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Regeneration Status of *Pterocarpus santalinus* L.f. (Red Sanders) Dominated Tropical Dry Deciduous Forest of Eastern Ghats in Andhra Pradesh, India

Pendela Surath Kumar [a++*], Sudhakar Reddy Chintala [b#], Swapnendu Pattanaik [c†] and M. Chiranjeeva Reddy [d‡]

[a] Department of Forest Ecology & Environment, Institute of Forest Biodiversity, Hyderabad, India.
[b] Forest Biodiversity and Ecology Division, National Remote Sensing Centre, Hyderabad, India.
[c] Forest Genetic & Tree Breeding Division, IFB, Hyderabad, India.
[d] Department of Silviculture and Agro Forestry, FCRI, Mulugu, Telangana, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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[++] Ph.D. Research Scholar;
[#] Scientist SG & Head;
[†] Scientist-G;
[‡] Assistant Professor & Head;
**Corresponding author: E-mail: 94skss@gmail.com;*

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ABSTRACT

Tropical dry deciduous forest regeneration dynamics are essential markers of biodiversity and ecological health. This study assesses the regeneration state of tree species in the Rajampet range, identifying a variety of patterns impacted by both natural and man-made influences. The study documented a total of 1391 adult individuals, 617 saplings, and 1646 seedlings from 67 species. *Pterocarpus santalinus* and *Chloroxylon swietenia*, two dominant species, showed "fair" regeneration potential, while *Phyllanthus emblica* and *Azadirachta indica* showed "good" regeneration potential. Nevertheless, a few species showed no regeneration, such as *Bauhinia racemosa* and *Albizia amara*. Overall Rajampet range regeneration is classified as 32.31 percent of species as "fair," 9.28 percent as "new," 15.38 percent as having "good" regeneration, and 43.08 percent as lacking.

Keywords: Regeneration; biodiversity; ecological health; dominant.

1. INTRODUCTION

The nature of a dry deciduous forest community's and species diversity greatly depends on its regeneration potential as well as the level of biotic pressure it faces. The regeneration status of the vegetation reflects the health of the forest ecosystem (Yadav et al., 2019). The regeneration status was studied based on seedlings, saplings, and adult population (Fayiah et al., 2018). Globally, tropical dry deciduous forests are rich in biodiversity and have distinctive characteristics (Gentry, 1995; Medina, 1995). It is the ability of a species to complete the life cycle (Singh et al., 2016) that is crucial to the existence of species in a community under variable environmental conditions (Khumbongmayum et al., 2005). Any species' regeneration depends on a specific range of habitat conditions that determine its geographic distribution (Grubb, 1977). For both ecologists and foresters, it is crucial to understand how forest tree species regenerate (Silk et al., 2003). The biotic and abiotic factors affect forest regeneration (Yadav et al., 2017; McDonald et al*.,* 2010; Grubb, 1977). Viability of forest population rapidly changed due to environmental changes (Condit et al., 1996; Stork, 2010), local habitat characters (Chaturvedi et al., 2012), and community composition (Sagar et al., 2008), while insects, disease, herbivores, and competing vegetation will also influence forest regeneration (Ward et al., 2006).

2. METHODOLOGY

The present investigation was carried out in the tropical dry deciduous forest of Kadapa district, Andhra Pradesh, India. The study site includes the Rajampet Forest Range (28202.37 ha) forest stand, which has diverse vegetation attributes and is representative of the region's vegetation. The area is situated at 14.19543°N latitude and 79.15847°E longitude. The study region reflects a tropical climate with an average temperature of 19^0 C (January) to 36^0 C (May). The total average annual precipitation is about 1045 mm. It grows very well on dry, hilly, often rocky ground and prefers mostly lateritic and gravelly soil (Purkayastha, 1996). The forests are mostly tropical (i.e., dry deciduous, dry deciduous scrub, and moist deciduous) over the entire region (Champion and Seth, 1968). The stratified random sampling was done and laid out on a 31.62 m x 31.62 m plot in the study area. A total of 34 quadrats were laid out for regeneration data collection in the Rajampet range. The trees were measured within the main plot (22.36 m x 22.36 m), and the girth at breast height (GBH) of individuals was measured at species level. Subplots of 3 m x 3 m size were laid out 30 m from the middle of the main plot of 0.1 ha in all four directions to collect samples for regeneration. Individuals of all species encountered in each quadrate were counted and their girth measured. Individuals with ≥30 cm girth (gbh) were considered adults. Saplings with ≥10 cm to < 30 cm girth and seedlings with < 10 cm girth were identified. The status of the regeneration of species was determined based on the population size of seedlings, saplings, and adults, following a modification of the method used by Khumbongmayum et al*.* (2006), Shankar (2001), and Khan et al*.* (1987).

(a) Good regeneration, if seedlings > saplings > adults;
(b) Fair regeneration, if seedlings > or ≤ saplings ≤ adults;
(c) Poor regeneration, if a species survives only in sapling stage, but no seedlings (though saplings may be < or > adults);

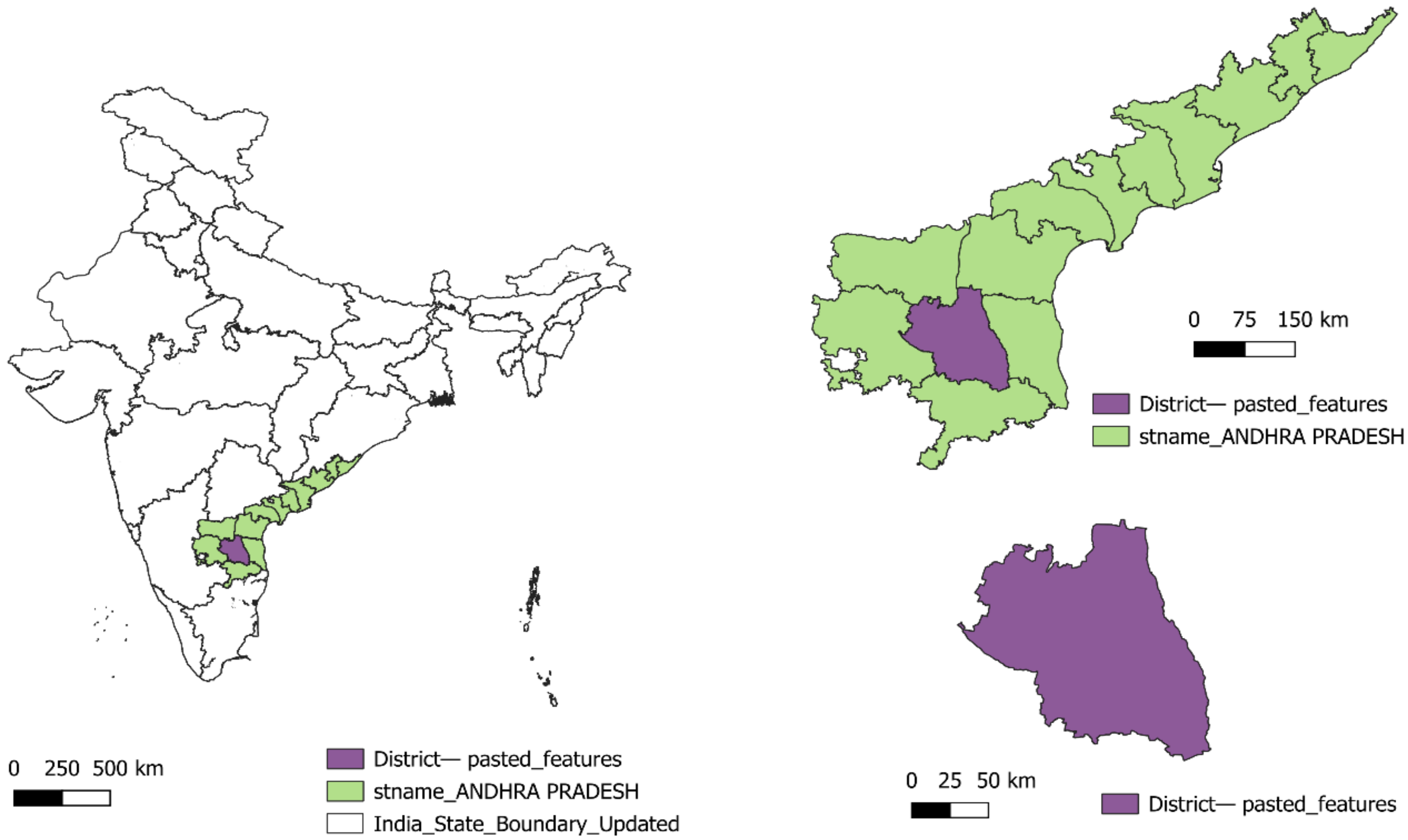

Fig. 1. location map of study area, Kadapa district

(d) None, if it is absent both in sapling and seedlings stages, but found only in the adults

(e) New, if a species has no adults, but only saplings and/or seedlings.

3. RESULTS

Tree regeneration status estimates for the Rajampet range: Species-wise tree regeneration status for Rajampet range is presented in Table 1. A total of 1646 seedlings, 617 saplings and 1391 adults belonging to 61 species were recorded in the Rajampet range. The forest was mainly dominated by Red sanders and their associates. The regeneration status of Rajampet range can be described having 15.38%, 32.31%, 9.28 and 43.08 of total species recorded as good, fair, new and no regeneration (Fig. 2) respectively. The regeneration status of tree species in the Rajampet range presents a varied pattern, with several species demonstrating significant regeneration potential, while others exhibit limited or no regeneration. Based on the number of individuals with respect to seedling, sapling, and adults counts in the sample quadrats laid out throughout the Rajampet range, *Pterocarpus santalinus* a key species in the region, shows substantial regeneration with 382 seedlings, 142 saplings, and 280 adult individuals, classifying its regeneration as "Fair." Similarly, *Chloroxylon swietenia* displays a robust regeneration trend, with 221 seedlings, 82 saplings, and 180 adults, also categorized as "Fair." Species such as *Anogeissus latifolia*, *Hardwickia binata*, and *Strychnos nux-vomica* contribute to the overall fair regeneration status, each showing moderate numbers of juveniles and mature individuals. On the contrary, species like *Albizia amara*, *Cassine glauca*, and *Bauhinia racemosa* demonstrate no regeneration, as no seedlings or saplings were observed. Notably, *Azadirachta indica*, *Lagerstroemia parviflora*, and *Phyllanthus emblica* exhibit "Good" regeneration, indicating better recruitment and future population sustainability. The overall regeneration status of the tree community in the Rajampet range is assessed as "Fair," with certain dominant species thriving, while others face challenges in recruitment and regeneration.

Table 1. Tree regeneration status recorded for the Rajampet range

Sl.no	Scientific name	Seedlings	Saplings	Adults	Regeneration Interpretation
1	*Albizia amara*	0	0	2	None
2	*Albizia odoratissima*	0	0	3	None
3	*Anogeissus latifolia*	124	65	138	Fair
4	*Azadirachta indica*	5	0	1	Good
5	*Bauhinia racemosa*	0	0	3	None
6	*Bredelia montana*	5	2	0	New
7	*Bridelia retusa*	8	0	2	Good
8	*Buchanania axillaris*	16	9	22	Fair
9	*Butea monosperma*	3	0	0	New
10	*Canthium didymum*	0	0	5	None
11	*Cassia fistula*	9	3	17	Fair
12	*Cassine glauca*	0	0	2	None
13	*Chloroxylon swietenia*	221	82	180	Fair
14	*Cleistanthus collinus*	0	0	4	None
15	*Croton scabiosus*	32	11	27	Fair
16	*Dalbergia latifolia*	0	0	4	None
17	*Dalbergia paniculata*	18	10	18	Fair
18	*Diospyros chloroxylon*	0	0	5	None
19	*Diospyrous melanoxylon*	11	0	3	Good
20	*Dolichandrone atrovirens*	104	55	76	Fair
21	*Dolichandrone falcata*	0	0	9	None
22	*Drypetes sepiaria*	0	0	2	None
23	*Ehretia Laevis*	0	0	1	None
24	*Erythroxylum monogynum*	0	0	8	None
25	*Ficus amplissima*	0	0	2	None
26	*Ficus glomerata*	0	0	7	None
27	*Gardenia gummifera*	98	26	45	Fair
28	*Gardenia resinifera*	13	4	21	Fair
29	*Givotia moluccana*	0	0	9	None

Sl.no	Scientific name	Seedlings	Saplings	Adults	Regeneration Interpretation
30	*Givotia rottleriformis*	14	5	8	Fair
31	*Grewia americanus*	0	0	6	None
32	*Grewia orbiculata*	96	32	48	Fair
33	*Gyrocarpus assiaticus*	0	0	8	None
34	*Hardwickia binata*	86	28	56	Fair
35	*Ixora pavetta*	0	0	8	None
36	*Lagerstroemia parviflora*	7	3	2	Good
37	*Lannea coromandelica*	12	0	17	Fair
38	*Limonia acidisima*	0	0	2	None
39	*Madhuca longifolia var. latifolia*	0	0	3	None
40	*Mallotus philippensis*	6	5	0	New
41	*Mangifera indica*	2	4	0	New
42	*Manilkara hexandra*	0	0	9	None
43	*Mimosa prainlana*	23	9	32	Fair
44	*Mitragyna parviflora*	4	2	0	New
45	*Phyllanthus emblica*	14	13	2	Good
46	*Plecospermum spinosum*	0	0	10	None
47	*Polyalthia cerasoides*	0	0	5	None
48	*Pongamia pinnata*	3	0	8	Fair
49	*Psydrax dicoccos*	0	0	2	None
50	*Pterocarpus marsupium*	14	5	27	Fair
51	*Pterocarpus santalinus*	382	142	280	Fair
52	*Pterospermum xylocarpum*	0	0	11	None
53	*Randai spinosa*	6	0	4	Good
54	*Semecarpus anacardium*	0	0	3	None
55	*Soymida febrifuga*	8	5	12	Fair
56	*Strychnos nux-vomica*	39	11	18	Fair
57	*Strychnos potatorum*	93	13	26	Fair
58	*Syzygium alternifolium*	52	21	62	Fair
59	*Syzygium cumini*	7	4	0	New
60	*Terminalia alata*	0	0	28	None
61	*Terminalia chebula*	12	6	9	Fair
62	*Terminalia pallida*	17	11	9	Good
63	*Terminalia tomentosa*	0	0	11	None
64	*Uvaria tomentosa*	13	8	4	Good
65	*Wrightia tinctoria*	25	0	18	Good
66	*Ziziphus glabrata*	15	7	18	Fair
67	*Ziziphus xylopyrus*	29	16	11	Good
	Overall total	**1646**	**617**	**1391**	**Fair**

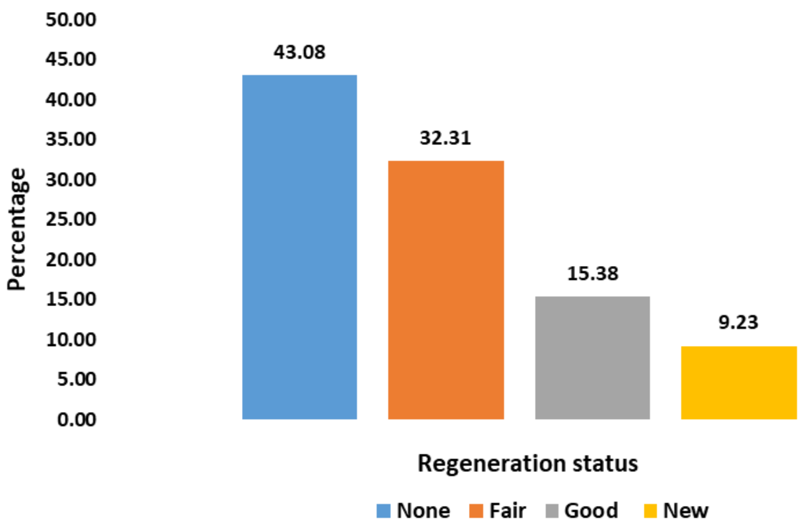

Fig. 2. Regeneration status estimates for Rajampet Range

4. DISCUSSION

Red Sanders (*Pterocarpus santalinus*) and *Chloroxylon swietenia* are the only species to have shown significant regeneration, while other species have shown good, fair, or no regeneration. Forest health and sustainability depend on a mix of species with different regeneration potentials in tropical regions (Jones et al., 1994). Similarly to Rajampet, studies of Chhattisgarh's Sal forests show that dominant species can regenerate strongly (Abhishek Raj, 2018), suggesting that major canopy species promote a stable community structure. However, some species in the Rajampet range, like *Albizia amara* and *Cassine glauca*, exhibit no regeneration. This is similar to other studies that found certain species largely restricted to the tree stage without seedlings or saplings, possibly due to biotic pressures and limited resources (Fayiah et al., 2018; Mishra et al., 2013). Factors influencing regeneration, including canopy gaps, soil nutrient availability, light density, and biotic pressures, are well documented (Prakasham et al., 2016; Chaubey and Sharma, 2013; Singh et al., 2021). For instance, heavy grazing, fire, and soil nutrient depletion have adversely impacted seedling establishment in the Western Ghats (Murthy et al., 2002). In Rajampet, such factors may similarly affect species with no regeneration, suggesting the need for protective measures to support species with limited recruitment.

This limited regeneration is common in tropical forests, where anthropogenic pressures like grazing and fire impact juvenile growth and seedling establishment (Murthy et al., 2002; Saberwal, 1995). Furthermore, tropical dry forests often exhibit a "reverse J-shaped" distribution, indicative of continual recruitment for some species but not all, leading to a future shift in species composition (Subashree et al., 2020). In Rajampet, species like *Azadirachta indica* and *Phyllanthus emblica* exhibit "good" regeneration, suggesting promising recruitment similar to the oak-dominated forests of Garhwal Himalaya, where significant regeneration efforts for certain key species are advised due to concerns over long-term sustainability (Sing et al., 2016).

5. CONCLUSION

The regeneration condition of tropical forests, such as the Rajampet range, highlights the significance of ecological elements in determining the health of forests. Resilient ecosystems and biodiversity depend on effective management that encourages natural regeneration. Addressing environmental issues and encouraging sustainable activities can ensure the long-term health and balance of these essential ecosystems.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

Abhishek, R. (2018). Population structure and regeneration potential of Sal dominated tropical dry deciduous forest in Chhattisgarh, India. *Tropical Plant Research, 5*(3), 267–274.

Champion, H. G., & Seth, S. K. (1968). *A revised survey of the forest types of India*. Government of India Publication, New Delhi, India.

Chaturvedi, R. K., Raghubanshi, A. S., & Singh, J. S. (2012). Effect of grazing and harvesting on diversity, recruitment and carbon accumulation of juvenile trees in tropical dry forests. *Forest Ecology Management, 284*, 152–162.

Chaubey, O. P., & Sharma, A. (2013). Population structure and regeneration potential of Sal (*Shorea robusta* Gaertn. f.) and its associates in Sal Bearing Forests of Satpura Tiger Reserve. *International Journal of Bioscience and Biotechnology, 5*(6), 63–70.

Condit, R., Hubbell, S. P., & Foster, R. B. (1996). Changes in tree species abundance in a neo tropical forest: Impact of climate change. *Journal of Tropical Ecology, 12*, 231–256.

Fayiah, M., Singh, S., Mengesha, Z., & Chen, B. (2018). Regeneration status and species diversity of a mixed dry deciduous forest: A case of Barah forest, Jabalpur, Madhya Pradesh, India. *Indian Journal of Tropical Biodiversity, 26*(1), 17–29.

Gentry, H. A. (1995). Diversity and floristic composition of neotropical dry forests. In

Bullock, S. H., Harold, A. M., & Medina, E. (Eds.), *Seasonally dry tropical forests* (pp. 147–192). Cambridge University Press, Cambridge.

Grubb, P. J. (1977). The maintenance of species richness in plant communities: The importance of the regeneration niche. *Biological Reviews, 52*, 107–145.

Jones, R. H., Sharitz, R. R., Dixon, P. M., Segal, D. S., & Schneider, R. L. (1994). Woody plant regeneration in four floodplain forests. *Ecological Monographs, 64*(3), 345–367.

Khan, M. L., Rai, J. P. N., & Tripathi, R. S. (1987). Population structure of some tree species in disturbed and protected sub-tropical forests of North-East India. *Acta Oecologica, 8*(3), 247–255.

Khumbongmayum, A. D., Khan, M. L., & Tripathi, R. S. (2005). Survival and growth of seedlings of a few tree species in the four sacred groves of Manipur, Northeast India. *Current Science, 88*, 1781–1788.

Khumbongmayum, A. D., Khan, M. L., & Tripathi, R. S. (2006). Biodiversity conservation in sacred groves of Manipur, Northeast India: Population structure and regeneration status of woody species. *Biodiversity and Conservation, 15*, 2439–2456.

McDonald, M. A., McLaren, K. P., & Newton, A. C. (2010). What are the mechanisms of regeneration post-disturbance in tropical dry forest? *Environmental Evidence.*

Medina, E. (1995). Neotropical dry forests. In Bullock, S. H., Mooney, H. A., & Medina, E. (Eds.), *Seasonally dry tropical forests* (pp. 146–194). Cambridge University Press, Cambridge.

Mishra, A. K., Bajpai, O., Sahu, N., & Kumar, A. (2013). Study of plant regeneration potential in tropical moist deciduous forest in Northern India. *International Journal of Environment, 2*, 153–161.

Murthy, I. K., Murali, K. S., Hegde, G. T., Bhat, P. R., & Ravindranath, N. H. (2002). A comparative analysis of regeneration in natural forest and joint forest management plantations in Uttara Kannada District Western Ghats. *Current Science, 83*, 1358–1364.

Prakasham, U., Meshram, P. B., Khatri, P. K., Singh, S., & Singh, J. (2016). Influence of canopy gap on regeneration of Sal (*Shorea robusta*) in borer affected area of Dindori Forest Division, Madhya Pradesh. *Indian Journal of Tropical Biodiversity, 24*(1), 1–7.

Purkayastha, S. K. (1996). *A manual of Indian timbers*. Sribhumi Publishing Company, Calcutta, India.

Saberwal, V. K. (1995). Pastoral politics: Gaddi grazing, degradation and biodiversity conservation in Himachal Pradesh, India. *Conservation Biology, 10*, 741–749.

Sagar, R., Raghubanshi, A. S., & Singh, J. S. (2008). Comparison of community composition and species diversity of understorey and overstorey tree species in a dry tropical forest of northern India. *Journal of Environmental Management, 88*(4), 1037–1046.

Shankar, U. (2001). A case of high tree diversity in a Sal (*Shorea robusta*) dominated lowland forest of eastern Himalaya: Floristic composition, regeneration and conservation. *Current Science, 81*(7), 776–786.

Singh, S., Chand, H. B., Khatri, P. K., Kumar, D., Kewat, A. K., Kumar, A., & Singh, K. P. (2021). Phytosociology and regeneration status in different permanent preservation plots across different forest types in Madhya Pradesh, Central India. *Grassroots Journal of Natural Resources, 4*(2), 179–198.

Singh, S., Malik, Z. A., & Sharma, C. M. (2016). Tree species richness, diversity, and regeneration status in different oak (*Quercus* spp.) dominated forests of Garhwal Himalaya, India. *Journal of Asia-Pacific Biodiversity, 9*, 293–300.

Slik, J. W. F., Kebler, P. J. A., & Van Welzen, P. C. (2003). *Macaranga* and *Mallotus* species (Euphorbiaceae) as indicators for disturbance in the mixed lowland dipterocarp forest of east Kalimantan (Indonesia). *Ecological Indicators, 2*, 311–324.

Stork, N. E. (2010). Reassessing extinction rates. *Biodiversity Conservation, 19*, 357–371.

Subashree, K., Dar, J. A., Karuppusamy, S., & Sundarapandian, S. (2021). Plant diversity, structure and regeneration potential in tropical forests of Western Ghats, India. *Acta Ecologica Sinica, 41*(4), 259–284.

Ward, J. S., Worthley, T. E., Smallidge, P. J., & Bennett, K. P. (2006). *Northeast forest regeneration handbook: A guide for forest owners, harvesting practitioners, and public officials*. USDA Forest Service, Newton Square, PA.

Yadav, D. K., & Jhariya, M. K. (2017). Tree community structure, regeneration and patterns of diversity in natural and plantation forest ecosystem. *Research in Environment and Life Science, 10*(4), 383–389.

Yadav, D. K., Jhariya, M. K., & Ghosh, L. (2019). Vegetation inter-relationship and regeneration status in tropical forest stands of Central. *Journal of Plant Development Sciences, 11*(3), 151–159.

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