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Plant Invasions, Biodiversity Conservation and Ecosystem Functioning: A Moment towards Amalgamation

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Abstract: *Biodiversity Conservation has drawn special attention of Environmentalist, Management authority and Planner. After habitat conservation and management, controlling plant invasion has become a challenging task for the biodiversity conservationist. Ecosystem functions depends a lot on the existence of biodiversity. The present study area, Amchang Wildlife Sanctuary, is under serious pressure from several anthropogenic activities supporting the growth and establishment of non-native species. Present study investigate the impact of Lantana camara invasion in Amchang, with special emphasis on species diversity, species density, abundance and primary productivity and at large ecosystem functioning. This study has shown the decline in species diversity and species density and abundance of number of native species under Lantana invasion while more native species diversity was recorded in control area. Ecosystem function depends a lot on the primary productivity, hence it was considered as the determining factor for ecosystem function status in Amchang and recorded decline in ecosystem function under invasion. In such scenario plant invasion and ecosystem functioning should be given priority while determining the site for biodiversity conservation.*

Keywords: *Anthropogenic activities, plant invasion, Species diversity, primary productivity, Ecosystem functioning, Biodiversity conservation.*

1. INTRODUCTION:

Global biodiversity is under tremendous pressure from several natural and global change agents. Biodiversity declination is the most dramatic and irreversible aspects of anthropogenic global change, and biological invasion is the second largest threat of biodiversity loss after habitat destruction (Cronk & Fuller 1995; Vitousek*et al.* 1996). Several studies have showed the impact of invasion in general on vegetation structure, and have attempted to experiment the diversity-stability hypothesis (Elton 1958), and the diversity-invasibility hypothesis (Law & Morton 1996; Rejmanek 1989, 1996; Tilman 1997). It is also shown that exotic species invasions influence distribution and abundance of native species (D'Antonio & Vitousek 1992), and affect regeneration of native flora (Tireman 1916). Exotic plant species can also divert pollinators and dispersers of native species towards themselves, thus hindering the reproductive success of native species (Brown *et al*. 2002; Schurkens & Chittka 2001). However, this is still insufficient to effectively manage and control invasions; exotic species have the susceptibility to invade sites of varying conditions, and multiple species with widely differing traits can invade the same site, so the underlying principles related to invasion mechanisms and control are not always universally applicable. Invasion by both native and exotic plants is a common problem in ecosystems, and the pervasive effects of invasive woody plants on native communities and ecosystem is well documented (Grice, 2004; Jackson et al., 2002; Wearne and Morgan, 2004).

The habitat of present study area is witnessing the impact of several agents like encroachments, deforestation, hill cutting and other unsustainable land use practices. Expansion of urban area is creating widespread pressure on the existing biological stock in the sanctuary. Guwahati city is expanding towards the sanctuary as a consequence it is witnessing the change of land-use pattern, from agricultural land and forest land to residential and commercial establishment prominent in sanctuary. Ahead of all this the city population is also creating pressure by collecting the soil and timber from the sanctuary. Though the Lantana invasions in this habitat are not as serious as the other anthropogenic activities yet it is by no means a problem to be ignored, as it can impact at large on the biological resources existing there.

The primary goal of this study was to assess the impact of Lantana invasions on the native species diversity, density and productivity. Ecosystem functioning of an ecosystem depends at large on its productivity; hence special emphasis was given to determine the productivity under invasion of Lantana and in uninvaded area. The study can be considered as the basis for identification of site for conservation of biodiversity as it would help in asses the species diversity in response to invasion.

2. MATERIALS AND METHODOLOGY:

2.1 Study area

The Study is largely based on the most disturbed areas of Amchang Wildlife Sanctuary (Amchang here from), to visualize the impact of invasion on the native species diversity, abundance and species density existing there (Fig. 1). Urbanisation in Guwahati is creating extensive pressure on the existing biological resources in the sanctuary. Amchang is situated in the eastern part of the capital city of Assam, i.e., Guwahati. The area of Amchang is 78.64 sq km, primarily comprises three reserved forests (RF): Amchang RF (53.18 sq km), Khanapara RF (09.96 sq km) and South Amchang RF (15.50 sq km). The sanctuary is important for conservation of isolated small population of Elephants (*Elephants maximus*). Besides Elephants Amchang is also harbouring animals like Leopard (*Panthera pardus*), Sambar (*Cervus unicolor*), Barking deer (*Muntiacus muntjak*); among primates the most endangered species like Hoolock Gibbon (*Hylobates hoolock*), Capped Langur (*Trachypithecus pileatus*) are recorded in small troops. In the rich pristine habitat of the Sanctuary, bird like Oriental pied Hornbill (*Anthracoceros albirostris*), Lesser Racket- tailed Drongo (*Dicrurus remifer*), Hill Myna (*Gracula religiosa*), Gold-fronted leaf bird (*Chloropsis aurifrons*) can be visualised. Present study included a small part of Amchang

Fig. 1: A Scenic view of the invaded site at Amchang.

2.2 Study Species:

Lantana camara, one of the world's 10 worst invasive species was introduced in India during the early part of the nineteenth century (Bansal 1998). *Lantana* is a native of tropical America which was introduced to India as an ornamental plant to be planted in gardens as hedges. Since then, the species has spread rapidly into both farm and forest lands. It is one of the most widespread, terrestrial invasive species in India today. *L camara* is a low erect or subscandent, vigorous shrub with stout recurved prickles and a strong odour of black currents (Fig. 2).

Fig. 2: A view of the Lantana camara.

The species grows to nearly 6 feet High and spreads up to 8 feet in width, its root system is very strong and it gives out a new flush of shoots even after repeated cuttings. Stems and leaves are covered with rough hairs and emit an unpleasant aroma when crushed. Leaf is ovate or ovate-oblong, acute or sub-acute, crenate-serrate, rogues above, scab rid on both sides The leaves are 2-5 inches long by 1-2 inches wide with rounded tooth edges and a textured surface. The small flowers are held in compact spaces that are typically 1-2 inches across. Flower colour may also vary from white to yellow, orange to red, pink to rise in unlimited combinations. In addition the flowers usually change in colour as they aged. Inflorescences are compact, dome-shaped, 2-3 cm across, and contain 20-40 sessile flowers. Fruit small, greenish-blue black, blackish, drupaceous, shining, with two nutlets, 5-7 mm in diameter, and appear almost throughout the year and are dispersed by birds. Seed setting takes place between Septembers to May with 1 - 20 seeds on each flower head.

2.3 Field Method

Study area was selected in such a way that there is an uninvaded area near the invaded area. Fifty quadrants were laid randomly in *L. Camara* invaded areas. For each of them, more than 3 m away, a quadrant was laid in nearby uninvaded area with negligible (small seedlings) or without *L. camara* invasion. These quadrants served as control. In totality, 100 quadrants with dimension of 5 × 5 m^2 were laid within the study period. In all quadrants individuals of different species were counted carefully and within the quadrant another 1 x 1 m^2 quadrant was laid down and upper part of the species were cut down for measurement of productivity. Species diversity and density were calculated according to Misra (1968).

2.4 Data Analysis

Species density was calculated using Margalef's index that is R1= S -1 / In(n) (Margalef, 1958) and Menhinick's index that is R2= S / √ *n* (Menhinick, 1964), in both cases S is total number of species in sample and *n* is total number of individuals in sample.

Species diversity was calculated in each of 5 × 5 m^2 sampling plots. Diversity indices were calculated using the following equations:

$$H' = -\sum_{i=1}^{S} pi \ln pi$$

(Shannon and Wiener 1963) *H'* = Shannon–Wiener index, *S* = number of species, *pi* = The relative contribution of i^{th} species to the cover, ln = natural log (i.e. base 2.718).

Simpson's index that is $\lambda = \sum_{i=1}^{s} (n_i /N)^2$

(Simpson, 1949) where, N denotes total number of individuals in all species in sample, *n* is the number of individuals belonging to the i^{th} species and S is total number of species in sample.

A 1(invaded) × 1 (uninvaded) factorial ANOVA (Analysis of Variance) was carried out to test the effect of invasion on biomass data. The statistical package SPSS 13 was used to run ANOVA.

3. RESULTS AND DISCUSSION:

3.1 Species Diversity and Species Density:

In this study *L. camara* invaded localities were compared with uninvaded localities which were regarded as a representative of *Lantana* free localities of past, and the difference in both of these was observed as change brought about after *Lantana* invasion. A total of 82 species was recorded in uninvaded area while invaded area has shown dominance of 62 species. Diversity and density was calculated for the native shrubs species, there was a remarkable difference in between invaded and uninvaded localities (Table 1).

Table 1: Ecological indices in *L. camara* invaded and uninvaded localities.

Ecological Indices		Locality	
		Invaded	Uninvaded
Species Density	Margalef's index (R1)	0.51	0.59
	Menhinick's index (R2)	0.15	0.18
Species Diversity	Simpson's index (λ)	0.29	0.34
	Shannon's index (H')	1.21	1.29

Species diversity and density in invaded area was significantly low in comparison to uninvaded area (Fig. 3). This pattern of difference may be described as the change occurring after *L. camara* invasion. Similar pattern was supported as increased *Lantana* population leads to ecological disturbance that can change foraging behaviour of native pollinators, which consequently may result in reduced reproductive output of some native species (Ghazoul, 2004). The decrease in population of the native species is a subject of concern, because, after losing their larger population to *L. camara* invasion there is a possibility that these species may face an inbreeding depression (Ghosh, 2004).

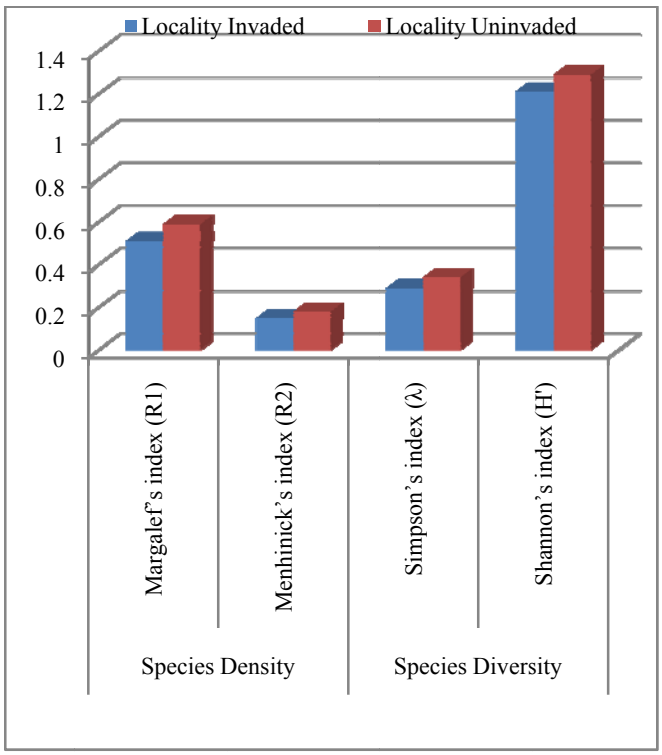

Fig. 3: Diagrammatic representation species diversity and Species density in invaded and uninvaded area.

3.2 Productivity and Ecosystem Functioning:

Productivity of the native species under invasion was remarkably lower in comparison to the uninvaded site. Comparative analysis of variance of productivity data for invaded and uninvaded area has showed significant result (0.042) hence it can be safely argued that with the increased *Lantana* invasion the productivity of the native species decline to a significant extent (ANOVA,Table 2). Ecosystem functioning like co_2 consumption, o_2 production, checking soil erosion etc. will also be detoriated as a result of decline in the productivity, since ecosystem function depends on the productivity to a large extent. *Lantana* is also known to displace natural shrub communities as well as prevent natural regeneration of some tree species (Ambika *et al.*, 2003, Sharma and Raghubanshi, 2006). Hence it may be stated that with the *Lantana* invasion the native species productivity is at stake.

Table 2: ANOVA

Plant Invasion	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	162.813	33	4.934	2.264	.042
Within Groups	34.873	16	2.180		
Total	197.685	49			

4. CONCLUSION

L. camara poses a serious threat to native flora existing in Amchang. Native species density, diversity and productivity has shown extraordinary declination in the invaded area hence it can be safely concluded that overall health of native species were poor in invaded areas. It would be a great deal if *Lantana* invasion process mostly selects the endemic and rare species habitat. However, More extensive and further investigations are required to prove whether the case is same or not. N. E. India is the hub of endemic and rare species, so there is a maximum possibility of the extinction of species without knowing their services as a consequence of invasion. Further, it is to be tackled sincerely that how can productivity of native species be kept intact or enhanced to maintain safe and healthy ecological system. It requires the immediate committed attention of the managers and the research communities that at least we could have save our native species in their natural home.

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