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Comparative analysis of species composition in invasive species (*Lantana camara*) eradicated and non-eradicated forest area of Dindigul forest division of Tamil Nadu

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Abstract
The present work examined the impact of *Lantana camara* invasion on species diversity in tropical forest of Palani Forest Range, Dindigul Forest Division, Tamil Nadu, India. Simple random sampling techniques were used for vegetation analysis. In the study area, 16 tree species, 13 shrubs and 9 herbs were documented in *Lantana camara* eradicated area. In non eradicated area, 12 tree species, 8 shrubs and 6 herbs were documented. It is interesting to note that, the density of trees, shrubs and herbs were high in *Lantana camara* eradicated area with superior ground vegetation. This study confirms the superior regeneration and high density of native flora (trees, shrubs and herbs) in *Lantana camara* eradicated area and this would also help in protecting the native flora.

Keywords: Invasive species, *Lantana camara*, vegetation analysis, species conservation

1. Introduction
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. Vegetation is the most precious gift, nature has provided it 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.

In India, the natural ecosystems, particularly reserve forest in different forest region are exposed to several threats like habitat destruction, anthropogenic pressure, pollution, climate change effects and invasive species. Plant invasions are posing a great threat to biodiversity which is already threatened by habitat destruction due to human population growth. 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) [4] and habitat destruction (Williams and West, 2000) [7]. 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 (Hiremath and Sundaran, 2005) [2]. 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

Lantana camara, one of the most destructive invasive species, is widely distributed worldwide that too in biodiversity hotspot areas like Western Ghats. It 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 *Lantana camara* 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 *Lantana*

camera affected areas of Palani Forest Range, Dindigul Forest Division of Western Tamil Nadu.

2. Materials and Methods

Palani Forest Range is located in Dindigul Forest Division of Tamil Nadu, India with an area of 112 sq.km. The study area receives rainfall from both south-west monsoon and north-east monsoon. The average annual rainfall is about 813.0 mm. The soil is generally laterite soil. Five forest types are present in Palani Forest Range namely Southern wet temperate, Southern Tropical wet evergreen, Southern tropical moist deciduous, Southern tropical dry deciduous and Southern tropical thorn forests, where the *Lantana camara* invasion is very high. Southern tropical dry deciduous forest of Palani, Tamil Nadu (11.23571°N latitude and 77.01268°E longitude) was chosen for studying the species composition in *Lantana camara* 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. The tree (above 1.37 m height), shrubs (above 1.37 m height and below 15 cm diameter), herbs and grass species herbs (less than 1.37 m height) were identified and documented. For assessing species composition, the density and relative density were studied using the formula mentioned below.

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) [1].

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

Relative density is the study of numerical strength of a species in relation to the total number of individuals of all the species (Curtis and McIntosh, 1951) [1].

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

3. Results and Discussion

Lantana camara 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, 16 tree species were documented in *Lantana camara* eradicated area and 12 trees species in non-eradicated area (Table 1). Four additional tree species were documented in the eradicated area are *Ailanthus excelsa, Ficus religiosa, Ficus retusa* and and *Senna siamea*. The density of *Tamarindus indica* in *Lantana camara non*-eradicated area was 0.80 where as in eradicated area the density was 2.00. The increase in density of *Tamarindus indica,* clearly indicates that the *Lantana camara* could have restricted the growth of native species. The similar observation was recorded in the density of *Atalantia monophylla* 0.6 in non-eradicated and 1.10 in eradicated area, *Albizia lebbeck* 0.5 in non-eradicated and 0.6 in eradicated area, *Sapindus emarginata* 0.7 in non-eradicated and 1.2 in eradicated area. Tracy and Sanderson (2003) [5] reported that the species composition was recorded maximum in the invasive species removed area and also this helps in promotion of the native species of particular region. Weidenhamer and Callaway (2010) [6] reported that, *Lantana camara* 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.

Thirteen shrubs species in *Lantana camara* eradicated area, and 8 in non-eradicated area were documented in the study area (Table 2). Five additional species namely *Acalypha fruticosa, Dodonaea viscosa, Jasminum angustifolium,* Murraya paniculata and *Tarenna asiatica* were documented in eradicated area. When compared to the *Lantana camara non*-eradicated area the eradicated area had high density of shrubs species; Density of *Ageratina adenophora* is 3.4 in non-eradicated and 3.8 in eradicated area, *Catunaregam spinosa* 1.1 in non-eradicated and 1.8 in eradicated area. The study also suggested that *Lantana camara* has remarkable negative impact on native plant species and reducing species density and may gradually reduce the species richness.

Nine herbs and grass species in *Lantana camara* eradicated area and 6 in non-eradicated area were documented. Three additional species documented in the eradicated area are *Oplismenus compositus, Sida cordifolia and Tribulus terrestris.* The density of *Achyranthes aspera* was 0.6 in non-eradicated and 1.1 in eradicated area, *Cynodon dactylon* 2.1 in non-eradicated and 3.7 in eradicated area, *Heteropogon contortus* 0.7 in non-eradicated and 0.9 in eradicated area, *Ocimum americanum* 0.3 in non-eradicated and 0.4 in eradicated area and *Evolvulus alsinoides* 0.8 in non-eradicated and 1.0 in eradicated area. It clearly indicates that the *Lantana camara* declined the density of herbs and grasses. The present study was in line with the findings of Sharma and Raghubanshi (2011) [3] that the growth architecture pattern of *Lantana* showed that it prevents light penetration to the forest floor, leading to the decline of tree seedlings and possibly the herb flora, but whereas the removal of invasive species helps in promoting the regeneration on the herbs and grasses.

The present study confirms that the eradication of *Lantana camara* helps in increasing the regeneration and density of the native flora. The information documented is first of its kind Palani Forest, Tamil Nadu which are useful in protecting the species in reserve forest.

Table 1: Vegetative characters of trees in eradicated and non-eradicated area of *Lantana camara* in Palani Forest Range

Scientific name	Family	Density		Relative density (%)	
		Eradicated	Non Eradicated	Eradicated	Non Eradicated
Ailanthus excelsa	Simaroubaceae	1.20	-	11.21	-
Albizia amara	Mimosaceae	0.50	1.20	4.67	12.63
Albizia lebbeck	Mimosaceae	0.60	0.50	5.61	5.26
Atalantia monophylla	Rutaceae	1.10	0.60	10.28	6.32
Azadirachta indica	Meliaceae	0.60	1.10	5.61	11.58
Bauhinia racemosa	Caesalpiniaceae	0.20	0.20	1.87	2.11
Diospyros paniculata	Ebenaceae	0.40	0.40	3.74	4.21
Ficus religiosa	Moraceae	0.20	-	1.87	-

Ficus retusa	Moraceae	0.20	-	1.87	-
Gyrocarpus americanus	Hernandiaceae	0.40	0.70	3.74	7.37
Leucaena leucocephala	Fabaceae	0.60	0.90	5.61	9.47
Sapindus emarginata	sapindaceae	1.20	0.70	11.21	7.37
Senna siamea	Fabaceae	0.70	-	6.54	-
Strychnos nuxvomica	Logoniaceae	0.50	0.90	4.67	9.47
Tamarindus indica	Caesalpiniaceae	2.00	0.80	18.69	8.42
Ziziphus mauritiana	Rhamnaceae	0.30	0.50	2.80	5.26

Table 2: Vegetative characters of shrubs in eradicated and non-eradicated area of *Lantana camara* in Palani Forest Range

Scientific name	Family	Density		Relative density (%)	
		Eradicated	Non Eradicated	Eradicated	Non Eradicated
Acalypha fruticosa	Euphorbiaceae	1.3	-	8.28	-
Ageratina adenophora	Asteraceae	3.8	3.4	24.20	14.11
Carissa carandas	Apocynaceae	1.1	1.2	7.01	4.98
Catunaregam spinosa	Rubiaceae	1.8	1.1	11.46	4.56
Dodonaea viscosa	Sapindaceae	0.2	-	1.27	-
Flueggea leucopyrus	Phyllanthaceae	1.4	1.7	8.92	7.05
Jasminum angustifolium	Oleaceae	0.9	-	5.73	-
Lantana camara	Verbenaceae	2.4	12	15.29	49.79
Murraya paniculata	Rutaceae	0.6	-	3.82	-
Randia dumetorum	Rubiaceae	0.6	1.4	3.82	5.81
Scutia myrtina	Rhamnaceae	0.6	0.9	3.82	3.73
Tarenna asiatica	Rubiaceae	0.4	-	2.55	-
Zizyphus oenoplia	Rhamnaceae	0.6	2.4	3.82	9.96

Table 3: Vegetative characters of herbs and grasses in eradicated and non-eradicated area of *Lantana camara* in Palani Forest Range

Scientific name	Family	Density		Relative density (%)	
		Eradicated	Non Eradicated	Eradicated	Non Eradicated
Achyranthes aspera	Amaranthaceae	1.1	0.6	12.22	12.00
Cynodon dactylon	Zygophyllaceae	3.7	2.1	41.11	42.00
Enteropogon monostachyos	Poaceae	0.5	0.5	5.56	10.00
Evolvulus alsinoides	Poaceae	1	0.8	11.11	16.00
Heteropogon contortus	Malvaceae	0.9	0.7	10.00	14.00
Ocimum americanum	Poaceae	0.4	0.3	4.44	6.00
Oplismenus compositus	Convolvulaceae	0.4	-	4.44	-
Sida cordifolia	Poaceae	0.7	-	7.78	-
Tribulus terrestris	Lamiaceae	0.3	-	3.33	-

4. Acknowledgement
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