ECOLOGICAL ATTRIBUTES OF SOME INVASIVE PLANT SPECIES OF JHIRNA RANGE IN CORBETT NATIONAL PARK RAMNAGAR, UTTARAKHAND

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Abstract: Invasive species are those that occur outside their natural range, spread rapidly and cause harm to other species, communities or entire ecosystem and to human well-being. Invasive plant species alter native community composition depletes species diversity, affect ecosystem process and thus cause huge economic and ecological imbalance. These plants possess a set of remarkable traits that allow them to colonize huge areas upon invasion. In India invasive species are present for over a century and some of them are world's worst invasive species. The invasive species are aggressive invaders outside their natural range and have been recognized as the second largest threat to biological diversity and other natural resources after habitat destruction. Present work was carried out to find the intensity of invasion (dominance, density, abundance, frequency and importance value index) of some invasive species distributed in Jhirna range of Corbett National Park, Ramnagar Uttarakhand and to understand the impact of invasive plants on the structure and composition of other species. The information and data were collected with the help of random sampling by placing quadrats of 1x1 m for herbs and 5x5 m for shrubs or 10x10 m for tree. Density, abundance, frequency, basal area and their relative measures for each species have been calculated. A total of five invasive species viz. *Parthenium hysterophorus*, *Cyperus rotundes*, *Eupatorium perfoliferum*, *Ageratum conzoides* and *Lantana camara* were distributed in the study area. Of these, the maximum density was recorded for *Lantana camara* (2820 individual ha^{-1}) followed by *Parthenium hysterophorus* (270 individual ha^{-1}), and *Eupatorium perfoliferum* (240 individual $ha^{-}1$). The *Lantana camara* was the dominant shrub species with 100% frequency.

Key words: Density, ecosystem, frequency, Importance value index, invasive

INTRODUCTION

An increasing number of invasive plant species that colonize natural areas, potentially threatening the diversity and interactions of native species have become the subject of ecological dialogue and experimentation over the last two decades (Pysek, 1995). The most successful non-indigenous species are capable of displacing native species and sometimes communities would have one or more of several characteristic such as effective reproductive and dispersal mechanisms, competitive ability superior to that of the natives in the original or modified system etc. (Gordon, 1988).

In India invasive species are present for over a century and some of them are world's worst invasive species. These plants possess a set of remarkable traits that allow them to colonize huge areas upon invasion. The invasive species are aggressive invaders outside their natural range and have been recognized as the second largest threat to biological diversity and other natural resources after habitat destruction.

Over the past several decades, there has been a heightened concern at the national or international levels about the impacts of habitats destruction and chemical pollution on biodiversity. The invasion by invasive plants is regulating in shifting of species composition of many communities towards a preponderance of weedy and undesirable species.

Present study describes ecological attributes of five invasive species viz. *Lantana camara*, *Parthenium hysterophorus*, *Eupatorium perfoliferum*, *Ageratum conzoides and Cyperus rotundus*of Jhirna range in Corbett National Park, Ramnagar, Uttarakhand. The main objectives of the study were: (i) to determine the intensity of invasion of selected invasive species and (ii) to determine biomass production of selected invasive species.

MATERIAL AND METHOD

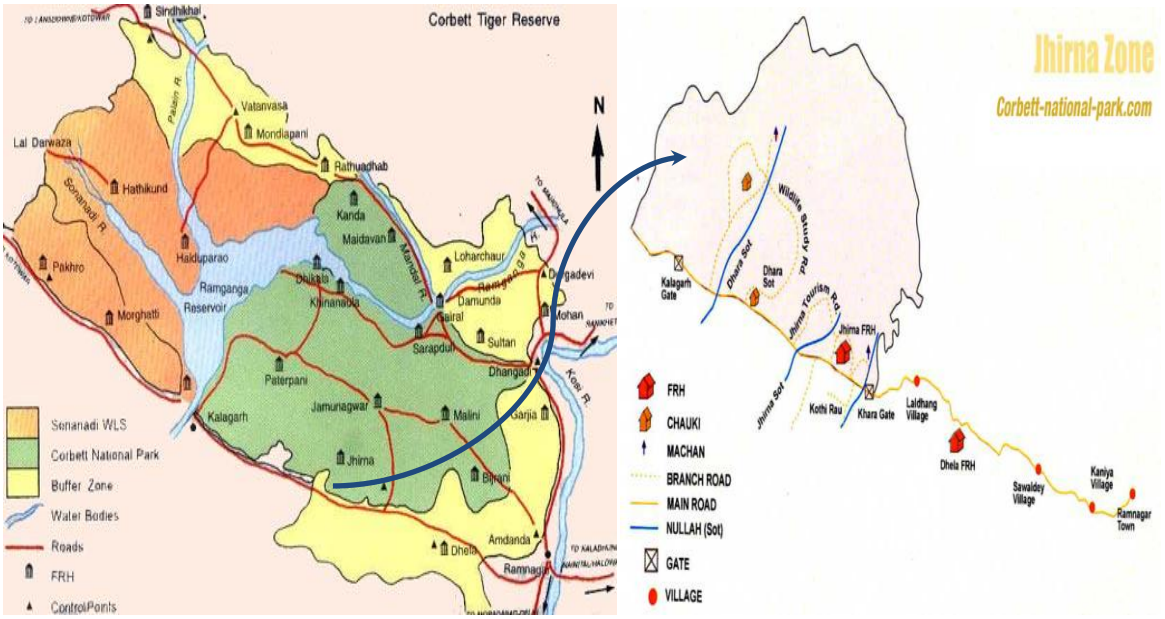
Study site

Jhirna range is located on the Ramnagar- Kalagarh main road running east-west direction through the Corbett national park, Ramnagar, Uttarakhand (Fig. 1). It is situated between latitudes $29^0$25' to $29^0$39'N and longitude $78^0$44' to $79^0$07'E with an area of 1,318.54km^2. Characteristic longitudinal valleys, geographically termed as Doons or Duns can be seen along the narrow tectonic zones between lineaments.

Climate

Jim Corbett National Park has a temperate climate. Like the rest of, India this region also experiences the three distinct seasons, viz. summer (March to mid June), monsoon (mid June to October) winter (November to February). The days can be very hot during summer time, with the temperature crossing the 40^0 C during most of the time. During monsoon, the humidity soars up to 98 %, making the weather very sultry. During winter the humidity level drops down to about 57%. The night temperature can fall down to 5^0 C. During the night, a local wind knows as 'dadu' blows in the region, lowering the temperature significantly.

Fig 1: Location Map of the study site.



Methods

Four sites invaded with each weed were selected at random in the Jhirna range. This range is known for its vegetation including dense mixed Sal and Shesham forests interwoven with bamboo thickets, short and tall grasses. Some of the trees that can be commonly identified at this range are ber (*Zizyphus mauritiana*), semal (*Bombax ceiba*), bael (*Aegle marmelos*), khair (*Accacia catachu*), tendu (*Diaspyros melanoxylon*) etc and invasive species like lantana (*L.camara*), eupatorium (*E. perfoliferum*), parthenium (*P. hysterophorus*), ageratum (*A. conzoides*), sida (*S. acuta*) and cyperus (*C. rotundus*). The nallas and ravines that go deep into the Jhirna forest have cluster of bamboo thickets and common green shrubs. A commonly seen plant that forms an integral part of the vegetation at the Jhirna forest is the *Ardisia solanaceae* that happens to be a succulent plant that make up for water scarcity for certain animals during the dry season.

An area invaded with selected invasive species was selected and 50 quadrat of $1m^2$ were laid randomly and various ecological indices (abundance, frequency, density and provenance value) were calculated following Misra (1968).For biomass estimation of herbaceous species, the invasive plants from 5quadrats (1x 1 m each) were uprooted and dry weight (after over drying at 80^oC till constant weight) was determined. For shrub species (*L. camara*) diameter (10 cm above ground level) measurements were taken and biomass was estimated using regression equation established for this species (Bargali et al 1992, Lodhiyal and Lodhiyal2003).

Methods used for Calculation of ecological indices

$$\text{Density(per square meters)} = \frac{H}{I}$$

Where:
H= total no. of individuals of a species in all the quadrat.
I= Total quadrat studied.

Abundance = H/J
Where:
H = Total no. of individuals of a species in all the quadrat.
J = No. of quadrat in which the species occurred.
Frequency = J/I x 100
Where:
J= No. of quadrat in which the species occurred.

I = Total quadrat studied.

$$\text{Simpson's Index } (\gamma) = \sum_{i=1}^{s} Pi^2 = \left(\frac{Ni}{N}\right)$$

(Simpson, 1949)
Where,
Pi is the proportional abundance of the ith species.
Ni= Number of individual of the ith species.
N= Total number of individuals of all species in the population.
Shannon's Index or α diversity (H') = H'= - $\sum_{i=1}^{s}(pilog2pi)$
or
$H' = -\sum_{i=1}^{s}\left(\frac{ni}{n}\right) log2\ (ni/n)$
(Shannon and Weaver, 1963)
where,
H'= Shannon's diversity index.
n_i= Proportion of individual of species i in the sample
n= total number of all species
Provenance Value was calculated following Misra (1968)

PV = RD+ RF
Where: RD = Relative density
RF = Relative frequency

RESULT

Comparative distribution of selected invasive species

Most of the invasive species belong to the family Asteraceae and the whole area of the Jhirna range forest is mostly covered with the *Lantana camara*, *Sida acuta* and *Cyperus rotundus.* Out of the five species selected, four were herbs and only one species (*L. camara*) was shrub. The maximum density was recorded for *L. Camara* (28.20 individual m^2) followed by *P. hysterophorus (*27.0 individual m^2), and *E. perfoliferum* (24.0individual m^2). Among herbs, *Eupatorium* was the dominant species with a PV value of 57.39 followed by *P. hysterophorus (*56.76) and *C. rotundus* (45) The *L. camara* was the dominant shrub species in the study area (Table 1).

The abundance and frequency of five invasive species was 2.8 to 28.2 and 50 % to 100%, respectively (Table 1). Maximum frequency was shown by *L. camara* (100%) and minimum by *A. conzoides*. All the species showed contagious distribution pattern (Table 1). Among herbs, *P. hysterophorus* showed maximum diversity and concentration of dominance while *Ageratum* and *Cypress* showed minimum diversity and concentration of dominance (Table 2).

Table 1. Distribution of selected Invasive plant species in Jhirna Range.

Ecological Indices	**Herb species**				**Shrub species**
	Parthenium hysterophorus	*Cyperus rotundus*	*Eupatorium perfoliferum*	*Ageratum conzoides*	*Lantana camara*
Abundance	4.5	2.8	3.4	3.4	28.2
Frequency	60	60	70	50	100
Density	27	17	24	17	28.2
PV	56.76	45	57.39	40.83	200
A/F Ratio	0.075	0.046	0.048	0.068	0.282

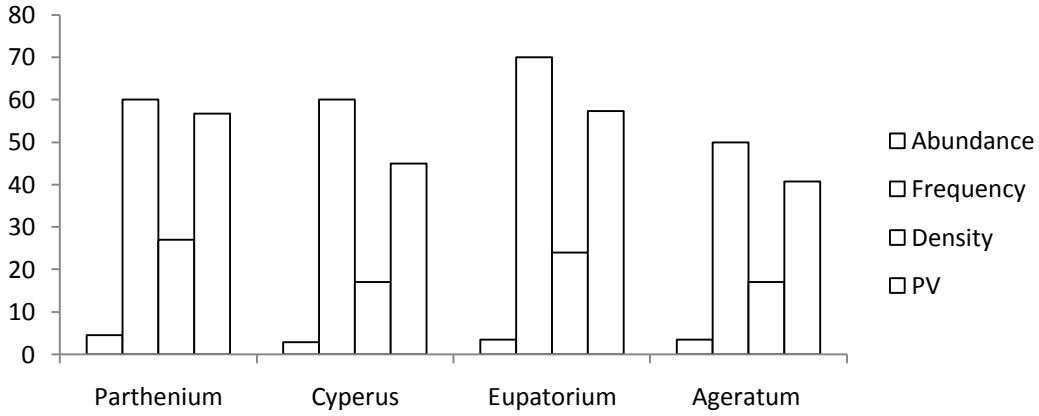


Fig 2: Comparative distribution of herbaceous invasive species in Jhirna range.

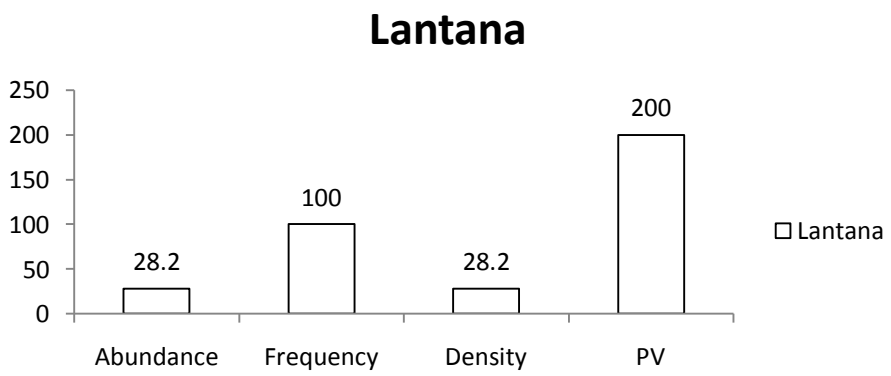


Fig 3: Distribution of invasive shrub species in Jhirna range.

Table 2: RD, RF CD and H' of selected invasive species in Jhirna range.

Ecological Indices	**Herbaceous species**				**Shrub species**
	Parthenium hysterophorus	*Cyperusrotundus*	*Eupatorium perfoliferum*	*Ageratumconzoides*	*Lantana camara*
Relative frequency	31.76	20	28.23	20	100
Relative density	25	25	29.16	20.83	100
CD	0.0053	0.0021	0.0042	.0021	0.0059
H'	0.275	0.204	0.256	0.204	0.284

Comparative biomass production of selected invasive species

Biomass (g plant^{-1}) of selected herbaceous invasive species ranged between 7.43 g plant^{-1} (*C. rotundus*) and 71.43 g plant^{-1} (*S. acuta*) (Table 3). *L. camara* showed 217.65 kg plant^{-1} biomass production.

Table 3. Biomass (g plant^{-1}) of selected invasive species.

Species	**Leaf**	**Stem**	**Root**	**Inflorescence**	**Total Biomass**	**Root: shoot ratio**
A. conzoides	4.76	1.94	3.37	-	10.07	0.50
C. rotundus	1.02	1.98	2.7	1.73	7.43	0.57
P. hysterophorus	4.39	5.04	2.31	0.48	12.22	0.23
S. acuta	25.08	35.11	11.24	-	71.43	0.18
E. perfoliferum	7.49	5.03	4.07	-	16.59	0.33
L.camara	84.36	64.09	69.2	-	217.65	0.46

DISCUSSION AND CONCLUSION

In recent years, the plant diversity is facing various threats and is reducing very rapidly. The invasion of species in the new regimes became a second highest threat to plant diversity after the habitat loss (Hobbs and Humphries 1995). *P. hysterophorus, A. conzoides* and *L. camara* are fast colonizing invasive species from tropical America which has spread in various areas of Himalaya. In the present study it was reported that *L. Camara* and *P. hysterophorus* have higher densities compared to other invasive species. The *Lantana* being the only shrub invasive species showed maximum provenance value (i.e. 200). The higher dominance of *L. camara* supported the growth of lesser number of species in its vicinity as compared to other species. Overall provenance value for herbaceous species showed that the distribution of a particular species in the area was higher for *E. perfoliferum* followed by *P. hysterophorus* and *C. rotundus.*

The invasion of these species in Jhirna range highly reduced the available habitat for the growth of other useful plant species. They directly or indirectly become responsible for the loss of diversity and productivity of plant species in the invaded area. Invasive species modify the geo-morphological, biogeochemical and hydrological, disturbance type and regimes as well as stand structure and recruitment rate of native species. Thus, these species alter the structure, function and dynamics of invaded habitats. The rapid growth rate relative to the natives might support this type of change (Vitousek 1990). All of these modifications increase the competitive advantage of the invading species, which may be better adapted to the new conditions and thus be able to dominate large areas (Vitousek 1990, D' Antonio and Vitousek 1992).Invasive non-indigenous plants have had a deleterious impact on biological diversity and ecosystem processes (Mack et. Al 2000).Thus there is urgent need for the management of forest area under invasion process to conserve the native plant species of the area.

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