

## **Bees: Earth's Backbone**

What does agricultural production, biodiversity, and habitat creation for animals have in common? The answer is simple, they are all dependent upon bees and require the useful services of pollination to help the planet thrive. However, the future looks bleak due to 21<sup>st</sup> century ecological destruction – which ranges from global warming, bee nutrition treatment, and pesticide use which all contributes to global bee populations “dying off at increasingly rapid rates” [1]. As the Earth transforms into a new geologic period named the “Anthropocene ... [defined] from anthropo, for man, and cene, for new —because human-kind has caused mass extinctions...and altered the atmosphere” such as maximizing exploitation of the environment, the new era creates miserable conditions for animals and proves something must be done to support bee population growth [2]. Three species of bumblebees have gone extinct, and it is imperative that understanding the importance of bees is a pre-requisite to solving this crisis at hand [3]. The bees are a harmless species that vastly benefit our everyday life and provide huge pollination contributions to Earth's ecosystems.

The rare situation of bee decline has been named Honeybee Colony Collapse Disorder or CCD to attempt to explain why rapid population loss is occurring [1]. Bumblebees were listed as an endangered species in January because a roughly 90% decline has occurred over the past 30 years, but optimism is necessary as the bee loss is reversible and can be fixed through our actions [4]. Bees provide an estimated \$3 billion worth of services through spreading pollen, yet industrial agriculture has created intensive chemical systems that have harmful effects to bees while simultaneously damaging development and behavior [4][5]. Extensive use of agriculture to maximize crop yields has destroyed the bee habitats and created an un-sustainable form of

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agriculture that creates a net worse environmental effect. Colony Collapse Disorder is intertwined with global warming due to extreme weather events that restrict flower development and creation of pollen for the bees to move [5]. Researchers have shown how climate change and bee decline is linked through additional forced migration of bee colonies causing disease risk, ecosystem destruction, and overall warmer temperature devastates the sustainability of colonies [5]. Global warming causes flower blooms to be off pattern and creates a mismatch between bee populations and plants needing pollination [14]. Rapid temperature rise in tropical regions has limited some bee populations from moving North, which creates dense populations – but hurts the overall global stability of bees [14].

Commercial bee colonies are faced with extreme suffering due to beekeepers evaluating profits over ethics, such as methods of using sugar water to feed bees as a cheaper alternative to natural nectar. Water is combined with high fructose corn syrup that lacks natural nutrients which causes immune systems to weaken and increase the risk of disease spread occurring inside the colony [6]. Beekeepers mostly use one food source for feeding colonies, or a monoculture diet, which is inferior to multiple pollen diets because it leads to malnutrition. Having multiple food sources contributes to a healthier immune system, balanced pH levels, and increased protein intake based solely from the way beekeepers choose to treat the colonies – not to mention a multiple pollen diet mimics natural bee diets. Training and education programs have been implemented to set global industry regulations and generate partnerships between the public governments and private farms, in goals of removing unethical bee practices and creating a sustainable honey industry [13]. We can create a change in bee treatment through choosing carefully what honey we purchase and supporting companies that

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use natural food for bees and hopefully create bee population growth. This can only occur through evaluating the consequences of honeybee farming and putting the lives of bees above our luxuries of honey and understanding the impacts of pesticide use.

Conservation groups and the use of social media to generate movements such as #SaveTheBees has raised support for limiting pesticide use and ensure local ecosystems can support healthy bees. For example, The U.S. Department of Agriculture has a program named Natural Resources Conservation Service that utilizes financial means to improve bee habitats and provide diverse food sources on public parks and farms that utilize pollination techniques [7]. The efforts range from planting wildflowers, control spread of invasive species, and encouraging farmers to use crops that sustain bee populations while helping other pollinators. In 2016 alone, the U.S. Department of Agriculture used \$4 million in assistance to farmers which benefit bee colonies but also strengthen crop growth, benefit various other wildlife, and increase organic matter to bolster ecosystem conditions. Although federal action has been successful, limiting animal habitat destruction is only possible through everyday choices. Individual initiatives such as becoming a backyard beekeeper by planting a diverse garden without pesticides increase local population growth [8]. Plants such as wildflowers and even weeds draw bees in and create habitat zones in schools, local gardens, or even your own backyard for bees to reproduce to grow populations.

Scientific research and educational knowledge of colony collapse disorder has spurred investment into a future with sustainable bee populations. The U.S. Environmental Protection Agency (EPA) has utilized research and bee analysis to determine root causes of bee decline in attempts to create a public response [9]. Research into bee pests, disease pathogens, and

pesticides has allowed the EPA to outline an action plan to establish monitoring of bee populations through working with beekeepers to conserve land and foster healthy practices based upon laws for endangered species [10]. Citizens have helped on public land through sponsoring various bee habitats and distributing education material such as films for schoolchildren, public service announcements, and scientists engaging with local governments [10]. Any effort taken towards bee population growth is necessary, which can be taken by contacting our local representatives to support bee research and directly help with suffering the bee species currently faces. Research into habitat destruction has allowed global action to occur in attempts to help the dying bee population and raise awareness for the crisis at hand. An example has been the "Bumble Bee Watch" which is created to report sightings of various bee species and allow experts to look at how population patterns interact with environmental changes [11]. The wildlife preservation teams then launch conservation efforts for bee populations while simultaneously identifying rare bee species in attempts to preserve them. The initiatives include promoting sustainable agriculture that allows bees to thrive and contacting beekeepers to enforce pesticide-free practices in key areas to help reduce the risk of bee extinction.

The bees are an extremely important part of Earth's biodiversity and provide help through pollination. However, it is important to note that other animals also need help – key pollinators such as butterflies, bats, and birds are threatened by environmental destruction and face similar conditions as the bees do [12]. Although many of us think of dinosaurs and pre-historic times with the word "extinction", the effects are taking place upon bee populations now – only a thorough understanding of colony collapse disorder can solve these impacts. The

report [12] indicates that 40% of pollinator species are facing extinction and crises will occur absent action taken. Mimicking our steps toward sustainable bee populations can benefit other pollinators by mitigating the impacts of climate change and doing our part in local communities to endorse safe agriculture practices, avoiding pesticide use, and raising awareness for scientific research. Creating a call to action is necessary to preserve the bee species as their contributions of global food production and habitat creation proves action now is key. Any efforts, such as changing our backyard pesticide practices and planting choices, is one step closer to solving the bee species threatened with extinction.

Thus, understanding the causes of bee colony collapse disorder, through global warming, pesticide use, and bee diet treatment it is necessary to create a change in current bee practices. An educational understanding of rapidly declining bee populations is a tool to change the world and persuade others to stand up for the bees. Changing our everyday choices like pesticide use and honey purchases or backyard flowers and bee habitat creation – creates a step in the right direction to fix the dying bee populations. Human life and bee life is intertwined through agricultural production and ecosystem support, it is necessary to prevent dangerous forms of environmental exploitation and boost populations. Conservation efforts are pointed in the right direction, but further action to help the bee species and other pollinators is an important and ethical action we should embrace.

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