
ECOLOGY AND MANAGEMENT OF AN INVASIVE SPECIES, *Eupatorium adenophorum* IN KUMAUN HIMALAYA

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ABSTRACT

Eupatorium adenophorum, an invasive plant species has potential to damage crops, environment and public health. It is recognised as one of the leading threats to biodiversity and imposes tremendous costs on agriculture, forestry, fisheries, wetlands, roadsides, natural areas and other human enterprises, including human health. The present study gives a better understanding of history, ecology and factors making this species invasive and offers possibility of taking control measures for their management practices.

Keywords: *Eupatorium adenophorum*, Invasive species, Kumaun Himalaya.

INTRODUCTION

An alien species is defined as a species, subspecies or lower taxon occurring outside of its natural range and dispersal potential and includes any part or gametes of such species that might survive and subsequently reproduce (Jansson 2000). An alien species can be called invasive when it becomes established in the natural or semi-natural ecosystems or habitat outside its natural range (IUCN 2000). These alien or exotic species when introduced unintentionally become invasive and cause harmful impact resulting in extinction of the indigenous species. Such biological invasions by animals, plants or pathogens may occur as the result of climatic changes as well as through human actions (Vermeij 1996; Williamson 1996). These plant species reproduce in a large number and thus have potential to spread over a large area. They have significant effect on the biological and human communities in which they appear. These effects include economic, environmental, aesthetic and biological harm to biodiversity, ecosystem function and human welfare (Ricciardi *et al.*, 2000). Their appearance is associated with perturbations resulting

from human population growth and activities that adversely affect the environment. Primarily human activity makes ecosystems more susceptible to invasion by upsetting the natural community, particularly disturbing plant communities through harvesting, grazing, and trampling (Groves *et al.*, 2001). Altered patterns in water, soil and nutrients can also facilitate the invasion of undesirable non native species. Biological invasion worldwide threatens biodiversity, ecosystem dynamics, resource availability, national economy and human health (Pejchar and Mooney 2009). In recent years invasive species also have gained considerable attention as major threats to native species and ecosystem in the Himalayan region by spreading over large areas in forests and along roads and rivers (Singh *et al.*, 2010). *Eupatorium Adenophorum*, native to Mexico and Costa Rica of Central America is a worldwide noxious invasive weed (Table 1& 2). It occurs throughout the world and is especially rampant in South-east Asia, Hawaii (U.S.), New Zealand, Australia and Pacific island. It is considered a threat to local economy and biodiversity. It was introduced in

India after 1498 (Biswas 1934) and it is likely that it was introduced into Nepal from India through eastern border (Banerji 1958) probably before 1950. Invasion of this exotic species have replaced the larger part of the vegetation in Kumaun (Fig. 1) and is considered as major threat to native plants and animals (Singh *et al.*, 2000; Agarwal 2002).

In general, an invasive species survive three processes: (i) Dispersal into new locality (ii) Colonization (iii) Enduring habitat occupation. The success of invasive alien plants is due to their opportunistic exploitation of anthropogenic disturbances, the absence of natural enemies, and frequently, their allelopathic competitive strategies.

Table 1. A brief description about *Eupatorium adenophorum*

Species	<i>Eupatorium adenophorum</i>
Common Name	Crofton weed
Local Name	Kala Bansa
Family	Asteraceae
Distribution	It is found upto 2200 meters above mean sea level, in ravine slopes and grassy localities.
Description	There are around 600 species in genus <i>Eupatorium</i> . It is a shrubby perennial with a woody rootstock and numerous upright branching stems.
Uses	Despite its obnoxious nature and bad economic/environmental consequences it is reported to possess diverse medicinal properties and finds use in traditional medicines. It is used in folk medicines as antimicrobial, antiseptic, blood coagulant, analgesic, antipyretic and enhancer of phenobarbitone induced sleep (Mandal <i>et al.</i> , 1981; Ansari <i>et al.</i> , 1983; Rai and Sharma 1994).

Table 2. Species invading in natural areas of Uttarakhand

Scientific Name	Local Name	Family	Introduced From/origin	Habit	Habitat
<i>Ageratum conyzoides</i>	Fulania	Asteraceae	Tropical America	Herb	Wastelands, pastures and forests
<i>Eupatorium adenophorum</i>	Kaala bansa	Asteraceae	Mexico and Costa Rica of Central America	Shrub	Forests
<i>Lantana camara</i>	Kuri	Verbenaceae	Tropical America	Shrub	Forests
<i>Parthenium hysterophorus</i>	Gajri ghaas	Asteraceae	Tropical America	Herb	Fields, forest areas, grass lands and urban areas, fallow wastelands, roadsides and overgrazed pastures

Table 3. Target Study Sites

	Forest Type	Altitude (m a.s.l.)	Study Sites/Aspects	Latitude	Longitude	Location
1.	<i>Pinus roxburghii</i>	1284-1320 1287-1318	Site I (NE) Site II (SW)	N 29°22'	E 079°34'	Champhi
2.	Mixed Oak	1335-1369 1337-1366	Site I (NW) Site II (S)	N 29°20'	E 079°31'	Sattal
3.	<i>Quercus leucotrichophora</i>	1952-2018 1950-2020 1955-2023	Site I (NE) Site II (E) Site III (SW)	N 29°24'	E 079°32'	Maheshkhan
4.	<i>Quercus lanuginosa</i>	2013-2040	(S)	N 29°24'	E 079°32'	Maheshkhan

The climatic and edaphic similarities between the original and new habitats are very important factors for the establishment of alien species (Holdgate 1986). For an example, humid tropics of the Asia and Africa with highly leached soils are similar to Latin American home of species such as *Lantana camara*, *Ageratum conyzoides*, *Eupatorium odoratum*, *Eupatorium adenophorum*, *Parthenium hysterophorus* enabling them to invade and colonise appropriate sites on these two continents (Ramakrishnan 1991). Spread of alien invasive species other than *Eupatorium* such as *Lantana*, and *Parthenium* species in natural forests has also been linked with climate change which will have a competitive impact on existing native species (Negi *et al.*, 2012). Disturbed habitats are known more prone to the invasion as compared to the well-managed ecosystems and habitats. Prolific seed crop, small seed size, persistent soil seed bank, high offspring production, potential long-distance dispersal of propagules, vegetative reproduction, relatively high CO₂ fixation capacity, shade tolerance, high adaptive ability, vegetatively fast spreading capabilities are some factors that favour growth of such species and reduce associated species. These characteristics of *Eupatorium* make escaping its field boundaries easy and successful.

STUDY SITES AND METHODOLOGY

A comparative analysis was done to study vegetation dynamics with particular focus on invasion of *Eupatorium adenophorum* along Gola catchment in Kumaun, west Himalaya (Table 3). Towards maintaining the compatibility of data sets with earlier studies, the approach and methodology followed in the present study was kept similar with the approaches of previous studies (Saxena 1979).

RESULTS AND DISCUSSION

The entry of *Eupatorium adenophorum* over the last 3-4 decades was revealing in the studied forest sites. The species was not earlier reported in the previous study (Saxena 1979) whereas; the present study reveals *E. adenophorum* with the maximum plant density in all the studied forest sites and thus, reflecting its high rate of proliferation (Fig. 1). The species density for this invasive species in these forests ranges from 250–1583 ind ha⁻¹ with maximum spread in the Banj-oak (*Q. leucotrichophora*, site II) followed by Rianj-oak (*Q. lanuginosa*) forests (Fig. 2). The emergence of this species is indicative of possible future changes in compositional diversity of the Himalayan forests.



Fig. 1. (a) & (b) Invasion by *Eupatorium adenophorum* in *Pinus roxburghii* forests of Sattal, Uttarakhand (c) & (d) Invasion by *Lantana camara* in mixed oak forest of Bhowali, Uttarakhand.

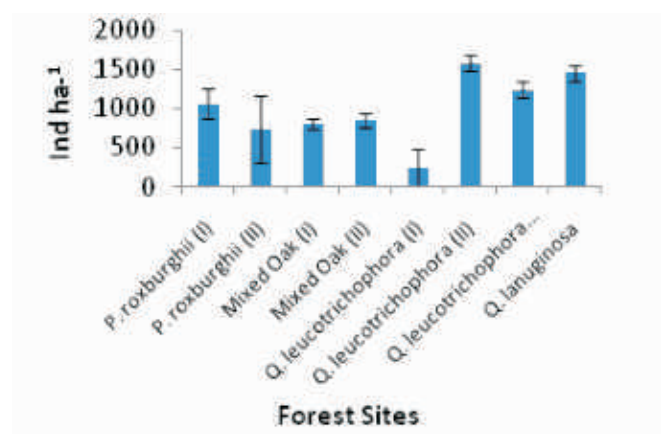


Fig. 2. Density Status of *E. adenophorum* in the selected forest sites

Ecology, management and control measures

The trailing branches of *Eupatorium* species easily root at the nodes on contact with the soil, enabling it to build up dense thickets consisting of many intertwined stems. It has a prolific asexual seed production due to apomixes and the seed rain in dense stands of this plant may reach up to a very high number. The dense stand is known to eliminate native vegetation by preventing their regeneration. This species is a serious threat to forest and their management is receiving considerable attention from researchers and forest departments. Knowledge of invasion biology and behaviour is needed to mitigate the harmful effects caused by this invasive species. Its

ecology still needs to be explored for appreciable progress in the area of its management. Efforts are being made to control established invasive species, but a better understanding of why species become invasive offers the possibility of taking suitable measures. It is controlled by slashing followed by ripping or ploughing, often combined with sowing other species after removal. Regular slashing reduces flowering and seed set, moreover the vigour and density of infestation. Several natural enemies and pathogens have also been reported that might be able to control the reproduction of this weed, such as *Procecidochares utilis*, *Cercospora eupatorii* and *Alternaria alternata*. Biological control of *Eupatorium* species using gall fly *Procecidochares utilis* has been carried out throughout world. It was successful in Hawaii, USA, and elsewhere (Bess and Haramota 1971). Some important herbicides recommended and used to control this plant include glyphosphate, 2, 4-D amine, dicamba and 2-methyl-4-chlorophenoxyacetic acid (MCPA), or triclopyr, applied in late summer when the plant is actively growing.

CONCLUSION

Eupatorium adenophorum an invasive species has serious environmental and economic consequences. Invasions by such species in a new area alter indigenous community composition, deplete species diversity, affect ecosystem process and thus cause huge economic and ecological imbalance. The major impact of alien invasion follows reduction in forest product availability, which adversely affects the livelihood because the subsistence of rural livelihood entirely relies on such forest products. There is an urgent need to utilize an integrated approach that combines various ecological aspects to design a better management on invasive species that are introduced intentionally or unintentionally. Concurrently, it is also more essential to understand why this species become invasive.

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