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Effect of Invasive Weeds on Plant Diversity of Sariska Tiger Reserve, Rajasthan, India

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ABSTRACT: The Sariska Tiger Reserve is home to a diverse range of plant and animal species, but it is facing the threat of invasion by non-native plant species. This article focuses on the effect of six common invasive weeds on the plant diversity of the reserve. These exotic species drastically reduce species richness in field experiment situation The paper highlights the importance of understanding the extent of invasion, the identity of invasive species, and the impact on native plant communities for effective management and conservation strategies. It discusses the mechanisms by which invasive weeds impact plant diversity, including competition, allelopathy, habitat modification, disruption of pollination, and seed dispersal. The paper also emphasizes the cascading effects of invasive weed species on the ecosystem and the need to develop management strategies to control their spread and protect plant diversity.

KEYWORDS: invasive weeds, plant diversity, competition, allelopathy, pollination, seed dispersal.

I. INTRODUCTION

The Sariska Tiger Reserve in Rajasthan, India, is an important ecosystem that supports a diverse range of plant and animal species, including several endangered and threatened species, which plays a vital role in maintaining the ecological balance of the region. However, the reserve is facing the threat of invasion by non-native plant species, including *Cassia tora*, *Lantana camara, Parthenium hysterophorus, Ageratum conyzoides, Chromolaena odorata, Mikania micrantha* and *Prosopis juliflora.* These invasive weed species have the potential to cause significant damage to the plant diversity and ecosystem functioning of the reserve which are threatening the natural plant diversity of the area (Bhatnagar et al., 2014). These invasive weeds not only outcompete native plant species but also alter the structure and function of ecosystems, resulting in reduced biodiversity and ecological integrity (Giriraj & Bagaria, 2021). The introduction and spread of invasive weeds is a growing problem in many parts of the world, including India, where they can cause ecological and economic harm to the ecosystems they invade (Nair et al., 2021). One such area that is particularly vulnerable to the effects of invasive weeds is the Sariska Tiger Reserve. Studies have shown that invasive weeds can have a negative impact on plant diversity in other ecosystems (Seebens et al., 2017; Catford et al., 2019). For example, in a study conducted in a grassland ecosystem in South Africa, invasive plant species were found to significantly reduce plant diversity and alter community composition (van Wilgen et al., 2012). Similarly, in a study conducted in the Western Ghats of India, invasive plant species were found to have a negative impact on plant diversity and alter the soil nutrient availability (Shankar et al., 2019). In this study, we aim to investigate the effect of invasive weeds on plant diversity in the Sariska Tiger Reserve. Specifically, we will identify the invasive plant species present in the reserve, assess their distribution and abundance, and quantify the impact of their invasion on plant diversity. We will also explore the potential ecological mechanisms driving the impact of invasive weeds on plant diversity and discuss the implications of our findings for the conservation and management of the Sariska Tiger Reserve.

II. METHODOLOGY

The Sariska Tiger Reserve encompasses diverse habitats, including dry deciduous forests, grasslands, and rocky slopes. We selected sampling sites across representative habitats within the reserve. Invasive Weed Identification: Field surveys were conducted to identify and document invasive weed species present in the reserve. Taxonomic keys and expert consultation aided in accurate weed identification. Vegetation surveys were conducted within predefined plots at each sampling site. Plant species richness, abundance, and diversity metrics were recorded using standard methods. Invasive weed abundance was quantified within vegetation plots using percentage cover or density measurements. Environmental variables, including soil characteristics, moisture levels, and light availability, were measured at each sampling site to assess their influence on plant diversity and weed invasion.

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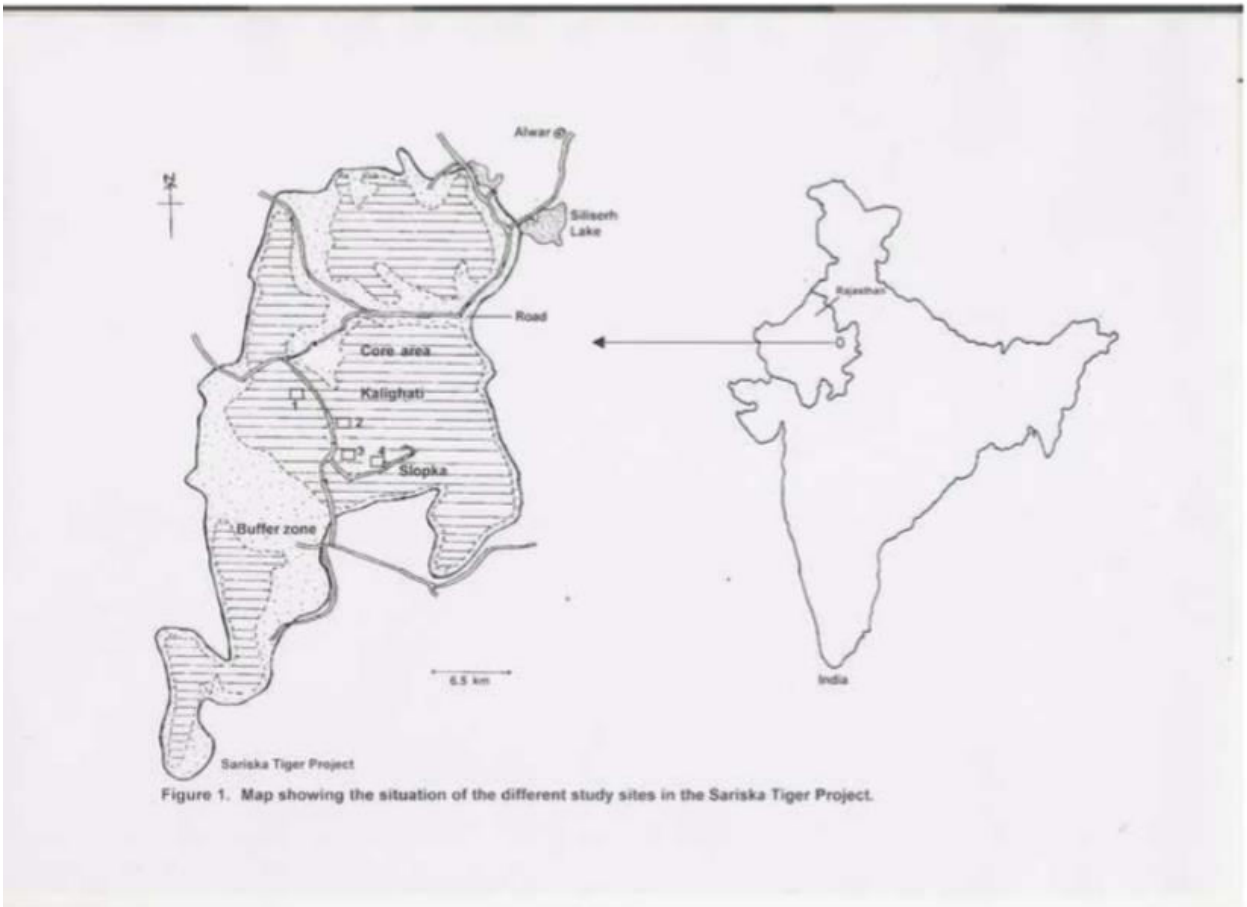

Figure 1. Map showing the situation of the different study sites in the Sariska Tiger Project.

Study area

III. RESULT AND DISCUSSION

Six most common invasive weed species found in the Sariska Tiger Reserve.

Lantana camara: This is one of the most widespread and problematic invasive species in India. It is a shrub that can grow up to 3 meters tall, and its leaves produce toxic compounds that prevent other plants from growing nearby. It is highly invasive and can form dense thickets that exclude native vegetation and impact wildlife habitat. *Parthenium hysterophorus:* Also known as Congress grass, this annual weed is native to Central and South America and was introduced to India in the 1950s. It produces allergenic compounds that can cause respiratory problems in humans and livestock. It is highly invasive and can form dense monocultures that exclude native vegetation. *Ageratum conyzoides*: This is an annual herb that is native to Central and South America and was introduced to India as a medicinal plant. It is highly invasive and can form dense stands that exclude native vegetation. *Chromolaena odorata*: This is a perennial herb that is native to Central and South America and was introduced to India as a medicinal plant. It is highly invasive and can form dense thickets that exclude native vegetation. *Mikania micrantha*: This is a woody vine that is native to Central and South America and was introduced to India as a medicinal plant. It is highly invasive and can climb and smother native trees and shrubs, reducing their growth and survival. *Prosopis juliflora*: Native to South America, Prosopis is a fast-growing tree species that invades grasslands and displaces native vegetation. It also has deep roots that can tap into underground water sources, reducing water availability for other plants.All the invasive species drastically reduce species richness of the indigenous species all study sites show few species in exotic species infested sites(Table.1)

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These invasive weed species have spread rapidly in the Sariska Tiger Reserve due to human activities such as grazing, habitat fragmentation, and road construction. The invasion of these weed species has resulted in significant changes in

Species Name	Site -1		Site -2		Site -3		Site - 4	
	With out C.T.	With C.T.	With out C.T.	With C.T.	With out C.T.	With C.T.	With out C.T.	With C.T.
Abutilon indicum (Linn.)Sweet	-*	-	-	-	-	-	0.07	-
Acalypha ciliate Forsk	-	-	-	-	0.08	-	-	-
*Acalypha lanceolata*Willd	-	-	1.05	-	-	-	0.70	-
Achyranthes aspera Linn.	-	-	0.44	0.7	0.35	0.68	0.62	-
Acrachne racemosa (Heyne)ohwi.	-	-	-	-	0.85	-	-	-
Adhatoda vasica Nees.in wall.	0.27	1.35	-	-	-	-	-	-
Alloteropsis cimicina (Linn.)Stapf.in Prain	10.62	-	-	-	1.24	-	-	-
Alysicarpus vaginalis (Linn.)DC.	0.54	-	0.66	-	0.46	-	-	-
Aristida adscensionis Linn.	1.73	-	2.6	-	8.57	3.99	-	-
Arnbia hispidissima (Lehm.)DC.	-	-	0.22	-	-	-	-	-
Boerhavia diffusa Linn.	0.33	-	0.49	-	0.42	0.29	0.78	-
Borreria articularis (Linn.f.) F.N. Will.	1.62	-	0.44	-	-	-	-	-
Bothriochloa pertusa (Linn)A. Camus.	7.98	-	0.68	-	2.26	-	-	-
Brachiaria ramosa (Linn.) Stapf	7.98	2.13	-	-	4.83	3.12	5.47	6.92
Brachiaria reptans (Linn.)Gardemer et Hubb.	-	-	3.65	3.6	1.1	-	-	-
Cardiospermum halicacabum Linn.	-	-	-	-	-	-	0.31	-
Cassia pumila Lamk	1.4	80.8	-	88	-	60.7	-	82.9
Cassia tora Linn.	-	-	-	-	-	-	-	-
Cenchrus biflorus Roxb.	-	-	2.38	-	-	-	-	-
Cenchrus setigerus Vahl.	3.72	3.69	9.30	-	-	-	-	-
Cenhrus ciliaris Linn.	1.89	-	1.44	-	-	-	-	-
Chenopodium album Linn.	0.22	-	-	-	-	-	-	-
Chloris dolichostachya Lagasca.	1.83	0.29	6.42	-	15.28	6.04	18.45	-
Chloris virgata Sw.	-	-	1.44	-	1.01	-	-	-
Chrysopogon fulvus Chiov.	1.72	-	1.21	-	-	-	-	-
Commelina benghalensis Linn.	-	-	6.81	-	0.82	-	-	-
Corchorus aestuans Linn.	0.6	-	-	-	-	-	-	-
Crotalaria medicagenia Lamk.	-	-	-	-	-	-	0.46	-
Cyperus bulbosus Vahl.	-	-	1.82	-	1.63	-	3.90	-
Cyperus iria Linn.	-	3.97	-	-	-	-	0.62	-
Dactyloctenium aegyptiacum Willd.	18.44	3.33	7.03	-	3.35	-	-	2.25
Desmostachya bipnnata (Linn.)Stapf	-	-	4.98	3.3	-	-	-	-
Dichanthium annulatum (Forsk.) Stapf	-	-	1.05	-	1.01	-	3.75	-
Digitaria adscendens (HBK) Henr.	6.9	-	3.87	2.2	11.15	1.36	9.07	-
Digitaria pennata (Hochst)Chiov.	-	-	-	-	-	-	2.18	-
Eleusine indica Gaertn	1.72	-	0.99	-	0.85	-	-	1.14
Elytraria acaulis (Linn.f.) Lindau.	-	-	0.83	0.5	-	0.78	-	-
Eragrostis ciliaris (Linn.)R.Br.	6.96	0.43	13.57	-	1.4	9.8	-	-
Eragrostis Plumosa Link.	-	-	-	-	5.92	-	-	-
Eragrostis Poaeoides P.Beauv.	5.23	-	-	-	0.93	-	-	-
Eremopogon foveolatus (Del.) Stapf.	-	-	-	-	0.54	-	-	-
Euphorbia hirta Linn.	-	-	0.38	-	0.51	-	2.93	-
Euphorbia ligularia Roxb.	-	-	-	-	-	-	0.39	-
Euphorbia parviflora Linn.	-	-	-	-	-	-	1.32	-
Euphorbia prostrate Ait.	-	-	-	-	-	-	1.09	
Evolvulus alsinoides (Linn.) Linn.	2.27	0.71	-	-	-	-	-	0.38

the plant community composition and structure, which have impacts on ecosystem functioning and biodiversity. It is crucial to develop effective management strategies to control the spread of these invasive weed species in the reserve. Invasive weed species have a significant impact on the plant diversity of the Sariska Tiger Reserve. These species can outcompete and displace native plant species, leading to a decrease in biodiversity and changes in ecosystem processes. Invasive weeds often possess aggressive growth characteristics, such as rapid growth rates, high reproductive capacity, and efficient resource utilization, which give them a competitive advantage over native plants. They can quickly establish dense populations and form monocultures, displacing native vegetation and reducing its density and abundance. One of the primary mechanisms by which invasive weeds impact native vegetation density is through competition. Invasive weeds are highly efficient in resource acquisition, which allows them to outcompete native plants for limited resources. They can deplete soil moisture, nutrients, and light, creating unfavorable conditions for the

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growth and survival of native plants. As a result, the density of native vegetation decreases as invasive weeds dominate the available resources.

Table: 1. Effect of the exotic weeds on relative density of herbaceous species in various study sites of Sariska Tiger Reserve. (c. t. exotic species)

Hemarthria compressa (Linn.f.) R.Br.	-	-	-	-	-	-	1.40	-
Heteropogon contortus (Linn.)P. Beauv. ex Roem. et Schult.	2.21	-	0.66	-	12.24	0.97	6.56	3.1
Hibiscus lobatus (Murr.) O.Ktze.	-	-	-	-	0.11	-	-	-
Indigofera hochstetteri Baker	-	-	-	-	0.27	-	-	-
Indigofera linnaei Ali.	-	-	0.38	-	-	-	-	-
Ipomoea dichroa (R.et S.) Choisy	-	-	0.16	-	-	-	-	-
Ipomoea eriocarpa R. Br.	-	-	-	-	0.15	-	-	-
Ipomoea nill (Linn.) Roth	-	-	-	-	-	-	0.07	-
Ipomoea pes-tigridis Linn	0.59	-	0.33	-	0.31	0.49	-	-
Iponoea emarginata O.Ketze.	0.32	-	-	-	0.15	-	-	-
Iseilema prostratum (Linn.) Anderss.	-	-	-	-	0.39	-	-	-
Leucas urticafolia (Vahl) J. Donn.	-	-	-	-	-	-	0.70	-
Melhania futteyporensis Munro ex Mast.	-	-	-	-	-	-	0.07	-
Mollugo nudicaulis Lamk.	-	-	0.16	-	-	-	0.15	-
Oplismenus burmannii HBK	-	-	-	-	-	-	3.90	-
Oxalis corniculata Linn.	-	-	-	-	-	-	0.86	-
Panicum adscendens HBK	-	-	1.27	-	-	-	2.18	-
Paspalidium flavideume(Retz.) A. Camus	-	-	-	-	7.97	2.9	6.56	-
Paspalum distichum Linn.	-	-	0.33	-	-	-	-	-
Pavonia zeylanica Cav.	-	-	-	-	0.11	-	0.39	-
Peristrophe bicalyculata (Retz.) Nees.	1.18	-	2.10	01	0.35	0.68	0.54	-
Perotis indica (Linn.) O. Ktze.	0.21	-	-	-	0.39	-		-
Phyllanthus niruri Hk. f. non. Linn.	-	-	0.22	-	-	0.39	0.46	0.91
Phyllanthus simplex Retz.	-	-	-	-	-	-	0.70	-
Physalis Minima Linn.	-	-	-	-	-	-	0.39	-
Pupalia lappacea (Linn.) Juss.	-	-	-	-	0.07	-	0.54	-
Rhynchosia minima (Linn.) DC.	-	-	-	-	0.15	-	0.15	-
Rhyncohsia capitata DC.	-	-	-	-	0.35	-	-	-
Rivea hypocrateriformis Choisy.	-	-	-	-	-	-	0.23	-
Rungia pectinata Ness.	-	-	-	-	-	-	0.39	-
Setaria glauca (Linn.) P. Beauv.	5.39	-	-	-	1.40	3.12	1.40	-
Setaria tomentosa. (Roxb.) Kunth.	-	-	0.44	-	-	-	-	-
Setaria verticillata (Linn.) P. Beauv.	0.33	-	15.06	-	7.17	2.73	10.32	-
Sida acuta Brum. f.	0.11	-	0.22	-	0.15	1.27	0.39	2.42
Sida cordifolia Linn.	0.16	-	1.16	-	0.19	0.68	2.97	-
Sida ovata Forsk.	-	-	0.16	-	0.35	-	0.16	-
Sida veronicifolia Lamk.	3.19	-	3.02	-	0.54	-	1.25	-
Solanum indicum Linn.	-	-	-	-	0.11	-	0.39	-
Sorghum halepence (Linn.) Press.	-	-	-	-	0.66	-	2.35	-
Sporobolus marginatus Hochst. ex A. Rich.	10.13	-	-	-	-	-	-	-
Tephrosia purpurea Baker p.p.	-	-	-	-	-	-	0.23	-
Tephrosia strigosa (Dalz.) Sant. et. Maheshw.	-	-	0.38	-	-	-	-	-
Tetrapogon tenellus (Roxb.) Chiov.	-	-	-	-	1.01	-	-	-
Tridax procumbens Linn	-	-	-	-	-	-	0.39	-
Triumfetta rhomboidea Jacq.	-	-	0.88	0.4	0.31	-	-	-
Vernonia cinerea (Linn.) Less.	0.43	-	0.33	-	0.27	-	-	-
Vigna trilobata (Linn.) Verdc.	-	-	0.27	-	0.15	-	-	-
Ziziphus mauritiana Lamk.	0.32	-	-	-	-	-	-	-
Total	186	141	180.6	129	256.5	1.03	128	133

* - means the relative density is nil.

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The following are some possible ways invasive weed species affect plant diversity:
Competition: Invasive weed species can outcompete native plant species for resources such as water, nutrients, and sunlight, reducing their growth and survival (Agrawal et al., 2018).
Allelopathy: Invasive weed species can release chemicals that inhibit the growth and development of native plant species, reducing their abundance and diversity (Rizvi et al., 2017).
Habitat Modification: Invasive weed species can modify the physical and biological characteristics of habitats, leading to changes in soil composition, water availability, and microclimate, which can negatively impact native plant species (Agrawal et al., 2018).

Disruption of Pollination: Invasive weed species can compete with native plant species for pollinators, reducing their reproductive success and ultimately affecting plant diversity (Rizvi et al., 2017).
Seed Dispersal: Invasive weed species can displace native plant species by increasing their seed production and dispersal, leading to changes in the composition and structure of plant communities (Agrawal et al., 2018).
These species can outcompete native plant species, disrupt pollination, modify habitats, and increase seed dispersal, leading to changes in ecosystem processes. It is essential to develop effective management strategies to control and mitigate the spread of invasive weed species and protect the plant diversity of the reserve.The study will assess the changes in plant species composition, diversity, and richness in areas invaded by these invasive weed species compared to non-invaded areas. The chapter will also explore the mechanisms by which invasive weed species impact plant diversity and ecosystem functioning, including competition, allelopathy, and habitat modification. The Impact of invasive weed species on the plant diversity of the Sariska Tiger Reserve has been extensively studied, and several research studies have shown the negative effects of these invasive species on the native flora. One of the most dominant invasive weed species in the reserve is *Lantana camara*. Studies have shown that Lantana can form dense monocultures, which exclude other plant species, leading to a significant decline in plant diversity and ecosystem functioning (Mishra et al., 2019; Singh et al., 2017). Similarly, *Parthenium hysterophorus* has also been found to reduce the species richness and abundance of native vegetation (Pandey et al., 2016). *Ageratum conyzoides, Chromolaena odorata,* and *Mikania micrantha* are other invasive species that have been found in the Sariska Tiger Reserve. These species have been known to alter the plant community structure and reduce the availability of food and habitat for wildlife. Additionally, these invasive species can also impact the soil quality, leading to changes in nutrient availability and soil moisture, further affecting the ecosystem processes (Pandey et al., 2016; Vyas and Singh, 2020).The impact of invasive weed species on the plant diversity of the Sariska Tiger Reserve has cascading effects on the entire ecosystem. The loss of plant diversity can lead to a decline in the populations of insects, birds, and mammals, which depend on native plant species for food and habitat. This can, in turn, affect the functioning of the ecosystem and lead to a loss of biodiversity.

IV. CONCLUSION

The invasion of non-native plant species, particularly invasive weeds, poses a significant threat to the plant diversity of the Sariska Tiger Reserve. The presence of invasive species such as *Lantana camara, Parthenium hysterophorus, Ageratum conyzoides, Chromolaena odorata, Mikania micrantha, and Prosopis juliflora* has led to detrimental effects on the native plant communities and ecosystem functioning within the reserve. The Impact of invasive weeds on plant diversity is primarily driven by mechanisms such as competition, allelopathy, habitat modification, disruption of pollination, and seed dispersal. These invasive species outcompete native plants for resources, release chemicals that inhibit the growth of native species, modify habitats, disrupt pollination processes, and increase seed dispersal, ultimately leading to changes in ecosystem processes and a decrease in plant diversity. Overall, the study of the effect of invasive weeds on plant diversity in the Sariska Tiger Reserve provides valuable insights into the ecological processes underlying the impacts of invasive species. The findings have important implications for the conservation and management of the reserve, as well as for the broader understanding of invasive species' effects on plant diversity in other ecosystems. By addressing the challenges posed by invasive weeds, it is possible to safeguard the rich plant diversity and ecological integrity of the Sariska Tiger Reserve for future generations.

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