INTERNATIONAL JOURNAL OF ADVANCED BIOLOGICAL RESEARCH

www.scienceandnature.org

PLANT DIVERSITY ASSESSMENT IN SURULI SACRED GROVE OF SOUTHERN WESTERN GHATS, TAMIL NADU, INDIA USING BIODIVERSITY SOFTWARE

Gangatharan Ramesh and Krishnasamy Muthuchelian
Department of Bioenergy, School of Energy, Environment and Natural resources, Madurai Kamaraj University, Madurai 625 021, Tamil Nadu, India

ABSTRACT
This study mainly aims to examine the origin, prevalence and perpetuation of the sacred grove as well as the inventories of plant diversity in the grove and to assess the plant diversity in the Suruli sacred grove of Cumbum valley of Southern Western Ghats, Theni district, Tamil Nadu using biodiversity software (Biodiversity pro beta version). The diversity indices were calculated using the software 'BIODIVERSITY PRO' beta version (McAleece 1997). Phytosociological studies carried out in the Suruli sacred grove using the Biodiversity Pro software showed a total of 40 species consisting 34 genera and 25 families. The absolute stand density for the study site is 370 ha^{-1}. Twenty five families were recorded in the study site. Asteraceae is the most dominant family in the study site. The plot of principal components analysis revealed that the *Xanthium indicum and Panicum* sp showed a higher value when compared to other species in the study area. Bray-Curtis cluster analysis (single link) results reveal the percentage of similarity between the species *Polyalthia cerasoides*, *Streospermum personatum*, *Thespesia populnea, Albizzia lebbeck* and *Tamarindus indica* showed a 100% similarity. The Suruli sacred grove is very much within the stand density range of the tropical forest of the world and India. However, the decline in the stand density of the study site is due to the mild disturbance caused by the biotic interference.

KEYWORDS: Plant diversity, sacred grove, biodiversity Software, Western Ghats

INTRODUCTION

Sacred groves are small patches (from less than a hectare to up to few km^2) of native vegetation types traditionally protected and managed by the local communities, though a wide range of management practices are possible (Ramakrishnan 1997). These are one of the finest examples of people's initiative in conserving native biodiversity. When the concept was born, patches of natural vegetation were demarcated by ancient societies and equated to God for the purpose of conservation. They were distinct segments of various landscapes containing trees and other forms of life and geographical features (Gadgil & Vartak, 1975). The way of conserving natural biodiversity through preservation plots in forest areas or sacred groves is a unique feature in Indian culture (Khullar 1992). Sacred groves are characterised by rare species preserved on isolated land with social and religious beliefs of people (Kulkarni & Shindikar 2005). These sacred groves are more or less pockets of climax vegetation preserved on religious grounds. These forests are the true indicators of the type of vegetation that once existed here before the dawn of modern civilisation. The concept of sacred groves has also been widened to include any patch of trees, natural or anthropogenic, which is dedicated to a village God. Several restrictions were framed on resource use pattern, which were woven into the tapestry of cultural traditions (Somashekar 1999).

Worldwide, groves have been reported from parts wherever indigenous societies existed. The presence of a grove closer to the Arctic, consisting of birch and fir trees called Kozmis copse in Kanis region is considered sacred. Visitors offer therein ware and other articles (Hughes & Chandran 1998). In India, sacred groves occur in a variety of ecological situations. They have evolved under resource-rich situations as in Meghalaya in North-East India, Western Ghats region in South India or in the Bastar region in the state of Madhya Pradesh in Central India. In that sense, it contradicts the view point that forest conservation measures always follow from some perception of resource scarcity, because all the above examples are from resource-rich situations, unlike the situation elsewhere, as in arid regions (Rodgers, 1994).

METHODOLOGY

The study area Suruli is a holy place with a difference with its unusual temple, holy stream and awaits all devotees who wish to come and touch into its intense spirituality. Suruli Hills is situated in the Western Ghats of South India, at least five miles from the nearest village of Surulipati (Fig.1). Here, amidst green forests alive with monkeys and birds, Lord Muruga as Dhandayuthapaniswami reigns supreme, and one is struck with the air of spirituality. It is said that through the centuries, thousands of beings, both on the physical and the subtle, inner planes, have lived and performed austerities in the many caves that honeycomb these hills.

FIGURE 1. Map showing location of Suruli in southern Western Ghats of Tamil Nadu, India.

Lord Muruga, who here transcends all tattvas, has assumed a humble form and abides in very natural and simple surroundings - a temple which is nothing but the trunk of a huge tree, rendered to stone by the herbal action of a stream flowing over it from above. The sound of the stream flowing over the temple and falling about ten feet in front of it serves to accent the deep silence that pervades the locale. Suruli Hills is also the place where Lord Muruga chalked out war strategies in His battle against the asuras. He choose Suruli Hills to confer with His war generals after finding out that all His plans were previously being leaked out to the enemy camp. Lord Vishnu Himself, as *Bootha Narayana* (Phantom Narayana), took over the security of the hills and stationed Himself at the boundary. The Kailasanathar Temple cave is situated 800 meters above the falls. There are 18 caves at those heights, each of them, the story goes, and hiding water springs with curative powers. Near the main Kailasanathar Cave, there is also a dargah where the body of a Muslim mystic from the 17th Century, Abubacker Masthan, is interred.

Methods

Phytosociological studies were carried out during August 2003-August 2004, using the quadrat method. The density, frequency, basal area and importance value index (IVI) were estimated using 20 randomly placed quadrats (10 x 10 m^2) for trees (individuals with GBH more than 30 cm), shrubs (5 x 5 m^2) and herbs (1 x 1 m^2) at each study site of natural forest ecosystems. Similarly climbers of all sizes whose base fell inside the plot (10 x 10 m^2) were studied at each study site (Kershaw 1973; Misra 1968). Density (ha^{-1}) and basal area values were calculated for each tree species.

Data analysis

The diversity indices were calculated using the software 'BIODIVERSITY PRO' beta version (McAleece 1997). Frequency and abundance of trees, shrubs, herbs, and climbers were summarized on a quadrat basis. Frequency was expressed as either absolute (number of plots in which the species occurred) or relative (the ratio of absolute frequency of a species to the total number plots multiplied by 100). Abundance is the number of individual plants per plot. Species richness was measured by hierarchical richness index. Fisher's alpha diversity and species diversity was measured by Simpson's concentration index (Magurran 1998). Incidence-based Coverage Estimator (ICE) and Chao2, best satisfied the requirements of an ideal estimator, which are graphically represented by plotting the estimators and observed species richness against the cumulative number of plots sampled (Chazdon *et al*., 1998). The close similarity and variation among the plant species were explained by Bray-Curtis analysis.

RESULTS

The results of phytosociological studies carried out in the Suruli sacred grove using the Biodiversity Pro software shows a total of 40 species belonging to 34 genera and 25 families. The average alpha diversity indices value of the Suruli sacred grove is 3.5966. The samples (quadrats) 7 (4.732) and 6 (4.362) showed an increase in the alpha diversity values followed by sample 9 (3.895). The least alpha diversity value was observed in sample 5 (2.604). Simpson's index showed a higher value in the sample 8 (0.383), 1 and 2 (0.294), followed by sample 9 (0.281) and the least value of Simpson's index was observed in sample 6 (0.155). The sample 1 (1.52) showed a least Shannon diversity index and the sample 6 showed a higher Shannon diversity index (2.007) (Fig. 2). In the study site, species accumulation curves approach an asymptote. The species area curve reveals that of the cumulative number of 38 species which attained an equilibrium at the sample 8 (Fig. 3).

The plot of principal components analysis reveals that the *Xanthium indicum, Panicum* sp showed a higher value of 112.46 and 56.55 and the least principal component value when compared to other species in the study area (Fig. 4). Bray-Curtis cluster analysis (single link) results reveal the percentage of similarity between the species which occurred in the Suruli sacred grove. A 100% similarity was observed in the clusters of 35, 36 and 37. A 50% similarity was observed in the clusters of 7-15.

FIGURE 2. Results showing Alpha diversity index, Simpsons index and Shannon index of the plant communities in the Suruli sacred grove of Cumbum valley of Southern Western Ghats of Tamil Nadu, India

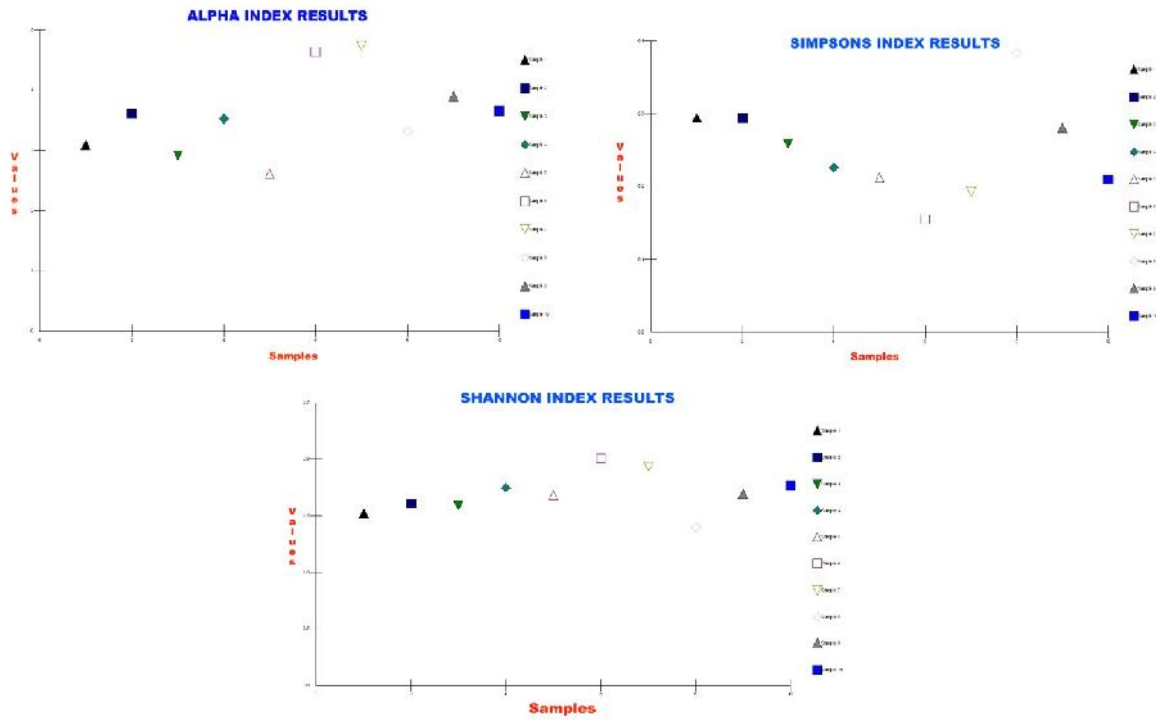
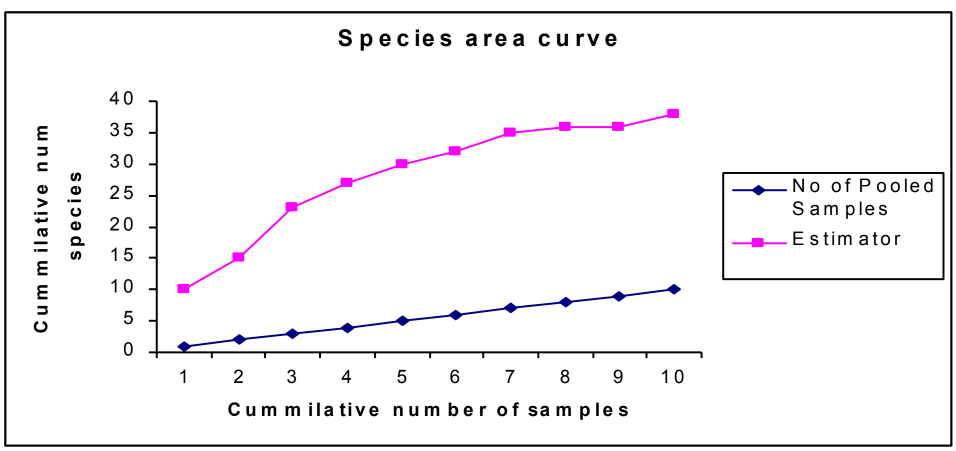
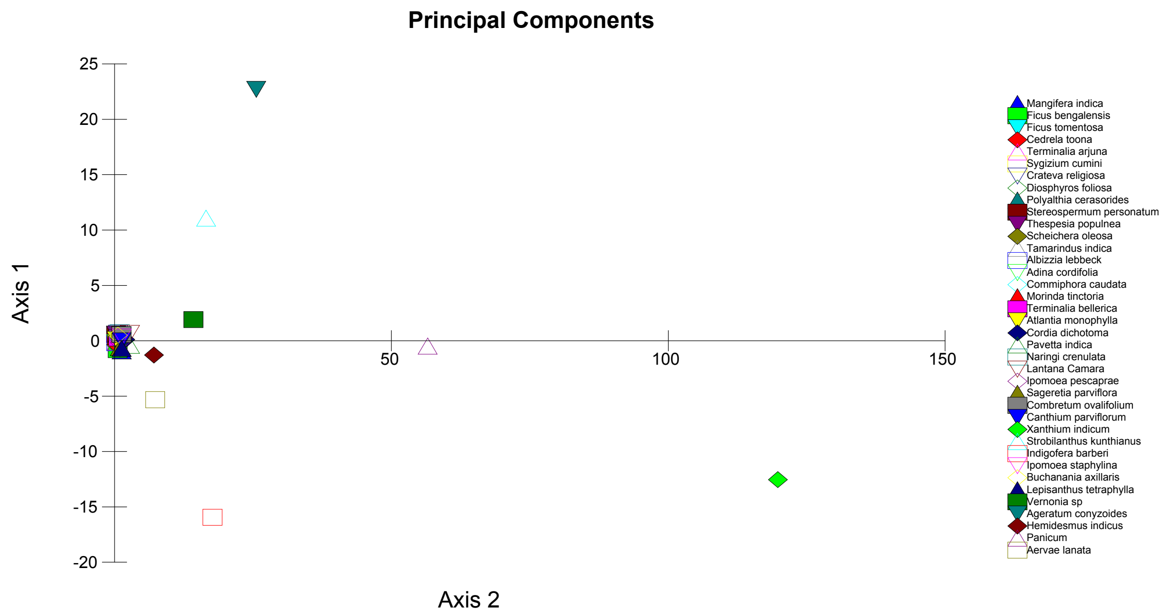


FIGURE 3. Species area Curve of the plant communities in the Suruli sacred grove of Cumbum valley of Southern Western Ghats of Tamil Nadu, India



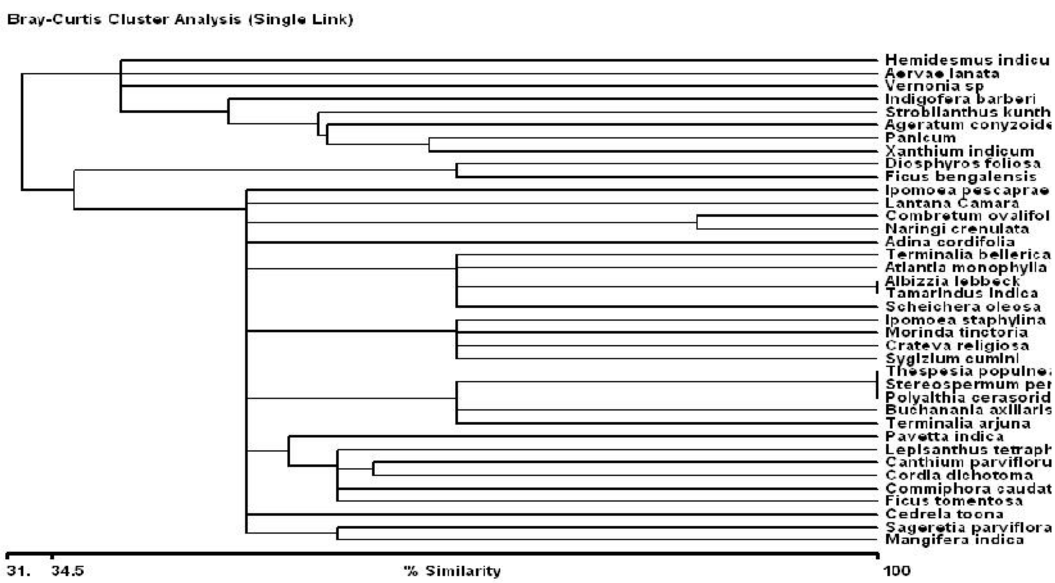
The clusters 25-33 showed a 66.66% with a distance of 33.33%. Cluster 24 showed a similarity of 64.49% and a distance of 35.50%. A 60% and 40% similarity and distance was observed in cluster 23. The clusters 19–22 showed a similarity of 57.14% and distance of 42.85%. Cluster 18 showed 56.37% similarity and 43.62 % of distance. 55.63 % of similarity and 44.36 % of distance in cluster 17. Cluster 16 showed a 53.33 % of similarity and 46.66 % of distance. A 40 % similarity and 60 % distance is observed in clusters 3, 4 and 5. Cluster 6 showed a 48.51 % similarity and 51.48 % of distance. Cluster 1 and cluster 2 showed a similarity of 32.25 % and 33.36% and a distance of 67.74 % and 63.63 % respectively (Fig. 5).

FIGURE 4. Results showing principal component of the plant communities in the Suruli sacred grove of Cumbum valley



of Southern Western Ghats of Tamil Nadu, India

FIGURE 5. Results showing Bray-Curtis analysis of the plant communities in the Suruli sacred grove of Cumbum valley of Southern Western Ghats of Tamil Nadu, India



DISCUSSION

Biodiversity of an area is related to a variety of factors such as topography, climate, and soil and natural/human disturbances. The species richness of 20 tree species in the 0.1 ha of the tropical moist deciduous forest in the Suruli sacred grove of Cumbum valley reflects its low diversity status. The tree species number for a humid tropical forest of silent valley in the Western Ghats of India was 84 per 0.4 ha (Singh *et al*., 1981). According to Proctor *et al*., (1983) and Whitemore (1984), in tropical rainforests, the range of tree species count per ha is from about 20 to a maximum of 223.

The absolute stand density for the study site is 370 ha^{-1}. The Shervarayan and Kalrayan hills of Eastern Ghats, respectively, stocked a range of 640 to 986 trees ha^{-1} (Kadavul & Parhtasarathy 1999a) and 367 to 667 trees ha^{-1}(Kadavul & Parthasarathy 1999b). whereas the tree densities in various tropical evergreen forest of Western Ghats of penisular India were 574 to 915 stems ha^{-1} in medium elevation forest of Kalakad Varagalaiar, Anamalais (Ayyappan & Parthasarathy 1999) reserve forest ranged of 270 to 673 trees ha^{-1} this in southern Western Ghats and 635 stems ha^{-1} in Uppangala forest of central Western ranges between 245 and 859 (Ashton 1964; Campbell *et al*., 1992; Richards 1996) with intermediate values of 448 to 617 stems ha^{-1} in Costa Rica (Wattenberg & Breckle 1995), 420 to 777 stems ha^{-1} in Brazil (Campbell *et al*., 1992) and 639 to 713 stems ha^{-1} in Central Amazonia (Ferreira and Prance 1998).

Twenty five families were recorded in the study site. Asteraceae is the most dominant family in the study site. Leguminosae (3 species), Rubiaceae (3 species) and Combreteace were the most speciose families in the Suruli sacred grove of Cumbum valley, while in the Shervarayan hills Euphorbiaceae (8 species) and Rubiacea (5 species) were most speciose (Kadavul & Parthasarathy 1999a). Broad-leaved forests in Taiwan showed Lauraceae (9 species) and Rubiaceae (7 species) as dominants (Hara *et al*., 1997). In central Amazonian upland forests, Leguminosae, Lauraceae, Sapotaceae, Chrysobalanaceae and Moraceae were the richest families (Ferreira & Prance 1998). Thus the Suruli sacred grove is very much within the stand density range of the tropical forest of the world and India. However, the decline in the stand density of the study site is due to the mild disturbance caused by the biotic interference.

CONCLUSION

The Suruli sacred grove of Cumbum Valley has been partly disturbed by the biotic interference at the periphery for the past few decades for various socio-cultural reasons. These climax natural forest are being preserved because they encompass village Gods within the grove, which are worshipped as religious beliefs and taboos of the people weaken, the pressure on these forest increases. This is also happening in many other sacred groves in Tamil Nadu. The temples within the grove are still enjoying the place of worship but the forest surrounding it become relatively unimportant. In many places no strong taboos exist against biomass extraction. Invariably the biomass extraction is limited to cutting and chopping of lower branches. However, this is done under the cover of darkness. It is important that people realize the values of these patches of forest and make low levels of resource extraction in a regulated manner, which would facilitate sustainable resource use. But the local administration of the scared groves is averse to this idea because according to them it may further weaken the religious faith and belief. Sacred grove's traditional conservation management needs to be supported and strengthened by other appropriate institutional inputs.

ACKNOWLEDGEMENT

This work was supported by the Department of Bioenergy, School of Energy, Environment and Natural resources, Madurai Kamaraj University, Madurai 625 021, Tamil Nadu, India.

REFERENCES

Ashton, P.S. (1964) Speciation among tropical trees: some deductions in the light of recent evidence. *Bot. J. Linn. Socl*. pp. 155-196.

Ayyappan, N. and Parthasarathy, N. (1999) Biodiversity inventory of trees in a large scale permanent plot of tropical evergreen forest of Varagalaiar, Anamalais, Western Ghats, India. *Biodiversity and Conservation.* **8**: 1533-1554.

Campbell, D.G., Stone J.L. and Rosees, A.Jr. (1992) A comparison of the phytosociology and dynamics of three floodplain (vaezea) forest of known ages, Riojurua, Western Brazilian Amazon. *Bot. J. Lin. Soci.* **108**: 213-237.

Chazdon, R.L, Colwell, R.K., Denslow, J.S. and Guariguata, M. R. (1998) Statiscal methods for estimating species richness of woody regeneration in primary and secondary forests of North Eastern Costa Rica. *Forest biodiversity research, monitoring and modeling. Conceptual background and old world case studies* (ed. By F. Dallmeier and J.A. Comiskey). Parthenon Publishing, Paris. pp. 285-309.

Ferreira, L.V. and. Prance, G.T. (1998) Species richness and floristic composition in four hectares in the Jau National Park in upland forests in Central Amazonia. *Biodiversity and Conservation.* **7**: 1349-1364.

Gadgil, M. and Vartak, V.D. (1975) Sacred groves of India - A plea for continued conservation. *J. Bombay Nat. Hist. Soc*. **73**: 623-647.

Hara, M., Hirata, K., Fujihara, M., Oona, K. and Hsich, C.F. (1997) Floristic composition and stand structure of three evergreen broad-leaved forests in Taiwan, with special reference to the relationship between micro-landform and vegetation pattern. *National Historical Research.* **4**: 81-112.

Hughes, J.D. and Chandran, M.D.S. (1998) Sacred groves around the earth: An overview. In *Conserving the Sacred for Biodiversity*. Edited by: Ramakrishnan, P.S, K.G. Saxena and V. Chanderashekara. New Delhi: Oxford and JBH Publishing Co. pp. 869 876.

Kadavul, K. and N. Parathasarathy (1999b) Structure and composition of woody species in tropical semi-evergreen forest of Kalrayan hills, Eastern Ghats, India. *Tropical Ecology*. **40**: 77-90.

Kadavul, K. and Parthasarathy, N. (1999a) Plant biodiversity and conservation of tropical semi-evergreen forest in the Shervarayan hills of Eastern Ghats, India. *Biodiversity and conservation*. **8**: 421-439.

Kershaw, K.A. (1973) Quantitative and dynamic plant ecology (2nd ed.). Edward Amold, London. p. 308.

Khullar, P. (1992) Conservation of biodiversity in natural forest through preservation plots- A historical perspective. *Indian Forester.* **118(5)**: 37-337.

Kulkarni, D.K. and Shindikar, M. (2005) Plant diversity evaluation in Shirkai sacred grove, Pune District, Maharashtra. *Indian Journal of Forestry,* **28(2)**: 127-131.

Magurran, A. (1998) *Ecological diversity and its measurement*. Princeton University press, New Jersy.

McAleece, N. (1997) *Biodiversity professional beta version*. The Natural History Museum and Scottish Association for Marine Science.

Misra, R. (1968) *Ecology work book*. Oxford and IBH Publication. New Delhi. p. 244.

Proctor, J. (1983). Tropical forest litter fall. Problem of data comparison. In: Sutton, S.L., T.C. Whitemore and A.C. Chadwick (eds). *Tropical Rain Forest: Ecology and Management*. Blackwell Scientific Publications, Oxford, U.K. p. 267-273.

Ramakrishnan, P.S. (1997) Conserving the sacred groves for biodiversity: the conceptual frame work. Proceedings of Regional workshop on the role of sacred groves in conservation and management of biological diversity pp 16-34.

Rodgers, W.A. (1994). *Man India.* **74**: 339–348.

Singh, J.S., Singh, S.P., Saxena, A.K. and Rawat, Y.S. (1981) The silent valley forest ecosystem and possible impact of proposed hydroelectric project reports on the silent valley study; Ecology Research Circle, Kumaun University, Nainital. p.69.

Somashekar, S.Y. and Vijayanagara Adhyayanagalu (2001) Kannada Adhyayana, (Kannada) Quarterly Journal, Ed. Rahamath Tarikere Vol. 7, No. 4 (Apr- Jun 2001), Kannada University Hampi, Vidyaranya. pp. 132-146.

Wattenberg, I. and Breekle, S. (1995) Tree species diversity of a premontane rain forest in the Cordillera de Tilaren, Costa Rica. *Biotropica.* **1**: 21-30.

Whitemore, T.C. (1984) Tropical rain forests of the Far East. 2nd edn. Oxford University press, Oxford, U.K. p. 352.