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Comparative analysis of species composition in invasive species (*Prosopis juliflora*) eradicated and non-eradicated forest area of Sathyamangalam forest division of Tamil Nadu

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Abstract
The present work examined the impact of *Prosopis juliflora* invasion on the species diversity in tropical forest of Bhavanisagar Forest Range, Sathyamangalam Forest Division. Simple random sampling techniques were used for vegetation analysis. In the study area, 18 tree species, 19 shrubs and 15 herbs were documented in *Prosopis juliflora* eradicated area. In non eradicated area, 11 tree species 10 shrub species and 7 herb species were documented. It is interesting to note that, the density of trees, shrubs and herbs were high in *Prosopis juliflora* eradicated area with superior ground vegetation. This study confirms the superior regeneration and high density of native flora in *Prosopis juliflora* eradicated area and this will help in protecting the native species of forest by removing the *Prosopis juliflora*.

Keywords: Invasive species, *Prosopis juliflora*, species composition, vegetation analysis

1. Introduction
Biodiversity is the variety and unevenness between existing creatures and also the environmental difficult of that they form a portion, counting variety among classes and environments. Biodiversity manifests at species, genetic and ecosystems levels, and takes straight consumptive value in nutrition, farming, drugs and manufacturing; it conjointly accorded with visual and entertaining values. Biodiversity conserves environmental stability and endures evolutionary practise and the services provided by diverseness are nutrition production, nutrient sport, soil preservation, climate laws, air, water structure controlling, waste management and pest controlling.

Invasive plants are non-native organism and they have the potential to cause, injury to the environment, economic loss and human health. Invasive species exist one among the most significant drivers of environmental transformation universal. An invasive plant establishes in regular or semi natural environments and there by continue to cause alteration and threatens natural living organisms. According to World Conservation Union, invasive plants are mostly considered to be the second greatest pressures to biodiversity after habitat destruction (Buckley and Roughgarden, 2004) [2]. Generally invasive species put forth profound ecological effects on biotic populations and biological roles of the environments at affected places and harmfully decrease the biodiversity of environments. Existing systematic evidence (Bohn and Huth, 2017) [1] proposes that these invasive species are unique and cause significant threat to ecological facilities produced by the inherent societies. Automatic, biochemical and natural regulator sequencers are usually engaged to remove the exotic plants. Though, the constructive utilization of exotic plants is one of the possible options to succeed the threat of the invasive florae. There are about 180 exotic species were occupied in the region of (10 million hectares) of South Africa and huge money has been spent for their control. India is also facing a severe problem associated with most destructive and invasive plants. The harmful alien invasive species are *Acacia mearnsii*, *Choromolaena odorata*, *Ipomoea carnea*, *Lantana camara*, *Parthenium hysterophorus* and *Prosopis juliflora* (Wilgen *et al*. 2001) [11].

Vegetation is the most obvious physical representation in the majority of terrestrial ecosystem. The structure and composition of the vegetation not only reflects the nature of basic trophic structure but also forms habitat for numerous organisms. The knowledge of the floristic

composition of a plant community is a prerequisite to understand the overall structure and function of any ecosystem (Mandal and Joshi, 2014) [6]. Vegetation is the most precious gift, nature has provided to us, as it is meeting all kinds of essential requirements of the humans in the form of food, fodder, fuel, medicine, timber, resins, and oil, etc.

Invasive species are broadly defined as those species that are not native to an area that was adversely affecting the native species composition due to the production of prolific seeds. Invasion of alien plant species have become a major threat to global plant biodiversity (Sharma *et al*. 2005) [8] and habitat destruction (Williams and West, 2000) [12]. Plant invasion poses a threat to natural and managed ecosystem globally with India not an exception. The effects of the invasive species leads to the increase in carbon assimilation rates, change in soil nutrient status, increased flammability, threat to native species and changes in habitat suitability for native animal species, which is severally affecting the entire forest ecosystem (Hiremanth and Sundaran, 2005) [5]. Earlier studies reported that the change in composition and structure of communities were observed due to the invasion of the non-native species and that leads to the destruction of the entire ecosystem processes.

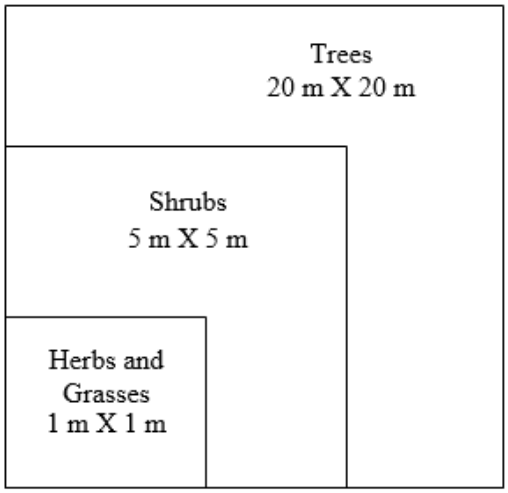
Prosopis juliflora is popularly recognized as Honey Mesquite in the western biosphere, and popularly known as Seemaikaruvelam, Udaimaram in Tamil Nadu. They belong to Leguminaceae (Fabaceae) family and subfamily Mimosoideae. *Prosopis juliflora* are fast growing, salt-tolerant and drought-tolerant and can grow in parts receiving as little as 50 mm of rainfall per year. This is a rhizomatous permanent weed dominating an important part of productive farming lands in most of the emerging countries as well as India.

One of the most destructive invasive species is *Prosopis juliflora*, which is widely distributed worldwide that too in biodiversity hotspot areas like Western Ghats. *Prosopis juliflora* is considered to be a weed of international significance, because of its widespread distribution and substantial impact on agriculture, forestry and biodiversity. The consequences of *Prosopis juliflora* invasion at the ecosystem level are little understood and there is an urgent need for studies on biological invasion. This study could provide information to improve the species composition in *Prosopis juliflora* affected areas of Bhavanisagar Forest Range, Sathyamangalam Forest Division of Western Tamil Nadu.

2. Materials and Methods

Bhavanisagar Forest Range is located in Sathyamangalam Forest Division with an area of 141 sq.km. The study area receives rainfall from both south-west monsoon and north-east monsoon. The average annual rainfall received in the study area is about 717.0 mm. The soil is generally laterite soil. Two forest types are present in Bhavanisagar Forest Range namely Southern tropical dry deciduous and Southern tropical thorn forests, where the *Prosopis juliflora* was invaded in very high. Southern tropical dry deciduous forest of Bhavanisagar with 11.3024 °N latitude and 77.0423 °E longitude was chosen for studying the species composition in *Prosopis juliflora* affected and cleared area. Simple random sampling techniques were used for vegetation analysis by laying out twenty sample plots (10 in eradicated and 10 in non-eradicated) of nested quadrat with a sample plot size of 20 m X 20 m for trees, 5 m X 5 m for shrubs and 1 m X 1 m for herbs and grasses.

2.1 Dimension of the sample plot



The tree species (above 1.37 m height) present in 20 m x 20 m quadrat, shrubs (above 1.37 m height and below 15 cm diameter) present in 5 m x 5 m quadrat, herbs and grass species (herbs - less than 1.37 m height) present in 1m x 1 m quadrat were identified and documented. For assessing species composition in *Prosopis juliflora* eradicated and non-eradicated area the density and relative density were studied using the formula mentioned below.

2.2 Density

Density is an expression of the numerical strength of a species where the total number of individuals of each species in all the quadrats is divided by the total number of quadrats studied. (Curtis and McIntosh, 1951) [4].

$$\text{Density} = \frac{\text{Total number of individuals of all species in all quadrats}}{\text{Total number of quadrats studied}}$$

2.3 Relative density

Relative density is the study of numerical strength of a species in relation to the total number of individuals of all the species.

$$\text{Relative density (\%)} = \frac{\text{Density of individual species}}{\text{Density of all species}} \text{X } 100$$

3. Results and Discussion

Prosopis juliflora is a strong allelopathic weed which has the potential to interrupt regeneration process of native species by decreasing germination, reducing early growth rates and selective increasing mortality resulting in a reduction of seedling diversity. In the present study, 18 tree species (Table 1) were documented in *Prosopis juliflora* eradicated area and 11 trees species in non-eradicated area (Table 1). The newly documented tree species in the eradicated area was *Butea monosperma, Bauhinia racemosa, Wrightia tinctoria, Gmelina arborea, Millettia pinnata, Sapindus emarginatus* and *Strychnos nux vomica*. The density of *Acacia planifrons* in in *Prosopis juliflora non*-eradicated area was 4.0 where as in eradicated area the density was 8.70. The density of *Acacia planifrons* increased in eradicated area. It clearly indicates that the *Prosopis juliflora* is adversely affecting the native species composition. The similar observation was recorded in the density of *Cassia siamea* (0.6 in non-eradicated and 0.90 in eradicated area), *Leucaena*

leucocephala (0.5 in non-eradicated and 0.6 in eradicated area), *Tamarindus indica* (0.2 in non-eradicated and 0.6 in eradicated area). Tracy and Sanderson (2003) [9] reported that the species composition was high in the invasive species removed area and also this helps in promotion of the native species of particular region. The finding by Weidenhamer and Callaway (2010) [10] reported that, *Prosopis juliflora* grows faster than native plant species by capturing the resources efficiency, creating substantial biomass in the inter-canopy and at the edge of the forest.

A total of 19 shrub species in *Prosopis juliflora* eradicated area, and 10 shrubs species in non-eradicated area (Table 2). The additional shrub species documented in the eradicated area are *Acalypha fruticosa, Catunaregam spinosa, Desmidorchis umbellata, Dodonaea viscose, Flueggea leucopyrus, Gmelina asiatica, Randia dumetorum, Senna auriculata* and, *Solanum nigrum.* When compared to the *Prosopis juliflora non*-eradicated area the eradicated area showed increasing trend of density of *cassia auriculata* (0.8 in non-eradicated and 1.2 in eradicated area), *Solanum torvum* (0.7 in non-eradicated and 0.9 in eradicated area) and *Ziziphus oenoplia* (0.9 in non-eradicated and 1.0 in eradicated area). The study confirms that *Prosopis juliflora* has remarkable negative impact on native plant species and also causes reduction in species density and may gradually reduce the species richness also.

A total of 15 herbs and grass species (Table 3) were documented in *Prosopis juliflora* eradicated area and 6 in non-eradicated area. The newly documented herbs and grasses species in the eradicated area are *Brachiaria ramose, Cayratia pedata, Chloris barbata, Commelina benghalensis, Euphorbia hirta, Heteropogon contortus, Sida acuta* and *Sida cordifolia.* The density of *Achyranthes aspera* (0.3 in non-eradicated and 0.9 in eradicated area), *Elytraria acaulis* (0.5 in non-eradicated and 1.6 in eradicated area) and *Tribulus terrestris* (0.8 in non-eradicated and 0.9 in eradicated area) was high in eradicated area compared to non eradicated area. It clearly indicates that the *Prosopis juliflora* colonization leads to decline in density of herbs and grasses. The present study was in line with the findings of Sharma and Raghubanshi (2011) [7] that the growth architecture pattern of *Prosopis juliflora* prevents light penetration to the forest floor, leading to the decline of tree seedlings and possibly the herb flora, but the removal of this invasive species helps in promoting the regeneration of herbs and grasses.

The present study confirms, invasive species (*Prosopis juliflora*) eradicated area was rich with the floral composition compared to the non-eradicated area. The removal of *Prosopis juliflora* in Bhavanisagar Forest range helped in regeneration and density of the native vegetation, which are highly useful in protecting the species richness of reserve forest.

4. Acknowledgement

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Table 1: Vegetative characters of trees in *Prosopis juliflora* eradicated and non-eradicated area of Bhavanisagar Forest Range

Scientific name	Family	Density		Relative density (%)	
		Eradicated	Non Eradicated	Eradicated	Non Eradicated
Acacia planifrons	Fabaceae	8.70	4.0	40.28	3.72
Albizia amara	Fabaceae	0.20	0.4	0.93	14.42
Azadirachta indica	Meliaceae	0.40	0.4	1.85	6.72
Butea monosperma	Fabaceae	0.20	-	0.93	-
Bauhinia racemosa	Fabaceae	0.30	-	1.39	-
Wrightia tinctoria	Apocynaceae	0.40	-	1.85	-
Chloroxylon swietenia	Rutaceae	0.40	0.6	1.85	3.72
Cassia siamea	Fabaceae	0.90	0.6	4.17	14.42
Diospyros melanoxylon	Ebenaceae	0.50	0.5	2.31	18.83
Gmelina arborea	Lamiaceae	0.60	-	2.78	-
Gyrocarpus americanus	Hernandiaceae	0.50	0.6	2.31	8.72
Leucaena leucocephala	Fabaceae	0.60	0.5	2.78	10.20
Millettia pinnata	Fabaceae	0.20	-	0.93	-
Prosopis juliflora	Fabaceae	6.30	14.6	29.17	8.03
Sapindus emarginatus	Sapindaceae	0.20	-	0.93	-
Tamarindus indica	Fabaceae	0.60	0.2	2.78	8.37
Ziziphus jujuba	Rhamnaceae	0.20	0.4	0.93	2.85
Strychnos nuxvomica	Loganiaceae	0.40	-	1.85	-

Table 2: Vegetative characters of shrubs in *Prosopis juliflora* eradicated and non-eradicated area of Bhavanisagar Forest Range

Scientific name	Family	Density		Relative density (%)	
		Eradicated area	Non Eradicated area	Eradicated area	Non Eradicated area
Acalypha fruticosa	Euphorbiaceae	1.40	-	8.70	-
Carissa carandas	Apocynaceae	0.30	0.90	1.86	8.74
cassia auriculata	Fabaceae	1.20	0.80	7.45	7.77
Catunaregam spinosa	Rubiaceae	0.90	-	5.59	-
Desmidorchis umbellata	Apocynaceae	1.40	-	8.70	-
Dodonaea viscose	Sapindaceae	0.90	-	5.59	-
Flueggea leucopyrus	Phyllanthaceae	0.70	-	4.35	-
Gmelina asiatica	Lamiaceae	0.90	-	5.59	-
Jasminum angustifolia	Oleaceae	0.70	1.10	4.35	10.68
Jatropha gossypifolia	Euphorbiaceae	0.70	1.80	4.35	17.48

Lantana camara	Verbenaceae	0.60	0.50	3.73	4.85
Randia dumetorum	Rubiaceae	0.70	-	4.35	-
Scutia myrtina	Rhamnaceae	0.90	0.90	5.59	8.74
Senna auriculata	Caesalpinioideae	0.70	-	4.35	-
Solanum nigrum	Solanaceae	0.60	-	3.73	-
Solanum virginianum	Solanaceae	0.90	1.90	5.59	18.45
Solanum torvum	Solanaceae	0.90	0.70	5.59	6.80
Toddalia asiatica	Rubiaceae	0.70	0.80	4.35	7.77
Ziziphus oenoplia	Rhamnaceae	1.00	0.90	6.21	8.74

Table 3: Vegetative characters of trees in *Prosopis juliflora* eradicated and non-eradicated area of Bhavanisagar Forest Range

Scientific name	Family	Density		Relative density (%)	
		Eradicated area	Non Eradicated area	Eradicated area	Non Eradicated area
Abutilon indicum	Malvaceae	0.70	0.70	6.03	13.00
Achyranthes aspera	Amaranthaceae	0.90	0.30	7.76	5.60
Brachiaria ramosa	Poaceae	1.00	-	8.62	-
Cayratia pedata	Poaceae	0.50	-	4.31	-
Chloris barbata	Gramineae	1.10	-	9.48	-
Commelina benghalensis	Commelinaceae	0.30	-	2.59	-
Cynodon dactylon	Poaceae	0.50	0.60	4.31	11.10
Elytraria acaulis	Acanthaceae	1.60	0.50	13.79	9.30
Euphorbia hirta	Euphorbiaceae	0.70	-	6.03	-
Heteropogon contortus	Cyperaceae	0.90	-	7.76	-
Leucas aspera	Lamiaceae	1.00	1.80	8.62	33.30
Ocimum americanum	Lamiaceae	0.40	0.70	3.45	13.00
Sida acuta	Malvaceae	0.40	-	3.45	-
Sida cordifolia	Malvaceae	0.70	-	6.03	-
Tribulus terrestris	Zygophyllaceae	0.90	0.80	7.76	14.80

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