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Impact of Chromolaena odorata (Asteraceae) on vegetation of the northern Western Ghats of Goa and adjacent areas of Karnataka and Maharashtra

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Abstract:

Biodiversity of the Western Ghats is under great threat due to invasion of exotic species. *Chromolaena odorata* (L.) King & H.E. Robins. (Asteraceae) is one of the world worst weeds which caused great ecological environmental loss. In the present study, reconnaissance survey in forest and grassland ecosystems of Goa and adjacent areas of Maharashtra and Karnataka have been carried out to identify the infested patches of *C. odorata*. The comparative studies were carried out between infested and adjacent intact patches by 10 × 10 m. quadrat method. The total 84 infested and 84 non-infested quadrates were studied. The exclusive presence of plant species in infested and non infested quadrats and common to both is studied. The results showed a strong negative correlation between weed area and canopy gap as well as weed area and number of herbs and saplings which indicates decreased number of herbs with increased patch size.

Keywords: *Chromolaena odorata*, invasive assessment, India.

1 Introduction

Bioinvasion takes place when species get introduced, established and spread to the new geographical area (Batish *et al*. 2011). The introduction of the species in newer areas is mainly driven by human activities (Vitousek *et al*. 1997) affecting the native flora and fauna. The communities with lesser number of species and diversity are likely to get affected more to invasion than comparatively richer communities (Elton, 1958).

Chromolaena odorata (L.) King & H.E. Robins., a shrub native of Central America (Tripathi *et al*. 2012). In 1840, it has been probably introduced as an ornamental plant in Botanical Gardens of Kolkata (Voigt, 1845; Lai *et al*., 2006) and then spread in different parts of India. It is not only common in open areas and along the roads but also spread in dry deciduous forests and interior areas of shrub jungles (Prashanthi and Kulkarni, 2005). The economic losses due to invasion in United States, India and South Africa amounted to 150, 130 and 800 billion US dollars respectively and in China 119.8 billion Yuan (Wang *et al*. 2009). It impacts on ecological environment, economy and also it adversely affects on human health and may cause new diseases (Wang *et al*. 2009).

The *Chromolaena odorata* impacts on biodiversity, conservation and ecotourism (Goodman, 2003). It greatly threats the terrestrial biodiversity (Goodall *et al*. 2000). The weed has its allelopathic properties (Sahid and Sugau, 1993) due to that it dominates the vegetation and replaces the other invaders like *L. camara* (R. Muniappan personal observations) (2003).

There is an urgent need to take the steps to control the predominance of *Chromolaena odorata* (Sahu, *et al*. 2010). The effect of invasion of *C. odorata* on vegetation in northern Western Ghats was studied in present work.

2 Materials and Methods

Study area:-

The study-area is the northern Western Ghats restricted to the state of Goa and adjoining areas of Karnataka and Maharashtra. The area extends from Deccan plateau in the east to the west coast through the mountains of the Western Ghats. The sampling area covers North and South districts of Goa, Sindhudurg and Kolhapur districts of Maharashtra, and Belgaum and Uttar Kannada of Karnataka.

Field study:-

The reconnaissance survey in forest and grassland ecosystems of study area was undertaken to identify the grassland and forest ecosystems invaded by *Chromolaena odorata* and affected patches were used for further study.

The comparative studies in between invaded and adjacent intact patches in each ecosystem were carried out. The parameters involved species composition, quantitative studies including species diversity using quadrats of 10 x 10 m., study of canopy gaps, soil, litter, slope, aspect, proximity to the adjacent disturbed site. Herbs, Shrubs, Trees, Seedlings, Climbers, and Creepers were identified from each quadrat, Weed patch area was found out for each quadrat. Change in the species composition with invasion was studied. Effect of weeds on recruitment of native species was estimated and that was correlated with weed patch size and age.

Field trips were carried out from June 2007 to May 2011 to record the distribution of populations of *C. odorata*, using GARMIN GPS 12 handheld receiver. Total 168 of which 84 infested and 84 non-infested quadrats were studied for *C. odorata*.

3 Results and Discussion

Area of Infestation:

Through intensive field trips throughout the study area, 84 localities have been found to be infested with *Chromoleana odorata*. The distribution pattern shows that the infestation is seen on the western side of the Western Ghats which receives very high rainfall. Vegetation is mostly moist-deciduous forests, followed by semi-evergreen and evergreen forests. It's occurrence is mostly seen in disturbed areas especially roadsides, periphery of the forests or within the forest wherein the trees are either cut or burnt. Out of 84 infested sites, 38 sites are located in Goa, 29 in Karnataka and 17 sites in Maharashtra.

These areas receive >3000 mm rainfall. It's presence in these high rainfall receiving areas is as expected, as temperature and precipitation were considered prime factors for its presence (Yadav & Tripathi, 1981) and <1200 rainfall mm is a limiting factor (Norbu,2004). The availability of moisture in these areas is probably important for its growth and establishment as water stress affects its distribution (Foxcroft & Martin, 2002).

Negative correlation between canopy gap and weed area (Fig. 1) though weak appear to be important. Several reports exist with regard to light requirement and canopy cover for the establishment of *C. odorata* in forest. Open sunny habitats than the dense shady forests (Ambika, 2007; Codilla & Metillo, 2011), forest cover delaying the invasion (de Rouw, 1991)

and open sunny areas with good moisture (Ambika, 2002) are some of them. High correlation between light intensity and cover of *C. odorata* and high negative correlation between forest canopy density and cover of the weed are highlights of these findings. However, from the present study it appears that negative correlation between the canopy gap and weed patch size is due to evaporation of moisture from the soil in the larger canopy gaps, which limits its growth.

Data from 84 quadrats have been gathered to analyze the impact of weed on the vegetation as well as possible effects of components of vegetation on the weed establishment. Study shows that 23 species of trees, 33 shrubs, 58 herbs and 12 climbers/creepers and seedlings/saplings of 21 species totaling 147 plant species are present exclusively in quadrats not infested with *C. odorata*. However, their role in not allowing the establishment of *C. odorata* is not ascertained and needs further studies. Similarly there are 133 plant species that were recorded exclusively from the quadrats infested with *C. odorata*. These include 16 trees, 30 shrubs, 15 seedlings, 4 climbers, 1 creeper and 67 herbs, though this does not provide any clue whether these species favor the establishment and growth of *C. odorata* or they are coinvaders. In the third category, there are 192 plant species that include 74 herbs, 53 trees, 33 shrubs, 11 climbers and seedlings and saplings of 21 species that are common to both infested and non-infested sites. Correlation of vegetation characters in relation to area occupied by *C. odorata* is shown in Table 1.

There is a strong negative correlation between weed area and canopy gap as well as weed area and number of herbs and saplings, indicating that number of herbs and saplings go down with increasing weed patch size in each quadrat, thus severely affecting the recruitment. It may be due to its allelopathic effect (Onwugbuta-Enyi, 2001; Suwal, 2010) or in addition through physical smothering (Zachariades &Goodall, 2002). Another observation is that there is a positive but weak correlation between weed area and total number of trees as well as total number of tree species, if combined with negative correlation between canopy gap and weed area indicates that some amount of shade is preferred by weed to establish well. Its success in establishing is linked to medium light intensity (Norbu, 2004) which is provided by intermediate disturbance through small canopy gaps. There is a positive correlation (0.757) between number of tree species and total number of trees on one side (Table 1), and number of species of herbs and saplings on the other side, suggesting that with the opening up of the canopy number of herbs and saplings come up, and in the process an opportunity also arises for *C. odorata* to establish. A weak negative correlation is seen between weed area and number of species (herbs and saplings) (Fig. 2) though cause and effect is not established.

Table 1: Correlation of vegetation character in relation to area occupied by *C. odorata*

	Weed area	**Canopy Gap**	**Total no. of trees**	**No. of tree spp.**	**No. of spp (Herbs & saplings)**
Weed area	1.000				
Canopy Gap	-0.302	1.000			
Total no. of trees	0.132	-0.070	1.000		

No. of tree spp.	0.190	-0.046	0.757	1.000	
No. of spp (Herbs & saplings)	-0.457	0.083	-0.303	-0.239	1.000

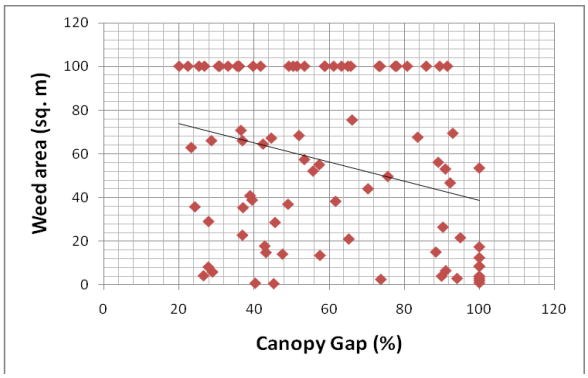

Fig. 1: Slight negative correlation between canopy gap and and *Chromolaena odorata* patch size

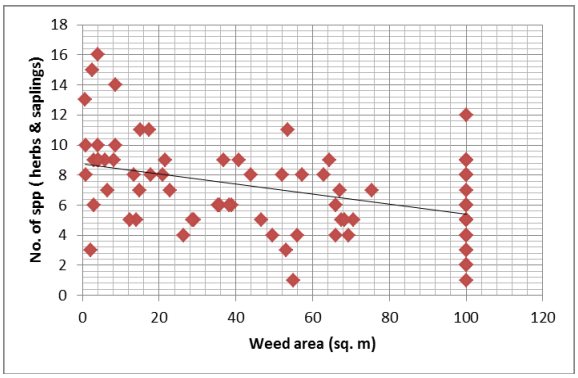

Fig. 2: Scatter diagram showing slight decrease in number of herbs with increasing area of occupancy by *C. odorata*

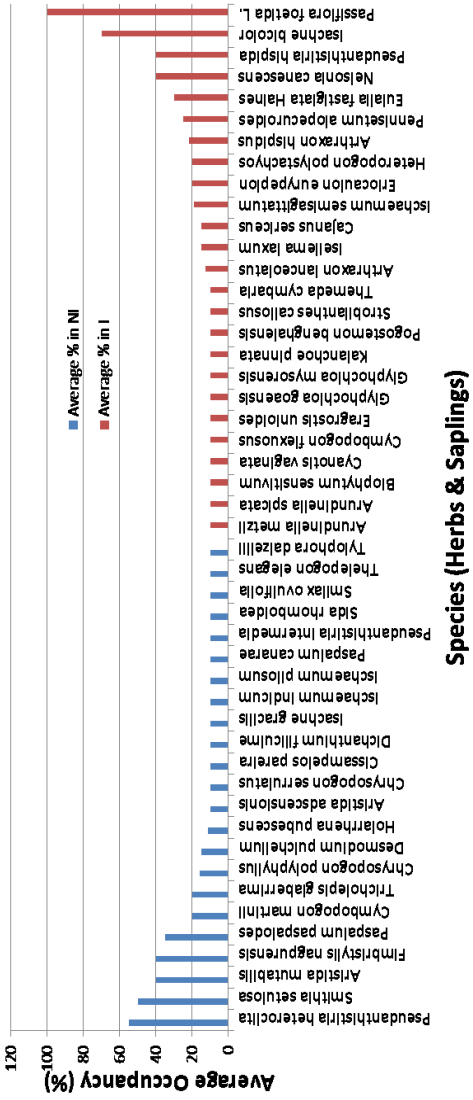

Fig. 3: Herbs and saplings exclusively present in sites infested / non-infested with *C. odorata* (The average % is calculated by working out the percentage of their

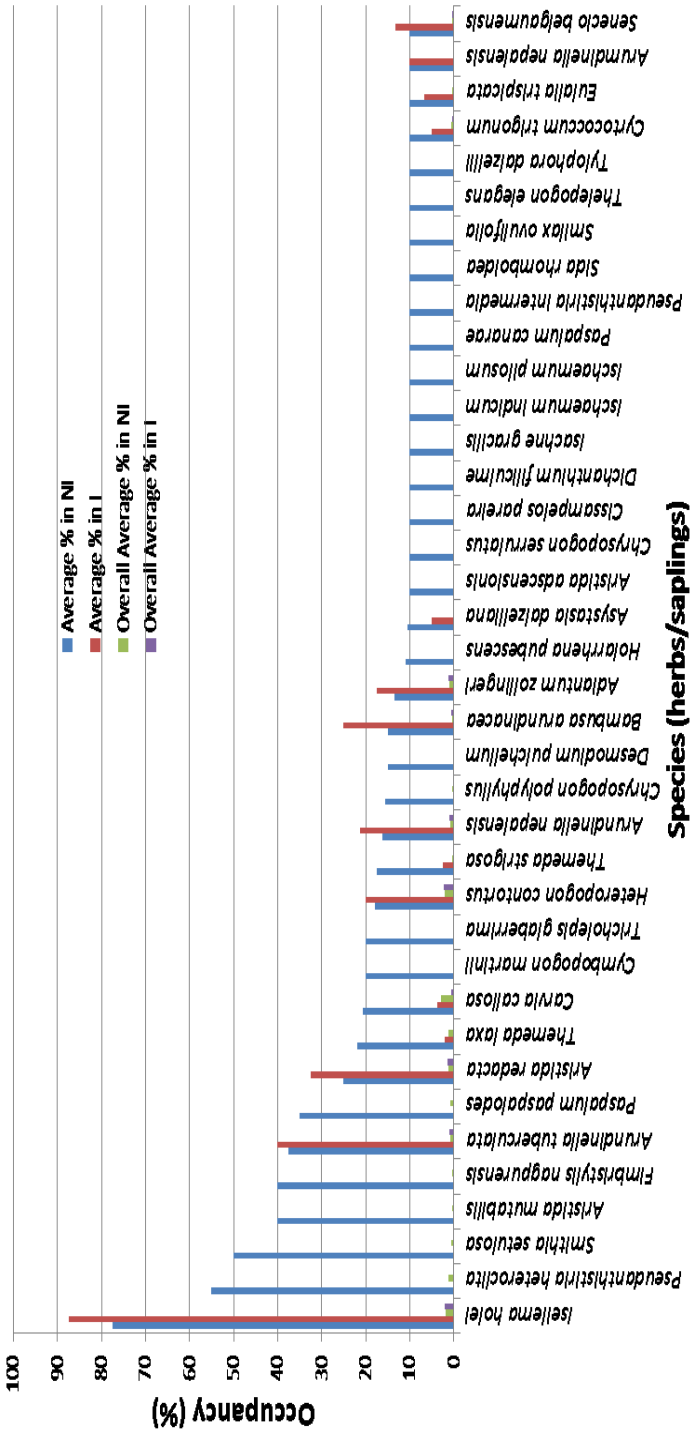

Fig. 4: Herbs and saplings predominantly present in sites not infested with *C. odorata* (The average % is calculated by working out he percentage of their occupancy in each quadrat divided by the no. of quadrats in

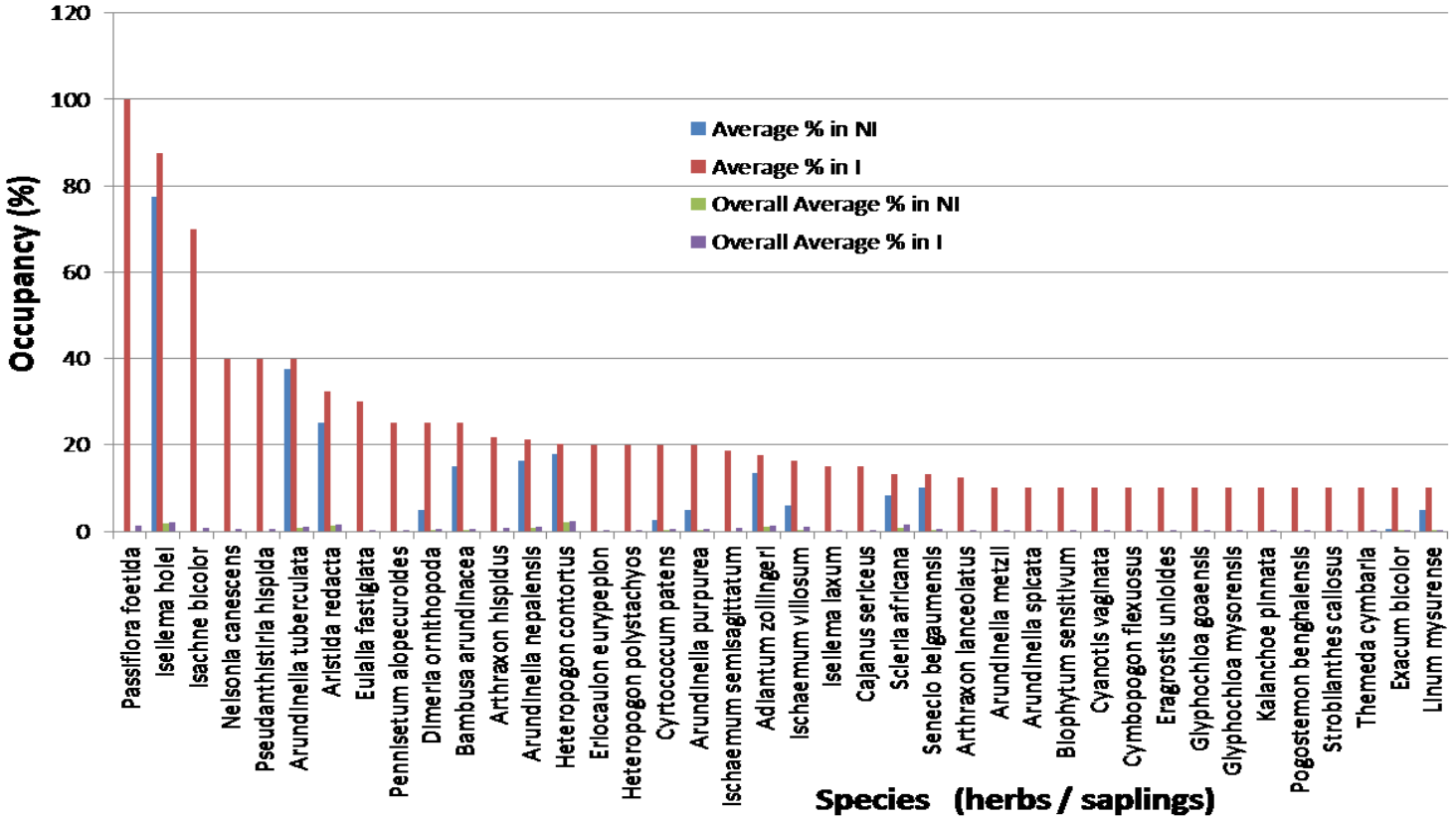

Fig. 5: Herbs and saplings predominantly present in sites infested with *C. odorata* (The average % is calculated by working out the percentage of their occupancy in each quadrat divided by the no. of quadrats in which they are present; overall average = % of occupancy / total no. of quadrats studied)

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4. Conclusion and Future Scope

There is an urgent need to take the steps to control the predominance of *Chromolaena* The effect of invasion of *C. odorata* on vegetation in northern Western Ghats was studied in present work.

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