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STUDIES IN WILD PLANT POLLINATOR DIVERSITY, ITS CONSERVATION AND POLLINATION BENEFITS

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ABSTRACT
Pollinators are important agriculturally and ecologically. They are ecosystem service providers and increase the yield of plants all over the world. A rich floral community and a more diverse pollinator community enhance pollination in plants by facilitating reproduction, productivity and diversification of plants. Pollinators are very crucial for the functioning of agricultural ecosystems. Crop plant production, all over the world, is dependent on insect pollination. Our study area is the largest and important 'Orange' producing belt of India. In *Citrus* plants, 95% fruit setting is possible after pollination with honeybees. Recent developments in agriculture and the increased use of insecticides and growth-promoting foliar sprays resulted in a decrease in pollinator diversity and density. Thus, attempts have been made to study the diversity of pollinators. Appropriate measures will be suggested for the conservation of pollinator diversity.

Keywords: Wild Plant, Pollinator Diversity, Conservation, Warud, Amravati.

INTRODUCTION:

Plant-Pollinator relationships are important agriculturally and ecologically. Pollinators are ecosystem service providers and increase the yield of plants all over the world [1-3]. Pollinators are very crucial for the functioning of agricultural ecosystems. Crop plant production is dependent on insect pollination [4]. Rich floral communities and more diverse pollinator communities enhance pollination in plants by facilitating reproduction, productivity and diversification of plants [5, 6]. Butterflies are an important group of insects adored by humans. Butterflies are pollinators as adults and paste as larvae. Therefore, more collaborative research work is needed to establish the role of butterflies as pollinators [7].

Insect pollination affects the yield of 75 globally important crops. Over the last 50 years, the yield of pollinator-dependent crops has increased and become variable than pollinator-independent crops. Insect pollinated crop yields fetch higher sale prices than pollinator independent plants. An estimated 5-8% of global crop production would be lost without pollination services. This will lead to a change in the human diet and the inappropriate expansion of agricultural land. Pollinator losses could result in a substantial rise in the global rate of preventable diseases. Loss of pollinators may produce a negative impact on the reproduction of wild plants [8].

The role of wild bees in pollination is well known [9]. Bees are important for the maintenance of ecological equilibrium and biodiversity in the natural world. Bees visit more than 90% of the

leading 107 global crop types. Bees can help to ensure livelihood security and alleviate poverty among rural communities through honey harvesting and apiculture practices based on innate as well as local knowledge. However, there is growing evidence highlighting the role of wild pollinators and of diverse pollinator assemblages in contributing to global crop production [8]. Pollination is essential for roughly 25,0000 flowering plants. Plants and pollinators, through specialized interaction, have evolved together to achieve mutually beneficial goals[10]. Honeybees' ability to offer optimum pollination services has been decreased in the last 20 years. On the contrary, insect-pollinated crop yield has been increased significantly during the same period. This suggests that the wild pollinators also provide pollination services in crop plants. These results would help us for successful pollination administration at the field and landscape levels [10].

In recent years, pollinator density is declining continuously. This has resulted in a negative impact on the productivity of plants. The worldwide decline in insect pollinators has raised questions about the availability of pollination services. Urbanization is the main cause behind declining pollinator diversity and density. Use of insecticides, monoculture practices, pollution and climate change, use of modern Agri-techniques, reduction of suitable habitats for foraging and nesting resulted in the loss of pollinator diversity [11-13]. Increased field size, simplified crop rotation and homogenization of agricultural landscapes added to this. Therefore, sustainable management of agriculture and biodiversity has become impossible[14].Risk to pollinators is from pesticides (including insecticides, acaricides, fungicides, molluscicides and herbicides) through toxicity and level of exposure. Herbicides reduce the abundance and diversity of flowering plants. Climate change will change the seasonal activity and ranges of many pollinator species[8]. Insecticides, like neonicotinoids and other, can damage pollinators after close contact. Nutritionally poor insect pollinators are more prone to disease, insecticides and pesticides [10].

Wild and managed pollinators gives extensive advantages to society. These advantages includes not only major contributions in food security for increasing global populations, famers and beekeeper subsistence and sociocultural values but also in the maintenance of large diversity along with ecosystem equilibrium. Honeybees produce honey and other bee-keeping products (wax) and support cultural values. Insect pollinated cash crops provide employment and income for millions. Pollinator-dependent plants also contribute to the 'Non-Timber Forest Produce'. Pollinators and their products benefit society indirectly as sources of inspiration for art, religion, traditions, technology and education[8, 15].

Pollinator conservation has become a challenge due to the loss of floral diversity. Loss of foraging and nesting resources has been a major factor. The creation of floral rich habitats, flower-rich buffer strips, field-border planting, use of temporary flowering cover crops would help us to promote pollination services [16].

Study Area:

Warud tahsil is situated on the North-East side of Amravati district in Maharashtra State. It lies between 21 21' 33" to 21 38'54" North latitudes and 78 1'54" to 78 25'7" East longitudes. The total geographical area is 745 Sq. Km. Along North-East and North-West

borders, Satpuda Hill Ranges are supporting rich 'Dry Deciduous Forest'. The total population of Warud tahsil is 224984 (2011 Indian Census). Warud tahsil has an agriculturally based economy. The area of Warud tahsil is famous for orchards of Mandarin Oranges and is commonly known as 'California of Vidarbha'. Forest areas (Mahendri forest, Rawala Forest, and Shekhdari Forest) are rich in floral diversity. However, forest cover has been reduced by 3.43% (25.6 Sq. Km.) from 1978 to 2008. The use of forest land for human settlements and intensive agricultural activities are the major responsible factors [17].

METHODOLOGY:

We focused on the Warud tahsil area of Amravati district for the study of pollinator diversity. Data were standardized to ensure the species names and taxonomic groups. Pollinators recorded were classified into taxonomic groups, such as- 1) Honeybees (including *Apis cerana indica*, *A. dorsata*, *A. florea* and others as *Apis* sp.) 2) Bumblebees 3) Stingless bee 4) Sweat bees 5) Carpenter Bees 6) Butterflies and moths 7) Ants 8) Beetles and 9) Birds. The dominant taxonomic group and species were identified based on recorded data.

Sampling was restricted to daytime only with favorable conditions for pollinator activity. Pollinator diversity was recorded in sampling areas by slowly walking along. The study was carried out in 2019 and 2020. The diversity of pollinators was recorded along the roadsides, field borders and in forest areas (Mahendri forest, Rawala forest and Shekhdari forest) during different seasons of the year. Field photographs of the pollinator were taken for the identification of pollinators. Weekly observational tours were conducted for pollinators during different hours of the day. Honeybee forage plants were recorded.

RESULT AND DISCUSSION:

During this wild pollinator study, it was found that honeybees are the dominant pollinators and are responsible for providing pollination services in most of the wild plants. Decrease in forest cover by 3.43% (25.6 Sq. Km.) from 1978 to 2008, due to anthropogenic pressure, is the major threat to wild pollinator diversity, density and the pollination services provided by these pollinators. Loss of green, natural fencing along the field border, excessive use of pesticides and herbicides in the management of orange orchards and agriculture adding to the decline of wild pollinator diversity. *Apis mellifera* is not recorded from the study area during the present work; indicates that *A. millifera* has been lost from this area. A list of 37 wild flowering plants along with their wild pollinators and a photo-plate of 30 selected wild pollinators is also given for reference. Total Nine taxonomic groups of wild pollinators have been recorded during the study.

It was also noted that, though Warud tahsil is famous for orchards of mandarin oranges and 95% fruit set can be achieved in *Citrus* by using honeybees as pollinators, owners of the orange orchards are little aware of diversity and density of pollinators, conservation of pollinators and role of honey bees in orange orchard management. The use of pesticides is a common practice in the management of orange orchards. High doses of pesticides are used to spray after regular intervals. This has resulted in a decrease in the diversity and density of honeybees and other wild pollinators. Another change noticed during this study, throughout the area, is eradication and removal of green and natural field-border fencing and fixing of barbed steel wires. Eradication and removal of green fences have completely disturbed the foraging and nesting

resources of wild pollinators. Many economically and ecologically important plants are on the verge of local extinction. Herbicides are regularly used to spray not only along the orange orchards but also in other crop fields too. All these activities have completely disturbed pollinator diversity and the services provided by these natural creatures. Continuation of these activities will result in a decline in the diversity and density of pollinator communities in the future. This is going to affect the production of oranges because honeybees are the key pollinators of orange plants.

Insect pollination helps to increase the yield of plants in form of fruits and seeds. Farmers from a developing country, where agricultural inputs are costly, can improve agricultural production by using these natural service providers.

Information gathered in this study can be used for the conservation of pollinator diversity and density in wild and cultivated areas. There is a need to incorporate this knowledge in the perception of local peoples, farmers, and those who are interested in agriculture and in wildlife conservation. Government schemes should be launched for the promotion of pollinator diversity. Conservation of green agricultural fencings, plantation along the roadsides, creation of green belts and active participation of farmers society are some of the ways that would help us to increase pollinator diversity.

Many countries started several action plans for the conservation of bees. Convention on Biological Diversity (CBD) established the 'International Pollinator Initiative (IPI)' in 2000 for the conservation and sustainable use of pollinators. Scientific data regarding the decline in pollinator density and disappearance of honey bees, especially *Apis millifera*, is largely deficient in Asian countries like India. Therefore, research-oriented action plans, for the conservation of honey bees, are essentially required. Mellisopalynological studies provide information about foraging resources. This type of data can be used in the management of pollinator and pollination services through the conservation of economically important plant species. Preparation of a list of pollinators, at the national level, is essential for policymakers and practitioners, management of ecosystem services and conservation programs [18].

CONCLUSION:

Pollinators are one of the most important components of biodiversity. They provide ecosystem services for the production of food. Conservation of pollinators has become a challenge for all of us. The creation of floral rich habitats and reduction in the use of insecticides can help us to conserve pollinator diversity. Local peoples and the farmers should be educated about the direct or indirect benefits of pollination and the consequences of rapidly declining pollinator diversity. Eco-friendly agricultural practices should be promoted by providing organic fertilizers and foliar sprays to the farmers.

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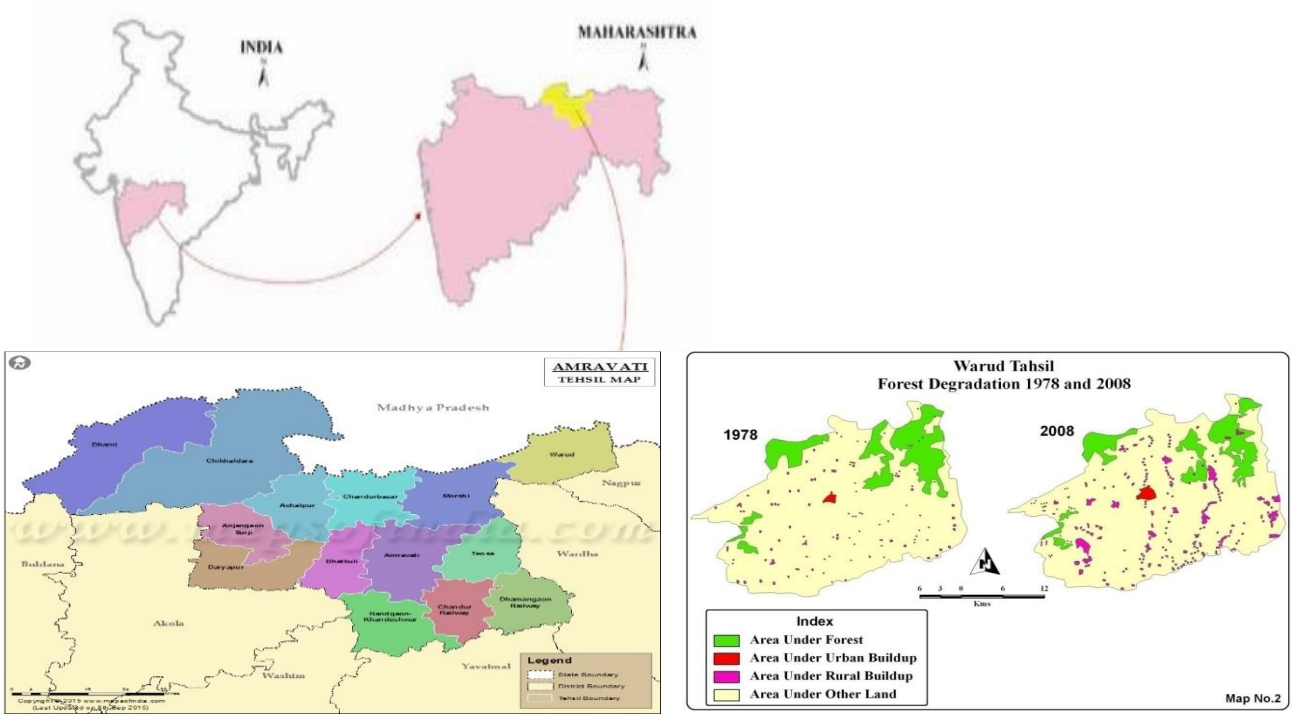

Courtesy: Khandar and Waindeshkar, 2012

Table 1: List of wild plants and their pollinators.

Sr. No.	Plants Name	Pollinators Recorded (Common Name)	The Scientific name of Pollinator
1	*Chlorophytum tuberosum*	Sweat Bee	*Lipotriches* sp.
2	*Cleome chelidoni*	Honeybee	*Apis florea*
3	*Cleome chelidoni*	Honeybee	*Apis dorsata*
4	*Cleome chelidoni*	Honeybee	*Apis florea*
5	*Ammannia baccifera*	Leaf Beetle	*Chrysochus asclepiadeus*
6	*Abelmoschus mannihot*	Blister Beetle	*Mylabris phalerata, M. pustulata*
7	*Datura stramonium*	Mason Bee, Stingless bee	*Osmia bicornis, Tetragonula sp.*
8	*Coccinia grandis*	Honeybee	*Apis florea*

9	*Clematis heynei*	Honeybee	*Apis cerena*
10	*Datura metel*	Mason Bee	*Osmia bicornis*
11	*Calotropis procera*	Honeybee	*Apis florea, A. cerena, Xylocopa sp.*
12	*Vallaris solanacea*	Honeybee	*Apis dorsata*
13	*Withania somnifera*	Honeybee	*Apis florea*
14	*Calotropis gigantea*	Bumblebee, Carpenter bee	*Xylocopa sp.*
15	*Merremia dissecta*	Honey bee	*Apis florea*
16	*Tridax procumben*	Honey bee, butterfly, Moth	*Apis florea, A. cerena, Colatis danae, Eretmocera impactella*
17	*Opuntia elatior*	Red Ants, Honey bee	*Solenopsis invicta, Apis florea*
18	*Aspidopteris cordata*	Honey bee	*Apis florea*
19	*Milletia auriculata*	Common Bush-brown Butterfly	*Mycalesis perseus*
20	*Gloriosa superba*	Orange Blister Beetle	*Mylabris pustulata, M. phalerata*
21	*Calotropis gigantea*	Bumblebee	*Xylocopa sp.*
22	*Bidens pilosa*	Stingless Bee	*Tetragonula sp.*
23	*Abutilon pannosum*	Blister Beetle	*Mylabris pustulata, M. phalerata*
24	*Vachellia farnesiana*	Beetle,	*Euchroea sp.*
25	*Senna auriculata*	Carpenter ant	*Componotus sp.*
26	*Cadaba fruticosa*	Honey bee, Oman Butterfly	*Apis florea, Colatis danae*
27	*Cadaba fruticosa*	Oman Butterfly	*Colatis danae*
28	*Echinops echinatus*	Honey bee	*Apis florea*
29	*Lavandula bippinata*	Carpenter ant	*Camponotous pennsylvanicus*
31	*Ipomoea fistulosa*	Sweat bee	*Halictus poeyi*
32	*Erythrina variegata*	Red-vented Bulbul, honeybees	*Pycnonotus cafer, Apis florea, A. cerena*
33	*Bombax ceiba*	Common Myna, Brahminy sterling, Red vented bulbul	*Acridotheres tristis, Sturnus pagodarum, Pycnonotus cafer*
34	*Oroxylum indicum*	Sparrows	*Parus sp.*
35	*Urena lobata*	Carpenter ant	*Componotus sp.*
36	*Celosia argentia*	Silver Banded Butterfly	*Spindasis sp*
37	*Fleuggia macrocarpa*	Butterfly	*Spindasis sp.*


Chlorophytum tuberosum


Cleome chelidoni


Cleome chelidoni


Cleome chelidoni


Ammannia baccifera


Abelmoschus mannihot


Abelmoschus manihot


Datura stramonium


Coccinia grandis


Clematis heynei


Datura metel


Calotropis procera


Calotropis procera


Vallaris solanacea


Withania somnifera


Calotropis gigantea


Merremia dissecta


Tridax procumbens


Opuntia elatior


Aspidopteris cordata


Milletia auriculata


Gloriosa superba


Calotropis gigantea


Bidens pilosa


Abutilon pannosum


Vachellia farnesiana


Senna auriculata


Cadaba fruticosa


Cadaba fruticosa


Echinops echinatus

Photo Plate: Showing wild plants and their pollinator