



Native vegetation pattern and the spread of three invasive species in Palani Hill National Park, Western Ghats of India



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ARTICLE INFO

Article history:

Received 12 August 2015

Received in revised form 19 May 2016

Accepted 25 May 2016

Keywords:

Invasive Alien Species

Spatial relationship

Distribution models

Protected Areas

ABSTRACT

Invasions by exotic plants threaten the biodiversity and integrity of Protected Areas (PAs) by manipulating the species composition, the nutrient cycling and the hydrology prevailing in the specific habitat. Invasion of plant species in the natural ecosystem especially in the precincts of Western Ghats is due to rampant anthropogenic pressures. Complete assessment of the vegetation, richness distribution of Invasive Alien Species (IAS) and their association with the environmental drivers is essential to manage the PAs effectively. The present study analyses the richness of native vegetation with a comparative view on the distribution of *Lantana camara*, *Chromolena odorata* and *Pteridium aquilinum* in proposed Palani Hill National Park (PHNP), Western Ghats of Tamil Nadu. Secondly prepare models of the distribution of the target invasive species in the region. The biotic and abiotic data along with the vegetation type were generated and overlaid on IAS distribution to model the spread of target plant species. The study revealed that the distribution of invasive species negative relationship between the native species richness and positive relationship between the species dominance. Among the forest types dry evergreen, moist deciduous and tree savanna were found to be more vulnerable to invasion of *Lantana camara* and *Chromolena odorata*, wherein tree savanna and plantation were more vulnerable to invasion of *Pteridium aquilinum*. The information will strongly support effective management of Protected Areas.

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1. Introduction

Invasion of Alien Plant Specie rapidly changes the status of native community, structure and function of ecosystem [1–4], alters ecological integrity of native habitats and ecosystem [5,6], changes the resource availability for other organisms [7,8] out-compete with native plant species for resources [9] impacts the biological diversity [10,11], native communities [12,13] change the community structure and finally alter the species richness [14].

Studies on the distribution of native species [15] and native vegetation have become very essential to mitigate the impacts of invasive species [16,17]. Inventory of current situation and regional studies on invasive species have been given highest priority [18] as they are essential for invasive species risk assessment [19] and for effective control measures [20]. Extrapolated field samples, museum records [21,22], environmental stratified samples [23] remote sensing imagery [24,25] and GIS analysis of abiotic and biotic factors [26] are useful to generate spatial distribution of species, and the models have been developed using environmental factors [27] like spatial distribution of invasive species [28]. In the present study, the distribution status of three obligate

invasive species i.e. *Lantana camara*, *Chromolena odorata* and *Pteridium aquilinum* in the native vegetation of managed Protected Areas of Palani Hill National Park and their likelihood spread based on prevailing abiotic factors and disturbance factors such as anthropogenic pressure is analysed. The study will benefit in evaluating the ecological consequence of forest management of regional and global scale.

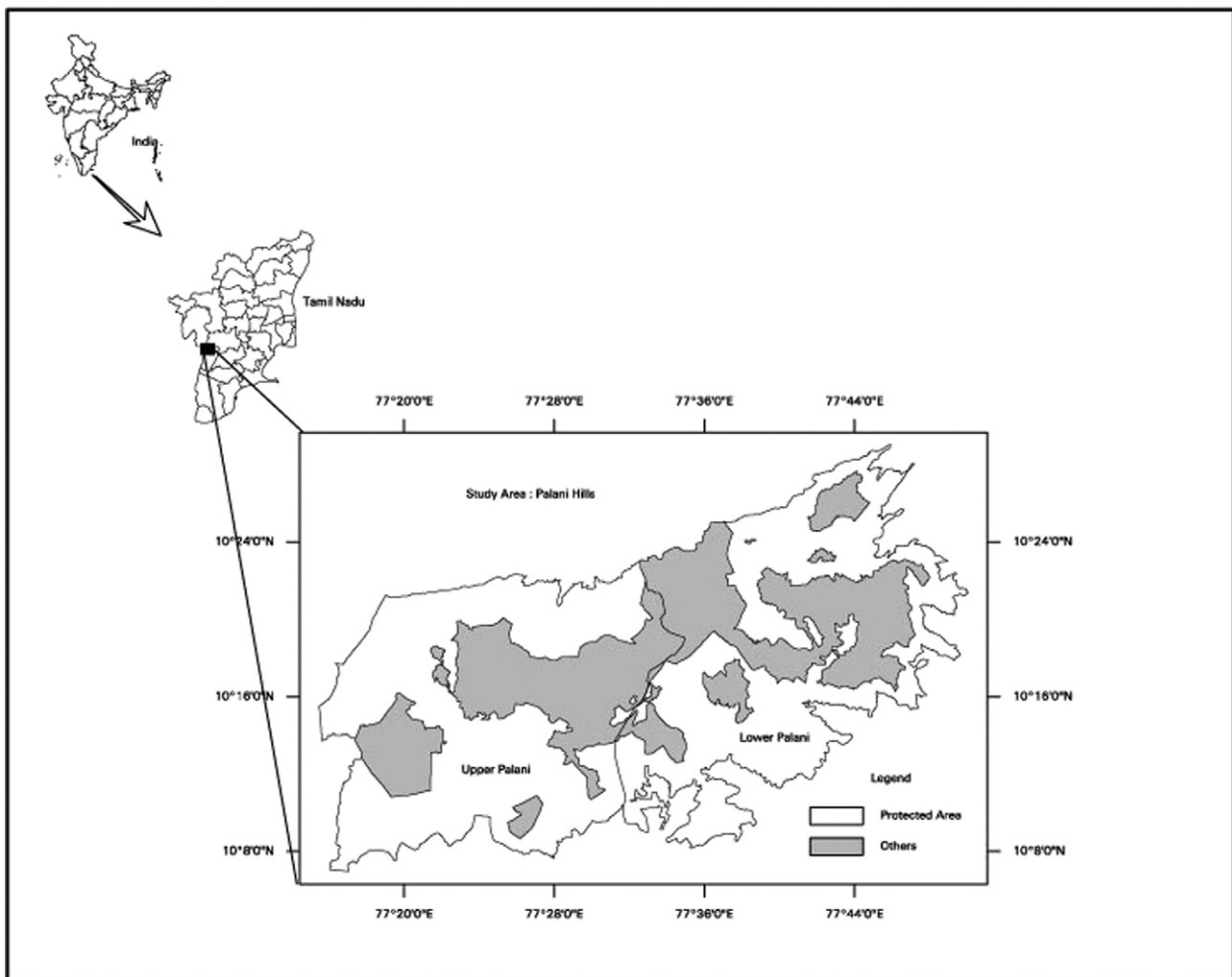
2. Material and methods

2.1. Study area

The Palani Hill (a part of Western Ghats) is located in the Western Part of Madurai City, Tamil Nadu, South India. The study area lies between 10°–05' and 10°–25' North and 77°–15' and 77°–50' East (location Map 1). The study area includes Palani Hill wild life sanctuary and proposed Palani Hill National Park (PHNP) occupying an area of about 1360 sq. km. Totally around 3015 plant species have been reported from the Palani Hills [29]. Based on the elevation ranges (800–2200 m) the hills are classified into Lower Palani and Upper Palani. The Upper Palani i.e., the western block is an undulating plateau, interspersed with shola vegetation (wet evergreen) and with few ravines or valleys, and are considered as one of most valuable treasures of the hill chains. Lower Palani consists of a

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Map 1. Location map of study area.

confused jungle of peaks with different types of wood land and scrub vegetation. The hills enjoy a subtropical climate, with a maximum temperature of 20 °C to 30 °C, and a minimum of 15 °C to 20 °C. The annual mean rainfall ranges between 800 to 1450 mm in Lower Palani and above 1400 mm in Upper Palani, and receives rain both from South West and North East monsoon. The Palani Hill consists of archaic plutonic rocks. The rocks in the hills are almost entirely Charnockites, bluish granite, though broad bands of feldspars and quartz cross the gneissic foliations are also seen. Kodaikanal is a well-known hill station situated on the Palani Hills. The name Kodaikanal has been derived from two Tamil words *Kodai* and *kanal* that means summer and a dense forest respectively denoting the pleasant environment prevailing there.

2.2. Methodology

2.2.1. Target invasive plant species

There are 337 exotic species belonging to 75 families identified from the Palani Hills [29]. Among them Myrtaceae contributed more species (30) followed by Solanaceae (21 sp.), Compositae and Graminae (20 sp.) respectively. There were extensive and gregarious growth of exotic species like *Acacia mearnsii*, *Ageratum conyzoides*, *Cymbopogon citratus*, *Chromolaena odorata*, *Coffea Arabica* and *Pteridium aquilinum* along with the target species. They are known to invade the gaps in the Protected Areas of Palani Hills, suppressing the growth of the native vegetation.

In this study *Pteridium aquilinum*, *Lantana camara* and *Chromolaena odorata* were selected as candidate species due to their extensive growth and excellent adaptability to the native environment.

- Lantana camara* L. (Wild Sage) is an indigenous plant of South America. One of the 100 “World’s Worst” invaders. It occurs in diverse habitats and on a variety of soil types. It doesn’t grow at ambient temperatures below 5 °C. The plant is found at altitudes ranging from sea level to 2000 m and can thrive very well with rainfall ranging from 750 to 5000 mm per annum. *Lantana* does not invade intact rain forests, but is found on their margins. Indiscriminate logging in natural forests create open spaces or gaps, where is readily encroached upon by *L. camara*.
- Chromolaena odorata* L. (Siam Weed) It is native to the warmer parts of south-eastern USA, Mexico, the Caribbean and tropical South America. One of the 100 “World’s Worst” invaders, potential weed of tropical and subtropical regions that invades riparian zones (banks of water courses/bodies), forest margins, roadsides, disturbed sites, waste lands, abandoned pastures, crops and plantations.
- Pteridium aquilinum* (L.) Kuhn (Bracken Fern) is native to western parts of North America. Bracken fern is found in acid soils in both older forests and in new pine forests, especially those frequently burned. It is also found in abandoned pastures and along forest margins. These fronts release allelopathic chemicals which prevent or suppress growth of plants in their immediate proximity.

2.3. Data generation

2.3.1. Biotic data

Geocoded IRS P6 digital scenes of path 100, Row 66 and 67 (February 2009 with <5% cloud cover) was acquired from Data center (NDC),

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