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Declining Pollinators and Bee Populations Endanger Global Food and Nutrition

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Abstract:

Both wild and domesticated insect pollinators have been in massive decrease over recent decades, putting the survival of insects, habitat stability, and global food security at threat worldwide, 87 of the main food crops are reliant on pollination by animals. Currently, they account for 35 percent of the amount of global food supply. For critical nutrients in human nutrition, pollinator-mediated foods are crucial. The current pollinator epidemic affects global and regional food production, can exacerbate secret hunger issues, weaken habitat stability, and can devastate habitats that underpin our framework of life support. An interconnected solution that addresses the main drivers concurrently is needed. This includes the establishment and conservation of floral and nursing tools, the global step out of the management of preventative overuse of Neonicotinoids, and the rehabilitation of regulatory research freedom.

Introduction:

The global decline in bee populations poses a heavy threat to a large range of plants that are vital to human well-being and livelihood and countries should do more to safeguard our main allies within the battle against hunger and malnutrition. Substantially more than 100 crop species providing 90 percent of the food production in 146 countries, 71 are bee-pollinated (majorly by wild bees), and many others are thrips, wasps, flies, beetles, moths, and other insects. Honeybees are considered the most promising method of pollinating entomophilous crops and this allows the crop yield to enhance both qualitatively and quantitatively (Abrol 2012). The farmers will receive the necessary pollination services by introducing honeybees in the fields (Greenleaf & Kremen 2006). The overall production of food in the world (15-30 percent) is driven by animal pollinators i.e., honeybees and birds (McGregor 1976; Roubik 1995). In order to produce high quality seed, it is desirable to become acquainted with the type of pollinators and also the pollination biology

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(Krishnakumar *et al.* 2018). Rather than honeybees, many more insect pollinators (flies, butterflies, and beetles etc.) have been also reported in cruciferous crops. Cross-pollination is the basic requirement of getting higher crop yield in the cruciferous crops because in the absence of the pollinating agents, the seed yield and crop size get reduced (Delaplane and Mayer, 2000). According to CFIA (1999) different genera of the pollinator insects, crop varieties and the environmental conditions also affect the rate of cross-pollination in rapeseed. By introducing honeybees in the fields, the farmers will obtain the adequate pollination services (Greenleaf & Kremen 2006). In India, most of the food crops need insect (mainly bees) pollinators for successful pollination. Pollination seems to be the most effective element in nature which protects and encourages crop biodiversity. It also helps to improve food production which really benefits society by providing improved food security and hence spend a substantial. Pollination in plants results in the production of fruits and seeds that make important diets of birds and mammals in the United States (Scardina and Flocken 2012). Hardly any of the food crops in India requires insect pollinators (mainly bees) for effective pollination. Oilseeds (such as sunflower, Niger, safflower), vegetables (cucurbitaceous plants, legume crops), and many fruit crops are completely dependent on pollinators Emergence of honeybees in cross-pollinated crops enhances seed yield and crop growth as well as the abundance of flora facilitates beekeeping industry and tends to produce better quality and honey quantity (Meena *et al.*, 2015). A decline in native wild pollinators has also been widely recorded in specific locations around the world, in addition to controlled bee colonies (Potts et al, 2010). Besides, a diverse community of wild bees is important to the protection of plant diversity and ecosystem functions in natural habitats (Jane Memmott *et al,* 2004). Pollinators are extremely important for the functioning of nearly all terrestrial ecosystems including those dominated by agriculture because they are at the part of sustainable productivity by plant reproduction (Kevan, 1999).

Minute Creatures and Immense Benefits:

Bees are among the foremost hard creatures on the earth that provide essential ecosystem services for pollination. Amazingly, 300 million flowers per day are often pollinated by one bee colony. Bees and other pollinators like birds and bats influence 35 percent of crop production around the world. Around two-thirds of the world crop plants depend upon insects or other pollinators to provide safe fruit and seeds for human

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consumption. Pollination supports human nutrition allowing many fruits, nuts, and seeds to be produced but also greater variety and better quality.

Why are Bees dying out?

Bees are endangered worldwide, thanks to intensive farming practices Mono cropping and excessive use of agricultural pesticides, new molecular insecticides, Los of biodiversity, pollution, and increasing climate change temperature furthermore as mite and viruses, which bees have not any natural protection. In February 2019, a world report found that each one insect in the world is decreasing by 2.5 percent annually. Unless this happens by the year 2119 the earth will not have any insects in the least.

Significance of Honeybee Products and Their Medicinal Values:

Products of the honeybee, like honey, pollen, royal jelly, propolis, bee venom, wax, and bee bread, were significant causes of social nutrition pharmaceutical and food additive processing. This makes honey and pollen ideal for the care of a variety of illnesses and diseases. (Sahinler *et. al.* 2005).

Major Threats To Pollinators and Bee Population Globally

Loss of Habitat:

Many forms of land use (e.g., agriculture, urbanization) dramatically alter forms of land cover, leading to the decline of several species' habitats, known as habitat loss (Fischer and Lindenmayer, 2007). Research has shown that habitat loss effects will reduce the population sizes, composition, and species diversity of pollinator populations, impacting species-level evolutionary processes. Several pollinator classes (e.g., Hymenoptera, Lepidoptera) have already shown significant declines (Potts *et al.*, 2010). Also, the decline of many populations of bumblebee and butterfly of Europe is possibly due to the depletion of unmanaged grasslands, wetlands, and significant floral resources (Goulson *et al.*, 2005; Biesmeijer *et al* . , 2006; Carvell *et al.*, 2006).

Monoculture:

Humans have enlarged the size of flower patches by planting crops in monoculture so much that a honeybee colony can't browse for several patches effectively: they're trapped in only one. For a shorter amount of time, the patch flowers bloom, and then the bees have little else to eat. This is awful for bees: they are more vulnerable to pesticides and viruses due to so much stress and insufficient diet.

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Usage of Pesticides:

The application of pesticides can be detrimental to bees in agriculture and vegetable gardens. Any pesticides can kill them if sprayed while bees are alive. During periods of the day when bees are not involved, pesticides should be sprayed on gardens and crops in order to mitigate their effects on bees. In order to reduce the lethal effects on bees, farmers should change their spraying routine. Due to their ability to affect non-target insect pollinators due to their intrinsic toxicity, the use of insecticides is of special concern (UNEP, 2010; EASAC, 2015). While there is also evidence that certain co-formulates of pesticides such as adjuvant or synergists can also display toxicity at high doses. Neonicotinoids are up to 10,000 times more harmful to bees than other insecticides, and their use can cause Colony Collapse Disorder (CCD) to have an immediate and long-term effect on bees. The European Red List of Bees describes pesticides as one of the major threats to bee populations, of which 9.2% are listed as endangered. By killing essential habitats such as native milkweed, glyphosate, the main ingredient in the common herbicide Roundup, is devastating monarch butterfly populations. The amount of clothianidin per single seed of maize processed at a dosage of 0.5 mg per kernel provides an adequate active ingredient to destroy more than 80,000 honeybees. Pesticides, however, may also have sub-lethal effects on Honeybees, which mean they do not really damage the bees, but they still have a detrimental effect. Sublethal consequences can involve adversely affecting or controlling bees' flight control and foraging skills. Spatial thinking lets the bee find its nest, while associative learning encourages the bee to equate plant characteristics with floral rewards, allowing a bee on a foraging trip to maximize the selection of rewards.

Colony Collapse Disorder (CCD)

Before 2013, 10 million bee colonies were destroyed due to CCD because of the neo-nicotinoids. Imidacloprid exposure to honeybee colonies has shown an effect on their abilities to navigate and understand and has decreased the ability of these colonies to survive winters. According to FAO (2005), the drop in the population of bee's costs US farmers 20 percent more to artificially pollinate their crops. For three years, Cox-Foster *et. al.* (2007) studied the bee colonies and concluded that Israeli Acute Paralysis was also a significant cause of CCD. And Glinski *et al.*, (2012) and de Miranda et al., (2011) found that varroa mites mediated bee immune suppression and also resulted in the Israeli Acute Paralysis Virus, Kashmir Bee

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Virus, and Deformed Wing Virus. Thus, they claimed that several factors are now the consequences of CCD.

Pathogens:

Diseases may have a direct effect on the wellbeing of pollinators, but can also interfere with other causes, such as inadequate diet, chemicals, etc., creating stress and therefore contributing to reductions in pollinators (vanEngelsdorp *et al.*, 2010; Van Bergen and Insect Pollinators Initiative, 2013). Viral diseases in bees are widespread, with over 18 identified; the key ones are:

- Acute bee paralysis virus (ABPV).
- Black Queen Cell Virus (BQCV).
- Chronic bee paralysis virus (CBPV).
- DWV; Israel Acute Paralysis Virus (IAPV).
- Kashmir bee virus (KBV).
- Sacbrood virus (SBV).

Bees are threatened by numerous viruses and parasites. These were better studied with honeybees. Varroa mites can do significant harm to the colonies of honeybees and are blamed every year for the loss of several colonies. In the colonies of different wild bumble bee species, tracheal mites are internal parasites of honeybees and have been observed, but we know little about their effect on colony health. Bacteria-induced American foulbrood is a severe honeybee disease, while chalkbrood, a fungal disease, severely impacts alfalfa leaf cutting bees. Along with new emerging pathogens caused by multiple viruses, the gut parasitic Nosema, a protozoan, has a detrimental effect on the health of honeybees and bumblebees. Other causes, such as inadequate diet, which itself can result from habitat depletion and destruction can intensify the effects of these pathogens and parasites. As described earlier, infections, such as new and emerging diseases associated with numerous viruses, the Varroa mites, the gut parasite Nosema, pesticides, and inadequate nutrition, are the main factors influencing honeybees. Such variables can interfere with each other, where habitat destruction or pesticides can lead to poor nutrition and bees are more vulnerable to disease due to poor nutrition.

GMO Crops:

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In IR crops, sensitivity to the transgenic trait has the ability to directly affect insect pollinators (Malone and Burgess, 2009). The toxicity of transgenic proteins or transgenic tissue to insect pollinators has been measured by experiments on GMO release, cultivation, and development (Andow and Zwahlen, 2006; Li *et al.*, 2014). Pollinators eat pollen and/or nectar, and their absorption could lead to decreased longevity or behavioral & physiological abnormalities since the transgenes are represented in both.

Pollution:

Metals such as cadmium, copper, iron, manganese, zinc have been shown to play a direct role in the widespread decline in Butterfly (Parnassius apollo) in Finland (Nieminen *et al.*, 2001). Strangely, there are no comprehensive studies on the impact of heavy metal emissions on the metabolism of the honeybee. New research on bumblebees found that in polluted environments, certain soil toxins (e.g., aluminum or nickel) could adversely impact bees (Meindl and Ashman, 2013). A steady decline in the diversity and abundance of solitary wild bees along heavy metal gradients in Poland and the UK was observed by Moroń *et al* 2012.

Climate Change:

Pollinators are one of the species most threatened by climate change because:

- Increases overwintering.
- Geographical distribution
- Insect invasion
- Changes in growth rates

Every year, climate change allows flowers to bloom half a day early, suggesting plants are already blooming a month earlier than 45 years ago. Faunas have 44 species of Bumblebees across the Tibetan plateau, climate change causing irreversible stream erosion as glaciers to melt resulting in habitat and Bumblebee population decline (Williams *et al.* 2018). Four populations of hummingbirds at risk in North America are pushing these four species to leave their native areas due to increasing conditions that raise warmer temperatures. Heat is extremely dangerous because it causes them to pursue shelter instead of grazing on nectar to cool off because their high appetite demands that they desperately need to eat. Bats living in temperate areas are more likely to lose prey detection volume, as hotter weather impacts hibernation periods of Bats and their prey supply. Extreme temperatures, droughts, flooding,

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other adverse weather conditions, and shifts in flowering are largely hindering pollination by desynchronizing production (flowers in bloom) with the availability of service providers (abundant and varied pollinator populations). A significant decrease in the pollination service will lead to improper production of seeds and therefore reduce the quality of the fruit that interferes with the supply of food in natural communities. This will inflict huge losses on farmers and generate economic inequality. Without bees, our grocery produce departments would tend to carry up to 50 percent fewer fruit and vegetables, and our favorite foods, such as strawberries, bananas, lemons, peppers, broccoli, and honey, will become a privilege of the past.

Food Supply Consequences:

The food supplies may be seriously affected by a reduction in pollinators. As most fruits need insects for pollination, fruit production will be heavily affected. It will become difficult to propagate many crops. Fortunately, our diet would be heavily influenced by a shortage of pollinators which would restrict the supply of different nutrients offered by many fruits and vegetables. A lack of pollinators will also impact the production of meat and the production of dairy products by restricting the production of alfalfa. A reduction in pollinators will therefore have a detrimental effect on human nutrition. The well-being of humans depends on pollinators being well. If this process begins, staple crops such as rice, maize, and potatoes will eventually replace nutritious crops such as bananas, nuts, and many vegetables, potentially resulting in an extremely unbalanced diet.

Solutions that can Save the Pollinators.

Common sense actions can restore and protect the world's bees and other pollinators. Here's a strong start:

- Ban Neonicotinoids pesticides.
- Use only the selective chemicals which are less harmful to the pollinating insects and managing the time of spray.
- Adoption of organic farming, use organic pesticides like botanicals\bio-pesticides.
- Protect pollinator health by preserving wild habitat.
- Proper sanitation of Apiary and avoid selecting sites for the apiary close to the towers and grids as the electromagnetic waves are also harmful to bees.

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- Restore ecological agriculture by planting a variety of pollinator-friendly flowers and plants that are native to your climate.
- Adapt to the crop rotation as well as mixed cropping.

Conclusion

As different plants are wind pollinated and other plants rely entirely on self-pollination for seed development, a lack of pollinators does not lead to the complete extinction of plants on earth. It will, however, change the composition of Plant populations that have extreme repercussions for the animals that feed on or use them for shelter. Such changes will have many consequences, many of which are hard to predict. Humans rely on plants, and pollinators feed on plants. In order to preserve life on earth and protect human survival and wellbeing, a balance must be maintained.

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