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ASSESSMENT OF FLORISTIC COMPOSITION AND BIOLOGICAL SPECTRUM OF FOREST VEGETATION IN THAKURMUNDA, MAYURBHANJ, ODISHA, INDIA

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ABSTRACT

The assessment of forest vegetation in Thakurmunda, located within the Mayurbhanj district of Odisha, reveals a diverse ecosystem typically characterised as Northern Tropical Dry Deciduous, Tropical Moist Deciduous and Semi-evergreen forest. Thakurmunda falls under the Karanjia Forest Division, where vegetation is heavily influenced by the presence of *Shorea robusta* (Sal). The floristic structure of forests in this region is defined by several Dominant Species. *Shorea robusta* is the primary tree species, often contributing over 40% of the total tree density. Common tree diversity associates include *Terminalia alata* (Asan), *Pterocarpus marsupium* (Piasal), *Madhuca indica* (Mahua), and *Diospyros melanoxylon* (Kendu). Comprises various shrubs and herbs, with families like Poaceae, Asteraceae, and Fabaceae showing high species richness. Based on Raunkiaer's life-form classification, the biological spectrum of the region's forest vegetation typically exhibits a Phanero-therophytic represent the highest percentage in forested areas (often >40–55%), reflecting the perennial woody nature of the climax vegetation. Therophytes are annuals and highly prevalent (often ~30%), particularly in disturbed sites or during the rainy season, indicating anthropogenic pressure or seasonal dry periods. Chamaephytes & Geophytes are generally show lower percentages compared to phanerophytes but contribute significantly to the ground-level biodiversity. This study aimed-to examine the floristic composition and biological spectrum of the region for classifies the plant species based on their life forms and with conservation of biodiversity.

***Key words*:** Species richness, Floristic composition, Biological Spectrum, Life-form, Biodiversity

Introduction

Forests are complex and dynamic ecosystems that support a wide range of plant species. Each plants playing a unique role in maintaining ecosystem balance and providing ecosystem services. All the life on the earth including human beings is directly or indirectly dependent on plants in many ways like food, cloth, shelter, medicines, etc. Besides, the forest products, it also provides the large habitation to various life form that from small insect to the large organisms and they are mutually dependent. However, increasing in human activities leads to degradation of ecosystem and floristic wealth (Mohanta and Sahu, 2021). Habitat fragmentation is the major threats for present extinction of species (Wilcox and Murphy, 1985). In India the rural population is about 68.8% of the country dependent on forest products. They worship the plants and believe that their God and ancestors spirits resides in the forest. They collect the forest products like dry leaves, fallen woods, small timber yielding plant, nuts, bamboo etc. which constitute the main source of income for them (Mathur and Soni, 1990). The floristic composition and biological spectrum of forest vegetation are essential components in understanding the structure and functioning of forest ecosystems. Floristic composition refers to the diversity and types of plant species present within a forest, encompassing trees, shrubs, and other plant life. It reflects the ecological conditions, climate, soil types and disturbances influencing species distribution.

It also aids in the identification of rare or endangered species and the understanding of plant community dynamics. Biological spectrum analysis categorizes plants according to their morphological and functional traits, offering a clearer understanding of vegetation structure and the predominant growth forms within a forest.

Plant species diversity is complex in nature and its structure and composition differs from place to place because of varying climatic condition and topography (Raturi, 2012). Compared to the other ecosystems, tropical forest ones, the most complex of all the terrestrial ecosystems are harshly exploited ecosystems of the biosphere (Bahuguna, 1999). It covers 7 % of the earth's land surface, but harbours more than half of the world's plant and animal biodiversity (Wilson, 1988). Despite its direct services for sustainable human life, they are disappearing at an overall rate of 0.8 to 2 % per year (May and Stumpf, 2000) and particularly dry deciduous forests are the most disturbed and least protected ecosystems on the earth (Murphy and Lugo, 1986). Even with a national policy aimed at conserving and improving nature, biodiversity is still decreasing. In addition to eutrophication, acidification and desiccation; habitat destruction, deforestation, human settlements, globalization, agricultural expansion, and other infrastructure related to development over the last century have accelerated the rapid decline of tropical forests throughout the world, which in turn bring about negative impacts on biodiversity, climate change, ecological services, soil productivity and the livelihoods of forest dwelling as well as rural people (Myers, 1992; Raghubanshi and Tripathi, 2009). Biodiversity has become the issue of global attention because of growing awareness of its importance on the one hand as ecosystem energy and on the other hand it allows building complex tropical networks and functions as insurance for ecosystem stability and resilience (Gaston and Spicer, 2004). The health of ecosystems, especially in mountainous regions, is closely allied to its plant biodiversity (Schafer, 2011) and vegetation classification is therefore the first step towards ecosystem conservation. Such studies may become a vital tool in the estimation of the level of adaptation to the environment and their ecological significance (Pascal and Pelissier, 1996).

Floristic studies have been carried out in various regions worldwide, reflecting the natural wealth and biodiversity of different ecosystems. These studies provide essential insights into the plant diversity of an area, highlighting the richness of species present and their roles in maintaining ecological balance. By documenting plant species, their distribution patterns, and biological spectrum, floristic studies contribute significantly to our understanding of biodiversity and environmental health. As pressures on natural ecosystems grow, such ecological assessments become ever more critical for sustainable conservation and management efforts.

Inventorying of floristic diversity is the baseline study for the exploration, conservation, sustainable use, and management of the biodiversity elements and monitor changes over the passage of time (Stork, 1995). The floristic diversity displayed by the vegetation of a particular region depends upon the climate and related environmental conditions. The life form spectra, leaf size and other phenotypic features reflect the existing ecological conditions and operative evolutionary processes, and thus can be used as a robust indicator for assessing the ecological health of a particular region. For example, the dominant life form represents the way plants have evolved in that region. Likewise, the leaf size reflects the day and night temperatures, rainfall and solar radiation of the area. Thus, life form and leaf size spectra are significant physiognomic features that are supposed to be the signals of the micro and macro-climate of a region (Shimwel, 1971). Similarly, the phenology, which refers to the timing of plant life-cycle events, is related to periodic weather and changes in the soil conditions of a particular place (Rathcke, 1985). The phenological attributes of the flora help in understanding the patterns of climatic and cyclic reproductive changes of the plant species (Lechowicz, 2001). Unravelling the patterns of these ecological traits can significantly improve our understanding on the functional aspects of flora of a particular region.

The floristic composition of a forest refers to the diversity and types of plant species present within a forest, encompassing trees, shrubs, herbs, and other plant life. It reflects the ecological conditions, climate, soil types and disturbances influencing species distribution. The floristic composition of any area gives us essential information about different plant species diversity and their distribution. It leads to the proper identification of plant species and there by conservation in a scientific and systematic way. The distribution of plant species is a valuable source of information for environmental factors and ecosystem services in a particular habitat. Floristic diversity is used to interpret plant species of any geographical area, whether cultivated or wild in their nature. The presence of all plant species found in a particular area is termed flora while vegetation is related to the importance of plant species, their life and leaf form, population, and distribution in relation to the space and time. Floristic inventory can help us to understand the features of vegetation

characteristics and it is important for human existence, economic health, ecosystem function, and stability.

The different forest products like food, timber, fuel has major role in biodiversity conservation, ecological balance, global warming, sustainable development etc. Now a day's increase in population that leads to decrease in agricultural and forest areas (Malik and Dhanda, 2003). The importance of forest and trees influence the rainfall and water supply. Different types of wild forest foods have great contribution to dietary diversity, increase the nutrition density of local diets. Forests and trees also provide the fuel wood. Forests provide the ecosystem services that essential for the sustainability in global agriculture.

The decrease in forest diversity is too serious environmental problem to the entire globe (Hare *et al*., 1997). Various processes that occur in the ecosystem become imbalanced which ultimately change the climate and this loss resulted in decline of economic development. Different types of environmental problems like global warming, air pollution, water pollution, soil pollution and irregular biogeochemical cycles occurs due to forest degradation and large number of species are extinct and destruction of their habitats. Thus, there is need of conservation of forest for sustainability of future generation as they provide a diverse range of resources (Power and Rothkar, 2015).

Floristic study gives the data of all the plant varieties in a given geographical region for protection and maintenance of forest and sustainable development. It is important for consolidated data of flora at regional level (Mohanta and Sahu, 2021). Floristic study measured at any level from global diversity to ecosystem, community, species population and essential for the preparation of local floras of urban areas. There are different factors that influence the existing vegetation in a region (Kar, 2024). Numerous floristic studies have been conducted across different ecological zones in Odisha, India, reflecting the region's rich and varied plant biodiversity. These studies span diverse habitats including forests, aquatic ecosystems, urban areas, and sacred groves, with a focus on species diversity, ecological classification, invasive species, and conservation value.

Kar *et al*., (2010) documented 36 species revealed that the therophytes percentage was found to be highest (30.55%) followed by chamaephytes (27.78%), hemicryptophytes (25%) and geophytes (16.67%) in a grassland community of Rangamatia in the District of Mayurbhanj, Odisha. The sacred groves as biodiversity reservoirs were explored by Panda *et al*., (2014) in Koraput district. Their study identified 94 species from 43 families, many of which had medicinal (39%) and religious (23%) significance. Despite their conservation value, several species were found under various threat categories, indicating the vulnerability of these traditional conservation systems. In the context of forest ecosystems, Sahoo *et al*., (2020) investigated tree species composition in the tropical moist deciduous forests of the Eastern Ghats. They recorded 5451 trees across 101 species, observing a decline in tree density and basal area with increasing human disturbance. A shift from trees in undisturbed areas to herbs in highly disturbed forests highlighted the impact of anthropogenic pressures.

Similarly, Dash *et al*., (2020) assessed the semi-evergreen forests in Hadagarh Sanctuary, reporting 68 species from 30 families, including significant dominants like *Azadirachta indica* and *Shorea robusta*. This baseline study emphasized the urgent need for management interventions to restore and sustain vegetation under threat from human activities. Panda *et al*., (2020) conducted a comprehensive floristic survey in Bhadrak district, Odisha, documenting 277 weed species from 198 genera and 65 families. The dominant families were Asteraceae, Poaceae, and Fabaceae, with the flora being primarily composed of forbs (50.5%). Life-form analysis revealed therophytes as the dominant class (48.7%). This study also highlighted the ethnobotanical uses of many weed species, reflecting local knowledge and utility.

Expanding on the aquatic ecosystem, Panda (2022) identified 167 plant species, including 38 hydrophytes and 129 species from moist habitats in the same district. Notably, species like *Eichhornia crassipes*, *Ipomoea aquatica*, and *Centella asiatica* were common across habitats. Therophytes again dominated (41.9%), followed by hydrophytes and chamaephytes. This research provided insight into the ecosystem services and management needs of aquatic and marshland flora. Focusing on urban flora, Mallik *et al*., (2023) documented 146 monocotyledonous species in and around Rourkela city. The Poaceae and Cyperaceae families were most prominent, with high utility in food, fodder, and medicine. This study contributes to the ongoing efforts to complete the Flora of Sundargarh district and broader state-level inventories. Kar (2025) assessed 40 species belonging to 33 genera, grouped under 15 families. Among them 12 species were grasses and 28 were non- grasses in a grassland community of Khariar in the District of Nuapada, Odisha.

The biological spectrum categorizes plants based on their life forms, which are determined by the position and

protection of their perennating buds (the parts of the plant that survive unfavorable periods). The classes are: Phanerophyte, Chamaephyte, Hemicryptophyte, Cryptophyte (Geophyte, Helophyte, Hydrophyte) and Therophyte has been established by Raunkiaer, (1934), a Danish ecologist.. The life form system of categorising plants is based primarily on the methods, by which plants survive the unfavourable season.

The reviewed literature suggested that many floristic surveys in Odisha have been carried out on specific areas including the protected areas. However, the information shows floristic survey in village areas often receives less attention as compared to other renowned forest areas. This can be a concern because these areas harbour significant biodiversity and are crucial for local livelihood and ecological function.

Materials and Methods

Study area

Thakurmunda block in the Mayurbhanj district is located close to the Southern region of Similipal National Park. The area is situated between 21° 302 54"N latitude to 86° 092 07"E longitude (Fig. 1). The region experiences a tropical climate, with minimum temperature 10°C to maximum temperature 40°C. Typically the rainy season runs from June to September with an average rainfall of 1500 mm. The topography of Thakurmunda block plays a significant role in shaping its flora. The region consists of valley forest, hills and open low land vegetation, creating multiple microhabitats that support a wide range of plant species. It is home to a variety of tree species, shrubs, herbs, and grasses, representing tropical dry deciduous, moist deciduous and Sal Forest type. The soil composition, which is rich in sandy-loamy along with the availability of water sources such as rivers and streams, enhances the growth of diverse vegetation.

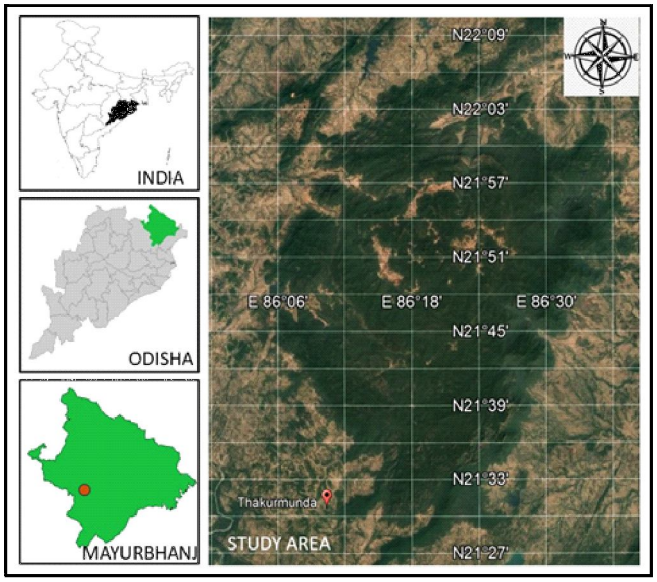

Fig. 1: Map showing the experimental site of Mayurbhanj.

Field survey and sample collection

A systematic field survey was conducted in different habitat types within the study area, covering various altitudinal zones and microhabitats to ensure a comprehensive representation of the flora. The survey was carried out during the month of October 2024 to April 2025. During the survey, plant specimens were photographed and collected from different sites. The collection involved the careful selection of plant parts, such as leaves, flowers, fruits, and seeds, for accurate identification and documentation (Fig. 2).

Plant identification and herbarium preparation

The plant specimens preferably along with reproductive parts were collected from the experimental site and brought to the laboratory for identification (Mueller Dombois and Ellenberg, 1974). Identification of all the species were made in consultation with various regional and national flora books *i.e.* The Botany of Bihar and Orissa (Haines, 1921-25); Supplement to the Botany of Bihar and Orissa (Mooney, 1950); Flora of Madras presidency (Gamble, 1915-36); Flora of Similipal (Saxena and Brahmam, 1989); Flora of Orissa (Saxena and Brahmam, 1994-96) and Flora of Madhya Pradesh (Verma *et al*., 1993; Mudgal *et al*., 1997 and Singh *et al*., 2001). Once identified, the plant specimens were prepared for herbarium deposition by pressing, drying, poisoning, mounting and labeling them according to the standard protocol. A well-organized herbarium was created and will be deposited at Herbarium, Department of Botany, Maharaja Sriram Chandra Bhanja Deo University (Fig. 3).

Documentation and biological spectrum analysis

All identified plant species were documented in excel sheet, including scientific name, family, local names etc. Information on native and exotic species was also recorded. To understand the biological spectrum of the region, the plant species documented were classified

Fig. 2: The Photographs showing field survey and sample collection.

Fig. 3: Photos showing plant identification and herbarium preparation.

based on their life forms, such as phanerophytes (trees and shrubs), chamaephytes (low-growing plants), hemicryptophytes (perennials), cryptophytes (underground plants), and therophytes (annual plants). The relative abundance of each life form was determined and analysed to understand the ecological composition of the area. This analysis provides insights into the plant community structure and the adaptive strategies of species within the study area.

Results

Floristic composition

A total of 170 species belonging to 141 genera and 57 families were documented from the study area. The most dominant families are in the order Fabaceae (20 genera & 26 species), Malvaceae (9 genera & 10 species), Rubiaceae (9 genera & 9 species), Euphorbiaceae (6 genera & 9 species), Poaceae (7 genera & 8 species), Acanthaceae (7 genera & 7 species), Anacardiaceae (6 genera & 6 species), Asteraceae (6 genera & 6 species), Moraceae (3 genera & 6 species) and Phyllanthaceae (2 genera & 6 species) (Fig 4). The percentage-wise contribution of different families were Fabaceae (15.29%), Malvaceae (5.88%), Rubiaceae & Euphorbiaceae (5.29%), Poaceae (4.70%), Acanthaceae (4.11%), Anacardiaceae, Asteraceae, Moraceae & Phyllanthaceae (3.52%), Apocynaceae, Convolvulaceae & Lamiaceae (2.94%) . The most speciose family was Fabaceae represented by 26 species, followed by the families Malvaceae (10 species), Rubiaceae & Euphorbiaceae (9 species each) (Fig. 4). The dominant species are *Senna tora* (L.) Roxb., *Senna occidentalis* (L.) Link, *Alysicarpus monilifer* (L.) DC., *Albizia lebbeck* (L.) Benth., *Mimosa rubicaulis* subsp. himalayana (Gamble) H.Ohashi etc. In Euphorbiaceae family, the dominant genera are Euphorbia, Croton etc. In Phyllanthaceae family, the dominant genera are Phyllanthus.

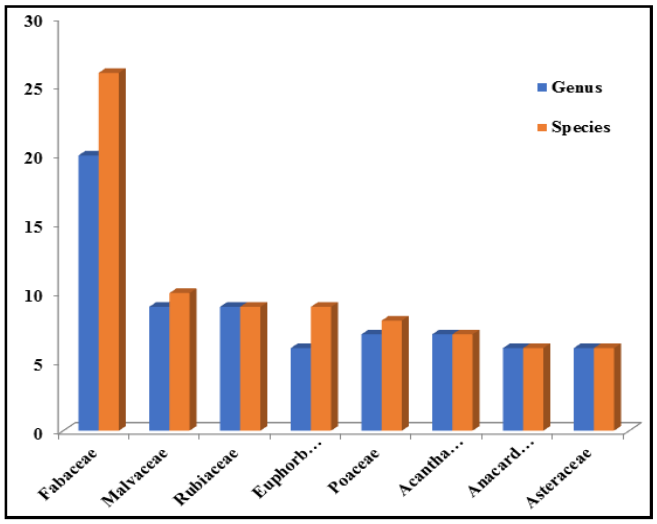

Fig. 4: Histograph showing the distribution of genus and species of dominant families.

Habit analysis revealed that, out of 170 species, trees possessed the highest number i.e., 68 followed by Shrub (50), Herb (38), Climber (11) and Liana (3) (Fig. 5). The important timber yielding trees species were *Shorea robusta* C.F. Gaertn., *Madhuca longifolia* (L.) J.F.Macbr., *Schleichera oleosa* (Lour.) Oken., *Pongamia pinnata* (L.) Pierre, *Syzygium cumini* (L.) Skeels, *Croton persimilis* Mull. Arg., *Azadirachta indica* A.Juss, *Mangifera indica* L., *Terminalia anogeissiana* Gere & Boatwr, *Tectona grandis* L.f. etc. The most common shrubs were *Barleria strigosa* Willd, *Annona squamosa* L., *Calotropis gigantea* (L.) W.T. Aiton, *Rauvolfia tetraphylla* L., *Holarrhena pubescens* Wall. Ex G.Don, *Alangium salviifolium* (L.f.) Wangerin, *Jatropha gossypiifolia* L., *Cajanus cajanifolius* (Haines) Maesen, *Millettia extensa* (Benth.) Benth. Ex Baker, *Clerodendrum infortunatum* L., *Helicteres isora* L., *Leea macrophylla* Roxb. ex Hornem. etc. Similarly, the common herbaceous species were *Andrographis paniculata* (Burm.f.) Wall. Ex Nees, *Cynodon dactylon* (L.) Pers., *Lepidagathis purpuricaulis* Nees, *Rungia pectinata* (L.) Nees, *Colocasia esculenta* (L.) Schott, *Dracaena roxburghiana* (Schult. & Schult.f.) Byng & Christenh., *Cyanthillium cinerum* (L.) H.Rob., *Heliotropium indicum* L., *Commelina benghalensis* L., *Evolvulus nummularius* (L.) L., *Cyperus difformis* L., *Euphorbia hirta* L., *Senna tora* (L.) Roxb., *Oldenlandia corymbosa* L. etc. Many people's are using climbers as

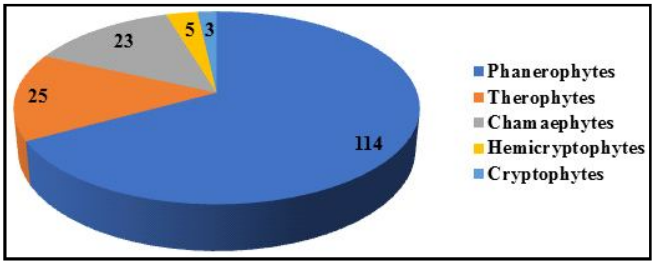

Fig. 5: Pie diagram showing the Life form of all species in this study area.

rassi for house chhapr, ropes etc., the woody tall plant and the herbaceous plants are used for fodder and preparataion of medicine that are used to cure various kind of diseases. Medicinal plant like nimba, begunia, sahada, anla, belo, kamini etc. are used for treatment and prevention of cardiovascular & skin diseases.

Fabaceae, Malvaceae, Rubiaceae and Euphorbiaceae were the dominant families of that area due to high complexity of these families to that area's climatic condition. The main species composition was *Shorea robusta* C.F. Gaertn., *Pongamia pinnata* (L.) Pierre, *Madhuca longifolia* (L.) J.F.Macbr., *Syzygium cumini* (L.) Skeels etc. The upper storey of the vegetation was covered by tall trees and shrubs with epiphytes like lichens, ferns, orchids and bryophytes. Different herbaceous species were distributed all over the forest. Some climber species 11 were also present in and around the dumped area, these species were *Hemidesmum indicus* (L.) R.Br., *Pergularia daemia* (Forssk.) Chiov., *Asparagus racemosus* Willd, *Camonea umbellata* (L.) A.R. Simoes & Staples, *Ipomoea obscura* (L.) Ker Gawl., *Dioscorea oppositifolia* L., *Arbus precatorius* L., *Smilax zeylanica* L. etc. Some bamboo species are also found in the hilly regions that forms an open and dense forest. Some of the exotic flora also found, which will be the serious threats to the forest.

In Thakurmunda forest some potential medicinal plant species were found that were *Azadirachta indica* A.Juss, *Ficus religiosa* L., *Streblus asper* Lour., *Phyllanthus emblica* L., *Aegle marmelos* (L.) Correa, *Murraya paniculata* (L.) Jack, *Pongamia pinnata* (L.) Pierre, *Ricinus communis* L. etc.

Biological spectrum

Biological spectrum of the flora based on the life form and prepared by following Raunkiaer system of classification (1934). The life form classes are Phanerophytes, Chamaephytes, Hemicryptophytes, Cryptophytes, Therophytes. Phanerophytes were the dominant life forms accounting for (67.05%; 114 species) of all species in the area, followed by Therophytes (14.70%; 25 species), Chamaephytes (13.52%; 23 species), Hemecryptophytes (2.94%; 5 species), Geophytes (1.17%; 3) (Fig. 5).

Discussion

Floristic diversity of a region is the total of the species within its boundaries, whether wild or cultivated, which is a reflection of vegetation & plant resources. Plant resources are affected by agriculture, overgrazing, anthropogenic interaction, mining activities & natural disaster. It is an important task to save and conserve plant wealth of India for welfare of humanity, which can be achieved by boosting taxonomic research and acknowledge dedicated taxonomist (Rao *et al.*, 1997). In the present study, the floristic diversity recorded in the Thakurmunda forest, comprising 170 plant species across 141 genera and 53 families, reflects a moderately rich flora comparable with other regions of Odisha, as documented in various studies.

For instance, Panda *et al.*, (2020) reported 277 weed species in the Bhadrak district, with Asteraceae, Poaceae, and Fabaceae being dominant. Although this study focused on weed flora, the richness and taxonomic composition share similarities with the Thakurmunda area in terms of dominant families and herbaceous life forms. However, unlike Thakurmunda, which includes wild and cultivated species, their focus was primarily on naturalized weeds, pointing to different vegetation dynamics. Dash *et al.*, (2020) in their assessment of semi-evergreen forests in Hadagarh Sanctuary found 68 species, significantly fewer than Thakurmunda. The lower diversity in Hadagarh could be due to more intense anthropogenic pressures, such as illegal logging and habitat fragmentation, which the authors note as key concerns. Thakurmunda, although affected by human activity, still retains relatively intact patches, suggesting a less degraded ecosystem. A unique perspective comes from Panda *et al.*, (2014), who investigated sacred groves in Koraput. They reported 94 sacred species, many with medicinal and cultural value. Though fewer in number, the groves support ecologically and ethnobotanically important species, reinforcing the idea that conservation is not merely about species counts but also ecological function and cultural relevance. Thakurmunda, though not explicitly sacred, may benefit from similar community-led conservation models.

Regarding the Raunkiaer's system, the life-form composition in the Thakurmunda forest was dominated by Phanerophytes followed by Therophytes and Chamaephytes in succession. The low percentage of Hemicryptophytes and Geophytes show that they are not adopted to climatic conditions in the region. In this study Phanerophytes and Geophytes usually comprises the highest and lowest percentages of life- forms respectively. The presence of high percentage of Phanerophytes indicates the existence of environments where drought, cold and exposure to strong winds are relatively infrequent. The buds are thus risk of exposure to drought stress or frost. The Phanerophytes followed by Therophytes, which indicate the existence of a heavy biotic pressure due to overgrazing and human interference. Low rainfall levels, high temperatures,

consecutive droughts, a short growing season and various factors of destruction such as overgrazing and agriculture were the most important factors for the increase of Therophytes. Therophytes are mainly present in the desert regions, the high occurrence of the life- form shows there are some anthropogenic and overgrazing effects of this area.

Conservation and Research Implications

The comparison suggests that although Thakurmunda is not the most species-rich forest in Odisha, it represents an important ecological unit with a unique composition. The findings reinforce the broader regional trend of human impact reducing floristic diversity, as observed in Eastern Ghats (Sahoo *et al*., 2020) and Hadagarh Sanctuary (Dash *et al*., 2020). There is an urgent need to initiate restoration programs, promote community participation, and expand floristic surveys to lesser-known regions like Thakurmunda to inform conservation planning. Additionally, as emphasized, enhanced taxonomic research and recognition of local flora through consistent monitoring can pave the way for sustainable utilization and biodiversity conservation, aligning scientific effort with community welfare.

Conclusions

Vegetation is an essential element of all major ecosystems. The result of our study in Thakurmunda forest highlighted the floristic composition and biological spectrum of forest vegetation which will help the policy maker and conservation biologists to conserve the diversity of this forest. In this study, the dominance of Planerophytes, Therophytes over other life forms seems to be response to drought, cold, and exposure to strong winds. In concern of threats to the biodiversity of Thakurmunda, awareness programme among the people along with forest department supervision and well-designed management practices should be taken. Further, proper utilization and sustainable harvesting of the medicinal and timber yielding plants will be another way of conservation of flora of Thakurmunda.

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