

## FLORISTIC COMPOSITION AND DIVERSITY IN THE FOREST FRAGMENTS OF DRY AND MOIST TROPICAL FOREST

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**Abstract:** The stand attributes in terms of structure and diversity across the forest fragments by forest types have been poorly investigated previously. Therefore, in the present investigation stand attributes i.e., floristic composition, structure and diversity of vegetation growing into two different forest types viz., dry tropical forest (DTF) and moist tropical forest (MTF) of the Chhattisgarh, India is examined. By using field data, collected through random sampling techniques from forest fragmented landscape in the dry and moist forests of Chhattisgarh, India, we were able to visualize the effects and influence on tropical forests. We observed changes in species composition, stand structure and diversity of concerned forest types. The most diverse families were Leguminosae (10), Anacardiaceae (7), Euphorbiaceae (4), Combretaceae (3), Myrtaceae (3), Rhamnaceae (3), Rubiaceae (2) and Rutaceae (2). In the present study a total of 8120 trees ha<sup>-1</sup> in all the forest sites representing 50 species and 23 families were encountered. The total density of trees varied from 390-2130 trees ha<sup>-1</sup>, being highest in DTF I while least in MTF II. The diversity indices values reflected that Shannon index recorded for various forest fragments ranged from 2.39-3.62, equitability from 0.75-1.25, species richness from 2.65-6.61, beta diversity from 6.02-20.0 and concentration of dominance from 0.12-1.0, respectively. The present reports highlights the sites conditions for phytosociological attributes at stand levels, which may enriched the information towards sustainable strategies, plan and management of these resource in addition to conservation priority.

**Keywords:** Biomass, C stock, Diversity, Forest fragments, Structure, Tropical forest

### REFERENCES

- Alexander, H.M., Foster, B.L., Ballantyne, F. IV, Collins, C.D., Antonovics, J. and Holt, R.D. (2012). Metapopulations and metacommunities: combining spatial and temporal perspectives in plant ecology. *J Ecol*, 100:88–103.
- Alone, R.A. (2014). Biomass, carbon stock and carbon sequestration in an age series of teak plantation in tropical environment. Ph.D. Thesis, I.G.K.V., Raipur (C.G.), 240 p.
- Aksins (1995). Speciation among tropical forest trees: some deductions in light of recent evidence. *Biol J Linn Soc*, 1:155-196.
- Apguaua, D.M.G., Pereira, R.M., Santos, G.C.O., Menino, G.G., Pires, M.A.L.F. and Dyp, T.N.G. (2015). Floristic Variation within Seasonally Dry Tropical Forests of the Caatinga Biogeographic Domain, Brazil, and Its Conservation Implications. *Int For Rev*, 17(S2):33.
- Arisdason, W. and Lakshminarasimhan, P. (2016). Status of Plant Diversity in India: An Overview. [http://www.bsienviis.nic.in/Database/Status\\_of\\_Plant\\_Diversity\\_in\\_India\\_17566.aspx](http://www.bsienviis.nic.in/Database/Status_of_Plant_Diversity_in_India_17566.aspx).
- Armesto, J.J., Mitzel, J.D. and Villagram, C. (1986). A comparison of spatial patterns of trees in some tropical and temperate forests. *Biotropica*, 18:1-11.
- Baisya, R., Barik, S.K. and Upadhyay, K. (2009). Distribution pattern of above ground biomass in natural and plantation forests of humid tropics in NE-India. *Tropical Ecology*, 50(2):295-304.
- Bargali, S.S., Pandey, V.P. and Bargali, K. (2014). Floral composition and diversity pattern in open and closed dry deciduous forest. *Vegetos*, 27(2):149-157.
- Bhat, D.M., Naik, M.B., Patagar, S.G., Hegde, G.T., Kandade, Y.G., Hegde, G.N., Shastri, C.M., Shetti, D.M. and Furtado, R.M. (2000). Forest dynamics in tropical rain forests of Uttara Kannada district in Western Ghats, India. *Current Science*, 79:975-985.
- Bihn, J.H., Verhaagh, M., Brandle, M. and Brandl, R. (2008). Do secondary forests act as refuges for old growth forest animals? Recovery of ant diversity in the Atlantic forest of Brazil. *Biol Conserv*, 141:733-743.
- Black, G.A., Dobzhansky, T. and Pavan, C. (1950). Some attempts to estimate species diversity and population density of trees in Amazonian forests. *Bot Gaz*, 111:413-425.
- Borah, N., Nath, A.J. and Das, A.K. (2013). Aboveground biomass and carbon stocks of tree species in tropical forests of Cachar districts, Assam, Northeast India. *International Journal of Ecology and Environment Sciences*, 39(2):97-106.
- Cairns, M.A., Haggerty, P.K., Alvarez, R., De Jong, B.H.J. and Olmsted, I. (2000). Tropical Mexico's recent land use and change: a region's

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contribution to the global carbon cycle. *Ecological Applications*, 10:1426-1441.

**Cairns, M.A., Olmsted, I., Granados, J. and Argaez, J.** (2003). Composition and aboveground tree biomass of a dry semi-evergreen forest on Mexico's Yucatan peninsula. *Forest Ecology and Management*, 186:125-132.

**Champion, H.G. and Seth, S.K.** (1968), *A revised Survey of the Forest Types of India*. Government of India Publication, New Delhi.

**Chauhan, D.S., Singh, B., Chauhan, S., Dhanai, C.S. and Todaria, N.P.** (2010). Regeneration and plant diversity of natural and planted sal (*Shorea robusta* Gaertn.F.) forests in the Terai Bhabhar of Sohagibarwa Wildlife Sanctuary, India. *J. American Science*, 6(3):32-45.

**Collinge, S.K.** (2009). *Ecology of fragmented landscapes*. Johns Hopkins University Press, Baltimore.

**Collins, C.D., Holt, R.D. and Foster, B.L.** (2009). Patch size effects on plant species decline in an experimentally fragmented landscape. *Ecology*, 90:2577-2588.

**Curtis, J.T. and McIntosh, R.P.** (1950). The interrelations of certain analytic and synthetic phytosociological characters. *Ecology*, 31:434-455.

**Devagiri, G.M., Money, S., Singh, S., Dadhawal, V.K., Patil, P., Khaple, A. and Hubballi, S.** (2013). Assessment of above ground biomass and carbon pool in different vegetation types of south western part of Karnataka, India using spectral modeling. *Tropical Ecology*, 54(2):149-165.

**Gairola, S., Sharma, C.M., Ghildiyal, S.K. and Suyal, S.** (2011). Live tree biomass and carbon variation along an altitudinal gradient in moist temperate valley slopes of the Garhwal Himalaya (India). *Current Science*, 100(10):1-9.

**Gandiwa, P., Finch, J. and Hill, T.** (2016). Vegetation structure and composition in the semi-arid Mapungubwe Cultural Landscape. *Glob J Environ Sci Manag*, 2(3):235-248.

**Haddad, N.M., Brudvig, L.A., Clobert, J., Davies, K.F., Gonzalez, A., Holt, R.D., Lovejoy, T.E., Sexton, J.O., Austin, M.P., Collins, C.D., Cook, W.M., Damschen, E.I., Ewers, R.M., Foster, B.L., Jenkins, C.N., King, A.J., Laurance, W.F., Levey, D.J., Margules, C.R., Melbourne, B.A., Nicholls, A.O., Orrock, J.L., Song, D.X. and Townshend, J.R.** (2015). Habitat fragmentation and its lasting impact on Earth's ecosystems. *Sci Adv*, 1:e1500052.

**Hoover, C.M., Leak, W.B. and Keel, B.G.** (2012). Benchmark carbon stocks from old growth forests in Northern New England, USA. *Forest Ecology and Management*, 266:108-114.

**Jha, C.S.** (1990). Land use and vegetation analysis of dry tropical forest region. Ph.D. Thesis, Banaras Hindu University, Varanasi, India.

**Jha, C.S. and Singh, J.S.** (1990). Composition and dynamics of dry tropical forest in relation to soil texture. *J Veg Sci*, 1:609-614.

**Jhariya, M.K.** (2010). Analysis of vegetational structure, diversity and fuel load in fire affected areas of tropical dry deciduous forests in Chhattisgarh. M.Sc. Thesis, I.G.K.V., Raipur (C.G.), 86 p.

**Jhariya, M.K., Bargali, S.S., Swamy, S.L. and Kittur, B.** (2012). Vegetational Structure, Diversity and Fuel Load in Fire Affected Areas of Tropical Dry Deciduous Forests in Chhattisgarh. *Vegetos*, 25(1):210-224.

**Jhariya, M.K., Bargali, S.S., Swamy, S.L., Kittur, B., Bargali, K. and Pawar, G.V.** (2014). Impact of forest fire on biomass and Carbon storage pattern of Tropical Deciduous Forests in Boramdeo Wildlife Sanctuary, Chhattisgarh. *Int J of Ecol Environ Sci*, 40(1):57-74.

**Jhariya, M.K.** (2014). Effect of forest fire on microbial biomass, storage and sequestration of carbon in a tropical deciduous forest of Chhattisgarh. Ph.D. Thesis, I.G.K.V., Raipur (C.G.), 259 p.

**Jhariya, M.K. and Yadav, D.K.** (2016). Understorey Vegetation in Natural and Plantation Forest Ecosystem of Sarguja (C.G.), India. *Journal of Applied and Natural Science*, 8(2):668-673.

**Jhariya, M.K.** (2017a). Vegetation ecology and carbon sequestration potential of shrubs in tropics of Chhattisgarh, India. *Environmental Monitoring and Assessment*, 189(10): 1-15. 518, <https://doi.org/10.1007/s10661-017-6246-2>.

**Jhariya, M.K.** (2017b). Influences of Forest Fire on Forest Floor and Litterfall in Boramdeo Wildlife Sanctuary (C.G.), India. *Journal of Forest and Environmental Science*, 33(4):330-341.

**Jhariya, M.K. and Yadav, D.K.** (2018). Biomass and carbon storage pattern in natural and plantation forest ecosystem of Chhattisgarh, India. *Journal of Forest and Environmental Science*, 34(1):1-11. DOI: 10.7747/JFES.2018.34.1.1.

**Jhariya, M.K., Banerjee, A., Meena, R.S. and Yadav, D.K.** (2019). Sustainable Agriculture, Forest and Environmental Management. Springer Nature Singapore Pte Ltd., 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore. eISBN: 978-981-13-6830-1, Hardcover ISBN: 978-981-13-6829-5. DOI: 10.1007/978-981-13-6830-1. Pp. 60.

**Kagezi, G.H., Kaib, M., Nyeko, P, Bakuneeta, C., Schadler, M., Stadler, J. and Brandl, R.** (2016). Impacts of land-use intensification on litter decomposition in western Kenya. *Web Ecol*, 16:51-58.

**Khurana, P.** (2007). Tree layer analysis and regeneration in tropical dry deciduous forest of Hastinapur. *Indian Forester*, 16(1):43-50.

**Krishnamurthy, Y.L., Prakasha, H.M., Nanda, A., Krishnappa, M., Dattaraja, H.S. and Suresh, H.S.** (2010). Vegetation structure and floristic composition of a tropical dry deciduous forest in Bhadra Wildlife Sanctuary, Karnataka, India. *Trop Ecol*, 51(2):235-246.

- Kumar, A., Jhariya, M.K., Yadav, D.K. and Banerjee, A.** (2017). Vegetation Dynamics in Bishrampur Collieries of Northern Chhattisgarh, India: Eco-restoration and Management Perspectives. *Environmental Monitoring and Assessment*, 189(8), DOI: 10.1007/s10661-017-6086-0.
- Kumar, J.I.N., Kumar, R.N., Bhoi, R.K. and Sajish, P.R.** (2010). Tree species diversity and soil nutrient status in three sites of tropical dry deciduous forest of western India. *Tropical Ecology*, 51(2):273-279.
- Laurance, W.F.** (1999). Ecology and management of fragmented tropical landscapes - introduction and synthesis. *Biol Conserv*, 91:101-107.
- Lieberman, D.** (1979). Dynamics of forest and thicket vegetation on the Accra plains, Ghana. Ph.D. Thesis, University of Ghana, Legon.
- Majumdar, K. and Datta, B.K.** (2015). Vegetation types, dominant compositions, woody plant diversity and stand structure in Trishna Wildlife Sanctuary of Northeast India. *J Env Bio*, 36:409-418.
- Metzker, T., Sposito, T.C., Martins, M.T.F., Horta, M.B. and Garcig, Q.S.** (2011). Forest dynamics and carbon stocks in Rio Doce state park an Atlantic rainforest hotspot. *Current Science*, 100(12):1855-1862.
- Mohanraj, R., Saravanan, J. and Dhanakumar, S.** (2011). Carbon stock in Kolli forests, Eastern Ghat (India) with emphasis on aboveground biomass, litter, woody debris and soil. *Forest Biogeosciences and Forestry*, 4, 61-65.
- Murphy, P.G. and Lugo, A.E.** (1986a). Ecology of tropical dry forest. *Annual Review of Ecology and Systematics*, 17, 67-88.
- Murphy, P.G. and Lugo, A.E.** (1986b). Structure and biomass of a subtropical dry forest in Puerto Rico. *Biotropica*, 18:89-96.
- Mutiso, F.M., Mugo, M.J., Cheboiwo, J., Sang, F. and Tarus, G.K.** (2015). Floristic Composition, Affinities and Plant Formations in Tropical Forests: A Case Study of Mau Forests in Kenya. *Int J Agric For*, 5(2):79-91.
- Naidu, M.T. and Kumar, O.A.** (2016). Tree diversity, stand structure, and community composition of tropical forests in Eastern Ghats of Andhra Pradesh, India. *J Asia Pac Biodivers*, 9:328-334.
- Nascimento, H.E.M. and Laurance, W.F.** (2002). Total aboveground biomass in central Amazonian rainforests: a landscape-scale study. *Forest Ecology and Management*, 168(1/3):311-321.
- Nilroung, S.** (1986). Structural characteristics, Rate of Gap Formation and Turnover Rate in Dry Dipterocarp Forest at Sakaerat. M.Sc. Thesis, Kasetsart University (in Thai).
- Nobel, I.R. and Dirzo, R.** (1997). Forests as human-dominated ecosystems. *Science*, 277:522-525.
- Oraon, P.R., Singh, L. and Jhariya, M.K.** (2014). Variations in Herbaceous Composition of Dry Tropics Following Anthropogenic Disturbed Environment. *Current World Environ*, 9(3):967-979.
- Oraon, P.R., Singh, L. and Jhariya, M.K.** (2015). Shrub Species Diversity in Relation to Anthropogenic Disturbance of Boramdeo Wildlife Sanctuary, Chhattisgarh. *Environment and Ecology*, 33(2A):996-1002.
- Panda, P.C., Mahapatra, A.K., Acharya, P.K. and Debata, A.K.** (2013). Plant diversity in tropical deciduous forests of Eastern Ghats, India: A landscape level assessment. *Int J Biodivers Conserv*, 5(10):625-639.
- Pande, P.K. and Patra, A.K.** (2010). Biomass and productivity in Sal and miscellaneous forests of Satpura plateau (Madhya Pradesh) India. *Advances in Bioscience and Biotechnology*, 1:30-38.
- Pawar, G.V., Singh, L., Jhariya, M.K. and Sahu, K.P.** (2014). Assessment of Diversity along the Disturbance Gradient in Dry Tropics of Chhattisgarh, India. *The Ecoscan*, 8(3-4):225-233.
- Phillips, E.A.** (1959). *Methods of Vegetation Study*. Holt R and Winston, New York USA. 105 p.
- Pimm, S.L. and Raven, P.** (2000). Biodiversity: extinction by numbers. *Nature*, 403:843-845.
- Prasad, R. and Pandey, R.K.** (1992). An observation on plant diversity of Sal and teak forest in relation to intensity of biotic impact of various distances from habitation in Madhya Pradesh, A case study. *Journal of Tropical Forestry*, 8(1):62-83.
- Puyravaud, J.P., Davidar, P. and Laurance, W.F.** (2010). Cryptic loss of India's native forests. *Conserv Lett*, 3(6):390-394.
- Ramirez-Marcial, N., Gonzalez-Espinosa, M. and Williams-Linera, G.** (2001). Anthropogenic disturbance and tree diversity in montane rain forest in Chiapas, Mexico. *For Ecol Manage*, 154:311-326.
- Rawat, V.S.** (2012). Litter fall and soil nutrient returns in community managed forest in Lamgara block of Uttarakhand. *Nature and Science*, 10(12):38-42.
- Richards, P.W.** (1996). *The tropical rainforest*. 2<sup>nd</sup> ed. Cambridge Univ. Press, Cambridge.
- Richards, P.W.** (2002). Composition of primary rain forest (II). In: Chazdon, R.L., Whitmore, T.C. (Eds.) *Foundations of Tropical Forest Biology*. The University of Chicago Press, Chicago and London, pp. 538-544.
- Rodgers, W.A.** (1990). A preliminary ecological survey of Algal spring Sariska Tiger Reserve, Rajasthan. *Journal of Bombay Natural History Society*, 87:201-209.
- Sagar, R. and Singh, J.S.** (1999). Species diversity and its measurement. *The Botanica*, 49:9-16.
- Sagar, R. and Singh, J.S.** (2003). Predominant phenotypic traits of disturbed tropical dry deciduous forest vegetation in northern India. *Community Ecology*, 4:63-71.
- Sahunalu, P., Chamrenpruk, M., Puriyakorn, B., Dhanmanonda, P., Suwannapin, W. and Prachaiya, B.** (1979). Structure of three forest types

in the Prom Basin, Chaiyaphum province. Forest Research Bulletin No. 63, Faculty of Forestry, Kasetsart University (in Thai).

**Sharma, C.M., Baduni, N.P., Gairola, S., Ghildiyal, S.K. and Suyal, S.** (2010). Tree diversity and carbon stocks of some major forest types of Garhwal Himalaya, India. *Forest Ecology and Management*, 260(12):2170-2179.

**Singh, J.S.** (2002). The biodiversity crisis: a multifaceted review. *Current Science*, 82:638-647.

**Singh, J.S., Saxena, A.K. and Rawat, Y.S.** (1984). India's silent valley and its threatened rain forests ecosystem. *Environmental Conservation*, 11:223-233.

**Singh, L. and Singh, J.S.** (1991). Species structure, dry matter dynamics and carbon flux of a dry tropical forest in India. *Annals of Botany*, 68:263-273.

**Singh, L., Yadav, D.K., Pagare, P., Lekha, G. and Thakur, B.S.** (2009). Impact of land use changes on species structure, biomass and carbon storage in tropical deciduous forest and converted forest. *International Journal of Ecology and Environmental Sciences*, 35(1):113-119.

**Singh, P. and Dash, S.S.** (2014). Plant Discoveries 2013 – New Genera, Species and New Records. Botanical Survey of India, Kolkata.

**Smiet, A.C.** (1992). Forest Ecology on Java: human impact and vegetation of montane forest. *J Trop Ecol*, 8:129-152.

**Sundarapandian, S. and Karoor, P.J.** (2013). Edge effects on plant diversity in tropical forest ecosystems at Periyar Wildlife sanctuary in the Western Ghats of India. *J Forest Res*, 24(3):403-418.

**Swamy, S.L.** (1998). Estimation of net primary productivity (NPP) in an Indian tropical evergreen forest using Remote Sensing data. *Ph.D. Thesis*, Jawaharlal Nehru Technology University, Hyderabad.

**Tang, J.W., Yin, J.X., Qi, J.F., Jepsen, M.R. and Lu, X.T.** (2012). Ecosystem carbon storage of tropical forests over limestone in Xishuangbanna, SW China. *Journal of Tropical Forest Sciences*, 24(3):399-407.

**Thakur, T. and Swamy, S.L.** (2012). Analysis of land use, diversity, biomass, C and nutrient storage of a dry tropical forest ecosystem of India using satellite remote sensing and GIS techniques. In: Proceedings of the 15<sup>th</sup> International Forestry and Environment Symposium, 15:273- 278.

**Thinh, N.V., Mitlohner, R. and Bich, N.V.** (2015). Comparison of floristic composition in four sites of a tropical lowland forest on the North-Central Coast of Vietnam. *J Nat Sci*, 1(8):144.

**Tiwari, A.K.** (1994). Mapping forest biomass through digital processing of IRS-1A data. *International Journal of Remote Sensing*, 15(9):1849-1866.

**Thokchom, A. and Yadava, P.S.** (2013). Biomass and carbon stock assessment in the sub-tropical forests of Manipur, North-East India. *International Journal of Ecology and Environment Science*, 39(2):107-113.

**UNEP** (2001). India: State of the Environment - 2001. United Nations Environment Programme.

**Visaratana, T., Pitprecha, K., Kiratiprayoon, S., Kampan, T. and Higuchi, K.** (1986). Structural characteristics and species composition of dry Dipterocarp forest (*Dipterocarpus tuberculatus* Roxb. Community type) at Salak Phra Wildlife Sanctuary. Technical Paper No. 10 Forest Ecology Section, FRd (in Thai).

**Wu, J.G.** (2013). Key concepts and research topics in landscape ecology revisited: 30 years after the Allerton Park workshop. *Landsc Ecol*, 28:1-11.

**WWF** (2002). Forest management outside protected areas. World Wildlife Fund (WWF), Gland, Switzerland.

**Yadav, D.K. and Jhariya, M.K.** (2017). Tree Community Structure, Regeneration and Patterns of Diversity in Natural and Plantation Forest Ecosystem. *Research in Environment and Life Sciences*, 10(4):383-389.

**Yadav, D.K., Ghosh, L. and Jhariya, M.K.** (2017). *Forest Fragmentation and Stand Structure in Tropics: Stand Structure, Diversity and Biomass. Lap Lambert Academic Publishing*. Heinrich-Bocking-Str. 6-8, 66121, Saarbrücken, Germany. Pp. 116. ISBN: 978-3-330-05287-1.

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

**Yadava, P.S.** (2010). Soil and vegetation carbon pool and sequestration in the forest ecosystem of Manipur, NE India. Pages 163-170, In: Qasim SZ, Goel M. (Editors) CO<sub>2</sub> Sequestration Technology for Clean Energy. Daya Publication House, New Delhi.