Strategies for conservation of wild bees

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Importance of wild bees

When we say bees, most of us think only about the honey bees. A total of 20,507 species of bees have been recorded from the World (Ascher and Pickering, 2020) and nearly 75-80% of crops are pollinated by wild bees and remaining crops are pollinated by honeybees (Allen and Allen, 1990). Contributions of wild bees in pollination have always been underestimated due to our inadequate understanding of their nesting behaviour and more reliance on domesticated honey bees. Several wild bee pollinators are known to be found worldwide, that includes leaf cutter bees, carpenter bees, bumble bees, sweat bees and mining bees, etc. Only a few species of bees have been manipulated by humans to a limited extent for pollination activities (Pitts-Singer, 2008). These non- *Apis* bees are efficient pollinators than honey bees in many crops. Studies have shown that, only one-third of the pollination services are provided by honey bees while the rest is done by wild bees in the United Kingdom (Breeze *et al*., 2011). Garibaldi *et al.* (2013) surveyed 41 crop systems worldwide and found that fruit set increased significantly with flower visitation by honey bees in only 14% of the crop systems and an increase in wild bee visitation enhanced fruit set in the remaining 86% of the crop systems. Visitation by wild bees and honey bees enhanced fruit set independently in different crop systems, so pollination by managed honey bees supplemented, rather than substituted for, pollination by wild insects.

The challenges in utilisation of wild bees for pollination is a management tactics exist only for few species including leaf cutter bees and bumble bees. Leaf cutter bees (Megachilidae: Hymenoptera) have been used in large scale pollination of legume crops especially Alfalfa (Lucerne). The leaf cutting bee *Megachile rotundata* reformed the alfalfa seed industry by boosting its yields from 450 kg ha^{1} (when managed by honey bees) to an outstanding 1300 kg ha^{-1} (Thakur, 2012). This led to the exploration for utilization of other wild bees for their pollination services. In recent decades, there is a decline in the pollinator population due to fire, habitat fragmentation, destruction of natural habitats, and indiscriminate use of pesticides (Potts *et al*., 2010). In this context, the conservation of wild bees is very important to maintain diversified ecosystems.

Conservation efforts

Presence of bee populations with greater abundance and rich diversity is necessary for guaranteed pollination of domesticated crops and wild plants. Wild bees provide millions to the economy of agriculture and their contributions to forests, grasslands and wild flowers though impossible to measure, should not be overlooked (Thakur, 2012). Studies have shown that simple wild bee conservation efforts such as addition of native flower strips can provide additional income to the farmers (Delphia *et al*., 2019). Maintenance of pollination services in crops alone is not adequate to defend the wild bee

conservation. The loss of interactions between the wild bees and plants could have inescapable effects accelerating species extinctions and negative impact on ecosystem functions (Biesmeijer, 2006 and Diaz *et al*., 2013). In order to prevent the collapse of ecosystem services, there is an urgent need for conservation of these wild bee pollinators.

Bee hotels: A new kind of hotel is opening around the world. Its guests are wild bees. These hotels don't offer maid service, but they do give bees a place to nest. The nest is provided with different-sized holes to facilitate nesting sites for different bee species.

Fig. 1. Reeds of *Ipomea cornea* developed for nesting of *Megachile* species

Though trap nesting in terms of bee hotels has been recommended to increase pollinator nesting sites but they are more prone to parasitization (Maclvor and Packer, 2015). Veereshkumar *et al.* (2015) developed a trap nest from reeds of *Ipomia cornea* and observed almost 85.55% parasitization by *Melittobia* species on *Megachile* species. It may be because the reeds used for trap nesting were placed in clusters and it was easy for the parasites to locate their hosts. Hence, it is recommended to distribute the trap nests in smaller clusters.

Field of Dreams hypothesis: This hypothesis assumes that pollinators follow plant community restoration. "If you build it, they will come" (Palmer *et al*., 1997). Habitat losses are cited as the most frequent factor for declining wild bee populations. Habitat enhancements are considerably effective in coping with habitat losses. Restoration may involve the use of floral communities, which are preferred by the wild bees. Hence, sound knowledge of the preferred floral communities and their blooming period is an imperative aspect of restoration. Use of wild flowers as hedgerows around the field margins increase diversity and abundance by providing reliable foraging opportunities (Pywell *et al.,* 2012).

Ground-nesting "bee bank": More than 25,000 bee species nesting in the ground tunnels, in dried hollow stems, in dead woods and some desert bees even burrow into sandstone. Different species of bees nest in different soil types, but the soil should contain at least 35 percent sand.

Fig. 2. Ground nesting *Megachile lerma*

Stimulation of floral blooming by burning the grasslands increase the potential foraging sites, however burning activities may directly destroy the larvae in stem or twig nests. Hence, unnecessary mowing and burning should be avoided to prevent mortality. Disturbances to the habitat should

be minimized to the practical extent during nesting season (Young *et al*., 2016).

Safe use of Pesticides: Many pesticides have lethal effects on bees. Many pesticides and herbicides can either kill the bees directly or severely weaken the health of a bee colony when they expose to the application or its residues. If possible, do not spray pesticides on flowers directly. If the bloom needs to be sprayed, apply the pesticides in the evening hours. Thus, bees will not be active in the field during evening hours. Systemic pesticides should be avoided during foraging season as they get sequestered in pollen and nectar. *Bt* based pesticides have been found to be non-toxic to wild bees (Mader *et al.* 2010). Organic farms support significantly more abundant wild bee populations compared to conventional farms due to reduced insecticidal and herbicidal usage, which ultimately leads to a greater diversity of floral communities (Holzschuh *et al.* 2008).

Implementation of bills: Introduction of farm bills/ Acts to fund habitat restoration on agricultural lands. In the United States, the Farm Bill is used to channel federal funding for habitat restoration and is governed by the Natural Resource Conservation Service and the Farm Service Agency. In the European Union, the government sponsors agricultural land conservation through Agri-Environment Schemes (AES). The Environmental Quality Incentives Program (EQIP) and the Wildlife Habitat Incentives Program (WHIP) had pollinators as a priority taxon (Vaughan and Skinner, 2008). Strict management policies regarding the introduction of managed bees into non-native regions should be implemented to prevent spill-over of pathogens such as chalkbrood infections to the native wild bees (Pitts-Singer and Cane, 2011). Such strict bills are much needed to conserve bees.

Future outlook

New practices for integrated management of both honey bees and wild bees assemblages will enhance global crop yields. Scientific research will continue to be an imperative component of wild bee conservation programmes. There is a need for intensive studies on floral and nesting habitats of lesser-known species, taxonomic identification of bees and location-specific studies. To monitor the population trends, a more reliable and direct standardized monitoring method should be developed. There is a need to evaluate the effectiveness and safety of trap nests from competitors and parasites.

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