

Sustainable endemic angiosperms in *Acacia mearnsii* plantation of Korakundha Range Forest, Nilgiris Forest Division, Tamil Nadu

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Abstract

Ancient man Lead a nomadic life in accord with nature. Human settlements began with man encroaching upon nature gradually. Modern civilization has endangered the environment. Essentials like transport vehicles and manufacturing facilities are the main causes of environmental degradation. Air contamination built up during the past century has resulted in global warming. Global warming can change the species composition in the ecosystem. Soil has become infertile and unsuitable for vegetation. Rainwater contamination by acidic discharge from motorized vehicles, factories and industries has resulted in acid rain. Acid rain has also contributed to soil infertility. Global warming has lead to a shortage of water for the vegetation. Most sensitive endemic plants are on the brink of extermination due to insufficient rainfall. *Acacia mearnsii* is an exotic plant from a tropical region and has suppressed other endemic plant species by releasing alkaloids in soil. Some endemic species under this Tree tolerate this condition and grow under its canopy. This research work shows the population of such endemic plant species in *Acacia mearnsii* plantation.

Keywords: global warming, climate change, endemic, exotic, plantation, *Acacia mearnsii*

Introduction

In prehistoric times every species depended upon another species to survive. Every species was part of the food chain. The predominance of humans has affected the survival of certain species by gradually interfering with the natural ecosystem. Global warming has changed the species composition of the ecosystem. Soil has become sterile and unsuitable for vegetation. Acid rain is the result of contamination of rainwater by acidic discharge from motorized vehicles, factories and industries. Some sensitive species on the earth could not survive the adverse environment. Some of these species have been identified and conserved by groups of people. Some species had adapted to the changing environmental conditions by natural selection. Most exotic tropical plant species survive well in disturbed environmental conditions. These disturb the natural ecosystem by their vigorous distribution more than other species. This is attributed to the fast growth of such species. Alien vegetation affects the structure of plant communities Orr *et al.* (2006) [13]. Plant invaders reduce local diversity by displacing established species, through competition for resources, allelopathic effects, or the development of hostile soil microbial feedbacks Yurkonis *et al.* (2005) [21]. For instance, *Acacia mearnsii*, the dominant exotic species from Australia, disturbs most tropical species in this region. In Nilgiris Forest Division major grasslands were spoiled by *Acacia mearnsii*. Introduced vegetation impacts nitrogen availability through changing the litter quantity and quality rates of N₂-fixation, and Nitrogen loss Evans *et al.* (2001) [5]. Invasions decrease native vegetation

growth, development and ecosystem stability by altering resource supply, changing trophic structure and relationships, or facilitating disturbances like fire through increased biomass production Evans *et al.* (2001) [5]. They spoil the other plant species habitat through the release of alkaloids like tannin in soil. Some endemic plants will be pushed towards extinction. This condition spoils the food web. Only adaptable species can survey in changeable environmental conditions. In Nilgiris Forest Division some endemic plants have adapted and grown well by absorbing sufficient penetration of sunlight under the canopy of *Acacia mearnsii*. This study helps to know about the relationship between some endemic plant species populations for conservation.

Materials and Methods

Trees (> 20 cm DBH) were enumerated from the 10 x 10-meter plots. Plots were established with a minimum spatial distance of 100 m and the number of sampling plots per site was decided based on the size of the area and number of species encountered. Saplings and shrubs (< 20 cm DBH and >1 cm GBH) were enumerated from nested subplots of 3 x 3 m established at each corner of the plot (4 subplots per plot).

Similarly, herbs and seedlings (<2m height) were enumerated from the nested subplots of 1 x 1m established at each corner of the plot (4 subplots per plot).

The supremacy of the species was decided using the Importance Value Index (IVI) of these species. Vegetation structure was assessed by examining the frequency, density,

cover and IVI applying the formula given below by Mishra (1968) [12], Curtis and McIntosh (1951) [2].

$$\text{Frequency} = \frac{\text{Total no of quadrats in which the species occurred}}{\text{Total no of quadrats studied}} \times 100$$

$$\text{Relative frequency} = \frac{\text{Frequency of species}}{\text{Frequency of all species}} \times 100$$

$$\text{Density} = \frac{\text{Total no of individuals of a species}}{\text{Total no of quadrats studied}}$$

$$\text{Relative density} = \frac{\text{Number of individuals of a species}}{\text{Number of individuals of all species}} \times 100$$

$$\text{Relative cover} = \frac{\text{cover of a species}}{\text{total cover of all the species}} \times 100$$

IVI = Relative frequency + Relative density + Relative cover, Rastogi (1999) and Sharma (2003),

All plants were identified to species using various regional floras Fyson (1932) [6], Gamble (1935), Matthew (1999) [11], Hooker (1880) [8], Wight (1849) [17], (1850) [18], (1851) [19], an online database like The Plant List (2013), Indian Biodiversity Portal (2015) [9].

Results

In this survey total of 67 plant species were identified. It includes 41 herbs, 14 shrubs and 14 tree species. Here 61% herbs, 21% shrubs, and 18% trees were recorded. *Themeda triandra* Forssk. (IVI=40.28), *Arundinella mesophylla* Nees ex Steud. (IVI = 13.89) species were dominant in herbs layer (Table 1), *Hedyotis leschenaultiana* DC. (IVI = 53.88), *Strobilanthes wightiana* Nees (IVI= 45.12) species were dominant in shrubs layer (Table 2), *Acacia mearnsii* De Wild. (IVI =38.94), *Viburnum hebanthum* Wight & Arn. (IVI = 32.52) were dominant in tree layer of sunlight penetrable plots (Table 3). *Cestrum aurantiacum* Lindl. (IVI=106.4), *Elatostema cuspidatum* Wight (IVI = 68.58) species were dominant in herbs layer (Table 4), *Cestrum aurantiacum* Lindl.

(IVI = 70.48), *Hedyotis leschenaultiana* DC. (IVI= 58.04) species were dominant in shrubs layer (Table 5), *Acacia mearnsii* De Wild. (IVI =116.87), *Cestrum aurantiacum* Lindl. (IVI = 80.29) were dominant in tree layer of sunlight impenetrable plots. (Table 6). *Leucas suffruticosa*, *Strobilanthes wightiana*, *Helichrysum buddleioides*, *Anaphalis neelgerryana*, *Anaphalis subdecurrans*, *Senecio lavandulifolius* and *Leucas lanceifolia* are those endemic plant species dominant under the canopy of *Acacia mearnsii*.

Discussion

Plant species introduced by human activity for beneficial purposes are recognized as components of ecosystems that interrupt resource partitioning because due to their invasive nature (D'Antonio *et al.* (1998) [3]. Invading species can alter the path of ravage vegetation by changing the natural intrusion regimes and reducing native species diversity Yurkonis *et al.* (2005) [20]. Alien vegetation, including *Acacia mearnsii*, forms dense stands of green leaf zone round the year, replaces seasonally dormant grasslands, permitting high rates of evapotranspiration Dye and Jarman, (2004) [4].

Communal grazing areas are being converted to bushland by the encroaching trees like *Acacia mearnsii* which exclude grasses and herbs. *Acacia mearnsii* grows to a height of approximately 10m tall blocking and reducing light to growing understory vegetation by shade effect resulted in slow and reduced growth of herbaceous vegetation Abdallah *et al.* (2007) [1], *Acacia mearnsii* produces copious amounts of litter with higher Nitrogen content, which leads to higher nutrient and Carbon content as found by Merchante *et al.* (2008) [10]. A natural ecosystem allows the growth of every suitable species. Some exotic species like *Acacia mearnsii* alter the natural ecosystem by their vigorous growth. Some sustainable endemic plants tolerate this condition and grow well under the canopy of *Acacia mearnsii*.

Table 1: Population of herb layer – plots in partial sunlight under the canopy.

Sl.No	Species	R.den	R.fre	R.cov	IVI
1	<i>Themeda triandra</i> Forssk.	22.82	6.77	10.69	40.28
2.	<i>Heteropogon contortus</i> (L.) P.Beauv.	5.38	5.26	3.24	13.89
3.	<i>Leucas suffruticosa</i> Benth.	5.03	4.51	3.53	13.07
4.	<i>Eulalia phaeothrix</i> (Hack.) Kuntze	4.93	4.51	0.60	5.96
5.	<i>Senecio lavandulifolius</i> Wall.	0.85	4.51	3.46	12.90
6.	<i>Pteridium aquilinum</i> (L.) Kuhn	5.65	4.14	4.33	14.12
7.	<i>Bupleurum distichophyllum</i> Wight & Arn.	0.61	4.14	0.46	5.21
8.	<i>Arundinella mesophylla</i> Nees ex Steud.	7.39	3.76	6.23	17.38
9.	<i>Eragrostis nigra</i> Nees ex Steud.	3.98	3.76	3.35	11.09
10.	<i>Anaphalis aristata</i> (DC.) DC.	0.20	3.38	0.14	3.68
11.	<i>Swertia corymbosa</i> Wight ex Griseb.	0.15	3.38	0.19	3.78
12.	<i>Anaphalis neelgerryana</i> (DC.) DC.	5.93	3.01	6.25	15.19
13.	<i>Brachiaria villosa</i> (Lam.) A.Camus	5.67	3.01	1.12	5.19
14.	<i>Osbeckia cupularis</i> D. Don ex Wight & Arn.	2.46	3.01	2.59	8.06
15.	<i>Satyrium nepalense</i> D.Don	1.58	3.01	1.66	6.24
16.	<i>Emilia sonchifolia</i> (L.) DC. ex DC.	1.06	3.01	5.97	14.65
17.	<i>Hypochoeris glabra</i> L.	2.68	2.63	3.23	8.54
18.	<i>Leucas hirta</i> (B.Heyne ex Roth) Spreng.	7.72	2.26	10.84	20.82
19.	<i>Chrysopogon nodulibarbis</i> (Hochst. ex Steud.) Henrard	4.14	2.26	3.21	7.75
20.	<i>Potentilla indica</i> (Jacks.) Th. Wolf	2.28	2.26	1.29	4.46

21.	<i>Centella asiatica</i> (L.) Urb.	1.08	2.26	0.72	3.49
22.	<i>Cymbopogon flexuosus</i> (Nees ex Steud.) W.Watson	0.92	2.26	1.52	4.85
23.	<i>Justicia japonica</i> Thunb.	0.51	2.26	0.50	3.11
24.	<i>Jasminum bignoniaceum</i> Wall. & G.Don	0.35	2.26	0.14	2.50
25.	<i>Malaxis versicolor</i> (Lindl.) Abeyw.	0.30	2.26	0.43	2.99
26.	<i>Helichrysum buddleioides</i> DC.	0.10	2.26	5.82	12.22
27.	<i>Helichrysum wightii</i> C.B.Clarke ex Hook. f.	0.19	1.88	0.31	2.38
28.	<i>Pleiocraterium verticillare</i> (Wall. ex Wight & Arn.) Bremek.	1.79	1.50	0.41	2.11
29.	<i>Erigeron karvinskianus</i> DC.	0.89	1.50	1.88	4.28
30.	<i>Erigeron canadensis</i> L.	0.19	1.50	3.76	7.05
31.	<i>Habenaria longicorniculata</i> J.Graham	1.65	1.13	0.33	1.58
32.	<i>Dichrocephala integrifolia</i> (L.f.) Kuntze	0.12	1.13	4.64	7.42
33.	<i>Gnaphalium uliginosum</i> L.	0.43	0.75	0.36	1.19
34.	<i>Spermacoce ocymoides</i> Burm.f.	0.31	0.75	0.96	1.94
35.	<i>Digitaria wallichiana</i> (Steud.) Stapf	0.23	0.75	1.81	2.99
36.	<i>Dichrocephala chrysanthemifolia</i> (Blume) DC.	0.08	0.75	1.31	2.38
37.	<i>Osbeckia leschenaultiana</i> Wight	0.03	0.75	0.14	0.93
38.	<i>Anaphalis subdecurrens</i> (DC.) Gamble	0.10	0.38	0.85	1.33
39.	<i>Coelogyne odoratissima</i> Lindl.	0.10	0.38	0.14	0.53
40.	<i>Coelogyne nervosa</i> A.Rich.	0.08	0.38	0.85	1.33
41.	<i>Drosera burmanni</i> Vahl	0.02	0.38	0.71	1.17
	Grand Total	100.00	100.00	100.00	300.00

Table 2: Population of shrub layer - plots in partial sunlight under the canopy.

S.No	Species	R.den	R.fre	R.cov	IVI
1.	<i>Hedyotis leschenaultiana</i> DC.	23.15	6.90	23.84	53.88
2.	<i>Strobilanthes wightiana</i> Nees	20.27	9.20	15.65	45.12
3.	<i>Rubus buergeri</i> Miq.	9.57	13.79	4.93	28.29
4.	<i>Cytisus scoparius</i> (L.) Link	9.47	6.90	9.75	26.11
5.	<i>Rubus ellipticus</i> Sm.	8.33	12.64	4.68	25.66
6.	<i>Ulex europaeus</i> L.	7.61	3.45	15.68	26.74
7.	<i>Rubus niveus</i> Thunb.	6.48	13.79	3.34	23.61
8.	<i>Ageratina adenophora</i> (Spreng.) R.M.King & H.Rob.	6.38	4.60	9.85	20.83
9.	<i>Senecio candicans</i> Wall.	3.50	6.90	3.60	14.00
10.	<i>Hypericum mysorense</i> F. Heyne	1.85	8.05	1.63	11.53
11.	<i>Gaultheria fragrantissima</i> Wall.	1.23	4.60	1.91	7.74
12.	<i>Rhodomyrtus tomentosa</i> (Aiton) Hassk.	1.13	4.60	1.75	7.48
13.	<i>Berberis tinctoria</i> Lesch.	0.72	3.45	1.48	5.65
14.	<i>Leucas lanceifolia</i> Desf.	0.31	1.15	1.91	3.37
	Grand Total	100.00	100.00	100.00	300.00

Table 3: Population of tree layer - plots in partial sunlight under the canopy.

S.No	Species	R.den	R.fre	R.cov	IVI
1.	<i>Acacia mearnsii</i> De Wild.	15.65	13.95	9.34	38.94
2.	<i>Berberis leschenaultii</i> Wall. Ex Wight & Arn.	12.17	11.63	8.71	32.52
3.	<i>Rhododendron arboreum</i> Sm.	12.17	9.30	10.89	32.37
4.	<i>Vaccinium leschenaultii</i> Wight	12.17	6.98	14.52	33.67
5.	<i>Syzygium densiflorum</i> Wall. Ex Wight & Arn.	10.43	11.63	7.47	29.53
6.	<i>Viburnum hebanthum</i> Wight & Arn.	10.43	6.98	12.45	29.86
7.	<i>Ilex denticulata</i> Wall. Ex Wight	6.96	11.63	4.98	23.56
8.	<i>Ilex wightiana</i> Wall. Ex Wight	6.09	4.65	10.89	21.63
9.	<i>Symplocos cochinchinensis</i> (Lour.) S. Moore	5.22	4.65	9.34	19.21
10.	<i>Syzygium calophyllifolium</i> (Wight) Walp.	3.48	6.98	4.15	14.60
11.	<i>Daphniphyllum neilgherrense</i> (Wight) K.Rosenthal	3.48	6.98	4.15	14.60
12.	<i>Eurya japonica</i> Thunb.	1.74	4.65	3.11	9.50
	Grand Total	100.00	100.00	100.00	300.00

Table 4: Population of herb layer - plots under the shade of the canopy.

S.No	Species	R.den	R.fre	R.cov	IVI
1.	<i>Cestrum aurantiacum</i> Lindl.	47.06	28.57	30.77	106.40
2.	<i>Elatostema cuspidatum</i> Wight	23.53	14.29	30.77	68.58
3.	<i>Nothapodytes nimmoniana</i> (J.Graham) Mabb.	11.76	14.29	15.38	41.44
4.	<i>Rapanea wightiana</i> (Wall. ex A. DC.) Mez	5.88	14.29	7.69	27.86
5.	<i>Rubus ellipticus</i> Sm.	5.88	14.29	7.69	27.86
6.	<i>Psychotria congesta</i> Spreng. Ex DC.	5.88	14.29	7.69	27.86
	Grand Total	100	100	100	300

Table 5: Population of shrub layer - plots under the shade of the canopy.

S.No	Species	R.den	R.fre	R.cov	IVI
1.	<i>Cestrum aurantiacum</i> Lindl.	28.99	8.00	33.48	70.48
2.	<i>Hedyotis leschenaultiana</i> DC.	25.39	10.67	21.99	58.04
3.	<i>Rubus buergeri</i> Miq.	11.98	16.00	6.92	34.90
4.	<i>Rubus ellipticus</i> Sm.	10.44	14.67	6.57	31.68
5.	<i>Rubus niveus</i> Thunb.	8.12	16.00	4.69	28.81
6.	<i>Ageratina adenophora</i> (Spreng.) R.M.King & H.Rob.	7.99	5.33	13.84	27.16
7.	<i>Lonicera ligustrina</i> Wall.	2.32	9.33	2.30	13.95
8.	<i>Gaultheria fragrantissima</i> Wall.	1.55	5.33	2.68	9.56
9.	<i>Rhodomyrtus tomentosa</i> (Aiton) Hassk.	1.42	5.33	2.46	9.21
10.	<i>Berberis tinctoria</i> Lesch.	0.90	4.00	2.08	6.99
11.	<i>Hypericum mysorense</i> F. Heyne	0.52	4.00	1.19	5.71
12.	<i>Leucas lanceifolia</i> Desf.	0.39	1.33	2.68	4.40
	<i>Grand total</i>	100	100	100	300

Table 6: Population of tree layer - plots under the shade of the canopy.

S.No	Species	R.den	R.fre	R.cov	IVI
1.	<i>Acacia mearnsii</i> De Wild.	55.45	18.18	43.23	116.87
2.	<i>Cestrum aurantiacum</i> Lindl.	33.65	15.15	31.49	80.29
3.	<i>Viburnum hebanthum</i> Wight & Arn.	1.69	10.61	2.97	13.97
4.	<i>Memecylon malabaricum</i> Kostel.	1.90	9.09	2.26	14.56
5.	<i>Syzygium densiflorum</i> Wall. Ex Wight & Arn.	1.48	7.58	2.77	11.83
6.	<i>Rhododendron arboreum</i> Sm.	1.27	7.58	3.47	11.01
7.	<i>Ligustrum perrottetii</i> A.DC.	0.63	7.58	2.38	11.22
8.	<i>Berberis leschenaultii</i> Wall. Ex Wight & Arn.	1.48	6.06	3.47	7.24
9.	<i>Daphniphyllum neilgherrense</i> (Wight) K.Rosenthal	0.42	4.55	2.97	6.64
10.	<i>Symplocos cochinchinensis</i> (Lour.) S. Moore	0.42	4.55	1.19	9.40
11.	<i>Syzygium calophyllifolium</i> (Wight) Walp.	0.74	3.03	1.32	6.29
12.	<i>Eurya japonica</i> Thunb.	0.63	3.03	1.32	6.29
13.	<i>Neolitsea zeylanica</i> (Nees & T. Nees) Merr.	0.21	3.03	0.99	4.23
	<i>Grand total</i>	100	100	100	300

(R. den – Relative density; R. frq – Relative frequency; R.cov – Relative cover; IVI –Importance value index)

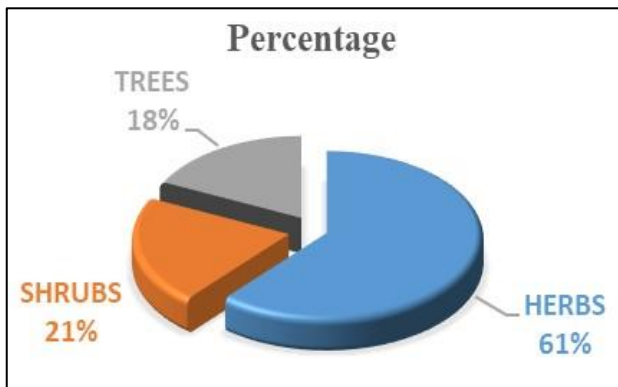


Fig 1: Percentage of different plant life forms in the survey sites.

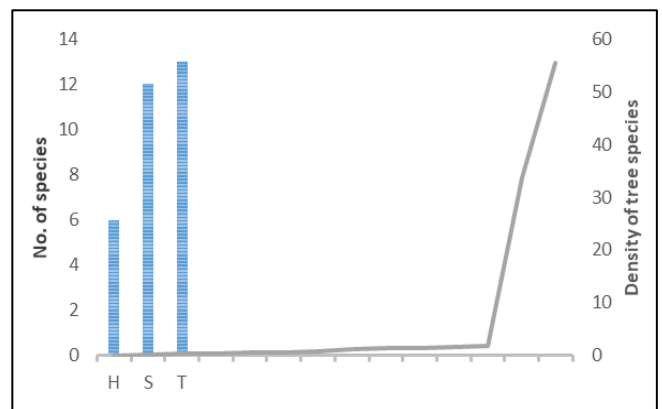


Fig 3: Species composition of plots under the shade of the canopy

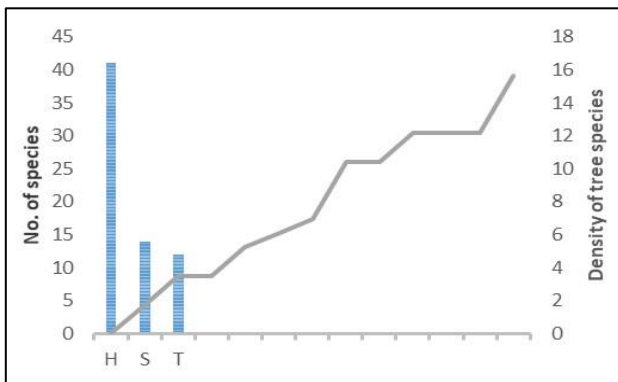


Fig 2: Species composition of plots in partial sunlight under the canopy

Acknowledgement

We are thankful to the Government of Tamilnadu Forest Department for permitting necessary facilities during fieldwork. We are thankful to Dr. V. Ravichandran, AJCBPDF, Botanical Survey of India, Southern Regional Center, Coimbatore for his support during the period of this research work.

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