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Pollinator Decline: A Major Issue in Crop Production

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ABSTRACT

Decline biodiversity results decline in pollinators and vis-a-vis. Ecosystem health and agriculture wealth depends on a particular invertebrate fauna to deliver pollination services. Extensive losses in pollinator guilds and communities can disrupt ecosystem integrity, a circumstance that today forces most farmers to rely on honey bees for much fruit and seed production. Today it seems that pollination services in many areas of agriculture are threatened by the inadequacy or lack of sustainable managed indigenous or imported pollinators. Pollinator shortage can adversely affect crop production and commodity market.

Key words: Honey bees, Polinators, Polinator decline, Ecosystem

Today alarming declines in the health and populations of pollinators poses a significant threat to the integrity of biodiversity, to global food webs and to human health and survival. About 75% of the genetic diversity of agriculture crops lost since the beginning of 20th century from the earth and 25% of the worlds species present in the mid 1980 will be lost by 2015 (FAO 1993). Wilson (1988) estimated that 0.2-0.3% of all species are lost every year. Habitat loss, fragmentation and degradation, pesticides, invasive species, parasites and diseases, exploitation and climatic change etc are major causes for pollinator decline (William and Osborne 2009). Disruption of pollinator systems and declines of certain types of pollinators has been reported on every continent except Antarctica (Kearns *et al*. 1998).

An estimated 62% of all flowering plants may be suffering reduced regeneration from seeds as a result of pollinator scarcity (Burd 1994). Over the past decade, farmers in Himalayan region have been complaining about decline in apple production and quality due to pollination related problems. Apart from habitat alteration from highly diverse natural ecosystem for less diverse agro-system, indiscriminate use of pesticides, and the over harvesting of honey through traditional honey hunting methods have contributed to the examination of both the diversity and abundance of pollinating insects. The number of commercially managed honey bee colonies in US has declined from 5.9 million in the 1940's to 4.3 million in 1985 and 2.7 million in 1995 (Meheshwari 2003).

Pollinator decline: Are they a real phenomenon

Pollinators are declining in number resulting in decreased seed and fruit set in the plants that they services (Buchnann and Nabhan 1996). In USA, the number of commercial honeybee colonies declined from 5.9 million (1940s) to 4.3 million (1985) to 2.7 million (1995) (Maheshwari 2003). In Costa Rica, wild bee species richness in degraded forest lands decline from 70-37 species in 14 years (Nebhan and Buchmann 1997).

Pollinator decline: Observation

About 75% of genetic diversity of agricultural crops lost since the beginning of 20th century from the earth and 25% of the world species present in the mid 1980 will be lost by 2015 (FAO 1993). Over 85% of the 7000 or so apple variety grown in last century is now extinct in the USA (FAO 1993). In 1970, genetic uniformity of maize in USA caused almost $1000 million loss and yield reduced by as much as 50% (Thapa 2006). Wilson (1988) estimated that 0.2-0.3% of all species are lost every year. The importance of pollinator management and managerial pollination International Centre for Integrated Mountain Development, Kathmandu, Nepal.

Causes

Habitat fragmentation, loss and degradation

Degradation and fragmentation as the main adverse habitat changes for pollinator populations. Hedgerows, field margins, embankments, and other waste places provide nesting habitat for some native bees. Removal of these often unappreciated habitats has been associated with dramatic declines in Germany's native bee fauna since the 1960s. Fragmentation and habitat destruction can add to the rate of genetic erosion by reducing gene flow between demes (locally interbreeding group within a geographic population), and increases the likelihood that populations and species will become extinct. When large habitats are fragmented into small isolated patches, it is not long before some of the animal residents decline in numbers to the point that they no longer provide effective ecological services.

Pesticides

Widespread usage of pesticides is a major threat to pollinators worldwide, especially with the onset of modern large-scale agricultural practices. This results in the requirement of large number of commercial bee colonies for pollination. These pollinators feed on the contaminated flowers, which has resulted in bee poisoning becoming the most important problem for beekeepers throughout the world. Honeybees are susceptible to almost all pesticides used commercially to control pests and diseases. Poisoned bees not only die but, even on exposure to sub lethal doses, suffer disruption in dance behavior and thereby breakdown of accurate communication of information about resources. Poisoned queens are unable to maintain control over the hive and are often superseded.

A survey conducted very recently to record flower visitors in insecticide sprayed and non-sprayed mustard crop is present in Table-1. The insect flower visitors in non-sprayed field were recorded over three times higher (19 insect species) than those in sprayed field (6 species). It is clear that pesticide spray has been one of the various factors for pollinator decline.

Table 1 Insect flower visitors in sprayed and non-sprayed mustard crop in chitwan

Common name	Scientific name	Sprayed field	Non-sprayed field
Lady beetle	*Coccinella* spp.	_	+
Bumble bee	*Bombus* spp.	_	+
Yellow handed wasp	*Xylocopa* spp.	_	+
Rice skipper	*Pelopidas methias*	_	+
Tiger moth	*Nyctemas lactinia*	_	+
Cowpea pod borer	*Lampides boeticus*	_	+
Cynthomid fly	*Cyntomis passalis*	_	+
Mustard sawfly	*Athalia proxima*	_	+
Nymaphalid butterfly	*Presis atlites*	_	+
Mud wasp	*Chlorion labatum*	_	+
Short horned grasshopper	*Oxya* spp.	_	+
Green stink bug	*Nezara viridula*	_	+
Blister beetle	*Mylabris* spp.	+	+
European honeybee	*Apis mellifera*	+	+
Asiatic honeybee	*Apis cerana*	+	+
Rock bee	*Apis dorsata*	+	+
Syrphid fly	*Milesia* spp.	+	+
Tabanid fly	*Tabanus* spp.	+	+
Hymenopteran wasp	*Sphex macuta*		

+ = Present, - = Absent Source: Thapa (2006)

Agricultural practices

Modern agriculture is large-scale, usually monoculture, and often involves removing surrounding natural vegetation. Monocultures reduce floral diversity, thus limiting the variety of pollinators that could be supported. Extensive cultivation with loss of intervening natural vegetation results in loss of nesting areas for pollinators such as bees, fewer larval host plants for pollinators such as butterflies as well as loss of diversity of microhabitats suitable for egg-laying and early development. Agricultural practices that require frequent tilling and irrigation also cause declines in soil nesting bees. In India, the soil nesting bees *Andrena ilerda* and *A. laena* that are important pollinators of the oilseeds, *Brassica compestris* and *B. juncea*, showed six and thirteen-fold declines from 1980 to 1992.

Parasites and pathogens

Infections by the parasitic mites *Varroa jacobsoni* and *Acarapsis woodi* have been devastating populations of commercial honeybees. *Varroa's* original host was the Asian honeybee *Apis cerana* from which it spread to *A. mellifera* when *A. mellifera* was introduced into Asia for beekeeping. The Thai sac brood viral disease in Asian honeybees has also been damaging to commercial pollinations.

Radiation

Radiations transmitted by cell towers affect the commercial apiary located near the towers. Currently it is not a top priority of pollinator decline.

Hive destruction

Bees are often viewed negatively by homeowners and other property owners. A search for carpenter bees on the Internet primarily yields information on removal rather than information regarding bees in a positive light. Recent hysteria regarding killer bees has contributed to these views. Beekeepers find increased vandalism of their hives, more difficulty in finding locations for bee yards, and more people inclined to sue the local beekeeper if they are stung, even if it is by a yellow jacket.

Light pollution

Increasing use of outside artificial lights, which interfere with the navigational ability of many moth species, and is suspected of interference with migratory birds, may also impact pollination. Moths are important pollinators of night blooming flowers and moth disorientation may reduce or eliminate the plants ability to reproduce, thus leading to long term ecological effect. This is a new field and this environmental issue needs further study.

Air pollution

Researchers at the University of Virginia have discovered that air pollution from automobiles and power plants has been inhibiting the ability of pollinators such as bees and butterflies to find the fragrances of flowers.

Consequences

Biological consequences

Less frequent flower visitation, abrupt or gradual decrease of seed and fruit production. Beekeeping sector in danger in several areas of the world. Self-compatible flower plants can suffer from inbreeding. There is pistil senescence.

Economic consequences

Economic value of a single wild bee serving as a pollinator of blueberry was estimated at $20 (Cane 1996). One hive of honeybees/ ha of apple orchards caused an increase in return equivalent to 700% of the cost of pollination services (Kevan 1997). Value of US crops yields of pollinators other than honeybees may be as high as $6.7 billion per annum (Nabhan and Buchmann 1997).

Impact of pollinators on world crops

The economic impact of insect pollination on worldwide basis amounted to 149 billion Euros or 21.3% of the total value of the crops that produce fruits or seeds for direct human use. The total value of crops used for human food is 1.65 billion Euros and 10 of the 20 most important crops worldwide depend to some extent on insect pollinators. 99% of the total world crop values, 54% of this value rest upon crops that depends on insect pollinators. Average value of crops that depends on insect pollinators is much higher than that of the crops not pollinated by insects such as cereals and sugarcane (Rs. 50, 160 and Rs. 9900/ metric tons, respectively). The pollinator deficits may increase the cost of production as the cost of providing pollinator services rises (Anonymous 2008).

CONCLUSION

We conclude that there is ample information to suggest the existence of pollinator declines that have affected, and are affecting agriculture productivity. Pollinator declines have different economic impacts on producers and consumers. It is essential to recognise that pollination is not a free service, and that investment and stewardship are required to protect and sustain it. Economic assessment of agriculture productivity should account for the cost of sustaining wild and managed pollinator populations.

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