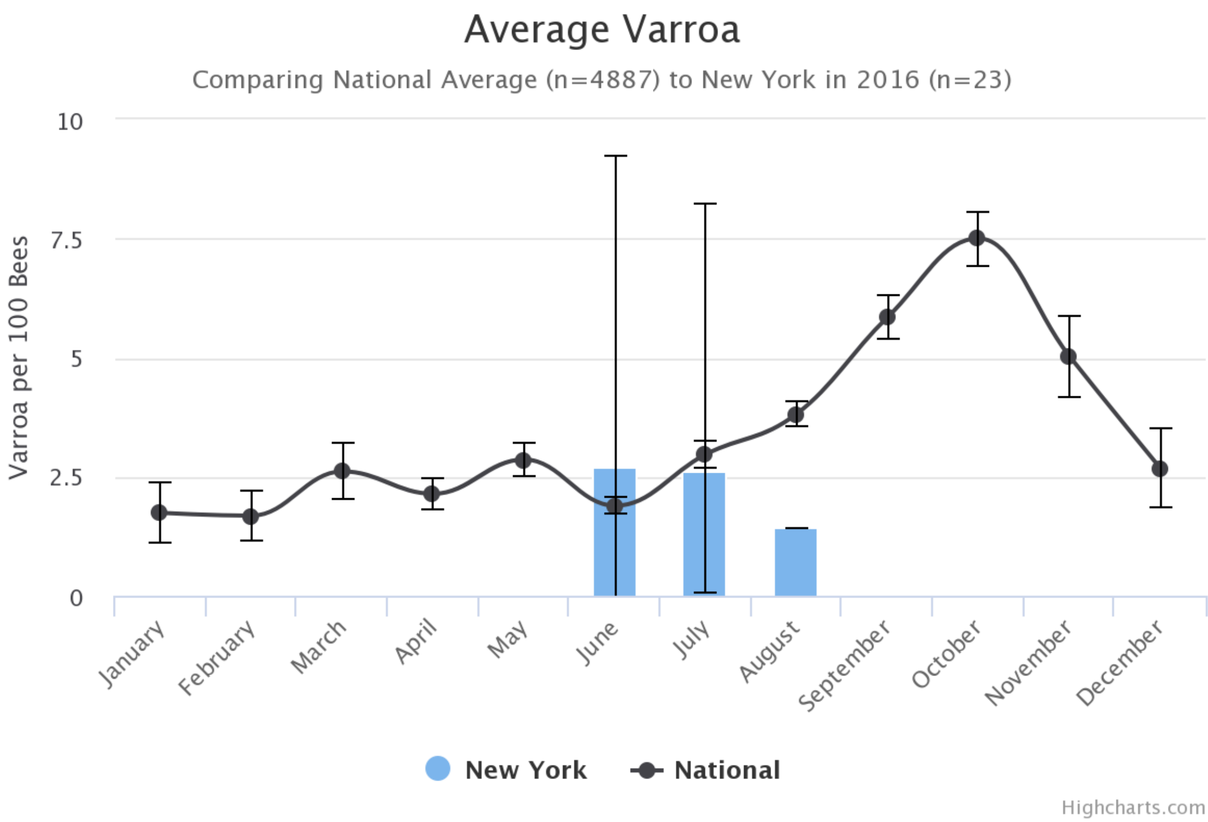


*Figure 4, Average Varroa in 2016. Source: Bee Informed Partnership, 2006-2017*

The blue bars in Figure 4 represent the average number of Varroa mites taken from a sample of 23 apiaries. The error bars reflect a 95% confidence interval that the true figure of the sample falls between the extremes. In many ways, this data is not especially compelling as proof of the Varroa mite's disastrous effects. Such a small sample size and such a large confidence interval makes this data too uncertain and runs the risk of extensively extrapolating a very limited data set. Though it would certainly be foolish to assert that the Varroa mite does not have an impact on honeybee populations, the impact of *Varroa destructor* on honeybee populations pales in comparison to that of pesticides.

What further complicates the presence of the Varroa mite is the heightened threat levels that apiculturists perceive. Figure 5 shows the composite samples of pesticides found in the Bee Informed Partnership's annual apiary survey. This figure shows the percentage of pesticide categories for both 2016 and the aggregate data since the Bee Informed Partnership began documenting this data in 2016. The *n* variable represent the number of different forms of pesticides detected within the number of apiaries. In the year 2016, the Bee Informed Partnership found 384 different Varroacides contained within 272 different apiaries. This averages to more than one unique Varroacide discovered within each sampled apiary. The Varroacides make up a substantial portion of all pesticides found within the sampled apiaries. Approximately 2 in every 5 pesticides found within samples were Varroacides.

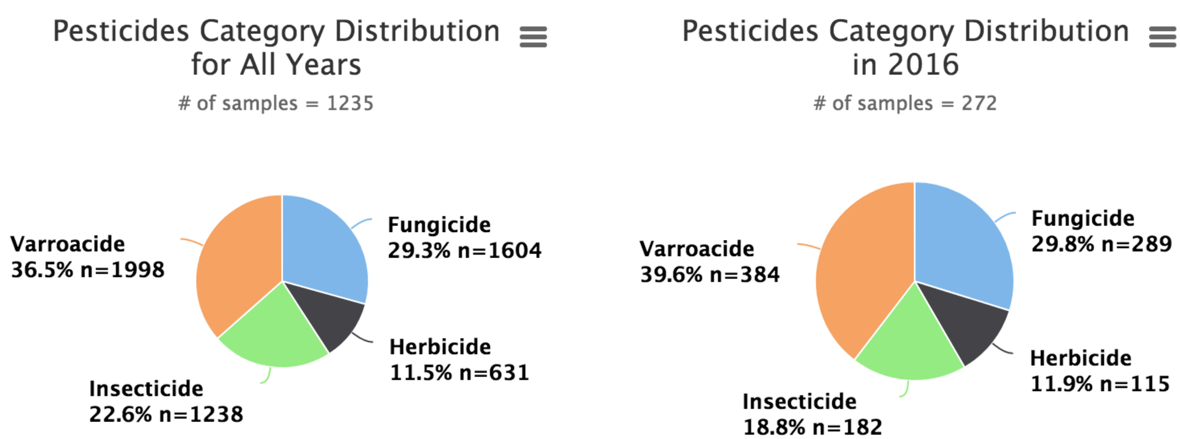


*Figure 5, Pesticide Use Distribution for 2016 and All Survey Years. Source: Bee Informed Partnership, 2006-2017.*

The high presence of Varroacides represent a logical response from beekeepers. Scientists have demonstrated the tangible parasitism of *Varroa destructor* present in beehives. As a result of the sensationalized fear of the Varroa mite, apiarists are eager to prevent this mite's infection by any means necessary. However, increased chemical intervention cannot be an acceptable response. Unlike other forms of pesticides which are more concerned with the surrounding environment, Varroacides are directly intended to be applied to honey bees. Instead of acting as a grand eliminator, Varroacides have actually been documented as forces of natural selection to which *Varroa destructor* adapts. By subjecting apiaries to relentless pesticide application, apiculturists are simply exacerbating an intermediate problem in attempting to eliminate an introductory one. While the presence of the Varroa mite poses a great threat to honey bee populations, chemical intervention with pesticides is an even greater threat to biodiversity.

The prominence of these pesticides in the New York state environment is a significant cause for concern. What makes these pesticides so dangerous to bees is their ability to infect, spread, and bioaccumulate within beehives. Because of the beehive's intricate social structure, *Apis mellifera* is highly vulnerable to infection by chemical pesticides. The social life of the bee is structured around the hive as its cornerstone. The infection matrix within the hive is profoundly amplified due to the bee's ecological niche and behavior. As a result of the honey bee's high risk to spreading pesticides, the issue of colony collapse disorder is further exacerbated.

## *Chapter 2 - Contextualizing the Honey Bee's Niche and Behavior*

When investigating the dilemma of colony collapse disorder, it is of the utmost importance to understand the ecological and social role the honey bee plays to illuminate why colony collapse disorder has reached such an alarming level. There are many major attributes of the honey bee's behavior that have unfortunately enabled the epidemic of colony collapse disorder. As a result of the bee's highly social and industrious existence, it further exacerbates the issue of pesticide contamination.

The most prominent attribute of the nature of *Apis mellifera* that factors into the creature's survival and well-being lies in the profoundly collective and cooperative nature of the beehive. The bees' actions are not only done to ensure the survival of the individual, but to also promote the well-being of the collective. Many of the bees' behaviors and practices serve complex social functions in addition to pragmatic survival. On bees' tendency to share food with one another within the hive, Ronald Ribbans remarks the role of food transmission as one that "helps the community to feed itself, to organize itself, and to defend itself, and we know that the special diet provided for queens, drones, and larvae helps the community to reproduce itself."[17] Social activity of bees is not only a cornerstone of their survival, but the very fabric in which their entire existence is based upon. It is through the collective network of the beehive that the honeybee has ensured its survival, existing within a living arrangement in which the well-being of the whole is valued as much as the well-being of the individual organisms.

On the nurturing cradle of the collective hive, Eugéne Evrard remarks that "the Bee does not live alone; even though she dies almost at once if parted from her fellows: she is one of the innumerable cells of an organised body."[18] In his observation, Evrard forges a bold claim that enters into a productive ideological framework of the bee colony as a superorganism. The superorganism is best imagined as a systematized conduit for the transmission of genetic material to ensure the proliferation of the species. The superorganism of the colony is used to optimize the colony's health through collective decision making and the division of specialized labor.[19] In the metaphor Evrard uses of the bee as a single cell within the collective that makes up a much greater body, the concept of the superorganism is evident. Even though the bees are technically capable of being autonomous and self-sufficient creatures, their potential for survival is exponentially magnified through the organization of the systematized colony.

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[17] Ronald Ribbands, *The Behavior and Social Life of Honeybees* (Norwich: Jarrold and Sons Limited, 1953), 194.
[18] Eugéne Evrard, *The Mystery of the Hive,* translated by Bernard Miall, (New York: Dodd, Mead and Company, 1923), 30.
[19]Jürgen Tautz, Helga R. Heilmann, and David C. Sandeman, *The buzz about bees : biology of a superorganism* (n.p.: Berlin : Springer, 2008).

Unfortunately, one of the consequences of this constant close proximity with all the members of the hive is the magnification of the infection matrix. The bees exist in extremely close collective contact for many tasks, including sharing food, swarming to start a new colony, nursing worker, drone, and queen larvae, and even simply taking up space within the hive. The great deal of physical contact through quotidian tasks leaves the honey bee privy to infection by a multiplicity of pesticides, viruses, and parasites.

In addition to the supreme density of the beehive, what also makes it vulnerable to infection is its function as an accumulative space for pollen. Whereas the immensely social structure of the inner hive leaves honey bees vulnerable to infection via internal factors, their industriousness and high coverage of external surface area makes the bee colony vulnerable to infection via external factors. In relation to the bee's reputation of a highly social creature as a part of a much greater collective hive, the bee also occupies a position as a figure of tireless industriousness and productivity. In writing on the near mechanized level of honeybee efficiency, Thomas D. Seeley frames the colony as "a machine which is designed to extract energy and other resources from the environment. By this view the individual foragers within a colony are simply component parts shaped to contribute in a small way to the larger goal of efficient foraging by a whole colony."[20] Since the bee's work entails a wide scale collection of pollen within the vicinity of the hive, a proportionately large surface area is covered in the bee's quotidian duties. Seeley calculates an average flight distance of 4.5 km per trip and the collection of 20 mg of pollen requiring approximately 1.3 million trips out of the hive.[21]

It is without a doubt that the bee is a highly industrious creature that has structured its entire survival around amassing the greatest amount of external food resources. What is even

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[20] Thomas D. Seeley, *Honeybee Ecology: An Adaptation in Social Life*, (Princeton: Princeton University Press, 1985), 80.
[21] Ibid., 83.

more significant is the blurred distinction between the life inside of the hive and the life outside. The location of the beehive is by no means permanent. In fact, the honey bee is constantly scouting for new locations of the hive as the populations are in transitory periods. On the great swarm exodus, Maurice Maeterlinck describes the process as a ritual performed by only the most healthy colonies that have grown beyond the physical constraints of the hive. “In obedience to the order of the spirit [...] 60,000 or 70,000 bees out of the 80,000 or 90,000 that form the whole population will abandon the maternal city at the prescribed hour. They will not leave at a moment of despair; or desert, with sudden and wild resolve, a home laid waste by famine, disease, or war. No, the exile has long been planned, and the favourable hour patiently awaited. Were the hive poor, had it suffered from pillage or storm, had misfortune befallen the royal family, the bees would not forsake it. They leave it only when it has attained the apogee of its prosperity.”[22] The practice of swarming is in actuality done once the enterprise of the hive cannot be contained by the physical constraints of the hive. For a hive to undergo this mass migration, it is actually an indicator of a hive’s good health. From this point of an exceptionally successful hive, the swarming process is undergone.

The honey bee’s migratory process from a mother nest to a daughter nest is noted for its high level of sophistication. Thomas D. Seeley documents the planning process of the hive’s exodus. “The start [of the swarming process] comes when a few hundred of a colony’s oldest bees cease collecting food and turn instead to scouting for new living quarters. This requires a radical switch in behavior. No longer do these bees probe bright-colored, sweet-scented sources of nectar and pollen; instead they investigate dark places [...] always seeking a small cave suitable for enclosing a honeybee nest. Upon discovering such a site, a scout spends nearly an

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[22] Maurice Maeterlinck, *The Swarm*, (New York: Dodd, Mead, and Company, 1906) 12-13.

hour examining it closely."[23] These converted scout bees scrutinize a great area around the entire hive, seeking to leave no stone unturned in the hunt for a new hive location. This process incentivizes the bees to be as meticulous and thorough in their surface area covered as possible. Another dimension of infection by pesticides is once again added; the scout bees not only subject themselves to the poisons of these surrounding environments, but also carry these poisons back with them to which they unknowingly expose the hive. Even if the other bees in the hive are not directly exposed to the chemicals of their surrounding environment, the dense and interactive nature of the beehive presents a formidable infection matrix.

The honey bee's instincts have evolved to develop a high propensity for efficiency in regards to pollen collection. However, this insatiable hunger has harmed the bee in its indiscriminate scope of pollen collection. On the bee's perpetual appetite, Evrard remarks on how "the mad thirst for honey, the intoxication which the fragrance emanating from it seems to provoke, the fever which it excites, deprive the Bee, so intelligent and circumspect, of much of her native prudence. It is not an unusual thing for a poisonous honey to kill her: yet she eagerly goes in search of it, and without the slightest hesitation."[24] Regarding the voraciousness of the honey bee's appetite, one of the fatal flaws of the honey bee surfaces. In the bees' massive collection of pollen and pursuit of honey, they lack the capacity to detect poisoned or infected nourishment - in the context of colony collapse disorder, particularly with respect to pesticides. Since the bee is incentivized to collect great amounts of pollen with great vitesse, they have no reason or capability to discriminate against tainted pollen. In their quest for accumulation, this renders the bee all too likely to pick up undesirable pathogens along the way.

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[23] Thomas D. Seeley, *Honeybee Ecology*, 71.
[24] Eugéne Evrard, *The Mystery of the Hive*, 180.

Even extending beyond pollination, the bees further render themselves vulnerable with the swarming process. As honey bees transfer to a new hive in order to expand their enterprises, their scrutinization requires that they scrutinize a wide surface area. As Evrard has documented, the honey bee is also tragically inept at detecting the presence of poisons. In her ventures outside of the hive, the honey bee continually makes herself vulnerable to the plethora of pesticides one can find dominating the North American agricultural landscape.

The consequences of these undesirable vectors is many. Pesticides have been demonstrated to not only inhibit honey bee health and wellness, but also to bioaccumulate in both the structure of the honeycomb and in the honey itself. In addition to the possibility of infecting the structure of the hive with pesticides, bees are also vulnerable to bringing Varroa mites back into the hive. Varroa mites have particularly been known to wreak havoc on bees in the larval or pupal stages, posing an especially large threat to the hive's ability to reproduce itself and pass along genetic material. Humans can only exacerbate the problem of Varroa mites by using varroacides as a divine hand of natural selection, leaving the hive full of both pesticides and pesticide resistant mites.

As a result of the bee's social behavior and methods of food collection outside of the hive, it has tragically left itself especially vulnerable to the wrath of colony collapse disorder. In addition to the bee being set up for mass death due to its ecological behaviors, mass die-offs of bees will also have a profoundly negative ecological impact on other species. What is being lost is not just the bee species themselves, but also the plethora of ecosystem services, benefits and necessities they provide the ecosystems in which they exist.

## *Chapter 3 - Ecosystem Services and the Need for a Holistic Paradigm*

The decimation of the bee populations by colony collapse disorder is a profoundly catastrophic phenomenon that would have myriad impacts on the plethora of biodiversity on Earth as a whole. Not only would humans be severely compromised in their ability to grow, sell, and consume food, but the greater food web as a whole would be severely hemorrhaged due to the loss of biodiversity. The reach of colony collapse disorder extends much further than the anthroposphere. Because of the effects of colony collapse disorder transcending the anthroposphere, problems arise when purely anthropocentric economic analysis is relegated to the crisis of colony collapse disorder. This approach is inadequate in that it offers a narrow and petty scope reducing the right of honey bees' security to the goods and services they provide to humans. This chapter seeks to argue for the bees' right to exist while taking caution to avoid the moral implications (or in this case, lack thereof) of using an exclusively anthropocentric economic lens to justify the continued existence of *Apis mellifera.* However, it is necessary to begin with the anthropocentric case for combatting colony collapse disorder. Once this basic and more facile framework is understood, the imperative must move to a wider scope than merely the anthrosphere.

In starting from the anthropocentric benefit of honey bees and radiating outward, this trajectory is best illustrated through the four types of ecosystem services. The Millennium Ecosystem Assessment defines ecosystem services as "the benefits people obtain from ecosystems. These include provisioning, regulating, and cultural services that directly affect people and the supporting services needed to maintain other services."[25] These four services often tend to overlap as lines between them are blurred in practice - ecosystems very rarely provide merely one. In regards to these services, the honey bee is truly exceptional in that it

[25] United Nations, "Ecosystem Services and Human Well-Being - General Synthesis," In *Millennium Ecosystem Assessment* (Washington, D.C.: World Resources Institute, 2005), 40.

provides all four services in varying degrees. The initial anthropocentric argument for *Apis mellifera*'s survival is self-evident. Such a versatile and dynamic creature with such a profound role on human development must be treated with the utmost respect and priority in its conservation. It is no exaggeration to say that the face of the Earth would be radically different without the ecosystem services provided by the honey bee.

The most tangible and immediate ecosystem service honey bees provide humans with are provisioning services. Provisioning services are those that impart a direct consumptive benefit to human beings, providing them with an end product. On the nature of provisioning services, Marc Conte describes them as those that are "generally traded in traditional markets, and their enjoyment by society requires concentrated efforts by some members of society (e.g., the time, capital, and labor of farmers to harvest each year's crop). [...] The value of these services comes from their consumptive use."[26] Honey bees' pollination actions result in the creation of a plethora of food products that produce direct human utility and profit.

Records in the form of rock paintings exist showing that humans have harvested bee production of honey for approximately 10,000 years. Eva Crane documents the presence of honey harvesting in European prehistoric artwork. "There has been a suggestion of bee-connected paintings in the palaeolithic art of Altamira in northern Spain, dating possibly from the last major glaciation of the Ice Age (30,000-9,000 B.C.). But mesolithic paintings in eastern Spain certainly show honey-hunting scenes. They have been dated provisionally to the period 8,000 - 2,000 B.C., on the grounds that associated paintings show no animals of the glacial period, that they provide some evidence of primitive agriculture, and that most of the human figures are unclothed, suggesting a climate optimum such as occurred around 6,000 B.C."[27] On

[26] Marc Conte, "Valuing Ecosystem Services," In *Encyclopedia of Biodiversity* 2nd ed., (2013), 2.
[27] Eva Crane, *The Archaeology of Beekeeping*, (Ithaca: Cornell University Press, 1983) 19-21.

records of African beekeeping, Crane notes the richness of the continent's rock paintings. She documents that "more than four thousand rock art sites are known in South Africa and Zimbabwe, and these countries are correspondingly rich in all the bee-associated subjects."[28] Prehistoric artwork has also provided evidence for beekeeping in Asia, specifically on the Indian subcontinent. "Five rock paintings are known, all in central India, and all showing *Apis dorsata* which gives the largest harvests. There are four in the Pachmarhi region - two in Jambudwip Shelter [...] and one each at Sonbhadra and Imlikhoh - and one [...] at Bhimberkah. This last is monolithic; the others are later."[29]

Beyond the products the honey bee actively makes like honey and beeswax, the honey bee's pollination services are one of the strongest driving forces of human agriculture. In a research article on the importance of pollination services to food security, Alexandra-Maria Klein and associates have found that 75% of all crop species depend on pollination services for reproduction either directly or indirectly; in addition, Klein and associates found that pollination services are responsible for supplying 35% of global crop biomass.[30] The impact of regulation services by pollinators spearheaded by *Apis mellifera* is substantial. In addition to the direct economic benefit gifted to human beings by the honey bee, the bees grant more intermediate largesses through their ecological activity.

Regulation services are defined by the Millennium Ecosystem Assessment as "the benefits obtained from the regulation of ecosystem processes."[31] These services are more intermediate by nature, and are less able to be traced to the direct activity of the organism

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[28] Ibid., 24.
[29] Ibid., 27
[30] Alexandra-Maria Klein, et al. "Importance of Pollinators in Changing Landscapes for World Crops.", *Proceedings: Biological Sciences,* no. 1608, (2007), 303-313.
[31] United Nations, "Ecosystem Services and Human Well-Being - General Synthesis," In *Millennium Ecosystem Assessment* (Washington, D.C.: World Resources Institute, 2005), 40.

providing the service. On the necessity of regulating services, S. Jha, L. Burkle, and C. Kremen emphasize that these are "essential for the reproduction of pollinator-dependent plants that supply humans with foods, fiber, forage, biofuels, firewood, timber, and medicine."[32] Not only is the work of pollinators crucial to the propagation of human products, but pollination services are also crucial to promote the welfare of the plants that provide human beings with benefit. It is in this second ecosystem service that the shift away from anthropocentrism begins. Rather than these ecosystem services being defined by that which they provide human beings, regulating services are defined through their capacity to provide state of health and well-being for a multiplicity of organisms that benefit *Homo sapiens.*

Cultural services are defined by the Millennium Ecosystem Assessment as "the nonmaterial benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences."[33] This ecosystem service is notable in that it is just on the cusp of escaping anthropocentric justification. Evolving past the question of functional utility, cultural services stress the ecosystem benefits people receive from the recreational, spiritual, and aesthetic splendor of nature - albeit, insofar as they appeal to human beings. On the cultural services provided by the bee, Frank C. Pellett documents the fundamentally charismatic effect that the bees possess on human beings. "While there are comparatively few who keep bees as a sole source of livelihood, there are many thousands who keep a few colonies for a diversion, as a side line [sic], or for the fun of the thing. Yes, it is safe to say that nearly every really successful beekeeper comes to feel a strong affection for the busy little insects, and to regard his bees as pets. [...] Perhaps some such feeling is essential to the

[32] S. Jha, L. Burkle, and C. Kremen, "Vulnerability of Pollination Ecosystem Services", *Climate Vulnerability,* (2013), 117-128.
[33] United Nations, "Ecosystem Services and Human Well-Being - General Synthesis," In *Millennium Ecosystem Assessment* (Washington, D.C.: World Resources Institute, 2005), 40.

pursuit, and the lack of it many account for the failure of some, who are not lacking in industry or patience, two very essential requirements."[34] In this instance, the primary locus of *Apis mellifera*'s value lies not within its ability to provide the beekeeper with the livelihood, but curiously enough with its ability to provide the beekeeper with amusement and enjoyment. In the last step towards relinquishing the anthropocentric paradigm on the honey bee, this category of ecosystem service places value on the utility generated by the honeybee firmly outside of monetary quantification.

In addition, the aforementioned prehistoric records of ancient beekeeping and harvest provide evidence of something much deeper than mere human reliance on the honey bee. In addition to depictions of honey harvesting practices, these prehistoric paintings provide evidence of humans' utter captivation with the honey bee. Not only was early human development concurrent with their proximity to honey bee populations, early humans across the world alike all exhibited a profound sense of fascination and delight regarding the honey bee. This illustrates evidence of the cultural services with which the honey bee provides the human being. Beyond the chemical nourishment of the honey harvested from these early beehives, the honey bees also provided a creative nourishment to inspire these examples of early cave artwork.

The final ecosystem service is the most holistic and biocentric category. The Millennium Ecosystem Assessment defines supporting services as "those that are necessary for the production of all other ecosystem services. They differ from provisioning, regulating, and cultural services in that their impacts on people are often indirect or occur over a very long time, whereas changes in the other categories have relatively direct and short-term impacts on

[34] Frank C. Pellett, *Lippincott's Farm Manuals: Productive Bee-Keeping*, (Philadelphia: J.B. Lippincott Company, 1916), 1

people."[35] Since supporting services are the most abstract to conceptualize and cannot quite directly materialize, they possess the greatest distance from the anthropocentric worldview. The supporting services also closely resemble the three principles of sustainability - reliance on solar energy, maintenance of biodiversity, and circulation of recycled chemicals. Despite being the most implicit and abstracted ecosystem service, it is arguably the most important with respect to upholding the integrity of the ecosystem. On the importance of these foundational ecosystem services, S. Jha, L. Burkle, and C. Kremen emphasize its holistic integrity. "Biodiversity loss in wild plant communities can have devastating effects on ecosystem services because wild plants are critical for ecosystem processes in both natural and human-altered landscapes. Aside from providing humans with food, medicines, fuel, and construction materials, wild plants also support important processes in agricultural, rural, and urban landscapes, such as pest-predation, nitrogen fixation, erosion control, water filtration and storage, and carbon sequestration."[36] It is in the supporting services that the honey bee's greatest benefit to the biosphere lies. The impact and value of the bee extends far beyond the finite scope and importance of the anthrosphere. It is through the gift of its pollination services that the honey bee is able to maintain the very fabric of the ecosystems in which it exists.

A great danger exists in viewing the dilemma of colony collapse disorder in exclusively anthropocentric economic terms. While *Apis mellifera* is responsible for every category of spoils reaped by *Homo sapiens* from the bounty of nature, it is of the utmost importance to acknowledge that the ecological benefits provided by the honey bee extend much further than mere human utility. One of the fatal flaws of using an exclusively anthropocentric economic analysis of the problem is that the value of life of the bees is merely relegated to the goods and

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[35] United Nations, "Ecosystem Services and Human Well-Being - General Synthesis," In *Millennium Ecosystem Assessment* (Washington, D.C.: World Resources Institute, 2005), 40.
[36] S. Jha, L. Burkle, and C. Kremen, "Vulnerability of Pollination Ecosystem Services", 123.

services with which they provide human beings. Conte woefully illuminates the ultimately anthropocentric analysis that an exclusive focus on a monetary paradigm provides. "Maintaining biodiversity is not typically considered an ecosystem service. Although there is some expectation that a focus on ecosystem services will ensure the continued existence of different species, the shift in focus to ecosystem services from species conservation clearly aims to highlight the value of functioning ecosystems to humanity."[37] The scope of anthropocentric analysis has its limitations, both functionally and morally. While it is easy to quantify the ecosystem services bees provide humans with, this largely limits the picture of the bees' inherent value to what they contribute to the biosphere.

One must also remember the emphatically consumptive relationship humanity possesses with nature. *Homo sapiens* is without a doubt the species possessing the largest impact on the land - his relationship is marked above all with a fundamental concern for manipulating and consuming nature to fit his desires. On the relationship between humanity's labor and its impact on the land, Karl Marx describes labor as "in the first place, a process in which both man and Nature participate, and in which man of his own accord starts, regulates, and controls the material re-actions between himself and Nature. He opposes himself to Nature as one of her own forces, setting in motion arms and legs, head and hands, the natural forces of his body, in order to appropriate Nature's productions in a form adapted to his own wants."[38] Marx places human entrepreneurship at odds with nature; the former is in direct opposition with the latter as the former works by any means necessary to crystalize the latter into a form the human finds the most desirable. Nature, otherwise interpreted as land, is reduced by *Homo sapiens* to a factor of production - nothing more than a mere means to an end.

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[37]Marc Conte, "Valuing Ecosystem Services", 3.
[38] Karl Marx, *Capital* (New York: Appleton & Co., 1909), 156-157

One can also find productive insight into the distinctions Marx makes between the difference between use-value and exchange value. The distinctions Marx makes between the two establishes the difference between pure utility and fiscal value. On use-value, Marx argues that "The utility of a thing makes it a use-value. But this utility is not a thing of air. Being limited by the physical properties of the commodity, it has no existence apart from that commodity. [...] Use-values become a reality only by use or consumption : they also constitute the substance of all wealth, whatever may be the social form of that wealth."[39] The use-value of an object is grounded within its physical form. The value of which it provides is more qualified than quantifiable. Use-value possesses an immediate consideration towards an object's utility, rather than its potential for conversion into capital.

In contrast with his practical definition of use-value, Marx presents his conception of the more abstracted exchange value. "Exchange value, at first sight, presents itself as a quantitative relation, as the proportion in which values in use of one sort are exchanged for those of another sort, a relation constantly changing with time and place. Hence exchange value appears to be something accidental and purely relative, and consequently an intrinsic value, i.e., an exchange value that is inseparably connected with, inherent in commodities, seems a contradiction in terms." [40] In contrast with the inherent use-value, Marx argues that exchange value is something relative, oscillating, and dynamic. The exchange value is constantly defined in relation to something else in a language of commonality. In addition, exchange value is also firmly abstracted from the utility a commodity provides.

One of the most woefully overlooked definitions of value that quantitative economic analysis underrepresents is the existence of non-use value. Paul Mwebaze defines non-use value

[39] Ibid., 2-3
[40] Ibid., 3

as "a value placed on an environmental good and which is unrelated to any actual, planned or possible use of the good."[41] The very existence of non-use value poses a challenge to traditional economic thinking and logic that is not to be overlooked - human beings are capable of being altruistic actors that can enjoy without using or consuming. In lieu of consumer satisfaction derived from consumption, non-use value shows that humans are capable of deriving satisfaction from deliberately and intentionally not exhausting a natural resource.

To think of the ecosystem services that the honey bee provides in terms of exchange value is greatly inhibiting for many reasons. Most importantly, to qualify the honey bee's provisions to the environment in terms of financial value greatly limits consideration to the anthroposphere. The language of commodities does not sufficiently account for the honeybee's profoundly intricate and benevolent impact on life on Earth. In addition, the language of exchange value fails to account for the plethora of positive externalities that the honey bee's existence provides. The ecosystem services provided by the bee tend to have a ripple effect in their exponential expansion of biologic welfare. The language of exchange-value cannot directly capture the health of an body of water, the fertility of the soil, or the effervescence of biodiversity in an ecosystem. Because exchange-value is primarily concerned with a commodity's potential to be exchanged for currency, this paradigm is insufficiently anthropocentric. In addition to exchange-value, even the use-value category presents its shortcomings.

The flaws of a financial qualification of *Apis mellifera*'s right to exist becomes apparent. Even if the language of exchange value were able to qualify the intermediate ecosystem services the honey bee is responsible for, using a fiscal unit of measurement is effectively meaningless.

[41] Paul Mwebaze et. al., "Measuring public perception and preferences for ecosystem services: A case study of bee pollination in the UK.", *Land Use Policy,* no. 71 (2018), 356.

Exchange value seeks to find a common point of translation in between different commodities. Fiscal language is unable to reflect the use value that the honey bee provides to not only human beings, but the rest of the biosphere as well. Over-reliance on the language of exchange value is reflective of the self-serving and opportunistic nature of anthropocentrism. The exploitative attitudes anthropocentrism exerts towards nature are cyclical, redundant, and are ultimately of a narrow and petty scope. In order to replenish *Homo sapiens*' respect for nature, it is of the utmost necessity for *Homo sapiens* to move beyond the anthropocentric ego and shift towards a holistic, biocentric appreciation for the gifts of which *Apis mellifera* bestows upon its environments.

Economic analysis is founded in the belief that human beings are rational, self-interested agents seeking to maximize their utility through consumptive decision making. However, the predictive social science of economics does not sufficiently capture the whole image. Humans often do not behave in a forecasted manner. In making economic decisions, humans are not perfectly informed, rational, neutral actors. While the quantifiable benefits of the ecosystem services provided by the honey bee are both legitimate and tangible, these services do not depict the entire picture. How does one quantify human altruism towards nature? While the predictive argument for economic analysis argues that humans act in self interest, attempts to quantify valuation of nature proves to be far more complex and is rooted in human thought, sentiment, and emotion. Even though there is a use for the data of the economic contributions of the honey bee to the biosphere, this is only a piece of a much larger story.

The crisis of colony collapse disorder is largely a result of the toxic demands of industrialized agriculture, specifically gratuitous use of pesticide and the increasing range of mobile beehives being used as pollination businesses. The epidemic is undoubtedly anthropogenic, as it has been birthed from humanity's wanton abuse of land through unsustainable land management practices. If colony collapse disorder is viewed through an anthropocentric lens, there are little lessons to be learned and no challenges to address. The problem of colony collapse disorder must be addressed more comprehensively through an ideological shift in perspective. To analyze the problem of colony collapse disorder through an anthropocentric lens is to do nothing to challenge the human ego which bred the problem in the first place. Solving the epidemic requires a philosophic shift to a biocentric lens that recognizes the honey bee's sublime contributions to its environments. One cannot hope to solve this environmental problem without questioning the attitudes that bred it in the first place.

## *Chapter 4 - Policy Adversity Against Bee-Friendly Public Parks*

The challenge is now apparent - in order to seek a solution to the epidemic of colony collapse disorder, a biocentric approach must be undergone in order to shift the focus of consideration away from human beings. To approach the dilemma of colony collapse disorder from an anthropocentric perspective would be a pointlessly circular action. Not only does the epidemic have the greatest impact on the honeybee, but the problem also exists due to anthropogenic material conditions. In order to take a radically new approach to colony collapse disorder, one must seek to reverse the damage generated from anthropocentric attitudes and structures rather than inappropriately remold them to a half-baked pragmatic ideology that benefits none of the environmental community stakeholders. In the place of the rampant environmental chauvinism that has bred the epidemic of colony collapse disorder, humans must shift towards actions of environmental wisdom. One must remember that the ecological health of the honey bee and the human being are deeply intertwined.

In seeking to find solutions to colony collapse disorder one must understand the anthropologic contexts from which cities are bred. Urban settings are both a mechanical and ideological locus of a brutal form of anthropocentrism. Cities are enforcers of a rupture between *Homo sapiens* and the natural world. The disconnect between human and the natural world is not merely a byproduct of cities, but both a foundation and a sustainer. Cities do not merely promote attitudes of exploitation and consumption in regards to natural resources, but are also founded on a disregard of the welfare of nonhuman species. On this calculated distancing from life outside of the anthrosphere, Niles Eldredge and Sidney Horenstein note that "alongside the intensified exploitation of so-called natural resources, and alongside the view that the continued existence of primordial inhabitants is a downright nuisance, lies the neglect of the natural world that is a logical extension of the fact that we live, in a very real sense, outside of the natural world."[42] The detachment from the natural world produced by urban settings is not merely relegated to neglect of other forms of life. At its logical conclusion, the unforgiving anthropocentrism of cities forges disconnect and apathy to the plight of other human beings.

Before this paper explores the specifics of urban park reformation, it is important to acknowledge a limitation of this approach. As the passage from Eldredge and Horenstein shows, cities are inherently unsustainable. It is largely unlikely that humans in their current state of unchallenged existence will ever radically transform the city to a form that absolves it of its environmental harm. However, this is not a sufficient reason to be discouraged. While the work is clearly cut out for environmental stewards, action can only manifest if one pledges to undertake it. By exhibiting apathy towards environmental degradation, one is complacent in environmental degradation. With that point being made, one can still strive for urban

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[42] Niles Eldredge and Sidney Horenstein, *Concrete Jungle: New York City and Our Last Best Hope for a Sustainable Future* (Oakland: University of California Press, 2014), 224

environmental reform within an existing paradigm. In transforming existing parks within a city using a biocentric approach, the park can be repurposed to benefit both honey bees and human beings alike.

New York City possesses over 28,000 acres of parkland, playgrounds, athletic fields, natural areas, recreational facilities, comfort stations, beaches, historic buildings, and parkways.[43]All of these facilities are managed by the Department of Parks and Recreation. In a 2017 report of pesticide usage in New York City by the Department of Health and Mental Hygiene, the Department of Parks asserts that "the major pest issues facing DPR are weeds (including weed shrubs and weed trees) and rodents. Rarer infestations of exotic insect pests and diseases, often targeting trees, also occur."[44]

Complications arise when one looks at the lax enforcement of pesticide laws and testing in New York City. In theory, New York City has laws in place to curtail heavy use of pesticides by city agencies. "New York City Local Law 37, enacted May 9, 2005, established new requirements regarding pesticide use on property owned or leased by the City, including the prohibition of certain pesticide products, posting of warning notices prior to applications, and new recordkeeping provisions."[45] While this law appears to promote accountability for pesticides used on New York City property, the Department of Parks and Recreation still disperses large amounts of pesticides within its parks and territories. Figure 6 shows the New York City Department of Parks' pesticide use figures, covering 4,160.1 gallons of pesticides applied over 5,704 instances in 2015.

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[43]New York City Division of Environmental Health, et. al., "Pesticide Use by New York City Agencies in 2016", (2017), 43

[44] Ibid., 43.

[45] New York City Department of Health and Mental Hygiene, "Summary of Local Law 37 (Pesticide Use by New York City Agencies)", (2005), 1.

**Table 40: Types of Pesticides Used by DPR in 2015**

| | Volume | | Weight | | Times Applied | |
|---|---|---|---|---|---|---|
| **Pesticide Type** | **Gallons** | **% of Total** | **Pounds** | **% of Total** | **Number** | **% of Total** |
| Rodenticide | 0.3 | 0.0% | 771.3 | 4.7% | 1,567 | 27.5% |
| Insecticide | 232.4 | 5.6% | 278.0 | 1.7% | 889 | 15.6% |
| Herbicide | 1268.9 | 30.5% | 6032.6 | 36.5% | 2,411 | 42.3% |
| Fungicide | 2619.6 | 63.0% | 9418.7 | 57.1% | 799 | 14.0% |
| Other | 39.0 | 0.9% | 6.7 | 0.0% | 38 | 0.7% |
| **Totals** | **4160.1** | | **16,507.3** | | **5,704** | |

Pesticides Use by NYC, 2015

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*Figure 6, Types of Pesticides Used by DPR in 2015. Source: New York City Division of Environmental Health, 2016.*

In addition to this large aggregate of pesticide output, the city of New York has also made exceptions for private properties. According to the Division of Environmental Health's report, the 2015 data on pesticide usage "includes pesticides applied on all city-owned golf courses. Local Law 37 exempts these locations from pesticide prohibitions."[46] The city of New York's methods for evaluating pesticide toxicity and control are ambiguous. Local Law 37 specifies that New York City agencies must maintain records of pesticide use for at least 3 years, and send annual application data to the New York City Department of Health and Mental Hygiene. The Department of Health and Mental Hygiene subsequently compiles all the data into an annual report which is released to the public. The New York City Department of Health lists provides prohibition lists from the federal Environmental Protection Agency and the California

[46]New York City Division of Environmental Health, et. al., "Pesticide Use by New York City Agencies in 2016", (2017), 43.

Environmental Protection Agency. The problem with the prohibition lists that the Department of Health and Mental Hygiene uses is that they are from 2004 and 2005. These lists are outdated by almost 15 years and ignore the dangers of continually new chemicals engineered by pesticide companies. Adverse health and environmental effects of chemicals must be constantly monitored to ensure that the health of both humans and their environments are protected.

What is the most striking about the Environmental Protection Agency's list of carcinogens is that it lists two of the pesticides that were detected in high concentration in New York apiaries by the Bee Informed Partnership. The Environmental Protection Agency lists Captan as a Group B2 probable carcinogen[47] and lists myclobutanil as a Group E carcinogen.[48]Even though there is a spotlight on the destructive potential of these chemicals, they still have been known to show up in the apiaries tested by the Bee Informed Partnership.

If these carcinogens are on the radar of environmental protection agencies, how do they keep showing up in apiaries? The answer lies in environmental protection and monitoring agencies' lax enforcement of environmental laws, and the weakness of these environmental laws as well. In order for the city of New York to make the shift towards more sustainable green spaces, community stakeholders must deeply evaluate the cost of pesticides and the immediate harm they infringe on the urban forest. Not only have the presence of pesticides been shown to have a tangible negative impact on honey bees, the presence of pesticides also greatly impairs the health of the urban ecosystem as a whole.

When looking at federal regulation and monitoring of toxic substances, federal litigation is equally insufficient. In 1976, the Environmental Protection Agency created the United States Toxic Substances Control Act. Post World War II saw a heightened production and presence of

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[47] Environmental Protection Agency, "Chemicals Evaluated for Carcinogenic Potential", (2004), 9.
[48] Ibid., 16.

hazardous industrial substances. On this rapid propagation, Sheldon Krimsky observes that "after World War II, commercial production of industrial chemicals exploded, yet remained largely unregulated as they became ubiquitous in agriculture, manufacturing, mining, construction, and consumer products."[49] Much like how Rachel Carson described the ecological infection of these pesticides, Krimsky notices a parallel propagation into American industrial life. In response to the heightened attitudes of environmentalism and grassroots activism in the 1970s, this policy was designed to pilot a protocol for testing of toxic substances. This act argues that "adequate information should be developed with respect to the effect of chemical substances and mixtures on health and the environment, [...] [and] adequate authority should exist to regulate chemical substances and mixtures which present an unreasonable risk of injury to health or the environment, and to take action with respect to chemical substances and mixtures which are imminent hazards."[50]

While this act seeks to prioritize human and environmental health and safety, this act also attempts to limit the power of the government in regulating toxic substances. The Toxic Substances Control Act asserts that "authority over chemical substances and mixtures should be exercised in such a manner as not to impede unduly or create unnecessary economic barriers to technological innovation while fulfilling the primary purpose of this chapter to assure that such innovation and commerce in such chemical substances and mixtures do not present an unreasonable risk of injury to health or the environment."[51] This act holds an inherent conflict of interest. Economic activity is the primary motivator for the use of pesticides - whether it be the case of industrial agriculture or horticulture. This third finding of Title 15, Chapter 51,

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[49] Sheldon Krimsky, "The unsteady state and inertia of chemical regulation under the US Toxic Substances Control Act", *PLoS Biology* 15, no 12, (2017), 2.
[50] Toxic Substances Control Act, 15 U.S.C. Chapter 51, Subchapter 1, § 2601 (1976).
[51] Ibid.

Subchapter 1, Sub-section 2601 compromises the entire project of the Toxic Substances Control Act. This policy opens up the opportunity for filibuster, where defenders of the use of a toxic substance can assert that it is necessary for economic activity.

While the Toxic Substances Control Act exists in theory to increase government accountability for toxic and hazardous substances, the Act's turbulent history in the United States has resulted in more roadblocks and impasses than increased health standards. Krimsky further discusses the two possible protocols when approaching toxic substance evaluation. The former would be to assume all substances are toxic until proven otherwise. The latter would be to assume all substances are safe until proven otherwise. Even though high vetting of toxic substances would be a preferable practice, Krimsky woefully notes that toxic chemicals are not given the attention they require. "In an ideal world where there is no limit on human resources, funds, or time within which information can be collected, analyzed, and decisions made, [...] a new chemical would not be approved for commercial use without a complete toxicological profile and characterization of potential hazards."[52] Another fatal flaw of the Toxic Substances Control Act soon becomes apparent - its need for a high investment of human capital and funds. High levels of scrutiny for toxic and hazardous substances are not feasible because of the recently slashed budget of the Environmental Protection Agency.

To top off the inherent obstruction of the Toxic Substances Control Act, the Environmental Protection Agency has made astoundingly slow progress on its vetting of toxic substances. On the rate which the Environmental Protection Agency has banned hazardous substances, Krimsky notes that "the Government Accountability Office (GAO) reported in 2013 that since 1976, the EPA has used its authority under TSCA to limit or ban only 5 existing

[52] Sheldon Krimsky, "The unsteady state and inertia of chemical regulation under the US Toxic Substances Control Act", 3.

chemicals: fully halogenated chlorofluoroalkanes, polychlorinated biphenyls (PCBs), dioxin, asbestos (later overturned by the courts), and hexavalent chromium. The agency did not have sufficient information to declare any other of the tens of thousands of chemicals unsafe."[53] This astoundingly slow process confirms the disheartening reality of the Toxic Substances Control Act. As a result of a lack of both government time and money, the act is incapable of keeping up with the large volume of hazardous chemicals and pesticides that the United States is creating. The Environmental Protection Agency is simply not sufficiently capable of rising to the challenge of vetting the ever-increasing chemicals that are being created and released to the American public.

This lack of resources to allow the act to work effectively can be seen reflected in the severely outdated prohibition lists used by the New York City Department of Health and Mental Hygiene. What can be inferred is that the dilemma of lax regulation of pesticide toxicity trickles down from the federal level to the state and municipal levels. The relationship between these insufficient regulations and colony collapse disorder are best represented with the metaphor of a tree structure. Whereas colony collapse disorder are the "leaves" of the problem, in that it is the most immediately visible manifestation, the insufficient regulation within New York City is the branch, meaning that it is the underlying arm that has caused this problem. The insufficient regulation of pesticides within the United States is the root - lax regulation and action at the federal level has resulted in community exposure to toxic pesticides at the local level.

## *Chapter 5 - Strategies Towards Apicentric Public Parks*

The emergence of colony collapse disorder serves as a grim warning that current human horticultural habits are far too unsustainable to continue as is. The die-offs of honey bees in such

[53] Ibid., 4.

unprecedented numbers are indicative of a greater human danger to the planet. However, colony collapse disorder also presents an opportunity for human beings to amend their actions and attitudes and to move forward with new environmental wisdom.

Before reaching the ideological and political conclusions this thesis seeks to present, one must first consider and challenge the inadequacies of older, anthropocentric environmental ethical thought. In his paper "Environmental Ethics and Weak Anthropocentrism", Bryan G. Norton seeks to reconcile two seemingly mutually exclusive concepts. Norton seeks to present anthropocentrism and holistic sustainability as not mutually exclusive. Norton introduces his idea of weak anthropocentrism, which asserts that humans can still act ethically with respect to the environment without assigning moral value to anything besides human beings. Norton argues that "weak anthropocentrism provides a framework adequate to criticize current destructive practices to incorporate concepts of human affinity of nature, and to account for the distinctive nature of environmental ethics. […] [These ideals] are sufficient to provide the basis of criticism of currently over-consumptive felt preferences."[54]

However, Norton is also highly apprehensive of assigning ethical weight to anything besides human beings. He argues that "in a post-Darwinian world, one could give rational and scientific support for a world view that includes ideals of living in harmony with nature, but which involve no attributions of the intrinsic value to nature."[55] Norton distinguishes the difference between felt preference and considered preference. He argues that when interests rooted in the former "are assumed to be constructed merely from felt preferences, they are thereby insulated from criticism and objection."[56] Norton contrasts the arbitrary nature of a felt

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[54] Bryan G. Norton, "Environmental Ethics and Weak Anthropocentrism" in *Environmental Ethics*, Vol. 6, No. 2, (Summer 1984), 191.
[55] Ibid., 184.
[56] Ibid., 183.

presence with the logical consideration he perceives one gives to a considered presence. "A considered presence, on the other hand, is an idealization in the sense that it only can be adopted after a person has rationally accepted an entire world view and, further, has succeeded in altering his felt preferences so that they are consonant with that world view."[57] Norton's argument for weak anthropocentrism creates a dichotomy between sentiment and rationality, arguing that direct moral value given to nature is nothing more than impulsive sentimentality. The importance of Norton's argument is that he believes humans can manage the planet in a sustainable manner while gatekeeping the moral community of ethical consideration.

Norton concludes his argument by asserting that "weak anthropocentrism provides a framework adequate to criticize current destructive practices to incorporate concepts of human affinity of nature, and to account for the distinctive nature of environmental ethics. [...] [These ideals] are sufficient to provide the basis of criticism of currently over-consumptive felt preferences."[58] Norton asserts that humans are fully capable of acting as benevolent managers of the planet because what aligns with human interests also aligns with the interests of the rest of the biosphere. As optimistic as Norton's argument is, his ahistorical image of weak anthropocentrism grossly overestimates the good of humans' presence on the Earth. However, there are organisms that exist on the Earth whose presence serve as benefactors, indicators, and controllers of the planet's health. These organisms are honey bees.

In the place of Norton's argument for a benevolent anthropocentrism, one should now consider a new favored locus of value for the environmental moral community. This thesis proposes an ethical shift towards *apicentrism*. Apicentrism requires a heavy ethical weight be given to human activity pertaining to the presence of the honey bee. As discussed in Chapter 3,

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[57] Ibid., 183.
[58] Ibid., 191.

the honey bee provides all four forms of ecosystem services and has a profound impact on the environment. The honey bee is the spearheader, the provisioner, the healer, and the maintainer of the ecosystem within which it exists. *Apis mellifera*'s unambiguously benevolent and mutualistic presence merits a special moral weight. Humans must relinquish their disproportionate weight and consideration they provide their own actions with - and shift this priority to the honey bee.

This thesis proposes to pilot the Apicentric City Parks Initiative in order to develop a more sustainable, healthy, and biocentric community within New York City parks. This initiative seeks to use honey bee stewardship as a means of ecological wisdom. Even though the focus will be given on preserving the health of the honey bee, the survival of *Apis mellifera* has a strikingly positive relationship with its surrounding community. In ecosystems where *Apis mellifera* thrives, many other species do as well. By caring for this keystone species, environmental stakeholders would soon realize that what benefits the honey bee benefits a multiplicity of other environmental community members.

One of the most crucial goals of the Apicentric City Parks Initiative is a radical shift away from the rampant pesticide usage that one can see in New York City parks. As reported by the Bee Informed Partnership data in Chapter 1, pesticides are able to bioaccumulate in the beehives and honey. These pesticides are highly dangerous to bee development and health. They have been shown to inhibit larval growth and physiological use. Despite environmental protection agencies Beyond merely impairing the honey bee's growth and health, the decline in bee populations will have a resulting ripple effect decline on the population of other species within the parks' environments. Without the bees' pollination services, plants will remain unable to produce fruit. This infertility continues along the food chain, and takes its toll on each trophic level.

The antagonistic scope of pesticides is fully capable of surpassing the local ecosystem as well. A crucial dimension of the pesticide dilemma that individuals overlook is that sites of pesticide application are by no means isolated from the rest of the surrounding environment. Therefore, the city of New York must eliminate the exemption clauses of Local Law 37 that allows golf courses and other specific areas of private property to The negative impact of pesticides is not just relegated to the bees, but also harms all other living creatures in the environment through bioaccumulation. Because of its contribution to the loss of biodiversity and its infection of public spaces with harmful chemicals, a biocentric transformation of public parks must abolish the use of pesticides.

In advancing from the abolition of pesticides, the Apicentric City Parks Initiative will subsequently shift to programs of reconstruction in city parks. One of the constructive ways that parks can be made more bee-friendly is through transformation and development of the urban forest. The urban forest is not necessarily a literal forest in an urban space, but rather the aggregate of vegetation within the park. "The urban forest may be defined as the sum of all woody and associated vegetation in and around dense human settlement."[59] Rather than structuring the urban forest around petty aesthetic considerations, an apicentric urban forest will use a biodiversity of native plants to the temperate deciduous forest biome. The installation of a diversity of fragrant plants such as *Zizia aurea*, *Verbena hastata,* and *Rudbeckia hirta* will attract pollinators and provide them with a stable habitat and food source. It is also of the utmost importance to exclusively use plants native to the greater New York City region. One of the main goals of the Apicentric City Parks Initiative will be to restore and promote the proliferation of biodiversity. Installation of exotic invasive species will not result in the increase of biodiversity

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[59] R.B. Singh and Rakhi Parijat, "Ecological Impact of the Land Use Change in Delhi Ridge: Anthropogenic Stress and Spatial Realities" in *Urban Sustainability in the Context of Global Change.* (Enfield: Science Publishers Inc., 2001), 189.

in the New York City ecosystem. By allowing the installation of invasive species, a new problem will simply be created; the transplanted populations will grow out of control and choke out existing florae. The biodiversity of the greater New York City region would actually suffer as a result of exotic species' introduction.

In order to promote sentiments of environmental stewardship, the Department of Parks and Recreation will also establish systems of volunteer planting and maintenance of the park's florae. Parks are often plagued by the neglect brought on by the common property principle. "The common property principle, where a natural resource is not owned by any one individual or organization but everyone has equal access, however, the underlined idea of trusteeship and not ownership, must apply. This rule makes it the duty of every person to care and pass on the possession of the resource to the next generation in the condition he/she found it in if not improve it."[60] By introducing a grassroots system of stewardship and connecting individuals to green spaces in their urban environments, community members will establish a precedent of environmental care. These programs of environmental stewardship would be spearheaded by former pesticide appliers, who would receive the career training to transition their gardening methods to become chemical-free.

In addition to cultivating a pollinator-friendly environment, parks must also design and implement synthetic beehives In order to effectively cultivate beehives in the city, humans must also take a biocentric, hands-off approach to apiculture. The goal of these beehives will not be to produce honey and wax, but to ensure the highest state of well-being for honeybees. It is of the utmost importance that no honey be collected from these hives. After the initial installation of the hive structure, humans will not meddle with these apiaries. In designing and implementing these

[60] Ibid., 201

hives, they will be done in an effort to mimic those in which wild bees live rather than their domesticated counterparts.

The goal of these biocentric beehives is to focus on the promotion of honeybee welfare, health, and well-being. Priority consideration will be given to honeybee preferences and habits in manifesting these hives. In a study on the ideal locations selected by honeybees, Thomas D. Seeley constructed many makeshift nest boxes in the effort to survey the attributes of a bee's speculative ideal hive. Seeley found many preferences exist within the wild colonies of *Apis mellifera* that had moved in. Seeley had found that bees respond to many variables - entrance size, entrance direction, entrance height above the ground, entrance height above the cavity floor, cavity volume, and comb presence within the cavity. On the nest entrance, Seeley found that "the bees had revealed to me that they prefer a nest entrance that is rather small, faces south, is high off the ground, and opens into the bottom of the nest cavity."[61]

All of these attributes seek to ensure the survival and protection of the colony. The small entrance facilitates easy defence of the hive. The high entrance makes the hive difficult to reach by ground predators. The entrance at the bottom of the nest minimizes heat loss due to convection currents. The entrance facing south provides a solar heated platform to enter and exit the hive. On the size of the hive's cavity, Seeley found that "bees avoid cavities smaller than 10 liters or greater than  100 liters, and that they very much like 40-liter cavities (about the size of a wastebasket), especially ones already equipped with combs."[62] This golden mean volume provides the adequate amount of storage space for honey while also being small enough to thermoregulate the insides. On the cultivation of wild beehives in Bronx parks, it would be of great benefit to replicate makeshift hives with these favorable qualities to bees rather than seek to

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[61] Thomas D. Seeley, *Honeybee Democracy*, (Princeton: Princeton University Press, 2010), 54-55.
[62] Ibid., 55-56

replicate apiculturist hives. In doing so, humans will finally be able to adequately challenge their attitudes towards not only the environment but one another as well.

Even though New York City Parks as they exist are anthropocentric epicenters of unsustainability, New York City parks may provide opportunities for grassroots environmental reform. Humans must answer the imperative to reform cities to become more bee-friendly. The benefit is not just relegated to bees. As propagators of biodiversity, the health of the entire surrounding ecosystem spills over from the health of the honeybees. In order to stop the environmental degradation and threats to the honey bees, the Department of Parks must increase its level of scrutiny for pesticides and must tighten the city's compliance with its pesticide regulations. Through the maintenance of the urban forest through grassroots stewardship and the implementation of biocentric beehives, public parks will be given an opportunity to rejuvenate and replenish their environmental degradation.

The proposed initiatives to transform urban park spaces in extend to a deeper importance than superficially reconceptualizing parks to benefit pollinators. The initiatives seek to challenge human ego through priorities of public space. The park ceases to become a quarantined greenspace to fit human desires and shifts to a milieu of biodiversity. In prioritizing the health and welfare of the flora and fauna of the park, humans are presented with an opportunity to begin to repair the damage done to the environment. The harmony of purposes of the public green space represents a shift towards a reaffirmation of a biocentric, sustainable, and equitable inter-specific community.

It would be insufficient to simply say that the solution to the problem of colony collapse disorder will end with heightened community awareness of the value of parks. Exploration into current American environmental policy, both at the municipal and the federal levels, reveal that environmental laws and regulations regarding pesticides present many complications. On the municipal level, pesticide laws are often very lax and fail to provide adequate sanctions for non-compliance. On the federal level, the Environmental Protection Agency often lacks both the human capital and the funds necessary to properly scrutinize hazardous substances in question. The New York City Department of Health and Mental Hygiene's list of toxic chemicals is a prime example of the intersection of these two issues. Not only does the Department of Health and Mental Hygiene provide little response to the detection of these chemicals, but the very protocol and categorization of hazardous chemicals from the Environmental Protection Agency is alarmingly outdated and bare. The inadequacies of these governmental institutions is something that must be addressed in order to attack the problem of colony collapse disorder at the root.

In order to attack the dilemma of colony collapse disorder, which manifests at the national level, the solution must be of a same scale as well. Ideally, the community building and education goals discussed in the Apicentric City Parks Initiative will not stop in the backyards of city residents. This protocol to reconnect New Yorkers with their environments intends to teach them the significance of natural capital and ecosystem services. Part of being a conscious environmental steward means being politically engaged and active in fights for environmental advocacy. It can be argued that the ultimate goal of the Apicentric City Parks Initiative would be to expand the focus of humans regarding their environmental communities. What would be a more appropriate means of manifesting this than by being politically active? Environmental stewards have a responsibility to remain politically engaged within their country, using their political power to advocate for environmental stewardship. Without this grassroots environmentalism driving political decision making, the already lax and inept Environmental

Protection Agency will only be further gutted. It is important to remember that national movements are not built in a day. In order to create a national sentiment of environmental awareness towards the dangers of pesticides, the substantial government change required to address colony collapse disorder must begin with grassroots advocacy work.

Thomas D. Seeley concludes *Honeybee Democracy* by evaluating the large scale lessons to take away from honey bee behavior. Seeley issues a challenge to human beings; in order to heal the *Apis mellifera* populations, humans must pay attention to the lessons the honey bees have to teach. Among other lessons, Seeley argues that humans must extend the moral consideration of their actions beyond themselves. "For the members of a decision-making group to work together productively, they must have a fair amount of alignment of interests so that they are inclined to form a cooperative and cohesive unit."[63] The goal of interspecific democracy that Seeley envisions would be to exist in a moral community in which moral standing is granted beyond mere human interests. However, this is very distant from the planet's current material reality. Humans are placing such a magnitude of distress on their environments due to viewing themselves as the only valid environmental stakeholders in an ethical community. In order to radically amend the human relationship with the honey bees, humans must widen the consideration of the consequences of their actions beyond the anthroposphere. A biocentric approach must be taken that dismantles the self-centeredness of human actions. *Apis mellifera* is in a current state of distress, and humans must take reparative action and decentralize themselves from environmental decision-making.

The relationship between *Homo sapiens* and *Apis mellifera* is one that is crucial to human development and survival. However, this mutualism is currently threatened. The attributes of honey bee behavior have incidentally exacerbated the dilemma of colony collapse disorder.

[63] Thomas D. Seeley, *Honeybee Democracy*, (Princeton: Princeton University Press, 2010), 220.

Because of their highly social and exploratory nature, the bees are highly vulnerable to infection by external poisons. The crisis has been bred by of humans' ever increasing pesticide usage following World War II. While the relationship between the honey bees and human beings has recently soured due to the industrialization of agriculture, opportunities present themselves to repair the damage and to learn from past missteps. On the lessons honey bees have to teach human beings, Thomas D. Seeley notes that "some have said that honeybees are messengers sent by the gods to show us how we ought to live: in sweetness and in beauty and in peacefulness. Whether or not this is true, I believe that the story of house hunting by honeybees can inspire the light of amazement about these beautiful little creatures."[64] The mythical and divine status that honey bees have adopted throughout human history are inspired by the sublime qualities they embody. Bees represent the benevolent figure of the nourisher because of their irreplaceable role in starting the food web with pollination. As a keystone species, they provide countless varieties of ecosystem services that sustain and benefit all other creatures in the surrounding environment. Saving the bees is no ordinary conservation effort - it is of remarkably high stakes.

Colony collapse disorder ultimately serves as a grand litmus test for the current state of the planet. The vast array of ecosystem services provided by the honey bee is reciprocated by ever increasing use of pesticides, habitat loss, and environmental degradation. This honey bee epidemic is symptomatic of greater attitudes of disrespect and apathy humans possess regarding the environment. Mankind's quest to continually abuse the environment is ultimately self-sabotaging. *Homo sapiens* is currently at a crossroads. If humans were to continue to abuse and neglect the environment, the future would be morose. This disregard for all forms of life expect humans is a direct affront on the biodiversity that has sustained the planet for millions of years. This continued denial of the value of the Earth's biodiversity would result in the planet's marked

[64] Ibid. 236

downfall. However, the fate of life on Earth is not yet sealed. Through a shifting towards a reimagining of biocentric attitudes, humans can do more than just repair the damage they have inflicted on the honey bees. With the ideological challenge of apicentrism, humans can reaffirm the value of biodiversity through a special focus and appreciation of the ecological niche of the honey bee. Through special consideration of the honey bee's well being and health, humans will extend this consideration to the delicate interconnectedness that holds every species on Earth in a state of well-being. The origins of colony collapse disorder extend much deeper than mere pesticide usage. It is through the specific case of colony collapse disorder that anthropocentric dilemmas of the environment become apparent. However, it is also through this same case study that the possibility of human reparation occurs. Through the reprioritization of the honey bee's well-being, humans can reaffirm the value of non-human life and repair the severed connections to the biosphere.

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