

Rajaji Tiger Reserve - A Natural Conservatory of Shivalik Biodiversity in Northern, India: The ground level perspectives and Socio-economic status

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Introduction

Abstract

Shivalik landscape has a diverse and biogeographically important floral and faunal assemblage due to its varied topographical features as well as the different climatic condition.

This landscape covers six states and a union territory namely Uttarakhand, Himachal Pradesh, Haryana, Punjab, Delhi and Jammu & Kashmir and Chandigarh of Northern India. In Uttarakhand, it covers many protected areas like Rajaji tiger reserve, Valley of flowers, Nanda Devi Biosphere reserve and many other protected areas which maintain the biodiversity of the area. The objective of this review was to collect information of the floral and faunal wealth of Shivalik and adjacent to Rajaji tiger reserve along with the important plants used by various pastoralists communities. Further, the review also highlights the culture, socio-economic status of pastoralists community in the tiger reserve.

Key words: Species, Biodiversity, Rajaji tiger reserve, Shivalik landscape, Gujjars

Introduction

The Indian Himalayan has highest mountain in the world (Devan, 1988). The Indian Himalaya support about 18,440 floral species (Singh and Hajra, 1996), in which 1,748 species comprises of medicinal plants (Samant et al., 1998) whereas 241 mammalian species and 979 birds species. The Western part of this Himalaya region spanning across Himachal Pradesh, West Bengal and Uttarakhand which is distinctly different from the Eastern region of Himalaya.

Methods and material

This paper is a combination of comparative review and field survey as well as the expert advices on the study area. For this purpose, we have applied several approaches to prepare the manuscript. The literature in the review was selected on the basis of personal knowledge (Knowledge based on earlier research in Shivalik and adjacent areas of Rajaji tiger reserve) and on of existing literature, supplemented along with Google-Scholar, Web of sciences and Scopus searches to fill in gaps and find recent papers. Data was also collected on the basis of field survey carried out during 2015-2018 in Rajaji tiger reserve. The search resulting in the more than hundreds of research paper which was reviewed for significance and relevance. Further special efforts was made to include those research papers which includes important finding of flora and fauna in Shivalik and adjacent areas of the Rajaji tiger reserve.

Shivalik Landscape : An analysis

The whole Himalaya has great diversity of plants which are still being utilized by the existing communities for their healthcare and traditional practice (Akash et al., 2020). In India, this area is known as sub Himalaya region. This landscape is located within the political boundaries of Nepal, Pakistan, India, which is 6 - 90 km in width and approximately 2000 km in length. The Shivalik landscape covers Uttarakhand, Himachal Pradesh, Punjab, Haryana, Jammu & Kashmir, Delhi and Chandigarh. Basis of the physiographic classification of Shivalik landscape, the two zones named Indo- Gangetic plains and Himalayan Ecosystem has great diversity of plants and animals.

Rainfall, temperature in the Shivalik landscape and adjoining areas of outer Himalaya

This landscape is known as 'kandi'(Mittal et al. 2000) due to its boulder soil dissected with large number of streams. The climate, rainfall vary from state to state in Shivalik landscape so it has different types of forest ecosystem. Winter start from October to February and summer from March to June. The rainy season start from July to September (Balokhra, 1999). The minimum temperature in the Shivalik landscape is 11°C in January (winter) and maximum in June up to 31°C (summer).

Table:1. Climatic details of essential parts of Shivalik Valley

Climatic zone	Altitude	Mean annual tem.(⁰ C)	Mean annual rainfall (Cm)	Mean max Tem (june-in ⁰ C)	Mean Min. Tem (jan ⁰ C)
Doon valley sub tropical	600-1000	21.1	212	29.4	13.3
Shivalik subtropical	400-800m	2240	150	31.0	14.0
Rajaji tiger Reserve	300-1000	38.5	150	42	6.1

(Source: Modified from Rawat and Bhainsora, 1995)

Phytosociological analysis in Shivalik landscape by different workers

Himalaya region comprises of about 8,000 angiosperm plants occur, out of which 1748 plants which are used in curing different human ailments by the local communities (Akash and Navneet, 2018 a,b,c,d; Akash et al., 2020; Wani et al., 2015, 2016). Shivalik landscape mainly comprises of Sub-tropical Dry Evergreen Forests, Northern Dry Mixed Deciduous Forest, Sub-tropical Pine Forests, Sub-tropical Broadleaf Wet Hill Forest, Moist Mixed Deciduous Forest, Dry Shivalik Sal Forest as well as the Tropical Semi-evergreen Forest (Champion & Seth, 1968; Akash et al., 2018a). It has been also observed in landscape that majority of alien species comes from Asia, followed by America, Africa, Europe, and Australia and mainly includes *Lantana camara*, *Ricinus communis*, *Ageratum conyzoides*, *Parthenium hysterophorus*, *Chenopodium ambrosioides*, *Bidens pilosa*, *Eupatorium odoratum*. These were found to be highly dominant alien species in the landscape (Akash et al., 2018b). According to Kohli et al., 2004, *Parthenium hysterophorus*, *Lantana camara*, area mainly responsible for harm of vegetation and these two species directly or indirectly affects the ecosystem as well as the functioning of habitats.

Table: 2. Faunal wealth analysis in Shivalik landscape by different workers

The Shivalik Landscape is characterized by great diversity of fauna which includes *Elephas maximus*, *Panthera pardus*, *Panther tigris*, *Cheetal* along with many species of birds and other animals.

Location	Studied fauna	Author and year
Rajaji tiger reserve	<i>Elephas maximus</i>	Hanna et al., 2001
Rajaji- Corbett tiger reserve	Do	Singh, 2002
Rajaji- Corbett corridor	<i>Panthera pardus</i> and <i>panther tigris</i>	Johnsingh and Negi, 2002
Rajaji tiger reserve	<i>Elephas maximus</i>	Joshi, 2005
Rajaji- Corbett tiger reserve	<i>Panthera pardus</i> and <i>panther tigris</i>	Johnsingh et al., 2003
Rajaji tiger reserve	do	Joshi et al., 2007
Rajaji tiger reserve	<i>Panthera tigris</i>	Harihar et al., 2007
Rajaji tiger reserve	do	Joshi and singh,2009
Rajaji- Corbett tiger reserve	do	Joshi et al.,2010
Rajaji tiger reserve	do	Joshi et al., 2011
Rajaji tiger reserve	do	Joshi, 2015
Rajaji- Corbett corridor	<i>Panthera pardus</i> and <i>Panther tigris</i>	Manjari and Krishnamurthy, 2015

Major protected areas in Shivalik landscape: An overview

The Shivalik landscape has varied topography, along with rich alluvial soil which makes it more diverse. This landscape has more than twenty one protected areas in six states of North Western part of India along with the one Union territory covering up to an area of 2500 Km². This landscape is

regarded 8th highly degraded agro -ecosystem of India (Akash et al., 2018 d; Akash and Navneet, 2018; Aggarwal et al., 2002; Rawat and Mukharjee, 2005) and covers an area of about 40000 Km² in which only 3000 km² falls under wildlife protected area network.

Table: 3.

S.N.	Name of the protected area and Area (sq km)	State/UT	Major faunal Attraction in sites	Major Floral attraction in sites
	Corbett national Park 520.80	Uttarakhand	<i>Panthera pardus</i> <i>Axis axis</i> <i>Elephus maximus</i>	<i>Acacia catatue</i> <i>Dalbergia sissoo</i> , <i>Shorea robusta</i> , <i>Mallotus phillipensis</i>
	Rajaji tiger Reserve 820.42	do	<i>Panthera tigris</i> <i>Elephus maximus</i> <i>Panthera pardus</i>	<i>Shorea robusta</i> <i>Adina cordifolia</i> <i>Dalbergia sissoo</i> <i>Anogeissus latifolia</i> <i>Mallotus phillipensis</i> ,
	Sonanadi wildlife sanctuary 301.18	do	<i>Panthera pardus</i> <i>Elephus maximus</i> , <i>Axis axis</i>	<i>Mallotus phillipensis</i> <i>Acacia catatue</i> <i>Cassia fistula</i> <i>Anogeissus latifolia</i> <i>Dalbergia sissoo</i>
,Da	Nandini wls 44.25	Jammu& Kashmir	<i>Sus scrofa</i> <i>Panthera pardus</i> <i>Macaca mulatta</i>	<i>Mallotus phillipensis</i> <i>Acacia nilotica</i> <i>Acacia catatue</i> <i>Dalbergia sissoo</i>
	Trikuta wls 27.75	do	<i>Sus scrofa</i> <i>Axis axis</i>	<i>Juniperus communis</i> <i>Abies pindrow</i> <i>Betula utilis</i>
	Ramnagar rakha Wls 12.75	do	<i>Macaca mulatta</i> <i>Sus scrofa</i> <i>Muntiacus muntjak</i> , a, <i>Boselaphus tragocamelus</i>	<i>Bahunia variegata</i> <i>Ficus religiosa</i> <i>Mallotus phillipensis</i> <i>Acacia Arabica</i> <i>A. catatue</i>
	Jasrota wls 25.75	do	<i>Panthera pardus</i> <i>Macaca mulatta</i> <i>Axis axis</i>	<i>Ficus religiosa</i> <i>Acacia Arabica</i> <i>A. catatue</i> <i>Dalbergia sissoo</i>
	Surinsar wls 55.50	do	<i>Pavo cristatus</i> <i>Gallus gallus</i>	<i>Ficus religiosa</i> <i>F. glomerata</i> <i>Dalbergia sissoo</i> <i>Bahunia variegata</i> <i>Mallotus phillipensis</i>
	Nara wls	Punjab	<i>Vulpes zerda</i> , <i>Gazella bennettii</i> , <i>Canis lupus</i> <i>Chlamydotis undulate</i> <i>Marmaronetta</i> <i>angustirostris</i>	<i>Acacia Arabica</i> , <i>A. catatue</i> <i>Dalbergia sissoo</i> , <i>Butea monosperma</i>

Jhajjar-Bacholi Wls 1.16	do	<i>Muntiacus muntjak</i> <i>Rusa unicolor</i> <i>Lepus spp.</i> <i>Pythonidae spp.</i> <i>Canis aureus</i>	<i>Dalbergia sissoo</i> <i>Butea monosperma</i> <i>Terminalia arjuna</i>
Takhni-rehampur Wls 3.82	do	<i>Sus scrofa</i> <i>Felis chaus</i> <i>Canis aureus,</i> <i>Panthera pardus,</i>	<i>Butea monosperma</i> <i>Dalbergia sissoo,</i> <i>Terminalia arjuna,</i>
Kathlaur-Kushlian wls 7.67	do	<i>Rusa unicolor</i> <i>Axis axis</i> <i>Muntiacus spp.</i> <i>Axis porcinus</i>	<i>Terminalia arjuna</i> <i>Butea monosperma,</i> <i>Dendrocalamus spp</i>
Sukhna lake wls 26.10	Chandigarh	<i>Gallus sonnerati</i> <i>Rusa unicolor</i>	<i>Butea monosperma</i> <i>Acacia Arabica</i> <i>Acacia catechu</i> <i>Dalbergia sissoo</i>
Gobinand sagar Wls 100.00	Himachal pradesh	<i>Ctenopharyngodon spp</i> <i>Gibelion catla</i>	<i>Anogeissus latifolia</i> <i>Acacia catechu</i> <i>A. Arabica.</i>
Naina devi Wls 123.00	do	<i>Martes flavigula</i> <i>Panthera pardus,</i> <i>Macaca mulatta</i>	<i>Bambusoideae spp.</i> <i>Dalbergia sissoo,</i> <i>Pinus spp.</i>
Shilli wls 2.00	do	<i>Semnopithecus spp.</i> <i>Muntiacus spp.</i> <i>Naemorhedus spp.</i>	<i>Dendrocalamus strictus</i> <i>Dalbergia sissoo</i>
Pong dam lake Wls 307.00	do	<i>Sus scrofa</i> <i>Panthera pardus</i> <i>Erethizon dorsatum</i> <i>Rusa unicolor</i>	<i>Leannea coromendelica</i> <i>Accacia catechu</i> <i>Anogeissus latifolia</i>
Simbalbara Wls 19.00	do	<i>Panthera pardus</i> <i>Naemorhedus spp.</i> <i>Rusa unicolor</i> <i>Muntiacus spp.</i>	<i>Mallotus phillipensis</i> <i>Shorea robus</i>
Kalesar NP 46.82	Haryana	<i>Elephus maximus</i> <i>Panthera pardus</i> <i>Prionailurus bengalensis</i> <i>Canis aureus indicus</i>	<i>Dalbergia sissoo</i> <i>Cassia fistuala</i> <i>Anogeissus latifolia</i>
Kalesar WS 54.36	do	<i>Prionailurus bengalensis</i> <i>Felis chaus</i>	<i>Cassia fistula</i> <i>Anogeissus latifolia,</i> <i>Dalbergia sissoo</i>
Morni Hills WS 22.27	do	<i>Rusa unicolor</i> <i>Axis axis</i> <i>Muntiacus spp.</i> <i>Sus scrofa</i>	<i>Clematis grata</i> <i>Terminalia bellerica,</i> <i>Murraya koenigii</i>

(Source : Akash and Navneet, 2018)

WS= Wildlife sanctuary, NP= National park

Rajaji tiger reserve: A Unique conservatory of Shivalik biodiversity

In Western Himalaya, protected areas are explored in terms of species richness but Rajaji tiger reserve is less explored area in comparison to other. It comes under Shivalik landscape just in the foothills of Himalaya and spread in an area of 820.42 sq km of the three district of Uttarakhand Viz. Haridwar, Pauri Garhwal and Dehradun. The tiger reserve extend over the Shivalic range from Dehradun-Saharanpur road in the North West to the Rawasan river in the southeast, which falls within the Gangetic biogeographic zone (Rodgers et al. 2002). The altitude, topography as well as the climate of tiger reserve vary greatly, due to which it supports a rich floristic richness.

Rajaji tiger reserve is distinct in terms of rich biodiversity and scenic beauty. This tiger reserve which is foliated by various types of forest which mainly includes *Acacia-Dalbergia* forest, Mixed forest of *Shorea- Mallotus*, Northern dry deciduous whereas some area represented the Savannah (Akash et al., 2018a,b,c,d; Akash and Navneet, 2018). These different forest community represents different weather condition. Generally winter season start from November to February in which the days are pleasant (approx. 20-25⁰C) but nights are cold with low humidity. The summer temperature rises rapidly from 40-45⁰C in the summer season (March to June) but the rainfall increases occasionally. The level of humidity is high in the rainy season (July to October). The annual rainfall ranges from 1200-1500 mm in the tiger reserve. Soils in the forest community is generally poor and infertile sometime accumulation of humus occur in few places. Rajaji is an important part of the terai landscape between Sharda and Yamuna river in Western Himalaya (Akash et al., 2018a). The Chilla range of the reserve is one of the great Centre of attractions for tourists (Akash et al., 2018b). The Chilla range of the reserve is one of the great centre of attractions for tourists (Akash et al., 2018b). The boundary of the Chilla-Motichur and Mohand forest division are traditionally been inhabited by Gujjars (a pastoralists community). They herd buffalo between high Himalayan pastures in summer and lower foothills in winters. There are different types of Gujjar community settlements within the tiger reserve. The area of the Chilla wildlife sanctuary comes under the protected forest network but now undergoing fast climatic variation in its ecological status and flora and fauna through anthropogenic pressures in form of grazing, lopping grazing and hydro-power project, trampling, scraping (Akash et al., 2019). But at the same time the tiger reserve maintains its integrity due to large forest area. This tiger reserve has nine forest division in which Chilla forest division is one of the centre of attraction for various tourist.

Table. 4: District wise area of Rajaji tiger reserve

The Tiger reserve spread in three districts of Uttarakhand which are given below:

	District	Area (hac.)
1.	Haridwar	33356.59
1.	Dehradun	23677.90
2.	Pauri Garhwal	25007.70
	Total	82042.19

Flora of the Park

Rajaji tiger reserve has great diversity of plant and animals. Forests study of the area reveals some important plant association such as the *Shorea – Terminalia-Bridelia* community, *Dalbergia-Acacia* Community, *Shorea – Mallotus- Adina* community and *Syzgium- Phoebe- Dryptes* community (Akash et al., 2019). Based on the Physiognomy, Permanent vegetation of the park may be classified broadly under the northern tropical moist deciduous forest and can be grouped according to Champion and Seth (1968): (a).Mixed forest (b). Sal (*Shorea robusta*) forest (c).Riverine forest (d).Scrubland (e). Grassland (f). Sub tropical Pine forest. Rajaji tiger reserve has nine forest ranges which includes natural as well as the planted forest community. The range wise type of forest is given below.

Table. 5 : Range wise forest type (Area in Hactare.)

Range Name	Tropical moist deciduous	Tropical dry deciduous	Sub tropical Pine	Non forest	Plantation	Total

	forest	forest	forest			
Motichur	5767.06	999.55	2.43	900.91	372.25	8042.20
Kansrau	6671.89	231.80	11.01	295.33	722.66	7932.70
Chilla	7551.25	5771.36	386.07	1118.06	3.06	14829.80
Gohri	7059.10	1366.91	737.84	1014.05	0.00	10177.90
Dholkhand	3538.32	1240.86	216.71	526.10	483.11	5995.10
Haridwar	1799.49	5075.09	31.28	479.60	1140.04	8525.50
Beribara	2634.34	3105.02	210.80	519.11	835.33	7304.60
Ramgarh	6966.15	327.93	58.85	284.59	65.348	7703.00
Chillawali	3504.80	4664.17	979.99	782.28	1600.15	11531.39
Total	45243.93	22504.03	2614.78	6521.61	5157.84	82042.19

Source: (FSI, 2011)

Table: 6. List of rare plant species in Rajaji tiger reserve with their IUCN status

Name	Family	IUCN status	Remarks
<i>Eremostachys superb</i>	Labiatae	EN	This plant is a herb with large yellow flower. It is generally found in the boundary of the Western Himalaya and adjoining areas of the tiger reserve. It blooms in feb- march. Rareness is due to grazing.
<i>Catamixis bachharoides</i>	Asteraceae	VN	It is a Shrub, bloom in the month of June and July. Rareness is due to gradual crumbling of the Shivalik cliffs.
<i>Euphorbia candicifolia</i>	Euphorbaceae	LC	It is small tuberous herb found on the southern grasses slopes of the reserve.
<i>Uraria picta</i>	Labiatae	LC	It is small herb found on dry Shivalic hills and adjacent to the boundaries of the reserve.
<i>Cordia vestita</i>	Boraginaceae	LC	It is a tree occurs in the Chilla range of the tiger reserve.
<i>Olex nana</i>	Oleaceae	EN	It is a woody plant occur near the temple of mansa devi and adjoining areas of Chilla.
<i>Euphorbia fusiformis</i>	Euphorbiaceae	LC	It is a small herb occurs near haridwar division of the tiger reserve.
<i>Coclospermum religiosum</i>	Bixaceae	LC	It is a big tree found on dry Shivalic hills.
<i>Aerides odorata</i>	Epidendroideae	LC	It is very common

			orchid in the tiger reserve occurs with highly fragrance. It blooms in the spring season.
Common orchids species inside the tiger reserve			
Genus	Family	IUCN status	Remarks
<i>Rhynchostylis retusa</i>	Do	LC	It is occur in dry areas of the rerserve and blooms in spring season.
<i>Epipogium roseum</i>	Do	Do	It is medium in sized occur in warmer part of the tiger reserve.
<i>Eulophia dabia</i>	Do	TN	It is very small sized orchid occur in the cold areas of the tiger reserve.
<i>Goodyera procera</i>	Do	LC	It is also a terrestrial orchid with beautiful flowers and generally bloom in early springs.
<i>Nervilla crociformis</i>	Do	Do	It is a terrestrial orchid occurs in the semi deciduous forest of the reserve.
<i>Oberonia falconeri</i>	Do	LC	It grows as hanging underneath branches of the host plant and blooms in spring season.
<i>Goodyera procera</i>	Do	LC	Terrestrial orchid with white flowers which bloom in early spring.
<i>Peristylus lawii</i>	Do	LC	It is a terrestrial orchid which has white flowers bloom in the beginning of rainy season. It occur in the Chilla forest division.
<i>Areides odorata</i>	Epidendroideae	LC	Commonly known as Fox Brush Orchid with light pinkish flowers. It blooms in summer season
<i>Eulophia graminea</i>	Do	LC	It is a terrestrial orchid which has green flowers blooms in early summer season.
<i>Nervila aragoana</i>	Orchidaceae	EN	It occurs as a terrestrial orchid bloom between January to april.

EN = Endangered, LC= Least concern, TN= Threthened, VN= Vulnerable

Source: Management Plane of Rajaji tiger reserve

Fauna of the Park

It was estimated that alone India comprises 92,000 species of fauna which is of 7.5% of the total world's faunal diversity (IUCN, 2014). Uttarakhand state is the important part of Northern India which has about 34,651 km² of forest and 79% of the state's geographical area. The protected forests area constitute approximately 28.52% (Forest Survey of India, 2011). Rajaji tiger reserve is an interesting natural habitat for fauna due to its location at the meeting point in the foothills of Himalaya and in the beginning of Indo- Gangetic plains. It support large viable population of the tigers and elephants. The whole area of the tiger reserve is natural home of *Panthera tigris*, *Panthera pardus*, *Hyaena hyaena*, *Elephas maximus*, *Melursus ursinus*, *Muntiacus muntjak*, *Nemorhaedus goral*, *Axis axis*, *Cervous unicolor*, *Sus scrofa*, *Ophiophagus Hannah*. Additionally, it also providing favourable life supporting condition to the fauna in Shivalik landscape.

Table. 7: Important faunal wealth of the tiger reserve with their IUCN status

S. No.	Common Name	Scientific Name	Family	IUCN status
1	Asian Elephant	<i>Elephas maximus</i>	Elepahntidae	EN
2	Indian gerbil	<i>Tatera indica</i>	Muridae	LC
3	Indian pangolin	<i>Manis crassicaudata</i>	Manidae	EN
4	Indian mole rate	<i>Bandicota bengalensis</i>	Muridae	LC
5	Jungle Cat	<i>Felis chaus</i>	Felidae	LC
6	Large Bandicot rat	<i>Bandicota indica</i>	Muridae	LC
7	Rusty Spotted Cat	<i>Prionailurus rubiginosus</i>	Felidae	TD
8	Indian Crested porcupine	<i>Hystrix indica</i>	Hystricidae	LC
9	Northern Palm squirrel	<i>Funambulus pennant</i>	Sciuridae.	LC
10	Red gaint flying squirrel	<i>Petaurista petaurista</i>	Sciuridae.	LC
Common bat species of the tiger reserve				
S. No.	Common Name of bat	Scientific Name	Family	IUCN status
1	Leaf nosed bat	<i>Hipposideros cineraceus</i>	Hipposideridae	LC
2	Lesser noctule	<i>Nyctalus leisleri</i>	Vespertilionidae	LC
3	Fulvous fruit bat	<i>Rousettus leschenaultia</i>	Pteropodidae	LC
4	Peter's tube-nosed bat	<i>Murina grisea</i>	Vespertilionidae	LC
5	Indian pipistrelle	<i>Pipestrellus coromandra</i>	Vespertilionidae	LC
Common birds species of the tiger reserve				
S. No.	Common Name of bat	Scientific Name	Family	IUCN status
1	Crested serpent eagle	<i>Spilornis cheela</i>	Accipitridae	LC
2	Northern goshawk	<i>Accipiter gentilis</i>	Accipitridae	LC
3	Red headed vulture	<i>Sarcogyps calvus</i>	Accipitridae	CE
4	Fire crapped tit	<i>Cephalopyrus flammiceps</i>	Paridae	LC
5	Black bellied tern	<i>Sterna acuticauda</i>	Laridae	EN
6	Large tailed nightjar	<i>Caprimulgus macrurus</i>	Caprimulgidae	LC
7	Great hornbill	<i>Buceros bicornis</i>	Bucerotidae	TD
8	Great slaty woodpacker	<i>Mulleripicus pulverulentus</i>	Picidae.	LC
9	Fire crapped tit	<i>Cephalopyrus flammiceps</i>	Paridae	LC
10	Sparrow hawk	<i>Accipiter nisus</i>	Do	LC
11	Shaheen falcon	<i>Falco peregrines</i>	Falconidae	LC
12	Velder fronted nuthatch	<i>Sitta frontalis</i>	Sittidae	LC

13	White crested thrush	<i>Garrulax leucolophus</i>	Leiothrichidae	LC
14	Red fowl	<i>Gallus gallus</i>	Phasianidae	LC
15	Kestrel	<i>Falco tinnunculus</i>	Falconidae	LC
16	Emerald dove	<i>Chalcophaps longirostris</i>	Columbidae.	LC
17	Oriental piedhornbill	<i>Anthracoceros albirostris</i>	Bucerotidae	LC
18	Indian rolled bird	<i>Coracias benghalensis</i>	Coraciidae	LC
19	Whited rumped shama	<i>Copsychus malabaricus</i>	Muscicapidae	LC
20	Shikra	<i>Accipiter badius</i>	Accipitridae	LC
Common snakes of the tiger reserve				
1	Copper headed trinket snake	<i>Coelognathus radiates</i>	Colubridae	LC
2	Common krait	<i>Bangarus caeruleus</i>	Elapidae	LC
3	Common blind snake	<i>Ramphotyphlops braminus</i>	Typhlopidae	LC
4	Common rate snake	<i>Ptyas mucosus</i>	Colubridae	LC
5	Common wolf snake	<i>Lycodon aulicus</i>	Colubridae	LC
6	Bumese python	<i>Python ivvitus</i>	Pythonidae	LC
7	Bronzed back tree snake	<i>Dendrelaphis tritis</i>	Colubridae	LC
8	Striped keelback	<i>Amphiesma stolata</i>	Colubridae	LC
9	Banded kurki	<i>Oligodon arnensis</i>	Colubridae	LC
Common turtle and tortoise in the tiger reserve				
1	Black pond turtle	<i>Melanochelys trijuga</i>	Geoemydidae.	TD
2	Gangetic soft shell turtle	<i>Nilssonia gangeticus</i>	Trionychidae	TD
3	Anderson flap shell turtle	<i>Lissemys punctata andersoni</i>	Trionychidae	LC
4	Ticarinate hill turtle	<i>Melanochely tricarinata</i>	Geoemydidae	EN
5	Indian roofed turtle	<i>Pangshura tecta</i>	Geoemydidae	LC
6		<i>Indotestudo elongata</i>	Testudinidae	EN
Some of the common frog of the tiger reserve				
1	Dubios's frog	<i>Nanorana minica</i>	Dicroglossidae	VN
2	Dudwa red frog	<i>Chiromantis dudwaensis</i>	Rhacophoridae	VN
3	Cricket frog	<i>Fejervarya limnocharis</i>	Dicroglossidae	LC
4	Common Indian toad	<i>Duttaphrynus melanosticus</i>	Bufonidae.	TD
5	Jaunsar cascade frog	<i>Amolops jaunsari</i>	Ranidae	TD
6	Marbled toad	<i>Bufo stomaticus</i>	Bufonidae	LC

Source: Modified from (Akash and Navneet, 2018; Rasily, 2008)

EN= Endangered, VN= Vulnerable, LC= Least concern, TD = Threatened, CE= Critical endangered,

Human wildlife interaction and conflicts in Rajaji tiger reserve

Rajaji tiger reserve is one of the India's important destinations for community and nature-based tourism site due to its huge rich floristic and faunal diversity. The presence of tigers and Asiatic elephants are the prime features which attracts the tourist all around the world. Human wildlife interaction takes place in many forms like property and crop damages, predation of livestock as well as the animal attack on peoples. Elephant- men conflicts are the main problem inside the tiger reserve as most of the remaining Gujjar and local community are present near the corridor areas of the reserve. Gujjars and pastoralists community are responsible for looping of many important plant

species like *Shorea robusta*, *Mallotus phillipensis* etc for fodder, fuel wood and. The bark of these plants are prefer food for elephant so big possibilities of men- animals conflicts occurs. It has been observed that from 1986 to 2008, Asiatic elephants have killed more than 70 people inside the reserve and more than 43 got injured. On the same way, 134 elephants have succumbed in the wild through various reason like electrocution, train accident, fall from hillock or by natural phenomenon (Joshi, 2010). In Chilla and Mohand forest division of tiger reserve, problem of leopard attack was occurring whereas in some of the areas which are very close to the animal corridor, attack of tiger and leopard on Gujjar's cattle was observed. Gujjars and other settlements inside the tiger reserve was a major problem in the past but due to the strict provision of Wildlife conservation Act, 1972 and its strong implementation by the government, they are relocated outside the tiger reserve. Their deras was situated near the animals corridor in the past where they looped important plant species *Ficus bengalensis*, *Aegle marmelos*, *Dendrocalamus strictus*, *Bauhinia variegata*, *Lagerstroemia parviflora*, *Grewia oppositifolia*. At present they are mainly present in Chilla, Motichur and Mohand forest division where they sometime affects the movement of elephants and other fauna. It has been also observed that due to the strong implementation of the wildlife act, the regeneration potentials got strengthened as various activities of these community was stopped (Joshi, 2010).

Conclusion

Shivalik landscape constitutes the richest sources of natural forest and biodiversity rich sites in Northern India. It is one of the vital components for sustaining the life and various ecosystem services and further have been playing a significant role in the socio-economic development of people or local community in adjacent areas of Western Himalaya. The well-known Rajaji tiger reserve is providing life support habitat for Asiatic elephants, tiger and various floral species. This tiger reserve is contributing as a source of revenue, subsistence as well as the raw material and other wealth and maintaining the ecological balance, keeping environmental sustainability as well as the food and fodder security. In the past, the tiger reserve has faced severe anthropogenic pressures but now due to the strong provision of wildlife act 1972 and strict laws by government whole the ranges except Chilla and Motichur of the tiger reserve are free from the pressures and other disturbances of pastoralist Gujjar. The policies of government in past only focussed on economic development but totally avoided environment as well as the protection of forest resource.

Various data collected from forest officials and concern literature study also reveals that the whole the Shivalik landscape has rich resources for human benefits and Rajaji tiger reserve is maintaining the integrity of this landscape by conserving the viable population of fauna and flora in this landscape as the main aim for establishment of this tiger reserve in Shivalik landscape was to protect the habitat of the viable population of tiger in Northern India. Although this aim was archived by the government because of the large area of this conservatory unit as well as the most favourable environmental condition for survival but there are various policy, conservation strategies and management are needed to protect the resource of forest both in terms of micro and macro level. Further sustainable development as well as the awareness among the locals and pastoralists community is essential so that they can use suitable policies for sustainable utilization of forest resource.

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