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**Global crop pollinators-not just bees!*****Sharanabasappa M. Ganganalli and Haseena Bhaskar\****

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Pollen transfer in plants is accomplished by various abiotic and biotic agents. Abiotic agents of pollination are inanimate physical forces like wind, water and gravity, and thus pollination is at random. Biotic pollination carried out by animals, termed as zoophily on the other hand, is accurate. Animal pollinators are engaged in a remarkable mutually beneficial interaction with the plants. By recent estimates, nearly 90 percent of the described angiosperm species are pollinated by animals (Ollerton *et al.*, 2011). Globally, animal pollinated crops have been estimated to constitute 1/3<sup>rd</sup> of the human diet (Klein *et al.*, 2007).

The biotic pollination naturally falls into several distinct classes: pollination by insects (entomophily), pollination by invertebrates such as snails and slugs (malacophily) and pollination by vertebrates, such as birds (ornithophily), bats (chiropterophily) and nonflying mammals (Simpson, 2010). Insect pollination or entomophily is the most common type and has played a major role in the evolution of angiosperms. Bee pollination (melittophily) of

crops is well documented and bees are often assumed to be the most important pollinators.

Wild pollinators other than honey bees recently have been recognized for their role in increasing and stabilizing crop-pollination services. Non bee insect pollinators include beetles (cantharophily), flies (myophily), butterflies (psychophily), moths (phalaenophily) and ants (myrmecophily). Midges in the family Ceratopogonidae (Diptera) are the most important pollinators of cacao globally (Adjaloo and Oduro, 2013). The African weevil, *Elaeodobius kamerunicus* was introduced into Malaysia in 1980 to increase pollination of oil palm, and within a few years, the weevil established in oil palm plantations nationwide. Following the introduction, the fruit set improved and yield increased by 20 percent in Peninsular Malaysia (Ponnamma, 1999). Ant pollination is a rare mutualistic association and often occurs with flowers that are low growing and inconspicuous. *Conospermum undulatum* (Proteaceae), a threatened plant species, endemic to Australia has evolved pollen with resistance to the negative effect of ant secretions on pollen grains, with ants providing

effective pollination services (Delnevo *et al.*, 2020).

Pollination by snails and slugs is considered as a rare and infrequent phenomenon. The graceful awl snail, *Lamellaxis gracile* plays a significant role in the pollination of morning glory, *Volvuopsis nummularium* (Convolvulaceae), especially on rainy days when the activity of bees is completely lacking (Sharma *et al.*, 2007). The nectar-feeding glossophagine bats searching for flowers are guided by their echolocation system as well as olfactory cues in detecting and recognizing nectar sources. (Helvesen *et al.*, 2002).

Bird pollination is as important as insect pollination in the tropics and in Southern temperate zones. Balasubramanian (2012) reported that 292 forest birds are involved in pollination and seed dispersal in south India. Out of them, birds belonging to family Nectariniidae, Sturnidae and Zosteropidae represented by sunbirds, mynas and starlings form the major avian pollinators in Indian forests.

Pollination appears to be increasingly endangered by human activities in many ecosystems worldwide. The need for conservation of pollinators must be fully recognized by biologists, ecologists and agriculturists for maintaining biodiversity and sustainable crop production. Conservation efforts for pollinators should focus on regulation of pesticides, integrated pest

management and conservation or restoration of natural/semi-natural habitat.

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