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Impact of invasive alien siam weed and congress grass on native flora

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ABSTRACT

Study was done on impact of invasive alien weeds *Chromolaena odorata* and *Parthenium hysterophorus* on native naturalized flora of few selected sites in Mysore, Karnataka. Total six sites were selected for the study. Of which, at 3 sites *C. odorata* and *P. hysterophorus* were present (sites 1, 2 and 3) while at other 3 sites *C. odorata* and *P. hysterophorus* were absent (sites 4, 5 and 6). At sites 1, 2 and 3, frequency, density and abundance of the native flora were low than the sites 4, 5 and 6. There was 30, 24 and 12% reduction of native flora at sites 1, 2, and 3, respectively. There was a constant fear of losing many medicinally and economically important plants due to invasion of these weeds.

Key words: *Chromolaena odorata,* Invasive weeds, Impact assessment, Native flora, *Parthenium*

Many alien weeds have been established on Indian soil ever since the late 15th century, following Portuguese settlement in the country. While the vast majority of these have become naturalized and seem to be the permanent denizens of our flora. A few aliens particularly those that have established in the last century or so have proved to be invasive that have rapidly spread like wild fire in all biogeographic sites and have not only taken a heavy toll of native biodiversity but also have affected human health.

Most of invasive weeds originated from Mexico and the tropical American region, have established themselves in vast areas in India. Although extinction of local populations due to spread of alien weeds was recognized as early as 1872 by Darwin (1872), but now the problem of biological invasions has received considerable attention (Rao and Kavitha 2012). Although elimination of native species due to invasion of alien species is well known (Dogra *et al*. 2009, Booth *et al*. 2003, Hulme 2003), quantitative assessments of the loss of native species is not well studied. While it is important to obtain baseline data on their correct taxonomic identification and distribution, it is also equally important to know the impact of invasive weeds on the local flora/native biodiversity in weed invaded and non-invaded areas. The Convention on Biological Diversity held in 1992 in Rio de Janeiro (Article 8h) also emphasized the serious threat to native flora from exotic invasive weeds and urges the scientific community to take steps for their control and eradication (Rao and Kavitha 2012).

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Chromolaena odorata (L.) King and Robinson ('bitter bush', 'jack in the bush', 'triffid weed). is a native of South and Central America, found very extensively in forests, forest cleared areas, agricultural lands, plantations, throughout Western Ghats from plains to ascending to *c.a.* 1000 m. Often forms pure patches as undergrowth of forests. It has emerged one of the 12 worst invasive weeds in Western Ghats. There are also reports on adverse effects of invasion of *C. odorata* responsible for the poor regeneration of trees in degraded forest areas.

Parthenium hysterophorus L. ('Santa Maria, fever few', 'congress grass', 'ragweed, *Parthenium*', 'white top weed') is a native of tropical America and Mexico. In India, it is naturalized throughout Western Ghats, lower Himalayas, North East India, grows in agricultural areas, range/grasslands, disturbed areas, suburb/shrublands, and urban areas. This is one of the worst weeds of Western Ghats which colonizes almost in pure population, vast areas along railway lines, roadsides, fallows, forest cleared areas and even in protected areas and the weeds has the capacity to fragment the native species to extinction. The species also causes health hazards to both human and cattle population (Nagarajachari 2005, Sushilkumar and Ray 2011).

Many agriculture fields associated with many important medicinal flora were observed to be infested heavily with *C. odorata* and *P. hysterophorus* which prompted us to take up a detail investigation on the impact of the invasive species on the quantitative loss of medicinal and other native species in those localities. Impact of *C. odorata* and *P. hysterophorus* is poorly studied in Mysore district of Karnataka state.

MATERIALS AND METHODS

Study area

Mysore district (Karnataka state) with an area of 4,126.45 km^2 forms the third richest in forest wealth in Karnataka. The district lies between 11^0 30' N to 12^0 50' N latitudes and 75^0 45' E to 77^0 45' E longitudes. Total 6 ecologically and topographically similar sites were selected. Site-1 experienced the infestation of *C. odorata* (Elachipalya near Chennapatna of Mysore district) and site-2 (foothills of Chamundi temple, Mysore) and site-3 (Shambhudevanapura near Malavalli, Mysore district) wa heavily invaded by *P. hysterophorus*. The remaining 3 sites selected in the adjacent localities were not infested with these alein weeds (site 4, 5, and 6). The study was carried out for one year from March 2012 to February 2013. In each of these areas, 30 quadrates were laid by random quadrate method. All the plant species encountered were collected in flowering and fruiting conditions and herbarium specimens were prepared following the standard procedure of Rao and Jain (1977). The specimens were correctly identified using the local floras.

The vegetation data collected for abundance, frequency and density were calculated using the following ecological method of Curtis and Mclntosh (1950) and with following formulae:

$$\text{Frequency (\%)} = \frac{\text{Total No. of quadrates in which the species occur}}{\text{Total number of quadrates studied}} \times 100$$

$$\text{Density} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Total number of quadrates studied}}$$

$$\text{Abundance} = \frac{\text{Total number of individuals of a species in all quadrates}}{\text{Total number of quadrates in which the species occurred}}$$

Frequency formulae for non infested sites is A>B>C>D>E and in infested sites frequency formulae is A<B<C<D<E.

RESULTS AND DISCUSSION

A total of 79 plant species were encountered in both weeds infested and non infested sites, of which 34 species were found in sites 1, 2 and 3 infested by *C. odorata* and *P. hysterophorus* and 45 species belonging to different families at non infested sites 4, 5, and 6. The flora present in all the sites differed with respect to density, abundance and frequency.

Phytosociological attributes of native or naturalized flora in localities infested by invasive alien weeds:

Site 1 (*C. odorata* invaded site)

Sida acuta and *Croton bonplandianum* were found to appear with highest frequency of 66.7% each, followed by *Hyptis suaveolens* (50%), *Calotropis procera* and *Leucas aspera* (33.3%), *Cassia auriculata, Lettsomia eliptica* (30%) and *Argyreia nervosa* (23.3%) and least frequent was *Achyrathus aspera* and *Celosia argentea* (16.7%) (Table 1).

More abundant species was *Calotropis procera* (9) followed by *Hyptis suaveolens* (also invasive species) (6.78), *Sida acuta* (6.28), *Achyranthes aspera* (6.10), *Leucas aspera* (5.37). Remaining species were least present with respect to their abundance.

Croton bonplandianum, Hyptis suaveolens and *Celosia argentea* were present with highest density 3.70, 3.63 and 3.0 respectively. Least was *Cipadessa baccifera* (0.16), *P. hysterophorus* (0.60) followed by *Calotropis procera* (0.50). Density of other species was average (Table 1).

Site 2 (*P. hysterophorus* invaded site)

Analysis of frequency in this site revealed frequency of *Mollugo cerviana* (20%), *Acalypha indica* and *Amaranthus spinosus* (16.7%) each. Similar frequency was exhibited by *Euphorbia hirta, E. prostrata, Alternanthera echinata, Tribulus terrestris* and *Zornia gibbosa* (13.3%). Least frequent was *Indigofera linifolia* (1%).

Most abundant species was *Alternanthera echinata* (20.70) followed by *Euphorbia prostrata* (14.3), *Amaranthus spinosus* (13.4), *Zornia gibbosa* (8.75). *Amaranthus speciosa* was least abundant (2.53). Remaining species shared average abundance.

Tribulus terrestris (2.93) and *Euphorbia hirta* (2.63) were found to be highly dense followed by *Portulacca olaracea* (2.03).

Site 3 (*Parthenium hysterophorus* invaded site)

Melochia corchorifolia and *Amaranthus spinosus* were the species found with high frequency of 66.7% and 50%, respectively followed by *Canthium parviflorum* (36.7%), *Abutilon indicum, Cassia tora* and *Flacourtia indica* (33.3%) each. Other species were found to be of average frequency.

Most abundant species was *Chenopodium album* (7.84) followed by *Canthium parviflorum* (6.50), *Sida acutangula* (6.33), *Cassia tora* (6.30). Least abundant was *Portulacca olaracea* (1.3) (Table 1).

Cassia tora (5.27) and *Chenopodium album* (4.03) exhibited high density values followed by *Canthium parviflorum* (2.7), *Abutilon indicum* (2.6), *Sida rhomboideae* and *Sida acutangula* (2.57).

Highly abundant species was *Chenopodium prostratum* (12.06) followed by *Cassia tora* (10.27), *Sida rhomboideae* (9.08), *Canthium parviflorum* (8.64), *Amaranthus spinosus* (8.8) *etc*, *Polycarpea corymbosa* was less abundant (4.1).

Cassia tora was most densely populated species (7.53) followed by *Chenopodium album* (6.03), *Abutilon indicum* and *Sida acutangula* (3.7), *Sida rhomboideae* (3.63) *etc*. Very less dense population of *Chenopodium prostratum* (2.07) was also observed (Table 1).

Site 4 (*C. odorata* absence *site*)

Croton bonplandianum (86.7%), *Sida acuta* (83.3%) were more frequent followed by *Hyptis suaveolens* (66.7%), *P. hysterophorus* (63.3%), *Phyllanthus* spp., (60%), *Boerhaavia diffusa* (56.7%), *Achyranthes aspera* and *Argyreia nervosa* (53.3%), *Cipadessa buccifera* (50%), *Calotropis procera* (43.3%), *Cassia auriculata* and *Rungia* spp., (33.3%) each. Less frequent species were *Aristida* spp., and *Solanum xanthocarpum* (17.7%) (Table 2).

Highest abundance value was observed in *Leucas aspera* (6.7) followed by *Sida acuta* (6.53), *C. bonplandianum* and *Rungia* sp., (5). Least was *Cipadessa baccifera* (1). Remaining species were abundant on an average scale.

Sida acuta population was found to be dense (5.7) followed by *C. bonplandianum* (5), *Celosia argentea* and *Hyptis suaveolens* (4) each. *Cipadessa baccifera* was least dense (0.33) in the locality. (Table 2).

Site 5 (site where *P. hysterophorus* was absent)

Alternanthera echinata, Mollugo cerviana, Mollugo monophylla and *Sida acuta* showed high frequency (80%) followed by *Acalypha indica, Euphorbia hirta, Amaranthus spinosus* (70%). Less frequency was seen for *Solanum nigrum* (30%) (Table 2).

The analyses of abundance shows that *Alternanthera echinata* was most abundant (17.75) followed by *Amaranthus speciosus* (11.75), *Indigofera linifolia* (10.8), *Desmodium triflorum* (10.75), *Mollugo monophylla* (10.57). *Trianthema portulacastrum* was least abundant (2.94). More densely populated plant species were *Sida acuta* (5.27) followed by *Phyllanthus amurus* (3.93), *Tribulus terrestris* (3.87), *Euphorbia hirta* (3.07), *Mollugo monophylla* (2.47), *Alternanthera echinata* (2.37) *etc*. Least densely populated species was *Portulacca olaracea* (0.7).

Table 1. Phytosociological attributes of native flora infested invasive alien weeds

Plants species	F (%)	A	D
Site 1: *C. odorata* infested area			
Achyranthus aspera	16.70	6.10	1.73
Argyreia nervosa	23.33	2.75	01.40
Calotropis procera	33.33	9.00	0.50
Cassia auriculata	23.33	3.57	1.03
Celosia argentea	16.70	5.91	3.00
Cipadessa buccifera	26.70	2.00	0.16
Croton bonplandianum	66.70	3.24	3.70
Hyptis suaveolens	50.00	6.78	3.63
Lettsomia sp.,	30.00	0.83	0.40
Leucas aspera	33.33	5.37	2.60
Parthenium hysterophorus	50.00	4.17	0.60
Sida acuta	66.70	6.28	2.70
Site 2: *P. hysterophorus* infested area			
Acalypha indica	16.70	5.60	0.70
Alternanthera echinata	13.33	20.70	2.03
Amaranthus speciosa	12.00	2.53	1.17
Amaranthus spinosus	16.70	13.40	0.73
Euphorbia hirta	13.33	8.10	2.63
Euphorbia prostrata	13.33	14.33	0.60
Indigofera linifolia	1.00	3.14	1.40
Mollugo cerviana	20.00	2.60	0.90
Phyllanthus amurus	10.00	5.00	2.60
Portulacca olaracea	10.00	7.00	0.40
Solanum nigrum	10.00	6.00	1.20
Tribulus terrestris	13.33	5.00	2.93
Zornia gibbosa	13.33	8.75	0.87
Site 3: *P. hysterophorus* infested area			
Abutilon indicum	33.33	5.35	2.60
Amaranthus spinosus	50.00	3.64	1.57
Argyreia pomacea	16.70	2.80	1.70
Canthium parviflorum	36.70	6.50	2.77
Cassia tora	33.33	6.30	5.27
Chenopodium album	26.70	7.84	4.03
Flacourtia indica	33.33	3.23	1.87
Melochia corchorifolia	66.70	5.80	1.40
Polycarpon prostratum	16.70	3.60	1.20
Portulaca olaracea	26.70	1.33	0.53
Sida acutangula	23.33	6.33	2.57
Sida rhomboideae	30.00	6.21	2.27
Tribulus terrestris	23.33	3.85	1.93
Trichodesma indicum	23.33	4.20	2.10

F= Frequency, A= Abundance, D=Density

Site 6 (site where *P. hysterophorus* was absent)

Highest frequency was exhibited by *Melochia corchorifolia* (83.3%) followed by *Amaranthus spinosus* (73.3%), *Canthium parviflorum, Cassia tora, Flacourtia indica* (66.7%). *Argyreia pomacea* (23.3%) was least frequent.

From the results it was evident that in non infested sites, most of the native flora fall under A-D (Site 4), A (Site 5), A-D (Site 6) frequency classes, hence the vegetation of local flora was semi heterogeneous. In infested sites, the native flora fall under A, B, C, D, E, hence was flora was categories as heterogeneous (Table 3 and 4).

Indian region has been at the receiving end of many exotic weeds ever-since the Portuguese settlement in India. While a vast majority of these have naturalized and appear to be the permanent denizens of native flora, yet a few have acquired invasive characters and have overtaken the native flora either completely killing these or drastically altering the native ecosystems in different biogeographic sites (Rao and Kavitha 2010).

On comparison of native plant species between infested and non infested sites, most of the medicinally important species like *Aristida* spp., *Boerhaavia diffusa, Phyllanthus* spp., *Solanum xanthocarpum* and *Rungia* spp. were not found in *C. odorata* invaded site 1.

Similarly at site 2 invaded by *P. hysterophorus,* disappearance of *Trianthema portulacastrum, Amaranthus speciosa, A. spinosus, Sida acuta, Mollugo monophylla* and *Desmodium triflorum* reflected the negative impact of *P. hysterophorus* on the survival of the native flora. Same was the case in site 3 infested with *P. hysterophorus* where *Chenopodium prostratum* and *Polycarpea corymbosa* were not found in all the three seasons. This clearly shows that approximately 30, 24 and 12% of the native vegetation was lost at site 1, 2 and 3, respectively. *C. odorata* and *P. hysterophorus* have interfered the growth and survival of native plant community which are highly medicinal in nature.

The invasiveness of *C. odorata* is attributed to the production of large quantities of propagules and also its capability to suppress the native vegetation through competative ability. Dominance of *P. hysterophorus* over other native flora throughout the year is due to its wide ecological amplitude. Ecological conditions in the study area like high soil moisture content, temperature around 25-30 °C and high humidity also supported the germination and growth of *P. hysterophorus. Parthenium* has been *reported* a C_3 type of plant, which has tendency to become a C_4 (Hegde and Patil 1982, Patil and Hegde 1983).

The plant species in both the sites (weed infested and non infested) differed in the frequency, abundance and density. This indicated that they have been severely affected by *C. odorata* and *P. hysterophorus*

Table 2. Phytosociological attributes of native flora in absence of invasive alien weeds

Plants species	F (%)	A	D
Site 4: Absence of *C. odorata*			
Achyranthus aspera	53.33	3.95	2.63
Argyreia nervosa	53.33	2.38	1.7
Aristida spp.,	16.7	1.2	1
Boerhaavia diffusa	56.7	2.7	1.33
Calotropis procera	43.33	5	0.83
Cassia auriculata	33.33	4.1	1.37
Celosia argentea	26.7	4.8	4
Cipadessa buccifera	50	1	0.33
Croton bonplandianum	86.7	5	5
Hyptis suaveolens	66.7	4	4
Lettsomia eliptica	40	1.33	0.7
Leucas aspera	46.7	6.7	6.7
Parthenium hysterophorus	63.33	3.33	1
Phyllanthus spp.	60	3.57	0.83
Rungia spp.,	33.33	5	1.33
Sida acuta	83.33	6.53	5.7
Solanum xanthocarpum	16.7	8	1.33
Site5: Absence of *P. hysterophorus*			
Acalypha indica	70	8	1.33
Alternanthera echinata	80	17.75	2.37
Amaranthus speciosa	40	11.75	1.57
Amaranthus spinosus	70	5.55	1.7
Desmodium triflorum	40	10.75	1.43
Euphorbia hirta	70	9.2	3.07
Euphorbia prostrata	60	8.33	0.83
Indigofera linifolia	50	10.8	1.8
Mollugo cerviana	80	4.75	1.27
Mollugo monophylla	80	10.57	2.47
Phyllanthus amurus	50	7.87	3.93
Portulacca olaracea	40	6.7	0.7
Sida acuta	80	6.7	5.27
Solanum nigrum	30	4.28	2.33
Trianthema portulacastrum	50	2.94	1.83
Tribulus terrestris	60	4.85	3.87
Zornia gibbosa	60	6.4	1.07
Site 6: Absence of *P. hysterophorus*			
Abutilon indicum	50	4.18	3.77
Amaranthus spinosus	73.33	8.8	2.93
Argyreia pomacea	23.33	5.91	2.37
Canthium parviflorum	66.7	8.64	4.03
Cassia tora	66.7	10.27	7.53
Chenopodium album	53.33	12.06	6.03
Chenopodium prostratum	60	4.76	2.07
Flacourtia indica	66.7	5.42	2.53
Melochia corchorifolia	83.33	5.7	2.47
Polycarpea corymbosa	20	4.1	2.73
Polycarpon prostratum	23.33	2.7	2.13
Portulaca olaracea	33.3	1.55	0.93
Sida acutangula	50	5.94	3.77
Sida rhomboidea	60	9.08	3.63
Tribulus terrestris	33.33	5.07	2.37
Trichodesma indicum	33.33	4.70	2.7

Table 3. Frequency classes of native flora in area infested with alien weeds

Site 1: *C. odorata* infested area		Site 2: *P. hysterophorus* infested area		Site 3: *P. hysterophorus* infested area	
Frequency classes	No. of species	Frequency classes	No. of species	Frequency classes	No. of species
1-20 A	2	1-20 A	13	1-20	2
21-40 B	6	21-40 B	0	21-40	10
41-60 C	2	41-60 C	0	41-60	1
61-80 D	2	61-80 D	0	61-80	1
81-100 E	0	81-100 E	0	81-100 E	0

Table 4. Frequency classes of native flora in the absence of invasive alien weeds

Site 4: Absence of *C. odorata*		Site 5: Absence of *P. hysterophorus*		Site 6: Absence of *P. hysterophorus*	
Frequency classes	No. of species	Frequency classes	No. of species	Frequency classes	No. of species
1-20	2	1-20	0	1-20	1
21-40	3	21-40	4	21-40	6
41-60	8	41-60	6	41-60	5
61-80	2	61-80	6	61-80	3
81-100	2	81-100	1	81-100	1

with regards to their growth and survival. Elimination of native flora is an indication that if these two invasive alien weeds are not checked at the earliest, there is a fear of losing many medicinally important plants from the area.

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REFERENCES

Booth BD, Murphy SP and Swanton CJ. 2003. *Weed Ecology in Natural and Agricultural Systems*. CABI Publishing, Willingford, Oxfordshire, UK., 288 p.

Curtis JT and McIntosh RP. 1950. The interrelations of certain analytic and synthetic phytosociological characters. *Ecology* **31**: 434–455.

Darwin C. 1872. *On the Origin of Species*, 6th edn. John Murray, London.

Dogra KS, Kohli RK and Sood SK. 2009. An assessment and impact of three invasive species in the Shivalik hills of Himachal Pradesh, India. *International Journal of Biodiversity and Conservation* **1**(1): 4-10.

Hegde BA and Patil TM. 1982. Effect of salt stress on the structure and the carbon flow mechanism in a noxious weed Parthenium hysterophorus L. *Weed Research* **22**: 51-56.

Hulme PE. 2003. Biological invasions: winning the science battles but losing the conservation war? *Oryx* **37**: 178-193.

Nagarajachari A. 2005. Parthenium: health hazards and prevention, pp. 73-76. In: *Proceeding of the Second International Conference on Parthenium Management.* 5-7, December 20050. University of Agricultural Sciences, Bangalore, India.

Patil TM and Hegde BA.1983. Pattern of starch distribution, CO_2 composition, concentration and photochemical reduction of tetranitrotetrazolium blue in *Parthenium hysterophorus*. *Photosynthetia* **17**: 64-66.

Rao RR and Jain SK. 1977. *A Hand Book of Field and Herbarium Methods*. Today & Tomorrow's Printers and Publishers. 157p.

Rao RR and Kavitha Sagar. 2010. Syndrella vialis (Less.) A Gray (Asteraceae)- another new invasive weed to South India. *Journal of Economic and Taxonomic Botany* **34**(4): 869-872 .

Rao, R.R. and Kavitha Sagar. 2012. Invasive alien weeds in tropics: the changing pattern in the herbaceous flora of Meghalaya in North East India, pp. 139-161. In: *Invasive Alien Plants: An ecological Appraisal for the Indian Subcontinent*" (Eds. Bhat JR *et al.*), CAB International

Sushilkumar and Ray P. 2011. Evaluation of augmentative release of *Zygogramma bicolorata* Pallister (Coleoptera: chrysomelidae) for biological control of *Parthenium hysterophorus* L. *Crop Protection* **30**: 587-591.