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Coleopteran Diversity and Composition during the Wet and Dry seasons in Keoladeo National Park, Bharatpur

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ABSTRACT:

The present study communicates the seasonal composition of Coleopteran fauna at Keoladeo National Park (KNP), Bharatpur (Rajasthan). India's location in tropics makes it very rich in Coleopteran fauna which play immense role in the functioning of terrestrial ecosystems. These invertebrate fauna though not well known and appreciated, plays a very significant role in the ecology of the terrestrial habitat. The utmost ecological impact of beetles results from their impact on floral species, their contribution to the breakdown of plant and animal litter and the formation of soil, and their predatory activities. Beetle populations may indicate vital factors such as the availability of detritus, plant cover and various soil attributes, such as moisture, hardness, and grain size composition. These factors differ for different species and even for eggs and larvae of the same species.

The present study is one of the first reports in this park that will come up with a perception about how various types and different degree of disturbances affect beetle's diversity and abundance. The effect of seasons on Coleopteran diversity was investigated in wet and dry seasons. Two sampling methods were used during the study. The sampling methods were employed in both wet and dry seasons at various locations in the national park. The abundance of beetles was higher in wet seasons but the diversity is recorded somewhat more in dry seasons. Sacarabids were found to be the most dominant type species in both the seasons.

Keywords: Coleoptera, Scarabids, Keoladeo National Park.

1. INTRODUCTION

India is very rich in terms of biological diversity ascribed to its unique bio geographic location, diversified climatic conditions and enormous eco-diversity and geo-diversity. India holds about 6.90% of total number of species of the phylum Arthropoda. Out of this total number of species reported in class Insecta are 59,353 which are about 6.83% of the total number of species of insects found in the world (ENVIS Centre, Zoological Survey of India). Order **Coleoptera** (Gk. *Coleos* – sheath, *ptera* – wing) is the largest group of organisms at the order level and show exceptionally diverse adaptations to wide range of environmental conditions & habits including terrestrial, arboreal, aquatic or subterranean species (Trigunayat and Sharma,2017). More than one out of every four named species of animal is a beetle. It is estimated that out of about 8, 00,000 described species of insects world over, Coleoptera alone shares about 3, 50,000 that belongs to 4 sub orders and 177 families (Sengupta and Pal, 1998). The research on coleopteran fauna plays an important role in understanding their role in terrestrial ecosystem as decomposers as well as in various avian food chains along with soil, vegetation, anthropogenic activities and other biological indications. According to Weisser & Siemann (2004), within terrestrial ecosystems, insects functions herbivores, pollinators, seed disperser, predators, parasites, detritivores or most importantly as ecosystem engineers. The major ecological impact lies from their effects on green plants, the breakdown of plant and animal debris and formation of soil and their predatory activities. Samways (2005) stated out that insects are the major modifiers and controllers of the physical state of abiotic and biotic materials. Nichols *et al.* (2008) noted that in terrestrial ecosystems, insects play vital ecological roles in different ecological processes which include nutrient cycling, seed dispersal, bioturbation, and pollination. Dung beetles help keep ecosystem healthy. These beetles are important for breakdown and recycling of dung into the soil enabling the nutrients in the dung to cycle through the ecosystem (Manning et al., 2021).

Keoladeo National Park, a highly dynamic 29 km^2 yet fragile ecosystem globally famous for its avifauna. In 1985, the National Park was declared under World Heritage Convention as UNESCO Natural World Heritage site basically under Criteria X. Coleopteran families like *Scarabaeidae*, *Carabidae* and *Cicindellidae* are specifically known to play a dominant role in recycling of organic matter that may impact the habitats of the park in various ways to make it sustainable for park ecosystem.

Stiling (2012) stated that the overall total of species is defined as species' richness and the overall total of individuals of a species is termed as species' abundance. The main objective to carry out this study was to investigate the composition and abundance of insects during the wet and dry seasons of the year in the Keoladeo National Park so as to get an idea about how beetle's population is affected during different seasons and the major factors or disturbances behind the seasonal variations amongst various species of beetles.

2. MATERIAL AND METHODS

2.1 Study Area

Keoladeo National Park (27°10'N, 77°31'E) was listed as Ramsar site in 1981 and declared as a National Park in 1982. It is also designated as World Heritage Site by UNESCO in 1985. The 29 km2 reserve is locally known as Ghana/Bird Sanctuary, and is a sheer mosaic of dry grasslands, woodlands, woodland swamps, and wetlands. The Park is internationally famous for its avian fauna and more than 350 species of birds which includes 42 species of raptors and 9 species of owls. KNP’s flora consists of over 375 species of Angiosperms of which 90 species are wetland species. The other fauna includes 27 species of mammals, 13 species of reptiles, 7 species of amphibians, 58 species of fishes and 71 species of butterflies, more than 30 species of dragonflies and more than 30 species of spiders inhabit the national park [Mathur *et al.* (2009); Trigunayat,(1997)].

Beetles play an essential role in the functioning and of terrestrial ecosystems. Beetles also plays important role in feeding composition of various insectivorous birds thereby reflecting the vital role of Coleoptera in avian food chains.

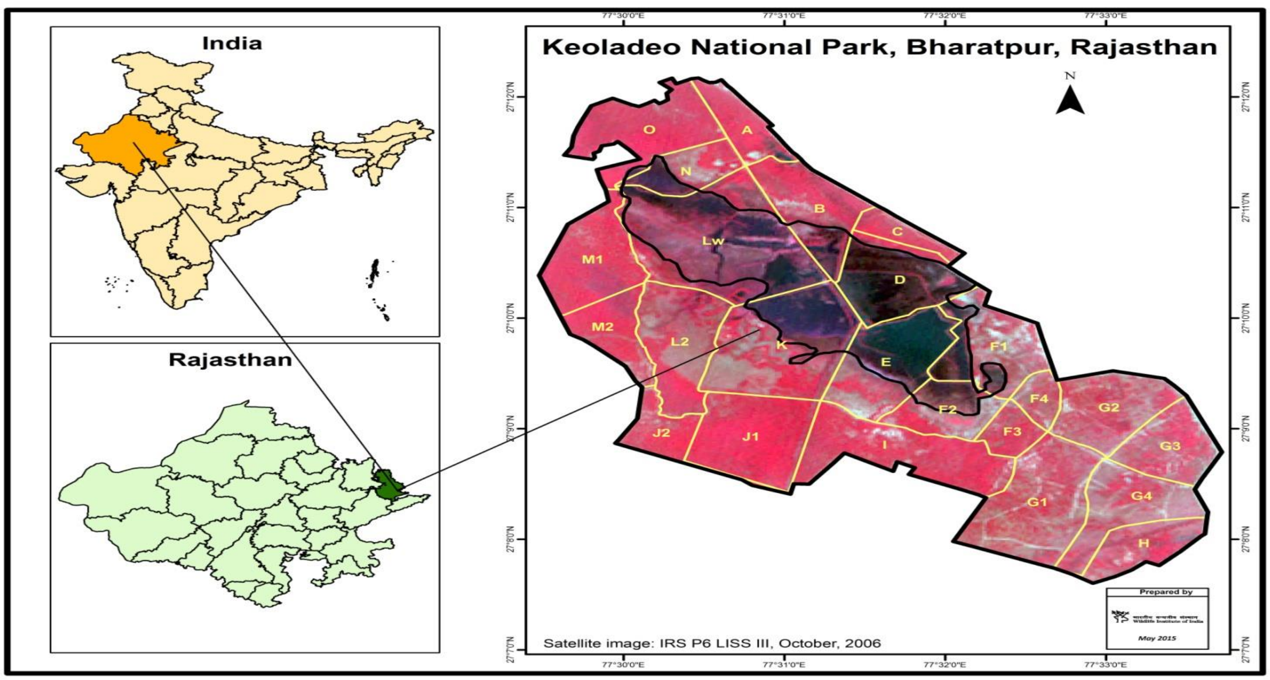

IMAGE :WII,INDIA

2.2 Identification of Sampling Sites

Various locations were selected inside different blocks of Keoladeo National Park and samples were collected strategically by majorly two sampling methods which are *manual collection* and *pitfall trap method*. The sampling is followed by curation, preservation in wooden insect boxes and taxonomic identification of coleopteran species. Samplings were carried out during the Dry Months May, 2018 to July, 2018 and Wet Months August, 2018 to October, 2018.

The sampling sites were chosen according to different habitat so as to cover most of the forest type in the national park for the investigation purpose.

The following sites were chosen according to their habitat characteristic and forest type inside the Keoladeo National Park

Site I *Grassland*

Site II *Woodland*

Site III *Saline Patches*

Four days each in both wet and dry seasons were spent at each sampling unit for study purpose. For each site collection was done two times in a year, both in dry and wet seasons.

Sampling Schedule at each site:

SITE	DRY SEASON	WET SEASON
I Grassland	May,2018	August,2018
II Woodland	June,2018	September,2018
III Saline Patches	July,2018	October, 2018

2.3 Sampling Methods

Basically two sampling techniques were employed in the present study. These are as follows

1. *Pitfall Trap Method*

Pitfall trap technique was employed for sampling from various sites following Mark Telfer's pitfall trapping protocol (Mark Telfer's, 2010). Plastic containers with the mouth diameter of 10 × 16 cm were buried in ground up to the rim with some fresh cow dung used as bait in it so that any insect passing through the site may fall down into the pitfall trap and then samples were recovered next day from the plastic container trap. They were laid along a 20 meter stretch on equal distance. The samples were collected in vials and glass bottles for further identifications and estimations of species composition and abundance values.

2. *Manual Collection Method*

Samples were collected manually also during field visits in the sampling periods. The beetles as directly picked up from leaves and bark of trees, ground, near dung heaps, road sides and few places around canteen near barrier and forest guest house.

Samples collected were then observed under Olympus Wide Zoom Stereo microscope, Model SZX-10 and SZX-16 respectively and anatomical details were noted for taxonomic identification purpose. Specimens were shifted to ethyl acetate killing bottles and then dried, pinned and preserved carefully for analysis. The collection was stored in wooden insect boxes with 1, 4-dichlorobenzene powder embedded into the corners of the boxes for preservation. Identification was done using reference keys (Fauna of British India)**,** books and published articles.

3. RESULTS

Summers are hot and dry (April – June) and winters are cold (Novermber – January). July to September marks short monsoon period and September – October constitutes post monsoon seasons. Spring, though not conspicuous, can be experiences in February – March. The climate is sub humid to sub arid. The temperature ranges as low as 0.2°C to 2°C in winters to as high as 48°C to 50°C in summers. Lowest humidity is recorded in summers and highest in Monsoon season. The average rainfall is 655mm (Vijayan, 1991).

More coleopteran specimens were found in wet season then dry season signifying more abundance of beetles in wet season but diversity is recorded somewhat more during dry season then wet season as more genera were recorded during dry season.

Table 1 - Checklist of beetles recorded in the study

S.NO.	FAMILY	GENUS	SCIENTIFIC NAME	NUMBER OF INDIVIDUALS REPORTED	WET	DRY
1.	***Scarabaeidae***	***Gymnopleurus***	***Gymnopleurus cyaneus (Fabricius, 1787)***	***175***	***125***	***50***
2.	***Scarabaeidae***	***Gymnopleurus***	***Gymnopleurus miliaris (Fabricius, 1775)***	***290***	***200***	***90***
3.	***Scarabaeidae***	***Helicopris***	***Heliocopris gigas (Linnaeus, 1758)***	***39***	***25***	***14***
4.	***Scarabaeidae***	***Catharsius***	***Catharsius platypus (Sharp, 1875)***	***80***	***67***	***13***
5.	***Scarabaeidae***	***Catharsius***	***Catharsius molossus (Linnaeus, 1758)***	***75***	***62***	***13***
6.	***Scarabaeidae***	***Catharsius***	***Catharsius sagax (Quenstedt, 1806)***	***130***	***97***	***33***
7.	***Scarabaeidae***	***Copris***	***Copris repertus (Walker, 1858)***	***65***	***52***	***13***
8.	***Scarabaeidae***	***Copris***	***Copris numa (Lansberge, 1886)***	***50***	***47***	***03***
9.	***Scarabaeidae***	***Copris***	***Copris furciceps (Felsche, 1910)***	***65***	***51***	***14***
10.	***Scarabaeidae***	***Copris***	***Copris andewersi***	***58***	***47***	***11***
11.	***Scarabaeidae***	***Onthophagus***	***Onthophagus catta (Fabricii, 1787)***	***200***	***180***	***20***
12.	***Scarabaeidae***	***Onthophagus***	***Onthophagus gulo (Arrow, 1931)***	***160***	***140***	***20***
13.	***Scarabaeidae***	***Onthophagus***	***Onthophagus oculatus (Arrow, 1931)***	***171***	***147***	***24***
14.	***Scarabaeidae***	***Onthophagus***	***Onthophagus crassicolis***	***150***	***123***	***27***
15.	***Scarabaeidae***	***Onthophagus***	***Onthophagus seniculus (Fabricius, 1781)***	***90***	***78***	***12***
16.	***Scarabaeidae***	***Onitis***	***Onitis siva (Gillet, 1911)***	***79***	***49***	***30***
17.	***Scarabaeidae***	***Onitis***	***Onitis falcatus (Wulfen, 1786)***	***70***	***55***	***15***
18.	***Scarabaeidae***	***Onitis***	***Onitis brahma (Lansberge, 1875)***	***66***	***51***	***15***
19.	***Scarabaeidae***	***Sisyphus***	***Sisyphus longipes (Olivier, 1789)***	***37***	***0***	***37***
20.	***Scarabaeidae***	***Aphodius***	***Aphodius sp.***	***90***	***67***	***23***
21.	***Scarabaeidae***	***Adoretus***	***Adoretus sp.***	***16***	***12***	***04***
22.	***Carabaeidae***	***Carabus***	***Carabus orientalis***	***39***	***25***	***14***
23.	***Carabaeidae***	***Scarites***	***Scarites terricola (Bonelli, 1813)***	***40***	***0***	***40***
24.	***Carabaeidae***	***Anthia***	***Anthia sexmaculata (Fab.)***	***20***	***0***	***20***
25.	***Melolonthidae***	***Holotrichia***	***Holotrichia consanguinea (Hope,1837)***	***70***	***62***	***08***

26.	*Coccinelloideae*	*Cocinella*	*Coccinella septempunctata (Linnaeus, 1758)*	*39*	*20*	*19*
27.	*Coccinellideae*	*Henospilachna*	*Henosepilachna vigintioctopuntata*	*4*	*03*	*01*
28.	*Coccinellideae*	*Cycloneda*	*Cycloneda sp.*	*3*	*0*	*03*
29.	*Cerambycideae*	*Monochamus*	*-*	*5*	*03*	*02*
30.	*Dysticidae*	*Cybister*	*Cybister tripunctatus (Olivier, 1795)*	*49*	*38*	*11*
31.	*Dysticidae*	*Erectes*	*Erectes sticticus*	*12*	*09*	*03*
32.	*Hydrophilideae*	*Berosus*	*-*	*11*	*08*	*03*
33.	*Hydrophilideae*	*Hydrous*	*Hydrous indicus*	*3*	*02*	*01*
34.	*Hydrophilideae*	*Coleostoma*	*Coleostoma horni*	*5*	*02*	*03*
35.	*Meloidae*	*Mylabris*	*Mylabris pustulata*	*80*	*65*	*15*
36.	*Meloidae*	*Cyaneolytta*	*Cyaneolytta violacea*	*66*	*50*	*16*
37.	*Tenebrionidae*	*Tribolium*	*Tribolium castaneum*	*30*	*28*	*02*
38.	*Tenebrionidae*	*Pimelia*	*Pimelia inexpectata*	*13*	*09*	*04*
39.	*Tenebrionidae*	*Pimelia*	*Pimelia indica*	*19*	*10*	*09*
40.	*Lampyridae*	*Luciola*	*Luciola praeusta*	*6*	*04*	*02*
41.	*Cicindellideae*	*Cicindela*	*Cicindela sp.*	*8*	*04*	*04*
42.	*Cicindellideae*	*Unidentified*	*-*	*3*	*0*	*03*
43.	*Curculionidae*	*Sitophilus*	*Sitophilus oryzae*	*2*	*0*	*02*
44.	*Curculionidae*	*Myllocerus*	*Myllocerus sp.*	*4*	*02*	*02*
	TOTAL			*2,687*	*2,019*	*668*

Table 2- Seasonal occurrence distribution of families

S.NO.	FAMILY	DRY / WET
1.	**SCARABAEIDAE (Dung Beetles)**	**Dry**
2.	**CARABAEIDAE (Ground Beetles)**	**Dry**
3.	**MELOLONTHIDAE (Cockchafers Beetles)**	**Wet**
4.	**COCCINELLIDEAE (Lady Bird Beetles)**	**Dry**
5.	**CERAMBYCIDEAE (Long Horned Beetles)**	**Wet**
6.	**DYTICIDAE (Predacious Diving Beetles, Water Beetles)**	**Wet**
7.	**HYDROPHILIDEAE (Water Scavenger Beetles)**	**Wet**
8.	**MELOIDAE (Blister Beetles)**	**Wet**
9.	**TENEBRIONIDAE (Darkling Beetles)**	**Wet**
10.	**LAMPYRIDAE (Fireflies)**	**Wet**
11.	**CICINDELLIDEAE (Tiger Beetles)**	**Dry**
12.	**CURCULIONIDAE (Snout Beetles)**	**Wet & Dry both**

4. DISCUSSION

Total 2,687 specimens were sampled during the wet and dry seasons of the year. A total of 2,019 individuals were collected in wet season and 668 individuals in dry season. High occurrence of beetles was recorded in wet season in present study signifying the effect and influence of rainfall on diversity and abundance of invertebrate fauna.

However, the abundance was high in wet season at Keoladeo National Park but the diversity is recorded more during dry season as compared to wet season. Temperature and precipitation may affect distribution and diversity of insects as attributes are crucial for survival and reproduction of species. Danks (2007) also stated that seasonal patterns in diversity are the result of natural selection, and these patterns was selected to optimize survival, reproduction, or both, in the individuals of the populations and reflect adaptations to ancestral conditions.

A total of 38 species were recorded in wet season and 44 in dry season. Therefore, coleopteran diversity is found to be more in dry season even though high abundance records in wet seasons. Alteration in the levels of water and humidity may leads to changes in structure of community and therefore species abundance as well as richness values. These seasonal variations in wet season in turn lead to heterogeneity of a particular habitat for better colonization of species at different climatic condition.

Out of the three sites studied for this purpose, the most diversity was found in Site I that is grassland ecosystem then at site II which is woodland ecosystem and least were recorded from saline patches that is from site III.

5. CONCLUSION

Scarabidae is the most dominant family in both wet and dry seasons. Dung beetles were more abundant in grassland habitat in comparison to woodland habitats which is in accordance to the fact that open grasslands provides more optimum habitat for larvae to survive and flourish. Wet season provides more suitable environment for some beetle species to flourish due to availability of more food and water. This in turn is responsible for abundance of few species and thereby determining the overall composition of the coleopteran fauna of National Park in wet season. However more number of species was recorded during dry season. Optimum weather and humidity favors invertebrate faunal existence and survival owing to variation in their composition seasonally.

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