International Research Journal of Natural and Applied Sciences
ISSN: (2349-4077)
Impact Factor 5.46 Volume 7, Issue 02, February 2020
Website- www.aarf.asia, Email : editoraarf@gmail.com

Floral and Faunal Diversity of Aravalli's with special reference to Sariska Tiger Reserve, Alwar, Rajasthan, India.

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ABSTRACT
Sariska Tiger Reserve is a Biodiversity Hotspot. Located within the Aravalli Range in Alwar, Rajasthan, Sariska Tiger Reserve is a prime example of the region's biodiversity. Established in 1955, it's a designated tiger reserve and a wildlife sanctuary. The reserve boasts a rich mosaic of habitats, including dry deciduous forests, grasslands, and rocky hills. This diversity supports a thriving population of tigers, leopards, sloth bears, chinkaras, and over 200 species of birds. The Aravalli Range, stretching across Rajasthan, Gujarat, Haryana, and Delhi, is one of the oldest mountain ranges in India, estimated to be over 700 million years old. Despite facing ecological challenges, the Aravalli's boast a remarkable diversity of flora and fauna. The Aravalli Hills exhibit a mosaic of vegetation types due to variations in rainfall, altitude, and soil composition. Here's a glimpse of the floral diversity: Dry Deciduous Forests: These are the dominant forest type, with trees like Anogeissus pendula (Dhok), Boswellia serrata (Salar), and Acacia catechu (Khair) being prominent. Scrublands: These drier areas consist of shrubs, grasses, and thorny bushes like Ziziphus mauritiana (Ber) and Capparis decidua (Kair). Riparian Forests: These forests occur along rivers and streams and are home to trees like Ficus religiosa (Peepal) and Syzygium cumini (Jamun). The rich plant life of the Aravallis provides food and shelter for a variety of fauna. The Aravalli Range is a vital habitat for numerous animals, including: Mammals: The majestic Bengal Tiger is the most iconic resident of Sariska Tiger Reserve. Other mammals include leopards, sloth bears, chinkaras, gazelles, and langurs. Birds: The Aravalli's are a haven for birdwatchers, with over 400 species documented. This includes raptors like eagles and owls, vultures, hornbills, and a variety of colourful songbirds. Snakes, lizards, and turtles are also part of the Aravalli fauna. The Aravalli ecosystem faces challenges like habitat loss due to deforestation and mining, overgrazing, and encroachment. Conservation efforts are underway to address these issues. These includes protected areas like National parks, wildlife sanctuaries, and tiger reserves like Sariska play a crucial role in protecting wildlife. Afforestation programs are also going on like planting trees to restore lost forest cover and create corridors for wildlife movement. Community engagement includes raising awareness about the importance of conservation and involving local communities in conservation efforts. By protecting the Aravalli Range's unique flora and fauna, we ensure a healthy ecosystem that benefits wildlife and people alike.

KEY WORDS: Floral and Faunal Diversity, Aravalli's, Sariska Tiger Reserve, Alwar, Biodiversity

Introduction:

Aravalli Mountains are most significant and suitable habitat to variety of flora and fauna of the region. Most of the protected areas are situated in the Aravalli mountain ranges, like Sariska Tiger Reserve, Sitamata Wildlife Sanctuary, Sajangarh Wildlife Sanctuary, Raoli tatgarh Wildlife Sanctuary, Jaisamand Wildlife Sanctuary, Mount Abu Wildlife Sanctuary and Fulwari-K-Nal Wildlife Sanctuary. Sariska Tiger Reserve is a tiger reserve in Alwar district, Rajasthan, India. It stretches over an area of 881 km2 (340 sq mi) comprising scrub-thorn arid forests, dry deciduous forests, grasslands, and rocky hills. This area was a hunting preserve of the Alwar state and was declared a wildlife sanctuary in 1958. The sanctuary area was earlier rich in wildlife. The tiger, panther, bear, wolf, hyena, sambhar, chital, chinkara, four-horned antelope, etc. were found in large numbers. But, due to different threats the numbers of wild animals have decreased. The rulers of this area and their keen interest in wildlife helped flourish the flora and fauna considerably.

The erstwhile Alwar State maintained a "shikarkhana" till 1949 it was transferred to the State Forest Department in 1950. With the enactment of Wildlife Protection Act in 1972 and declaring this area as a Wildlife. It has brought about physical change in the sanctuary but has not improved the qualitative and quantitative status of the wildlife. In the last few years the Sariska Tiger Reserve is under various types of threats, which needs a well-researched conservation and management strategies.

Material and Methods:

Study site: Sariska Tiger Reserve is a tiger reserve in Alwar district, Rajasthan, India. It stretches over an area of 881 km2 (340 sq mi) comprising scrub-thorn arid forests, dry deciduous forests, grasslands, and rocky hills. This area was a hunting preserve of the Alwar state and was declared a wildlife sanctuary in 1958. It was given the status of a tiger reserve making it a part of India's Project Tiger in 1978. The wildlife sanctuary was declared as tiger reserve and national park in 1982, with a total area of about 273.8 km2 (105.7 sq mi). Altitude varies from 900 to 3200 feet metric system above a level. Sariska is characterized by distinct winter, summer and monsoon. During summer, temperature fluctuates between 30 – 35oC, and reach may 48oC during May and June. Mean winter temperature is 5oC, and may go down to 2oC during December – January. The average annual rainfall is about 825 mm; minimum 423 mm and maximum 950 mm. This wide range of climatic conditions along with the great altitudinal variations provides different micro- habitats. Therefore, this sanctuary encompasses different vegetation types such as deciduous, dry-deciduous, dry-savannah-forest, euphorbia scrub and dry grasslands.

Topography: The Sariska Tiger Reserve is situated in parts of western slopes of the Aravalli Mountain ranges and the flat land adjoining it. The Aravalli ranges run from northeast to southwest and consist of series of detached hills and ridges, which rises to heights varying from

274 to 1055 meters. The slopes are gentle at the outer boundary and gentle to steep at sometimes becoming precipitatous near the top.

Geomorphology: The main geological formation in the sanctuary is Aravalli, Raialo and Delhi quartzite's rocks which forms central axes of Aravallis. All these rocks are of varying metamorphic nature consisting of phyllites to fine mica, shirts, argillaceous sand stone, gneiss, quartzite's slates, lime stone with frequent binding of marble and granite. The whole rock system has been disturbed and is very greatly fissured, while various strata are usually repeated several times in sections.

Methods

Data was collected as and when encountered during travelling and regular field visits recorded from December 2016 to December 2018 in and around Sariska National Park. A well-planned questionnaire was prepared for generating information on type of crops, crop raid behaviour, seasonality food preference, crop protection strategies, economic loss estimation and such other issues concerning livelihood and wildlife conservation. Besides this scane sampling and ad-libitum sampling methods (Altamann, 1974) were also used to collect additional information by direct observations. For population estimation of wild animal's census data of state forest department were used. Photography and videography were also done to confirm the presence of vertebrate pests in the study area. Data on the wildlife population were obtained through annual animal census conducted by State Forest Department. Besides this regular census by means of direct sightings and other supplementary evidence like calls, kills, pugmarks, droppings, etc. were also conducted during this long-term study. In the home range of the Hanuman langur study troops quadrates were laid, all trees were identified, enumerated and their location mapped. These quadrates were checked for new tree cutting once every month with phenological observations. The number of persons entering the sanctuary for tree cutting and amount of head loads, wood carts, camel carts, etc. were counted. One or two days in a month, sitting close to wood cutters' route near the entrance of the sanctuary or forest, the number of men and women entering and leaving with wood, grass, leaves, fruits, seeds, gum and other plant products were accounted during the course of study.

Result and Discussion:

Flora: Vegetation of Sariska Tiger Reserve is unique, because of wide climatic conditions with great altitudinal variations. Therefore, this sanctuary provides different microhabitats with different vegetation types such as deciduous, dry-deciduous, dry-savannah forest, euphorbia scrub and dry grasslands. The vegetation of ashows a striking difference from the plains and consists of a variety of plant taxa. The vegetation over the Aravalli hills and in the valleys appears denser and more luxuriant during monsoon months (Plate 1). The herbaceous ground cover flourishes very well during the rainy season. The summer season is favorable for the flowering of the woody plant species in the deciduous forests. Owing to the great

altitudinal variation this sanctuary encompasses different vegetation types such as dry deciduous, scrub, dry savannah forest, euphorbia scrub and dry grasslands.

The vegetation of the study site and its surrounding can be classified into (i) vegetation of hills (ii) valleys (iii) aquatic habitats and (iv) weeds (ruderals).

(i) Vegetation of hills: The sanctuary harbors typical vegetation of Aravalli range. As per Champion and Seth (1968) the vegetation of entire wildlife sanctuary may be considered as *Anogeissus* forest of northern tropical dry deciduous forest type. The area is covered by dense and luxurious flora characteristic of the Aravallis. The vegetation is dense and diverse in content. The vegetation in the sanctuary has clear-cut altitudinal zonation starting from the base and culminating towards the top. Vegetation can be classified into top, middle and foot of the hills.

At higher altitudes of 600 m and above, *Boswellia serrata* is the most dominant species. The other species are: *Aegle marmelos, Lannea coromandelica, Mellotus philippensis, Sterculia urens* and *Wrightia tinctoria*. The principal grasses on the top of hills are Apluda *mutica, Aristida spp*. and *Cymbopogon martinii*. The semi-stem parasite, *Dendrophthoe falcata* is also very common at 500 m and above, its host being *Boswellia serrata*. Such type of forest can be classified as *Boswellia* forest as suggested by Champion and Seth (1968). The *Anogeissus pendula* is the main dominant tree of the sanctuary particularly between base of hill to the middle around 350 – 600 meters above sea level. The other common tree species associated with it are: *Acacia chundra, A. leucopholea* and *A. senegal, Albizia odoratissima, Anogeissus latifolia, Bauhinia racemosa, Bridelia retusa, Butea monosperma, Capparis grandis, Cassia firtula, Dalbergia lanceolaria, Ehretia aspera, E. laevis, Ficus racemasa, Haldina cordifolia, Holarrhena pubescens, Lannea coromandelica, Mitragyna parvifolia, Wrightia tinctoria* and *Ziziphus mauritiana*. The common shrubs in this forest are: *Annona squamosa, Capparis sepiaria, Commifora wightii, Dyerophytum-indicum, Greusia damine, G. flavescens, G. tenax, G. villosa, Helicteres isora* and *Spermadictyon suaveolens*.

Common climbers encountered here are Abrus *precaterius, Ampilocissus latifolia, Asparagus racimosus, Cissampelos pareira, Cocculus hirsutus, Gloriosa superba, Lepta denia reticulata, Maerua arenaria, Rhynchosia minima, Rivea hypocrateri formis* and *Wattakaka volubilis*.

The ground flora comprises of herbs and under shrubs like Abutilon *ramosum, Acanthospermum hispidum, Aerva sanguinolenta, Anisomeles indica, Barleria prioritis, Bidens biternata, Blainvillea acmella, Blumea lacera, Boerhavia diffusa, Cassia absus, Cardiospermum halicacabum, Crotolaria hirsuta, Dipteracanthus patutus, Dicliptera verticillata, Elytraria acaulis, Evolvulus alsinoides, Indigofera cardifolia, Indoneesiella echisidea, Ipomoea dichroa, I. Pes-tigridis, Justicia heterocarpa, Kickxia ramosissima, Lavandula bipinnata, Lindenbergia muraria, Leucas cephalotes, L. urticaefolia, Melhania futteyporensis, Plumbago zeylanica, Sida cordata, S. cordifolia, S. ovata, Tephrosia purpurea,*

Core area

Buffer Area

Plate 1: Different geographical reasons of the Sariska Tiger Reserve

Tridax procumbens, Triumfetta pentandra, Drimia indica and *Vernonia cinerascens* along with the most common grass species *Apluda mutica*. The other grass species associated with it are Acrachne *racemosa, Aristida adcensionis, Brachiaria ramosa, Chloris quinquaselica, C. virgata, Cymbopogon martinii, Dichanthium annulatum, Digitaria ciliaris, Iscilema prostratum, Perotis hordeiformis* and *Tetrapogan tenellus*. At the foot of these hills in the sanctuary area *Anogeissus pendula, Ziziphus nummularia* and *Z. mauritiana* are very common. The other

common plants associated with these are *Acacia leucophloea, A. senegal, Bauhiania racemosa, Butea monosperma, Capparis decidua, Cassia auriculata, Dichrostachys cinerea*

Order	**Family**	Name & Scientific Name	Status
Carnivora	*Canidae*	Golden Jackal (*Canis aureus*)	Common
		Wolf (*Canis lupus*)	Rare
		***Fox (Vulpes bengalensis*)**	Very common
	Ursidae	***Sloth Bear* (*Melursus ursinus*)**	**Common**
	Viverridae	Palm Civet (*Paradoxurus hemaphroditus*)	Very common
		***Small Indian Civet* (*Viverricula indica*)**	**Common**
	Hespertidae	Grey Mongoose (*Herpestes edwardsi*)	Very common
		Small Indian Mongoose* (Herpestes auropunctatus*)	**Very common**
	Hyaenidae	***Striped Hyaena (Hyaena hyaena*)**	**Uncommon**
	Felidae	Jungle Cat *(Felis chaus*)	Uncommon
		Desert Cat *(Felis libyea*)	Rare
		Leopard *(Panthera pardus*)	Common
		Tiger (*Panthera tigris*)	Uncommon
Rodentia	Hystricidae	**Porcupine (*Hystix indica*)**	**Common**
Lagomorpha	Leporidae	**Indian Hare *(Lupus nigricollis)***	Common

Artioda ctyla	*Suidae*	**Wild boar *(Sus scrofa cristatus*)**	Very common
	Cervidae	Spotted Deer (*Axis axis*)	Very common
		Sambar *(Cervus unicolor*)	Very common
	Bovidae	Chowsingha (*Tetracerus quadricornis*)	Rare
		Bluebull *(Boselaphus tragocamelus*)	**Very common**
		Indian Gazelle *(Gazella gazella*)	**Uncommon**
Chrioptera	Pteropodidae	**Indian flying fox** (*Pteropus giganteus*)	**Common**
Primate	Cercopithecidae	**Hanuman langur (*Semnopithecus entellus*)**	**Very common**
		Rhesus Macaque *(Macaca mulatta)*	**Very common**

and *Euphorbia caducifolia*.

(ii) Vegetation of valleys: Valleys in the sanctuary are very rich in organic contents of soil and moisture, therefore the vegetation here is denser and more luxuriant as compared to hills. Along the streams and in the valleys *Butea monosperma* is the most dominant tree species. The other tree species associated with it are *Bombax ceiba, Briedelia retusa, Cordia dichotoma, Cordia gharaf, Diospyros melanoxylon, D. montana, Emblica officinalis, Ficus benghalensis, F. racemosa, F. religiosa, Flacouratia indica, Holopyelia integrifolia, Mallotus phillipensis, Phoenis sylvestris, Pongamia pinnata, Syzygium cumini, Tamarindus indica, Wrightia tomentosa* and *Ziziphus mauritiana*. The common shrubs associated with it are Adhatoda *zeylanica, Hamiltonia suaveolens, Kirganelia reticulata, Lantana camara. Miliusa tomentosa, Nerium indicum, Nyctanthes arbor-tristis, Vitex negundo* and *Woodfordia fruticosa*. Such type of forest can be classified as *Butea* forest as per Champion and Seth (1968).

The common moisture and shade loving herbaceous species are: *Euphorbia spp., Eclipta prostrata, Commelina* spp., *Oxalis carniculata, Phyla nodiflora, Trachyspermum stictocarpum* and *Verbena encelioides*. The occurrence of many species of ferns and bryophytes near moist-marshy, cool and shaded places, particularly near waterfalls, streams and in rock crevices is common. The common ones are *Actinopteris radiata, Adiantum capillus veneris, A. incisum, Cheilanthes farinosa, Pteris vittata, Riccia* spp., *Funaria* spp., and *Marsilia minuta*.

(iii) Vegetation of aquatic and marshy habitats: The hydrophytes are very poorly represented. They generally occur in puddles, along streams and falls. The aquatic species of the sanctuary are: *Azolla pinnata, Chara* spp., *Hydrilla verticillata, Potamogeton crispus, P. nodosus, Trapa bispinosa, Ceratophyllum demersum* and *Vallisneria spiralia*. The other aquatic plants seen here are Ipomoea *aquatica, Lemna perpusilla, Nymphaea nouchali* and N. *pubescens*. In puddles, streams and in riverbeds where some water is present *Typha angulata, Cyperus pangorei, C. rotundus* and *Scirpus littoralis* are common.

The common plants found in marshy habitats are: *Alternanthera sessilis, Ammannia baccifera, Bacopa monnieri, Bergia ammannioides, Dentella repens, Eclipta alba, Enicastema hyssopifolia, Phyla nodiflora* and *Veronica-anagallis aquatica*. Sedges and grasses abounding in marshy and swampy habitats are: *Bulbostylis barbata, Cyprus alulatus, C. difformis, C. iria, C. leavigatus, Scirpus roylei, S. tuberosus, Elecharis capitata, Echinochloa colonum, Eragrostis ciliaris, Heteropogan contortus, Paspalidium flavidum* and *Polypogon monspliensis*.

(iv) Weeds (ruderals): Besides the weeds of cultivated and fallow fields the common ruderals found are *Acanthospermum hispidum, Amaranthus hybridus, Argemone mexicana, Calotropis procera, Datura inoxia, Tridax procumbena* and *Xanthium strumarium*.

The common crops in the area are maize, wheat, oilseeds, sugarcane, cotton and a variety of vegetables. The common weeds of cultivated fields and irrigated lands are *Amaranthus* spp., *Chinopodium album*. *Oxalis carniculata, Portulaca quadrifida, Physalis minima, Solanum surratense* and *Withania somnifera*

Fauna:

The main wildlife of Sariska Tiger Reserve includes, Tiger (*Panthera tigris*), Leopard (*Panthera pardus*), Hyaena (*Hyaena hyaena*), Indian Wolf (*Canis lupus*), Jackal (*Canis aureas*), Hanuman Langurs (*semnopithecus entellus*), Fourhorned antelope (*Tetracerus quadricornis*), Chinkara (*Gazella gazellai*), Porcupine (*Hystrix indica*), Sambar (*Cervus unicolor*), Spotted Deer (*Axis axis*), Blue bull (*Boselaphus tragocamelus*), Sloth bear (*Melursus ursinus*), Toddy Cat (*Paradoxorus hermaphordiatus*), Jungle Cat (*Felis chaus*), Fox (*Vulpes bengalensis*), Mugger Crocodile (*Crocodilus palustris*) and Rock Python (*Python molurus*) (Plate 1). But, due to degradation and various forms of increasing biotic and abiotic pressures the number of wild animals has decreased considerably. Once tiger disappeared in

Sariska Tiger Reserve, in December 2005, a "Species Recovery Plan for Tigers" in Sariska Tiger Reserve was prepared. On 28th June and 4th of July 2008 respectively, and were kept in 1-ha enclosure. The tiger was released into the wild after eight days of observation on 6th July 2008, while the tigress was released on 8th July 2008 All these big cats are being monitored continuously for home ranges, feeding behavior, and reproduction through ground tracking using "homing in technique" and also through satellite tracking.

Table 1: Status of the major wildlife in the Sariska Tiger Reserve

Tiger, *Panthera tigris*

Wolf, *Canis lupus*

Panther, *Panther pardus*

Rhesus Monkey *Macaca mulatta*

Chittal, *Axis axis*

Plate 2: Mammalian Diversity Observed in the Study Area

The Tiger (*Panthera tigris*), Panther (*Panthra pardus*), Hyaena (*Hyaena hyaena*), Wolf (*Canis lupus*), Jackal (*Canis aureas*), Jungle cat (*Felis chaus*) and Fox (*Vulpus bengalensis*) are the main carnivores. These numbers in the last 14 years has increased considerably. Number of Tiger, Panthers, Hyaena & Jackals has increased regularly, whereas Wolves, Jungle cat and Foxes has shows marginal growth in their population with some declines in 1994-1995. The population of herbivores species wise has the population of Blue bull (*Boselaphus tragocanelus*) wild boar (*Sus scrofa cristatus*) and langurs (*Semnopithecus entellus*) Rhesus Macaque *(Macaca mulatta)* has grown up very high in the last 14 years. Whereas the population of animals likes Chowsingha (*Tetracerus quadricornis*), Sambhar (*Cervus unicolor*), Chittal *(Axis axis)* and Chinkara (*Gazella gazella*) have gone down or struggling for survival.

> Growth in the numbers of blue bull and Wild boar is due to their adaptation in feeding to the crop fields around the Sanctuary. Sloth bear and langurs adapt themselves to feed on the arboreal food, which is still in good amount. But the animals like Sambhar, Chowsingha and Chinkara are cannot adapt themselves to crop field and are mainly grazers depend on ground Food, which is completely wiped out or degenerated by overgrazing of heavy livestock pressure around Sariska Tiger Reserve.

A total of 201 species of birds have been recorded in the Sariska Tiger Reserve. Therefore, the SARISKA TIGER RESERVE would seem to support a fairly large number of bird species. During the normal rainfall years, when all dams and water bodies in and around SARISKA TIGER RESERVE area get filled up to their capacities there is obviously no scarcity of food materials (aquatic as well as terrestrial) which is perhaps enough for resident and migratory avifauna of SARISKA TIGER RESERVE. Also, the number of large trees, rocks, cliffs and small islands in the reservoirs provide enough "safe places" for roosting. These two factors may be the main reasons for the attraction of resident as well as migratory birds.

Out of 201 species of birds found in Sariska Tiger Reserve, eight species are listed in "Threatened Birds of the World" (Bird life International 2000). Of these 2 species *Gyps bengalensis* and *G. Indicus* are categorized as "critical", 2 species as "near threatened" (*Sarcogyps calvus* and *Mycteria lecocephala)* and 4 species, *Grus antigone, Rynchops albicollis, Parus nuchalis and Estrilda formosa* as "vulnerable". *Parus nuchalis* is endemic to India (Plate 3).

Variety of reptiles were observed during the long-term study among the snakes *Naja naja naja, Naja naja oxiana, Vipera russelli, Bioga trigonata, Trimeresurus gramineus, Python molurus, Eryx conicus, Typhlops acutus, Eryx xjohni, Ptyas mucosus, Argyrogena ventromaculatus, Argyrogena fasciolatus, Sphalerosophis arenarius, Echis carinatus* and *Xenochrophis piscator* were recorded from various localities of the SARISKA TIGER RESERVE. Ecologically SAriska Tiger Reserveis most significant and suitable habitat for snakes. Snake fauna of this region is having a deep influence on neighboring Palaearctico-Oriental snake faunal element. The snakes are important component of Aravalli ecosystem, they maintaining the balance of nature by predation on variety insect, small mammals and small birds.

Amongst the other reptiles the garden lizard, house gecko, rock gecko, monitor lizards, turtles, etc. are commonly found in the area (plate 4).

Major threats to wild taxa:

Road accidents: The Jodhpur–Udaipur highway passes through sanctuary between Sadari and Bokhada villages. Likewsie, Desuri – Charbhuja road corsses the sanctuary through Desuri-ki-Nal. The Kot-Diver Road passes through Divar-Ki-Nal. Sadari-Parshuram-Mahaveer temple road also passes through the sanctuary. Out of these roads Sadari-Bokhada and Desuri-Charbhuja are the highways. These are busy roads with heavy vehicles plying on these roads. The Ranakpur temple is a major tourist attraction and roads from different sides pass through it. In the SARISKA TIGER RESERVE study area a total of 31 cases of road accidents were recorded in 16 troops. 18 langurs were killed, 10 seriously injured and 5 sustained minor injuries. It was basically because of heavy traffic and roads passing through the sanctuary during December 1995 to August 2002 total 123 mammals from 16 species, 56 reptiles from 6 species and 89 other animals from amphibian and insects were killed in road accidents by Truck, bus, jeep and car (Plate 5). This includes langurs, cat family members, herbivores, reptiles, birds, amphibian, insects, etc. Many of them were injured. It is quite likely that several deaths of wild animals due to road accidents must have escaped my attention, which took place in my absence. This suggests that the sanctuary is vulnerable to loss of wild taxa as a result of road accidents, which is a very unhealthy sign for the survival of animals. I consider this as a serious threat to life and character of the Aravalli in general because the presence of state and national highway and roads are common in other national parks and wildlife sanctuaries also. If strict measures are not taken

the number of deaths of wild animals will continue to increase in the Aravallis leading to imbalance of wild taxa.

Overgrazing: Like several national parks, sanctuaries and closed areas in the Aravalli, SAriska Tiger Reserve is facing constant threat of livestock grazing. Overgrazing is the most serious problem in the SAriska Tiger Reservedue to heavy pressure of livestock. Due to unrestricted grazing the forest cover has degraded and ground cover is not replenished in natural course. About 199800 animals, which include 29200 cows, 18900 buffaloes, 90500 sheep, 5500 goats and 4800 camels, are living in and around the sanctuary. During 1997 in the study area, about 30,500 livestock including 3000 cows, 1500 buffaloes, 18000 sheep, 7000 goat and 1000 camels were observed grazing in the sanctuary. Although there was no competition observed with arboreal species like langurs but, a very high feeding competition on ground between langurs and livestock (in the area where grazing is allowed) was seen. Livestock pressure is perhaps the most serious threat because of legal and illegal grazing. There is a decline in ground foliage, bush and herb density due to overgrazing and trimming off of tree canopy as a result of browsing by goats and camels. This situation is common on the periphery of the sanctuary. But, quite often-large herds of goat, sheep, cow and camel enter into core areas as well. Their numbers often exceed 2 – 3 thousand at one time. This leads to competition amongst the livestock and native wild fauna including langurs. In the long-term study overgrazing is considered as a single major factor of biomass decline in SARISKA TIGER RESERVE.

Diseases: Wildlife of SARISKA TIGER RESERVE is also exposed to variety of diseases like, Foot and mouth Mange, Sarra, abortions and several viral, bacterial, protozoan and helminthes diseases. These are due to interaction of wild animals with domestic livestock population. The common grazing grounds and drinking water holes also exposes to diseases which may be transmitted from livestock to langurs and vice versa. The livestock carry a variety of diseases with them to sanctuary like, foot and mouth, skin, viral, bacterial, protozoan and helminthes diseases. These may spread in langurs and other wild animals. This threat is mounting every day because of lack of control on livestock entry into the sanctuary and increasing numbers of animals available in and around the action during grazing and drinking at common places inside the sanctuary. A judicious estimate of 1997 suggests that about 2 lack domestic animals like cow, buffalo, camel, sheep and goat depend partially or wholly in and around SAriska Tiger Reservefor fodder. Inside the sanctuary there are 5500 cows, 2300 goats, 71800 sheep, 880 camels and other animals, which depend on sanctuary for fodder.

Tree cutting: In January 1997, the area marked for studying langurs for roosting, food and feeding yielded data on woodcutting in the study area. A total of 450 trees belonging to 45 species and 30 families were marked. Of these, 68 trees (or 15% of the total trees) belonging to 16 species were cut for firewood, construction, fodder, etc. are also the food plants of langurs. Woodcutters preferred species such as *Acacia senegal, Anogeissus pendula, A. latifolia, Albizia lebbeck, Acacia catechu, Lannea coromandelica* and *Azadirachta indica*, etc. The sanctuary is deprived of trees and its products, which are important for the endemic fauna of sanctuary

including langurs. These trees provide food, fodder, shelter and sleeping support to a large number of species including langurs in addition to nesting of birds.

Exotic weed species: **Biotic pressure has resulted in the degradation of forest. Exotic weed species like Lantana (*Lantana camara*) and Vilayati babul (*Prosopis juliflora*) (Plate 6) which invaded the forest area replacing native species are blocking regeneration of local flora like *Anogeissus latifolia, A. pendula, Bauhinia racemosa, Boswellia serrata, Ficus benghalensis, F. racemosa, Ziziphus mauritiana, Z. nummularia* and shrub species like *Grewia flavescens, G. tenex, Helicteres isora, Annona squamosa*, etc in the whole aravallis protected areas. These species constitute main food of langurs and herbivores in different seasons. Near Ranakpur in the study area about 600 hectares of area is covered by *Lantana camara* and along the roadside and forest tracts by *Prosopis juliflora*, which is spreading with great speed. The entry and spread of weeds in any forest ecosystem or non-forest habitat is not uncommon. These species are not only degrading the ecosystem but are replacing the endemic plant species. The two main exotic weed species, which have entered in all the Aravalli protected areas in the past 40 – 50 years. These remain green year-round, grow fast and provide plenty of biomass. *Prosopis juliflora* is unpalatable to most wild and domestic animals. Only langurs can eat every parts of this plant. *Prosopis juliflora* is available on the periphery of the sanctuary along with forest tracks and routes, but have not yet reached to the core area of SARISKA TIGER RESERVE. This species has spread in the sanctuary from livestock and its spread is limited to those areas where the livestock could go for grazing. *Lanatana* is found in whole of the study area including the home ranges of focal troops. The species was brought for ornamental purposes and have now become a menace. Interestingly langurs eat all parts of *Lantana* regularly without any ill effect while all other wild animals and livestock avoid this bush. This suggest that langurs perhaps do not suffer from *Lantana camara* and *Prosopis juliflora*, but the ecosystem of the sanctuary is losing its character as both these species are growing very fast by replacing native plant species. The wild animals living in the sanctuary are not benefited by these species. It would therefore be in the greater interest of the sanctuary to eliminate these two species from the sanctuary to maintain bio-community balance by regulating phytoecology of the sanctuary. It is essential from the wildlife point of view that the *Lantana camara* and *Prosopis juliflora* be eradicated so that native species of grasses, shrubs and trees can be reestablished in place of *Lantana* and *P. juliflora*.**

Forest fire: Forest fires have occurred all over the world, the sources of these fires have been both natural and men made. It damaging flora and fauna of SARISKA TIGER RESERVE. Due to deciduous nature of forest leaf fall occurs in December to February. Fires take place during summer months after April. Sporadic fires continue till June. These fires appear to be accidental. In tribal areas however it may sometimes be caused by Advasis themselves during festivities of Bolma (Worship) in which they offer Magara Pooja by burning forest area. The fires are also caused due to negligence of right holders living inside the sanctuary. The heavy traffic between

Sadri – Sayra and Desuri - Charbhuja within the sanctuary area is also the cause of forest fires, because half burnt cigarettes and biris are thrown along the roadside, which often fall on the dry leaves and catch fire. It causes serious damage to the young generation of tender plants, which dies off while resistant plants may survive like *Butea monosperma, Acacia senegal, Anogeissus pendula* and *A. latifolia*. It causes tremendous damage to ground cover and to shrubs which forms ideal habitat for wild animals. Due to fire many animals like, insects, reptiles and birds are killed and their eggs destroyed. SARISKA TIGER RESERVE is prone to forest fires, which is either intentional or accidental or natural. In this study I recorded 4 major fires and 5 minor fires. One of the major fires continued for 10 days and was controlled only after massive efforts. Although no apparent effect on langurs were recorded except for increase antagonism because of temporary shifting of home range use. However, it creates problem for ground dwellers including langurs because of whipping out of forage species and loss of large numbers of vertebrates, reptiles and mammals, particularly those which are subterranean or burrowing in habits. A large number of bird nests and eggs were destroyed in these fires, which create local imbalance of fauna and flora.

Man, and Wildlife Conflict: Crop raid by different wild animals in particular mammals, like blue bull (*Boselaphus tragocamelus*), Sloth bear (*Melursus ursinus*), Wild boar (*Sus crofa*) *Hanuman langur (*Semnopithecus entellus*)* and Porcupine (*Hystix indica*) has been widely reported from all over the sanctuary, where they do considerable damage to crops, vegetable fields and orchards (Plate 7). Besides this direct loss, they also cause the indirect damage or loss like feeding upon the fruiting trees flowers, which reduces the fruit production considerably, which farmers cannot visualize. This man and wildlife conflict is mainly due to conversation of forests into large-scale monoculture plantation, shifting cultivation, forest cutting and encroachment in the home range of animals, which reduces the availability of natural food for wildlife. Farmers use many methods to protect their crop fields and orchards from wildlife. These methods include patrolling the fields, throwing stone with 'Gophan', keeping dogs, fencing by thorny twigs, potash bomb etc. The most commonly used crop protection strategy is guarding their fields by remaining vigilant during the crop reasons. This method is used by 60% of the farmers in the study area. 20% of field owners use "gophan", a device to throw stones towards animals to chase them away from the field. Few farmers (about 15%) using dogs for crop protection and to chase the wild animals. Many times, these dogs kill the wild animals, in particular juveniles and infants. While the remaining 5% farmers using dangerous methods like single shotgun, potash bomb and high voltage electric current in which wild animals usually killed or seriously injured (Plate 8).

Monoculture plantation: The SARISKA TIGER RESERVE forest area has lost some of its biodiversity due to large-scale open area and monoculture plantation blocks cover grasslands over the last 25 years or so. Such monoculture plantation areas are common in the buffer zone of the sanctuary and plantation near roadside. Common species used in such plantation are *Acacia senegal*, *Eucalyptus camaldulensis*, *Zizyphus mauritiana*, etc. Such areas are not an attractive place for the wild animals, but have some commercial value.

Size of the Sanctuary: The size of the Sariska Tiger Reserve is too odd, like the length of the sanctuary is about 60 km. and width are just 5 to 12 km. Which is a serious constrains for better management. Also, the home range of many animals is not covered in this width, like panther's average home range is about 25 sq. km. There for such animals have to move out of the sanctuary area and face the threats of road accident, poaching, hunting, etc.

Habitat Contamination by the Pesticides

Another potential threat which has been quite neglected by the wildlife researchers till date is pesticide contamination through the consumption of the pesticide contaminated food and water by vertebrate pests. Usually around the wildlife habitats there are crop fields, which are the perfect sites for the application of the fertilizers and pesticides. This aspect needs to be highlighted here is the pesticide contamination of the environment leading to the decline in the population of the animals especially by organochlorine pesticides (OCPs). Since many animals live in water and on shores and thrive on fishes and other aquatic animals therefore, they get exposed to OCPs because of bioconcentration and biomagnification of these xenobiotics. Here an example of bald eagle from USA needs to be considered. The bald eagle is the North American species with a historic range from Alaska and Canada to northern Mexico, is the national bird of the USA which has been an endangered species for many years. The reasons being the Habitat destruction and degradation, illegal shooting, and the contamination of its food source, because of DDT contamination, there is a decline in the eagle population, The banning of DDT by the Federal government of USA and related pesticides, habitat protection done by the Endangered Species Act, and conservation actions taken by the general American public have helped bald eagles to survive. Nevertheless, DDT and its residues contaminated nearby water areas, where aquatic plants and fish absorbed it and biomagnified it. Bald eagles, in turn, were poisoned with DDT as and when they consumed the contaminated fish. As a consequence, their eggs had shells so thin that they usually broke during incubation or otherwise failed to hatch at all. DDT contamination and its residues also affected other species such as peregrine falcons and brown pelicans. Many Other pesticides having the same structure as DDT are suspected to have caused increased death, in addition to the harmful effects on reproduction. By 1963, with only 417 nesting pairs of bald eagles existing, the species was facing the danger of extinction. At the time, a controversial step of banning the use of DDT and some related pesticides in the United States was taken by the federal government of the USA. That was in 1972, and it was the first step on the road to recovery for the bald eagle (U.S. Fish & Wildlife Service Migratory Bird Program, February 2021). This shows how dangerous DDT contamination is how disastrous it can be for the avian fauna. More scary studies have indicated that we have largely over looked the darker side of these chemicals as OCPs are reported to be carcinogenic (Mathur et al, 2002 & Ingber et al 2013) mutagenic (Ingber et al 2013&Yaduvanshi et al 2012) teratogenic (Yaduvanshi et al 2012 & ATSDR. Atlanta, GA.1994) immunosuppressive (Repetto. R & Baliga. S.S, 1997 & Corsinia et al, 2003) create endocrine dysfunction such as hypothyroidism or high estrogenic activity (Dewailly et al, 2000 & Rathore et al, 2002) disturb reproductive

processes (Pant et al ,2007 & Tiemann.U. 2008) growth depressants (Colborn et al, 1993 & Mercier. M, 1981) induces several psychogenic and neurogenic abnormalities in adult stages (Mactutus & Tilson, 1986 & Van Wendel de Jood et al,2001) and are associated with abortions, premature deliveries, still births and infants with low birth weights (Saxena et al, 1981; Saxena et al, 1980; Tyagi et al 2015; Chen. Q et al 2014 & Sharma & Bhatnagar, 1996). OCPs have been in use in India nearly for a half century now. Even after having clear cut evidence suggesting that these chemicals have the ability to eliminate entire species from the planet, the annual consumption of pesticides in India is about 85,000 tons of which OCPs comprise the bulk (India Environment Portal Knowledge for change, 30/10/1998.). Therefore, today OCPs are perhaps the most ubiquitous of the potentially harmful chemicals encountered in the environment and are still widely detected in humans despite the considerable decline in environmental concentrations (Dewan et al. 2003). This kind of environmental Contamination with organochlorine pesticides (OCPs) has also been reported by Sharma and her coworkers in 1996, from Jaipur City. She reported contamination of human samples like mothers' blood, cord blood, placenta and mothers' milk with OCPs. Presence of pesticides with OCPs shows that how these xenobiotics have contaminated our Mother Nature and now faunal diversity is facing danger of existence and Smooth-coated Otters is not staying away from this potential danger. It can be concluded that the magnitude of pollution is quantitatively enough to contaminate the food and environment and reaching out to all faunal diversity. It can be concluded that the magnitude of pollution is quantitatively enough to contaminate the food and environment and the pesticides reach the human body through various sources mainly by absorption form the gastrointestinal tract through contaminated food chain, are circulated in blood, stored milk and secreted during lactation resulting in sufficient neonatal intake. The battle against the harmful insects would be much less costly and more efficient, and the problem of contamination of the environment by toxic materials would be vastly reduced, if insect activities are controlled by natural means. The use of pest-specific predators; parasites or pathogens; sterilization of insects with the help of radiations; trapping insects using insect attractants like pheromones; use of juvenile hormones or hormone inhibitors may therefore be suggested as alternate ways of pest control (Sharma, 1996; Sharma & Bhatnagar, 1996 & 2017, Sharma, 2018).

Conservation & Management Strategies:

To overcome these threats and to achieve the conservation objective of the sanctuary certain strategies have to be followed. Following are the suggested strategies for the better management of the flora and fauna of the Sariska Tiger Reserve Wildlife Sanctuary.

Road accidents: Proper signboards of presence of the wild animal should be on the sharp turns and slops all along the roads in the sanctuary area. No water hole should be prepared near the roads. Speed of the vehicles must be controlled during the crossing of the sanctuary area.

Overgrazing: It is a great threat to the habitat regeneration and wild herbivores. For this extensive patrolling, a controlled number of cattle's have to allowed inside the sanctuary. Development of community land, panchayat land, vested lands with fodder plantation around the sanctuary periphery.

Tree cutting: To stop this intensive patrolling on foot and camel back in the affected areas by the SARISKA TIGER RESERVE staff needed. On the basis of collected information raids should be carried out by staff. Introduction of fuel wool saving device and goober gas plant in the villages near the sanctuary periphery to reduce the demand of fuel wood. Formation of Village Forest Committees (VFC) to prevent the tree cutting.

Exotic weed species: Irradiation and uprooting of erotic weed species like *Prosopis Juliflora* and *lantana camera* followed by plantation of native plants, shrubs and grasses.

Forest fire: Maintenance of existing fire lines. During fire season extra patrolling is the best way to reduce the forest fire. Education awareness with in the local peoples around the sanctuary. Man made fires can be controlled through village forest committees (VFC).

Diseases: Domestic cattle of all the villages in the sanctuary and within the 10 km. of sanctuary boundary must be vaccinated against Mange, Anthrax and FMD. No infectious cattle should allow in side the sanctuary.

Man, and Wildlife conflict: Power fencing around the effected area of the sanctuary, which has to be checked by SARISKA TIGER RESERVE staff or VFC. Villagers may be encouraged to go for non-edible cash crops. Farmers can go for *Euphorbia caducifloai* fence around the farms and field, which works very effectively against wild animals.

Monoculture plantation: Monoculture plantation should be avoided completely in the future plantation projects. New plantation projects must have equal ratio of native trees, shrubs, herbs and grasses, which has good production of leaves, fruits, flowers, seeds, gum, etc. which forms the main component of many wild animals. This keeps animals with in the sanctuary area and also reduces the threats.

Size of the Sanctuary: Increase in the size of the Sariska Tiger Reserve by adding the joining area. For this revenue land, vest land, panchayat land, should be included in habitat improvement and eco-develop projects. So, more area can be developed for grazing of domestic and wild animals. This reduces the pressure from the core area of the sanctuary.

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