

Chapter 6

The Effects of Climate Change on Agroecosystems, Including Changes in Honey Bee Populations

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ABSTRACT

The global competition for energy sources, conflicts over food and energy, geopolitical tensions, instability in global financial institutions, climate change skepticism, and concerns about food security have all sparked a heightened interest in restoring the populations of Hymenoptera insects, including honeybees, in agroecosystems worldwide. The environmental crisis, both globally and in regions like Ukraine, is heavily influenced by a combination of natural and human-induced factors. Identifying ecological issues, particularly those of anthropogenic origin, that impact the development and distribution of honeybee populations is crucial for prioritizing responses and informing management decisions related to environmental safety. Addressing these challenges requires a comprehensive understanding of the complex interactions between environmental factors and human activities, as well as a commitment to sustainable practices and conservation efforts to support the resilience of honeybee populations and the ecosystems they inhabit.

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BACKGROUND

Every year, global cataclysms make headlines worldwide, with many of these events being directly or indirectly linked to global climate change. Early comprehension of these processes offers an opportunity to mitigate the worst impacts and minimize future losses.

Numerous studies have compellingly illustrated that the average global temperature has been rising since the mid-1900s, primarily due to human activities such as the combustion of fossil fuels, leading to the release of CO₂ into the atmosphere. This phenomenon, often referred to as anthropogenic climate change, is widely recognized among climate scientists. Human actions are estimated to have caused approximately 1.0°C of global warming above pre-industrial levels, with estimates ranging from 0.8°C to 1.2°C. The climate crisis, coupled with biodiversity loss, stands as one of the most significant challenges facing our world today (Climate Change: Causes and Consequences, 2018; Kuzmych L., 2023).

Despite humanity's advancements and technological progress, all components of agroecosystems are intricately interconnected, and the disruption of one element can have adverse effects on the entire system. The adoption of intensive agricultural practices, the escalation of armed conflicts, the neglect of marine ecosystems, among other factors, have contributed to a significant decline in pollinating insects. These insects are vital to biological processes and the sustenance of life itself. According to global priority initiatives, the decline in their populations and the extinction of certain species could detrimentally impact society's food security programs (Kuzmych L. et al, 2022, 2023; Shivanna K.R. et al, 2020).

Bees rank among the most industrious creatures on Earth, playing a critical role in ecosystems by ensuring the pollination and subsequent reproduction of numerous cultivated and wild plants. This function is essential for food production, human livelihoods, and biodiversity conservation. Bees, along with other pollinators like birds and bats, contribute to 35% of global crop production, enhancing the yield of 87 of the world's principal food crops, as well as numerous medicinal herbs. Roughly two-thirds of the world's cultivated plants, which sustain human populations, rely on insect or animal pollination to produce nutritious fruits and seeds. Pollination not only boosts the quantity of fruits, nuts, and seeds but also enhances their variety and quality, thereby enriching human nutrition.

The decline in bees and other pollinators across many regions of the world is primarily attributed to intensive farming methods, monoculture practices, excessive use of agricultural chemicals, and rising temperatures linked to climate change. This decline not only affects crop yields but also poses a threat to global nutrition, as nutritious crops such as fruits, nuts, and vegetables are gradually replaced by staple crops like rice, maize, and potatoes. This shift toward staple crops could eventually lead to an imbalanced diet (Kuzmych L. et al, 2023; A. Yakymchuk et al, 2022; Declining bee populations pose a threat to global food security and nutrition, 2019).

A world without bees signifies more than just a lack of honey. It implies a reduction in nutritious food for human populations, particularly impacting the world's poorest individuals, who are most susceptible to malnutrition. The symbiotic relationship between bees and humans is reciprocal. Bees rely on human efforts to safeguard the environment, while humans depend on bees to pollinate essential crops such as fruits, vegetables, and nuts (The Last Beekeepers of San Antonio Tecómitl, Mexico, 2018). Approximately 90 percent of the world's flowering plants rely on pollination for reproduction. Despite being often overlooked, bees and forest beekeeping play a crucial role in sustaining forest ecosystems, as pollination aids in tree regeneration, contributing to the preservation of forest biodiversity (Bee-ing Grateful to our Pollinators, 2018). Bees and other pollinators provide a vital ecosystem service by facilitating outcrossing, thereby enabling the reproduction of numerous cultivated and wild plants (World Bee Day, 2023).

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