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Bumblebee: Economic and Environmental Aspects on Pollination

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Bee pollinators play an important role in crop production and productivity around the world. One-third of the food consumed by humans and animals is pollinated by bees, either directly or indirectly. Bees are necessary for sustainable agriculture and a healthy ecosystem because they pollinate agricultural and horticultural crops, flowering trees, and wildflowers, which offer food and shelter for other species and improve environmental quality. Without bee pollination, oil output will be substantially reduced due to poorer yields in oilseed crops such as cotton, rape, sunflower, coconut, peanut, and oil palm, according to research. Furthermore, grazing plants are developed from insect-pollinated seeds. There will be no better-quality blueberry, apple, strawberry, cucurbits, citrus, mandarin, apricot, blackberry, etc. on the dining table if the bee stops working.

The honeybee is well-known for its crucial role in agricultural pollination, but there are other pollinators who go unnoticed, such as wild bees and other entomophily. *Apis mellifera*, a worldwide domesticated bee species, makes up to four million flights each year, visiting approximately 100 flowers per trip, with pollination efficacy due to its consistency to flowers of one species (FAO, 2008). Nonetheless, some crops are more effective pollinators for wild bees than honeybees. Effective pollination is strongly dependent on floral form and pollinator ethology.

Bumble Bees as pollinators:

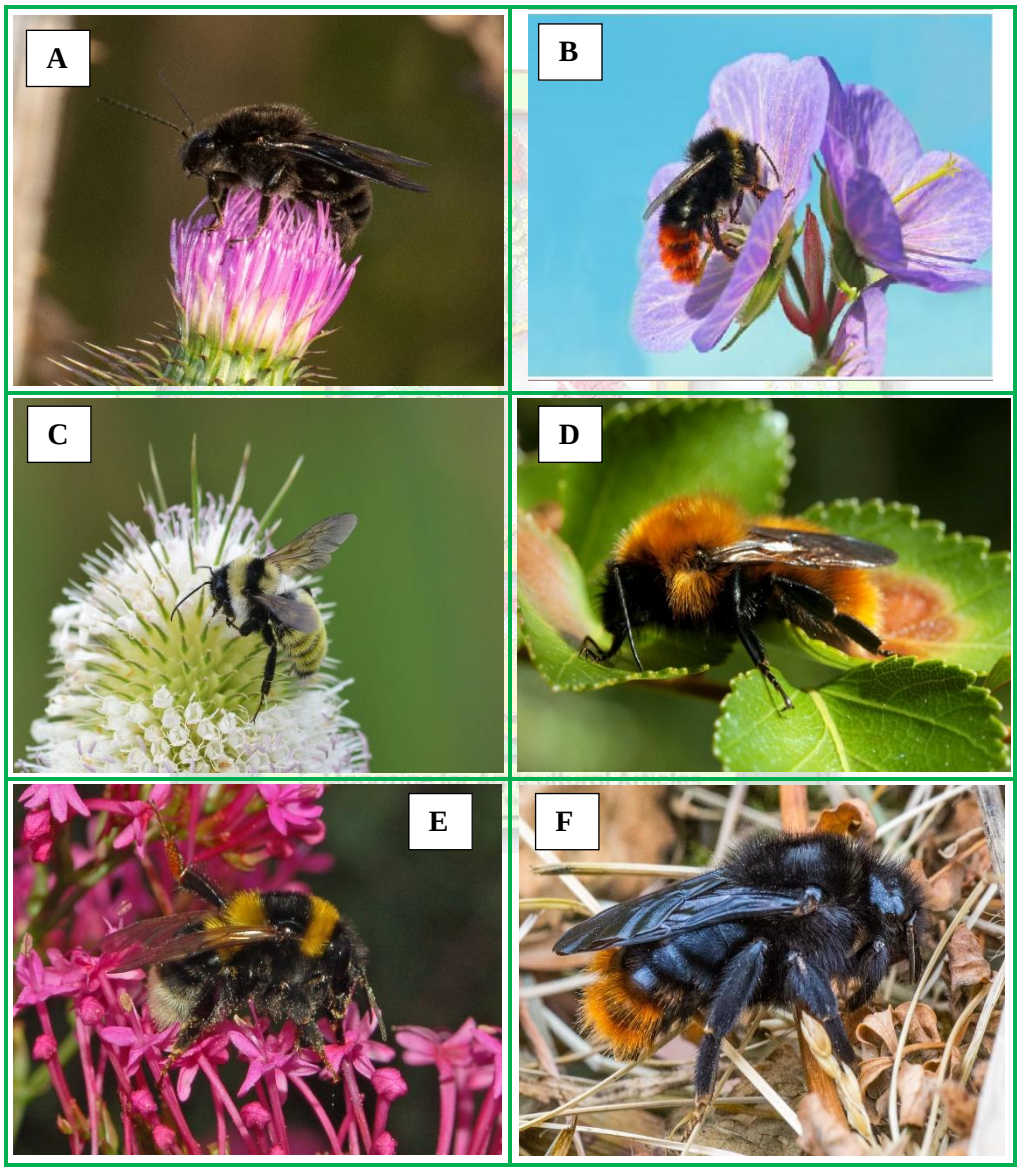
Apart from honeybees, bumble bees are the most essential agricultural pollinators, and they can be found in greater numbers at higher latitudes. Bumble bees are large, attractive insects that are of interest to children, scientists, beekeepers, naturalists, conservationists, home gardeners, farmers, and commercial bumble bee breeders. Bumble bees are highly social insects, yet their colonies are not as long-lasting as honeybee colonies. They do not have a honey surplus that can be harvested. They have a wider range of flowers to choose from and a longer flight season than honeybees. The stigma of a flower with a long corolla is readily reached by species with longer tongues, whereas a short tongue chews the corolla and makes its way to the stigma. As a result, honeybees cannot substitute pollinators of lengthy flowering plants. Long-tongued bumble bees have been declining in recent years in various parts of Europe, Asia, and North America due to habitat degradation, pesticide use, and agricultural mechanization (Free and Williams, 1973; Rasmont, 1988). In nature, bumble bee numbers change from year to year due to a variety of factors such as weather, parasites, and predators.

Bumble bees are large, sturdy insects that are black and yellow in hue. A black or yellow hairy abdomen distinguishes the bumble bee from the carpenter bee, which has a

black lustrous, hairless abdomen. The pollen basket on each hind leg of the foraging bumble bee is often full of pollen. Queens of bumble bees are approximately double the size of workers or males. A female bumble bee has a stinger on her abdomen. Males lack a stinger and have a rounded tip to their abdomen.

Distribution of Bumble Bees:

Bumble bees are generally found in temperate areas and are often found at higher latitudes and elevations, while some species can also be found in tropical lowlands (Wiki). *Bombus polaris* and *Bombus alpinus* are two species of bees that are found in severely cold locations where other bees would perish (Milliron and Oliver, 1966). They thrive in extreme cold conditions by regulating body temperature through solar radiation and an internal cooling mechanism known as heterothermy. They also survive at greater altitudes by expanding wing stroke amplitude (Dillon and Dudley, 2014).



Few Important species of Bumblebees: (A) *Bombus pauloensis* ((B) *Bombus lapidarius* C) *Bombus fervidus* (D) *Bombus dahlbomii* (E) *Bombus ruderatus* (F) *Bombus rupestris*

Nesting and social behaviours:

The location of a bumble bees nest varies depending on the species, but the majority of them prefer dark, dry cavities and undisturbed regions because they don't like to be exposed to direct sunlight for extended periods of time. Nesting takes place in a number of unusual locations, including dense grass, bird's boxes, tree lofts, compost heaps, under sheds, and abandoned rat tunnels. The number of bees in a well-established colony varies depending on the species and season of the year (Anonymous, 2019b). Bumble bees have a yearlong life cycle. In the spring, the queen establishes the colony. When the colony has a few hundreds of workers, new queens and males are produced, usually at the end of the season (Libbrecht and Keller, 2015). Bumble bee females are divided into two castes: queen and workers, with the queen having a longer lifespan and the young queen being able to hibernate and start a new nest (Röseler and van Honk, 1990; Libbrecht and Keller, 2015).

Economic importance:

Bumble bees can be found wherever there are flowering plants and play an important role as pollinators of wildflowers and crops. Many of the benefits and pleasures derived from natural bumble bee activities are difficult to quantify in monetary terms. Bumble bees pollinate numerous wildflower species that provide food for birds and small mammals. Honeybees are by far the most common pollinator species brought to field crops. For some plant species, bumble bees and honeybees are not interchangeable pollinators. In greenhouse grown tomatoes, sweet peppers, and strawberries, bumble bees are a viable alternative to labor-intensive manual pollination. For some plant species, the longer tongue and wing vibrating tendencies of bumble bees make them more efficient pollinators. Bumble bees are better foragers in cool, inclement weather than other bees.

Bumble bees for profit as commercial pollinators:

Bumble bees can detect the electric field of a flower that has recently been visited by other bees (Clarke *et al.,* 2013) and can distinguish flowers based on their temperature (Harrap *et al.,* 2017). They utilize these cues to determine which flowers are rewarding or unrewarding, as well as to determine other pollinators' visits (Saleh and Chittka, 2006; Saleh *et al.,* 2007; Pearce *et al.,* 2017). Their foraging is primarily for pollen rather than nectar. The huge size of the body allows for increased pollen load and better contact with flowers, whereas buzz pollination aids in more flower pollination.

Bumble bees can work in temperatures as low as 50°C, as well as on gloomy, foggy, and rainy days, when honeybees stay inactive. The crops which are more suited with bumble bee pollination are cucumbers, peppers, tomatoes, vegetables, seed crops, strawberries, blueberries, cane berries, melons and squash (Anonymous, 2019a). Bumble bees are often found to be self-medicate during forages where they dominantly visit to nectars having alkaloids anabasine when they are infected with parasite *Cithidria bombi* (Richardson *et al*., 2015; Palmer-Young *et al*., 2017).

Bumble bees are in trouble:

Several species of bumble bee are in rapid decline, while the fate of others is unknown. The western bumble bee, yellow banded bumble bee, and Franklin's bumble bee have all become extinct in substantial parts of their ranges, while the rusty-patched bumble bee was recently categorized as endangered. Similar losses have been reported by scientists in Europe, South America, and Asia.

Intensive agriculture has resulted in the replacement of farm animals that would ordinarily eat on clover and hay, which favours the bumble bee and encourages the growth of tall grasses, destroying habitat. The population of bumble bees in the United Kingdom plummeted in the early 1980s, with the last British short-haired bumble bee collected in 1988

(Goulson, 2013). Neonicotinoids have been linked to a decline in honeybee populations around the world, and some scientists believe neonicotinoids are to blame for colony collapse disorder. In addition to honeybees, neonicotinoids are a key contributor to the decline of wild bee pollinators. In comparison to uncontaminated colonies, neonicotinoids have an effect on brain function, which disrupts their everyday operations by causing more foragers to leave to collect pollen (Stanley, 2016).

Conservation needed:

Bumble bee conservation efforts must be focused on reducing the hazards to their population decline. To save bumble bees, further research into habitat restoration, agricultural practices manipulation, landscape modification for bumble bees, and the use of safe insecticides is needed. Bumble bees prefer management practices that promote floral abundance and diversity, such as replacing hedgerows, leaving land fallow, seeding wildflower strips, and restoring flower-rich grassland (Goulson *et al.,* 2008). As a result, the conservation of diverse bumble bee species only necessitates a small number of diverse food plants. To develop a niche for their survival and reproduction, bumble bees' preferred nesting and hibernation habitats must be thoroughly explored. Bumble bees can nest and hibernate in abandoned burrows in fields, as well as seeding field margins with grasses like tussocky and wildflowers (Svensson *et al.,* 2000; Carvell *et al.,* 2004; Pywell *et al.,* 2006).

Conclusion:

Bumble bees are a well-known wild pollinator with the ability to pollinate flowers in ways that honeybees cannot. Furthermore, they buzz pollinate and visit more flowers every minute. However, in recent years, the diversity and population of bumble bee species has decreased. The main causes of decline include habitat loss, agricultural mechanization, pesticide use, and climate change. As a result, conservation strategies such as landscape change and agricultural practice manipulation in favour of the bumble bee are required. The importance of bee pollinators in global food production has long been recognized but understanding on how to conserve them in order to maintain a clean environment is not widely appreciated or understood. As a result, additional research on bee pollinator conservation is required.

References:

1. Anonymous (2019a). Biological control system. *https://www.buglogical.com/bumble-beesnatural- pollination/* Date of accessed: 15-04-2019.
2. Anonymous. (2019b). Bumble bee conservation trust. *https://www.Bumblebeeconservation. org/bumblebee-nests/*Date of accessed: 15- 04-2019.
3. Carvell, C., Meek, W. R., Pywell, R. F. and Nowakowski, M. (2004). The response of foraging bumble bees to successional change in newly created arable field margins. *Biol. Conserv.,* **118:** 327-339.
4. Dillon, M. E. and Dudley, R. (2014). Surpassing Mt. Everest: extreme flight performance of alpine bumble bees. *Biol. Letters.,* **10.** *doi: org/10.1098/rsbl.2013.0922.*
5. FAO (2008). The value of bees for crop pollination. *http://www.fao.org/3/i0842/i0842e09.pdf.* Date of accessed: 15-04- 2019.
6. footprints to generate adaptive behaviour at flowers and nest. *Arthropod-Plant Inte*., **1**: 119-127. *Doi: 10.1007/s11829-007-9011-6.*
7. Free, J. B. and Williams, I. H. (1973). Genetic determination of honeybee (*Apis mellifera* L.) foraging preferences. *Ann. Appl. Biol.,* **73**: 137-141.
8. Goulson, D. (2013). An overview of the environmental risks posed by neonicotinoid insecticides. *J. Appl. Eco.,* **50:** 977-987.

9. Goulson, D., Lye, G. C. and Darvill, B. (2008). Decline and conservation of bumble bees. *Annu. Rev. Entomol*., **53:** 191-208. *doi: 10.1146/annurev.ento.53.103106.09.*
10. Harrap, M. J. M., Rands, S. A., Hempel de Ibarra, N. and Whitney, H. M. (2017). The diversity
11. Libbrecht, R. and Keller, L. (2015). The making of eusociality: Insights from two bumble bee genomes. *Genome Biol.* **16:** 75.
12. Milliron, H. E. and Oliver, D. R. (1966). Bumble bees from northern Ellesmere Island, with observations on usurpation by *Megabombus hyperboreus* (Schönh.) (Hymenoptera : Apidae). *The Canadian Entomologist,* **98**: 207-213.
13. of floral temperature patterns and their use by pollinators. *Elife.,* **6:** 1-18. *doi :10.7554/eLife.31262.*
14. Palmer-Young, E. C., Sadd, B. M., Irwin, R. E. and Adler, L. S. (2017). Synergistic effects of floral phytochemicals against a bumble bee parasite. *Ecol. Evol.* **7:** 1836-1849.
15. Pearce, R. F., Giuggioli, L. and Rands, S. A. (2017). Bumble bees can discriminate between scent-marks deposited by conspecifics. *Sci. Rep*. **7:** 1-11. *Doi: 10.1038/srep43872.*
16. Pywell, R. F., Warman, E. A., Hulmes, L., Hulmes, S., Nuttall, P., Sparks, T. H., Critchley, C. 294 *Wahengbam, Raut, Pal and Banu* N. R. and Sherwood, A. (2006). Effectiveness of new agri-environment schemes in providing foraging resources for bumble bees in intensively farmed landscapes. *Bio. Conserv.,* **129:** 192-206.
17. Rasmont, P. (1988). Monographic ecologique et zoogeographique des bourdons de France et del Belgique (Hymenoptera, Apidae, Bombinae). Dissertation, Docteur en Sciences agronomiques. Faculte des Sciences agronomiques de l'Etat, Gembloux, Belgique.
18. Richardson, L. L., Adler, L. S., Leonard, A. S., Andicoechea, J., Regan, K. H., Anthony, W. E., Manson, J. S. and Irwin, R. E. (2015). Secondary metabolites in floral nectar reduce parasite infections in bumble bees. *Proc. R. Soc. B.,* **282:** 250142471-20142471. *doi.org/10.1098/rspb.2014.2471.*
19. Röseler, P. F. and van Honk, C. G. J. (1990) Caste and reproduction in bumble bees. In: *Social Insects,* Engels, W. (ed.). Springer, Berlin, Heidelberg. *doi: org/10.1007/978-3-642-74490-7_8.*
20. Saleh, N. and Chittka, L. (2006). The importance of experience in the interpretation of conspecific chemical signals. *Behav. Ecol. Sociobiol*., **61:** 215-220. *doi: 10.1007/s00265-006-0252-7.*
21. Saleh, N., Scott, A. G., Bryning, G. P. and Chittka, L. (2007). Bumble bees use incidental
22. Stanley, Dara (14 March 2016). Chronic exposure to a neonicotinoid pesticide alters the interactions between bumble bees and wild plants. *Funct. Ecol*., **30:** 1132-1139. *doi :10.1111/1365-2435.12644.*
23. Svensson, B., Lagerlöf, J. and Svensson, B. G. (2000). Habitat preferences of nest-seeking bumble bees (Hymenoptera: Apidae) in an agricultural landscape. *Agr. Ecosyst. Environ.,* **77:** 247-255.