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Research Article

Invasive alien flowering plants of sacred groves vegetation in Kanyakumari district, Tamilnadu, South India

Pepsi, A[1], Celin Pappa Rani J[2], Jeeva, S[2] and Sukumaran, S[1]*

1Department of Botany and Research Centre, Nesamony Memorial Christian College, Marthandam, Kanyakumari District, 629165.
2Department of Botany and Research Centre, Scott Christian College, Nagercoil, Kanyakumari District,629003.
***Email:** sukunmcc@gmail.com

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Abstract

Invasive alien species pose a serious threat to our native biodiversity. A total of 94 alien plant species under 78 genera and 39 families were recorded from the sacred groves of the study area. Leguminosae was the dominant family followed by Euphorbiaceae and Compositae. Herbs (52%) were dominating than the other life forms such as shrubs (25%), trees (17%) and climbers (6%). The recorded Invasive alien plants were from 16 geographical elements in which 49 were from Tropical America. Out of the 94 species, 73% were introduced unintentionally and 27% intentionally. About 73% of the taxa get naturalized, 16% of plants were interfering and 11% of the plants were noxious to the native biodiversity. Most of the plants were used as medicine by the local inhabitants followed by ornamental, edible and so on. The present study was undertaken to inventorisation of the harmful invasive alien species of the sacred groves of Kanyakumari district, Tamilnadu.

INTRODUCTION

Exotic plants are species those were earlier present in other place, but due to intentionally or unintentionally they are introduced in to any new ecosystem and may causes sound effects on that ecosystem. These plants in their new ecosystem are referred to as 'alien' or 'exotic' plants; they normalize the world biota (Mooney and Hobbs, 2000). The International Union for Conservation of Nature and Natural Resources (IUCN) defines "alien invasive species" as an alien species which becomes established in natural or seminatural ecosystems or habitat as agent of change and threatens native biological diversity. They are non native plants become invasive when they are introduced purposely from outside their natural habitats into new areas where they express the capability to establish, invade and struggle along with native species (Randall and Marinelli, 1996; Pant and Sharma, 2010). Once introduced, they colonizes the new habitat and gets naturalized by getting incorporated into residential flora (Gyan *et al*., 2005) They can widely distributed among the all habitat as well as diverse ecosystem throughout the world (Aravindhan and Rajendran, 2014) and therefore they are considered as one of the severe threat to the biodiversity after the habitat destruction (Hobbs and Humphries, 1995). Every year, exotic species become more prevalent, expanding their ranges into areas designated as nature reserves (Cox, 1999). Global climate change may well accelerate the rate of introduction and spread of exotic plants into areas where they were previously absent, or increase their performance relative to indigenous species (Raizada *et al*., 2009).

Invasive alien species can have large damaging economic impacts on human enterprises such as fisheries, agriculture, grazing and forestry (Kannan *et al*., 2013). In a survey of 24 reserves worldwide, all were found to have exotic species, and some reserves harbored more exotic plant species than native species (Usher *et al*., 1988; Fine, 2002).

Many people introduce non-native species into new habitats for economic reasons (Mc Neely, 2001). At least 300,000 (10%) vascular plants have the potential to invade other ecosystems and affect native biota in a direct or indirect way and about 18% of the Indian flora constitutes aliens (Nayar, 1997). There are so many invasive species invading our state by improper industrial and agricultural activities which imbalanced our local ecosystem and become a threat to our native flora. These kinds of human impacts highly declines our native biodiversity (Sukumaran and Parthiban, 2014; Debnath *et al*., 2017). Introduction of these species create a threat to native biodiversity. Even though human depends on these non-native species for food, shelter, medicine ecosystem services, aesthetic enjoyment and cultural identity. Due to these aspects, introduced plants have an impact on native species with respect to household economy and national economy (Pant and Sharma, 2010). Some of the species were also introduced for ornamentation, enhanced economic status and as a medicinal plants, but after a period few of them become invasive on local ecosystem, replace the native vegetation and hampered the ecological structure of naïve one. Numerous studies have been conducted to explore the exotic floristic composition of variousr regions of the India (Mcdougall *et al*., 2011; Khuroo *et al*., 2012; Boro and Sarma, 2013; Das, 2013; Surendra *et al.*, 2013; Udaykumar *et al*., 2014; Debnath *et al*., 2015; Vyankatrao, 2017).

Sacred groves are the reservoirs of native vegetation (Khumbongmayum *et al*., 2006) and have been shown to have a major effect on conservation of ecology and environment due to restrictions associated with them (Anderson *et al*. 2005; Daye and Healey, 2015). They are the ancient means of in situ conservation of genetic diversity and are conserved through social, cultural and environmental values since time immemorial (Sasikala *et al*., 2014). The sacred forests are the last remnants of the native vegetation of the region protected by the villagers of that region (Karthik *et al*., 2015). They are believed to be a treasure trove of medicinal, rare, endangered and endemic species (Rao *et al*., 2015). It act as pristine patches of native biodiversity that are preserved in their original state over centuries due to religious beliefs, taboos and customs which have been followed from generations to generations (Subramanian *et al*., 2016). They are the sites to conserve habitats and serve as sanctuaries for endemic species (Jamir and Pandey, 2003). Sacred groves are relics of the forests that once covered a large part of Western Ghats (Hangarge *et al*., 2016). Invasion of exotic weeds into sacred groves has become a serious problem in the ecological functions. Local biodiversity of these groves are being depleted and further threatened by the domination of exotic weeds (Swamy *et al*., 2003).

Sacred groves of Kanyakumari district support numerous indigenous species and these groves are known as “Kaavu” or “Iyarkaikovilkal” by the local people of the district. Sukumaran and his coworkers carry out several studies on various aspects such as phytodiversity, conservation status, phytogeography, economic status, environmental sustainability, cultural diversity, sthalavrishas, pteridophytic diversity and medicinal plants (Raj and Sukumaran,1997; Sukumaran *et al*., 2006; Sukumaran, 2007a; Sukumaran, 2007b; Sukumaran and Jeeva, 2008; Sukumaran *et al*., 2008; Sukumaran and Raj, 2008; Sukumaran and Raj, 2009; Sukumaran and Raj, 2010: Sukumaran *et al*., 2010; Sukumaran *et al*., 2017). *Tectaria zeilanica* and *Petiveria alliacea* were rediscovered and new distributional record from the sacred groves of the district (Sukumaran *et al*., 2007; Sukumaran and Raj, 2008). But there was no study on exotic plants and its harmful effects. Though these groves are well protected, intrusion of exotic species was increased recently due to various anthropogenic activities and seed dispersal ability yet they were comparatively low when compared with other protected ecosystems. In this view present study aims to document the impact of exotic species in the sacred groves of Kanyakumari district.

MATERIALS AND METHODS

Study area

Kanyakumari District is the southernmost district of Tamilnadu. The district lies between 77° 15' and 77° 36' of the eastern longitudes and 8° 03' and 8° 35' of the northern latitudes. Kanyakumari spreads 1,684 km^2 and has almost all ecosystems such as forests, wetlands, freshwater resources, marine areas and the hills.

Topographically, it has prominent natural features such as richly varied and crowded vegetation, majestic undulating hills with surrounding plains, colorful seashores and plantations which make splendid landscapes (Kiruba *et al*., 2006).

The climate of the district is warm and humid; summer starts from March to May followed by southwest monsoon from June to September. October and November constitute the post-monsoon or retreating monsoon season with frequent thunderstorms. From December to February, northeast monsoon season is confined with rains and rest of the months is generally with bright weather. The mean annual rainfall was 167.64 mm and varied from 70 mm (minimum during February) to 442 mm (maximum – October) for the period of study. However, there is no rainfall in the month of January. The mean monthly temperature varied from a maximum of 32.6°C in the month of May to a minimum of 22.5°C in December. The soil of district is broadly classified into two major groups namely, red and alluvial soils. Red soil is further classified into red loam and sandy soils. Alluvial soil is divided in to coastal and river alluvial soils. The black colour of the forest soil is mainly due to high contents of humus and minerals.

Data Collection

An extensive field survey was undertaken to inventorie the sacred groves of Kanyakumari district during the study period (October 2014 – September 2016). Information about the existence of sacred groves was gathered from hereditary priests and the temple authorities, and various social organizations. With this background information thorough field surveys were carried out by visiting the sacred grove and documenting the exotic plants. Exotic plant species were identified and confirmed by using regional floras of Gamble and Fischer (1915 - 1936), Matthew (1999) and Nayar *et al*. (2014). Citations of the plants were obtained from the database of the plant list (IPNI) (http://www.ipni.org). All the preserved voucher specimens were deposited at Department of Botany and Research Centre, Nesamony Memorial Christian College, Marthandam.

The nativities and modes of introduction of the exotic species were recorded from the published literatures (Matthew, 1969; Sekar, 2012; Khuroo *et al*., 2012; Das, 2013; Debnath *et al*., 2015). Invasive alien species occurring in this region were categorized into Naturalized, Interfering and Noxious based on the literature survey of Srivastava *et al*., 2014 . Self-replacing plant populations by recruitment through seeds and capable of independent growth were categorized as *naturalized*. Alien and native plants which impacted agriculture adversely especially on the disturbed sites were taken as *noxious*. The species which were neither injurious nor noxious but caused profuse interference and hindrance to the growth of crop/native species over a large area by virtue of their vast numbers were taken as *interfering*.

RESULTS AND DISCUSSION

A total of 94 exotic plants were identified from the sacred groves of the study area, the gathered data were presented with botanical name, family, common name, habit, uses, nativity, mode of introduction and categories were tabulated (Table 1). This was15% of the total floristic wealth (613) recorded from the 289 sacred groves of the district (Pepsi, 2017). Nayar (1997) reported that 18% of the Indian flora constitutes alien plants but in the present study only 15% of exotic taxa were enlisted and it was proved that exotic plants invade even the protected areas. It may be due to anthropogenic activities and seed dispersal capacities. Out of 94 plant species recorded, 85 were dicotyledons (35 polypetalae, 33 gamopetalae and 17 monochlamydeae) and 9 were monocotyledons (Table 2), belonged to 78 genera and 39 families. The present work was closely correlated and most of the alien species studied were also reported by the number of workers in various ecosystems of India (Gyan *et al*., 2005; Reddy, 2008; Sekar, 2012; Srivastava *et al*., 2014; Debnath *et al*., 2015).

Table 2. Floristic analysis of the study area

Taxonomic Group	Class	Families	Genus	Species
Dicotyledons				
	Polypetalae	17	28	35
	Gamopetalae	11	29	33
	Monochlamydeae	6	13	17
Monocotyledons		5	8	9

Among the recorded taxa, 39 families and 78 genus were elucidated in which Leguminosae was a dominant family (11 taxa), followed by Euphorbiaceae (9 taxa), Compositae (7 taxa), Solanaceae (5 taxa), Apocynaceae, Convolvulaceae, Malvaceae, and Poaceae with 4 taxa each; Amaranthaceae, Annonaceae and Cactaceae with 3 taxa each; Acanthaceae, Agavaceae, Lamiaceae, Nyctaginaceae, Rubiaceae, Verbenaceae, Asclepidaceae and Capparaceae with 2 taxa each. Twenty families such as Anacardiaceae, Apiaceae, Araceae, Arecaceae, Bombacaceae, Caricaceae, Marantaceae, Onagraceae, Papavaraceae, Passifloraceae, Pedaliaceae, Piperaceae, Polygonaceae, Portulaceae, Scrophulariaceae, Sterculiaceae, Tiliaceae, Ulmaceae, Urticulariaceae and Zygophyllaceae with one taxon each. The present study was also supported by the previous work done by Rao and Murugan (2006). Studies carried out in various parts of India by various workers (Reddy, 2008; Singh *et al*., 2010; Sekar, 2012; Srivastava *et al*., 2014 and Debnath *et al*., 2015) suggested that family Compositae was dominant which was the codominant family in the present study. Genus such as *Annona*, *Ipomoea*, *Jatropha* and *Senna* were the dominating genus of 3 species each. The present study was supported by the previous work of Srivastava *et al*. (2014) and he found out *Ipomoea* was a dominant genera of exotic weeds in North Eastern Uttar Pradesh.

Habitwise distribution describes 49 species (52%) of herbs were dominating because of greater viability and tolerance to harsh conditions which result in the preponderance of herbs across the region (Srivastava *et al*., 2014). Their dominance may be also due to microclimate prevails in the sacred forests favours a good condition for the germination of seeds and its growth. In the present study herbs were followed by shrubs and trees of 23 species (25%) and 17 species (16%). Climbers were in least condition and constitute of about 6 species (6%) (Figure 2).

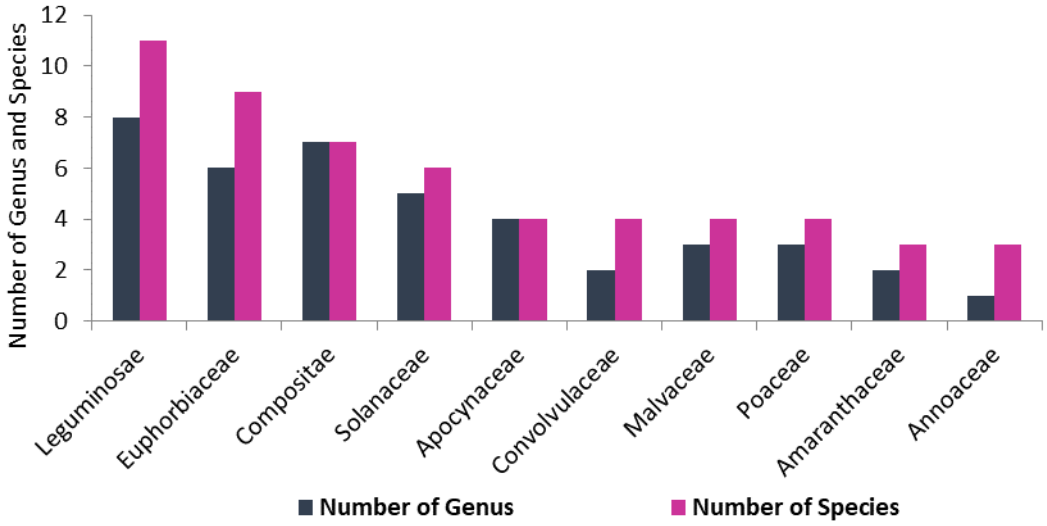

Figure 1. Top ten Families of exotic plants addressed in the study area

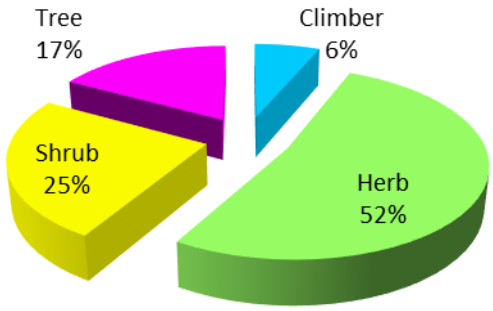

Figure 2. Habitwise distribution of invasive alien plants of the sacred groves

All the 94 non indigenous taxa were categorized into16 geographical elements (nativity) were recorded for the plants studied (Figure 3). Of these 49 were from Tropical America, followed by South America (I3 species), Tropical Africa (7 species), West Indies and Mexico (4 species each), Brazil (3 species), Australia, Central America, China and North America (2 species each) and Africa, America, Pantropics, South East Tropical Asia, Tropical West Africa and Tropical West Asia (1 species each). However the present study was supported by different findings throughout India. Reddy (2008) reported that 74% of exotic plants in India were originated from Tropical America and the same was reported from various states (Singh *et al*., 2010; Srivastava *et al*., 2014; Deshmukh *et al*., 2012; Sekar, 2012; Surendra *et al*, 2013; Debnath *et al*., 2015). Sukumaran (2007a) categorized 329 plant species recorded from 201 sacred groves of this district into 12 geographical elements.

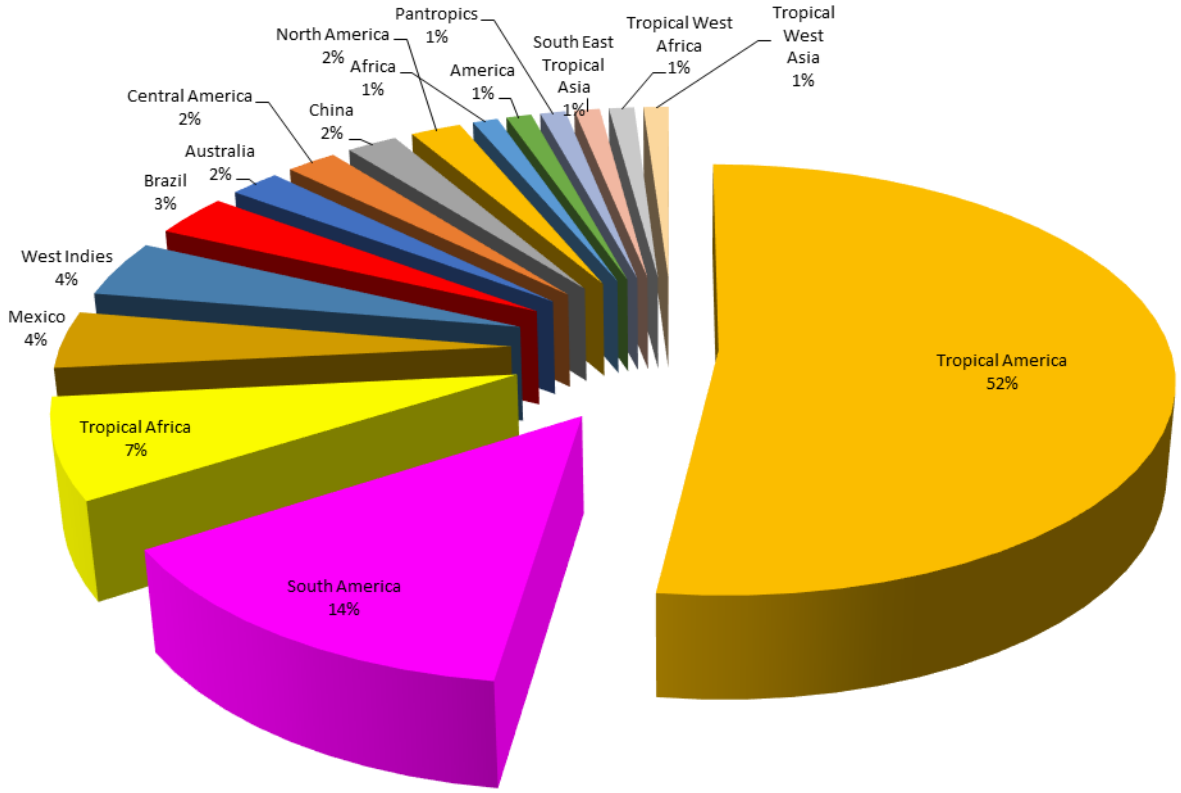

Figure 3. Percentage of geographical distribution of alien plants.

The enlisted taxa were categorized based on their mode of introduction (Sekar, 2012; Debnath *et al*., 2015). Many alien species support our farming and forestry systems in a big way. However, some of the alien species become invasive when they are introduced deliberately or unintentionally outside their natural habitats into new areas where they express the capability to establish, invade and out-compete native species (Raghubanshi, 2005). Sixty nine species were introduced unintentially and 25 of the species were introduced for its beneficial role to man. Even though unintentially introduced alien species flourish well and most of them are useful to mankind (Figure 4). Most of the invasive plants were naturalized (69), 15 were interfering. The following exotic plants such as *Ageratum conyzoides*, *Amaranthus spinosus*, *Antigonon leptopus*, *Argemone Mexicana*, *Axonopus compressus*, *Centrosema pubescens*, *Chromolaena odorata*, *Echinochloa crus-galli*, *Lantana camara* and *Mimosa pudica* were noxious (Figure 5). These noxious alien species were harmful to native species (Singh *et al*., 2010) and some of them are allergic to mankind causing diseses (Tripathi, 1999; Srivastava *et al*., 2014). By utilizing these weeds into manure and fodder their distribution and growth can be controlled. Toxic weed like *Parthenium* can be used as a source of nutrients for crops by converting it into compost and vermicompost (Vyankatrao, 2017).

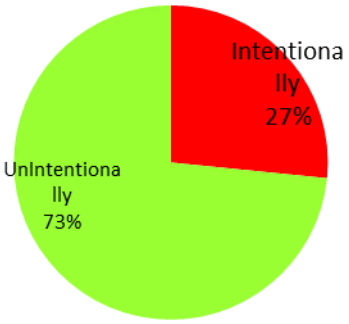

Figure 4. Mode of introduction of invasive species

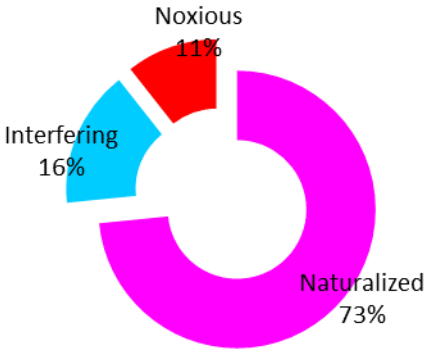

Figure 5. Categories of invasive species of the study area

While interpreting the uses of exotic plant species (Figure 6), most of the plants are used as medicinal (57%) followed by other values such as ornamental (16%), edible (13%), fodder (4%), biofuel (35%), and one species (1%) for green manure (*Gliricidia sepium*), soil binder (*Ludwigia adscendens)*, commercial (*Hevea brasiliensis)* and timber (*Senna siamea)*. The uses of *Gomphrena celosioides*, *Pilea microphylla* and *Pistia stratiotes* were unknown. Even though 10 taxa recorded were noxious they are used as medicine, manure, fodder, etc by the local people.

Conclusion

Sacred groves are the store house of rare, endemic and endangered species, conservation pockets of biodiversity, treasure trove of medicinal plants, genepool for wild relative cultivars, heritage centre for traditional culture and harmony. The native plants of these valuable groves are on the risk of extinction because of the invasion of the alien species. The invasive species cause severe impacts on biodiversity and ecosystem services and they are the serious hindrance to the conservation with significant undesirable impacts on the ecosystems. They can be eradicated largely by physical, chemical, biological and cultural methods (mulching). However these plants are highly resistant and with good regenerative potential they come up with greater vigoursity. So it can be controlled effectively by using it in ecological and economical needs. Researches should be carried out to eradicate these exotic plants and to create awareness from gross root level in rural and urban about these alien plants. So that planting of these alien plants should be largely minimized from the sacred lands and its environs.

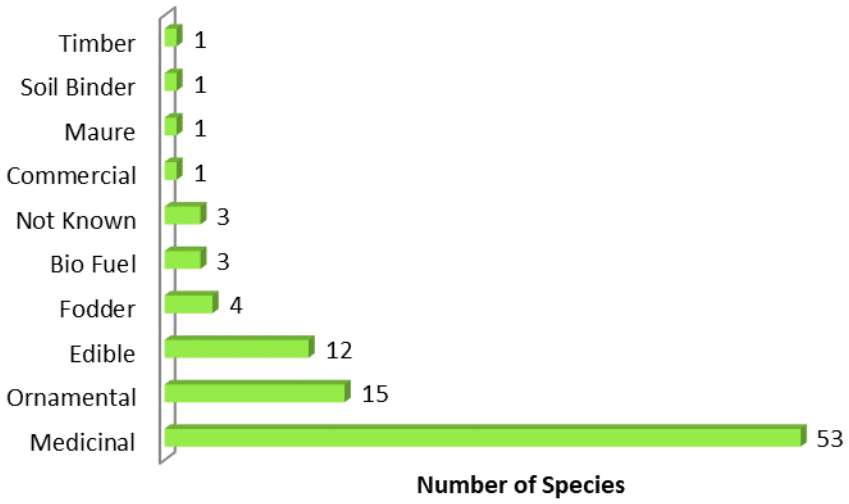

Figure 6. Economic utility of invasive alien plants of the sacred groves.

REFERENCES

Anderson DM, Salick J, Moseley RK and Xiaokun O, 2005. Conserving the sacred medicine mountains: A vegetation analysis of Tibetian sacred sites in Northwest Yunnan. *Biodiversty Conservation*, **14**: 3065-3091.

Aravindhan V and Rajendran A, 2014. Diversity of Invasive Plant Species in Boluvampatti Forest Range, The Southern Western Ghats, India. *American-Eurasian Journal of Agricultural and Environmental Sciences*, **14** (8): 724-731.

Boro A and Sarma GC, 2013. A check list of exotic plants in the Bornadai Wildlife Sanctuary in Assam, India. *Pleione*, **7**(1): 46-51**.**

Cox GW, 1999. Alien species in Northern America and Hawaii. Impacts on Natural ecosystems. Island Press, Washington, D.C., Pp 1-289.

Das AP, 2013. Diversity and distribution of invasive alien plants along the altitudinal gradient in Darjiling Himalaya, India. *Pleione*, **7**(2): 305-313.

Daye DD and Healey JR, 2015. Impact of land-use change on sacred forests at landscape scale. *Global ecology and conservation*, **3**: 349-358.

Debnath A, Paul C and Debnath B, **2017.** Two invasive alien giant sensitive weeds – new additions to the flora of Tripura, India. *Bioscience Discovery*, **8**(4): 720 – 725.

Debnath B, Debnath A and Paul C, 2015. Diversity of invasive plant species in Trishna wildlife Sanctuary, Tripura, Northeast India. *Life Science Leaflets, International Research Journal*, **70**: 9-21.

Deshmukh UB, Shende MB and Rathor OS, 2012. Invasive alien angiosperms of Chandrapur district of Maharastra (India). *Bionano Frontier*, **5**: 2-11.

Fine PVA, 2002. The invasibility of tropical forests by exotic plants. *Journal of Tropical Ecology*, **17**: 687-705.

Gamble JS and Fischer CEC, 1915–1935. Flora of the Presidency of Madras. Vol. I-III, Adlard & Co., London.

Gyan P, Sharma J, Singh S and Raghubanshi S, 2005. Plant ,invasions: Emerging trends and future implications. *Current Science*, **88**(5): 726-734.

Hangarge L, Kulkarni DK, Gaikwad VB, Mahajan, DM and Gunale R, 2016. Plant diversity of sacred groves and its comparative account with surrounding denuded hills from Bhor region of Western Ghats. *Bioscience Discovery*, **7**(2): 121-127.

Hobbs RJ and Humphries SE, 1995. An integrated approach to the ecology and management of plant invasions. *Conservational Biology*, **9**: 761-770.

Jamir SA and Pandey HN, 2003. Vascular plant diversity in the sacred groves of Jaintia hills in Northeast India. *Biodiversity Conservation*, **12**: 1497–1510.

Kannan R, Shackleton CM and Shanker RU, 2013. Playing with the forest: invasive alien plants, policy and protected areas in India. *Current Science*, **104**(9): 1159-1165.

Karthik S, Subramanjan M and Ravikumar S, 2015. Floristic studies on Kilcheruvi (Edaicheruvi) sacred grove at Cuddalore district, Tamilnadu, South India. *International Journal of Current Research in Biosciences and Plant Biology*, **2**(7): 192–205.

Khumbongmayum AD, Khan ML and Tripathi RS, 2006. Biodiversity conservation in sacred groves of Manipur, northeast India: population structure and regeneration status of woody species. *Biodiversity Conservation*, **15**:2439–2456.

Khuroo AA, Reshi ZA, Malik AH, Weber E, Rashid I and Dar DH, 2012. Alien flora of India: taxonomic composition, invasion status and biogeographic affiliations. *Biological Invasions*, **14**(1): 99-112.

Kiruba S, Jeeva S and Dhas SSM, 2006. Enumeration of ethnoveterinary plants of Cope Comorin, Tamil Nadu. *Indian Journal of Traditional Knowledge*, **7**: 576–578.

Matthew KM, 1969. Alien flora of Kodai Kanal and Palni Hills. *Records of Botanical Survey of India*, **20**: 1–241.

Matthew KM, 1999. The Flora of the Palani Hills South India, Vol. 3. The Rapinat Herbarium, Thiruchirapalli, Tamilnadu.

McDougall KL, Khuroo AA, Loope LL, Parks CG, Pauchard A, Reshi ZA, Rushworth I and Kueffer C, 2011. Plant invasion in mountains: global lessons forbetter management. *Mountain Research and Development*, **31**(4): 380-387.

McNeely JA, Mooney HA, Neville LE, Schei P and Waage JK, 2001. A global strategy on invasive Alien species, *In*: *Collaboration With the Global Invasive Species Programme*, IUCN, Gland, Switzerland.

Mooney HA and Hobbs RJ, 2000. Invasive Species in a Changing World. Island Press, Washington, D.C.

Nayar MP, 1997. Changing patterns of the Indian Flora. *Bulletin of Botanical Survey of India*, **19**: 145-154.

Nayar TS, Sibi M and Beegam AR, 2014. Flowering Plants of Western Ghats, India, Volume I & II. Tropical Botanic Garden Research Institute, Palode, Kerala, Pp. 1–1683.

Pant HM and Sharma N, 2010. Inventory of Some Exotic Cultivated Tree Species of Doon Valley and Their Ethnobotanical Uses. *Journal of Medicinal Plants Research*, **4**(20): 2144-2147.

Pepsi A, 2017. Floristic studies of the sacred forests of Kanyakumari District, Tamilnadu, India, Ph.D thesis, Manonmaniam Sundaranar University, Tirunelveli, India. (Unpublished).

Raghubanshi AS, Rai LC, Gaur JP and Singh JS, 2005. Invasive Alien species and biodiversity in India. *Current Science*, **88**(4): 539–540.

Raizada P, Singhj A and Raghubbanshi AS, 2009. Comparative responses of seedlings of selected native dry tropical and alien invasive species to CO_2 enrichment. *Journal of plant ecology*, **2**: 69–75.

Raj ADS and Sukumaran S, 1997. Observations on the sacred groves of south Tamil Nadu. *In*: Abstracts of National Symposium on Natural Resources Management Systems, St. Joseph College, Thiruchirapalli, Tamil Nadu.

Randall JM and Marinelli J, 1996. Invasive plants: Weeds of global garden, Brooklyn Botanical Gardens, New York, Pp 1-111.

Rao DS, Rao VS, Murthy PP, Rao GMN and Rao YV, 2015. Some Ethno medicinal plants of Parnasala sacred grove area Eastern Ghats of Khammam district, Telangana, India. *Journal of Pharmaceutical Sciences and Research*, **7**(4): 210–218.

Rao RR and Murugan R, 2006. Impact of exotic adventives weeds on native biodiversity in India: Implication for conservation. *In*: Invasive Alien Species and biodiversity in India (editors: Rai, LC and Gaur JP) Banaras Hindu University, Varanasi, Pp. 93-109.

Reddy CS, 2008. Catalogue of invasive Alien flora of India. *Life Science Journal*, **5**(2): 84–89.

Sasikala K, Harilal CC and Pradeepkumar G, 2014. Phytosociological Studies of two sacred groves in Mahe, U.T. of Puducherry, India. *Bioscience Discovery*, **5**(2): 154–159.

Sekar KC, 2012. Invasive Alien Plants of Indian Himalayan Region— Diversity and Implication. *American Journal of Plant Sciences*, **3**: 177-184.

Singh KP, Shukla AN and Singh JS, 2010. State-level inventory of invasive alien plants, their source regions and use potential. *Current Sciences*, **99**(1): 1-10.

Srivastava S, Dvivedi A and Shukla RP, 2014. Invasive Alien Species of Terrestrial Vegetation of North-eastern Uttar Pradesh. *International Journal of Forestry Research*, 1-9. Article ID 959875, http://dx.doi.org/10.1155/2014/959875.

Subramanian M, Karthik S, Ravikumar S and Dhamodaran R, 2016. A Study on the Plant Biocultural Diversity of Palrampattu and Vadakanandal Sacred Groves in Villupuram District, Tamil Nadu. *International Journal of Current Research in Biosciences and Plant Biology*, **3**(6): 92–100.

Sukumaran S and Jeeva S, 2008. A floristic study on miniature sacred forests at Agastheeshwaram, Southern peninsular India. *EurAsian Journal of Biosciences*, **2**: 66–72.

Sukumaran S and Parthiban B, 2014. Vascular plant diversity of Udayagiri fort, Kanyakumari district, Tamilnadu, India. *Bioscience Discovery*, **5**(2): 204-217.

Sukumaran S and Raj A.D.S. 2008· *Petiveria alliacea* Linn. (Phytolaccaceae): A new record from sacred groves of Kanyakumari district in Southern Western Ghats. *Journal of economic and Taxonomic Botany*, **32**(3): 595 – 598.

Sukumaran S and Raj ADS, 2009. Enumeration of aquatic and semi-aquatic angiosperms in sacred groves of Kanyakumari district, Southern Western Ghats. *Journal of Economic and Taxonomic Botany*, **33**(1): 26–31.

Sukumaran S and Raj ADS, 2010. Medicinal Plants scared groves in Kanyakumari district, Southern Western Ghats, *Indian Journal of Traditional Knowledge*, **9**(2): 294–299.

Sukumaran S, 2007a. Phytogeographical analysis of the sacred groves of Kanyakumari district, India. *Journal of Theoretical and Experimental Biology*, **3**(4): 171-176.

Sukumaran S, 2007b. Swacred groves as gene pool for Wild Relatives of cultivated plants. Indian *Journal of Botanical Research*, **4**(1): 143-148.

Sukumaran S, Jeeva S and Prasad, MNV, 2010. Sacred forests of South Travancore of South India. *Biological Diversity and Conservation*, **3**(3): 10-14.

Sukumaran S, Jeeva S, Raj ADS and Kannan D, 2008. Floristic Diversity, conservation status and Economical value of miniature sacred groves in Kanyajumari District, Tamil nadu, Southern Peninsular India. *Turkish Journal of Botany*, **3**: 185–199.

Sukumaran S, Jeeva S, Raj ADS and Laloo RC, 2007. Rediscovery of *Tectaria zeilanica* (Tectarioideae)–A rare fern from Vilavancode sacred grove, Southern Western Ghats, India, *Indian Journal of Forestry*, **30**(3): 331-332.

Sukumaran S, Pepsi A and Jeeva S, 2017. A survey on ethnomedicinal plants in the selected sacred of Kanyakumari district, Tamilnadu. *In*: Research practices and Appilication for Sustainable Devolpment (editors: Ponmurugon P, Ramasubramanian V and Marimuthu, T). MacMillan, New Delhi. Pp. 714-723.

Sukumaran S, Raj ADS, Irudayaraj V and Paulraj K, 2006. Enumeration of pteridophytes in the sacred groves of Kanyakumari district-South India, *Indian Fern Journal*, **23:** 45-51.

Surendra B, Muhammed AA, Temam SK and Solomon RAJ, 2013. Invasive Alien Plant Species Assessment in Urban Ecosystem: A Case Study from Andhra University, Visakhapatnam, India. *International Research Journal of Environment Sciences*, **2**(5): 79-86.

Swamy PS, Kumar M and Sundarapandian SM, 2003. Spirituality and ecology of sacred groves in Tamil Nadu, India. *Unasylva*, **54**:53–58.

The Plant List, 2013. Version 1.1. Published on the Internet; (http://www.theplant list.org).

Tripathi S, 1999. Plant diversity of grassland of north-eastern U.P. with emphasis on population of *Parthenium hysterophorus* L. Ph.D.thesis, Gorakhpur University, Gorakhpur, India.

Udaykumar M, Bharathidasan E and Sekar T, 2014. Invasive Alien Flora of Thiruvallur District, Tamil Nadu, India. *Scholars Academic Journal of Biosciences*, **2**(4): 295-306.

Usher MB, Kruger FJ, Macdonald IAW, Loope LL and Brockie RE, 1988. The ecology of biological invasions into nature reserves: an introduction. *Biological Conservation* **44**: 1–8.

Vyankatrao NP, 2017. Conversion of *Parthenium hysterophorus* L. Weed to compost and vermicompost. *Bioscience discovery*, **8**(3): 619 – 627.

Table 1. Check list of Invasive species of the sacred groves of Kanyakumari district.

Botanical Name	Family	Common name	Ha	N	MI	C	U
Acacia mangium Willd	Leguminosae	Hickory Wattle	T	Au	I	Na	M
Acacia mearnsii Willd.	Leguminosae	Merralls Wattle	T	Au	I	Na	O
Acalypha siamensis Oliv.ex Gage.	Euphorbiaceae	Siamese Acalypha	S	TAM	Ui	Na	M
Acanthocereus tetragonus (L.) Hummelinck	Cactaceae	Triangle Cactus	S	SA	Ui	Na	M
Agave cantula (Haw.) Roxb. ex Salm-Dyck	Agavaceae	Cantala Bombay Aloe	H	TAM	Ui	Na	O
Ageratum conyzoides (L.) L.	Compositae	Goat weed	H	TAM	Ui	No	M
Amaranthus spinosus L.	Amaranthaceae	Prickly Amaranth	H	TAM	Ui	No	E
Anacardium occidentale L.	Anacardiaceae	Cashew	T	SAM	I	Na	E
Annona muricata L.	Annoaceae	Soursop	T	TAM	I	Na	E
Annona reticulata L.	Annoaceae	Netted Custard Apple	T	TAM	I	Na	E
Annona squamosa L.	Annoaceae	Custard Apple	T	TAM	I	Na	E
Antigonon leptopus Hook. & Arn.	Polygonaceae	Coral Vine	C	TAM	Ui	No	M
Argemone mexicana L.	Papaveraceae	Mexican Prickly Poppy	H	SAM	Ui	No	M

Axonopus compressus (Sw.) P.Beauv.	Poaceae	Carpet grass	H	NAM	Ui	No	F
Boerhavia erecta L.	Nyctaginaceae	Erect Spiderling	H	NAM	Ui	In	M
Borassus flabellifer L.	Arecaceae	Palmyra palm	T	TAF	Ui	Na	E
Bougainvillea spectabilis Willd.	Nyctaginaceae	Green Bougainvillea	S	B	Ui	Na	O
Brugmansia suaveolens (Humb. & Bonpl. ex Willd.) Bercht. & J.Presl	Solanaceae	Angels Trumpet	S	Mx	Ui	Na	O
Caesalpinia pulcherima (L.) Sw.	Leguminosae	Peacock Flower	S	TAM	I	Na	O
Calotropis gigantea (L.) Dyand	Asclepiadaceae	Crown Flower	S	TAF	Ui	In	M
Calotropis procera (Aiton) Dryand	Asclepiadaceae	Rubber Bush	S	TAF	Ui	In	M
Capsicum annuum L.	Solanaceae	Capsicum	H	TAM	I	Na	E
Carica papaya L.	Caricaceae	Papaya	T	TAM	I	Na	E
Cascabela thevetia (L.) Lippold	Apocynaceae	Mexican Oleander	S	Mx	Ui	Na	O
Cassia fistula L.	Leguminosae	Amaltas	T	P	I	Na	M
Catharanthus roseus (L.) G. Don.	Apocynaceae	Periwinkle	H	TAM	Ui	Na	M
Ceiba pentandra (L.) Gaertn.	Bombacaceae	Kapok	T	TAM	I	Na	M
Centrosema pubescens Benth.	Leguminosae	Spurred Butterfly Tree	C	TAM	I	No	M
Cereus pterogonus Lem.	Compositae	Columnar Cactus	H	TAM	Ui	Na	O
Chloris barbata Sw.	Poaceae	Swollen finger grass	H	TAM	Ui	Na	F
Chromolaena odorata (L.) King and Rob.	Compositae	Siam Weed	H	TAM	Ui	No	M
Cleome gynandra L.	Capparaceae	Wild Spider Flower	H	TAM	Ui	Na	M
Cleome rutidosperma DC.	Capparaceae	Fringed Spider Flower	H	TAM	Ui	Na	M
Croton bonplandianum Baill.	Euphorbiaceae	Bantulasi	H	SAM	Ui	Na	M
Datura metel L.	Solanaceae	Devil's Trumpet	H	TAM	I	In	M
Echinochloa colona (L.) Link	Poaceae	Jungle rice	H	SAM	Ui	In	F
Echinochloa crus-galli (L.) P.Beauv.	Poaceae	Barnyard Grass	H	SAM	Ui	No	F
Eclipta prostrata (L.) L.	Compositae	False Daisy	H	TAM	Ui	Na	M
Emilia sonchifolia (L.) DC. Ex DC	Compositae	Purple Sow Thistle	H	TAM	Ui	Na	M
Epiphyllum oxypetalum (DC.) Haw.	Cactaceae	Queen of the night	S	CAM	Ui	Na	M
Eryngium foetidum L.	Apiaceae	Long Coriander	H	Mx	I	Na	M
Euphorbia hirta L.	Euphorbiaceae	Asthma weed	H	TAM	Ui	Na	M
Euphorbia cyathophora Murray	Euphorbiaceae	Painted Leaf Poinsettia	H	TAM	Ui	In	M
Evolvulus nummularius (L.) L.	Convolvulaceae	Roundleaf Bindweed	H	TAM	Ui	Na	M

Gliricidia sepium (Jacq.) Walp.	Leguminosae	Mexican Lilac	T	SAM	I	Na	Ma
Gomphrena celosioides Mart	Amaranthaceae	Water globe head	H	TAM	Ui	Na	NK
Gomphrena globosa L.	Amaranthaceae	Gomphrena	H	A	Ui	Na	O
Hevea brasiliensis (Willd. ex A.Juss.) Mull.Arg.	Euphorbiaceae	Rubber	T	B	I	Na	Co
Hibiscus rosa-sinensis L.	Malvaceae	Shoe flower	S	C	Ui	Na	M
Hibiscus schizopetalus (Dyer) Hook.f.	Malvaceae	Japanese Hibiscus	S	TAF	Ui	Na	O
Hyptis suaveolens (L.) Poit.	Lamiaceae	American Mint	H	TAM	Ui	In	M
Ipomoea alba L.	Convolvulaceae	Moon Vine	C	TAM	Ui	Na	E
Ipomoea carnea Jacq.	Convolvulaceae	Bush Morning Glory	C	TAM	Ui	In	O
Ipomoea obscura (L.) Ker. Gawl.	Convolvulaceae	Obscure Morning Glory	C	TAF	Ui	In	M
Ixora coccinea L.	Rubiaceae	Ixora Pink	S	C	Ui	Na	O
Jatropha curcas L.	Euphorbiaceae	Physic Nut	S	TAM	I	Na	BF
Jatropha gossypiifolia L.	Euphorbiaceae	Bellyache Bush	S	TAM	Ui	Na	BF
Jatropha podagrica Hook.	Euphorbiaceae	Australian Bottle plant	S	TAM	I	Na	O
Justicia gendarussa Burm. F.	Acanthaceae	Gandarussa	S	TWAs	Ui	Na	M
Lantana camara L.	Verbenaeae	Lantana	S	TAM	Ui	No	M
Ludwigia adscendens (L.) H. Hara	Onagraceae	Water Primerose	H	TAM	Ui	Na	Sb
Malvaviscus arboreus Cav.	Malvaceae	Sleeping Hibiscus	S	TAM	Ui	Na	O
Maranta arundinacea L.	Marantaceae	West Indian Arrowroot	H	Mx	I	Na	E
Mimosa pudica L.	Leguminosae	Touch Me Not	H	B	Ui	No	M
Ocimum americanum L.	Lamiaceae	Hoary Basil	H	TAM	Ui	Na	M
Opuntia dillenii (Ker Gawl.) Haw.	Cactaceae	Prickly Pear	S	TAM	Ui	Na	M
Passiflora foetida L.	Passifloraceae	Love in a Mist	C	SAM	I	In	E
Pedalium murex L.	Pedaliaceae	Large Calotrops	H	TAM	Ui	Na	M
Peperomia pellucida (L.) Kunth	Piperaceae	Shiny Bush	H	SAM	Ui	Na	M
Physalis minima L.	Solanaceae	Ground Cherry	H	TAM	Ui	Na	M
Physalis angulata L.	Solanaceae	Cutleaf Ground Cherry	H	TAM	Ui	Na	M
Pilea microphylla (L.) Liebm.	Urticulaceae	Gunpowder Plant	H	SAM	Ui	Na	NK
Pistia stratiotes L.	Araceae	Water Cabbage	H	TAM	Ui	In	NK
Plumeria rubra L.	Apocynaceae	Common White Frangipani	T	TAM	Ui	Na	O
Portulaca oleracea L.	Portulacaceae	Pursiane	H	TAM	I	Na	M
Rauvolfia tetraphylla L.	Apocynaceae	Wild Snake Root	H	WI	I	Na	M

Ricinus commUis L.	Euphorbiaceae	Castor Bean Plant	S	SAM	Ui	In	BF
Ruellia tuberosa L.	Acanthaceae	Minnie Root	H	TAM	Ui	Na	M
Sansevieria trifasciata Prain.	Agavaceae	Snake Plant	H	TWAf	I	Na	O
Scoparia dulcis L.	Scrophulariaceae	Sweet Broom Weed	H	TAM	Ui	Na	M
Senna alata (L.) Roxb.	Leguminosae	Candle Bush	S	WI	Ui	Na	M
Senna occidentalis (L.) Link	Leguminosae	Coffee Senna	S	SAM	Ui	Na	M
Senna siamea (Lam.) H.S.Irwin &Barneby	Leguminosae	Siamese Cassia	T	SETAs	I	Na	Ti
Solanum torvum Sw.	Solanaceae	Turkey Berry	S	WI	Ui	In	M
Spermacoce hispida L.	Rubiaceae	Indian Pavetta	H	TAM	Ui	In	M
Stachytarpheta jamaicensis (L.) Vahl	Verbenaceae	Blue Porter Weed	H	TAM	Ui	Na	M
Synedrella nodiflora (L.) Gaertn.	Compositae	Cinderella Weed	H	WI	Ui	Na	M
Tamarindus indica L.	Leguminosae	Tamarind	T	TAF	I	Na	E
Trema orientalis (L.) Blume	Ulmaceae	Charcoal Tree	T	Af	Ui	Na	M
Tribulus terrestris L.	Zygophyllaceae	Puncture Vine	H	TAM	Ui	Na	M
Tridax procumbens (L.) L.	Compositae	Tridax Daisy	H	CAM	Ui	Na	M
Triumfetta rhomboidea Jacq.	Tiliaceae	Burr Bush	H	TAM	Ui	Na	M
Urena lobata L.	Malvaceae	Caesar weed	H	TAF	Ui	In	M
Waltheria indica L.	Sterculiaceae	Sleepy Morning	H	TAM	Ui	Na	M

Ha - Habit: C – Climber; H – Herb; S – Shrub; T-Tree.
N – Nativity: A – America; Af - Africa; Au – Australia; B – Brazil; CAM – Central America; Ch – China; Mx – Mexico; P – Pantropics; SAM – South America; SETA – South East Tropical Asia; TAF – Tropical Africa; TAM – Tropical America; TWAf – Tropical West Africa; TWAs – Tropical West Asia; WI – West Indies. **MI- Mode of Introduction:** I – Intentionally; Ui – Unintentionally.
C – Categories: In – Interfering; Na – Naturalized; No – Noxious.
U – Uses: E – Edible; O – Ornamental; F – Fodder; M – Medicinal; Ma – Manure; NK – Not Known; Sb – Soil binder; Ti – Timber.

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