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Status of Invasive Plant Species in the Dry Savanna Grasslands of Rajiv Gandhi Orang National Park, Assam

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ABSTRACT

The grasslands in the floodplains of North East India are known for its faunal diversity with special reference to its mega herbivores. This ecosystem is presently under threat with the invasion of various plant species. We studied current status of invasive plant species in dry savanna grassland of Rajiv Gandhi Orang National Park, Assam. Four invasive plants species have been recorded from the study area viz. *Ageratum conyzoides* (L.), *Chromolaena odorata* (L.) R. M. King & H. Rob., *Mikania micrantha* Kunth, and *Mimosa diplotricha* Sauvalle. Among the invasive plants, *Chromolaena* had the highest density (261 individuals ha^{-1}) and IVI (7.88) followed by that of *Mikania* and *Mimosa. Chromolaena* was the most frequent species, while *Ageratum* was the least recorded plant. The status assessment of invasive plant species in this very important protected grassland ecosystem in North East India will be helpful in making a sound management protocol for the invasive plant species.

Key Words: Invasive Plant Species; Dry Savanna Grassland; Rajiv Gandhi Orang National Park; North East India

INTRODUCTION

Grasslands are the land dominated by herbaceous and shruby vegetation with a little or no tree cover and are maintained by fire, grazing, drought and freezing temperatures (Suttie et al. 2005, White et al. 2000). In India, grasslands are generated due to the massive deforestation followed by regular disturbance including fire, flood, grazing or cultivation; they are in successional stages and can be considered as tropical grasslands or savanna in stable sub climax stage (Bharucha and Shankarnarayan 1958, Yadava 1990, Anonymous 2013). The grassland of flood plains in Northeast India is dominated by *Phragmites-Saccharum-Imperata* grass and covers the Brahmaputra valley and parts of Manipur and Tripura. In low rainfall areas or dry areas *Saccharum spontaneum*, *Imperata cylindrica*, *Phragmites karka*, *Saccharum arundinaceum* were the common species. While, in the swampy areas *P. karka* is the dominant species along with *Saccharum narenga, Sclerostachya fusca*, *Lessaria hexandra* (Shukla 1996). These grasslands are the home to grassland specialist fauna. Thus, most of these grasslands are protected by establishing national parks and wildlife sanctuaries.

Invasive species are those that occur outside their natural range, spread rapidly and cause harm to other species, communities, or entire ecosystems and to human well-being (Singh et al. 2010). In India *Ageratum conyzoides* L., *Parthenium hysterophorus* L., *Eupatorium adenophorum* and *Lantana camara* L. are the well recognized alien invaders which pose threat to indigenous plant communities under various habitats and areas from plains to hills (Dogra et al. 2010).With the invasion of various alien and indigenous species now, most of these grasslands are under different degree of threats. There are quite a few reports of invasion from the grasslands of Assam viz. Kaziranga, Orang, Manas and Pabitora (Vattakkavan et al. 2002, Uma Shankar 2002, Mishra 2005, Lahkar et al. 2011). Management of these grassland habitats have become a challenge to the

management authorities due to the invasion. In the present study, we tried to assess: i) The invasive species diversity in the area ii) Current status of invasive species in the area iii) The various phytosociological characters pertaining to invasive species in the dry savanna areas of Rajiv Gandhi Orang National Park.

STUDY AREA

Rajiv Gandhi Orang National Park (RGONP) (26°29' to 26°40' N and 92°16' to 92°27' E) is located in the flood plain regions of Darrang and Sonitpur districts of Assam (Figure 1). The RGONP covers 78.8 km^2 area comprising of grasslands dotted by woodlands and water bodies (Talukdar and Sharma 1995). The average annual rainfall in the area is 3000 mm with relative humidity varying from 60% in March to 95% in July. The average temperature in the winter season is 8° C which rises up to 37° C in summer (Sarma 2010). The habitat of RGONP is composed mainly of Eastern Himalayan Moist Deciduous forest (3C/C3b), Eastern Seasonal Swamp forest (4D/SS1), Khair-Sisoo Forest (5/1S2), Eastern Wet Alluvial Grassland (4D/2S2) and Plantations (Champion and Seth 1968). One-Horned Rhino (*Rhinoceros unicornis* Linnaeus, 1758), Royal Bengal Tiger (*Panthera tigris* Linnaeus, 1758), Asiatic Elephant (*Elephas maximus* Linnaeus, 1758), Hog Deer (*Axis porcinus* Zimmermann, 1780) and Wild Pig (*Sus scrofa* Linnaeus, 1758) are the faunal species found in the grassland habitat. The grasslands also provides an important habitat to Bengal Florican (*Houbaropsis bengalensis* Gmelin, 1789) and Pygmy hog (*Porcula salvania* Hodgson, 1847).

METHODOLOGY

Based on the earlier works of Sarma (2010), the entire grassland of Rajiv Gandhi Orang National Park was divided into two broad grassland type: i) Dry savanna ii) Wet alluvial grassland (Sarma 2010). The study was carried out from January 2013 to December 2014. The entire National Park was divided into 367 grids (each measuring 600 m x 500 m) out of which 211 grids fell in grassland area of the Park. Among these, 112 fell under dry savanna grassland. Vegetation was sampled in the randomly selected 26 grids by the quadrat method and the status of invasive species in the grassland ecosystem of RGONP was examined (Misra 1968, Sharma and Raghubanshi 2010, and Mao and Gogoi 2010). In each grid, four 1m x 1m quadrats were laid randomly (Singh

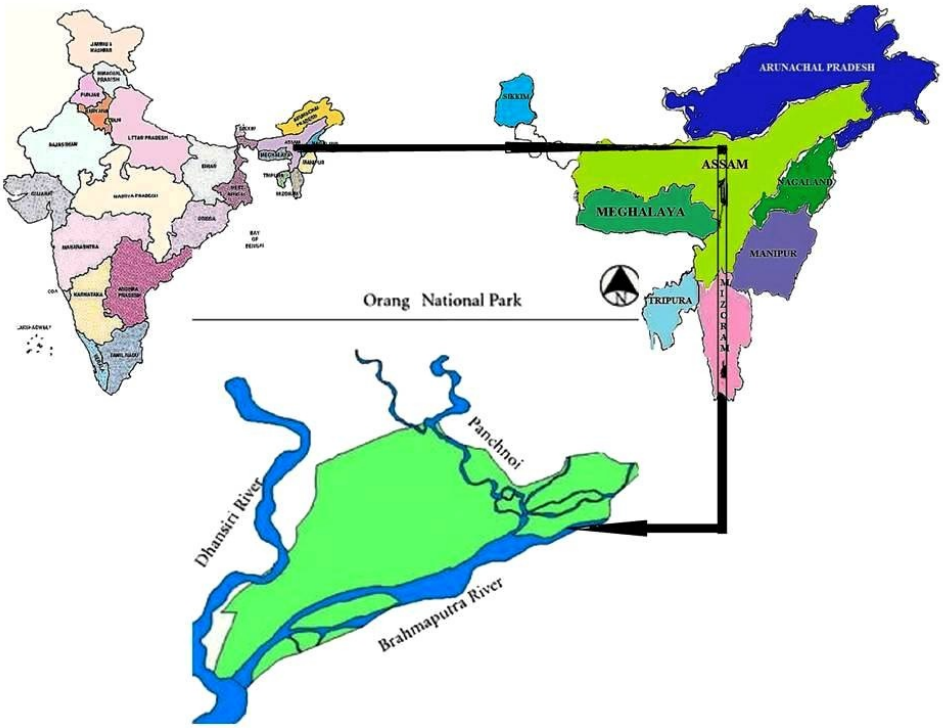

Figure 1. Location map of Rajiv Gandhi Orang National Park, Assam

and Yadava 1974, Ramakrishnan and Ram 1988, Anderson and Ingram 1993, Karunaichamy and Paliwal 1994, Kent and Coker 1994, Gibson 2002). In few grids however, four quadrats could not be sampled due to inaccessibility of the area. Quadrat size was fixed by species area curve method (Cain 1938, Mall and Billore 1974). A total of 97 sampling efforts were made to study the distribution of invasive species in the dry savanna grassland. Each individual of grass and other plant with functional roots were considered as an individual (Singh 1967, 1969, Uma Shankar 1991, Hickey and King 2000). In case of creeping plant, unit having functional roots inside the quadrat was considered as an individual (Saxena and Singh 1980). Basal cover was determined by measuring basal diameter for ten individuals of each species using a calliper (Uma Shankar 1991). These data were used to calculate density, frequency and basal area (Misra 1968), and Importance Value Index (Curtis 1956). PAST software (Hammer et al. 2001) and SPSS (http://www.spss.co.in) Were used for all statistical analyses.

RESULTS

Sixty-seven plant species were recorded from the dry savannah grasslands of RGONP (Annexure I). Three distinguished plant types were observed (Table 1, Annexure I) in which grass species recorded the highest density followed by other plant types and invasive plant. *Imperata cylindrica* was the densest among the grass species. A total of four invasive plant species were recorded during the survey period namely *Ageratum conyzoides* (L.) L., *Chromolaena odorata* (L.) R.M.King and H.Rob., *Mikania micrantha* Kunth, *Mimosa diplotricha* Sauvalle (Table 2). Among them the first three species belong to the family Asteraceae, while *Mimosa diplotricha* belongs to the family Leguminosae. Among the invasives, *Chromolaena* was the most recorded plant, while *Ageratum* was the least recorded invasive species in the studied quadrat (Table 2). There is a significant difference in the occurrence of all the invasive plants in the studied quadrats ($\chi^2 = 19.98$, df=3, $P < 0.01$); while there was no difference of occurrence of *Chromolaena, Mikania* and *Mimosa* in the studied quadrat ($\chi^2 = 3.73$, df=2, NS). Again, there was no difference in the relative occurrence of invasive species ($\chi^2 = 0.21$, df=3, NS). Among the invasive plants *Chromolaena* had the highest density (261 ha^{-1}) and IVI (7.9) followed by *Mikania* and *Mimosa* (Table 2).

Table 1. Density, frequency and Importance Value Index of different plant types in the dry savanna grassland of Rajiv Gandhi Orang National Park, Assam

Plant Types	Density (indiv. ha^{-1})	Frequency (%)	IVI
Grass	22849	100	217
Invasive	345	39	15
Other plants	3920	77	68

DISCUSSION

In the dry savanna grasslands of RGONP, the density, frequency and IVI of invasive species is comparatively less than grass and other herbaceous plants. This may be due to the fact that the area is newly invaded by these species which are gradually increasing their number. As increase in invasive species results in the decrease in diversity and leads to the dominance of a particular type of species (Arvind et al. 2010), the invasive species should be considered strongly for their management. Among the invasive plants recorded in the area, *Chromolaena* was the most frequent one followed by *Mikania*, *Mimosa* and *Ageratum*. Asteraceae was the dominant family for the invasive plants (Dogra 2009).

Table 2. Status of invasive species in the dry savanna grassland of Rajiv Gandhi Orang National Park, Assam

Species	Family	Density (individuals ha^{-1})	Frequency (%)	Abundance	IVI
Ageratum conyzoides (L.) L.	Compositae	16	1.12	13	0.34
Chromolaena odorata (L.) R.M.King & H.Rob.	Compositae	261	25.84	9	7.88
Mikania micrantha Kunth	Compositae	45	16.85	2	3.80
Mimosa diplotricha Sauvalle	Leguminosae	21	7.87	2	2.15

Similar types of observations were also reported from Meghalaya where a marked dominance of *Ageratum conyzoides, Chromolaena odorata, Mikania micrantha* were found in the grasslands of different altitudinal gradient (Uma Shankar et al. 1991). Though *Mikania* and *Mimosa* had less density and frequency, yet they are strong invasive and created blanket covering over the grasses and covered a large area under it (Vattakkavan et al. 2002**,** Lahkar et al. 2011), while *Chromolaena* is found in patches mixed with the grassland. In the dry savanna grasslands of RGONP, *Chromolaena* patches can be seen predominantly in the Bhutia Ali and Magurmari region. They also formed understorey vegetation in the pure and mixed patches of *Lagerstromea* spp. Such types of invasion of *Chromolaena* are also reported from the grasslands of Manas National Park (Lahkar et al. 2011). The prevalence of *Mimosa* and *Mikania* were observed more in the edges adjoining wet grassland, roads and animal trails and old rhino hides (personal observation). Blanket covers of *Mikania* and *Mimosa* can be seen in the surroundings of *ghuli* (small water holes where the rhinos take rest during daytimes) (personal observation). This may be due to the natural disturbances that creates open areas with no competition of native species (Hobbs and Huenneke 1992, Hierro et al. 2005); resulting in the dominance of aggressive invasive colonizers like *Mikania* and *Mimosa*. Although *Mikania* and *Mimosa* were recorded in low numbers in the study area yet being aggressive stranglers and in suitable environmental conditions can create blankets over a large area with their inherent ability to branch profusely from a single plant. Both *Mimosa* and *Mikania* are creating havoc in the other protected areas of Assam including Kaziranga and Manas (Uma Shankar 2002, Vattakkavan et al. 2002**,** Mishra 2005**,** Lahkar et al. 2011). The invasive species are better competitor than the native species in most of the environments and can adapt and grow better in changing climatic conditions (Bradford et al. 2007). The protected areas are vulnerable to changes and the invasive species act like drivers of change by changing the ecosystem functions as well as their property (Dassonville et al. 2008). As increase in the invasive species can result in the decrease of biodiversity, thus proper management of these invasive species are urgently required. The RGONP stands as an isolated islands and is hence the unique ecosystem is more prone to invasion. Since fire is the prime tool used by the park authorities to maintain the grassland ecosystem, invasive species like *Chromolaena* may change the grassland by changing the fire regime (Hiremath and Sundaram 2005). Though the current status of invasive species is recorded low, yet their prolific rate of regeneration and spread can be a cause of concern for the area and in some areas they are already seen dominating over the other species. They are in a stage that without proper management programme they can invade the area in the coming years. Thus, a sound strategy should be evolved for the better management of this unique habitat that houses many unique floral and faunal species.

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Annexure I.

Phytosociological characteristics of plants species found in the dry savanna grassland of Rajiv Gandhi Orang National Park, Assam

Plant name	Density (indiv. ha^{-1})	Frequency (%)	IVI
Ageratum conyzoides (L.) L.	16.41	1.12	0.30
Alpinianigra (Gaertn.) Burtt	569.37	11.24	6.60
Alternanthera sessilis (L.) R.Br. ex DC.	0.05	1.03	0.26
Apluda mutica L.	98.47	12.36	3.20
Arundo donax L.	138.87	12.36	3.70
Axonopus compressus (Sw.) P. Beauv.	460.80	3.37	2.70
Bombax ceiba L.	15.15	6.74	1.80
Centellaasiatica (L.) Urban	44.19	2.25	0.60
Chromolaena odorata (L.) R.M.King &H.Rob.	261.33	25.84	7.90
Chrysopogon aciculatus (Retz.) Trin.	583.26	2.25	3.20
Cissusquadrangularis L.	68.17	10.11	2.50
*Commelinadiffusa*Burm.f.	0.23	1.03	0.36
Convolvulus arvensis L.	0.01	1.03	0.24
Costusspeciosus (J.Koenig) Sm.	1.26	1.12	0.30
Curcuma sp.	26.51	2.25	0.70
Cymbopogonflexuosus (Nees ex Steud.) W.Watson	234.82	6.74	4.00
Cynodon dactylon (L.) Pers.	2465.59	7.86	11.90
*Cyperuscorymbosus*Rottb.	0.28	1.03	0.25
*Cyperusdigitatus*Roxb.	0.30	2.06	0.59
*Cyperusrotundus*L.	147.71	1.12	0.90
Cyperusbrevifolius(Rottb.) Hassk.	36.61	2.25	0.60
Desmodiumgangeticum (L.) DC.	2.08	32.68	7.63
Desmodiumtriflorum (L.) DC.	2.93	5.15	3.52
Dichanthium sp.	5.89	5.09	4.70
Eleusine indica (L.) Gaertn.	54.29	2.25	0.80
Eragrostis sp.	0.57	1.03	0.49
Eulaliafastigiata (Nees ex Steud.) Haines	801.67	16.85	10.00
Flemingiamacrophylla (Willd.) Merr.,	0.36	9.28	3.37
Floscopa scandens Lour.	3.79	1.12	0.30
Grewia sapida Roxb. ex DC	26.51	7.86	1.80
Hemarthriacompressa (L.f.) R.Br.	607.25	3.37	3.30
*Hydrocotylesibthorpioides*Lamk.	71.96	3.37	1.00
Imperatacylindrica (L.) Raeusch.	12585.53	55.06	70.60
Ipomea sp.	0.02	5.06	0.50
Leeaasiatica (L.) Ridsdale	59.34	25.84	7.70
Leersiahexandra Sw.	10.10	1.12	0.30
*Mikaniamicrantha*Kunth	45.45	16.85	3.80
*Mimosa diplotricha*Sauvalle	21.46	7.86	2.10
Mucunaprurita (L.) Hook.	0.08	2.06	0.50
Murdannianudiflora (L.) Brenan	0.42	1.03	0.42
Neyraudia reynaudiana (Kunth) Keng ex Hitchc	107.31	7.86	3.10
Ophiuros megaphyllus Stapf ex Haines	12.62	1.12	0.40
Osbeckianepalensis Hook. f.	6.31	4.49	1.00
Oxalis corniculata L.	10.10	2.25	0.50
Paederiafoetida L.	1.26	1.12	0.20
Paspalum conjugatum P.J.Bergius	15.15	1.12	0.30
*Polygala scandens*Vell.	26.51	4.49	1.10
Polygonumbarbatum L.	0.29	1.03	0.37
Pygmaeopremnaherbacea (Roxb.)	10.10	1.12	0.30
Rotalaindica (Willd.) Koehne	0.10	1.03	0.28
Saccharumspontaneum L.	840.80	24.72	16.60
Saccharum narenga (Nees ex Steud.) Hack.	3957.83	47.19	74.00
Saccharum ravennae (L.) L.	338.34	10.11	10.60
Sacciolepisinterrupta (Willd.) Stapf	0.07	1.03	0.27
Syzygiumfruticosum DC.	0.01	1.03	0.24
*Sterculiavillosa*Roxb.	3.79	2.25	0.60
Tamarix dioica Roxb. ex Roth	51.76	4.49	2.70
Vetiveria zizanioides (L.) Nash	143.92	2.25	2.10
Ziziphus sp.	6.31	2.25	0.60
UN Climber sp. 1	1.37	15.31	3.06
UN Climber sp. 2	1.85	7.22	2.53
UN Grass sp.	0.68	4.12	1.27
UN Herb sp. 1	0.06	1.03	0.26
UN Herb sp. 2	0.01	1.03	0.31
UN Herb sp. 3	1.18	2.06	0.98
UN Shrub sp. 1	0.03	1.03	0.24
UN Shrub sp. 2	0.05	2.12	0.52