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# Tree diversity and disturbance of *kaan* forests: Relics of a community protected climax vegetation in the Central Western Ghats

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**Abstract:** A comparative description of tree diversity of community-protected *kaan* forests and state-managed reserve forests influenced by the level of disturbance and rainfall was assessed in Sagar *taluk*, Shimoga district, Karnataka, India. *Kaan* forests and state-managed reserve forests in regions of high and low rainfall were assessed for tree diversity. In each sampled site, a transect of 1 km and two 25 m² regeneration quadrats were laid. *Kaan* forests possessed a higher species richness, with 85 tree species, than the reserve forests (57). Basal area and tree density were also higher in the *kaan* forests, although the difference was only marginal in some instances. Richness of endemic, rare, endangered and threatened species, as well as species of medicinal or economic importance, was higher in the *kaan* forests than in the reserve forests. The total number of species, and the number of evergreen species, were negatively correlated with the level of disturbance. Further, with increased disturbance, the number of rare, endangered and threatened species also decreased, as did the number of endemics.

**Resumen:** Se realizó una descripción comparativa de la diversidad de árboles de los bosques *kaan* protegidos por la comunidad y de las reservas forestales administradas por el Estado en funcióndel nivel de perturbación y precipitación en el *taluk* Sagar, distrito Shimoga, Karnataka, India. Se evaluó la diversidad de árboles en los bosques kaan y las reservas forestales administradas por el Estado en regiones de alta y baja pluviosidad. En cada sitio de muestreose establecieron un transecto de 1 km y dos cuadrosde regeneración de 25 m². Los bosques kaantuvieron una mayor riqueza específica, con 85 especies arbóreas, que las reservas forestales (57). El área basal y la densidad de árboles también fueron más altos en los bosques kaan, aunque la diferencia fue sólo marginal en algunos casos. La riqueza de especies endémicas, especies raras, en peligro de extinción y amenazadas, así como especies de importancia medicinal o económica, fue mayor en los bosques *kaan* que en las reservas forestales. El número total de especies y el número de especies perennifolias se correlacionaron negativamente con el nivel de perturbación. Además, conforme se incrementó el disturbio, el número de especies raras, amenazadas y en peligro de extinción también se redujo, al igual que el número de especies endémicas.

**Resumo:** Uma descrição comparativa da diversidade arbórea de florestas comunitárias *kaan* protegidas e reservas florestais estaduais de gestão pública influenciadas pelo nível de perturbação e da precipitação foi efectuada no *concelho* Sagar, distrito de Shimoga, Karnataka, na Índia. As florestas *kaan* e as reservas florestais geridas pelo estado, em regiões de alta e baixa pluviosidade foram avaliados quanto à diversidade arbórea. Em cada local amostrado, foi estabelecido um transepto de 1 km e dois quadrados de regeneração de 25 m². As florestas *kaan* possuíam uma maior riqueza específica, com 85 espécies de árvores, em comparação com as

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florestas da reserva (57). A área basal e a densidade de árvores também foram maiores nas florestas *kaan*, embora a diferença fosse apenas marginal em alguns casos. A riqueza de espécies endémicas, espécies raras, ameaçadas de extinção, bem como espécies de importância medicinal ou económica, foi maior nas florestas *Kaan* do que nas florestas da reserva. O número total de espécies, e o número de espécies sempreverdes, estavam negativamente correlacionados com o nível de distúrbio. Além disso, com o aumento da perturbação, o número de espécies raras, ameaçadas de extinção também diminuiu, assim como o número de endemismos.

**Key words:** Central Western Ghats, endemic, *kaan* forest, rare endangered and threatened species, sacred forests.

## Introduction

India has a rich tradition of conserving nature, rooted deeply in its culture from time immemorial. Social institutions such as the maintenance of sacred groves, sacred trees, sacred ponds, sacred animals, birds, fishes etc. are some of the prime examples of traditional conservation practices. Sacred forest patches of the Western Ghats are recognized by different names in different regions. The forested districts of Uttara Kannada and Shimoga in the central Western Ghats of Karnataka are dotted with several groves with lofty lush-green forest cover known as '*kaans'*; literally meaning "thick evergreen forests" (Joshi & Gadgil 1991). These forest patches are also called '*devar kaans*' (sacred forests), as the natives of these regions preserve *kaan* forests traditionally as the abodes of sylvan deities maintaining a lasting relationship with nature (Gokhale 2004; Talbot 1909). These *kaan* forests are distributed through the landscapes of Karnataka that are more favourable for the deciduous formations (Pascal 1998). *Kaan* forests are the symbols of the good old traditional practice of conservation, and are also good examples of community-managed resources, as practised in the Western Ghats (Murthy Indu *et al*. 2000). As a result of these, we still possess the great heritage of a diverse gene pool of many forest species. Resources such as black pepper and wild nutmeg were harvested from these forests and were used in trade during the pre-colonial period. Today *kaan* forests are regarded as the relics of natural climax vegetation, as they harbour several rare and sensitive endemic plant species (Chandran & Gadgil 1991; Gokhale 2004). For instance, *Dipterocarpus indicus* Bedd., is reported in only three *kaan* forests of Uttara Kannada; good populations of *Myristica fatua* var. *magnifica* (Bedd.) Sinclair and *Semecarpus kathalekanensis* Das & Swam. (a recently described tree species) and a fragile palm species *Pinanga dicksonii* (Roxb.) Blume are found in Kathle *kaan* swamp forest near the world-famous Jog waterfalls (Chandran 1997). The only natural population of *Vateria indica* L. of the Uttara Kannada district is found in a *kaan* forest of Mattigar hamlet in Siddapura *taluk* (Chandran 1997). New populations of *Syzygium travancoricum* Gamble and *Madhuca bourdillonii* Gamble, once believed to be extinct from their type localities, have been discovered recently in relic patches of *kaan* forests of Uttara Kannada district by Chandran *et al*. (2008).

However, social taboos around these sacred *kaan* forests have been loosened due to the influence of modern lifestyle and agriculture. Increase in the human population and declining fertility of agricultural land have increased dependence on the *kaan* forests as a source of income and hence resulted in non-sustainable harvesting of the resources. Encroachment, and illegal felling of the valuable timber trees, have increased and thereby eroded plant wealth. Apart from these effects, *kaan*s are also exposed to different kinds of exploitation such as conversion of these landscapes into monoculture plantations, allotting them for rehabilitation purposes, etc. (Gokhale 2004). Thus there is a fear of losing rich treasures of traditional conservation culture as well as protected biodiversity in these landscapes. Since *kaan* forests are located in areas of high to moderate rainfall, it is likely that species composition is influenced by both rainfall and by the level of disturbance; forest disturbance would affect local diversity and in turn the dependent fauna (Parthasarthy 2001). Unfortunately, these effects have not been documented recently. In this

**Table 1.** Details of study sites.

| Sites | Geo-coordinates | | | Area (ha) | Management |
|---|---|---|---|---|---|
| | Latitude | Longitude | Altitude (m) | | |
| High-rainfall area | | | | | |
| Kugwe *kaan* | 14º 10'" N | 74º 58' E | 603 | 167 | Village Committee |
| Hunsur *kaan* | 14º 11" N | 74º 55' E | 598 | 49 | Village Committee |
| RF-I (Control) | 14º 11' N | 74º 56' E | 593 | 73 | Forest Department |
| Low-rainfall area | | | | | |
| Jambani *kaan* | 14º 13' N | 75º 09' E | 739 | 76 | Village Committee |
| Huttadimba *kaan* | 14º 10' N | 75º 09' E | 656 | 100 | Village Committee |
| RF-II (Control) | 14º 18' N | 75º 12" E | 647 | 87 | Forest Department |

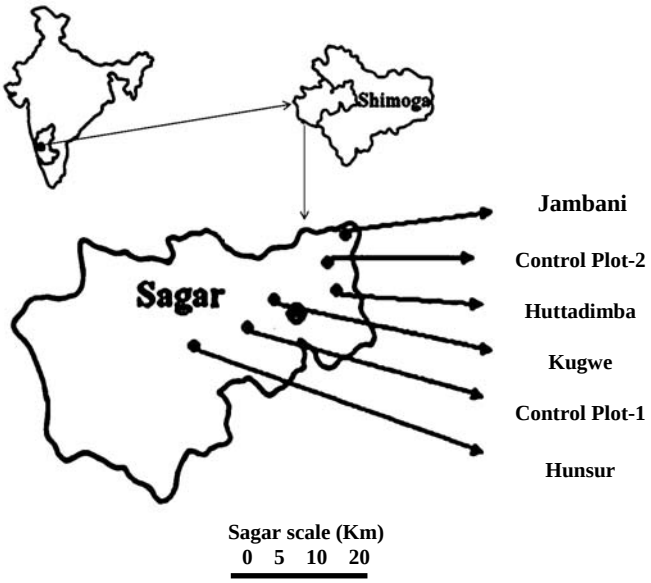


**Fig. 1.** Map showing study sites in Sagar *taluk*.

context we have studied the diversity of the *kaan* forests as influenced by the level of disturbance as well as by the rainfall regime.

## Materials and methods

### *Study area*

The study sites are located in Sagar *taluk* of Shimoga district, Karnataka state, India between 14º 05' and 14º 13' N latitude and 74º 50' and 75º 09' E longitude. The total geographic area of Sagar *taluk* is 193,999 ha of which 66,125 ha (34 %) is covered with forests. There are four distinct vegetation types in the region, including dry scrub and deciduous vegetation to the east contrasted with evergreen and semi-evergreen forests in the hills. *Kaan* forests are the unique landscape of this *taluk* among other forest landscapes. More than 82 *kaan* forests have been reported from Sagar *taluk* (Gokhale 2004). According to official records in Sagar *taluk*, *kaan* forests cover an area of 5254.97 ha (8 % of the total forest area).

### *Study sites*

In order to study their floristic diversity, *kaan* forests of the villages Kugwe, Hunsur, Jambani and Huttadimba in Sagar *taluk* were chosen (Fig. 1). Two *kaan*s each from the high and low rainfall parts of the study area were considered. One state-managed forest from each rainfall area was taken as a "control plot" to compare the effect of different modes of management or conservation practices on tree species richness.

### *Features of study sites*

Study sites were divided into those with high and low rainfall. The study sites of these categories are 25 km away from each other. The geographic coordinates of all the study sites were noted using a GPS receiver (Table 1).

I. High rainfall area: This area lies towards the western side of the Sagar *taluk* with an annual rainfall about 2000 to 2500 mm per year, and it is very close to the Western Ghats.
   1. Kugwe *kaan*: It is located in the high-rainfall area; it is about 167 ha in extent, and has been protected over 100 years. This *kaan* is just 4 km from the town of Sagar, which is the main centre of the *taluk* and has a well-established committee for managing their community forest.
   2. Hunsur *kaan*: This *kaan* is also in the high-rainfall zone, with an area of 49 ha. It is about 10 km from Sagar town; the

distance between the Kugwe and Hunsur *kaan* is about 6 km. This *kaan* has a history of protection over 100 years, and has a well-constituted committee for managing the forest area.

3. Reserve forest-I: This is a state-managed forest area located between the Kugwe and Hunsur *kaan* forests, with an area of 73 ha.

II. Low rainfall area: This area lies towards the eastern side of the Sagar *taluk,* which is close to the Deccan plateau of the district. This area receives an annual rainfall of 1000 to 1500 mm, and has an extended period of dry weather. The study sites in this region are:

1. Jambani *kaan*: This *kaan* forest is about 76 ha in size and has a history of more than 100 years of protection. Jambani *kaan* is 20 km away from the town of Sagar. A village forest protection committee takes care of the management of the forest area.
2. Huttadimba *kaan*: The area of this *kaan* forest is about 100.08 ha, and has been protected for 100 years. This *kaan* is about 15 km away from the town of Sagar. This *kaan* forest is also managed by a well-established village forest protection committee.
3. Reserve forest-II: This is a state-managed forest with an area of about 87 ha, lying in between the Jambani and Huttadimba *kaan* forests.

### *Sampling methods*

In order to study the vegetation, a belt transect of 1000 m x 5 m (0.5 ha) was laid in each of the *kaan* forests as well as in the control plots. Each sampling belt of 5 m x 1000 m was divided into 10 equal parts, and in each of these 5 x 100 m sections the girths of all trees ≥ 30 cm were recorded.

The total number of trees of a species in the ten sections, multiplied by 2, was a measure of the density ($D_i$) of species i in that plot, its frequency ($F_i$) was defined as the number of sections in which it was recorded, and its dominance ($M_i$) was defined as its total basal area. These vegetation records were analysed for species richness, diversity index (Shannon-Weaver index: Krebs 1985), relative density ($R_F$) and Relative basal area ($R_M$). They were also used to calculate the Importance Value Index (IVI) of each species, which, following Curtis & McIntosh (1950), was defined as the sum of the relative values of D, F and M, expressed as percentages, i.e.

$IVI = R_D + R_F + R_M$

where, $R_D$ = Relative Density= $100(D_i / \Sigma D_i)$, and similarly for $R_F$ and $R_M$; IVI thus has a maximum possible value of 300.

To study the regeneration status of the different tree species, two 5 m x 5 m quadrats were placed, one at each end of the transect. In each quadrat, the numbers of individual saplings and seedlings of the various tree species were counted. To assess the biotic interference or the disturbance factors on vegetation, we considered lopping, cut stumps, litter collection, removal of soil, fire, weed invasion, signs of foot paths, water diversion, fuel-wood collection, and collection of other non-timber products, as the main parameters. For each forest, the level of disturbance indicated by each of these ten parameters was scored from 0 (Undisturbed) to 3 (Severely disturbed). The ten scores were added, and the sum multiplied by 100/30 to give a percentage Combined Disturbance Index (CDI).

## Results and discussion

### *Species richness, density, diversity indices*

A total of 110 tree species were recorded from the six forests studied; they are listed in the Appendix Table 1. In *kaan* forests, 85 species belonging to 68 genera and 38 families were recorded. In the state-managed forests, the corresponding figures were a total of 57 species belonging to 50 genera and 30 families. The numbers of species, genera and families in the different forest types are detailed in Table 2.

The *kaan* forests of the two rainfall areas shared a higher proportion of tree species (42 %) than the state-managed forests with different rainfall (28 %). Overall, about 29 % of tree species were shared between *kaan* forests and state managed forests. Of the total tree species recorded 48 % occurred in kaan forests only, 22 % in state managed forests only. Vegetation analysis (Table 3) shows that species richness was higher in community-

**Table 2**. Taxonomic diversity of the forests studied.

| | *Kaan* forests | | State-managed forests | |
|---|---|---|---|---|
| | Low-rainfall | High-rainfall | Low-rainfall | High-rainfall |
| Species | 52 | 68 | 28 | 31 |
| Genera | 47 | 58 | 25 | 28 |
| Families | 30 | 30 | 19 | 17 |

**Table 3.** Characteristics of the forests studied.

| Location | Parameters | | | | |
|---|---|---|---|---|---|
| | Species richness | Shannon index (H') | Alpha index | Density (no. ha$^{-1}$) | Basal area (m$^2$ ha$^{-1}$) |
| High rainfall area | | | | | |
| Kugwe *kaan* | 53 | 3.11 | 17.11 | 387 | 23.62 |
| Hunsur *kaan* | 42 | 3.48 | 24.22 | 372 | 43.70 |
| RF-I | 31 | 3.01 | 20.6 | 254 | 20.60 |
| Low rainfall area | | | | | |
| Jambani *kaan* | 38 | 2.98 | 14.42 | 384 | 48.80 |
| Huttadimba k*aan* | 31 | 2.55 | 13.06 | 254 | 23.00 |
| RF-II | 28 | 2.72 | 07.46 | 274 | 22.60 |

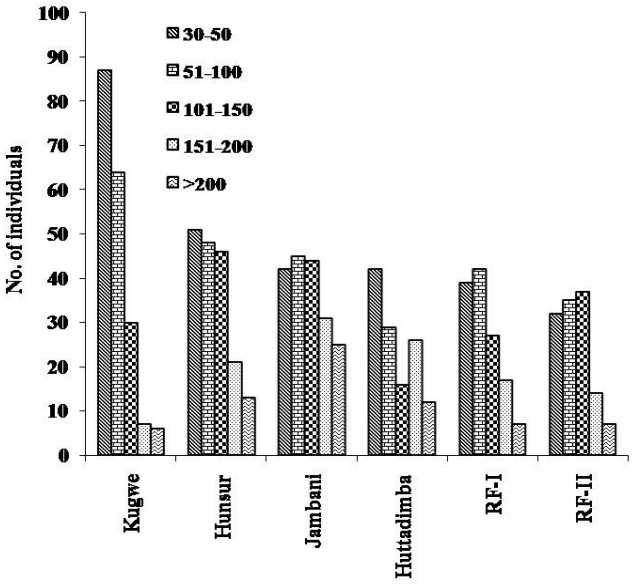


**Fig. 2.** Girth class distribution of trees (ranges of girth in cm).

protected *kaan* forests than in state-managed reserve forests. *Kaan* forests in the high-rainfall area (viz. Hunsur and Kugwe) showed higher tree species richness (53 and 42) than those in the low-rainfall area (viz. Jambani and Huttadimba) which recorded a species richness of 38 and 31 respectively. The state-managed forests recorded lower species richness (31 and 28 respectively for high and low rainfall areas) than the *kaan* forests. This suggests that community protection and community management result in higher species diversity than the formal system of state management of forests.

Among *kaan* forests, the species diversity index (Shannon-Weiner-H') was highest in Hunsur (3.5) and Kugwe (3.2), as against 2.98 and 2.55 in Jambani and Huttadimba. The alpha diversity index was also greatest (24.22) for the Hunsur *kaan,* but less than 16 in the other *kaan* forests; this shows the influence of the longer period of protection and management. It was also observed that the rainfall regime influences greatly the floristic richness. The higher species richness observed in the high-rainfall area than in the low-rainfall area suggests the influence of rainfall regime on species diversity. Further, it is also clear that the diversity increases with strong protection and better management even in low-rainfall area like the Jambani *kaan* (2.98). Species diversity indices (H') of *kaan* forests reported here are comparable to those reported for other regions of the central Western Ghats such as Naravi (3.6), Someshwara (3.2) and Magod (4) (Pascal 1992; Singh *et al.* 1986).

### *Girth class distribution*

Girth class distribution of trees reveals that the stand was better in all the *kaan* forests than in the state managed forests (control plots) where more disturbance was observed (Fig. 2). In general, among state-managed forests, the number of individuals of lower gbh class was equal to that of higher girth class, suggesting a higher level of extraction of individuals of lower girths for poles and fuel wood. Murali *et al.* (1996) have also reported a similar extraction pattern for the Biligiri Rangaswamy Temple (BRT) wildlife sanctuary in southern India.

### *Basal area*

A high basal area (48.8 m² ha$^{-1}$ and 43.7 m² ha$^{-1}$ respectively) was recorded in Jambani and Hunsur *kaan*s, values in Kugwe and Huttadimba *kaan*s being 23.6 m² ha$^{-1}$ and 23.0 m² ha$^{-1}$ respectively. Though the Kugwe *kaan* has been protected for a

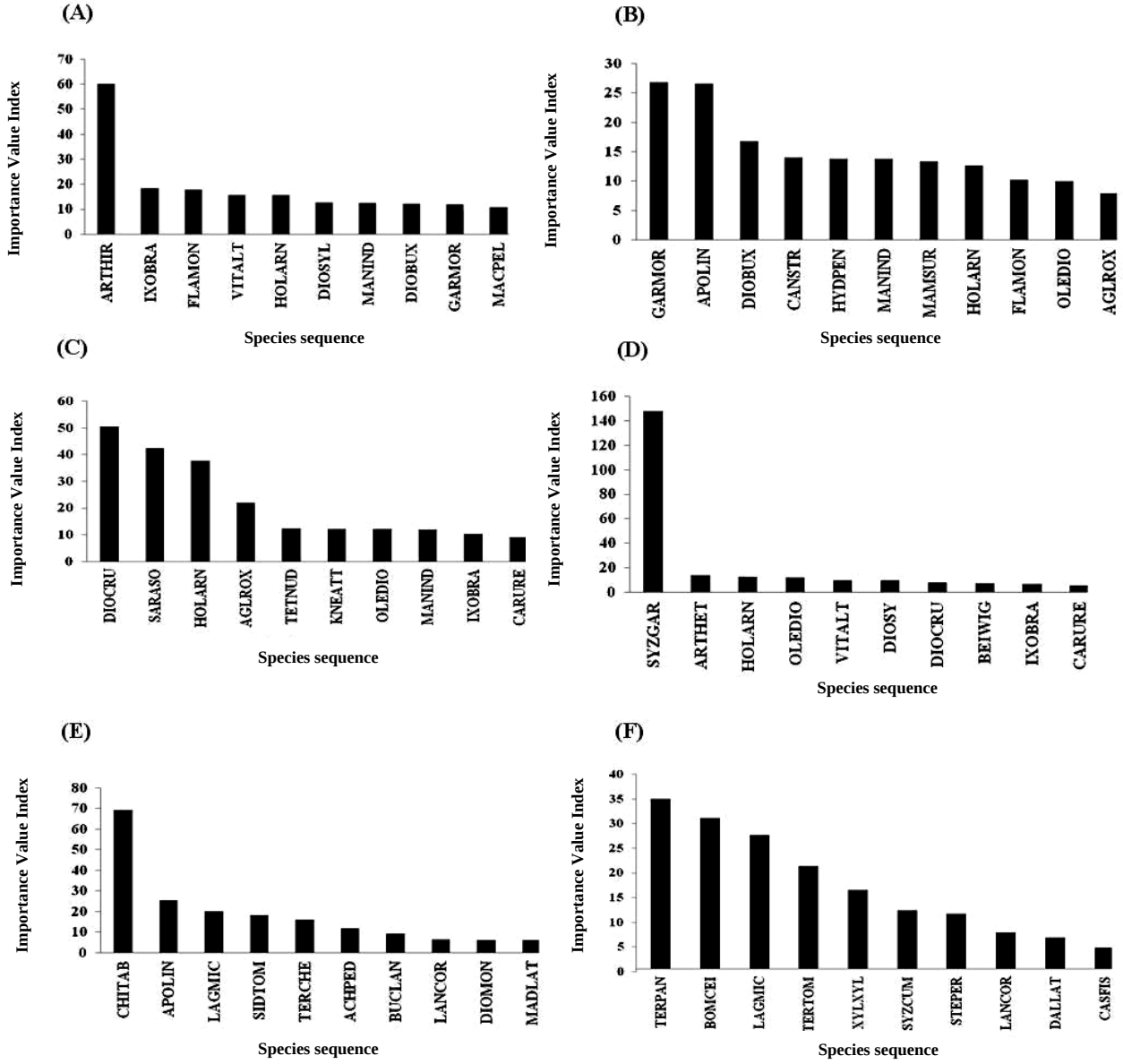


**Fig. 3.** Importance Value Index of top ten species of Kugwe *kaan* (A), Hunsur *kaan*, (B), Jambani *kaan* (C), Huttadimba *kaan* (D), RF-I (E) and RF-II (F).

longer period, the standing stocks have declined due to high extraction. The higher basal areas recorded in Hunsur *kaan* (higher rainfall area) and Jamabani *kaan* (lower rainfall area) are perhaps a result of good protection provided to them through strong community action. On the other hand, state-managed reserve forests showed a lower basal area of 20.6 $m^2$ $ha^{-1}$ (high rainfall area) and 22.6 $m^2$ $ha^{-1}$ (low rainfall area), indicating the extraction of lower as well as higher girth classes for timber and other purposes.

### *Importance Value Index of species*

The Importance Value Index (IVI) of tree species (Fig. 3) in the *kaan* forests of the higher rainfall area (Hunsur and Kugwe) suggested that *Artocarpus hirsutus* Lam. (IVI = 59.71), *Garcinia morella* (Gaertn.) Desr. (26.86), and *Aporusa lindleyana* (Wight.) Bail. (26.61) were the dominants. These species were followed by the species *Flacourtia montana, Diospyros buxifolia* (Blume.) Hiern., *Vitex altissima* L.f. and *Canarium strictum*

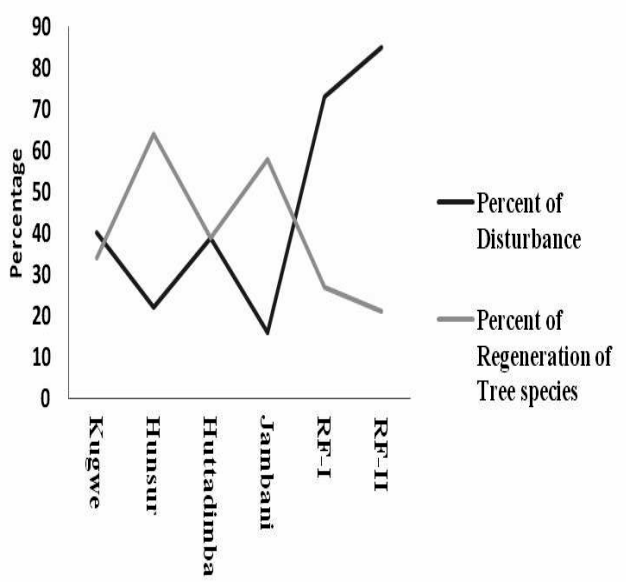


**Fig. 4.** Percent of regeneration of tree species and level of disturbance.

Roxb. On the other hand, among the *kaans* in the low- rainfall area, *Syzygium gardneri* Thw. (147.77), *Diospyros crumenata* Thw. (50.45), *Saraca asoca* (Roxb.) de Wilde. (42.38) and *Holigarna arnottiana* Hook. f. (37.84) were the dominants, followed by *Aglaia roxburghiana* Hiern., *Artocarpus heterophyllus* Lam., *Olea dioica* Roxb. and *Knema attenuata* (Hook. f. & Thoms.) Warb.. In the state-managed reserve forests of the high and low rainfall areas, *Chukrasia tabularis* A. Juss. (69.29), *Terminalia paniculata* Roth. (35.01), *Bombax ceiba* L. (31.17), *Lagerstroemia microcarpa* Wight. (27.75) and *Aporusa lindleyana* Wight. (25.58) were the dominant species with the highest IVI values, followed by *Terminalia tomentosa* (Roxb. ex DC) Wight. & Arn., *Sideroxylon tomentosum* Roxb., *Xylia xylocarpa* (Roxb.) Taub. and *Terminalia chebula* Retz.. The study shows that the community-protected *kaan*s, under both rainfall regimes, were dominated by evergreen species, whereas deciduous species dominated the state-managed reserve forests. This suggests the importance of community protection to *kaan* forests.

### *Regeneration status of tree species*

Most of the dominant tree species showed a better regeneration status in all the *kaan*s than in the state-managed reserve forests compared with them (Fig. 4). Hunsur and Jambani *kaan*s, in the high and low rainfall areas respectively, had the highest percent of tree species which were regenerating individuals (64 % and 58 % respectively). The other *kaan*s of both rainfall regions also had a good proportion of regenerating species (Kugwe 34 %, Huttadimba 39 %); but compared to Hunsur and Jambani *kaan*s these figures appear to be low because of their higher disturbance score. In contrast, in both state-managed reserve forests (control plots), the regeneration percentage of the dominant tree species (27 % and 21 %) was very low. It is quite clear that greater protection leads to better regeneration. Decreases in regenerating individuals were observed after the protection was withdrawn in some of the village forests under Joint Forest Management, as was reported in Uttara Kannada district by Hegde *et al.* (2005). From the commercial point of view, these state-managed reserve deciduous forests are valuable, as they contain many hardwood timber species. Repeated annual fires, continued grazing, and illicit felling of timber trees, resulted in low regeneration, as well as low density of the vegetation (Vargheese & Menon 1998).

### *Distribution of RET, endemic, evergreen, medicinally important and economically important species*

Evergreen species, species recognised as Rare Endangered or Threatened (RET), (Ravikumar & Ved 2000) species of medicinal or economic importance (Nair 2000; O. Sumy *et al.* 2000; Ved & Goraya 2008), as welll as species endemic to the Western Ghats, (Nayar 1996) were all more numerous in the community-protected *kaan*s (Table 4). On the other hand, the state-managed reserve forests of both rainfall areas had fewer species in all these categories than the *kaan* forests. It is very clear that the mode of protection and also the level of disturbance influence the occurrence of these species. It is also found that a prudent manner of protection leads to the establishment of microclimatic condition that favour some of the ecologically sensitive species, such as *Canarium strictum* Roxb., *Diospyros crumenata* Thw., *Garcinia morella* (Gaertn.) Desr. *Knema attenuata* (Hook. f. & Thoms.) Warb., *Saraca asoca* (Roxb.) de Wilde., and *Syzygium gardneri* Thw.. Similar observations were also reported by Chandran & Gadgil (1991) and Pascal *et al.* (1998).

### *Species occurrence as a function of disturbance*

The species composition, structure and regeneration of any vegetation type are directly depen-

**Table 4.** Numbers of species in different categories in *kaan* forests and state-managed reserve forests.

| Categories of species | Sites | | | | | |
|---|---|---|---|---|---|---|
| | High rainfall area | | | Low rainfall area | | |
| | Kugwe *kaan* | Hunsur *kaan* | RF-I | Jambani *kaan* | Huttadimba | RF-II |
| Evergreen species | 28 | 44 | 3 | 33 | 19 | 2 |
| Rare, Endangered & Threatened species | 8 | 14 | 1 | 5 | 3 | 0 |
| Endemic species | 16 | 21 | 1 | 13 | 9 | 0 |
| Medicinally important species | 8 | 12 | 3 | 7 | 10 | 2 |
| Economically important species | 17 | 24 | 12 | 14 | 13 | 4 |

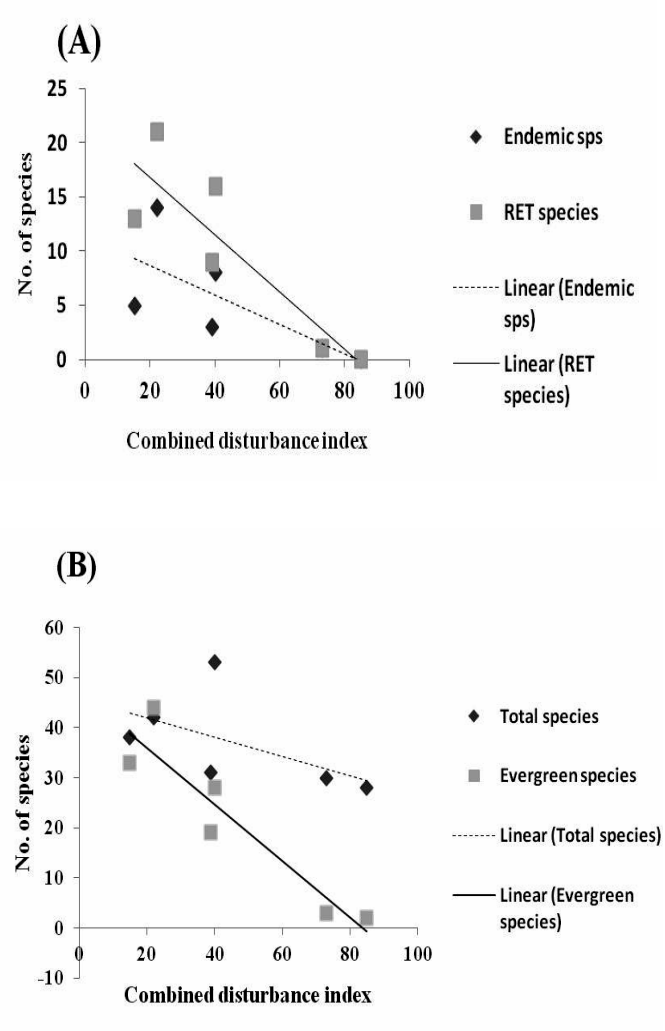


**Fig. 5.** Number of Rare, Endangered or Threatened (RET) and endemic species (A), total species and evergreen species (B), as a function of disturbance.

dent upon the degree of degradation (Arjunan *et al.* 2005; Ravindranth & Gadgil 1995). Increase in the disturbance or degradation decreases species richness (Mishra *et al.* 2004). In the present study the number of RET and endemic, as well as evergreen species, decreased with the increase in degradation (Fig. 5). In this study, the highest percentage of disturbance was recorded in state-managed reserve forests, both in the high and low rainfall area (> 70 %) followed by the Kugwe (40 %) and Huttadimba (39 %) *kaan*s of the high and low rainfall areas respectively. Hunsur (22 %) and Jambani (15 %) *kaan*s had very low levels of degradation. A higher level of disturbance resulted in a decrease in the number of RET and endemic, species, as well as the number of evergreen species. However, in terms of the total number of species in the vegetation in the Kugwe and Huttadimba *kaan*s, there were no notable changes, because of invasion by deciduous species like *Lagerstroemia microcarpa* Wight., *Macaranga peltata* (Roxb.), *Terminalia bellirica* (Gaertn.) Roxb., *Terminalia paniculata* Roth., *Tetrameles nudiflora* R. Br. and *Vitex altissima* L. f., made possible by canopy openings. Recently Tadwalkar *et al.* (2012) have also adopted CDI and shown that increase in level of disturbance is negatively associated with zoochory.

## Conclusions

Better protection and management have resulted in increases in tree species diversity as well as in biomass production. Hunsur and Jambani *kaan*s in the high and low rainfall areas had good forest vegetation, as their mode of protection and manage-

ment had been good. Though Kugwe *kaan* is located in the high-rainfall area with climax vegetation, the disturbance percentage is quite high because its proximity to Sagar town means that there is much illegal poaching and felling; consequently there are more deciduous species. It would be possible to bring the disturbed area under complete forest cover through the protection of natural regeneration and encouraging natural succession (Alamgir & Al-Amin 2007).

Providing good protection and adopting better management practices in moderately disturbed *kaans* could return the vegetation to high species richness and stocking density. It would also give a better chance of establishment to sensitive evergreen species, to endemic species, and to those in RET categories, as well as to economically important species, through natural succession. This is evidenced in Jambani *kaan*, which has higher diversity despite being located in a low-rainfall region because of better protection.

*Kaan* forests are the remnants of traditional conservation efforts by the aboriginals of this region. These patches of *kaan* forests are still essentially of climax character, and are the abode of ecologically sensitive plant species. Pascal (1988) and Gadgil *et al*. (2011) have opined that restoring these climax patches would be difficult if they are perturbed by an external influence. Hence these *kaan* forests could be considered as ecologically sensitive sites akin to Ecological Sensitive Areas (ESAs) proposed to be established all along the Western Ghats (Gadgil *et al*. 2011).

## References


Alamgir, M. & M. Al-Amin. 2007. Regeneration status in a proposed biodiversity conservation area of Bangladesh. *Proceedings of Pakistan Academy of Science* **44**: 165-172.

Arjunan, M., Jean-Philippe Puyravaud & Priya Davidar. 2005. The impact of resource collection by local communities on the dry forests of the Kalakad-Mundanthurai Tiger Reserve. *Tropical Ecology* **46**: 135-143.

Chandran, M. D. S. & Madhav Gadgil. 1991. *Sacred Groves - Safety Forests of Uttara Kannada*. IUFRO Forest History Conference, Fraiburg.

Chandran, M. D. S. 1997. On the ecological history of the Western Ghats. *Current Science* **73:** 146-155.

Chandran, Subhash M. D., D. K. Mesta, G. R. Rao, Sameer Ali., K. V. Gururaja & T. V. Ramachandra. 2008. Discovery of two critically endangered tree species and issues related to relic forests of the western ghats. *The Open Conservation Biology Journal* **2**: 1-8.

Curtis, J. T. & R. P. Mclntosh. 1950. An upland forest continuum in the Praine-forest border of Wisconsisn. *Ecology* **32**: 476-496.

Gadgil, M., R. J. Ranjit Daniels, K. N. Ganeshaiah, S. Narendra Prasad, M. S. R. Murthy, C. S. Jha, B. R. Ramesh & K. A. Subramanian. 2011. Mapping ecologically sensitive, significant and salient areas of Western Ghats: proposed protocols and methodology. *Current Science* **100**: 175-182.

Gokhale, Yogesh. 2004. Reviving traditional forest management in western ghats; study in Karnataka. *Economic and Political Weekly* **(July 13)**: 3556-3559.

Hegde, G. T., K. S. Murali, D. M. Bhat, P. R. Bhat & N. H. Ravindranath. 2005. Effect of protection on regeneration in some selected village forests under community protection in Uttara Kannada district, Karnataka, India. *Current Science* **88**: 10.

IUCN. 2011. *IUCN Red List of Threatened Species. Version 2011.1*. <http://www.iucnredlist.org>. Downloaded on 16 June 2011.

Krebs, C. J. 1985. *Ecology*: *The Experimental Analysis of Distribution and Abundance*. Harper and Row. New York.

Murthy Indu, K., P. V. Rekha, Shrikant Gunaga, S. Patgar, M. B. Naik, Y. H. Prakash, A. Nambi, S. Indrani, Rajashekhar & N. H. Ravindranath. 2000. Community forestry: An ecological, economic and institutional assessment in the western ghats. 2000. pp. 173-189. *In*: N. H. Ravindranath, K. S. Murali & K. C. Malhotra (eds.) *Joint Forest Management and Community Forestry in India*: *An Ecological and Institutional Assessment*. Oxford & IBH Publishers.

Joshi, N. V. & Madhav Gadgil. 1991. On the role of refugia in promoting prudent use of biological resources. *Theoretical Population Biology* **40:** 211-229.

Mishra, B. P., O. P. Tripathi, R. S. Tripathi & H. N. Pandey. 2004. Effects of anthropogenic disturbance on plant diversity and community structure of scared groves in Meghalaya northeast India. *Biodiversity and Conservation* **13**: 421-436.

Murali, K. S., U. Shanker, U. R. Shaanker, K. N. Ganeshaiah & K. S. Bawa. 1996. Impact of NTFPs extraction on regeneration, population structure and species composition. *Economic Botany* **50**: 252-269.

Nair, K. K. N. 2000. *Manual of Non-Wood Forest Produce Plants of Kerala*. Kerala Forest Research Institute, Kerala, India.

Nayar, M. P. 1996. *Hot Spots of Endemic Plants of India, Nepal and Bhutan*. Director, Tropical Botanic

Garden and Research Institute, Palode, Trivendrum. Kerala, India.

Parthasarathy, N. 2001. Changes in forest composition and structure in three sites of tropical evergreen forest around Sengaltheri, Western Ghats. *Current Science* **80**: 389-393.

Pascal, J. P. 1998. *Wet Evergreen Forests of Western Ghats of India; Ecology and Structure Floristic Composition and Succession.* French Institute, India.

Pascal, J. P. 1992. Evergreen forests of the western ghats: structural and functional trends. pp. 385-408. *In*: K. P. Singh & J. S. Singh (eds.) *Tropical Ecosystems : Ecology and Management.* Wiley Eastern Ltd., New Delhi.

Pascal, J. P., B. R. Ramesh & G. Bourgeon. 1988. The Kaan forests of the Karnataka plateau (India): Structure and floristic composition, trend in the changes due to their exploitation. *Tropical Ecology* **29**: 9-23.

Ravikumar, K. & D. K. Ved. 2000. 100 *Red-Listed Medicinal Plants of Conservation Concern*. Foundation for Revitalization of Local Health Tradition. Bangalore, India.

Ravindranath, N. H. & Madhav Gadgil. 1995. *Community Forestry: An Ecological, Economical & Institutional Assessment in Western Ghat*. Report submitted to Ford Foundation New- Delhi.

Singh, J. S., S. P. Singh, A. K Saxena & Y. S. Rawat. 1986. *Ecology Research Circle.* Kumaun University, Nainital.

Sumy, O., D. K. Ved & R. Krishnan 2000. *Tropical Indian Medicinal Plants; Propagation Methods.* Foundation for Revitalization of Local Health Traditions (FRLHT).

Tadwalkar, M. D., Amruta M. Joglekar, Monali Mhaskar, Radhika B. Kanade, Bhanudas Chavan, Aparna V. Watve, K. N. Ganeshaiah & Ankur A. Patwardhan. 2012. Dispersal modes of woody species from the northern Western Ghats, India. *Tropical Ecology* **53**: 53-67.

Talbot, W. A. 1909. *Forest Flora of the Bombay Presidency and Sind*. Vol. I. Printed in Government at the Photozinccographic Press, Poona.

Varghese, A. O. & A. R. R. Menon. 1998. Vegetation characteristic of southern moist mixed deciduous forests of Agasthyamalai region of Kerala. *Indian Journal of Forestry* **21**: 337-344.

Ved, D. K. & G. S. Goraya. 2008. *Demand and Supply of Medicinal Plants in India.* Bishen Singh Mahendra Pal Singh, Dehradun & FRLHT, Bangalore, India.

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**Appendix Table 1.** Species recorded in the transects (For abbreviations, see footnote).

| Species (Evergreen species are in **bold**) | Conservation status | Economic value | High-rainfall area | | | | | | Low-rainfall area | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hunsur | | Kugwe | | RF-I | | Jambani | | Huttadimba | | RF-II | |
| | | | D | B | D | B | D | B | D | B | D | B | D | B |
| ***Acronychia pedunculata* Bedd.** | - | M | 2 | 0.33 | - | - | 1 | 0.35 | - | - | - | - | - | - |
| ***Actinodaphne hookeri* Meissn** | E, Vu | M | 2 | 0.29 | 6 | 0.34 | - | - | 7 | 0.33 | 4 | 0.11 | - | - |
| *Adina cordifolia* Hook. | - | - | - | 2 | 0.19 | - | - | - | - | - | - | - | - | - |
| ***Aglaia roxburghii* Miq.** | - | - | 10 | 0.69 | - | - | - | - | 30 | 1.04 | 4 | 0.86 | - | - |
| ***Ailanthus malabarica* DC.** | - | N | - | - | - | - | - | - | - | - | 3 | 0.97 | - | - |
| *Albizzia lebbeck* Benth. | - | T | - | - | - | - | 5 | 1.20 | - | - | - | - | 7 | 1.21 |
| ***Alseodaphne semicarpifolia* Nees.** | - | - | - | - | - | - | 7 | 1.22 | - | - | - | - | - | - |
| *Alstonia scholaris* Brown. | - | M | - | - | 1 | 0.32 | - | - | 2 | 0.59 | 5 | 0.59 | - | - |
| ***Aphanamyxis polystachya* (Wall.) Parker** | Vu | M | 4 | 0.14 | - | - | - | - | - | - | - | - | - | - |
| *Apurosa lindleyana* Bail. | - | - | 34 | 0.73 | 20 | 0.19 | 32 | 0.57 | - | - | 7 | 0.36 | - | - |
| *Artocarpus hirsutus* Lamk. | - | T | 4 | 0.45 | 34 | 0.55 | - | - | - | - | - | - | - | - |
| ***Artocarpus integrifolia* Linn.** | - | N | - | - | - | - | - | - | - | - | 15 | 2.13 | - | - |
| *Artocarpus lakoocha* Roxb. | - | N | - | - | 2 | 0.58 | 5 | 1.32 | - | - | - | - | - | - |
| ***Beilschmiedia wightii* Benth.** | E | T | 2 | 0.89 | 2 | 0.79 | - | - | 7 | 0.88 | 7 | 1.70 | - | - |
| *Bombax ceiba* L. | - | - | - | - | 2 | 1.12 | 6 | 0.49 | - | - | 4 | 0.87 | 19 | 2.03 |
| *Buchnania lanzan* Spreng. | - | N | - | - | - | - | 12 | 0.54 | - | - | - | - | - | - |
| *Butea monosperma* (Lam.) Taub. | - | N | - | - | - | - | 5 | 0.97 | - | - | - | - | - | - |
| *Callicarpa tomentosa* (L.) Murr. | - | - | - | 4 | 0.12 | - | 2 | 0.07 | - | - | - | - | - | - |
| *Calycopteris floribunda* Lam. | - | - | - | - | - | - | - | - | - | - | - | - | 2 | 0.10 |
| ***Canarium strictum* Roxb.** | Vu | N | 11 | 1.95 | - | - | - | - | - | - | - | - | - | - |
| ***Canthium dicoccum* Roxb.** | - | - | 8 | 0.36 | - | - | - | - | - | - | - | - | - | - |
| *Careya arborea* Roxb. | - | - | - | - | - | - | - | - | 1 | 2.14 | - | - | 14 | 0.26 |
| ***Caryota urens* Linn.** | - | N | 3 | 0.68 | - | - | 5 | 0.56 | 15 | 0.59 | 6 | 0.35 | - | - |
| ***Casearia ovata* (Lam.) Willd.** | - | - | - | - | - | - | - | - | 2 | 0.17 | - | - | - | - |
| *Cassia fistula* Linn. | - | M | - | - | - | - | 6 | 0.47 | - | - | - | - | - | - |
| *Celtis philippensis* Decne. | - | - | 4 | 0.35 | - | - | - | - | - | - | - | - | - | - |

**Appendix Table 1.** Continued.

| Species (Evergreen species are in **bold**) | Conservation status | Economic value | High-rainfall area | | | | | | Low-rainfall area | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hunsur | | Kugwe | | RF-I | | Jambani | | Huttadimba | | RF-II | |
| | | | D | B | D | B | D | B | D | B | D | B | D | B |
| ***Chionanthus malabaricus* (Wall. ex. G Don.) Bedd.** | - | - | 2 | 0.11 | 6 | 0.53 | 4 | 0.41 | - | - | 4 | 0.14 | - | - |
| ***Chrysophyllum roxburghii* G.Don.** | E | - | 3 | 0.79 | - | - | - | - | 2 | 0.66 | - | - | - | - |
| *Chukrassia tabularis* Adr. Juss. | - | M | 2 | 0.10 | - | - | 16 | 1.20 | - | - | 4 | 1.24 | 5 | 1.23 |
| ***Cinnamomum malabatrum* (Burm. f.) Bl.** | E, Vu | N | 10 | 0.29 | 4 | 0.11 | - | - | 4 | 0.89 | 2 | 0.08 | - | - |
| *Cordia dichotama* Forst. | - | - | - | - | - | - | - | - | - | - | 3 | 0.37 | - | - |
| *Dalbergia latifolia* Roxb. | - | T | - | - | - | - | 5 | 1.30 | - | - | - | - | 8 | 0.23 |
| *Dendrocalamus strictus* Nees. | - | N | - | - | - | - | - | - | - | - | - | - | 3 | 0.43 |
| ***Diospyros buxifolia* Hiern.** | - | - | 24 | 0.62 | 16 | 0.12 | - | - | - | - | - | - | - | - |
| ***Diospyros candolleana* Wight.** | E, Vu | - | 4 | 0.22 | - | - | - | - | - | - | - | - | - | - |
| ***Diospyros crumenata* Thw.** | E, En | - | 3 | 0.80 | - | - | - | - | 58 | 1.81 | 9 | 0.84 | - | - |
| *Diospyros montana* Roxb. | - | - | 2 | 0.18 | 2 | 1.11 | 8 | 0.34 | - | - | | - | 4 | 0.43 |
| ***Diospyros oocarpa* Thw.** | E | - | - | - | - | - | - | - | 4 | 0.15 | - | - | - | - |
| ***Diospyros paniculata* Dalz & Gibs.** | E, En | - | 2 | 0.15 | - | - | - | - | - | - | - | - | - | - |
| ***Diospyros sylvatica* Roxb.** | E | - | 4 | 2.13 | 14 | 0.49 | - | - | - | - | - | - | - | - |
| ***Dysoxylum malabaricum* Bedd.** | E, Vu | T | 1 | 0.09 | - | - | - | - | - | - | - | - | - | - |
| ***Elaeocarpus serratus* L.** | - | - | 6 | 0.32 | 12 | 0.08 | - | - | - | - | - | - | - | - |
| *Entada scandens* Benth. | - | - | 4 | 1.65 | - | - | - | - | - | - | - | - | - | - |
| ***Euonymus indicus* Heyne ex. Wall.** | E | - | - | - | - | - | - | - | 2 | 0.16 | - | - | - | - |
| *Ficus bengalensis* Linn. | - | M | - | - | - | - | 3 | 0.84 | - | - | - | - | - | - |
| *Ficus callosa* Willd. | - | - | 2 | 0.98 | - | - | - | - | 4 | 2.95 | - | - | - | - |
| *Ficus talbotii* King. | - | - | - | - | - | - | - | - | - | - | - | - | 8 | 2.97 |
| *Ficus tsjahela* Rheede ex. Burm. f. | - | - | - | - | - | - | - | - | 2 | 0.78 | - | - | - | - |
| *Ficus virens* Aiton. | - | - | 2 | 1.62 | - | - | - | - | - | - | - | - | - | - |
| *Flacourtia montana* Grah. | - | N | 14 | 0.22 | 14 | 0.76 | - | - | - | - | 5 | 0.12 | 2 | 0.48 |

**Appendix Table 1.** Continued.

| Species (Evergreen species are in **bold**) | Conservation status | Economic value | High-rainfall area | | | | | | Low-rainfall area | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hunsur | | Kugwe | | RF-I | | Jambani | | Huttadimba | | RF-II | |
| | | | D | B | D | B | D | B | D | B | D | B | D | B |
| ***Garcinia gummi-gutta* (L.) Robson.** | E. Vu | N | 3 | 2.24 | - | - | - | - | - | - | - | - | - | - |
| ***Garcinia indica* Chois.** | Th | N | 2 | 0.41 | - | - | - | - | - | - | - | - | - | - |
| ***Garcinia morella* Desr.** | E | N | 40 | 0.53 | 17 | 0.20 | - | - | - | - | - | - | - | - |
| ***Gnetum scandens* Roxb.** | E | - | - | 2 | 0.27 | - | - | 2 | 0.58 | - | - | | - | - |
| *Grewia tilaefolia* Vahl. | - | N | - | - | - | - | - | - | - | - | - | - | 6 | 0.36 |
| ***Harpulia arborea* (Blanco) Radlk.** | - | - | - | - | - | - | - | - | 6 | 1.88 | - | - | - | - |
| *Holarrhena antidysentrica* Hook. f. non (L.)Wall. | - | M | - | - | - | - | 6 | 0.41 | - | - | - | - | - | - |
| ***Holigarna arnottiana* Hook. f.** | E | - | 12 | 2.93 | 20 | 0.26 | 3 | 0.69 | - | - | 15 | 0.38 | - | - |
| ***Holigarna grahamii* Hook. f. Radlk.** | E | - | - | - | - | - | - | - | 28 | 3.08 | - | - | - | - |
| ***Hopea ponga* (Dennst.) Mabberly** | E, En | - | 5 | 0.78 | - | - | - | - | - | - | - | - | - | - |
| ***Hydnocarpus pentandra* (Buch-Ham.) Oken** | E, Th | M | 18 | 1.53 | 2 | 0.12 | - | - | 8 | 0.54 | 3 | 0.72 | - | - |
| ***Ixora brachiata* Roxb.** | - | - | 8 | 0.33 | 30 | 0.58 | - | - | 18 | 0.38 | 9 | 0.14 | - | - |
| ***Knema attenuata* (Hook. f. & Thoms.) Warb.** | E, En | - | 4 | 0.10 | 8 | 1.04 | - | - | 16 | 2.37 | - | - | - | - |
| *Lagerstroemia microcarpa* Wgt. | - | T | - | - | 6 | 0.20 | - | - | 2 | 1.89 | 3 | 1.23 | 26 | 0.50 |
| *Lagerstroemia parviflora* Roxb. | - | - | - | - | - | - | 6 | 0.51 | - | - | - | - | - | - |
| *Lannea coramandelica* (Houtt.) Merr. | - | - | - | - | 4 | 0.34 | 8 | 0.56 | - | - | - | - | 8 | 0.32 |
| ***Litsea floribunda* (Bl.) Gamble.** | E | - | - | - | 6 | 0.78 | - | - | - | - | - | - | - | - |
| ***Litsea mysorensis* Gamble.** | E, Vu | - | - | - | - | - | - | - | 4 | 0.44 | - | - | - | - |
| *Macaranga peltata* (Roxb.) Muell.-Arg. | - | - | - | - | 14 | 0.52 | - | - | 8 | 0.26 | 3 | 0.45 | 5 | 0.56 |
| *Madhuca latifolia* (Roxb.) Macbride. | - | N | - | - | - | - | 8 | 0.42 | - | - | - | - | 6 | 0.27 |

**Appendix Table 1.** Continued.

| Species (Evergreen species are in **bold**) | Conservation status | Economic value | High-rainfall area | | | | | | Low-rainfall area | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hunsur | | Kugwe | | RF-I | | Jambani | | Huttadimba | | RF-II | |
| | | | D | B | D | B | D | B | D | B | D | B | D | B |
| ***Mammea suriga* (Buch.-Ham. ex Roxb.) Kosterm.** | - | N | 20 | 1.64 | - | - | - | - | 4 | 0.73 | 5 | 0.30 | - | - |
| ***Mangifera indica* Linn.** | - | N | 18 | 2.26 | 12 | 0.45 | - | - | 10 | 4.73 | - | - | - | - |
| *Margaritaria indica* (Dalz.) Airy Shaw | - | - | 3 | 0.65 | - | - | - | - | - | - | - | - | - | - |
| ***Memecylon malabaricum* Cogniaux.** | E | - | - | - | - | - | - | - | 6 | 0.15 | - | - | - | - |
| ***Memecylon wightii* Thw.** | E | - | 3 | 0.78 | - | - | - | - | 2 | 0.27 | 5 | 0.16 | - | - |
| *Meyna laxiflora* Roxb. | - | - | 2 | 0.26 | - | - | - | - | - | - | - | - | 6 | 0.53 |
| ***Mimusops elengii* Linn.** | - | N | 5 | 1.01 | 6 | 0.52 | - | - | 2 | 0.21 | 8 | 1.10 | - | - |
| *Mitragyna parviflora* (Roxb.) Korth. | - | T | - | - | - | - | - | - | - | - | - | - | 8 | 0.53 |
| *Nothapodytes nimmoniana* (Graham) Mabberely. | Vu | M | - | - | - | - | - | - | - | - | 3 | 0.07 | - | - |
| ***Nothopegia racemosa* (Dalz.) Ramam.** | E | - | 4 | 0.78 | 8 | 1.34 | - | - | - | - | - | - | - | - |
| ***Olea dioica* Roxb.** | - | - | 18 | 0.75 | 12 | 1.98 | - | - | 16 | 1.01 | 14 | 0.28 | - | - |
| ***Persea macrantha* (Nees.) Kosterm.** | E, Vu | - | 3 | 1.58 | - | - | - | - | - | - | - | - | - | - |
| *Phyllanthus emblica* Linn. | - | M, N | - | - | 1 | 0.28 | 3 | 0.54 | - | - | - | - | - | - |
| *Polyalthia coffeoides* Benth. | - | - | - | - | - | - | - | - | 2 | 0.16 | - | - | - | - |
| ***Polyalthia fragrans* Benth.** | - | - | - | - | 2 | 2.05 | - | - | - | - | - | - | - | - |
| *Pterocarpus marsupium* Roxb. | - | T | - | - | - | - | 6 | 0.48 | - | - | - | - | 7 | 0.59 |
| ***Pterospermum reticulatum* W. & A.** | En | - | - | - | 2 | 0.92 | - | - | - | - | - | - | - | - |
| *Santalum album* Linn. | Vu | M | - | - | - | - | 2 | 0.92 | - | - | - | - | - | - |
| *Sapindus laurifolius* Vahl. | - | N | - | - | - | - | - | - | - | - | 3 | 0.14 | - | - |
| ***Saraca asoca* (Roxb.) de Wsilde.** | En | M | - | - | - | - | - | - | 68 | 0.47 | - | - | - | - |
| ***Sideroxylon tomentosum* Roxb.** | E | - | - | - | 4 | 0.20 | 20 | 0.79 | - | - | - | - | - | - |

**Appendix Table 1.** Continued.

| Species (Evergreen species are in **bold**) | Conservation status | Economic value | High-rainfall area | | | | | | Low-rainfall area | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Hunsur | | Kugwe | | RF-I | | Jambani | | Huttadimba | | RF-II | |
| | | | D | B | D | B | D | B | D | B | D | B | D | B |
| *Sterculia guttata* Roxb. | - | - | 4 | 0.96 | - | - | - | - | - | - | - | - | - | - |
| *Stereospermum personatum* (Hassk.) Chatarjee | - | - | 6 | 2.70 | - | - | - | - | 2 | 1.84 | - | - | 11 | 1.13 |
| ***Symplocos racemosa* Roxb.** | E | M | 3 | 0.37 | 4 | 0.77 | - | - | - | - | - | - | - | - |
| ***Syzygium cumini* (L.) Skeels.** | - | N | 7 | 0.50 | 2 | 0.42 | - | - | - | - | - | - | 10 | 1.55 |
| ***Syzygium gardneri* Thw.** | E | T | - | - | - | - | - | - | - | - | 73 | 3.00 | - | - |
| ***Syzygium laetum* (Ham.) Gandhi.** | E | - | 2 | 0.31 | - | - | - | - | - | - | - | - | - | - |
| *Tabernaemontana heyneana* Wall. | - | M | 4 | 0.82 | 4 | 0.2 | 5 | 0.36 | - | - | 6 | 0.09 | - | - |
| *Terminalia bellirica* Roxb. | - | T, M | - | - | - | - | 5 | 0.74 | - | - | - | - | 7 | 0.72 |
| *Terminalia chebula* Retz. | - | M | - | - | - | - | 22 | 0.35 | - | - | - | - | - | - |
| *Terminalia paniculata* Roth. | - | T | - | - | - | - | 6 | 0.64 | - | - | - | - | 30 | 1.12 |
| *Terminalia tomentosa* W. & A. | - | T | - | - | - | - | 8 | 0.58 | - | - | - | - | 21 | 0.80 |
| *Tetrameles nudiflora* R. Br. | - | - | - | - | 2 | 0.81 | - | - | 10 | 5.09 | 4 | 1.94 | - | - |
| *Toona ciliata* Roemer. | - | - | 4 | 0.43 | - | - | - | - | - | - | - | - | - | - |
| ***Trichilia connaroides* (Wight & Arn.) Bentevelezen** | - | - | 2 | 0.10 | - | - | - | - | 4 | 0.35 | - | - | - | - |
| *Ventilago madarspatana* Gaertn. | - | - | - | - | - | - | - | - | 2 | 0.19 | - | - | - | - |
| ***Vepris bilocularis* (Wight & Arn.) Engl.** | - | - | - | - | - | - | - | - | 1 | 0.32 | - | - | - | - |
| *Vitex altissima* Linn. | - | T | 6 | 2.31 | 2 | 0.35 | 5 | 0.96 | 5 | 5.85 | 12 | 0.95 | 6 | 0.95 |
| *Xylia xylocarpa* (Roxb.) Taub. | - | T | - | - | - | - | - | - | - | - | - | - | 32 | 0.67 |
| *Zanthoxylum rhetsa* (Roxb.) DC. | - | T | - | - | 2 | 0.74 | 6 | 0.45 | - | - | 1 | 0.11 | - | - |
| | | TOTAL | 387 | 43.69 | 372 | 23.63 | 254 | 20.60 | 384 | 48.81 | 254 | 23.07 | 274 | 22.60 |

Abbreviations:
Headings: RF= Reserve Forest; D = Density (Stems $ha^{-1}$); B = Basal Area ($m^2 ha^{-1}$)
Conservation Status: E - Endemic to the Western Ghats (Nayar 1996), En - Endangered, Vu - Vulnerable, Th - Threatened (Ravikumar & Ved 2000), (IUCN 2011) (Sumy, Ved & Krishnan 2000), (Nair 2000).
Economic Value: M - Medicinal (Ravikumar & Ved 2000); N = -Non-Timber Forest Produce; T = Timber (Ved & Goraya 2008).