

## Know Your Desert

### Ecosystem Services, Threat and Floral Resources of Pollinators in Arid Zone

Pollinators provide vital ecosystem services under regulating series in the form of pollination for the sustainable production of cereals, pulses, oil seeds, fruits and vegetables. They come in all shapes and sizes and more than 100,000 invertebrate species- such as bees, moths, butterflies, beetles, and flies- serve as pollinators worldwide. It is amazing to see that at least 1,035 species of vertebrates, including birds, mammals and reptiles also pollinate many plants species. Pollination is a process of transferring pollen from the male stamen to the female pistil in a flower. Some plant species are pollinated abiotically with the help of wind or water. Most species, nevertheless, are pollinated biotically. Thus, pollinators become key biotic components of the ecosystem for sustaining human population as well as wild life flora and fauna. It is also the fact that pollinators such as bees, birds and bats affect 35 per cent of the world's crop production, increasing outputs of 87 of the leading food crops worldwide, as well as many plant-derived medicines which need to be envisaged properly.

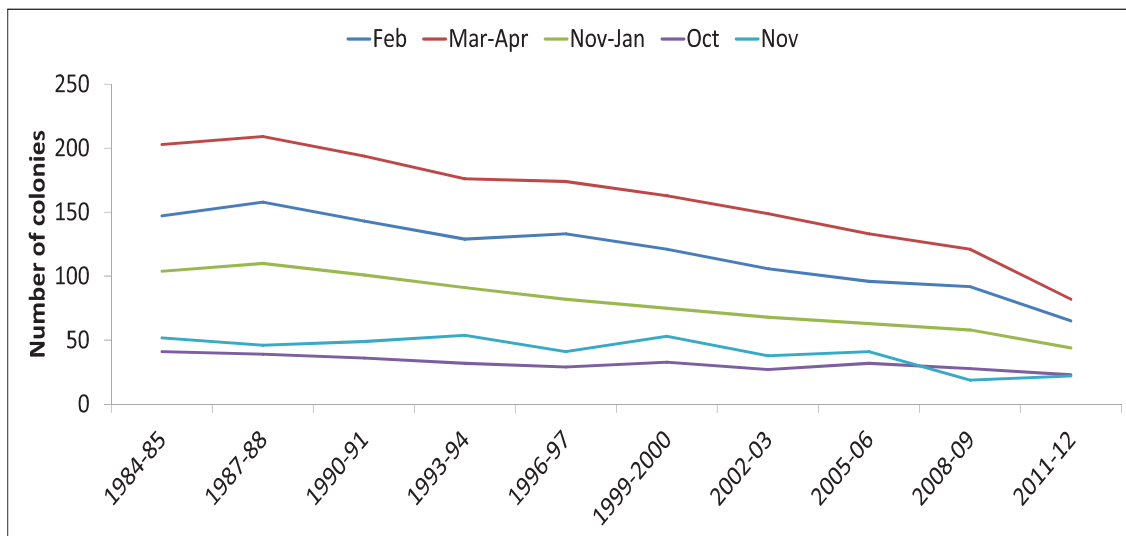
Among large number of insect pollinators, bees (honey bee, bumble bees, and carpenter bees) play most prominent and dominant role in ensuring crop production and have been documented to be capable of increasing yield in 96 per cent of animal-pollinated crops. The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) report of 2012 reflects that the annual economic value of pollinators is \$235-577 billion whereas the economic value of bee pollination has been estimated to about £153 billion per year for agriculture to the world. About 70 per cent of crop plants and 80 per cent of wild plant species are directly dependent on insect pollination for fruit and seed set. Although many of the better volume crops (e.g. rice and wheat) are wind-pollinated, a large proportion of fruit crops (apple, melon and berry), oil seed crops (rapeseed mustard and sun flower) and other crops like cucurbits, pigeon pea, coriander etc. require insects mediated pollination. Pollinators not only ensure seed and fruit formation but also enhance productivity and quality of seed and fruits. Crops dependent on insect mediated pollination are potentially vulnerable to declines in pollinator stocks. Inadequate pollination can result not only in reduced crop yields but also in delayed yield and a higher percentage of inferior fruits.

### Global initiative to conserve & sustain pollinators

The international initiative for the conservation and sustainable use of pollinators was established by the 5<sup>th</sup> Conference of Parties to the Convention on Biological Diversity (CBD) as a cross cutting initiative within its work on agricultural biodiversity through "facilitating and coordinating the initiative in co-operation with other relevant organizations who were invited to support actions in countries subject to pollinators decline." The FAO Global action on pollination services for sustainable agriculture also provides guidance to the member countries and relevant tools to use and conserve pollination services that sustain agro-ecosystem function. The IPBES, created in 2012, summarized a comprehensive picture of the decline in pollinators such as bees and butterflies. Global pollination benefits are dominated by a small number of countries and China is by far the most important country followed by India, USA, Brazil, Japan and Turkey.

### Decline in population and diversity of pollinators

There is a clear evidence of recent declines in both wild and domesticated pollinators, and parallel declines in the plants that rely upon them. Some evidences include declines in colonies of honey bee in the USA (59%) and Europe (25%) between 1985 and 2005. In India also, a loss of 45% of *Apis dorsata* colonies has been reported by Chaudhary Charan Singh Haryana Agricultural University, Hisar at their Campus between 1984 and 2012 (Fig. 1). In the arid and semi-arid region of India, many crops (rape seed and mustard) solely rely for their pollination on the wild honey bees *Apis florea* and *Apis dorsata*. Persistent decline in the number of giant honey bee colonies over the years is a serious loss of pollination service to the ecosystem and thereby obviously towards regulating services. Intensification in agriculture, indiscriminate



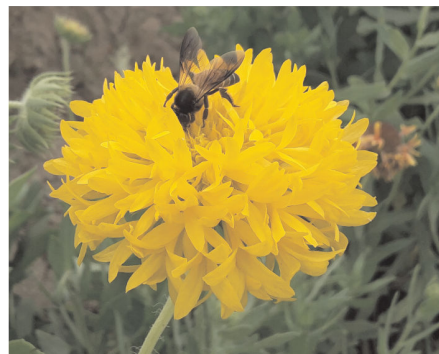
**Fig. 1. Pattern of decline of giant honey bee colony in semi-arid environment of Northwest India (adopted from Sihag, 2014)**

use of pesticide, loss of natural habitat and climate change has been reported to be a major cause for decline in honey bee colonies and population. Among these, changes in land use pattern has been suggested as one of the major factors that led to loss of the perennial herbaceous vegetation i.e. seasonal succession source of pollen and nectar required to sustain social bee colonies.

#### Floral resources for honey bee in arid and semi-arid region

Honey bees require carbohydrates, proteins, fats, minerals, vitamins, and water for the maintenance, growth and development of their colonies. These elements are sourced by flowering plants in the form of pollen (proteins, fats, minerals, vitamins) and nectar (carbohydrates). Therefore, conservation of wild plants that provide floral resources (nectar and pollen) and knowledge about temporal dynamics in providing these resources is necessary for conserving the diversity of pollinators. In this regard an observation was made at ICAR-CAZRI-RRS, Pali for dominance of honey bee species on native flora and ornamental flowers. In this area *Apis dorsata* (giant honey bee), *Apis florea* (dwarf honey bee) and *Xylocopa finestra* (carpenter bee) are dominant and common bee pollinators (Fig. 2). Some of the most important tree plants of arid region are good sources of pollen and nectars during driest month when availability of pollen and nectar become limited. These are Khejri (*Prosopis cineraria*), Rohida (*Tecomella undulata*), and Kair (*Capparis decidua*).

*P. cineraria* is one of the widely distributed trees in hot arid region of the India. The inflorescence is 8-12 cm long and small and creamy white to pale yellow coloured flowers profusely occur during March to May. *P. cineraria* inflorescence attracts large number of foragers of *Apis florea* during this period. *C. decidua* possess large, highly conspicuous and coloured flowers (red and orange) and flowers twice a year (summer and winter). In summer, plants flowers during February to July and in winter during September to December. During this flowering period they provided pollen and nectar to the carpenter bees (*Xylocopa finestra*) and giant honey bee (*Apis dorsata*). *T. undulata* flowers are large, corolla tube with pale yellow to orange colour and appear in dense clusters from February to May. These flowers are good sources of nectar and are heavily visited by *Apis dorsata* and sun birds. The ornamental flowering plants of family Asteraceae like *Chrysanthemum*, *Calendula*, *Gaillardia* and Marigold are very good sources of pollen and nectar. Planting of these enhance diversity and population of honey bee during January-March (Fig. 2).

*Apis florea* *Colophospermum mopane**Apis florea* on *Prosopis cineraria**Apis florea* on *Calendula officinalis**Apis florea* on *Chrysanthemum indicum**Apis dorsata* on *Gaillardia pulchella**Apis dorsata* on *Tagetes erecta*

**Fig. 2. Honey bee (*Apis florea* and *Apis dorsata*) foraging on flowers of trees and shrubs**

**Dipak Kumar Gupta, A.K. Shukla, Keerthika A,  
M.B. Noor Mohamed, Kamla K. Choudhary and B.L. Jangid**  
ICAR-CAZRI, RRS, Pali-Marwar

## *Technological options*

### **Rejuvenation of drying *Prosopis cineraria* through Biocontrol agents in arid region**

*Prosopis cineraria* (Indian Mesquite) locally called as Khejri or Janti is believed to be the best suitable agroforestry species, due to its deep taproot system, soil fertility improvement and yield augmentation of under storey crops. Khejri offers nutritious supplementary food (pods, seed, etc.), top-feed (leaves and pods) and protection-cum-shelter for the benefit of humans and livestock during all the seasons.

In last two decades, large scale mortality of *P. cineraria* (Khejri) trees have been observed in certain pockets of the region due to *Ganoderma lucidum*, a root rot causing soil borne plant pathogen. The disease is more prevalent in sandy soils where trees grow under rainfed conditions. Soil moisture stress coupled with high temperature (55°C) during summer months predispose the host to fungal infection. The spread of the disease from diseased plant to healthy is through root to root contacts. Another important observation was that road side plantation of *Acacia tortilis* which has a lateral root system has increased the infection chances in *Prosopis cineraria* which also develop lateral root because of availability of moisture at upper soil depth (Fig. 3). Mechanical ploughing and tractorization injured the lateral roots of *Prosopis*