P: ISSN No. 0976-8602 RNI No.UPENG/2012/42622 VOL.-V, ISSUE-I, January-2016
E: ISSN No. 2349-9443 Asian Resonance

Study of Diversity of Mammals of Rajaji National Park (U.K.) in Relation to Ecoclimatic Changes Due to Anthropogenic Disturbances

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Abstract

In Indian subcontinent the Himalaya is well recognized for its rich and diverse biodiversity and for its. Significance in providing the life supporting system for several million people in the northern region. For effective in situ conservation of its biological resources India has an elaborate Protected Area Network (PAN). The Rajaji National Park is one of the largest protected area with rich flora and fauna on the Himalayan foothill. Extensive field studies related to biodiversity in the Shivalik areas of Uttarakhand were carried out in Rajaji National Park. But due to fragmentation, boundaries of the park cause erosion in wild life biodiversity. The present study on diversity of mammals in relation to anthropogenic disturbances has been carried out in Chilla range and Motichur range of Rajaji National Park. A total of 26 species of mammals belonging to 15 families were recorded from both the ranges during study period. Among herbivores chital or spotted deer was the most common species distributed in both the range. Asian elephant *(Elephas maximums)* one of the biggest animal is the flagship species of Rajaji National park. Antelopes are represented as large Nilgai or blue bull *(Boselaphus lragocamelus),* Goral *(Naemorhaedus goral*) are widely distributed as both the range of Rajaji National Park.

The carnivore mammals included jungle cat *(Felis chaus affinis),* jackal *(Canis aureus indicus)* Civet *(Viverricula indica*) and leopard cat *(Felis bengalensis)* present in both the ranges.

Keywords: Biodiversity, Park, Mammals, Anthropogenic Disturbances.

Introduction

Diversity is the spice of life is an old saying. Biological diversity has been the back bone of human food, health and livelihood security system, ever since human civilization started. Diversity is also an index of ecosystem well being. The scientist considers biological diversity as a concept encompassing all the species of plants, animal and micro-organisms and the ecosystem and ecological processes of which they are parts. Flora and fauna are incredible and price less gifts of nature. Nature has been generous enough in India in providing a rich variety of flora and fauna which constitutes the wildlife. India has a rich heritage of wildlife as well as a long history and tradition of conservation. The conservation ethic was imbibed in the sylvan surroundings of the ashrams of our sages which were the seats of learning in the country's ancient past. The first recorded game laws were promulgated by Kautilya in his Arthashatra in the third century B.C. Indian mythology is equally profuse in references to our regard and love for wild animals and were thus provided with religious sanctity and ensured conservation. Biologist have identified India as one of the top 12 mega diversity country of the world, harboring an estimated 50,000species out of some 10-30 million species of living organisms. Beautiful and charismatic mammals are biodiversity icons. But a quarter of mammalian species are now threatened with extinction, as ecosystems reel under the impact of a growing and ever more demanding human population. The latest red list of endangered species brought out by World Conservation Union (WCU) mammals top the list of animal facing extinction. The list suggested that 25% of mammal's species face the threat with global extinction.

Wilson (1993) tabulated an order wise breakup of families, genera and species of Class Mammalia found in India. A number of studies have been carried out on the floral and faunal wealth of Rajaji National Park in different ecological aspects. Williams (1974) has reported that van Guijjars came to the Rajaji area in the 18th century where they have lived since generations in "deras". Singh (1969) reported in his paper about the census of elephants conducted in 1966-67 in U.P. In India about 172 species of animals are considered to be threatened by IUCN or 2.9% of the world's total number of threatened species (Groombridge 1983). These include 53 species of mammals, 69 birds, 23 reptiles and 3 amphibians. Saxena (1986) studied about the forest cover change between proposed Rajaji National Park and Corbett National Park during the period 1972-1983 for identifying elephant corridors using remote sensing techniques.

Kothari *et.al.* (1989, 95) reported that 69% of protected areas have human population residing within their boundaries with a far higher number in peripheral areas. Sales *et.al.* (1989) studied feeding habits of a radio collared elephants in the Rajaji National Park and found that feeding grounds are turning very fast in thin layers and cause the main migratory trends towards adjoining farmer's field. Khatti (1994) had suggested for an urgent need to protect and manage the habitat to improve the conservation status of tiger and its prey species in the park. Gupta and Sharma (1995) studied the impact of industrial activity of area Dehradun, Rishikesh, Haridwar range. Bist (2000) reported that the forest loss would lead to the extinction of species and the disruption of vital ecological processes. Singh *et.al.* (2001) stated human habitation is fast closing in and on the boundaries of many national parks and sanctuaries in India.

Aim of the Study

It is well known that conservation strategies may be improved if information on species pattern is taken into consideration. Biodiversity comprising the variability of genes, species and ecosystem is essential for maintain the basic process on which life depends and is key to sustainable development. It not only provides food medicine and products of commercial and non commercial use but also maintains life in and out of any ecosystem. The sanctuaries and national parks provide protection and optimum living conditions to wild animals. The dense human population and intense anthropogenic activities surround this park, there by exerting tremendous pressure on the park environment. The present study has been carried out keeping in mind all the pressures on the park and to get some remedial solutions to preserve flora and fauna of the national park.

Study Area

Rajaji National Park (RNP) is located between 77º5 7, 7' 7" and 78º 23' 36" east and 29º 51' 7" and 30º 15' 50" North in the district of Haridwar, Dehradun and Pauri Garhwal of Uttarakhand state of Northern India. The river Ganges divided Rajaji National Park into two portions as it flows through the park for about 20 kms. Rajaji National Park is distinctly known for its pristine scenic beauty and rich floral as well as faunistic biodiversity. Three sanctuaries in the Dehradun Shivalik area Rajaji, Motichur and Chilla were amalgamated into a large protected area and named as Rajaji national Park in the year 1983. Rajaji has a magnificient ecosystem nested in the Shivalik ranges and the beginning of the vast Indo Gangetic plains, hence representing rich floral diversity. Rajaji National Park is the second largest protected area of Uttrakhand state thus representing vegetation of several distinct zones and forest types like riverine broad leaf Chirpine forest, scrub land and grassy pasture lands. For carrying out study on mammalian diversity in relation to anthropogenic disturbances the two sites were selected.

1. Chilla Range
2. Motichur Range

The Chilla range comprises an area of 249.00 km². in the east of Rajaji National Park. It is spread over 14, 829.8 ha. and situated between 29º 5' 26" to 30º 03' 00" N latitude and 78º, 3' 26" to 78º 23' 36' E longitude. This range is having dense forest cover with all essential elements, which makes an area highly suitable for elephants.

Motichur Range

Motichur range was created in 1935 with an area of 89.5 km² and spread over 115 ha. It is situated between 29º 59' 30" to 30º 05' 00" N latitude and 78º 4' 30" to 78º 15' 30" E longitude. The river Song& Suswa cross this sanctuary and finally mingle with river Ganga. The river Ganga marks the eastern boundary of Motichur range and separated it from the Chilla range. Motichur forest is a moist deciduous forest with sal (*Sharea robusta***)** as the principal constituent contributing to nearly 5% of the total tree. The two narrow but very important forest corridors, which allow the elephant to move conveniently, are situated in between Motichur and Chilla range, north of the Raiwala town. Both the corridors are 1 Km. wide and about 4 Km. in length and are considered as essential for the seasonal migration of elephant in search of food, shelter and various other physiological and psychological needs. (Johnsingh*, et.al*, 1990)

Materials and Methods

The biotic and abiotic factor of an area plays an important role on the floral and faunal constituents because both are integrated through food chain. The characteristic feature of the climate of Rajaji National Park is of extreme variation throughout the year. Here winter is with 4.0ºc to 5.0ºc of temperature where as summer with extreme 45.0ºc to 48.0 ºc of temperature in both the study sites. The maximum rainfall recorded in the month of July and August ranging between 200-600 mm. The humidity variation as observed from the study sites varied from 20% to 80%. A detailed survey of both the study sites was carried out in order to analyze the composition of the vegetation and the diversity of mammals.

Vegetation

Vegetation is one of the basic resources used to define a biological system because it is the most easily recognizable habitat component and it forms life support system for all other members in any ecosystem. According to the forest classification of Champion and Seth (1968) seven types of forest recognized in Rajaji national Park.

During the seventies nearly 12 sq.km of natural vegetation, largely grassland, within the present park boundary, were replaced by *Eucalyptus*, teak and *Ailanthus* plantation, all alien to this ecosystem. The common tree species include *Anogeissus latifolia, Acacia catechu, Bombon cieba, Shorea robusta, Dalbergia sissoo, Cassia fistula* etc. Other species of minor occurrence include *Aegle marmelos, Albizia odoratissima, Bauhinia malabarica, Emblica officinalis, Ficus bengalensis*, and others.

The undergrowth is sparse on steep slopes, however on gentle slopes the undrestorey consists of species such as *Mallotus philippensis, Adhatoda zeylinica, Murraya koenigii* etc. Only one species of bamboo *Dendrocalamus strictus* is found in this area, which is mostly confined on the hillsides along the '*raus'.*

Study of Mammals

It is difficult to observe (direct method) the animals in park because of dense subtropical vegetation and presence of foothills with bushes taller than the animals especially in the rainy season. The difficulty of observing even the largest mammal in the dense tropical vegetation is well known (Borner, 1979; Van Strien, 1985). Thus the study incorporated both direct as well as indirect method.

The visiting day record is based on direct sighting of animals, indirect evidences like feeding sign, footprints (impression time in) etc. The direct sighting were noted in prepared performa, recording the group, composition, age and sex, if observed in groups and also the place of sighting, time and vegetation type.

In few of the places the indirect count method for checking the mammals, group or individual in the study area was also used. This involves path counts, frequency of animal sign (faceaes, foot prints), their movement etc. Besides these scanning and sampling questionnaires from forest officials, local villagers also conducted.

Diversity Index

The diversity of mammals were calculated with Shannon-Weiner Index (1963)

$H^1 (S) = -\sum p_i \log p_i$

Where

H = Shanon-Weiner Index of Diversity,

$p_i = ni / N$,

n_i = the total number of individuals of a species i time and

N = the total number of individuals of all species.

S = total number of species.

Identification of Anthropogenic Disturbances

An assessment of the impacts of resource dependency of the pastoralist gujjar community and other resident villagers and the potential threats of development projects and urbanization in the surrounds of the study areas on the wildlife values and habitat quality formed an important component of the study. To understand the level and reason of disturbances caused by the different anthropogenic activities in the area survey of both the sites was carried out.

Results and Discussion

A total of 26 species of mammals belonging to 15 families were recorded from both the ranges of Rajaji National Park during the study period. The diversity index of mammal shows that maximum diversity was 2.81 and minimum 1.47 in Chilla range and in Motichur range it was 2.68 minimum while minimum was 1.47. (Table 1 & 2)

Table – 1

Monthly Mean Mammalian Diversity of Chilla Range (Study period 2006-2008)

S. No.	Month	2006	2007	2008
1	January	2.46	2.64	2.81
2	February	2.67	2.67	2.71
3	March	2.76	2.81	2.70
4	April	2.27	2.33	2.43
5	May	1.94	1.92	2.22
6	June	1.79	1.88	2.10
7	July	1.47	1.61	1.50
8	August	1.55	1.89	2.24
9	September	1.82	1.91	2.16
10	October	2.04	2.04	2.15
11	November	2.18	2.18	2.20
12	December	2.43	2.49	2.49

Table – 2

Monthly Mean Mammalian Diversity of Motichur Range (Study period 2006-2008)

S.No.	Month	2006	2007	2008
1	January	2.40	2.32	2.48
2	February	2.62	2.68	2.68
3	March	2.65	2.54	2.56
4	April	2.22	2.24	2.36
5	May	1.91	1.87	1.89
6	June	1.68	1.66	1.59
7	July	1.47	1.47	1.95
8	August	1.55	1.55	1.76
9	September	1.73	1.70	1.79
10	October	2.05	2.12	1.93
11	November	2.17	2.16	2.21
12	December	2.41	2.39	2.25

Comparative Mammalian Diversity during 2006-2008

P: ISSN No. 0976-8602 RNI No.UPENG/2012/42622 VOL.-V, ISSUE-I, January-2016
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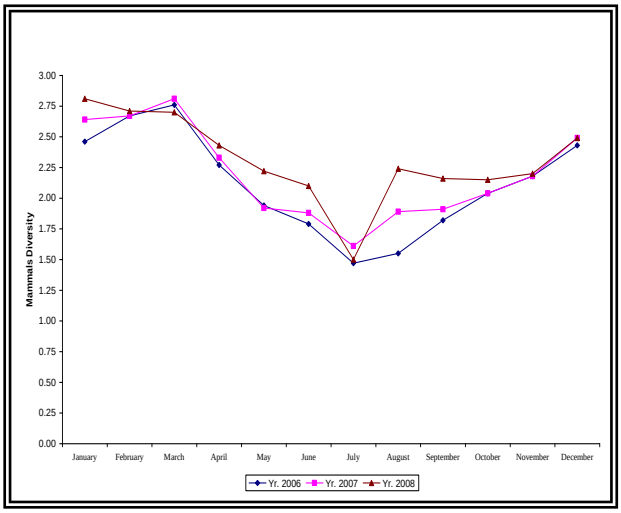

Fig. 1 Chilla Range

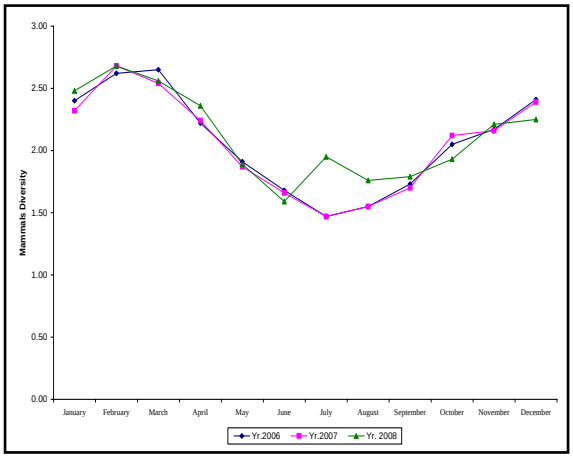

Fig. 2 Motichur Range

The mammalian fauna of the world is resented by 4629 species belonging to 1135 genera, 136 families and 26 orders. (Wilson and Reeder 1993) In Indian Union 390 species belonging to 180 genera, 42 families and 13 orders are found.

One of the biggest mammal elephant is the dominant species of both the ranges of the park. Both the corridors are very important for the elephant as well as for other big animals like tiger, leopards is located at one side of the study area i.e. between Motichur and Chilla range. The elephant uses a wide range of territory for the movement for different physiological and psychological purposes. This Chilla-Motichur corridor is highly disturbed due to Rail road and National highway passing. Number of adjacent villages extended upto the roads which have caused human - elephant conflict in this area on many occasion.

One of the India's five major population of elephants (One of the largest mammal) lives in North West India where 90% of the total of 750 elephants occur in Raja ji and Corbett National Parks and adjacent reserve forest. (Johnsingh et.al.1994)

A Group of Elephant in Motichur Range

Flock of Deer in Chilla Range

Among the herbivores chital or spotted deer (*Axis axis*) was the most common species widely distributed in both the ranges. Few populations of hog deer (*Axis peroconius)* also found in several more open areas of both the ranges. Barking deer (*M. muntjak*) and sambhar (*Cervus unicolor*) are fairly distributed in the more dense forest area and on the gentler slopes of the Shivalik hills in both ranges. It forms the main prey species of the tiger in the park. Antelopes are represented as large Nilgai (*Boselaphus tragocameles*) and Goral (*Naemohaedus goral*) are fairly distributed in the study area. The small size mammals like Indian hare (*Lupus nigrisolis*), Squirrels (*Funambulus)* common among carnivores. Tiger and leopard cat (*Feilis bangalensis)* enriched the mammals fauna of Rajaji National Park both the animals show their presence in both the ranges. Leopards are rather more in number than tiger and apart from pugmarks their presence may some times be detected by their cough calls.

The jungle cat (Felis *chaus affinis*), Civet (Viverricula *indica*) Leopard cat (*Felis bengalensis*) enriched the mammalian fauna of the park.

Dominant Species

The five most frequently recorded mammalian species in both the ranges of the park (data based on percentage of sighting during 2006-08) are Indian elephant (*Elephas maxicus indicus)* Hog deer (*Axis perciuns),* chital *(Axis axis)*, barking deer (*Muntiacus muntiak vaginalis)* and monkey *(Macaca mulata)*. The small size mammals like Indian hare *(Lupus nigrisoilis),* squirrels (*Funambulus*), common mongoosa (*Herpestes edwardasi* were also commonly seen during visits.

Discussion

One of the most fascinating features of Indian biodiversity is its mammalian fauna. Mammals are found in all types of habitats from heights of the Himalaya to the plains thick rain forest to the anal region and from terrestrial to aquatic realm. But due to numerous causes of habitat destruction, encroachment of human being in wild areas results a lot of threat to the animals many of the mammalian species are exploited by human being for their skin, fur and wool, horns, antlers and tusk. Human habitation is fast closing in on the boundaries of many national parks and sanctuaries in India. The human population of India which about 17% of the local humanity of the world is highly misappropriate keeping in view the land areas of the country which is hardly 2% of the world is total landmass. Jairajpuri (1971). The park is surrounded by 57 villages and inhabited earlier by more than 10,000 gujjars. Their was a regular conflict between park management and the people living in and around the park. The main reason of conflict is the rehabilitation plans. The Rajaji National park is in confrontation with a large resource dependent population and the major activity of biodiversity conservation is in jeopardy. Though the park management restricted a lot of activities of villagers and gujjars, the nomadic community also rehabilitated from the park even the mortality rate increased due to poachers and hunters. Shrinkage of habitat due linear developments like rail lines, road, canals and human habitation in and around the protected areas give rise to human animal conflict. Rawat (1982) noticed that one of the major factors of mortality recorded so for was due to drowning of animals in the canal, locally known as Shakti Canal, which passed through Chilla Sanctuary from Kunao to Chilla. The Rajaji National park is one of the biggest parks with thick vegetation and rich is biodiversity but like any other protected area in India it also suffered from habitat loss fragmentation and degradation The encroachment towards the periphery of the park by human population accentuated the biotic pressures on the forest area of the park.

Although India has made significant progress in conserving its biodiversity values through establishment of protected areas in different biogeography zones and within different provinces national park and wildlife sanctuaries in India which enjoy a high level of protection are also being degraded rapidly due to heaving grazing non sustainable interaction of resource and one major reason poaching and hunting of mammals snakes, amphibians etc. Exhaustive linear fragmentation in wild life habitats through construction of forest, roads, power transmission lines, unbridled proliferation of private on the fringes of forest areas have increased anthropogenic pressure on wild life.

Conclusion

The study shows that encroachment of forest land anthropogenic disturbances seriously causes threat to fauna of the park. The Rajaji National Park is one of the largest national parks for the protection of wild animals. The location of the national park is also very specific as it is located near Ganges River on one site and on another side surrounded by Himalayan ranges which is rich in flora as well as fauna. The study revealed that there is a lot of pressure on the park due to lopping, grazing and poaching animals. Numerous constructions of power houses and peripheral residential areas totally disturbed the environment of the park and their resident. The conflict between man and elephant is very common due to anthropogenic disturbance which is harmful for both the ends. Now numerous planning's are applicable and entry of peripheral population totally restricted. Gradually the relocation program of Gujjars from the park shows a healthy recovery of vegetation and simultaneously the wild life numbers especially mammals also increase.

Acknowledgements

I would like to express deep sense of gratitude to my supervisor Prof. Joshi for his valuable advice guidance. Without the co-operation and the permission of forest officials of Motichur Range and Chilla Range of Rajaji National Park, field studies would have not been possible. I express my deep gratitude and thanks to them to permit me for my visit to the park.

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