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Threats to Honeybee Life

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All types of bees belong to the series of insects known as hymenoptera, accurately meaning "membrane pinion". This order consists of some 'one lakh' species comprising wasps, ants, sawflies. Among 25,000 or more narrated species of bees, the majority are single bees, mostly laying eggs in tunnels, which they gouge themselves. All honeybees are social and cooperative insects. Honeybees play a crucial role in pollinating flowers, fruits, and vegetables. Bee visits plants for its food, nectar and pollen. This floral fidelity of bees is due to their preference for nectars having sugar contents and pollens with higher nutritive values. Honeybees are best known for the honey they produce. But the principal economic role of honeybees in nature is to pollinate hundreds and thousands of flowering plants and ensure seed set in quantity and quality. Flowering plants offer nectar and pollen to honeybees and honeybees reciprocate their obligation by bringing about pollination, maintaining genetic diversity and continuation of the plant species. But honeybees are still of greater importance to farmers for the pollination service they offer and increase crop yields both qualitatively and quantitatively through pollination.

There are three different categories of hive members. Workers build and guard the hive, search for nourishment (pollen and nectar from flowers), and clean the air by beating their wings. Bees are flitting creatures having close relationship to wasps and ants and are responsible for pollination and producing honey and bee wax. They are present on every continent except Antarctica, in every habitat containing insect fecundated flowering plants on the planet. Bees are very important for man as 'Albert Einstein' quotes "If the bee disappears from the surface of the earth, man would have no more than four years left to live." The honeybee is unique for the dancing manoeuvres it uses inside the hive to convey details to other bees about the position, range, size, and quality of a certain food source in the neighborhoods. Over the past few decades, honeybee populations have faced numerous challenges that have led to their decline.

These challenges include exposure to various pathogens, the widespread use of pesticides, and significant environmental changes (Kom *et al.*, 2019). The decline in honeybee populations has been documented in many regions, including North America, Europe, and Asia, with some areas experiencing more severe losses than others. The intensification of agriculture, habitat loss, and climate change have further exacerbated these issues, making it increasingly difficult for honeybee colonies to thrive (García-Valcárcel *et al.*, 2019).

Different threats to honeybee population

Pathogen infections: Viral pathogens are a significant threat to honeybee populations, with Deformed Wing Virus (DWV) being one of the most prevalent and destructive. The spread of DWV is closely linked to the parasitic mite Varroa destructor, which facilitates the transmission of the virus among bees. The mite's role in the global epidemic of DWV has been well-documented, showing that the virus has spread rapidly from European honeybees (*Apis mellifera*) to other regions, driven by trade and movement of bee colonies (Giacobino *et al*., 2016). Apart from viral diseases several fungal diseases pose a significant threat to honeybee populations, especially those resulting from Nosema species. Microsporidian fungus called *Nosema apis* and *Nosema ceranae* infect honeybees' digestive tracts, causing diarrhea and decreased colony productivity.

Parasitic infection: One of the biggest dangers to honeybee populations is parasitic infections, especially those caused by *Varroa* destructor. In addition to causing direct harm by consuming the hemolymph of bees, varroa mites can serve as carriers of many viral infections, such as DWV (Wilfert *et al*., 2016). Because of the mites' capacity for rapid proliferation and growing resistance to chemical treatments, beekeepers around the world face a significant challenge from these pests. Research has shown that *Varroa* mites destabilize the within-host dynamics of DWV, leading to lethal levels of the virus and contributing to colony collapse (Nazzi *et al*., 2012).

Impact of Pesticides: The most commonly used class of insecticides worldwide, neonicotinoids are a major threat to bee populations. These systemic pesticides, which include Imidacloprid, Thiamethoxam, and Clothianidin, are commonly found in nectar and pollen, exposing foraging bees to direct exposure. Pesticides, in particular, have been identified as a significant threat to honeybee populations. These chemicals can have various detrimental effects on bees, ranging from acute toxicity to more subtle, sublethal impacts on behavior and physiology. Additionally, the interaction of pesticides with other environmental stressors can exacerbate their harmful effects. Both acute and chronic exposures to pesticides can negatively impact honeybees. Acute exposure often involves high doses over a short period, while chronic exposure involves lower doses over extended periods. Studies have shown that field-realistic doses of neonicotinoids can significantly reduce bee survival rates and affect their behavior and physiology. Sublethal levels of pesticides can have substantial impacts on bee behavior and physiology. These include changed social behaviors, decreased foraging efficiency, and learning and memory problems. For instance, it has been demonstrated that bumblebees' nursing behavior is reduced when exposed to Imidacloprid.

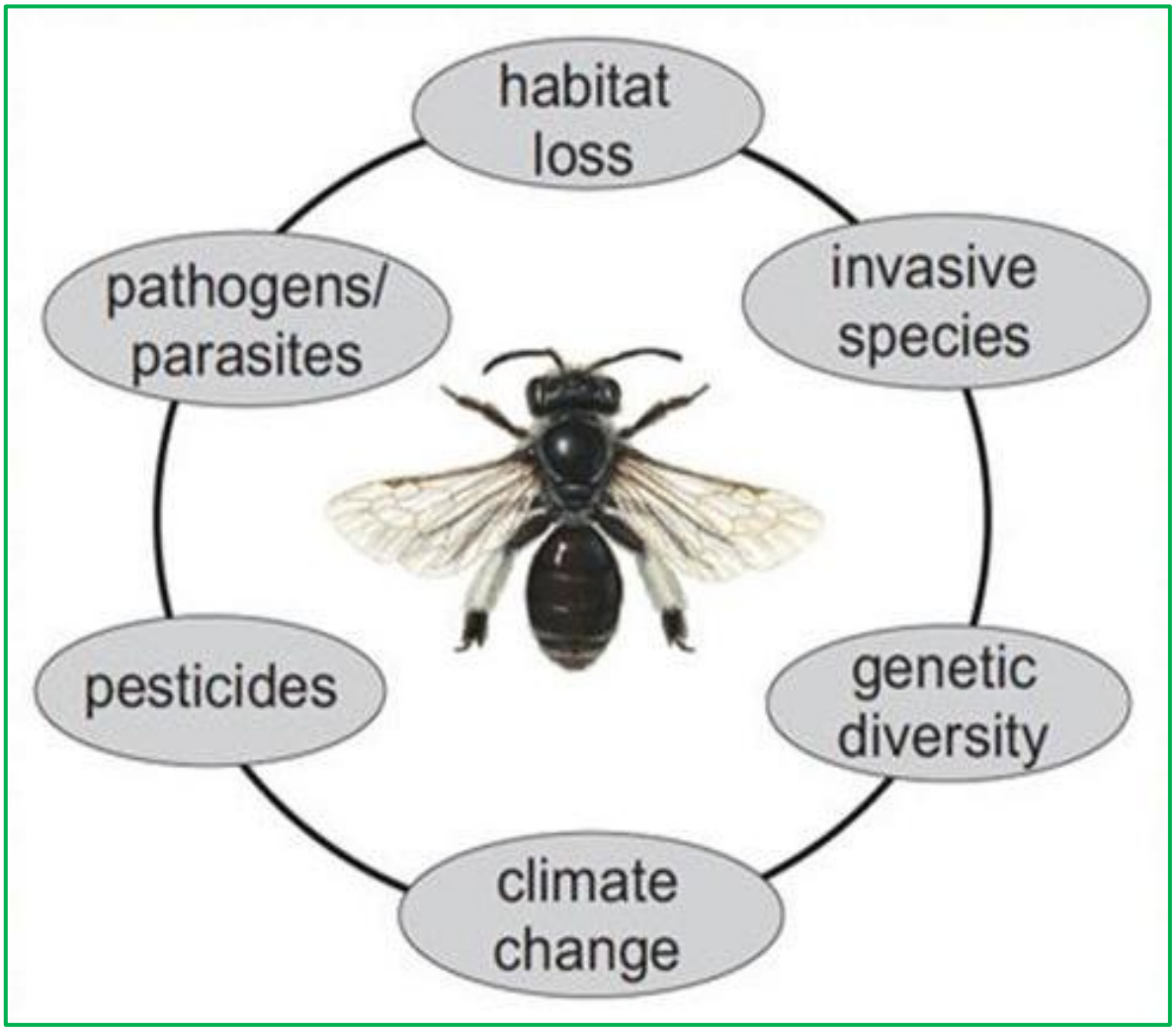
Impact of Environmental change: The health, behavior, and survival of honeybee populations are all greatly impacted by environmental changes. Two major factors contributing to honeybee population declines are habitat loss and fragmentation; the loss of semi-natural habitats has reduced the availability of floral resources and nesting sites, which are essential to bee survival. Agricultural intensification and urbanization have made matters worse by turning once-diverse landscapes into monocultures and urban areas, which has reduced the availability of diverse pollen and nectar sources.

Combined Effects of Multiple Stressor: The interaction between pathogens and pesticides has been shown to significantly impact honeybee health. For instance, studies have demonstrated that the combination of the microsporidian parasite Nosema and neonicotinoid pesticides like Thiamethoxam and Imidacloprid can lead to increased mortality and reduced immunocompetence in honeybees. These synergistic effects are particularly concerning as they can exacerbate the decline in bee populations. Additionally, the combination of *Nosema ceranae* and the insecticide fipronil has been found to have a synergistic effect on honeybee survival, especially when stressors are applied at the emergence of honeybees. Changes in floral resources, driven by both natural and anthropogenic factors, significantly impact

honeybee populations. The decline in the abundance and diversity of flowers due to habitat loss, agricultural practices, and invasive species reduces the availability of essential nutrients for bees. Seasonal variations in floral resource availability can create periods of food scarcity, particularly during critical times of the year when bee populations are at their peak. al., 2015). Enhancing floral diversity and availability through agri-environmental schemes and sustainable farming practices can help mitigate these effects and support bee health and productivity.

Conclusion

Pathogens, pesticides, and environmental changes pose a serious threat to honeybee populations, which are vital pollinators that support ecosystems and agriculture and greatly contribute to global food security. This paper explores the many factors that affect honeybee health, including the effects of bacterial, fungal, viral, and parasitic pathogens as well as the sublethal effects of acute and chronic pesticide toxicity and their effects on honeybee behavior and physiology. Environmental changes, including habitat loss, climate change, pollution, and alterations in floral resources, play a critical role in the decline of honeybee populations. Addressing these challenges requires a multifaceted approach that includes habitat restoration, sustainable agricultural practices, and effective management of pollutants and pests. By identifying and minimizing these environmental stressors, we may help ensure the survival and health of honeybee populations, which are crucial for ecosystem services and agricultural productivity.



		
Varroa mite	Wax moth	DWV symptoms

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