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# Diversity and Abundance of Beneficial Insects in Forest Ecosystem of Madhya Pradesh

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**ABSTRACT: Natural ecosystem services such as soil formation, nutrient cycling, pollination of plants and biological control of pests are provided by beneficial insects. But in present scenario due to heavy and indiscriminate use of chemicals decrease the diversity of these insects. Hence conservation point of view study was conducted to survey the diversity of beneficial insects in different agro climatic zones of Madhya Pradesh in the year 2017- 2020. Ten different species of beneficial insects were surveyed from the area. Diversity indices were calculated by using Shannon- Weiner index; Margalef's index and Evenness index. The result shows that the diversity of beneficial insects in forest ecosystem in Madhya Pradesh is rich and diverse.**

**Keywords:** Ecosystem, Diversity, Pollination, Beneficial insects, Madhya Pradesh.

## I. INTRODUCTION

Natural enemies and pollinators which are mainly included in beneficial insects provide ecosystem services like pest diseases management and pollination. Various group of organisms that include parasitic insects, predators, nematodes and microorganisms are natural enemies. Predatory insects are usually fairly active, large and conspicuous in their behaviour. They consume many insect preys in their life (Lee *et. al.* 2001). Praying mantis, earwigs, true bugs, spiders, ground beetles, ladybird beetles, lacewings and hoverfly larvae are common predators of insect pests (Cork *et al.*, 2003). Coccinellid beetles are important natural enemies for biological control of coccids, small larvae, adelgids, aleyrodids, aphids, insect eggs and phytophagous mites, which are harmful to agricultural and forest plantations (Kundoo and Khan 2017). According to Lee and Landis (2001) insect Parasitoids are organisms which develop within their pest hosts. Insect pollination provides remarkable economic and aesthetic benefits as well as cultural value to human society. Some beneficial insects such as bees (honeybees and wild bee), butterflies, moths and flies play a key role in pollination of food crops and flowering plants (Nicholls and Altieri 2013; Gajbe 2019a&b). Most annual crops depend on pollination for seed production and fruit set to achieve good yield. Globally, around 35% of crop production is a result of pollination and it is estimated that about 70 % crop plants are pollinated by insects (Das *et al.*, 2018). Since a long time honey and bee wax which is obtained from *Apis* spp. is being used in medicines (Getanjaly *et al.*, 2015). *Apis dorsata* is one of the key natural resource complementary to forest and agriculture for its contribution to pollination service and it can be an income generating activity for farmers, tribal honey hunters as well as traditional beekeepers. Some insects such as termites, Ants, caterpillars etc. are being used by people as food in many countries (Mahapatro (2015); Kumari & Sudhanshu 2009). Being a primary producer of silk, silkworm, Bombax mori is an economically important insect. The silk is also harvested from the *Antherea* spp. that is found in the India, Japan and China's forests and can be dyed, spun, into thread and woven into fabric. *Laccifer lacca*, is a scale insect that secrete lac as a protective covering over the body, brown in colour and it usually grows on Acacia trees in India and Burma. Lac is commercially important and it is used as inks, polishes, dyes, sealing waxes etc.

Madhya Pradesh state, with subtropical climate, is located in the geographic heart of India between the latitude of 21.6°N - 26.30°N and longitude of 74°9′E - 82°48′E and has hot dry summer (April–June) followed by monsoon rains (July-September) and relatively dry winter. The average rainfall is

about 1194 mm. Important forest formation of the state include Teak and the Sal forests while areas bearing Bamboo are widely distributed.

## II. MATERIALS AND METHODS


**Fig. 1.** Agro-climatic zones of Madhya Pradesh.

**Study sites:** The present study was conducted during April 2017 to December 2020. Survey in different seasons was carried out in moist, semi moist and dry forest areas in eleven agro-climatic zones. Chhattisgarh Plains (six localities), Northern Hills of Chhattisgarh (ten localities); Kymore Plateau (twenty four localities) Vindhyan Plateau (four localities) Central Narmada Valley (three localities); Satpura Plateau (four localities) Gird Zone (eleven localities); Bundel Khand Zone (three localities); Malwa Plateau (eight localities); Nimar Valley (six localities); Jhabua Hills (seven localities) of Madhya Pradesh to collect the beneficial insects. The study was focused on the ten different species of important beneficial insects viz., Parasite Wasp, *Trichogramma raoi*, *Apanteles machaeralis*, *Xanthopimpla cera*, Predator Bug, *Canthecona furcellata*, Predator Seven-spot Ladybird Beetle, *Coccinella septempunctata*, Dragonfly, *Crocothemis servilia*, Pollinator, Honey bee, *Apis dorsata*, Productive insect, wild silk worm, *Antheraea paphia*, Productive insect , Lac insect, *Kerria lacca*, Human food/medicine insect, Red Ants, *Oecophylla smaragdina.*

**Sampling:** Sampling was carried out by using sweep net (diameter 30 cm and 1.5 mm mesh), hand picking, light trap and search method. Records were maintained for the number of individuals of each species collected during every survey trip. Sampling was carried out as described by Janzen and Schooner (1968). Population estimation was carried out to determine the biodiversity of insects for which each selected site was divided in to ten quadrats measuring 10 × 10 $m^2$ and four such quadrats were randomly chosen for sampling of insect population. Catch per unit time method (Sanjayan *et al.*, 1994) was used for population estimation. Thirty minutes were spent in each quadrat (2ha/site) during morning between 9 to 11 am. Beneficial insects were collected, enumerated, photographed and identified with the help of literature. Some species were identified after their comparison with reference collection housed at TFRI , ZSI and Jabalpur.

**Data analysis:**

**Shannon -Weiner index:**

$H = - \Sigma Pi \ In \ Pi$

Where, $Pi = S/N$,

S = number of species, N = total number of individuals, In = logarithm to base e

**Evenness index:**

Evenness index was calculated as per Pielous, 1966.

Pielou's Evenness Index $e = H/In \ S$

Where, H = Shannon and Wiener diversity index, S = total number of species in the sample

**Margalef's index:**

Species richness was estimated as per (Margalef, 1958)

Margalef's index $= (S - 1) /In \ N$

Where, S = total number of species, N = total number of individuals in the sample, In = natural logarithm

**Table 1: List of beneficial insects with percentage composition in study area.**

| S. No. | Name of species | Total number of individuals | Individuals (%) |
|---|---|---|---|
| 1. | *Trichogramma raoi* | 131 | 6.86 |
| 2. | *Apanteles machaeralis* | 201 | 10.5 |
| 3. | *Xanthopimpla cera* | 67 | 3.51 |
| 4. | *Canthecona furcellata* | 161 | 8.44 |
| 5. | *Coccinella septampunctata* | 84 | 4.40 |
| 6. | *Crocothemis servilia* | 110 | 5.76 |
| 7. | *Apis dorsata* | 674 | 35.3 |
| 8. | *Antheraea paphia* | 132 | 6.92 |
| 9. | *Kerria lacca* | 104 | 5.45 |
| 10. | *Oecophylla smaragdina* | 243 | 12.7 |
| | Number of species=10 | Total =1907 | |

**Table 2: Shannon-Weiner diversity, richness and evenness index of beneficial insects.**

| Year | 2017 | 2018 | 2019 |
|---|---|---|---|
| Species diversity | 2.08 | 2.02 | 2.04 |
| Richness | 1.20 | 1.19 | 1.19 |
| Evenness | 0.90 | 0.87 | 0.87 |

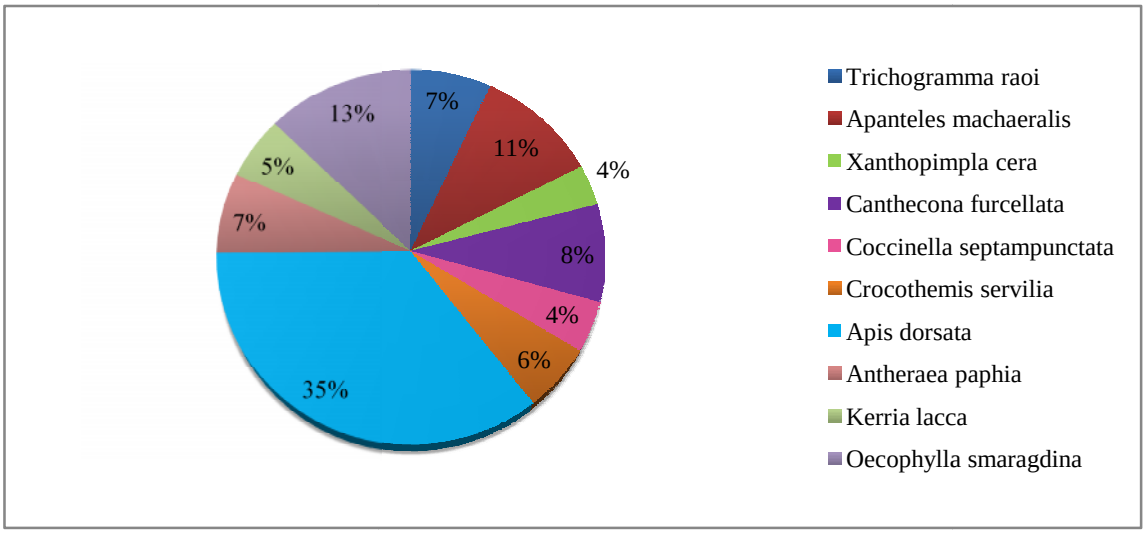


**Fig. 2.** Showing Percentage composition of each beneficial insect.

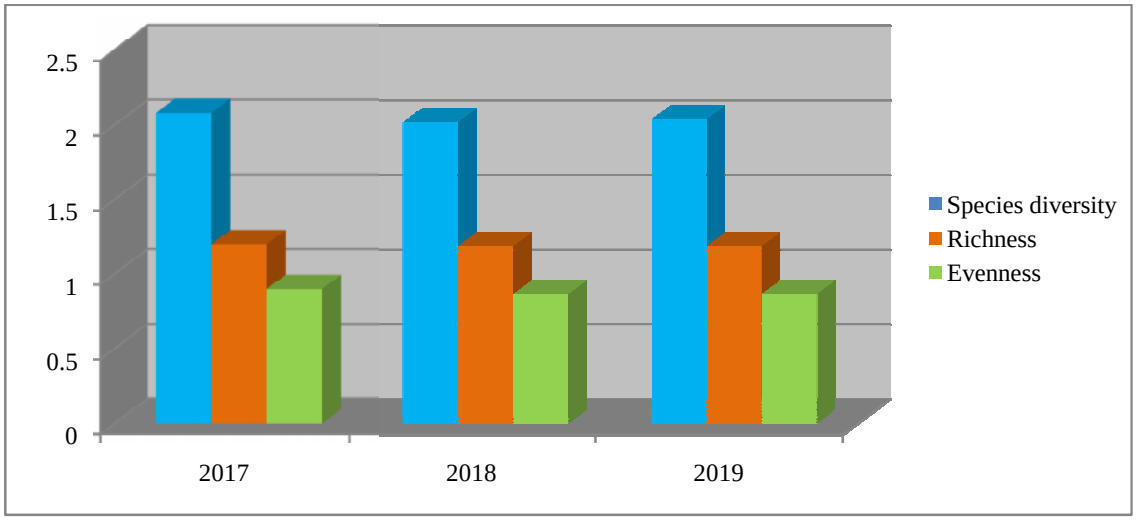


**Fig. 3.** Showing species diversity, richness and evenness of ten beneficial insects with year.

## III. RESULT AND DISCUSSION

During the present study 1907 individuals of ten beneficial insects were collected from forest ecosystem of 11 agro climatic zones of Madhya Pradesh. As far as percent composition of each beneficial insect is concerned honeybee, *Apis dorsata* was the most dominant (35.3%) followed by red ants *Oecophylla smaragdina* (12.7%), *Apanteles machaeralis* (10.5%), *Canthecona furcellata* (8.44%), *Antheraea paphia* ((6.92), *Trichogramma raoi* (6.86) , *Crocothemis servilia* (5.76%), *Kerria lacca* (5.45%), *Coccinella septampunctata* (4.40 %) and in *Xanthopimpla cera* (3.51%) (Fig. 2).

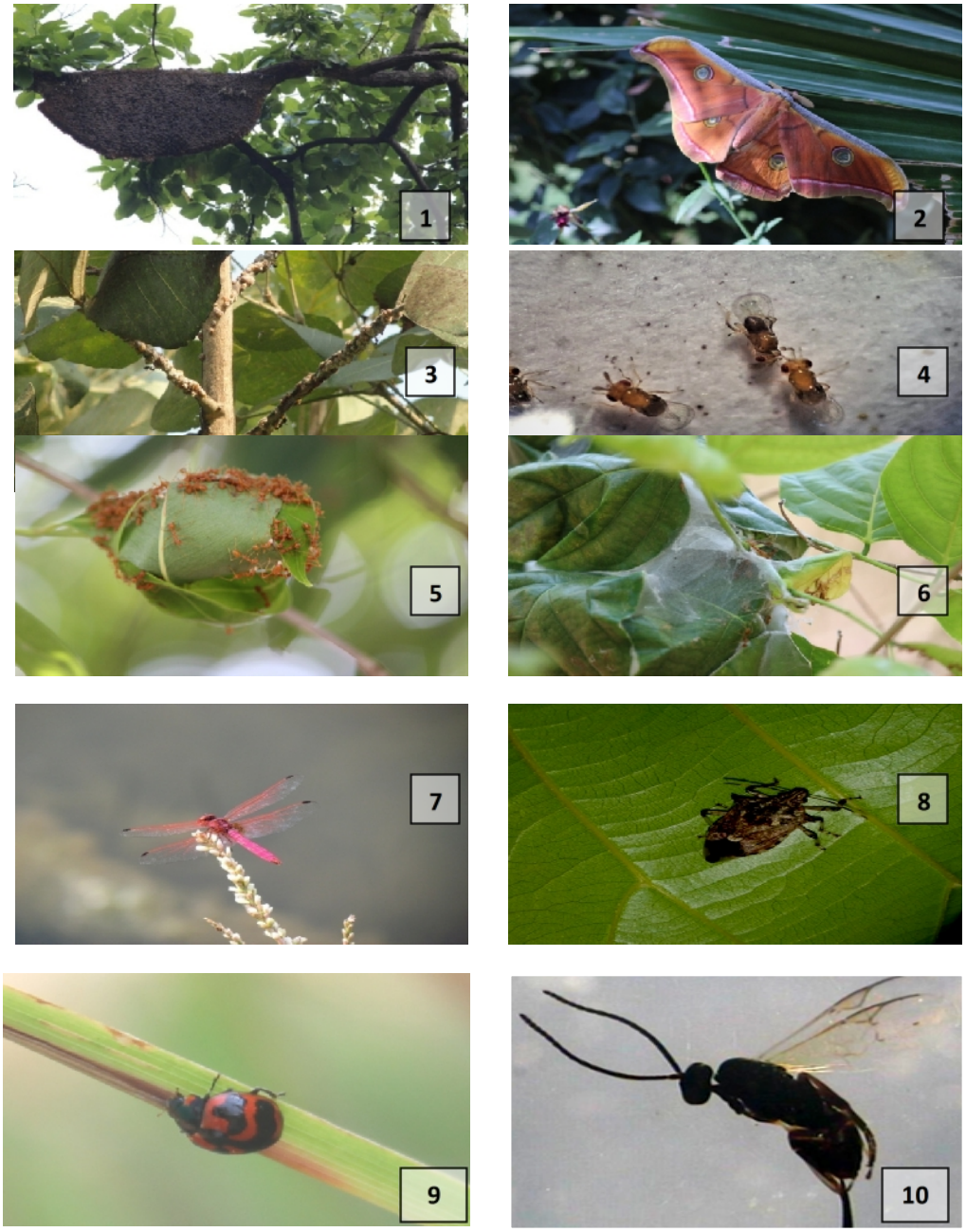


**Plate: 1.** Honey bee, *Apis dorsata* colonies on *Shorea robusta*, **2.** Adult of *Antherae paphia*, **3.** Lac insect *Kerria lacca* on *Butea*, **4.** Adult of *Trichogramma raoi*, **5.** Red ants, *Oecophylla smargadina* on *Madhuca indica*, **6.** *Oecophylla smargadina* on *Pongamia pinnata*, **7.** Dragonfly, *Crocothemis servilia* on grass spp., **8.** Predatory bug, *Canthecona furcellata* in Sal *Shorea robusta* forest, **9.** Ladybird beetle *Coccinella* spp. on grass spp., **10.** Adult of *Apanteles machaeralis*.

The variety and diversity of species in the study sites can be found by calculating Species diversity index, richness and evenness. Analysis of beneficial insect species diversity revealed that the maximum diversity, richness and evenness index was found in the year 2017 (2.08), (1.20) and (0.90) respectively (Table 2, Fig. 3). The result shows that the study areas are rich and diverse in beneficial insects. This study is the first of its kind in the area. Hence, it is difficult to determine whether the beneficial insects diversity in the area is increasing or decreasing.

In forest ecosystem *Apis dorsata* plays an important role as a key stone species. Since the nests are located on cliff faces and underside of branches of tall trees, far above the ground, they are not easily accessible. They serve as a source of good quality wax and honey while are migratory in nature. *Trichogramma raoi* is an indigenous species of Madhya Pradesh identified by Yousuf (2003, 2007). Roychoudhary *et al*., (2015) studied the potentiality of egg parasitoid *Trichogramma raoi* against the major insect pests of teak and concluded that to combat both the major insect pests of teak, (Skeletonizer and defoliator) introduction of indigenous egg parasitoid, *Trichogramma raoi* in teak forests is an effective biological control measure and will be helpful in increasing the population of this native species in the area. During the monsoon season, Odonates were widely distributed. As the life cycle of Odonates mainly depend upon aquatic environment, lack of water during summer season creates a challenge to their survival (Das *et al*., 2013; Gajbe 2019b). In India, especially in Central India, wildlife conservation only focused on large mammals. Public awareness is of utmost importance to conserve the natural habitat of these bio-indicators and regulators of harmful insects in our ecosystems. Illegal cutting of Asan (*Terminalia tomentosa*), Arjuna (*Terminalia arjuna*) and Sal (*Shorea roubusta*), irrational and injudicious use of Arjuna by pharmaceutical agencies, indiscriminate collection of natural cocoons of *Antheraea* spp., smuggling of tasar cocoons and rapid urbanisations are some of the burning problems for tasar silk biodiversity in India (Bukhari *et al*., 2019).

Considering the use of beneficial insects and their economic importance it is necessary to conserve these insects. But lack of awareness about the benefits of these insects, people

use different management practices to kill them along with the insect-pests. Broad principles for supporting the beneficial insects and more specific management practices should be made properly. Thus for survival and conservation of beneficial insects, avoiding indiscriminate use of chemical pesticides, habitat conservation in the form of larger patches of remnant vegetation may be useful.


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